64th Aquatic Plant Management Society ANNUAL MEETING

St. Petersburg, FL | July 15 - 18, 2024

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Committee Chairs

Awards	Ryan Wersal
Bylaws and Resolutions	James Leary
Education and Outreach	Sonja Wixom
Exhibits	Dean Jones
Finance	Andy Fuhrman
Meeting Planning	Tom Warmuth
Membership	Matthew Johnson
Nominating	Brett Hartis
Past President's Advisory	Brett Hartis
Program	Jeremy Slade
Proposal Review	Brett Hartis
Regional Chapters	Gray Turnage & Lyn Gettys
Strategic Planning	Mark Heilman
Student Affairs	Andrew Howell

Special Representatives

AERF	Carlton Layne
Science Policy	Lee Van Wychen
BASS	Jeremy Slade
CAST	Gray Turnage
NALMS	Terry McNabb
RISE	Matthew Johnson
Women of Aquatics	Amy Kay
WSSA	Andrew Howell

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
2024	Jason Ferrell	St. Petersburg, FL

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
John Gardner, John Madsen	2023

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
JJ Ferris	2023

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
Amy Kay	2023

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
Ryan Thum	2023

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
Conrad Oberweger	University of Florida	2023

Outstanding International Contribution Award

An individual or group recognized for completion of research or outreach activities that is inter-national 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
Tobias Bickel	Queensland Department of Agriculture and Fisheries	2023

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

Kathryn A. Gannon, Raymond M. Newman, Ryan A. Thum	Montana State University	2023

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 Greer	U.S. Army Corps of Engineers	2023
Ryan Wersal	University of Minnesota, Mankato	2023

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 Michael D. Netherland 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.

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 offers aquatic resource services including vegetation mapping, vegetation management services, phosphorus mitigation, fish management, 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.

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, and 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 1961 to 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.

Nutrien Ag 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 Ag 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 Ag Solutions has to offer. Visit: NutrienAgSolutions.com/Specialty.

Oase (Oh-ah-suh) Professional, with US headquarters in Aurora, Ohio, is a global leader in fountain and water technology. We supply award-winning, innovative products, that are holistic and environmentally friendly, to lake and pond management companies, golf courses, municipalities and zoos. We offer the most effective solutions to your toughest lake and pond problems, whether it's too much organic sludge, too many nutrients or too little oxygen. Our proprietary formulations are developed and engineered in Germany to the highest quality standards in the industry and are now made and distributed in North America after decades of success in Europe. We use nature to our advantage, leaving nothing behind but beautiful, healthy water. And you receive the most value for your dollar with quick and sustainable results when following our suggested treatment plans. Be prepared to improve results, save time, reduce site visits, and exceed all of your lake and pond management goals with Lake Therapy by Oase Professional.

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.

TIGRIS is revolutionizing surface water management. Formed in 2022, we operate as a platform company, bringing together the industry's most talented and respected veterans alongside top-performing providers across the nation. We are an organization dedicated to ensuring our waters and people thrive. Our goal is to forge a unique organization with a new approach to water management. Instead of relying on one-size-fits-all solutions or a limited service spectrum necessitating multiple vendors, TIGRIS provides comprehensive solutions from a single source. Our team of local specialists tailors these solutions to the specific needs of our clients' environments. Combined with the support and resources of a large national organization, TIGRIS introduces a transformative approach to surface water management. "One call covers it all," when it comes to your lake, pond, and wetland management and stormwater solutions.

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*.

AIRMAX
Romeo, MI

Alligare, LLC
Opelika, AL

Aquatic Control, Inc.
Seymour, IN

Aquatic Ecosystem Restoration Foundation*
Marietta, GA

AquaMaster Fountains
Kiel, WI

Atticus, LLC
Cary, NC

Bayer
St. Charles, MO

BioBase LLC
St. Paul, MN

BioSafe Systems
East Hartford, CT

Brewer International
Vero Beach, Florida

Cygnet Enterprises
Flint, MI

Earth Science Laboratories
Rogers, AR

EasyPro Lake & Pond Products
Grant, MI

FloridAquatic Lake Mgmt/Truxor Harvester USA
Fort Myers, FL

Florida & Midwest APMS Chapters*
Eagle Lake, FL & Seymour, IN

Frontier Precision
Jacksonville, FL

Heritage PPG
McKinney, TX

Kasco Marine
Prescott, WI

Leading Edge Aerial Technologies
Port Orange, FL

NuFarm Americas
Alsip, IL

Nutrien Ag Solutions
Loveland, CO

Oase Professional
Aurora, OH

Orion Solutions
Rocky Mount, VA

Pump Out USA Inc
DeFuniak Springs, FL

SePRO Corporation
Carmel, IN

Syngenta
Greensboro, NC

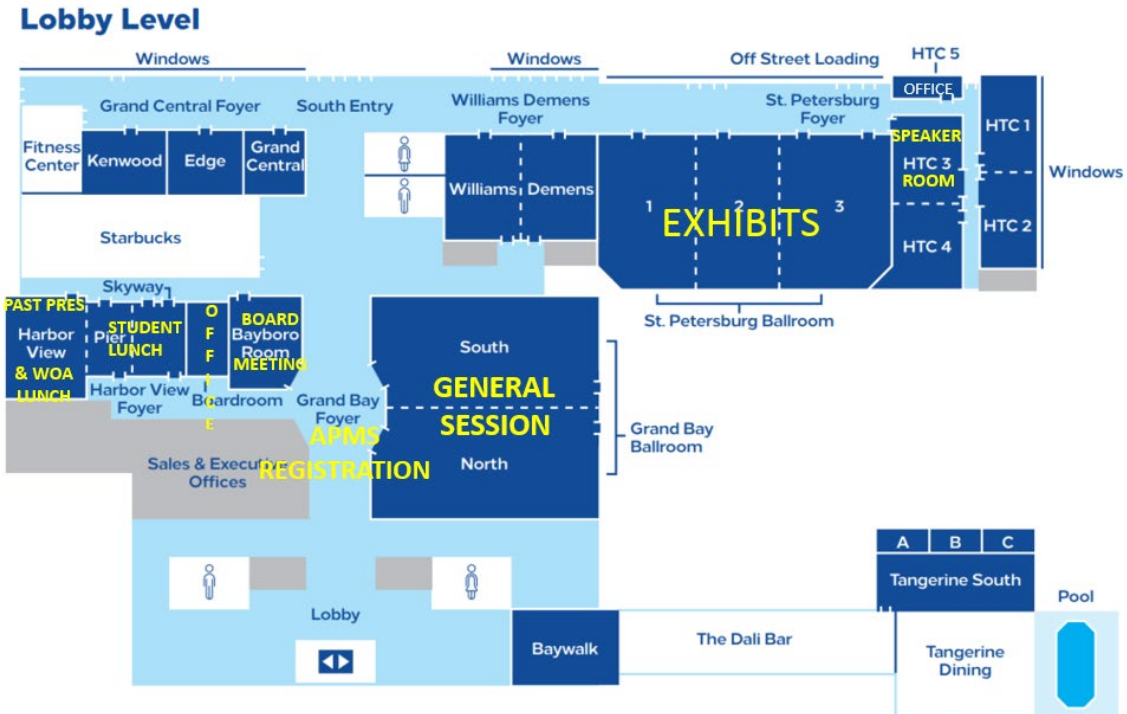
TIGRIS
Bordentown, NJ

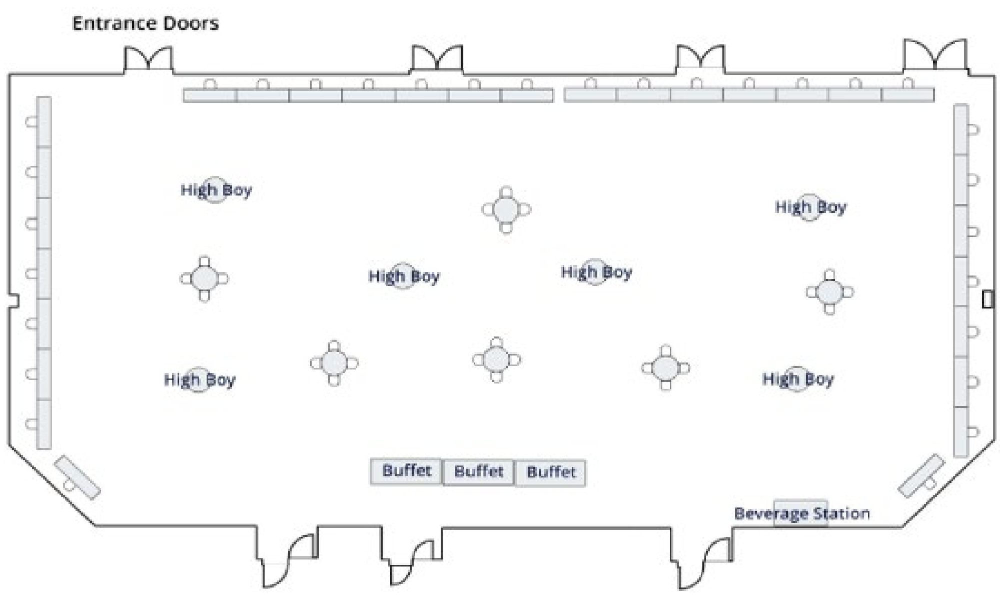
UPL Environmental Solutions
Cary, NC

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

Women of Aquatics*
Trout Valley, IL

Conference and Event Rooms Floor Maps





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 Grand Bay Ballroom. 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 Grand Bay Foyer from 12:00 to 4:30 pm on Monday July 15 and will continue from 7:00 am to 4:30 pm on Tuesday and Wednesday July 16 and 17, and 7:00 am to 11:30 am on Thursday July 18.

Exhibits
Exhibits will be open from 7:00 am Tuesday July 16 through 5:00 pm Wednesday July 17 in St. Petersburg Foyer.

Continental Breakfasts / Networking Breaks
Continental breakfasts and mid-morning and afternoon networking breaks will be served each day in St. Petersburg Ballroom. 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 breakout discussion and conference needs. Check at the meeting registration desk with Mr. Bill Torres to reserve.

Student Meet-and-Greet; Offsite:
Monday, July 15, 6:00 pm to 7:00 pm, Oak and Stone ***199 Central Ave, St. Petersburg, FL 33701***
All students registered for the meeting are invited to gather at *Oak and Stone* 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; Offsite:
Monday, July 15, 7:00 pm to 9:00 pm, Oak and Stone ***199 Central Ave, St. Petersburg, FL 33701***
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 16, 7:00 am to 7:50 am, Bayboro Meeting Room
Two representatives from each APMS regional chapter are invited to attend the Regional Chapter Discussion, provided by APMS sponsors. Regional Chapters Co-Committee Chairs Gray Turnage and Lyn Gettys will be the moderators for discussions on aquatic plant management activities in each region. Please contact Gray to confirm your attendance.

Student Affairs Luncheon:
Tuesday, July 16, 12:10 pm to 1:30 pm, Skyway Meeting Room
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. Andrew Howell, Student Affairs Committee Chair, will be the moderator. Please contact Andrew to confirm your attendance.

Past Presidents' Luncheon:
Tuesday, July 16, 12:10 pm to 1:30 pm, Harbor View Meeting Room
All APMS Past Presidents are invited to attend the Past Presidents' Luncheon to provide insight into matters facing APMS and aquatic plant managers. Brett Hartis, Immediate Past President, will be the moderator. Please contact Brett to confirm your attendance.

Poster Session Reception:
Tuesday, July 16, 6:00 pm to 7:30 pm, St. Petersburg Foyer/St. Petersburg Ballroom
Posters will be available for viewing from 7:00 am Monday to 5:00 pm Wednesday in *St. Petersburg Foyer.* Poster presenters will be on hand during the Evening Poster Reception on Tuesday, July 16, 6:00 pm to 7:30 pm in *St. Petersburg Foyer*.

Women of Aquatics Luncheon:
Wednesday, July 17, 12:10 pm to 1:30 pm, Harbor View Meeting Room
Amy Kay will host the Women of Aquatics Luncheon to discuss opportunities for women in the field of aquatic plant management. Please contact Amy to confirm your attendance.

USACE ERDC/AERF Symposium:
Wednesday, July 17, 12:10 pm to 1:30 pm, Williams Demens Meeting Room
"Enhancing Harmful Algal Bloom Management: Integrating Satellite Remote Sensing and In-situ Data for Effective Mitigation" Contact Alyssa Eck for information.

Awards Reception/Banquet:
Wednesday, July 17, 6:00 pm to 10:00 pm, Reception (Grand Bay Foyer), Banquet (Grand Bay Ballroom)
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 students 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 with a web link for the meeting which will be held virtually following the conference.

Events-at-a-Glance

Monday – July 15:

8:00 am - 4:00 pm	APMS Board of Directors Meeting (Bayboro Meeting Room)
7:00 am - 5:00 pm	Student Tour (Field sites)
12:00 pm - 5:00 pm	Exhibits and Poster Setup (St. Petersburg Ballroom)
12:00 pm - 4:30 pm	Registration (Grand Bay Foyer)
6:00 pm - 7:00 pm	Student Meet & Greet (Oak and Stone; offsite)
7:00 pm - 9:00 pm	President's Reception (Oak and Stone; offsite)

Tuesday – July 16:

7:00 am - 5:00 pm	Exhibits (St. Petersburg Ballroom)
7:00 am - 7:50 am	Continental Breakfast (St. Petersburg Ballroom)
7:00 am - 7:50 am	Regional Chapters Breakfast (Bayboro Meeting Room)
7:00 am - 4:30 pm	Registration (Grand Bay Foyer)
8:00 am - 5:20 pm	General Session (Grand Bay Ballroom)
12:10 pm - 1:30 pm	Student Affairs Luncheon (Skyway Meeting Room)
12:10 pm - 1:30 pm	Past-Presidents' Luncheon (Harbor View Meeting Room)
6:00 pm - 7:30 pm	Poster Session Reception (St. Petersburg Foyer/St. Petersburg Ballroom)

Wednesday – July 17:

7:00 am - 5:00 pm	Exhibits (St. Petersburg Ballroom)
7:00 am - 8:00 am	Continental Breakfast (St. Petersburg Ballroom)
7:00 am - 4:30 pm	Registration (Grand Bay Foyer)
8:00 am - 4:45 pm	General Session (Grand Bay Ballroom)
12:10 pm - 1:30 pm	Women of Aquatics Luncheon (Harbor View Meeting Room)
12:10 pm - 1:30 pm	USACE/AERF Symposium (Williams Demens Meeting Room)
6:00 pm - 7:00 pm	APMS Awards Banquet Reception (Grand Bay Foyer)
7:00 pm - 10:00 pm	APMS Awards Banquet (Grand Bay Ballroom)

Thursday – July 18:

7:00 am - 8:00 am	Continental Breakfast (St. Petersburg Ballroom)
7:00 am - 11:30 am	Registration (Grand Bay Foyer)
8:00 am - 11:30 am	General Session (Grand Bay Ballroom)

PROGRAM

TUESDAY MORNING - JULY 16, 2024

7:00 AM Continental Breakfast (St. Petersburg Ballroom)

7:00 AM Regional Chapters Breakfast (Bayboro Meeting Room)

Plenary Session - Back to the Basics: Control Methods - Past, Present, Future

LOCATION: Grand Bay Ballroom
TIME: 7:50 AM - 10:30 AM
MODERATOR: Jeremy Slade
SePRO Corporation
Carmel, IN

***SPEAKER**

07:50 AM Presidential Address – Dr. Jason Ferrell

08:00 AM Plenary Session Introduction

08:10 AM Back to the Basics: Control Methods - Past, Present, Future: Chemical Control.
Jason Ferrell
University of Florida, Gainesville, FL

08:30 AM Back to the Basics: Control Methods - Past, Present, Future: Biological Control.
Nathan E. Harms
US Army Engineer Research and Development Center, Lewisville, TX

08:50 AM Back to the Basics: Control Methods - Past, Present, Future: Physical/Cultural Control.
Marc Bellaud
SOLitude Lake Management, Shrewsbury, MA

09:10 AM Back to the Basics: Control Methods - Past, Present, Future: Mechanical Control.
Benjamin P. Sperry
US Army Corps of Engineers, Gainesville, FL

09:30 AM Back to the Basics: Control Methods - Past, Present, Future: Genetic Engineering.
Ramon G. Leon
North Carolina State University, Raleigh, NC

09:50 AM Back to the Basics: Control Methods - Past, Present, Future: Technology Development and Implementation.
Andrew W. Howell
North Carolina State University, Raleigh, NC

10:10 AM Control Methods - Panel Discussion

10:30 AM Networking Break (St. Petersburg Ballroom)

Student Oral Competition

LOCATION: Grand Bay Ballroom
TIME: 10:50 AM - 12:10 PM Eastern Time
MODERATOR: Andrew W. Howell
North Carolina State University
Pittsboro, NC

***SPEAKER † STUDENT CONTEST**

10:50 AM **†Improving Biological Control of *Pontederia crassipes* Through Crossbreeding Experiments of *Megamelus scutellaris* and Plant Productivity Surveys. Madison Self**[1], Lyn Gettys[1], Megan Reid[1], Melissa Smith[2], Carey Minteer[3]
[1]University of Florida, Ft. Lauderdale, FL
[2]United States Department of Agriculture, Davie, FL
[3]University of Florida, Vero Beach, FL

11:10 AM **†Salinity Tolerance 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

11:30 AM **†Ecology of Alligatorweed: Historic Pest and Future Threat. Samuel A. Schmid**, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

11:50 AM **†Efficacy of Selected Herbicides on Three *Hydrilla verticillata* Biotypes. Kara Foley**, Robert J. Richardson
North Carolina State University, Raleigh, NC

12:10 PM **Lunch on Your Own**

12:10 PM **APMS Past Presidents' Luncheon (Harbor View Meeting Room)**

12:10 PM **APMS Student Affairs Luncheon (Skyway Meeting Room)**

TUESDAY AFTERNOON - JULY 16, 2024

Student Oral Competition Continued

LOCATION: Grand Bay Ballroom
TIME: 1:30 PM - 5:20 PM
MODERATOR: Brittany Chesser
Texas A&M AgriLife Extension Service
College Station, TX

***SPEAKER † STUDENT CONTEST**

01:30 PM **†Accumulated Growing Degree Days of Cuban Bulrush (*Oxycaryum cubense*) in the Southeastern U.S. Maxwell G. Gebhart**[1], Allison C. Squires[2], Ryan M. Wersal[3], Gray Turnage[1], Christopher R. Mudge[4], Benjamin P. Sperry[5]
[1]Mississippi State University, Starkville, MS
[2]Minnesota State University, Mankato, St. Peter, MN
[3]Minnesota State University, Mankato, Mankato, MN
[4]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[5]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

01:50 PM **†Evaluating Photosynthetic Efficiency of Parrotfeather (*Myriophyllum aquaticum*) to Determine Invasive Potential in the Midwest. Alyssa J. Anderson**[1], Christopher T. Ruhland[1], Gray Turnage[2], Ryan M. Wersal[1]
[1]Minnesota State University, Mankato, Mankato, MN
[2]Mississippi State University, Starkville, MS

02:10 PM **†The Effect of Photoperiod Interruption on Dioecious Hydrilla Propagule Production. Daniel C. Canfield**[1], Benjamin P. Sperry[2], Michael W. Durham[1], Candice M. Prince[1], Greg MacDonald[1]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

02:30 PM **†Impacts of Water Depth Changes on Aquatic Vegetation and Nutrients: Insights for Pond Management. Daphne Miles**, Hannah Whaley, Anna N. Faust, La Toya Kissoon-Charles
Missouri State University, Springfield, MO

02:50 PM **Industry Update – SePRO Corporation**

03:00 PM **Networking Break (St. Petersburg Ballroom)**

03:20 PM **†Using Pulse Amplitude Modulation Fluorometry to Characterize Fluridone Response on a Large Number of Watermilfoil Strains. Ashley L. Wolfe**, Ryan Thum
Montana State University, Bozeman, MT

03:40 PM **†ALS-Inhibiting Herbicide Sensitivity Comparison Between Florida Water Hyacinth Populations. Hannah J. Brown**[1], Corrina J. Vuillequez[1], Jonathan Glueckert[2], Michael W. Durham[1], Candice M. Prince[1], Benjamin P. Sperry[3]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

04:00 PM **†Desiccation Tolerance of Giant Salvinia *(Salvinia molesta)* in Simulated Boat Trailer Conditions. Corrina J. Vuillequez**[1], Jonathan Glueckert[2], Benjamin P. Sperry[3], Michael W. Durham[1]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

04:20 PM **†Developing Novel, Remote Sensing Techniques to Detect the Impact of Biological Control on Water Hyacinth, *Pontederia crassipes* Mart. Usman Mohammed**[1], Carey R. Minteer[1], Aditya Singh[2], Melissa C. Smith[3], Stephen Lantin[4]
[1]University of Florida, Fort Pierce, FL
[2]Univeristy of Florida, Gainesville, FL
[3]USDA - ARS, Fort Lauderdale, FL
[4]University of Florida, Gainesville, FL

04:40 PM **†Automating Water Hyacinth (*Eichhornia crassipes*) Detection Using Deep Learning on RGB UAS Imagery. Amber E. Riner**[4], Jonathan Glueckert[1], James Leary[2], Greg MacDonald[3], Amr H. Abd-Elrahman[5]
[1]University of Florida, Boynton Beach, FL
[2]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL
[3]University of Florida, Gainesville, FL
[4]Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL
[5]University of Florida, Wimauma, FL

05:00 PM **†Mapping Aquatic Vegetation in Every Lake in Rhode Island and New Hampshire Using Shoebox-Sized Satellites. Thomas Howard**
Resolve Hydro LLC, Brown University, Providence, RI

Poster Session

LOCATION: St. Petersburg Ballroom/Foyer
TIME: 6:00 PM - 7:30 PM

***PRESENTER † STUDENT CONTEST**

†Integrating Chemical and Biological Control of Alligatorweed (*Alternanthera philoxeroides*): Submersed Herbicides and Thrips. **Samuel A. Schmid**, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

†A Review of the Taxonomy, General Biology, and Ecology of *Vallisneria*. **Maxwell G. Gebhart**, Gray Turnage
Mississippi State University, Starkville, MS

†Investigating Herbicide Efficacy and Behavior for Controlling Eurasian Watermilfoil in Bear Lake. **Olanrewaju E. Adeyemi**, Eric P. Westra, Corey V. Ransom, Mirella F. Ortiz
Utah State University, Logan, UT

†Evaluation of the Salinity Tolerance of Giant Salvinia *(Salvinia molesta)* Using Concentration-Exposure Time Methods. **Corrina J. Vuillequez**[1], Jonathan Glueckert[2], Benjamin P. Sperry[3], Michael W. Durham[1], Jessica E. Spencer[4]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[4]US Army Corps of Engineers Engineer Research and Development Center, Jacksonville, FL

†Comparing Efficacy of Chemical Controls on Native and Non-native *Vallisneria* Taxa. **Delaney Davenport**[1], Kara Foley[1], Mark A. Heilman[2], Robert J. Richardson[1]
[1]North Carolina State University, Raleigh, NC
[2]SePRO Corporation, Carmel, IN

†Evaluation of Concentration-Exposure Time Requirements for Water hyacinth and Water lettuce Control Using Submersed Treatments of Imazamox. **Hannah J. Brown**[1], Corrina J. Vuillequez[1], Jonathan Glueckert[2], Michael W. Durham[1], Candice M. Prince[1], Benjamin P. Sperry[3]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

†Monitoring Water Hyacinth Herbicide Treatments with Unoccupied Aerial Systems. **Amber E. Riner**[4], Benjamin P. Sperry[1], Jonathan Glueckert[2], Michael W. Durham[3], Greg MacDonald[3], James Leary[5], Corrina J. Vuillequez[3], Amr H. Abd-Elrahman[6]
[1]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]University of Florida, Gainesville, FL
[4]Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL
[5]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL
[6]University of Florida, Wimauma, FL

†Evaluation of Herbicide Efficacy on *Hottonia palustris.* **Kara Foley**[1], Erika J. Haug[2], Amy Smagula[3], Robert J. Richardson[1]
[1]North Carolina State University, Raleigh, NC
[2]NCSU, Raleigh, NC
[3]New Hampshire Department of Environmental Services, Concord, NH

†Herbicide Behavior in Hybrid Milfoil and Hydrilla When Applied in Combination. Tia M. Lawrence[1], Mirella F. Ortiz[2]
[1]Utah State University, Department of Plants, Soils, and Climate, Logan, UT
[2]Utah State University, Logan, UT

†Growth Response and Nitrogen Removal or Release by an Azolla Species. Anna N. Faust, La Toya Kissoon-Charles
Missouri State University, Springfield, MO

†Intact Herbicide Translocation. Francielli S de Oliveira, Mirella F. Ortiz
Utah State University, Logan, UT

†Development and Application of a Novel Index for Enhanced Hydrilla Detection in Aquatic Ecosystems Using Sentinel-2 Imagery. Ayesha Malligai M[1], Amr Abd Elrahman[1], James K. Leary[2]
[1]University of Florida, Plant City, FL
[2]University of Florida, Gainesville, FL

The Role of Temperature on Clade-C Hydrilla Turion Sprouting and Growth. Andrew W. Howell[1], Kara Foley[2], Benjamin P. Sperry[3], Robert J. Richardson[2]
[1]North Carolina State University, Pittsboro, NC
[2]North Carolina State University, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Northern Hydrilla (*Hydrilla verticillata* ssp. *lithuanica*): Discovery and Establishment Outside the Connecticut River. Jeremiah Foley
Connecticut Agricultural Experiment Station, Wallingford, CT

Evaluating Seed Germination and Early Growth Response of Water Chestnut Under a Range of Salinity and Temperature. Kristina Hellinghausen[1], **Lynde L. Dodd**[2]
[1]Oak Ridge Institute for Science and Education, Lewisville, TX
[2]US Army Engineer Research and Development Center, Lewisville, TX

Documenting Phenological Growth Patterns of Connecticut River Hydrilla in Mesocosm Conditions. Jens P. Beets[1], Kara Foley[2], Benjamin P. Sperry[3], Robert J. Richardson[2]
[1]USDA-ARS, Davis, CA
[2]North Carolina State University, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Multi-year Outdoor Mesocosm Experiment Reveals Differences in *Butomus umbellatus* L. Genotype Growth and Susceptibility to Imazamox and Triclopyr. Nathan E. Harms[1], Bradley T. Sartain[2], Catilin Strickland[3], Blake DeRossette[4], Andrew B. Coomes[5]
[1]US Army Engineer Research and Development Center, Lewisville, TX
[2]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[3]US Army Engineer Research and Development Center - ORISE, Vicksburg, MS
[4]US Army Engineer Research and Development Center, Vicksburg, MS
[5]USACE-ERDC-EEA, Vicksburg, MS

CAST: The Science Source for Food, Agricultural, and Environmental Issues. Gray Turnage[1], Todd Baughman[2], Tom Peters[3], Anthony Witcher[4], Jill Schroeder[5], Greg Dahl[6]
[1]Mississippi State University, Starkville, MS
[2]Texas A&M, Lubbock, TX
[3]North Dakota State University, Fargo, ND
[4]Tennessee State University, McMinnville, TN
[5]New Mexico State University, Las Cruces, NM
[6]WSSA, St. Paul, MN

***AquaPlant*: An Extension Tool for Aquatic Vegetation Identification & Management. Brittany Chesser**, Todd Sink
Texas A&M AgriLife Extension Service, College Station, TX

Field Observations of an Intermittent Endothall Drip-Application in a North Florida Impounded Spring Run for Hydrilla (*Hydrilla verticillata*) Control. Jonathan Glueckert[1], Michael W. Durham[2], Daniel C. Canfield[2], Benjamin P. Sperry[3], Ian J. Markovich[4]
[1]University of Florida, Boynton Beach, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[4]US Army Corps of Engineers Engineer Research and Development Center, Clewiston, FL

Field Demonstrations for Water Chestnut (*Trapa* spp.) Management – Year 1. Lynde L. Dodd[1], Ryan McIntyre[2], Kristina Hellinghausen[3], Nancy Rybicki[2], Christopher R. Mudge[4], Benjamin P. Sperry[5]
[1]US Army Engineer Research and Development Center, Lewisville, TX
[2]George Mason University, Fairfax, VA
[3]Oak Ridge Institute for Science and Education, Lewisville, TX
[4]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[5]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Use of Unmanned Aircraft Systems and Tracer Dye to Monitor Herbicide Spray Distribution. Glenn M. Suir[1], **Christopher R. Mudge**[2], Shea L. Hammond[3], Justin L. Wilkins[3], Scott Bourne[3], Sam S. Jackson[3], Brandon L. McGrew[3], Andrew M. Steen[3], Shelby L. Goss[3], David R. Sexton[4]
[1]U.S. Army Engineer Research & Development Center, Lafayette, LA
[2]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[3]U.S. Army Engineer Research & Development Center, Vicksburg, MS
[4]Louisiana State University, Baton Rouge, LA

Evaluation of an Operational Demonstration of a Potential Aquatic Plant Control and Nutrient Mitigation Technology in Lake Okeechobee, Florida. Michael W. Durham[1], Benjamin P. Sperry[2], Jonathan Glueckert[3]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[3]University of Florida, Boynton Beach, FL

Using Experimentally Determined Physiological Response to Thermal Extremes to Model Climatic Suitability of the Alligatorweed Thrips, *Amynothrips andersoni*. Ian A. Knight[1], Nathan E. Harms[2], Megann M. Harlow[2], Felix Bingham[3]
[1]US Army Engineer Research and Development Center, Vicksburg, MS
[2]US Army Engineer Research and Development Center, Lewisville, TX
[3]Oak Ridge Institute for Science and Education, Vicksburg, MS

Field Observations of Floating Plant Control Following Submersed Treatments of Imazamox in Central Florida. Kelli L. Gladding[1], Benjamin P. Sperry[2], James Leary[3], Amber E. Riner[4], Hannah J. Brown[5]
[1]University of Florida, Center for Aquatic and Invasive Plants, New Smyrna Beach, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[3]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL
[4]Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL
[5]University of Florida Center for Aquatic and Invasive Plants, Gainesville, FL

USACE Jacksonville District Invasive Species Management Early Detection and Rapid Response to Giant Salvinia (*Salvinia molesta*) in the St. Johns River Basin. Jessica M. Spencer[1], **Tyler J. Green**[2], Jon S. Lane[1], Ian J. Markovich[3]
[1]US Army Corps of Engineers Invasive Species Management Branch, Jacksonville, FL
[2]US Army Corps of Engineers Invasive Species Management Branch, Palatka, FL
[3]US Army Corps of Engineers Invasive Species Management Branch, Clewiston, FL

WEDNESDAY MORNING - JULY 17, 2024

7:00 AM Continental Breakfast (St. Petersburg Ballroom)

LOCATION: Grand Bay Ballroom
TIME: 8:00 AM - 12:10 PM
MODERATOR: Ryan M. Wersal
Minnesota State University, Mankato
Mankato, MN

***SPEAKER**

08:00 AM Not all Coppers are the Same. David G. Hammond
Earth Science Labs, Inc, Larkspur, CA

08:20 AM Evaluating a Novel Copper Formulation for Improved Delivery and Efficacy. West M. Bishop
SePRO Corporation, Whitakers, NC

08:40 AM Field Demonstration for Management of Diploid Flowering Rush (*Butomus umbellatus*) at Ottawa National Wildlife Refuge, Ohio. Bradley T. Sartain[1], Nathan E. Harms[2], Andrew B. Coomes[3], Ashton B. DeRossette[4]
[1]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[2]U.S. Army Corps of Engineers Engineer Research and Development Center, Lewisville, TX
[3]USACE-ERDC-EEA, Vicksburg, MS
[4]USACE, Vicksburg, MS

09:00 AM Comparison of UAAS and Operational Standard Equipment for Variable-leaf Watermilfoil Control. Andrew W. Howell[1], Kara Foley[2], Benjamin P. Sperry[3], Robert J. Richardson[2]
[1]North Carolina State University, Pittsboro, NC
[2]North Carolina State University, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

09:20 AM Development of a Maintenance Control Program for Giant Salvinia (*Salvinia molesta*). Christopher R. Mudge[1], David R. Sexton[2], Samantha L. Prinsloo[3], Ian A. Knight[4], Andrew W. Howell[5], Benjamin P. Sperry[6]
[1]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[2]LSU AgCenter, Baton Rouge, LA
[3]Louisiana State University, Baton Rouge, LA
[4]United States Army Corps of Engineers - Engineering Research and Development Center, Vicksburg, MS
[5]North Carolina State University, Pittsboro, NC
[6]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

09:40 AM Intraspecific Variation in Thermal Tolerance and Plasticity of the Adventive Parrot's Feather Weevil, *Phytobius vestitus*, in the USA. Nathan E. Harms[1], **Megann M. Harlow**[2], Ashton B. DeRossette[3], Ian A. Knight[3], William A. LeVan[4]
[1]US Army Engineer Research Development Center, Lewisville, TX
[2]US Army Engineer Research and Development Center, Lewisville, TX
[3]US Army Engineer Research and Development Center, Vicksburg, MS
[4]Oak Ridge Institute of Science and Engineering, Lewisville, TX

10:00 AM Industry Update - Orion

10:05 AM Industry Update - Syngenta

10:10 AM Networking Break (St. Petersburg Ballroom)

10:30 AM **Mesocosm Evaluation of Combination Foliar Herbicide Treatments for Aquatic Alligatorweed Management: Impact on Stem Fragment Viability and Biomass. Daniel Clements**[1], Deborah E. Hofstra[2], Paul D. Champion[1], Iñigo Zabarte-Maeztu[1]
[1]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand
[2]National Institute of Water and Atmospheric Research, Hamilton, New Zealand

10:50 AM **Returning Macrophytes to a Degraded Lake. Deborah E. Hofstra**
National Institute of Water and Atmospheric Research, Hamilton, New Zealand

11:10 AM **Field Control Efficacy of Flumioxazin and Florpyrauxifen-benzyl on Invasive Aquatic Plants in Australia. Marie Bigot**[1], Tobias Bickel[2], Louise Gill[2]
[1]CSIRO, Brisbane, Australia
[2]Queensland Department of Agriculture and Fisheries, Brisbane, Australia

11:30 AM **Ongoing Chemical Control Trials for Alligatorweed Growing in Moist Soil Habitats. Gray Turnage**
Mississippi State University, Starkville, MS

11:50 AM **Response of Four *Vallisneria* Taxa to Aquatic Herbicides. Jens P. Beets**[1], Erika J. Haug[2], Benjamin P. Sperry[3], Robert J. Richardson[4]
[1]USDA-ARS, Davis, CA
[2]NCSU, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[4]North Carolina State University, Raleigh, NC

12:10 PM **Lunch on Your Own**

12:10 PM **USACE/AERF Symposium (William Demens Meeting Room)** Contact Alyssa Eck for information

12:10 PM **Women of Aquatics Luncheon (Harbor View Meeting Room)**

WEDNESDAY AFTERNOON - JULY 17, 2024

LOCATION: Grand Bay Ballroom
TIME: 1:30 PM - 4:45 PM
MODERATOR: Brett W. Bultemeier
University of Florida
Gainesville, FL

***SPEAKER**

01:30 PM **Phenology and Resource Allocation Strategies of Diploid Flowering Rush (*Butomus umbellatus*) in Ohio and New York. Ryan M. Wersal**[1], Maxwell G. Gebhart[1], Andrew R. Hannes[2], Nathan E. Harms[3], Bradley T. Sartain[4], William L. Wolanske[5], Mia Yeager[6]
[1]Minnesota State University, Mankato, Mankato, MN
[2]3Buffalo District, US Army Corps of Engineers, Buffalo, NY
[3]US Army Corps of Engineers Engineer Research and Development Center, Lewisville, TX
[4]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
[5]New York State Department of Environmental Conservation, Basom, NY
[6]Cleveland Museum of Natural History, Cleveland, OH

01:50 PM **Targeting Overwintering Cyanobacteria in Sediments: A Demonstration on Proactive Algaecide Treatments in an Urban Pond. Andrew D. McQueen**
US Army Engineer Research and Development Center, Vicksburg, MS

02:10 PM **Improving Biological Control and Integrated Management of Water Hyacinth in South Florida. Megan K. Reid**[1], Lyn A. Gettys[2], Melissa C. Smith[3], Seth Farris[4]
[1]University of Florida IFAS, Davie, FL
[2]University of Florida, Davie, FL
[3]USDA Agricultural Research Service, Fort Lauderdale, FL
[4]USDA Agricultural Research Service, Davie, FL

02:30 PM **Quantifying Select Native Plant Species' Response to Herbicide Exposure. Michael W. Durham**[1], Benjamin P. Sperry[2], Corrina J. Vuillequez[1], Jonathan Glueckert[3]
[1]University of Florida, Gainesville, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[3]University of Florida, Boynton Beach, FL

02:50 PM **Industry Update – UPL NA Inc**

02:55 PM **Industry Update – AERF**

03:05 PM **Networking Break (St. Petersburg Ballroom)**

03:25 PM **Hydrilla (*Hydrilla verticillata*) Control After Whole-Lake Treatments of Bispyribac-sodium in Central Florida Lakes. Kelli L. Gladding**[1], Benjamin P. Sperry[2], Jonathan Glueckert[3], Ian J. Markovich[4]
[1]University of Florida, Center for Aquatic and Invasive Plants, New Smyrna Beach, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[3]University of Florida, Boynton Beach, FL
[4]US Army Corps of Engineers Engineer Research and Development Center, Clewiston, FL

03:45 PM **Concentration-Exposure Time Requirements for Hygrophila (*Hygrophila polysperma*) Control. Jonathan Glueckert**[1], Corrina J. Vuillequez[2], Michael W. Durham[2], Benjamin P. Sperry[3]
[1]University of Florida, Boynton Beach, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

04:05 PM **USACE Jacksonville District Invasive Species Management Operation Support Center (ISMOSC) roll with APC Hydrilla Demonstrations and Research. Ian J. Markovich**[1], Benjamin P. Sperry[2], Tyler J. Green[3], Jeremy M. Crossland[4]
[1]US Army Corps of Engineers, Clewiston, FL
[2]US Army Corps of Engineers, Gainesville, FL
[3]US Army Corps of Engineers Invasive Species Management Branch, Palatka, FL
[4]US Army Corps of Engineers Invasive Species Management Branch, Jacksonville, FL

04:25 PM **Determining the Potential of Early Season Algaecide Control for Lyngbya *(Microseria wollei)*. Jessica Baumann**[1], Robert J. Richardson[2]
[1]North Carolina State University / Dept. Crop and Soil Sciences, Raleigh, NC
[2]North Carolina State University, Raleigh, NC

04:45 PM **APMS Annual Business Meeting (Grand Bay Ballroom)**

06:00 PM **APMS Awards Banquet Reception (Grand Bay Foyer)**

07:00 PM **APMS Awards Banquet (Grand Bay Ballroom)**

THURSDAY MORNING - JULY 18, 2024

7:00 AM Continental Breakfast (St. Petersburg Ballroom)

LOCATION: Grand Bay Ballroom
TIME: 8:00 AM - 11:20 AM
MODERATOR: Lyn A. Gettys
University of Florida
Davie, FL

***SPEAKER**

08:00 AM National Invasive Species Impact Tables on the USGS Nonindigenous Aquatic Species Database. Ian A. Pfingsten
US Geological Survey, Gainesville, FL

08:20 AM Understanding the Endangered Species Act and How Pesticide Labels are Changing. Brett W. Bultemeier
University of Florida, Gainesville, FL

08:40 AM Revisiting Melaleuca Individual Plant Treatments in Wetlands. Stephen F. Enloe
University of Florida, Gainesville, FL

09:00 AM Investigating the Potential for Hybridization of Water Chestnut Introduced in the US. Lynde L. Dodd[1], Ryan Thum[2], Nancy Rybicki[3], Laura Meyerson[4]
[1]US Army Engineer Research and Development Center, Lewisville, TX
[2]Montana State University, Bozeman, MT
[3]George Mason University, Alexandria, VA
[4]University of Rhode Island, Kingston, RI

09:20 AM Literature Review of *Microseira wollei* (*Lyngbya*) Distribution, Environmental Triggers, and Risks. Alyssa J. Calomeni-Eck, Andrew D. McQueen
US Army Engineer Research and Development Center, Vicksburg, MS

09:40 AM Networking Break (St. Petersburg Ballroom)

10:00 AM Long-term Monitoring Reveals Impacts of Invasive Aquatic Plants in Two Southwest Missouri Reservoirs. La Toya Kissoon-Charles, Daphne D. Miles, Anna N. Faust, Hannah L. Whaley
Missouri State University, Springfield, MO

10:20 AM Illinois Pondweed Common Nursery and Reciprocal Planting Research. Lyn A. Gettys[1], **Jennifer H. Bishop**[2], Madison Self[3], Joseph W. Sigmon[1], Kyle Thayer[1]
[1]University of Florida, Davie, FL
[2]University of Florida, Hollywood, FL
[3]University of Florida, Ft. Lauderdale, FL

10:40 AM Distribution and Field Identification of a Non-native, Hybrid Eelgrass (*Vallisneria spiralis* x *V. denseserrulata*) in Florida. Craig T. Mallison[1], Margaret S. Bass[2], Bradley T. Furman[2]
[1]Florida Fish and Wildlife Conservation Commission, Lakeland, FL
[2]Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL

11:00 AM Reclaiming Use and Revenue of Unique Swimming Area from Harmful Algal Blooms. Sonja L. Wixom
TIGRIS, St. Cloud, MN

11:20 AM Meeting Concludes

65th Annual Meeting
Omni Providence Hotel
Providence, Rhode Island

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.

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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.

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ORAL ABSTRACTS

Abstracts are listed in alphabetical order by title.

Accumulated Growing Degree Days of Cuban Bulrush (*Oxycaryum cubense*) in the Southeastern U.S. **Maxwell G. Gebhart**[1], Allison C. Squires[2], Ryan M. Wersal[3], Gray Turnage[1], Christopher R. Mudge[4], Benjamin P. Sperry[5]
[1]Mississippi State University, Starkville, MS
[2]Minnesota State University, Mankato, St. Peter, MN
[3]Minnesota State University, Mankato, Mankato, MN
[4]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[5]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Cuban bulrush is an aquatic epiphyte that can form large floating islands of plant material and debris restricting human access to water and disrupting ecological processes in impacted waterbodies. With increasing temperatures in the U.S., there is potential for the geographic increase of the current Cuban bulrush invasion happening within the southeast. By developing Accumulated Degree Day (ADD) predictive models and collecting biomass in several states (Mississippi, Louisiana, and Florida), a predicted baseline temperature for physiological growth of Cuban bulrush as well as ADD needed to attain peak biomass were determined. Peak emergent biomass occurred during fall (September and October) and was maintained into winter. Predictive models estimated 6,469 (Mississippi), 7,111 (regional), 7,643 (Florida), and 7,903 (Louisiana) ADD were needed for Cuban bulrush to attain peak emergent biomass. The ADD estimates corresponded to a range of calendar days (292 in Mississippi to 334 days in Florida) and base temperature thresholds (-6º C in Mississippi to -2º C in Florida) needed for peak emergent biomass occurrence. These models suggest Cuban bulrush can tolerate low air temperatures allowing for survival and growth to occur during moderate winter conditions common in midwestern and some northern U.S. states. However, models for southern populations (i.e., Florida) were less accurate as winter temperatures tended to be warmer yielding year-round growth of Cuban bulrush. While Cuban bulrush can grow aggressively in warmer temperatures, calculated base temperature thresholds suggest further expansion into climates much cooler than the southeastern U.S. is possible.

ALS-Inhibiting Herbicide Sensitivity Comparison Between Florida Water Hyacinth Populations.
Hannah J. Brown[1], Corrina J. Vuillequez[1], Jonathan Glueckert[2], Michael W. Durham[1], Candice M. Prince[1], Benjamin P. Sperry[3]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Herbicide resistance, although historically rare in aquatic plant management, is of utmost importance in the discipline due to the limited number of registered aquatic herbicides. Water hyacinth [*Eichhornia crassipes* (Mart.) Solms] is suspected to have populations in Lake Tohopekaliga, FL which have developed decreased sensitivity to the acetolactate synthase (ALS)-inhibiting herbicide, penoxsulam. Lake Tohopekaliga has an extensive history of chemical control and ALS-inhibitor herbicide use for a multitude of aquatic plant species. Likewise, ALS-inhibitors are notorious for high occurrences of

herbicide resistance in terrestrial systems. Therefore, we evaluated the relative sensitivities of two water hyacinth populations to ALS-inhibitor herbicides through dose-response bioassays. A population from Lake Tohopekaliga was compared to a population from Rodman Reservoir, FL that has a minimal history of ALS-inhibitor use. Plants from both populations were established in 19 L outdoor mesocosms and treated using both foliar and subsurface applications of penoxsulam and imazamox to evaluate for cross resistance. Penoxsulam and imazamox were applied at 0, 0.00375, 0.015, 0.06, 0.24, 1, 4, and 16 times the maximum label rate for each herbicide. Treatments were arranged as a factorial with four replicates each in a completely randomized design. The study was replicated twice (June & September 2023) in Gainesville, FL. Biomass was harvested seven weeks after treatment. Data were fit to dose-response regression models using the 'drc' package in R. Data suggests that populations on Lake Tohopekaliga may be developing reduced sensitivity to penoxsulam, but further research is needed to determine the cause of differential responses.

Automating Water Hyacinth (*Eichhornia crassipes*) Detection Using Deep Learning on RGB UAS Imagery. **Amber E. Riner**[4], Jonathan Glueckert[1], James Leary[2], Greg MacDonald[3], Amr H. Abd-Elrahman[5]
[1]University of Florida, Boynton Beach, FL
[2]Center Aquatic and Invasive Plants, UF/IFAS, Gainesville, FL
[3]University of Florida, Gainesville, FL
[4]Center for Aquatic and Invasive Plants, Institute of Food and Agricultural Science, University of Florida, Gainesville, FL
[5]University of Florida, Wimauma, FL

Water hyacinth (*Eichhornia crassipes*), an invasive aquatic plant, poses significant ecological and navigational challenges in Florida's freshwater systems. Effective management relies on early detection and targeted herbicide application. This study aims to enhance water hyacinth surveillance by integrating small unoccupied aerial systems (sUAS) equipped with RGB cameras, with deep learning neural networks (DNN) to automate the detection process. Aerial surveys were conducted over Lake Lochloosa and Lake Tohopekaliga in various seasons during 2022 using high-resolution optical sensors. Images from the fall, summer, and winter on Lake Lochloosa were processed and analyzed to train a DNN model for detecting water hyacinth. Remaining surveys were used to evaluate the performance of the model across different spatial and temporal environments. Two deep learning models, Deeplabv3 and UNET, were evaluated. Deeplabv3 demonstrated superior accuracy (79%) in detecting water hyacinth within the same lake and season it was trained. Accuracy and recall decreased across both models with the size of the water hyacinth patch. Additionally, there was a decrease in recall, but not precision, when the model was applied to a different lake than it was trained on, indicating variability in detection efficiency across different environments. Our approach highlights the benefits and limitations of sUAS and DNN integration in creating a systematic, high-resolution surveillance method for managing invasive species. By automating the image analysis process, we can provide timely, actionable intelligence to field operators, enhancing resource allocation and treatment efficacy. This study supports the adoption of advanced aerial and machine learning technologies in environmental management, contributing to more efficient and sustainable control of water hyacinth in Florida's lakes. The practical outcome is an accessible technology support system that optimizes management decisions, thereby improving maintenance control efforts overall.

Comparison of UAAS and Operational Standard Equipment for Variable-leaf Watermilfoil Control. **Andrew W. Howell**[1], Kara Foley[2], Benjamin P. Sperry[3], Robert J. Richardson[2]
[1]North Carolina State University, Pittsboro, NC
[2]North Carolina State University, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Unoccupied aerial application systems (UAAS) are becoming increasingly adopted for aquatic weed management. Benefits of UAAS include the ability to autonomously treat sites that limit ground-based spray equipment while reducing applicator and environmental risks associated with traditional treatment methods. Prior UAAS investigations have primarily focused on differences between UAAS and ground-based foliar application tactics for weed control in terrestrial systems. However, no data is available that directly compares in-water application strategies between UAAS and boat-based treatments in aquatics. In the present studies, we evaluated varying application techniques with UAAS and standard boat-based operations to deliver the herbicide, florpyrauxifen-benzyl, to three separate ponds containing variable-leaf watermilfoil (*Myriophyllum heterophyllum*). The first two ponds received treatments using two different UAAS application patterns as directed in-water sprays, whereas the third pond served as a positive control mimicking an operational treatment with watercraft. Results indicate some variation in variable-leaf watermilfoil control occurs between the UAAS treatment approaches tested, but both aerial herbicide methods evaluated show potential for management. Discussion will include the influence of UAAS delivery of herbicide on in-water dissipation patterns and the effectiveness of these treatments for submersed plant control.

Concentration-Exposure Time Requirements for Hygrophila (*Hygrophila polysperma*) Control. **Jonathan Glueckert**[1], Corrina J. Vuillequez[2], Michael W. Durham[2], Benjamin P. Sperry[3]
[1]University of Florida, Boynton Beach, FL
[2]University of Florida, Gainesville, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

East Indian Hygrophila (*Hygrophila polysperma*) is a fast-growing emergent and submersed aquatic invasive plant introduced to Florida in the 1950's through the aquarium trade. It has become increasingly problematic in slow-moving and quiescent springs, rivers, canals, and storm water treatment areas (STA) where it can grow to occupy the entire water column, out-shade native species, and clog irrigation and flood-control structures. Hygrophila distribution is likely to increase due to spread by vegetative fragments. Currently, there is limited information about its biology and options for control and management. Therefore, in December 2023, a split plot design mesocosm study was initiated at the UF/IFAS Center for Aquatic & Invasive Plants to determine the efficacy of in-water applications of 6 aquatic herbicides on Hygrophila at 3 different rates and concentration exposure times. Treatments were applied by mixing the appropriate volume of herbicide with 2 L of well water and then distributing the mixture around the 900 L mesocosm. At 12, 24 or 48 hours after treatment, 4 random replicates were pulled from the treatment tanks and placed into mesocosms filled with untreated well water. Above-ground biomass was harvested at 6 weeks after treatment. Dry weight biomass was subjected to analysis of variance for percent reduction of shoot biomass by exposure time and by treatment. There were no significant interactions between herbicide, exposure time, or concentration. 48 hour and 24 hour exposure times were not different, but were more effective then 12 hour exposure times across all treatments. Diquat and florpyrauxifen-benzyl were most effective at reducing shoot biomass with reductions of 60 and 40% respectively. Flumioxazin and monoamine salt of endothall reduced biomass by 10%. Plants

treated with carfentrazone and dipotassium salt of endothall exhibited positive growth rates. The study is being replicated in Spring 2024 to examine potential seasonal differences in efficacy.

Desiccation Tolerance of Giant Salvinia *(Salvinia molesta)* in Simulated Boat Trailer Conditions.

Corrina J. Vuillequez[1], Jonathan Glueckert[2], Benjamin P. Sperry[3], Michael W. Durham[1]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

The continued spread of giant salvinia (*Salvinia molesta*) threatens the ecology and utility of water bodies. Boat traffic has been shown to be a major vector of aquatic invasive species. However, the potential for giant salvinia survival under boat trailer conditions is currently unknown. Therefore, experiments were conducted to evaluate the viability of giant salvinia following desiccation events under simulated boat trailer conditions. Giant salvinia was subjected to four environments: open-air, plastic boat bunks, wood boat bunks, and carpeted boat bunks for exposure times that ranged from 12 hours to 16 days. After predetermined time intervals, plants were placed into recovery mesocosms, and moisture loss and survival were recorded. Data were subject to ANOVA to test for main effects and interactions. Subsequently, data from separate experimental runs were fitted to a log-logistic model and regressed over exposure time. Effective times (ET) to result in 50% (ET_{50}) and 90% (ET_{90}) mortality were estimated from regression models. In open-air conditions, plants did not survive following 12 hours of desiccation. Based on ET_{50} values in run 1, plants on plastic boat bunks survived 1.5 to 1.9 times longer than on wood or carpet boat bunks, respectively. However, no differences in ET_{50} values between boat bunk types were observed in run 2 which was likely due to higher humidity than in run 1. In run 1, ET_{90} values for carpet, wood, and plastic boat bunks were 2.7, 3.2, and 5.4 days, respectively. Likewise in run 2, ET_{90} values for carpet, wood, and plastic boat bunks were 4.6, 5.1, and 5.4 days, respectively. Regardless of run or environment, 100% mortality was observed after eight days of exposure. Consequently, these results indicate that giant salvinia may require at least eight days of desiccation to prevent spread to new systems.

Determining the Potential of Early Season Algaecide Control for Lyngbya *(Microseria wollei)*.

Jessica Baumann[1], Robert J. Richardson[2]
[1]North Carolina State University / Dept. Crop and Soil Sciences, Raleigh, NC
[2]North Carolina State University, Raleigh, NC

Lyngbya *(Microseria wollei)* is a filamentous cyanobacteria that has become increasingly problematic throughout the southeastern region of the United States. A successful lyngbya treatment program has been established within Lake Gaston, NC/VA that utilizes chelated-copper based algaecides to manage this nuisance species throughout the system. Currently, this annual treatment program initiates in April, when water temperatures are approximately 65° F, and continues monthly through September. While the chelated-copper based algaecides produce favorable control responses in lyngbya during this time, the freshwater mussels may also be sensitive to exposure. The compounding effects of copper with naturally encountered environmental stressors, such as increased water temperatures and decreased dissolved oxygen levels, can exacerbate negative impacts. The objective of this study was to determine if the timing of the current treatment protocol could be modified to allow for early season, cold water algaecide applications to decrease stress on sensitive organisms. While cold water algaecide applications would minimize these compounding stressors experienced by mussel populations, it is unknown what impacts these timing adjustments would have on the overall efficacy of lyngbya treatment programs. To determine if changes in seasonal water temperatures or physiological responses of lyngbya impacts the efficacy of chelated-copper based algaecides, monthly evaluations were conducted in a growth chamber environment which mimicked the concurrent water temperatures occurring at Lake Gaston. These evaluations tested the efficacy of both Captain XTR® and Cutrine Ultra® (SePRO corporation) when treatment applications were conducted during the months of February, March, April, and May. Preliminary results indicate that the response of lyngbya varied between treatments, with control not being at detectable levels until water temperatures reached 65° F. These results suggests that treatment efficacy will likely be limited under early season, cool water conditions.

Developing Novel, Remote Sensing Techniques to Detect the Impact of Biological Control on Water Hyacinth, *Pontederia crassipes* Mart. **Usman Mohammed**[1], Carey R. Minteer[1], Aditya Singh[2], Melissa C. Smith[3], Stephen Lantin[4]
[1]University of Florida, Fort Pierce, FL
[2]Univeristy of Florida, Gainesville, FL
[3]USDA - ARS, Fort Lauderdale, FL
[4]University of Florida, Gainesville, FL

Pontederia crassipes Mart. Solms (water hyacinth) is an aquatic plant in the family Pontederiaceae?. It is native to South America and is considered one of the most invasive aquatic weeds worldwide. It was first introduced into the United States in 1884. Water hyacinth causes extensive damage by covering large water bodies, altering aquatic habitat by reducing dissolved oxygen and light penetration and blocking access to agricultural and recreational activities. Two weevils, *Neochetina* spp (Coleoptera: Curculionidae), and a planthopper, *Megamelus scutellaris* (Hemiptera: Delphacidae) were released into Florida in 1970s and 2010 respectively, to control water hyacinth and mitigate its effect on freshwater ecosystems. Assessing the impact of biocontrol on water hyacinth is essential to maintain support, demonstrate efficacy, and inform additional control activities. Methods of accessing aquatic habitats for assessment are cumbersome, costly, and can be dangerous. These methods are subjective, often restrictive, challenging, and time consuming. Unmanned Aerial Systems (UAS) based remote sensing can provide a safe, quick, and efficient survey in areas where access is difficult and dangerous for traditional survey methods. In this study we developed methods that accurately detect the impact of biocontrol on water hyacinth using UAS. Hyperspectral data were collected in the lab on water hyacinth plants with varying levels of biocontrol agent pressure. Results showed that *M. scutellaris* and *Neochetina* spp treatments exhibit higher spectral reflectance than the control treatment at the blue, green, and red region of the spectrum, after 4 weeks of exposure. However, the control and *M. scutellaris* treatment exhibits higher reflectance value than *Neochetina* spp. at the NIR-band. Overall, the results of this study illustrate the potential of UAS based remote sensing and classification algorithms in detecting and classifying biocontrol damage.

Development of a Maintenance Control Program for Giant Salvinia (*Salvinia molesta*). Christopher R. Mudge[1], David R. Sexton[2], Samantha L. Prinsloo[3], Ian A. Knight[4], Andrew W. Howell[5], Benjamin P. Sperry[6]

[1]U.S. Army Engineer Research & Development Center, Baton Rouge, LA
[2]LSU AgCenter, Baton Rouge, LA
[3]Louisiana State University, Baton Rouge, LA
[4]United States Army Corps of Engineers - Engineering Research and Development Center, Vicksburg, MS
[5]North Carolina State University, Pittsboro, NC
[6]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

The concept of maintenance control relies on frequent low volume applications of aquatic herbicides to keep plant populations at low densities. This method reduces total volume of herbicides applied to the system, despite more frequent interventions, and has been successfully utilized to manage water hyacinth in Florida. Giant salvinia grows more rapidly than water hyacinth and little is known of the frequency of management required to maintain plants at the lowest feasible densities. A mesocosm trial was initiated in May 2024 to evaluate the use of maintenance control for a full year on giant salvinia. Plants were established at an initial 2% coverage in 1,136 L containers and treated with a tank mix of glyphosate and flumioxazin when plants reached an herbicide action threshold of 5, 25, 50, or 100% plant area coverage (PAC). A 0 PAC (no plant) control to monitor organic matter deposited from the environment and an untreated reference where plants were allowed to grow undisturbed and reach 100 PAC for the entire study were also included. Every two weeks, water pH and PAC were recorded and treated if action threshold reached. The trial will conclude in early June 2024 and all material will be dried, weighed, and analyzed. To date, although the 5 PAC treatments required more frequent herbicide applications, the amount of pesticide was considerably less than the higher action thresholds since more spray solution was required to treat the entire experimental unit. Since the pH was unaltered and remained >8.0, plant growth was slow until =50 PAC was reached. At the annual conference, final data for frequency of applications, total volume of herbicides applied, sedimentation, and water pH will be presented since the research has not concluded.

Distribution and Field Identification of a Non-native, Hybrid Eelgrass (*Vallisneria spiralis* x *V. denseserrulata*) in Florida. Craig T. Mallison[1], Margaret S. Bass[2], Bradley T. Furman[2]

[1]Florida Fish and Wildlife Conservation Commission, Lakeland, FL
[2]Florida Fish and Wildlife Conservation Commission, St. Petersburg, FL

This research project investigated a non-native, hybrid eelgrass (*Vallisneria spiralis* x *V. denseserrulata*) first detected in Florida in 2019. Objectives were to 1) determine the distribution of the hybrid in Florida, 2) identify and describe morphological trait differences of native and hybrid eelgrass to improve field identification, and 3) monitor and evaluate relative abundance and intermixing of the two species in a system where they coexist. Genetic testing of 334 eelgrass samples revealed 50 hybrid samples from eleven water bodies. Additionally, 27 samples of non-native *V. spiralis* were collected in five water bodies. The greatest occurrence of non-native eelgrass was observed in South Florida, while all samples from Northwest Florida were native. Analysis of morphology revealed three traits useful in separating native and non-native eelgrass in the field, including lateral leaf pigment, pigmented midvein, and basal form. We developed an un-tested dichotomous key based on the combinations of these traits, and 86% of the 2,140 samples in our dataset were strongly correlated (96%) with the dominant genetic identity per combination. Most samples contained traits that could be used in the field to accurately identify them as native or non-native. In the Lake Ida-Lake Osborne system, abundance of non-native eelgrass peaked during April 2022 and declined over the study period. Native and non-native eelgrass frequently occupied the same areas and the number of sites where both species were collected was nearly twice the number of sites where only one species was collected. Trend analysis revealed that the number of sites with only native eelgrass was similar over the study but the number of sites with only non-native eelgrass declined by 48%. Results illustrated that non-native eelgrass was not invasive at our sampling sites on this system, as the number and composition of non-native samples did not increase over the two-year period.

Ecology of Alligatorweed: Historic Pest and Future Threat. **Samuel A. Schmid**, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

Alligatorweed (*Alternanthera philoxeroides*) is an invasive, aquatic plant which is native to South America and first introduced in the United States (U.S.) over a century ago and has since invaded most of the Southeast. Programs to control alligatorweed with classical biological control exhibited great success initially with the alligatorweed flea beetle (*Agasicles hygrophila*). However, the flea beetle used in the U.S. is a poor climate match for invasive alligatorweed, rendering it ineffective in large portions of the invaded range. The alligatorweed thrips (*Amynothrips andersoni*) is a biological control agent that has been studied much less thoroughly but shows promise as an alternative candidate in locations unsuitable for the flea beetle. There is evidence that the thrips are more tolerant to cold temperatures than the flea beetle and recent experiments have shown significant alligatorweed reduction by the thrips. However, the current distribution of the thrips is poorly described, and as the global climate changes, the ecological niches of these species may shift. The objective of this research is to model and contrast the ecological niches of alligatorweed and these two biological control agents under present-day and future climate scenarios. This niche modeling effort was conducted using Maxent to produce ecological niche models (ENMs) for the three target species under three climate scenarios: (1) present day, (2) 2040 best case (SSP1-2.6), and (3) 2040 worst case (SSP5-8.5). Our findings suggest substantial range expansion northward for all three species under future scenarios. Additionally, we found that alligatorweed has greater niche overlap with the thrips than with the flea beetle under all climate scenarios, which suggests that the thrips has greater utility as a biological control agent than the flea beetle in portions of the invaded range that experience colder temperatures.

Efficacy of Selected Herbicides on Three *Hydrilla verticillata* Biotypes. **Kara Foley**, Robert J. Richardson
North Carolina State University, Raleigh, NC

Over 50 years of research activities have documented herbicide efficacy on monoecious and dioecious biotypes of *Hydrilla verticillata* in the United States. Recently, a genetically dissimilar biotype of *H. verticillata* was introduced to the Connecticut River and control options are not well understood. This biotype exhibits several morphological and ecological differences when compared to monoecious and dioecious hydrilla, therefore management strategies may differ as well. Eight selected aquatic herbicides were evaluated through a greenhouse trial at North Carolina State University. Apical fragments of monoecious, dioecious, and Connecticut River hydrilla biotypes were established under greenhouse conditions and exposed to high and low rates of each selected active ingredient. Treatments included endothall, copper, diquat, florpyrauxifen-benzyl, and flumioxazin with 24 or 72 hours of exposure time,

and penoxsulam, fluridone, and topramazone with 45 days of static exposure time. Post-treatment plant symptomology was monitored and biomass was harvested six weeks after the end of herbicide exposure. Comparison of post-treatment control found that endothall (100% control with all tested treatments), diquat (68 – 100% control with tested treatments), and florpyrauxifen-benzyl (63 – 88% control with tested treatments) provided moderate to excellent control of Connecticut River hydrilla at tested rates and exposure times. Penoxsulam (100% control with all tested treatments) and high rates of fluridone (95% control) also effectively controlled the Connecticut River hydrilla biotype, however long exposure times may not be feasible on an operational scale in a flowing riverine system. In general, the Connecticut River hydrilla biotype was more sensitive to treatments when compared to the monoecious and dioecious biotypes. This work will serve as a baseline for future research and management efforts for the novel Connecticut River hydrilla biotype that continues to thrive in the Northeastern United States.

Evaluating a Novel Copper Formulation for Improved Delivery and Efficacy. **West M. Bishop**
SePRO Corporation, Whitakers, NC

A new formulation of an ethylenediamine chelated copper herbicide/algaecide was recently registered with the USEPA (Komeen® Descend; EPA Reg. No. 67690-25). A primary differentiating factor in this formulation is the utilization of highly porous microcrystals (MicroCrystal Technology). These microcrystals, with a size range of 0.25-1mm, absorb the liquid formulation and allow slower and controlled release toward the benthic areas of a water resource. This formulation is applied like a liquid but performs like a granule with enhanced delivery of copper to target aquatic weeds and macroalga by releasing in targeted localized zones and benthic portions of water column. Case studies of using this formulation have shown positive efficacy such as eelgrass (*Vallisneria* spp.) and the invasive macroalga starry stonewort (*Nitellopsis obtusa*). Patent pending MicroCrystal Technology advances the strategic and efficient use of copper complexes and other aquatic herbicides and algaecide formulations.

Evaluating Photosynthetic Efficiency of Parrotfeather (*Myriophyllum aquaticum*) to Determine Invasive Potential in the Midwest. **Alyssa J. Anderson**[1], Christopher T. Ruhland[1], Gray Turnage[2], Ryan M. Wersal[1]
[1]Minnesota State University, Mankato, Mankato, MN
[2]Mississippi State University, Starkville, MS

Parrotfeather (*Myriophyllum aquaticum*) is an invasive, heterophyllous, aquatic plant from South America. This plant is known to create 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. Dark-acclimated (F_v/F_m) measurements, or measurements that depict photosynthetic potential, showed both leaf forms have the high potential to be efficient at temperatures from 0-35°C. Light-acclimated (fPSII) measurements indicated similar patterns in the emergent leaf form; however, the submersed leaf form showed significant signs of temperature stress at 0-4°C. Gas exchange measurements were completed

using the LI–6800 and LI-6800-18 at 3 temperature optimums (4°C, 25°C, 35°C). Eurasian watermilfoil and a hybrid milfoil strain were also measured to compare physiological abilities. Results indicate that the true quantum yield for emergent parrotfeather surpasses all submersed leaf forms with a yield of $1e^{-2}$ at all three optimums. Submersed parrotfeather exhibited similar yields to Eurasian and hybrid milfoil at 4°C and 35°C and was doing significantly better than the other two strains at 25°C. An accumulated degree day model on the submersed form supports this data showing a base threshold temperature of 5°C. All results indicate parrotfeather should have no issue being able to survive and invade in the Midwest.

Field Control Efficacy of Flumioxazin and Florpyrauxifen-benzyl on Invasive Aquatic Plants in Australia. **Marie Bigot**[1], Tobias Bickel[2], Louise Gill[2]
[1]CSIRO, Brisbane, Australia
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Invasive aquatic plants are a pervasive issue around the world as they can cause significant socio-economic and environmental impacts. In Australia, their control has been particularly challenging due to a lack of effective and economical control tools. Recently, the Australian Pesticides and Veterinary Medicines Authority registered two new herbicides for the control of aquatic weeds: Flumioxazin (Clipper herbicide, December 2021) and florpyrauxifen-benzyl (ProcellaCOR FX, March 2024). Slightly different formulations of these two herbicides were already registered for aquatic use in the USA for many years, suggesting great potential in Australia. The control efficacy of flumioxazin and florpyrauxifen-benzyl was investigated in field trials in Australia. A range of submergent and emergent plant species were treated with these herbicides in various environmental conditions. Depending on the species, the products were applied in-water and/or foliar sprayed to determine best possible management strategy. The two herbicides provided good to excellent control of the tested problematic weeds with minimal non-target damage to many native emergent species when used within prescribed dosage. Flumioxazin efficiently controlled cabomba (*Cabomba caroliniana*), Amazon frogbit (*Limnobium laevigatum*), hairy water hyssop (*Bacopa lanigera*), Mexican water lily (*Nymphaea mexicana*) and water lettuce (*Pistia stratiotes*). Florpyrauxifen-benzyl efficiently controlled sagittaria (*Sagittaria platyphylla*), rotala (*Rotala rotundifolia*) and parrot's feather (*Myriophyllum aquaticum*). Flumioxazin also controlled sagittaria, but the results were variable across sites. Flumioxazin and florpyrauxifen-benzyl represent promising tools for future aquatic weed control. While they can effectively manage a range of aquatic plants, ongoing research efforts are focusing on investigating non-target damage to further inform management strategies.

Field Demonstration for Management of Diploid Flowering Rush (*Butomus umbellatus*) at Ottawa National Wildlife Refuge, Ohio. **Bradley T. Sartain**[1], Nathan E. Harms[2], Andrew B. Coomes[3], Ashton B. DeRossette[4]
[1]US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
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Diploid flowering rush is widespread in the Great Lakes region of the US yet management R&D has largely focused on best-practices to control triploid populations. Twelve treatment plots (0.08 ha^{-1} ea.) were established in June 2023 at Ottawa National Wildlife Refuge, Ohio to evaluate chemical control of

diploid flowering rush. Plots were assigned to one of three foliar herbicide treatments (imazapyr, imazamox, glyphosate) or designated as a non-treated reference. Each treatment was replicated across three plots and herbicide treatments were administered 14 June 2023. Mean water depth within plots ranged from 0.0 to 13.3 cm at treatment. Point-intercept surveys and biomass sampling were performed pre- and post-treatment within each plot to assess treatment efficacy and impacts to co-occurring species. Prior to treatment, all plots had 100% flowering rush occurrence across a grid of 17 sample locations. Pre- vs. post-treatment assessments indicated flowering rush height and coverage were reduced by a greater percentage in herbicide treated plots with a lower mean water depth. In addition, only imazamox and imazapyr treatments in plots with minimal water reported a significant decrease in aboveground biomass. No significant decrease in below ground biomass was reported pre- to post-treatment for any treatment. In plots treated with imazamox or imazapyr flowering rush coverage was reduced =40%, whereas reductions in coverage ranged from 4 to 34% in glyphosate treated plots. Personal communication with Refuge biologists also indicated that plots with reduced flowering rush coverage consistently supported greater numbers of wading birds and wildlife throughout the summer. A second year of treatments and assessments are planned for 2024 to evaluate ongoing reductions in flowering rush biomass.

Hydrilla (*Hydrilla verticillata*) Control After Whole-Lake Treatments of Bispyribac-sodium in Central Florida Lakes. **Kelli L. Gladding**[1], Benjamin P. Sperry[2], Jonathan Glueckert[3], Ian J. Markovich[4]
[1]University of Florida, Center for Aquatic and Invasive Plants, New Smyrna Beach, FL
[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
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In the early 2000's, Hydrilla populations in Florida developed resistance to fluridone and in 2011 resistant strains to endothall were identified in Central Florida. Since the early 2000s, several new herbicide active ingredients were registered for aquatics use; however, several of these new chemistries have not been widely adopted and little operational use information exists. Consequently, whole-lake treatments of bispyribac-sodium across three central Florida lakes were recently monitored to document herbicide dissipation, hydrilla control and, native plant response. The results of these monitoring efforts will be presented.

Illinois Pondweed Common Nursery and Reciprocal Planting Research. Lyn A. Gettys[1], **Jennifer H. Bishop**[2], Madison Self[3], Joseph W. Sigmon[1], Kyle Thayer[1]
[1]University of Florida, Davie, FL
[2]University of Florida, Hollywood, FL
[3]University of Florida, Ft. Lauderdale, FL

Illinois Pondweed, also known as *Potamogeton illinoensis* is a native submersed plant that is useful in aquatic restoration projects. In these greenhouse (mesocosm) experiments we collected eight ecotypes of *P. illnoensis* from separate ecosystems throughout Florida and evaluated their growth under common nursery and reciprocal planting conditions to identify ecotypes that might be more widely adapted than the species. The common nursery study used five artificial substrates that ranged from 100% peat to 100% sand and four fertilizer levels ranging from 0 to 4 g of controlled release fertilizer per L of substrate, whereas reciprocal plantings utilized substrates collected from the eight "pondweed source" lakes plus two additional lakes where Illinois pondweed is scarce or absent. Plants were cultured for 16 weeks; plant height (longest shoot in each container) was recorded, then all material was subjected to a destructive harvest. Harvested plant material was separated into aboveground shoots and belowground roots, washed clean of substrate and other debris, and then dried in a forced-air oven at 65 °C until a constant weight was achieved. The dry weight of these plants was weighed, and the data was analyzed. Ecotype and fertilizer rate had significant effects on Illinois pondweed growth under both common nursery and reciprocal planting conditions. Also, substrate affected most growth parameters in the reciprocal planting experiments. These experiments revealed that ecotype selection may be an important consideration when planning aquatic restoration projects that include Illinois pondweed as ecotype influences plant growth and establishment, at least in greenhouse studies.

Impacts of Water Depth Changes on Aquatic Vegetation and Nutrients: Insights for Pond Management. **Daphne Miles**, Hannah Whaley, Anna N. Faust, La Toya Kissoon-Charles
Missouri State University, Springfield, MO

Spring-fed impoundments in the Ozarks experience fluctuations in water depth. These fluctuations might promote algae growth and cause shifts in dominant aquatic plant growth forms (i.e., submerged to emergent). Changes in water depth and volume can also impact nutrient concentrations algal growth. It is not well understood how changes in water depth impact the plants in these spring-fed systems. William's Pond is a spring-fed impoundment that faced a dam malfunction, causing below-average water depth for nearly 2 years. We measured aquatic plant cover, water depth, and nutrients seasonally before, during, and after the dam malfunction. Decreased water depth was expected to increase filamentous algae and floating plants (FAV) and decrease submerged plants (SAV). During the dam malfunction (2020-2021), water depth was lower ($<$1m) than after the dam was fixed (2022-2023). During this period, species richness stayed the same between low and high water years, however, emergent plants grew where they didn't before. Algae cover was highest and SAV cover was lowest in winter 2021 compared to winter in other years. Algae cover was highest in spring 2021 compared to spring in other years but SAV cover remained constant. FAV cover was highest and algae cover was lowest in fall 2021 compared to fall in other years. Water temperatures were higher in high water years in summer and fall. Turbidity and chlorophyll-a were higher in low water years in spring and summer, with dissolved oxygen following the same trend in spring and winter. Changes in water depth impacted water clarity and quality, which was associated with shifts in the aquatic plant community. Shading from algae and decreased water depth might explain the decreased SAV. Our findings indicate that changes in water depth led to annual and seasonal differences in the aquatic plant community.

Improving Biological Control and Integrated Management of Water Hyacinth in South Florida.
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[2]University of Florida, Davie, FL
[3]USDA Agricultural Research Service, Fort Lauderdale, FL
[4]USDA Agricultural Research Service, Davie, FL

Water hyacinth, *Pontederia crassipes*, is a highly invasive floating plant that originates from South America. Introduced to the US in 1884, it is problematic in numerous freshwater systems, and is also invasive in several countries throughout the world. Several registered herbicides are used to manage the species in the US, and four biological control agents have been introduced. Mesocosm studies have shown that herbicide use can be reduced significantly if biological control is integrated with chemical control, and this could thus reduce the costs of management. To replicate these mesocosm studies in a field setting, we are deploying booms on Lake Okeechobee to section off areas of water hyacinth intermixed with native plants. These sites will be sprayed with 2,4-D and penoxsulam at three rates: operational, half rate, and a control with water only. There will be four replicates per treatment, with an additional four replicates containing no water hyacinth and only native plants, resulting in a total of 24 sites. Vegetation coverage will be monitored, and abundances of biocontrol agents recorded. In addition to the work on Lake Okeechobee, augmented releases of one of the biocontrol agents will be conducted at selected sites, to attempt to mimic augmentative control efforts implemented by researchers in South Africa. By improving the techniques used to manage water hyacinth in south Florida, we can reduce costs and improve efficacy of management strategies.

Improving Biological Control of *Pontederia crassipes* Through Crossbreeding Experiments of *Megamelus scutellaris* and Plant Productivity Surveys. **Madison Self**[1], Lyn Gettys[1], Megan Reid[1], Melissa Smith[2], Carey Minteer[3]
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[3]University of Florida, Vero Beach, FL

Water hyacinth, *Pontederia crassipes* Mart. [= *Eichhornia crassipes* (Mart.) Solms] is a free-floating perennial aquatic plant in the family Pontederiaceae. This plant is native to South America but has become one of the world's worst invasive plants (Holm et al. 1977). *Megamelus scutellaris* (Berg) (Hemiptera: Delphacidae) is the most recently released biological control agent in South Florida. Two populations of *M. scutellaris* have been released in Florida, one from Argentina in 2010, and another from Paraguay in 2013. The population from Paraguay was determined to have a higher heat tolerance and better suited for control in South Florida (Foley, Minteer, & Tipping 2016). Understanding differences between populations of insects used for biological control can become largely important for improving applications in the field. This experiment aims to conduct crossbreeding experiments between the two populations to determine if they are reproductively isolated. Understanding differences between environmental factors also play a role in improving control efforts. Multiple studies have revealed that water nutrient levels heavily effect the growth of plants and the success of biological agents (Ripley et al. 2006, Marlin et al. 2013, Miller et al. 2019). In another set of experiments, chlorophyll-a fluorescence and leaf gas exchange measures will be used as a proxy for plant health. These measurements will be compared across South Africa, Florida, and Northern California, three regions where *P. crassipes* is invasive and *M. scutellaris* is established. *P. cordata*, a congener of *P. crassipes*, will also be measured. This plant is invasive in South Africa, native in Florida and not established, but found in California. These comparisons along with subsequent water nutrient measurements and insect counts will provide insight into the varied success of control across these regions and provide information to improve future control efforts in these areas.

Intraspecific Variation in Thermal Tolerance and Plasticity of the Adventive Parrot's Feather Weevil, *Phytobius vestitus*, in the USA. Nathan E. Harms[1], **Megann M. Harlow**[2], Ashton B. DeRossette[3], Ian A. Knight[3], William A. LeVan[4]

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The success of a biological control program to manage invasive aquatic weeds may depend on the thermal tolerance of the agent and the climate in which the agent is utilized. Understanding the geographic variation of a species' thermal tolerances and plasticity within its geographic range may allow for the selection of a climatically relevant and efficacious insect agent. Parrotsfeather, *Myriophyllum aquaticum*, is a South American aquatic plant that is considered invasive in several locations around the globe. In the southeastern USA, where *M. aquaticum* has been introduced, we discovered a native weevil (*Phytobius vestitus*; historically associated with *M. heterophyllum)* that damages parrotfeather and restricts its growth. To aid in determining the potential value of this species as a biological control agent where management is needed, we conducted a series of experiments to investigate the upper and lower thermal tolerances of *P. vestitus* from four geographically separate southern USA populations. Additionally, we determined the variation in rapid cold hardening (i.e., a physiological process in which an organism prepares for cold temperatures; RCH) using two temperature ramping speeds. Furthermore, we investigated whether *P. vestitus* displayed an acclimation response by implementing an elevated holding temperature for 36 hours prior to high-temperature exposure. Louisiana-collected weevils were most susceptible to cold temperatures (fast ramp CTmin = 0.85° C) while weevils collected from Texas were most tolerant (fast ramp CTmin = -0.25° C). Louisiana and Oklahoma weevil populations exhibited RCH, indicating that those populations may be best suited for a biological control program in cooler climates or where conditions may change quickly. All populations exhibited acclimation response to high temperatures, but the largest response was for the Louisiana population. Our findings highlight the importance of considering geographic variation in biological control agent thermal tolerances for use in specific climates around the world.

Investigating the Potential for Hybridization of Water Chestnut Introduced in the US. **Lynde L. Dodd**[1], Ryan Thum[2], Nancy Rybicki[3], Laura Meyerson[4]
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[3]George Mason University, Alexandria, VA
[4]University of Rhode Island, Kingston, RI

Collaborative applied research conducted under the US Army Corps of Engineers' Aquatic Plant Control Research Program studies hybridization potential of introduced water chestnut species, *Trapa natans* and *T. bispinosa* var. *iinumai*. Range expansions for each species in the mid-Atlantic and Northeastern regions of the US race towards overlap warranting investigation into this possibility, especially considering that offspring of hybridized species can exhibit stronger invasive traits when compared to their parents. Greenhouse experiments conducted at the University of Rhode Island and ERDC's Lewisville Aquatic Ecosystem Research Facility evaluated manual and passive methods of cross-pollination between both species of *Trapa*. Genetic relationships were determined from ITS (Internal Transcriber Spacer) sequencing and PCR-based AFLP (Amplified Fragment Length Polymorphism) methods. Results from this study indicate that hybridization appears unlikely between both species of water chestnut.

Literature Review of *Microseira wollei* (*Lyngbya*) Distribution, Environmental Triggers, and Risks.
Alyssa J. Calomeni-Eck, Andrew D. McQueen
US Army Engineer Research and Development Center, Vicksburg, MS

The biphasic cyanobacterium, *Microseira wollei* (formerly *Lyngbya wollei*) has been known to cause noxious growths within water bodies in the southeastern U.S. However, growths have reportedly increased throughout the U.S. with recent (2010) problematic populations observed in the Great Lakes Region (e.g., Lake Erie and Lake St. Clair). With more locations facing this cyanobacterium, consolidated and synthesized information regarding distribution, environmental triggers promoting growth, as well as human and ecological health risks are needed. A strategic literature review was performed to address these topics. *M. wollei* is distributed within eastern states and provinces in North America, extending from Canada to Florida. *M. wollei* grows in areas with a pH from 7 to 9, specific conductance from 250 to 1,200 µS/cm, light intensities from 11 to 100 µmol photons $m^{-2}s^{-1}$, temperatures from 20 to 35 ?, and nutrient concentration ranging from 0.6 mg/L NO_3-N to 83 mg/L NO_3-N and 0.55 mg/L PO_4 -P to 5.5 mg/L PO_4-P. Environmental drivers may be site-specific and specific to the *M. wollei* population; therefore, the environmental drivers identified in this literature review are a starting point that can be used to inform site-specific investigations. Human health risks from *M. wollei* may originate from toxins, disinfection byproducts, and potentially, fecal indicator bacteria. The most prevalent toxins produced by *M. wollei* are saxitoxins, a group of neurotoxins. The potential human health risks associated with toxin production of *M. wollei* highlight the need for adaptive management of this harmful cyanobacterium.

Long-term Monitoring Reveals Impacts of Invasive Aquatic Plants in Two Southwest Missouri Reservoirs.
La Toya Kissoon-Charles, Daphne D. Miles, Anna N. Faust, Hannah L. Whaley
Missouri State University, Springfield, MO

Invasive aquatic plants impact water quality, outcompete native plants, and have adverse effects on aquatic life. Two invasive aquatic plants were discovered in two southwest Missouri reservoirs by persons on nature walks. *Potamogeton crispus* (curly-leaf pondweed) was found in a spring-fed pond in southwest Missouri. *Azolla* sp.(mosquito ferns) was found growing in Lake Springfield, an impoundment of the James River in Springfield, Missouri. In the first study, we conducted seasonal vegetation surveys for the last seven years to monitor the abundance of *P. crispus* and other plants in the spring-fed pond. During this time, the pond's dam malfunctioned causing decreased water depths for almost two years. *P. crispus* abundance increased during the dam malfunction and after the dam was fixed. This coincided with decreased abundance of filamentous algae and other submerged plants. We are now conducting monthly surveys to determine the impacts of increasing *P. crispus* abundance on native aquatic plants and its relation to water chemistry of the spring-fed pond. In the second study, after initial observations of *Azolla* in Lake Springfield, we observed it spreading to other parts of the lake over the last four years. *Azolla* has a symbiotic relationship with a nitrogen-fixing cyanobacteria, *Anabaena azollae Strasburger*. This symbiotic relationship can add excess nitrates to Lake Springfield and cause algal blooms. The US EPA listed Lake Springfield as impaired due to high algal abundance caused by excess nutrients. *Azolla* in Lake Springfield can compound this problem since it releases nitrates upon decomposition. We are monitoring Lake Springfield every 2-3 months to assess *Azolla* abundance. To determine the impacts of *Azolla*, we will measure nitrate concentrations and algal abundance within and outside of *Azolla* mats. Findings for both studies will help us understand impacts of these invasive aquatic plants and help with developing effective management strategies.

Mapping Aquatic Vegetation in Every Lake in Rhode Island and New Hampshire Using Shoebox-Sized Satellites. Thomas Howard

Resolve Hydro LLC, Brown University, Providence, RI

Traditional methods for aquatic vegetation monitoring, such as acoustic mapping and rake throw surveys, provide high-quality, in-situ data on the distribution of aquatic vegetation in waterbodies. However, these methods necessitate field data collection, which is inherently limited in both spatial and temporal scope. This presentation will detail the development and application of a satellite-based method for generating statewide maps of aquatic vegetation at low-cost, high-frequency, and high-accuracy. In this study, over 17,000 in-situ observations of aquatic vegetation were paired with coincident satellite data to train machine learning algorithms to detect submerged, floating, and emergent vegetation using high-resolution satellite imagery collected by a constellation of nearly 130 shoebox-sized satellites. Testing on over 7,000 hold-out samples has demonstrated that the developed detection approach achieves approximately 86% accuracy across diverse water conditions, including hypereutrophic waters. In this presentation, we will describe the development of this remote sensing-based approach and initial findings from its application to approximately 2,500 waterbodies in New Hampshire and 600 waterbodies in Rhode Island. This presentation will showcase the user-friendly dashboard developed to use this data to enhance targeted field monitoring and management, provide lake-specific estimates of treatment and monitoring costs, describe statewide aquatic vegetation phenology, and inform policy decisions on invasive species prevention and management.

Mesocosm Evaluation of Combination Foliar Herbicide Treatments for Aquatic Alligatorweed Management: Impact on Stem Fragment Viability and Biomass. Daniel Clements[1], Deborah E. Hofstra[2], Paul D. Champion[1], Iñigo Zabarte-Maeztu[1]

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[2]National Institute of Water and Atmospheric Research, Hamilton, New Zealand

Management of alligatorweed (*Alternanthera philoxeroides*) using approved herbicides in aquatic environments is a cost-effective method to reduce biomass and minimize weed impacts. Herbicides are regularly used in regions where biological control agents (e.g., alligatorweed flea beetle, *Agasicles hygrophila*) do not successfully overwinter and where eradication or management of large-scale infestations is required. However, multiple herbicide applications over successive years are currently required to kill above ground alligatorweed and deplete underground biomass to eventually exhaust the plant. The herbicides glyphosate, triclopyr, metsulfuron and imazapyr have been used for control of alligatorweed in aquatic situations in New Zealand and Australia. Production of viable alligatorweed stem fragments, following individual herbicide treatments is a recognized challenge to achieving eradication. Potential options to improve management outcomes for alligatorweed is to combine currently used herbicides, however the degree of viable fragment production post-treatment has not been evaluated. Therefore, a mesocosm study was established to evaluate the effect of herbicide combinations on the production of viable alligatorweed stem fragments, above ground biomass and below ground biomass. The study concluded that the combination treatment of glyphosate + metsulfuron (2.17 + 0.036 kg a.i. ha^{-1}, respectively) provided more effective control of alligatorweed (293 days after treatment) and minimized the number of viable stem fragments produced, compared to currently used herbicides when applied individually. The glyphosate + metsulfuron treatment produced 70% less viable stem fragments compared to metsulfuron and imazapyr when applied individually and 27% less viable stem fragments compared to glyphosate. Triclopyr and glyphosate + triclopyr treatments did not effectively control overwater biomass throughout the trial. The mesocosm results indicate that more effective alligatorweed control programs can be developed using the glyphosate + metsulfuron combination.

National Invasive Species Impact Tables on the USGS Nonindigenous Aquatic Species Database.

Ian A. Pfingsten
US Geological Survey, Gainesville, FL

The introduction of aquatic invasive species (AIS) can have devastating economic and environmental impacts. Aquatic invasive species are one of the largest threats to biodiversity, recreation, infrastructure, and agriculture world-wide. There is a need to better understand the impacts of AIS, as the effects of their initial presence may go unnoticed or be unrecognizable until management actions are needed and may prove ineffectual. Information on a species' impact is often scattered throughout the peer-reviewed literature and in unpublished agency reports, making it hard to summarize in a useful way. To effectively identify and summarize known AIS impacts, the U.S. Geological Survey's Nonindigenous Aquatic Species (NAS) database created species impact tables. Implementing an exhaustive and comprehensive literature review, NAS scientists have created an archive of invasive species impact data and displayed it in easy-to-read, publicly available, interactive tables. The tables are comprised of comprehensive literature reviews for each species and each reference is classified as experimental, observational, or anecdotal. There are three impact categories (Ecological, Economic, and Human Health), with fifteen different impact subcategories. The impact tables are dynamic and will continue to be updated regularly with current literature, becoming an integral part of the NAS database. Having access to online, interactive invasive species impact tables combined with species occurrence data on the NAS database drastically reduces the time involved in creating invasive species management plans and increases the accuracy of the estimated cost of potential species impacts.

Not All Coppers Are the Same. **David G. Hammond**
Earth Science Labs, Inc, Larkspur, CA

Frequency and severity of Harmful Algae Blooms (HABs) across the U.S. have increased markedly in recent years, causing a variety of operational and safety concerns, especially those stemming from cyanotoxins. Copper-based algaecides have long been an important tool for management of source water – to the extent that in some jurisdictions copper was over-used and there has been a backlash against it. There is clearly a need for more efficient copper formulations that achieve performance objectives with minimal impacts on the environment. Recent advances in formulation chemistry have led to liquid ionic coppers, which are a more efficient way of delivering copper, providing superior performance with less chemical applied, and less impact on the environment. Liquid ionic copper is used to control Harmful Algae Blooms (HABs) in recreational lakes and in the source water serving drinking water treatment plants, where it provides a valuable a pre-treatment step that improves raw water quality parameters by reducing organics (TOC), formation of disinfection by-products (DBPs), and compounds that cause undesirable taste and odor (T&O) impacts. Data from real world case studies will be presented, illustrating that a formulation of liquid copper delivered as cupric ions yields superior results, superior pest control, and better cost-effectiveness at lower doses of active ingredient. The data illustrates that in most instances, facilities switching from conventional copper to liquid ionic copper are able to achieve

similar results by applying only 20% of the elemental copper previously applied, reducing cost, sparing non-target organisms, and decreasing overall impacts on the environment.

Ongoing Chemical Control Trials for Alligatorweed Growing in Moist Soil Habitats. Gray Turnage
Mississippi State University, Starkville, MS

Alligatorweed (*Alternanthera philoxeroides*) is the most widespread aquatic weed in Mississippi. Alligatorweed is capable of growing in aquatic, wetland, and terrestrial sites and switches growth form from a rhizomatous mat forming plant (aquatic) to a prostrate growth form with tap roots (terrestrial) which allows it to survive stressors such as drawdown or drought. Much is known regarding the impacts and control of alligatorweed in aquatic sites, however, less is known regarding control of alligatorweed in terrestrial or moist soil sites primarily managed as waterfowl habitat. 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 (approx. 2,000 ac) in the Mississippi flyway in western Mississippi; the WMA is primarily managed for waterfowl habitat. Alligatorweed has infested many ponds in the WMA and displaced desirable vegetation utilized as waterfowl forage. In 2022, initial foliar herbicide screening for operational control of alligatorweed found that imazapyr, bispyribac-sodium, topramezone, and florpyrauxifen-benzyl reduced plant biomass 74 to 84% one year after treatment. A second trial initiated in 2023 (and still ongoing), found that bispyribac-sodium, florpyrauxifen-benzyl, imazapyr, fluridone, flumioxazin, picloram, and select two-way herbicide tank mixtures reduced alligatorweed biomass 59 to 98% 12 weeks after treatment with tank mixtures generally achieving greater than 75% biomass reduction. All herbicide applications included a 0.5% v:v MSO surfactant and were applied at a 467.7 L/ha (50 gal/ac) diluent rate. This is the first report of alligatorweed control by bispyribac-sodium, topramezone, or fluridone suggesting that these herbicides may provide another alligatorweed control option for resource managers.

Phenology and Resource Allocation Strategies of Diploid Flowering Rush (*Butomus umbellatus*) in Ohio and New York. Ryan M. Wersal[1], Maxwell G. Gebhart[1], Andrew R. Hannes[2], Nathan E. Harms[3], Bradley T. Sartain[4], William L. Wolanske[5], Mia Yeager[6]
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Flowering rush (*Butomus umbellatus* L.) is an emergent perennial monocot that has invaded numerous aquatic systems along the U.S. - Canadian border. Currently, there are two known cytotypes of flowering rush, diploid and triploid, within the invaded range, though most studies have been focused on the triploid cytotype with little information about diploid plants. Phenology and resource allocation were studied on the diploid cytotype of flowering rush in three study sites (Mentor Marsh, Ohio; Tonawanda Wildlife Management Area, New York; and Unity Island, New York) to understand seasonal resource allocation, influences of environmental factors on growth, and to optimize management strategies. Whole-plant samples were harvested once a month during the growing season at each site from 2021 to

2023. Collected plant metrics were regressed to the collected air temperature, water temperature, and water depth. Aboveground biomass peaked from July-September and comprised 50-70% of total biomass, with the rhizome biomass peaking in September-November and comprising 40-50% of total biomass. Rhizome bulbil densities peaked during fall (September-November) at 3,000-16,000 rhizome bulbils m^{-2}. Regression analysis resulted in strong negative relationships between rhizome starch content and air temperature (r^2=0.53) and water temperature (r^2=46). Other significant, though weak relationships, were found including a positive relationship between aboveground biomass and air temperature (r^2=0.16), a negative relationship between rhizome bulbil density and air temperature (r^2=0.19), a positive relationship between leaf ramet density and air temperature (r^2=0.14) and a positive relationship between plant height and water depth (r^2=0.21). Rhizomes and rhizome bulbils combined stored up to 60% of total starch and present a unique challenge to management as these structures cannot be reached directly with herbicides. Therefore, management should target the aboveground tissue before peak production (July) to reduce internal starch storage which could limit regrowth over several years.

Quantifying Select Native Plant Species' Response to Herbicide Exposure. **Michael W. Durham**[1], Benjamin P. Sperry[2], Corrina J. Vuillequez[1], Jonathan Glueckert[3]
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In aquatic and natural areas, herbicide applications that result in direct contact with non-target plant species often cannot be avoided. However, adjusting herbicide rate, application volume, and adjuvants can potentially aid in enhancing target species control while minimizing injury to non-target plants. A mesocosm study was conducted to investigate four native plant species sensitivity to non-ionic surfactant applied at 0.25% v/v and methylated seed oil applied at 1% v/v applied at three application volumes, 140, 468 and 935 L/ha. Adjuvant applied alone did not result in any injury, nor were there differences noted to sensitivity when applied with 4.68 L/ha of 2,4-D amine. A second mesocosm study was conducted to examine the effects of 24 and 72 hour exposures times of three rates of florpyrauxifen-benzyl, dipotassium endothall, diquat and two rates of the combination of endothall and diquat on the submersed aquatic plant *Sagittaria subulata*. Plants are currently being evaluated for reduction in density over time and survivability. Results from this study are forthcoming and should provide insight into hydrilla management strategies where these two species co-exist.

Reclaiming Use and Revenue of Unique Swimming Area from Harmful Algal Blooms. **Sonja L. Wixom**
TIGRIS, St. Cloud, MN

The Clean Water Act (CWA) was established in 1972 and was the source of inspiration for individual states to develop their own water quality standards for surface water contaminants in accordance with federal guidelines. The most scrutinized and studied parameter for lakes is Phosphorous (P), the limiting nutrient for aquatic vegetation growth. High levels of P combined with high levels of Chlorophyll a (Chl *a*) and/or low Secchi depth (turbidity) can render a waterbody as recreationally impaired and often at risk for Harmful Algal Blooms (HABs). Despite the great efforts made in recent years to reduce nutrient inputs from the watershed via Best Management Practices in a historically agricultural area, issues with excessive plant growth and HABs persist leaving in-lake nutrient mitigation as the most viable option to combat these issues. Previously the only accepted management options was removing sediment and aluminum sulfate treatments; however, new technologies and techniques give rise to management opportunities using phosphate biding minerals, such as Lanthanum Modified Bentonite (LMB). This case study features a unique one-acre swimming area that has been closed early in recent years for the presence of persistent HABs, costing the organization tens of thousands of dollars. Hopewell Quarry, in Hopewell, New Jersey, has established partnerships to complete a nutrient remediation project integrating EutroSORB materials, a LMB inspired technology platform designed to reduce bioavailable phosphorous within the water column and sediment-water-interface. This case-study demonstrates the economic and cultural value of nutrient mitigation, the effect on algal assemblages, and reduction of Harmful Algal Bloom frequencies.

Response of Four *Vallisneria* Taxa to Aquatic Herbicides. **Jens P. Beets**[1], Erika J. Haug[2], Benjamin P. Sperry[3], Robert J. Richardson[4]
[1]USDA-ARS, Davis, CA
[2]NCSU, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[4]North Carolina State University, Raleigh, NC

Greenhouse mesocosm experiments were conducted in 2023 to investigate herbicide efficacy on two native eelgrass species (*Vallisneria americana* Michx. and *V. neotropicalis* Vict.) and two nonnative taxa (*V. australis* S.W.L. Jacobs & Les and *V. spiralis* × *V. denseserrulata* Makino). Herbicide applications included endothall, diquat, florpyrauxifen-benzyl, fluridone, at select combinations of these herbicides. Endothall alone provided 90-100% aboveground biomass reduction at 3000 µg L^{-1} with at least 24 hours of continuous or intermittent exposure. Florpyrauxifen-benzyl applied alone resulted in minimal aboveground biomass reduction. Fluridone applied at 10 µg L^{-1} with 45 days of exposure resulted in 94.5% biomass reduction on *V. americana* and 7.1- -47.9% other tested taxa. The combination of flumioxazin and florpyrauxifen-benzyl resulted in 90-100% aboveground biomass reduction and endothall combined with florpyrauxifen-benzyl resulted in 93-100% aboveground biomass reduction. Reductions in belowground biomass mirrored trends observed in aboveground biomass. No selective treatments were identified between native and invasive *Vallisneria* tax, although efficacy was observed on hydrilla bioindicator plants. These insights provide a basis of understanding for differences between these *Vallisneria* for researchers moving forward with selectively targeting hydrilla in the presence of native *Vallisneria* species and two new aquatic invasive plants. Future research should expand treatment and concentration exposure scenarios, increase the study period past six weeks, as well as identify potential integrated plant management strategies for field scenarios.

Returning Macrophytes to a Degraded Lake. **Deborah E. Hofstra**
National Institute of Water and Atmospheric Research, Hamilton, New Zealand

The return of native macrophytes to degraded lakes has been the goal of an increasing number of studies over the last few decades. However, many project stop at the water's edge, dealing only with catchment issues and not the in-lake barriers to restoration. In particular, when plants have been lost from a lake for a long time, the native seedbank may not be healthy enough for plants to easily re-establish. This presentation describes experimental studies and a field trial using different approaches to overcome the in-lake barriers to restoration and accelerate the re-establishment of desirable native macrophytes. As

well as laboratory studies to assess the potential scale of benefits from different plant combinations, to provide guidance on which species could be used when and where, to maximize ecosystem stability in restoration.

Revisiting Melaleuca Individual Plant Treatments in Wetlands. Stephen F. Enloe
University of Florida, Gainesville, FL

Melaleuca (*Melaleuca quinquenervia*) is an Australian tree in the Myrtaceae family that has invaded wetlands across south Florida. It was historically planted in the Everglades to facilitate drainage efforts for agriculture and development but rapidly spread. It forms dense stands that alter soil chemistry, fire intensity, and exclude native wetland species. Extensive research and management efforts for large scale Melaleuca removal were initiated in the 1990's and these included aerial and ground based herbicide treatments, mechanical, and biological controls. The effort was extremely successful and the treatments developed then are still the commercial standards today. These included individual plant treatments (IPT) such as a girdle + herbicide treatment and cut stump herbicide treatment. Both approaches utilize a tank mix of glyphosate and imazapyr. However, glyphosate use has been banned in certain areas in south Florida, prompting a need for treatment alternatives. To address this, studies were conducted to evaluate triclopyr as a potential tank mix partner with imazapyr for melaleuca girdle and cut stump treatments. Locations included infested sites near Charlotte Harbor and Bonita Springs, Florida. Treatments were applied to separate studies in the dry season (May) and wet season (November) in 2022. For the girdle + herbicide study, we found that triclopyr (86 g L^{-1}) tank mixed with imazapyr (60 g L^{-1}) was comparable to glyphosate (120 L^{-1}) tank mixed with imazapyr (60 g L^{-1}). Application timing did not influence the outcome. Similar efficacy occurred across the same herbicide treatments when applied as cut stump treatments. These results indicate triclopyr may serve as an effective replacement for glyphosate when tank mixed with imazapyr for melaleuca control. Future work should examine triclopyr applied alone with these techniques.

Salinity Tolerance of Flowering Rush, *Butomus umbellatus*. Andrew B. Coomes[1], Bradley T. Sartain[2]
[1]USACE-ERDC-EEA, Vicksburg, MS
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Flowering rush is an invasive aquatic plant in North America that causes deleterious effects to native ecosystems. There are two cytotypes, a triploid and diploid, and multiple genotypes contained within the diploid cytotype currently established in the U.S. Despite its presence in river drainages connected to estuarine areas, documentation on the salinity tolerance of flowering rush is scarce. Currently, information is limited to anecdotal reports suggesting intolerance to saline conditions. A better understanding of the osmotic tolerance of this species is essential to providing insight into its' invasive range and better inform management efforts. These studies investigated vegetative propagule germination and growth of four genotypes of flowering rush when exposed to a range of salinities (0-35 ppt). Germination and growth were assessed through benchtop and mesocosm experiments. Germination varied among cytotypes with triploids outperforming diploids at higher salinities. Diploid genotypes showed a significant decrease in germination past 5ppt, while triploid germination were equivalent to the control up to 15ppt. Propagules remained viable following salinity exposure indicating that vegetative reproductive structures are capable of persisting until more favorable conditions are met. In the growth study, ANOVA indicated no genotype effect, but a significant salinity treatment effect. When averaged across genotype, mean relative daily growth rate was significantly lower for all treatments when compared to the control and no differences were detected among treatments at treatments greater than 10ppt. This study corroborates previous classification of this species as a glycophyte or intolerant to saline conditions.

Targeting Overwintering Cyanobacteria in Sediments: A Demonstration on Proactive Algaecide Treatments in an Urban Pond. Andrew D. McQueen

US Army Engineer Research and Development Center, Vicksburg, MS

Most cyanobacteria that form harmful algal blooms (HABs) in inland waterbodies can overwinter in sediments. This field demonstration within an urban pond was conducted to bolster the database on the novel use of algaecide treatments to proactively target overwintering cyanobacteria located in sediments prior to HAB formation. In March 2023, a peroxide-based algaecide was applied to sediments of a water feature located in urban Kansas City, Kansas, and cyanobacteria responses were measured over subsequent weeks and months. Multiple lines of evidence were used to discern impacts of proactive treatments on overwintering cells in sediments and HAB severity throughout the growing season. Although results used to measure cyanobacterial responses were mixed, 3 of 5 lines of evidence indicated proactive algaecide treatments were effective at decreasing the transfer of cyanobacteria to the water column and HAB severity during months when HABs tended to occur. Microcystin concentrations immediately post-treatment (hours) remained at the analytical detection limit (0.10 µg/L) and were below USEPA risk-based thresholds, highlighting the benefits of application prior to the exponential growth phase of toxin-producing cyanobacteria. These results expand the dataset and methodology for field scale proactive algaecide applications targeting overwintering cyanobacterial cells in sediment to mitigate and delay HAB development.

The Effect of Photoperiod Interruption on Dioecious Hydrilla Propagule Production. Daniel C. Canfield[1], Benjamin P. Sperry[2], Michael W. Durham[1], Candice M. Prince[1], Greg MacDonald[1]

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[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Hydrilla (*Hydrilla verticillata)* has been dubbed the "perfect aquatic weed" due to its competitiveness and persistence of vegetative propagules, especially subterranean turions. Previous research has shown that turion formation is photoperiod-dependent as monoecious and dioecious biotypes produce these structures under long and short days, respectively. However, interruption of dark periods (night) in dioecious hydrilla strains has been previously suggested as a method to reduce subterranean turion production. Therefore, a mesocosm experiment was conducted and repeated in Florida to evaluate photoperiod interruption duration on dioecious hydrilla propagule production. Light fixtures with 45-watt incandescent bulbs and a digital timer were suspended over mesocosms. Photoperiod interruptions were initiated at 2:00 am daily from October to May for run one and October to mid-April for run two. Data loggers were used to verify photoperiod interruption. Run one was conducted in 2022 and tested interruption periods ranging from zero to 100 minutes. Run two was conducted in 2023 and tested interruption periods ranging from zero to 900 minutes. In both experimental runs, propagule numbers decreased with increasing photoperiod interruption time. Mature tuber count was reduced by 49% for run one and 57% for run two. Both runs reduced turion and immature tuber counts by over 80%. No treatment eliminated propagule production. Decreased propagule production coincided with increased

rhizome biomass. Future variations of this experiment should investigate higher light intensities and pure red wavelengths to examine if reproduction can be further suppressed. Future experiments should investigate if combining photoperiod interruption with herbicide treatments can increase hydrilla control.

Understanding the Endangered Species Act and How Pesticide Labels Are Changing. Brett W. Bultemeier
University of Florida, Gainesville, FL

Both the Endangered Species Act (ESA) and the Federal Insecticide Fungicide Rodenticide Act (FIFRA) have been around since the 1970's, but the two are in conflict and undergoing changes like never before. The EPA has faced numerous lawsuits and been behind on many initiatives for years. As a direct result they are fundamentally altering how FIFRA and ESA will interact and be dealt with going forward. This presentation will highlight what is in place now, what is proposed going forward, and provide guidance on what is likely to remain years from now. If you don't know what a PULA is or think a BLT is simply a great sandwich, then this presentation is for you.

USACE Jacksonville District Invasive Species Management Operation Support Center (ISMOSC) Roll with APC Hydrilla Demonstrations and Research. Ian J. Markovich[1], Benjamin P. Sperry[2], Tyler J. Green[3], Jeremy M. Crossland[4]
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The U.S. Army Corps of Engineers (USACE) Jacksonville District Invasive Species Management branch (ISM) operates the Invasive Species Management Operation Support Center whose roll is to provide technology, expertise, and support for managing invasive species through the USACE enterprise. Over the last few years, the ISMOSC has begun to fully integrate with APC Hydrilla Demo and Research efforts. In the past year the ISMOSC has supported APC efforts in 4 USACE Districts (SAJ, SAM, LRH, and NED). This will be a sharing of the operations support that went into the research applications and support for managers at USACE installations.

Using Pulse Amplitude Modulation Fluorometry to Characterize Fluridone Response on a Large Number of Watermilfoil Strains. Ashley L. Wolfe, Ryan Thum
Montana State University, Bozeman, MT

Fluridone is typically an effective method for watermilfoil control. However, distinct watermilfoil strains exhibit considerable variation in fluridone response, ranging from highly sensitive to highly resistant. Furthermore, fluridone use patterns vary from place to place, and any given strain may respond well to one use pattern, but not necessarily to another (e.g., 3 versus 6 ppb). Therefore, we are interested in developing diagnostics that can predict fluridone efficacy for specific strains and use patterns. Developing diagnostics for fluridone response requires phenotypic data on dose-response for hundreds to thousands of unique genetic strains. This presents a logistical challenge, because the number of strains that can be characterized at a number of different fluridone concentrations is limited by time and space constraints. In this study, we compared rooted plant dose-response assays of several watermilfoil genotypes based on biomass versus photosynthetic capacity, as measured with Pulse-Amplitude Modulation fluorometry (PAM). We found that dose-response assays using PAM generally tracked those using biomass, but in roughly half the time (four versus eight weeks after treatment). With some further development, we plan to apply these assays in two ways. First, we plan to incorporate the fluridone response information into a newly-developed web application, MilfoilMapper. Second, we plan to use similar phenotyping methods to assist in genetic mapping studies to assist the development of molecular tests for fluridone response.

USACE/AERF Symposium

"Enhancing Harmful Algal Bloom Management: Integrating Satellite Remote Sensing and In-Situ Data for Effective Mitigation"
U.S. Army - Engineer Research and Development Center (ERDC) and Aquatic Ecosystem Restoration Foundation (AERF)

Background: The Aquatic Nuisance Species Research Program (ANSRP) through the Water Resources Development Act (WRDA) authorized the U.S. Army Corps of Engineers (USACE) to implement a technology demonstration program focused on scalable technologies for harmful algal bloom (HAB) detection, prevention and management intended to decrease harmful algal bloom frequency and impacts on our Nation's water resources (https://ansrp.el.erdc.dren.mil/HAB.html)

The project titled ***"Improving HAB Mitigation with Satellite Remote Sensing and In Situ Data"*** was funded through ANSRP in 2023.

Project Purpose: Due to the stochastic nature of many HABs (i.e., wind and wave driven), it can be challenging to plan, implement, and evaluate mitigation efficacy at scale due to spatial and temporal changes in HABs in terms of bloom density and location. With recent advancements in cost-effective HAB detection and quantification approaches using satellite-borne remote sensing technologies there is a unique opportunity to adapt these technologies to better inform mitigation for successful outcomes. Much of the research to date associated with remote sensing has focused on monitoring with little emphasis on mitigation. Therefore, the overall objective of this research effort is to strategically engage within the broader HAB mitigation community of practice (private, academic, federal, state, or other NGOs) in order to:

1) identify data needs and challenges for informing HAB mitigation and identify strategies of integrating satellite-based imagery data and GIS-based tools as additional lines of evidence to plan, initiate, and monitor mitigation, and
2) curate in situ treatment efficacy data in the contingent US and correlate satellite-based imagery data to demonstrate the approach in practice.

APMS Meeting Objective: To gain insight from HAB mitigation practitioners to explore applications of remote sensing for HAB management, pertinent case studies and datasets evaluating remotely sensed data.

POSTER ABSTRACTS

Abstracts are listed in alphabetical order by title.

***AquaPlant*: An Extension Tool for Aquatic Vegetation Identification & Management. Brittany Chesser**, Todd Sink
Texas A&M AgriLife Extension Service, College Station, TX

Satellite survey data shows Texas contains over 1.3 million ponds, making up approximately 22% of privately owned waters in the United States by surface area. This amount of water comes with both water quality and security issues, which is further exacerbated by nuisance aquatic vegetation and seasonal water scarcity issues in the state. With more than 600 species of aquatic and obligate wetland species of vegetation in Texas, management issues are abundant and varied, complicating management for private water owners. There are no state or federal agencies tasked with management of aquatic vegetation issues in private waters, other than the Texas A&M AgriLife Extension Service. This led to the creation of the AquaPlant website (AquaPlant.tamu.edu) which launched in 1996 with 86 aquatic plants. Over the years, the website has been updated to showcase over 245 aquatic plant profiles. The website is designed to help landowners properly identify aquatic plants in their ponds or tanks, which is the first step in effective management. Within recent years, website analytics have become a useful tool to passively collect data regarding the AquaPlant website traffic, including user demographics and page visits. Regular monitoring of these analytics can direct outreach efforts and may be useful to aquatic plant managers. This poster examines 18 months of website traffic from September 1, 2022, to March 1, 2024.

A Review of the Taxonomy, General Biology, and Ecology of *Vallisneria*. Maxwell G. Gebhart, Gray Turnage
Mississippi State University, Starkville, MS

Vallisneria has recently become a genus of plants under management as several species and hybrids have rapidly invaded many areas of the U.S. The assemblage of invasive species and hybrids in the *Vallisneria* genus prompts a needed synthesis of the currently known biological and ecological information; however, the genus has undergone several major taxonomic changes thus sifting through documentation regarding individual species can be challenging. *Vallisneria*, more commonly referred to as eelgrass or tape grass, is a genus of submersed monocot plants that play a critical role in aquatic ecosystems. It was previously thought that *Vallisneria* contained only 2 species: *V. americana* and *V. spiralis*. However, evidence collected in the last 20 years suggests there are as many as 16 species in the genus including a second species native to North America, *V. neotropicalis*. Aside from the numerous taxonomic changes, literature regarding the biology and ecology of *Vallisneria* is nearly nonexistent regarding most species in the genus except *V. americana* and *V. spiralis*. Similarly, ecological tolerances to environmental factors like salinity and nutrient loading have been reported for some species but tolerances occur across large gradients. Because previous literature is often confounding, the aim of this work is to provide a contemporary context of the *Vallisneria* genus to clarify information regarding species and hybrids in North America and to inform and focus future research priorities.

CAST: The Science Source for Food, Agricultural, and Environmental Issues. **Gray Turnage**[1], Todd Baughman[2], Tom Peters[3], Anthony Witcher[4], Jill Schroeder[5], Greg Dahl[6]
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[2]Texas A&M, Lubbock, TX
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The Council for Agricultural Science and Technology (CAST) convenes and coordinates networks of experts to assemble, interpret, and communicate credible, unbiased, science-based information to policymakers, the media, the private sector, and the public. At a time when the internet has made it more challenging to separate accurate and inaccurate information, it has never been more critical for reputable sources to deliver trusted, non-partisan information from authorities in their respective fields. The primary work of CAST is to publish task force reports, commentaries, special publications, and issue papers written by volunteer experts and academics from many disciplines including food and animal sciences, agricultural technologies, plant and soil sciences, and natural resource management.

Comparing Efficacy of Chemical Controls on Native and Non-native *Vallisneria* Taxa. **Delaney Davenport**[1], Kara Foley[1], Mark A. Heilman[2], Robert J. Richardson[1]
[1]North Carolina State University, Raleigh, NC
[2]SePRO Corporation, Carmel, IN

Vallisneria is a genus of submersed aquatic macrophytes that is distributed globally and has been used widely within the aquarium trade. The species *Vallisneria americana* has been selected for many revegetation projects across the United States as it provides a wide variety of ecosystem services. In recent years, genetic evaluations have revealed that there are two native species (*V. americana and V. neotropicalis*) and more concerningly, two non-native populations (*V. australis* and *V. denseserrulata x spiralis*) of *Vallisneria* within the United States. The establishment of these non-natives raises concerns for management due to lack of knowledge surrounding their ecology and response to chemical control regimes. The primary objective of this study was to examine the efficacy of two chemicals: copper (Komeen® Descend) and fluridone (Sonar® Genesis). These products were used individually and in combination on three different *Vallisneria* taxa (*V. neotropicalis, V. australis,* and *V. denseserrulata x spiralis)*. Bi-weekly visual control ratings were conducted and biomass harvested 12 weeks after treatment (WAT). Preliminary results indicate that *V. neotropicalis* was most sensitive to max label rate of Komeen® Descend (1 ppm; 80% control at 8 WAT) and the Komeen® Descend (0.5 ppm) + Sonar® Genesis (10 ppb) combination (79% control at 8 WAT). *V. denseserrulata x spiralis* responded similarly to the treatments, with Komeen® Descend (1 ppm) providing 75% control at 8 WAT and the Komeen® Descend (0.5 ppm) + Sonar® Genesis (10 ppb) combination providing 68% control at 8 WAT. *V. australis* was the least sensitive to all treatments, with Komeen® Descend (1 ppm) providing only 51% control at 8 WAT.

Development and Application of a Novel Index for Enhanced Hydrilla Detection in Aquatic Ecosystems Using Sentinel-2 Imagery. **Ayesha Malligai M**[1], Amr Abd Elrahman[1], James K. Leary[2]
[1]University of Florida, Plant City, FL
[2]University of Florida, Gainesville, FL

Hydrilla, an invasive aquatic plant and federally listed noxious weed in the US, poses a significant threat to aquatic ecosystems, rapidly expanding from hundreds to tens of thousands of acres within 2-3 years. Notable infestations in Lake Yale and Lake Apopka, with 80% and 30% coverage by 2021, respectively, highlight the urgency for effective monitoring and management. Traditional in-water hydrilla mapping methods, while accurate, are inefficient. This study leverages Sentinel-2's high-resolution imagery to enhance large-scale lake monitoring through remote sensing. We investigated various spectral band combinations, ratios, and indices to identify optimal factors for hydrilla detection under varying water clarity conditions. A novel three-band index was developed, effectively distinguishing hydrilla from algae, water, and emergent vegetation. This index was validated against ground truth data, showing high precision in identifying hydrilla. Despite low recall due to sub-surface omission errors, these findings mark significant progress towards a platform for routine, comprehensive regional hydrilla mapping, facilitating better management and conservation efforts.

Documenting Phenological Growth Patterns of Connecticut River Hydrilla in Mesocosm Conditions. **Jens P. Beets**[1], Kara Foley[2], Benjamin P. Sperry[3], Robert J. Richardson[2]
[1]USDA-ARS, Davis, CA
[2]North Carolina State University, Raleigh, NC
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Hydrilla (*Hydrilla verticillata*) is an invasive perennial submersed plant that has been documented in the United States since the 1950s. There have historically been two strains of hydrilla, hereafter referred to as biotypes, recorded in the United States, and have been characterized as 'monoecious' and 'dioecious'. Recently, a third genetically distinct biotype was identified in the Connecticut River, CT. Little is known about growth and phenological differences in this new invader, therefore, we aimed to compare these differences by biotype, including flowering and turion formation in a series of mesocosm experiments. Plants were established in Raleigh and Laurel Springs, NC and periodic harvests were performed. No significant differences were observed in peak aboveground biomass, relative growth rate or timing of these metrics between the three hydrilla biotypes, although the predicted peak biomass for dioecious hydrilla did not occur during the study period. Surprisingly, monoecious hydrilla had lower peak belowground biomass than dioecious and Connecticut River hydrilla despite its abundant subterranean turion production. Monoecious hydrilla had significantly more aboveground biomass and subterranean turions 180 days after planting. Connecticut River hydrilla produced 73.8 axillary turions per plant 180 days after planting compared to 32.8 axillary turions produced by monoecious hydrilla and 1.2 axillary turions produced by dioecious hydrilla. This research suggests the newly documented biotype of hydrilla in the Connecticut River has many similarities to the other two biotypes in the United States but further research is needed to better understand the phenology and ecology of this invasive plant.

Evaluating Seed Germination and Early Growth Response of Water Chestnut Under a Range of Salinity and Temperature. Kristina Hellinghausen[1], **Lynde L. Dodd**[2]
[1]Oak Ridge Institute for Science and Education, Lewisville, TX
[2]US Army Engineer Research and Development Center, Lewisville, TX

Water chestnut (genus *Trapa*) is an invasive freshwater macrophyte that has been introduced into the U.S. Chesapeake Bay region. While the salinity tolerance of *T. natans* is well understood, the tolerance range of congeneric *T. bispinosa* var. *iinumai* has not been determined. This study was designed to fill this knowledge gap by measuring seed germination, biomass, and viability across an increasing gradient of salinity ranging from 0 to 20 ppt for a duration of 55 days. The same endpoints were measured across two ambient temperatures (25? and 30?) to better understand the relationship between temperature and salinity. Initial results indicate that *T. natans* germinated and produced aboveground biomass across a wider salinity range (up to 20 ppt) than *T. bispinosa*, which tended to favor dormancy under high salinity (>10 ppt). However, there was 0% germination for all *T. natans* under the higher temperature (30?). Viability tended to decrease with increasing salinity for *T. bispinosa* and was relatively consistent across temperature for both species. Results from this study provide insight for ongoing management efforts of water chestnut and predicting its potential for spread into brackish regions within its introduced range.

Evaluation of an Operational Demonstration of a Potential Aquatic Plant Control and Nutrient Mitigation Technology in Lake Okeechobee, Florida. Michael W. Durham[1], Benjamin P. Sperry[2], Jonathan Glueckert[3]
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[2]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL
[3]University of Florida, Boynton Beach, FL

Despite the set goal for total maximum daily load (TMDL) of total phosphorus (TP) for Lake Okeechobee of 40 $\mu g\ L^{-1}$, TP has continued to increase from 93 to 133 $\mu g\ L^{-1}$ since 1986. This equates to over 500 tons of phosphorus inputs per year. A field demonstration project was conducted in 2022 that aimed to mechanically harvest waterhyacinth, macerate the plant material, and pump it as a slurry to a terrestrial site as a potential novel technology to reduce total phosphorus in Lake Okeechobee. Our objective was to make general observations and collect operational data for future consideration of the technology in USACE aquatic plant control operations and nutrient mitigation efforts. Based on field observations and assuming no breakdowns, it would take approximately 885 hours for this operation to clear the 35-acre demonstration area. Based on the average waterhyacinth biomass in the demonstration site, approximately 998 lbs of phosphorus was removed from the system equating to the removal of approximately 0.1% of the total phosphorus input each year. Furthermore, many of the shallow-water areas were inaccessible to the harvesters and served as a refugia. These plants quickly reinfested the site within a few months.

Evaluation of Concentration-Exposure Time Requirements for Water Hyacinth and Water Lettuce Control Using Submersed Treatments of Imazamox.
Hannah J. Brown[1], Corrina J. Vuillequez[1], Jonathan Glueckert[2], Michael W. Durham[1], Candice M. Prince[1], Benjamin P. Sperry[3]
[1]University of Florida, Gainesville, FL
[2]University of Florida, Boynton Beach, FL
[3]US Army Corps of Engineers Engineer Research and Development Center, Gainesville, FL

Water hyacinth [*Eichhornia crassipes* (Mart.) Solms] and water lettuce [*Pistia stratiotes* L.] are two of the most prolific free-floating aquatic invasive plants in the Southeast United States. Historically, these plants have been managed proactively using foliar applications of 2,4-D and diquat. Although effective, foliar applications can result in up to 25% of spray deposited into the water column, appear heavy-handed which can negatively affect public support for management, and, without extensive monitoring efforts, can result in refuge populations. These issues highlight the need for an alternative herbicide delivery technique, such as subsurface applications, which have the potential to provide managers with a discrete application method that could be more economical, efficient, and effective than foliar applications in certain scenarios. Preliminary work suggests that static treatments can be effective on water hyacinth and water lettuce, but research is needed to evaluate different concentrations and exposure times. To address this, we conducted an outdoor mesocosm study evaluating three subsurface imazamox application rates (25, 50, and 100 ppb) and five different exposure times (7, 15, 30, 60, and 90 days) on these species. Once treatments met their exposure time, mesocosm were flushed and plants were reintroduced to non-treated water. Visually evaluated control (%) data were collected weekly and biomass was collected 90 days after treatment. Biomass reduction (%) of water lettuce never exceeded 50% of the nontreated controls regardless of concentration or exposure time, suggesting that subsurface imazamox treatments cannot be used to effectively manage this species. Water hyacinth requires at least 60 days of exposure time for subsurface treatments of imazamox at high concentrations (100 ppb) to approach at least a 75% biomass reduction. Although further research evaluating half-lives (t1/2) and field trials is needed to make application recommendations for use of subsurface imazamox applications in water hyacinth control, optimized subsurface applications are expected to be another valuable tool for floating plant management.

Evaluation of Herbicide Efficacy on *Hottonia palustris* .
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Hottonia palustris ("featherfoil", "water violet") was recently documented in Lake Winnipesaukee, New Hampshire's largest lake with significant economic value. This species is popular within the water garden and aquarium trades, but has not been documented in any other major natural system in the United States. Due to the growth habit and reproductive capacity of *H. palustris*, it has the potential for rapid spread within New Hampshire's waterbodies and could negatively impact ecosystem services and economic values. Management options for *H. palustris* are not well documented. This study consisted of a small-scale greenhouse evaluation of EPA registered herbicides on *H. palustris*. Treatments included 200 and 400 ppb flumioxazin, 0.18 and 0.37 ppm diquat, 25 and 50 ppb florpyrauxifen-benzyl, 2 and 4 ppm 2,4-D, 1.5 and 2.5 ppm triclopyr, 250 and 500 ppb imazamox, and 2.5 and 5.0 ppm endothall with 72 hour exposure times and 75 and 150 ppb penoxsulam and 45 and 90 ppb fluridone at static exposure times. At 6 weeks after treatment (WAT), treatments with flumioxazin and endothall at tested rates yielded highest percent visual control, with means of 100% and 96%, respectively. Diquat at 0.37 ppm also provided effective visual control of *H. palustris* at 6 WAT (94% control). Results of this work will help to inform future field management options for *H. palustris* in New Hampshire.

Evaluation of the Salinity Tolerance of Giant Salvinia *(Salvinia molesta*) Using Concentration-Exposure Time Methods. **Corrina J. Vuillequez**[1], Jonathan Glueckert[2], Benjamin P. Sperry[3], Michael W. Durham[1], Jessica E. Spencer[4]
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Giant salvinia (*Salvinia molesta*) is present in 20 countries including the US and is regarded as one of the world's worst aquatic weeds. Invasions have occurred in Florida, but giant salvinia has not yet become established in the state. Florida is particularly vulnerable to giant salvinia invasion due to the warm climate and suitable conditions for growth. However, the tolerance of giant salvinia to tidally-driven salinity levels present in Florida has yet to be investigated. Therefore, the salinity tolerance of giant salvinia over a range of salt concentrations and exposure times was evaluated at mesocosm scale using methods common in herbicide concentration-exposure time studies. Salinity levels ranged from 0.25 to 16 parts per thousand (ppt) and exposure times ranged from 0.75 to 24 hours. A static exposure (two weeks) at each salinity level was included for reference. Biomass and survival were recorded following the two-week experiment. Data was subject to ANOVA to test for main effects and interactions. In both runs, no clear exposure time response was observed until salinity level reached 8 ppt (25% seawater). Complete mortality was not observed in any treatment; however, future work will investigate longer recovery periods. These data indicate that giant salvinia can survive and persist after short exposures to partial saline conditions similar to those found in lower portions of tidally-influenced rivers in Florida.

Field Demonstrations for Water Chestnut (*Trapa* Spp.) Management Year 1. **Lynde L. Dodd**[1], Ryan McIntyre[2], Kristina Hellinghausen[3], Nancy Rybicki[2], Christopher R. Mudge[4], Benjamin P. Sperry[5]
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Collaborative applied research conducted under the U.S. Army Corps of Engineers' Aquatic Plant Control Research Program is currently developing management strategies of introduced water chestnut species, *Trapa natans* and *T. bispinosa* var. *iinumai*. While much information exists on management in the U.S., specifically targeting *T. natans*, knowledge gaps exist in translating management strategies from one congener to another, and whether currently employed strategies are successful in reducing impact and spread of this invasive aquatic plant. Demonstrations and lessons learned from Year 1 of a 2-year project work focus on determining what management approach works best in an operational setting to control two water chestnut species. While not all known strategies are reviewed, those currently being implemented and recent findings from greenhouse and mesocosm studies were demonstrated during the summer of 2023 at field sites in NY for *T. natans*, and in VA and MD for *T. bispinosa*. Preliminary results indicate that foliar herbicide applications work well to reduce biomass for both species of water chestnut, but that biomass harvesting strategies employed for *T. natans* will need further investigation for implementation large-scale for *T. bispinosa* control. Findings from this 2-year study will be used to refine water chestnut management strategies.

Field Observations of an Intermittent Endothall Drip-Application in a North Florida Impounded Spring Run for Hydrilla (*Hydrilla verticillata*) Control. **Jonathan Glueckert**[1], Michael W. Durham[2], Daniel C. Canfield[2], Benjamin P. Sperry[3], Ian J. Markovich[4]
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Merritt's Mill Pond is a 270-acre impounded pond in Jackson County, FL, formed by first magnitude spring, Jackson Blue Spring, which contributes to 70% of the flow in the waterbody. Topped out infestations of *Hydrilla verticillata* covers nearly 100 surface acres of the pond. Treatments with fluridone were relatively unsuccessful due to high water exchange in the pond which causes low residency time of herbicide and insufficient exposure times. More recent treatments have consisted of Endothall, applied by boats using trailing hoses. Previous small-scale research on Endothall has detailed lower concentration and exposure times required to kill hydrilla. However, field treatments in the flowing water of the Mill Pond have yielded inadequate results. Here, we detail field demonstrations of a whole pond treatment, using a metered drip application from a single injection point at Jackson Blue Spring. Site specific hydrology was examined prior to the application of Endothall with rhodamine WT. The dye, applied at 10 parts per billion (ppb), was used to simulate an herbicide application to track movement and dissipation through the waterbody. Endothall treatments at 5 parts per million (ppm) were initiated on June 14 and 15 2023 and applied for 11 hours each day. A second treatment was applied on September 18 and 19 for 2023 for 10 hours each day. Point intercept and hydroacoustic surveys were conducted to quantify SAV throughout the system pre and post treatment. Relative abundance of hydrilla after the drip application was dependent on distance from the injection site.

Field Observations of Floating Plant Control Following Submersed Treatments of Imazamox in Central Florida. **Kelli L. Gladding**[1], Benjamin P. Sperry[2], James Leary[3], Amber E. Riner[4], Hannah J. Brown[5]
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In Florida, over 10K hectares of water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*) are treated annually. The management goal for these invasive floating plants to keep populations as low as is feasible (maintenance control). Traditionally, 2,4-D has been used for water hyacinth control and diquat has been used for both water hyacinth and water lettuce control. while these foliar-applied herbicides have been an institutional standard for decades, they are not always entirely

selective and can temporarily result in injury to other native aquatic plants often leading to complaints from public stakeholder groups. Therefore, a need for exploring alternative treatment methods in order to reduce the negative optics of foliar applications was identified. Operational-scale field observations from in-water applications of imazamox plus flumioxazin for selective and simultaneous water hyacinth and water lettuce control will be presented.

Growth Response and Nitrogen Removal or Release by an Azolla Species. **Anna N. Faust**, La Toya Kissoon-Charles
Missouri State University, Springfield, MO

Azolla sp. (mosquito ferns) are fast-growing, floating aquatic ferns that form mats on quiet waters in temperate and tropical regions. Azolla species are known for their symbiotic relationship with the nitrogen-fixing cyanobacteria, Anabaena azollae Strasburger. This symbiotic relationship promotes Azolla growth and enriches waters with nitrates, leading to algal blooms. Azolla is problematic because it forms dense mats in nutrient-rich waters, which negatively impact water quality, native plants, and amphibian larvae. Two species (*Azolla microphylla* and *Azolla caroliniana*) are native to Missouri but are not common in the state. We observed Azolla outside of its known range in Lake Springfield (Springfield, Missouri) in fall 2020 and collected samples for identification and greenhouse propagation. We carried out greenhouse experiments to measure (1) the response of Azolla to varying nitrate concentrations and (2) the impact of Azolla on water nitrate concentrations. We hypothesized that Azolla growth would initially increase and then decrease with increasing nitrate concentrations and will subsequently increase the water nitrate concentrations. Our findings will improve our understanding of the potential impacts of Azolla growth on the water quality of Lake Springfield.

Herbicide Behavior in Hybrid Milfoil and Hydrilla When Applied in Combination. **Tia M. Lawrence**[1], Mirella F. Ortiz[2]
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Hybrid watermilfoil (*Myriophyllum spicatum ´ M. sibiricum*) and hydrilla [*Hydrilla verticillata* (L.f.) Royle] are among the most common aquatic weeds in the United States. Both species exhibit rapid vegetative growth rates and reproductive methods that enable them to outcompete native plants. Herbicide treatment is a very cost-effective form of managing these invasive populations; however, repeated treatment to populations via the same mode of action (MOA) can result in herbicide resistance, as evidenced by hydrilla's resistance to fluridone in the 1990s. Combining herbicides with different MOAs is an effective strategy to delay resistance. The purpose of these studies was to determine the impacts on herbicide absorption and translocation when applying herbicides with different MOAs in combination compared to applying them alone. Dioecious (DHV) and monoecious (MHV) hydrilla were tested using endothall and florpyrauxifen-benzyl alone and in combination, while hybrid watermilfoil (HWM) was tested using endothall, 2-4-D, and a mixture of both herbicides. Herbicide accumulation in shoots and translocation to the roots were measured over 96 and 192 hours for HWM and hydrilla, respectively. Herbicide accumulation in plants was generally not affected when the herbicides were applied in combination, except for 2,4-D in HWM, which increased by 80% in the presence of endothall. Herbicide shoot-to-root translocation decreased in all treatments, except for endothall in DHV when combined with florpyrauxifen-benzyl. These data do not suggest that there would be operational impacts from herbicides mixtures, but there appears to be changes in herbicide behavior, primarily shoot-to-root translocation, when these herbicides are applied in combination.

Intact Herbicide Translocation. Francielli S de Oliveira, Mirella F. Ortiz
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Endothall and 2,4-D have been extensively used to control aquatic weeds, and our understanding of their *in planta* behavior remains limited in aquatic weed species. 2,4-D is considered systemic in aquatic plants based almost entirely on its behavior in terrestrial counterparts. Recent studies using radiolabeled 2,4-D and endothall demonstrated that plants can translocate radioactivity from shoots to root systems; however, these values were generated by biological sample oxidation, and therefore, there was no way to determine if the radioactivity in the roots was parent herbicide or a metabolite. Thus, this research used multiple analytical methods to investigate the systemic behavior of 2,4-D and endothall in aquatic plants. Radiolabeled and non-radiolabeled 2,4-D and endothall were used to track their parent herbicide and metabolite movement in hybrid watermilfoil and dioecious hydrilla, respectively. The results showed that 68% of 2,4-D was extractable from shoots, while 57% was extractable from roots. For endothall, 61.7% was extractable from shoots and 86.0% from roots. About 17% of extracted ^{14}C-2,4-D from shoots and 41% of extracted ^{14}C-endothall from shoots metabolized into one single unidentified metabolite. The intact 2,4-D and endothall present in roots were approximately ten times less than in shoots. Specifically, the intact 2,4-D detected in shoots was 1.31 µg g^{-1} dry weight (DW), and 0.11 µg g^{-1} DW was detected in roots. For endothall, 1.08 µg g^{-1} DW was detected in shoots and 0.12 µg g^{-1} DW in roots. The combined approach of ^{14}C-labeled studies and analysis of unlabeled herbicides using LC-MS/MS indicates that both 2,4-D and endothall have similar *in planta* behavior, with approximately 8-10% of the absorbed intact active ingredients translocating to the roots of these aquatic plants.

Integrating Chemical and Biological Control of Alligatorweed (*Alternanthera philoxeroides*): Submersed Herbicides and Thrips. Samuel A. Schmid, Gray Turnage, Gary N. Ervin
Mississippi State University, Starkville, MS

Alligatorweed (*Alternanthera philoxeroides*) is an invasive aquatic plant that is globally distributed and presents hazards for use of water resources and impairs ecosystem structure and function. This species has been established in the United States for over a century and has been subjected to intensive chemical control and biological control efforts. Chemical control conventionally consists of foliar herbicide application, but these methods often allow regrowth from robust stoloniferous networks underwater. Biological control is dominated by a flea beetle (*Agasicles hygrophila*), but this species is cold intolerant and unusable in large portions of the invaded range. This study investigated two alternative methods of alligatorweed control: submersed herbicide applications and thrips (*Amynothrips andersoni*) biological control alone and as an integrated technique. These methods were tested in 12-week mesocosm trials over two stages. Stage one tested five different chemistries applied in-water at a high and low rate compared to non-treated reference plants and plants receiving foliar applications of glyphosate + imazapyr (i.e., positive control). Stage two tested the most efficacious rate of each chemistry from stage one as solo treatments or in combination with thrips biological control. Herbicides tested in this study were penoxsulam (150 and 75 ppb), bispyribac-sodium (45 and 22.5 ppb), imazamox (500 and 250 ppb), fluridone (150 and 75 ppb), and topramezone (50 and 25 ppb). All herbicides (except bispyribac-sodium) effectively controlled alligatorweed as submersed applications (>76% reduction for most). Also, thrips effectively controlled alligator weed (54% reduction), although at the rates that were tested, no herbicide treatments benefitted from the addition of thrips biological control. While this study shows both submersed herbicide applications and thrips effectively control alligatorweed, there are still substantial research gaps that need to be investigated.

Investigating Herbicide Efficacy and Behavior for Controlling Eurasian Watermilfoil in Bear Lake. **Olanrewaju E. Adeyemi**, Eric P. Westra, Corey V. Ransom, Mirella F. Ortiz
Utah State University, Logan, UT

Like other aquatic ecosystems, Bear Lake faces significant challenges posed by invasive aquatic plants like Eurasian watermilfoil (EWM) (*Myriophyllum spicatum*). This invasive species disrupts the natural ecosystem, degrades water quality, and fosters disease vectors by forming dense canopies, adversely affecting fish populations, water temperature, and oxygen levels. To address this issue, this project examined the behavior and effectiveness of commonly used herbicides for EWM control, along with the influence of Bear Lake's unique water chemistry on the growth of EWM. Fifty 15 cm EWM shoots were planted in two separate greenhouse tanks, one filled with Bear Lake water and the other with tap water. Growth was evaluated for 3 months, measuring plant height and aboveground and belowground biomass. Degradation and behavior of herbicide were evaluated by applying florpyrauxifen-benzyl to ten 2 L tanks (five tanks containing Bear Lake and five containing tap water). Samples were collected at intervals of 0, 1.5, 3, 6, 12, 24, 48, and 72 hours after treatment, and herbicide concentrations were analyzed using HPLC. The efficacy of 2,4-D in controlling established EWM plants was investigated by applying 2 ppm of 2,4-D into two separate tanks containing twenty-five established EWM plants, with visual evaluations conducted weekly over 28 days. Results show that EWM shoots planted in Bear Lake water develop more vigorously than those in tap water. This is demonstrated by higher shoot production in Bear Lake water plants, as well as height differences of 20, 25, and 27 cm between Bear Lake and tap water plants at 30-, 60-, and 90 days post-planting. The degradation of florpyrauxifen-benzyl in both Bear Lake and tap water followed similar trends, with concentrations decreasing as hours after application increased. However, degradation of florpyrauxifen-benzyl in tap water exhibited consistently higher numerical values than Bear Lake water across all time intervals.

Monitoring Water Hyacinth Herbicide Treatments with Unoccupied Aerial Systems. **Amber E. Riner**[4], Benjamin P. Sperry[1], Jonathan Glueckert[2], Michael W. Durham[3], Greg MacDonald[3], James Leary[5], Corrina J. Vuillequez[3], Amr H. Abd-Elrahman[6]
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Water hyacinth (*Eichornia crassipes*) is a free floating, invasive plant that is proactively managed in Florida due to its negative impacts on native wildlife, navigability, and flood control. Herbicides are commonly utilized to manage water hyacinth, but environmental conditions, human error, and resistance can reduce efficacy. Therefore, herbicide applications should be followed by frequent monitoring efforts.

Unoccupied aerial systems (UAS) equipped with red-green-blue (RGB) cameras are inexpensive and can quickly capture large areas for post-treatment surveillance. However, the research on using RGB vegetation indices (VIs) to monitor herbicide applications in aquatic vegetation is limited. The focus of this study was to identify a VI to remotely monitor various water hyacinth herbicide treatments. UAS imagery and visual control ratings were acquired weekly and biomass was collected during two, six week studies. Nine VIs were calculated and correlated with visual control and biomass. Generalized linear mixed models were fitted to model the effects of herbicide and season on visual control, biomass, and the best performing VI. Additionally, GLMMs were fitted to predict visual control and biomass from the VI. The Carotenoid Reflectance Index (CRI = 1/B □ 1/G) was had the highest and smallest range of correlations with visual control (-.51 to -.87). Herbicides with the same mode of action had similar trends between visual control and CRI. Integrating UAS with water hyacinth herbicide management will provide opportunities for more frequent or comprehensive monitoring than traditional post-treatment monitoring activities.

Multi-year Outdoor Mesocosm Experiment Reveals Differences in *Butomus umbellatus* L. Genotype Growth and Susceptibility to Imazamox and Triclopyr. **Nathan E. Harms**[1], Bradley T. Sartain[2], Catilin Strickland[3], Blake DeRossette[4], Andrew B. Coomes[5]
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The lineage (genotype) of a plant invader determines much about the way it establishes, spreads, and impacts the receiving habitat, and the types of management needed to achieve effective control. We investigated phenology, biomass production and allocation, and response to herbicide application of four flowering rush (*Butomus umbellatus*) genotypes (triploid GT1; diploid GT3, GT4, GT5) in a multi-year common garden mesocosm experiment. We initiated the experiment with a single propagule per replicate from each genotype then conducted monthly observations over thirty-one months to investigate phenological differences. In addition, foliar herbicide applications of imazamox or triclopyr were conducted during year's two and three at rates previously determined to be efficacious against *B. umbellatus* in small-scale studies. Annual year-end destructive harvests of plant biomass were conducted to provide comparisons of herbicide efficacy and to highlight differences in plant growth between genotypes. Flowering occurred May through October for all genotypes, but was reduced in years two and three, including almost no flowering in triploid plants after year one. Maximum leaf abundance occurred in August or September for all genotypes. After one season of growth, biomass was greater for diploid genotypes and was allocated primarily to leaves. However, by year 3 triploid plant biomass was greater than diploid genotypes G4 and G5, but not genotype G3. Bulbil production occurred only in diploid genotypes; at the conclusion of year 3 G4 and G5 plants produced nearly 15,000 and 20,000 mean bulbils respectively, whereas diploid G3 plants produced less than 5,000 mean bulbils per container. Herbicide treatments were effective in reducing biomass overall, but triploid and diploid G3 plants were far more susceptible than diploid G4 and G5 plants. These results demonstrate the importance of investigating differences between lineages of invasive plants.

Northern Hydrilla (*Hydrilla verticillata* Ssp. *lithuanica*): Discovery and Establishment Outside the Connecticut River. Jeremiah Foley
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Hydrilla [*Hydrilla verticillata* (L. f.) Royle], an invasive aquatic weed, has had a rich introduction history into the United States, with multiple subspecies being introduced since the 1960s. The most recent occurred before 2016, when northern hydrilla (*Hydrilla verticillata ssp. lithuanica*) was discovered in the Connecticut River. By 2021, following a 3-yr survey from Agawam, MA, to the Long Island Sound by the Connecticut Agricultural Experiment Station Office of Aquatic Invasive Species, H. verticillata ssp. lithuanica was found in more than 113 km of the river, occupying 344 ha. Since this survey, there has been concern that H. verticillata ssp. lithuanica would spread to nearby waterbodies and have a significant negative impact. Here, we report the first documented spread and establishment of H. verticillata ssp. lithuanica from the Connecticut River to five waterbodies in Connecticut and one in Massachusetts. Of the eight sites where H. verticillata observations were made, 75% (n = 6) were confirmed to be H. verticillata ssp. lithuanica and 25% (n = 2) to be Hydrilla verticillata ssp. peregrina (wandering hydrilla). Except for one site, all six locations infested with H. verticillata ssp. lithuanica provide watercraft access through public or private boat ramps. The authors also postulate on the mechanisms facilitating the spread and establishment of this subspecies.

The Role of Temperature on clade-C Hydrilla Turion Sprouting and Growth. Andrew W. Howell[1],
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A genetically distinct hydrilla [*Hydrilla verticillata* (L.f.) Royle] population (clade-C) discovered in the lower Connecticut River has prompted numerous biological inquiries into the plant's phenology and subsequent management requirements. A unique attribute of clade-C hydrilla appears to be the sole reliance on axillary turion production for plant reestablishment. This distinctive trait differs from that of monecious or dioecious hydrilla, which forms both axillary and subterranean turions for succession. Prior studies indicate water temperature as a key factor in propagule sprouting and the overall recruitment success of monoecious and dioecious hydrilla biotypes. However, uncertainty remains on the influence of temperature on clade-C hydrilla turions. In the present study, we investigate the role of water temperature (N = 7 treatments; 9 to 33 °C) on the sprouting and growth of clade-C hydrilla propagules using a water-cooled gradient table. Monoecious and dioecious hydrilla subterranean turions were included to provide reference to previous works. Results for clade-C axillary turions showed T_{50} (time to 50% sprouting) was achieved by 9.5 days at 14 °C, with time to sprouting rapidly decreasing as temperatures approached temperature =22.8 °C. Results also suggest clade-C propagules form lateral roots before sprouting under cool water conditions (=18.7 °C) which may indicate a strategy to anchor rather than grow rapid vegetation at these temperatures. These findings may be used to direct the timing of vegetation surveys and the initiation of plant management activities as they relate to clade-C hydrilla control.

USACE Jacksonville District Invasive Species Management Early Detection and Rapid Response to Giant Salvinia (*Salvinia molesta*) in the St. Johns River Basin. Jessica M. Spencer[1], **Tyler J. Green**[2], Jon S. Lane[1], Ian J. Markovich[3]
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The U.S. Army Corps of Engineers (USACE) Jacksonville District Invasive Species Management branch (ISM) rapid response of Giant salvinia that was identified in a City of Jacksonville stormwater pond in Fall of 2023. This presentation will tell the story of how it was first detected, reported, and managed. This rapid response was developed among several agencies at the local, state, and federal levels. This is a continuing effort, so information will also be provided on how to identify this federally listed noxious weed and where to report it.

Use of Unmanned Aircraft Systems and Tracer Dye to Monitor Herbicide Spray Distribution.
Glenn M. Suir[1], **Christopher R. Mudge**[2], Shea L. Hammond[3], Justin L. Wilkins[3], Scott Bourne[3], Sam S. Jackson[3], Brandon L. McGrew[3], Andrew M. Steen[3], Shelby L. Goss[3], David R. Sexton[4]
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Chemical control, primarily via selective herbicide application, is a widely used method for managing invasive and nuisance aquatic plants. Selective herbicides tailored to target species offer cost-effective solutions, especially for large-scale infestations, due to their flexibility in application methods and timing. However, challenges persist, including public opposition, risks to non-target organisms from misapplication, and associated unintended costs. Monitoring herbicide movement is laborious and expensive, with spray distribution poorly understood. To address these challenges, a study was initiated to evaluate the effectiveness of unmanned aerial systems (UAS) equipped with multispectral sensors to detect the inert fluorescent dye rhodamine water tracer (RWT). By detecting and quantifying RWT post-foliar application, operational monitoring can be improved, thus reducing uncertainty and enhancing herbicide applications. Using lab-top and outdoor mesocosm experiments, the study assessed multispectral sensor effectiveness in detecting RWT. The lab-top study employed tripod-mounted sensors to detect various RWT concentrations (0 to 3000 ppb) and turbidity levels (0, 30, 60, and 90 NTU) in 15 L outdoor test tanks. For the mesocosm study, UAS-mounted sensors collected reflectance data for each tracer dye concentration (0 to 200 ppb) and turbidity level (10 to 90 NTU) combination across four trials, with three repetitions per treatment. Analysis revealed strong correlations between red and green bands and dye concentrations, with saturation points observed above 150 ppb and under high turbidity conditions. The Jo24a algorithm (ln(B650/B531)) yielded the highest coefficient of determination, with r^2 values of 0.42 and 0.82 for the 90 and 30 NTU treatments, respectively. These findings demonstrate significant potential for leveraging hyperspectral imagery to identify and measure the presence of RWT (herbicide) applied to aquatic ecosystems.

Using Experimentally Determined Physiological Response to Thermal Extremes to Model Climatic Suitability of the Alligatorweed Thrips, *Amynothrips andersoni*. **Ian A. Knight**[1], Nathan E. Harms[2], Megann M. Harlow[2], Felix Bingham[3]
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The alligatorweed thrips (AWT), *Amynothrips andersoni*, was introduced into the Southeastern United States in the 1970s for the biological control of the invasive aquatic alligatorweed, *Alternanthera philoxeroides*. The impact of AWT on alligatorweed biocontrol was largely overshadowed in the subsequent decades by the alligatorweed flea beetle, which was lauded for its role in reducing alligatorweed infestations across the southeast. In recent decades, alligatorweed has continued to spread into more temperate regions of the US where flea beetles have failed to establish and provide effective control. This has resulted in an increased reliance on chemical control and renewed interest in AWT, which have been demonstrably more cold-tolerant than the flea beetles. To better understand the physiological limits of the AWT and predict their effective range withing the US, we experimentally-determined the upper (upperlimit of chill injury zone) and lower (lower limit of thermal injury zone) thermal limits of AWT, then created a predictive model using 1-minute resolution climate data from weather stations across the contiguous US to estimate mortality due to climatic extremes. The resulting map can be used to identify regions that are climatically suitable for biological control with AWT. This approach is novel in that we use empirically-derived physiological data to make predictions, whereas previous efforts to predict species distributions largely relied on correlative models based on climate matching between areas. This work is ongoing, and at the annual conference, final data for the upper and lower limits, model parameters, and resulting climatic suitability models will be presented.