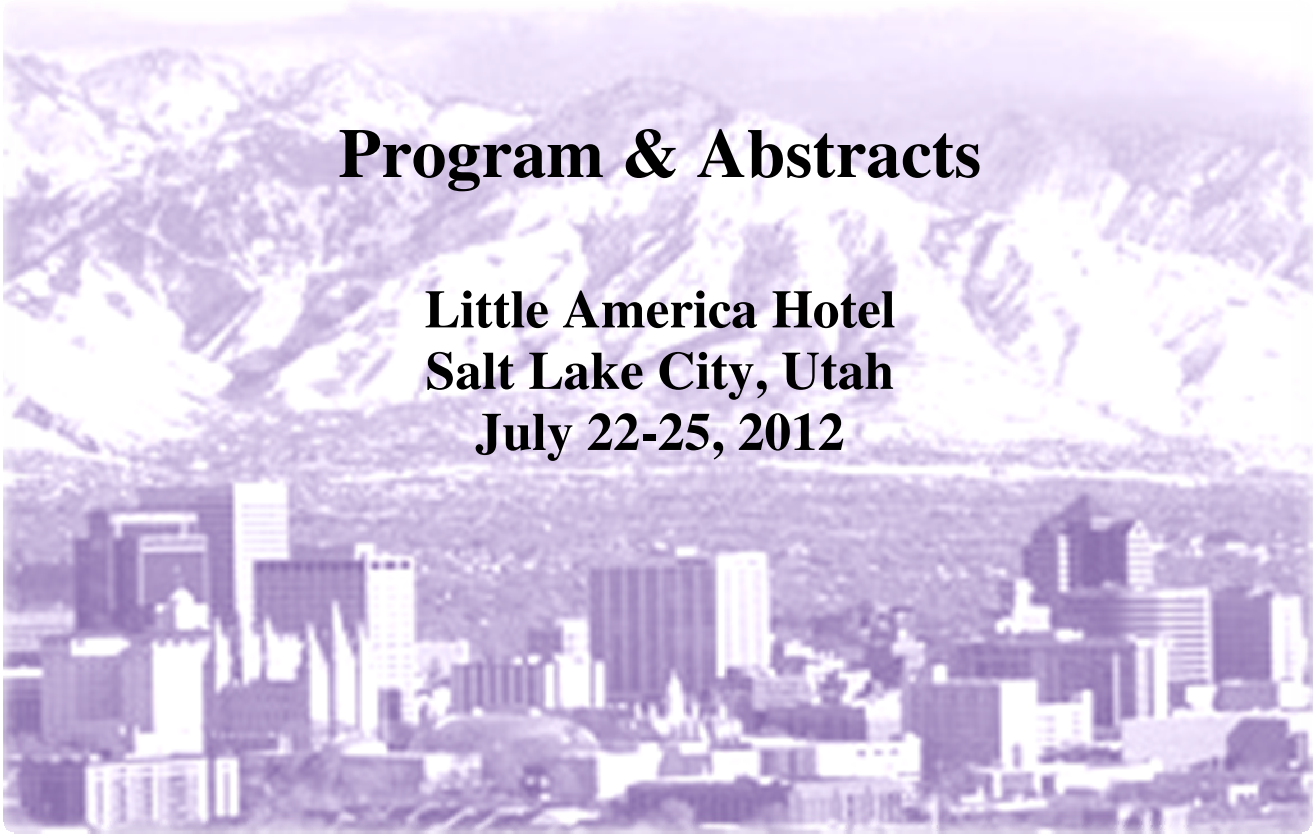
# 52nd Annual Meeting of the Aquatic Plant Management Society

# Program & Abstracts

**Little America Hotel**
**Salt Lake City, Utah**
**July 22-25, 2012**


**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.

**The Objectives of the Society** are to assist in promoting the management of nuisance aquatic plants, to provide for the scientific advancement of members of the Society, to encourage scientific research, to promote university scholarships, and to extend and develop public interest in the aquatic plant science discipline.

**Our Mission:** The Aquatic Plant Management Society strives to promote environmental stewardship through operations, research, education and outreach related to integrated management of vegetation in aquatic systems.

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The Aquatic Plant Management Society thanks Duke Energy Carolinas for their generous contribution to print and distribute the Program for the 52nd Annual Meeting!

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| Scholastic Endowment | John Gardner |
| Strategic Planning | John H. Rodgers, Jr. |
| Student Affairs | Rebecca Haynie |
| Website | Ryan Wersal |

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| | |
|---|---|
| AERF | Carlton Layne |
| BASS | Gerald Adrian |
| CAST | Ryan Wersal |
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| Science Policy Director | Lee Van Wychen |
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# APMS Presidents and Meeting Sites

| | | |
|---|---|---|
| 1961 | T. Wayne Miller, Jr. | Fort Lauderdale, Florida |
| 1962 | T. Wayne Miller, Jr. | Fort Lauderdale, Florida |
| 1963 | William Dryden | Tampa, Florida |
| 1964 | Herbert J. Friedman | Tallahassee, Florida |
| 1965 | John W. Woods | Palm Beach, Florida |
| 1966 | Zeb Grant | Lakeland, Florida |
| 1967 | James D. Gorman | Fort Myers, Florida |
| 1968 | Robert D. Blackburn | Winter Park, Florida |
| 1969 | Frank L. Wilson | West Palm Beach, Florida |
| 1970 | Paul R. Cohee | Huntsville, Alabama |
| 1971 | Stanley C. Abramson | Tampa, Florida |
| 1972 | Robert J. Gates | Miami Springs, Florida |
| 1973 | Brandt G. Watson | New Orleans, Louisiana |
| 1974 | Alva P. Burkhalter | Winter Park, Florida |
| 1975 | Luciano “Lou” Val Guerra | San Antonio, Texas |
| 1976 | Ray A. Spirnock | Fort Lauderdale, Florida |
| 1977 | Robert W. Geiger | Minneapolis, Minnesota |
| 1978 | Donald V. Lee | Jacksonville, Florida |
| 1979 | Julian J. Raynes | Chattanooga, Tennessee |
| 1980 | William N. Rushing | Sarasota, Florida |
| 1981 | Nelson Virden | Jackson, Mississippi |
| 1982 | Roy L. Clark | Las Vegas, Nevada |
| 1983 | Emory E. McKeithen | Lake Buena Vista, Florida |
| 1984 | A. Leon Bates | Richmond, Virginia |
| 1985 | Max C. McCowen | Vancouver, British Columbia |
| 1986 | Lars W. J. Anderson | Sarasota, Florida |
| 1987 | Dean F. Martin | Savannah, Georgia |
| 1988 | Richard D. Comes | New Orleans, Louisiana |
| 1989 | Richard Couch | Scottsdale, Arizona |
| 1990 | David L. Sutton | Mobile, Alabama |
| 1991 | Joseph C. Joyce | Dearborn, Michigan |
| 1992 | Randall K. Stocker | Daytona Beach, Florida |
| 1993 | Clarke Hudson | Charleston, South Carolina |
| 1994 | S. Joseph Zolczynski | San Antonio, Texas |
| 1995 | Steven J. de Kozlowski | Bellevue, Washington |
| 1996 | Terence M. McNabb | Burlington, Vermont |
| 1997 | Kurt D. Getsinger | Fort Myers, Florida |
| 1998 | Alison M. Fox | Memphis, Tennessee |
| 1999 | David F. Spencer | Asheville, North Carolina |
| 2000 | J. Lewis Decell | San Diego, California |
| 2001 | Jim Schmidt | Minneapolis, Minnesota |
| 2002 | David P. Tarver | Keystone, Colorado |
| 2003 | Richard M. Hinterman | Portland, Maine |
| 2004 | Ken L. Manuel | Tampa, Florida |
| 2005 | Eric P. Barkemeyer | San Antonio, Texas |
| 2006 | Jeffrey D. Schardt | Portland, Oregon |
| 2007 | Donald W. Doggett | Nashville, Tennessee |
| 2008 | Jim Petta | Charleston, South Carolina |
| 2009 | Carlton Layne | Milwaukee, Wisconsin |
| 2010 | Greg MacDonald | Bonita Springs, Florida |
| 2011 | Linda Nelson | Baltimore, Maryland |
| 2012 | Tyler Koschnick | Salt Lake City, Utah |

# APMS Award Recipients

## Honorary Members (year of honor)

| | |
|---|---|
| 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 | 1988 |
| Luciano “Lou” Gallagher | 1988 |
| Max C. McCowen | 1989 |
| James D. Gorman | 1995 |
| T. Wayne Miller, Jr. | 1995 |
| A. Leon Bates | 1997 |
| Richard Couch | 1997 |
| William 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 | 2010 |
| Randall K. Stocker | 2010 |
| Steven J. de Kozlowski | 2010 |
| Carole Lembi | 2011 |

## President’s Award (year of award)

| | |
|---|---|
| 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 |

## Max McCowen Friendship Award (year of award)

| | |
|---|---|
| Judy McCowen | 1995 |
| John E. Gallagher | 1997 |
| Paul C. Myers | 2000 |
| William T. Haller | 2002 |
| Bill Moore | 2006 |

# APMS Award Recipients *(continued)*

## T. Wayne Miller Distinguished Service Award (year of award)

| | |
|---|---|
| Gerald Adrian | 2005 |
| Linda Nelson | 2007 |
| Surrey Jacobs | 2009 |
| Amy Richard | 2010 |
| Michael Netherland | 2011 |

## Outstanding Graduate Student Award (year of award)

| | | |
|---|---|---|
| Ryan Wersal | Mississippi State University | 2010 |
| Joe Vassios | Colorado State University | 2011 |

## Outstanding Research/Technical Contributor Award (year of award)

| | |
|---|---|
| Michael D. Netherland, Dean Jones, Jeremy Slade | 2010 |
| Kurt Getsinger | 2011 |

## APMS Graduate Student Research Grant (year and amount of grant)

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 and Steve Hoyle, North Carolina State University, 2010 - $40,000
*Monoecious Hydrilla: Phenology and Competition*

# Sustaining Members

**Alligare, LLC** is a leading supplier in industrial vegetation management and a subsidiary of Makhteshim-Agan Industries, the world's largest manufacturer of post patent crop protection chemicals. Our markets include vegetation management, forestry, right-of-way, range and pasture, and aquatics. Alligare works directly with manufacturers around the world to bring the highest level of product quality and service to our customer. Alligare Specialists provide product and service faster and more cost effectively than a traditional sales force.

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

**Applied Biochemists**®, A Lonza Business., is proud of its active membership and participation with the APMS for over 40 years. As a manufacturer and supplier of algaecides, aquatic herbicides and other water management products, we highly value the science and integrity the APMS brings to our industry. We are part of a leading life sciences company, dedicated to the development, production and application of a wide variety of products to improve the recreational and functional value of water, and quality of life throughout the world.

**Aqua Services, Inc.** is a full-service, aquatic resource management company that specializes in aquatic vegetation management. Established in 1983, the company has provided aquatic plant management for entities in the southeastern U.S. that include the Army Corps of Engineers, the Tennessee Valley Authority, Southern Company, and the Pearl River Valley Water Supply District. Aqua Services also provides lake management consulting including electro-fishing assessments, water quality analysis and enhancement, and recreational lake design.

**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. Our web site is www.aquatechnex.com and our news blog is www.aquatechnex.wordpress.com.

**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 Applied Biochemists, AquaBlok, BioSafe Systems, Brewer International, SePRO, Syngenta, United Phosphorus, AquaMaster, Kasco, and Otterbine. Aquatic Control, has four offices that offer aquatic vegetation management plans including vegetation mapping and application services, fountain and aeration system installation, maintenance, and service throughout the Midwest.

**BioSonics, Inc.** has worked with the aquatic community for more than 30 years, applying the science of hydroacoustics to assess and monitor underwater habitats. Specialized analysis software developed in cooperation with the U.S. Army Corps of Engineers enables rapid, economical, reliable collection and assessment of submersed aquatic vegetation distribution and abundance. Tested and proven around the world; reliable, repeatable, quantifiable data from the BioSonics DT-X scientific echosounder can also provide information on fish and substrate.

**Brewer International**, located in Vero Beach, Florida, has been a chemical manufacturer since 1973. This location is perfect because the company purchases limonene, which is a low viscosity oil derived from the peel of citrus fruit. This natural ingredient is used in many of Brewer's formulations including two New OMRI Listed Organic surfactants: Organic-Kick and Vin-Kick. The company offers aquatic surfactants Cide-Kick, Cygnet Plus, I'Vod, and Poly Control 2. Check out our web site www.brewerint.com.

**Clarke Aquatic Services** is a global environmental products and services company. Our mission is to make communities around the world more livable, safe, and comfortable. By understanding our customers' needs, we tailor service programs that draw on our unmatched breadth of industry experience, expertise, and resources. We pioneer, develop and deliver environmentally responsible mosquito control and aquatic services to help control nuisances, prevent disease, and create healthy waterways.

**Crop Production Services, Inc.** (CPS) is a national distributor dedicated to providing innovative solutions and quality products for our customers in the aquatic industry. With our experienced sales force and national warehouse network, CPS provides fast, reliable access to the products our customer's need, the services our customers want, and emerging technologies that will address vegetation management needs today and into the future. At CPS, we work closely with customers to develop solutions for their vegetation management programs.

**Cygnet Enterprises, Inc.** is a national single source distributor of aquatic management products with offices and warehouses in Michigan, Indiana, Pennsylvania, North Carolina, California and Idaho. Cygnet is proud of its reputation for outstanding service, friendly, knowledgeable staff and our unmatched support of the aquatics industry. Cygnet Enterprises is the **only** aquatic distributor at the voting Gold Member level in the Aquatic Ecosystem Restoration Foundation (AERF). Cygnet Enterprises is the **only** distributor that is a Charter Member of the AERF. Please visit www.cygnetenterprises.com

**ReMetrix LLC** is the national leader in aquatic habitat mapping. Since 1999 ReMetrix has mapped over 1.5 million surface acres of aquatic resources through the combined use of hydroacoustic surveys, remote sensing analyses, species sampling, sediment sampling, GIS, GPS-linked underwater imaging, and complementary technologies. ReMetrix has also become a leader in geospatial data management for aquatics by creating custom software tools and web applications for end-users.

**SePRO Corporation** is recognized as an industry leader in providing the highest level of technical services to customers who operate in specialty niche markets in the USA. SePRO's key business segments include the U.S. Aquatics Industry, Horticulture / Greenhouse Markets, and Professional Turf Management. After 19 years, SePRO continues to seek ways to enhance our services, solutions and capabilities in support of the Aquatic Resource Management Community. www.sepro.com

Invasive weeds can devastate both natural and commercial habitats. **Syngenta Professional Products** provides high performance products to control destructive weeds while helping to restore the habitat of aquatic environments. Proven herbicides for the weed control industry from Syngenta include Reward®, and Refuge™, the latest and most concentrated glyphosate in the aquatics market.

**United Phosphorus, Inc.** manufactures and markets aquatic herbicides and algaecides for lakes, ponds, and irrigation canals. These products are marketed as Aquathol®, Hydrothol®, Cascade®, Teton®, Symmetry® and Current®. UPI is a leader in the development of new uses, techniques, and formulations to improve aquatic plant management strategies. UPI is a worldwide producer of crop protection products with U.S. operations based in King of Prussia, PA. For more information please visit www.upi-usa.com or cascadeforcanals.com.

**Valent Professional Products** has the solutions applicators have been waiting for.Our products manage tough aquatic plants and provide the selectivity you can count on to maintain desirable vegetation. **Clipper™ Herbicide** provides rapid, contact control of many tough aquatics plants including cabomba and watermeal. It's tough. It's fast. It's gone. Clear the way with **Tradewind™ Herbicide** - systemic and selective control of hydrilla, watermilfoil and other aquatic plants. www.valentpro.com

**Vertex Water Features**, a division of Aquatic Systems, Inc. is a science and engineering based aeration system manufacturer that provides custom designed water quality solutions distributed through its dealer network to interested lake owners, lake managers, developers and government agencies throughout North America and internationally. www.vertexwaterfeatures.com 1-800-432-4302 sue@vertexwaterfeatures.com

# Meeting Sponsors

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

## Platinum

***United Phosphorus, Inc.***
*Exton, Pennsylvania*

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## Silver

***Crop Production Services, Inc.***
*Loveland, Colorado*

***Helena Chemical Company***
*Tampa, Florida*

***SePRO Corporation***
*Carmel, Indiana*

***Syngenta Professional Products***
*Greensboro, North Carolina*

***Winfield Solutions, LLC***
*Ville Platte, Louisiana*

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## Bronze

***Alligare, LLC***
*Davidson, North Carolina*

***Applied Biochemists, A Lonza Business***
*Germantown, Wisconsin*

***Red River Specialties***
*Shreveport, Louisiana*

***Valent USA Corporation***
*Memphis, Tennessee*

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## Contributor

***AquaMaster Fountains and Aerators***
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***Aqua Services, Inc.***
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***Aquatic Control, Inc.***
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*Pompano Beach, Florida*

# Scholastic Endowment Sponsors

The Aquatic Plant Management Society appreciates the generous support of the following scholastic endowment sponsors. Revenues generated through the Raffle at the Awards Banquet and Silent Auction are applied toward the Scholastic Endowment Fund which supports student attendance and functions at the Annual Meeting, the APMS Graduate Student Research Grant, and Student Director participation on the Board of Directors.

## Raffle Contributors

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*Pompano Beach, Florida*

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***Brewer International***
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*Carmel, Indiana*

***Syngenta Professional Products***
*Greensboro, North Carolina*

***Valent USA Corporation***
*Walnut Creek, California*

***Vertex Water Features***
*Pompano Beach, Florida*

***Winfield Solutions, LLC***
*Saint Paul, Minnesota*

# Exhibitors

The Aquatic Plant Management Society thanks the following companies
for exhibiting their products and services.

***Airmax Ecosystens, Inc.***
*Romeo, Michigan*

***Alligare, LLC***
*Opelika, Alabama*

***Applied Biochemists, A Lonza Business***
*Germantown, Wisconsin*

***Applied Polymer Systems***
*Woodstock, Georgia*

***AquaMaster Fountains and Aerators***
*Kiel, Wisconsin*

***Aquatic Control, Inc.***
*Seymour, Indiana*

***Aquatic Eco-Systems, Inc.***
*Apopka, Florida*

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*Canoga Park, California*

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*Seattle, Washington*

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***Valent USA Corporation***
*Walnut Creek, California*

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*Pompano Beach, Florida*

***Winfield Solutions, LLC***
*Ville Platte, Louisiana*

# General Information

**Program Organization**
The Agenda is organized by day and time. Posters and abstracts are organized alphabetically by presenting author.

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

**Meeting Registration Desk**
The meeting registration desk will be located in Foyer A&B located in front of the Ballroom A&B meeting rooms for the duration of the meeting. For specific times, please see the Agenda-at-a-Glance pages for each day in this Program. Messages will be posted at the meeting registration desk.

**Exhibits**
Exhibits will be open from 7:00 a.m. Monday to 10:30 a.m. Wednesday in Ballroom C - Foyer C.

**Posters**
Posters will be open for viewing from 7:00 a.m. Monday to 10:30 a.m. Wednesday in Ballroom C - Foyer C. A Poster Session and Reception will be held on Monday from 6:00 p.m. to 7:30 p.m. in Ballroom C - Foyer C. Poster presenters are required to attend the Poster Session to answer questions. In addition, presenters are requested to be in attendance during refreshment breaks. The Poster Reception is sponsored by Crop Production Services.

**Continental Breakfasts / Refreshment Breaks**
Continental breakfasts and mid-morning and afternoon refreshment breaks, graciously sponsored by BioSafe Systems, LLC, Brewer International, Helena Chemical Company, and Valent USA Corporation will be served each day in Ballroom C - Foyer C. Please see the Agenda-at-a-Glance for specific times, locations, and sponsors.

**APMS Student Affairs Luncheon**
The Student Affairs Luncheon will be held Monday, 12:10 p.m. to 1:40 p.m. in the Flagstaff Room. All students registered for the meeting are invited to attend. This luncheon will be a great opportunity to meet other students, interact with the APMS leadership, and learn how to become more involved in the Society. Rebecca Haynie, Student Affairs Committee Chair, will be the moderator. Please contact Rebecca by noon Sunday, July 22 to confirm your attendance. This luncheon is sponsored by SePRO Corporation.

**APMS Annual Business Meeting**
The APMS Annual Business Meeting will be held Monday, 4:30 p.m. to 5:00 p.m. in Ballroom A&B. All APMS members are encouraged to attend.

**APMS Regional Chapters Presidents' Breakfast**
The Regional Chapters Presidents' Breakfast will be held Tuesday, 6:30 a.m. to 8:00 a.m. in the Flagstaff Room. Representatives from each APMS regional chapter are invited to attend this breakfast. Michael Netherland, APMS Vice President and Regional Chapters Committee Chair, will be the moderator for discussions on aquatic plant management activities in each region. Please contact Mike by 8:00 a.m. Monday, July 23 to confirm your attendance. This breakfast is sponsored by Red River Specialties.

**APMS Past Presidents' Luncheon**
All APMS Past Presidents are invited to attend the Past Presidents' Luncheon on Tuesday, 12:10 p.m. to 1:40 p.m. in the Flagstaff Room. Linda Nelson, Immediate Past President, will be the moderator. Please contact Linda by noon Monday, July 23 to confirm your attendance. The luncheon is sponsored by Alligare, LLC.

**APMS Special Events**

***President's Reception**, Sunday, July 22, 7:00 p.m. to 9:00 p.m., Ballroom B*
The APMS cordially invites all registered delegates, guests, and students to the President's Reception, graciously sponsored by Syngenta Professional Products and Winfield Solutions, Inc. Enjoy a casual gathering visiting with old friends and making new acquaintances while savoring hors d'oeuvres and your favorite beverage. Non-registered guests may purchase tickets at the meeting registration desk.

***Poster Session and Reception**, Monday, July 23, 6:00 p.m. to 7:30 p.m., Ballroom C - Foyer C*
The APMS cordially invites all registered delegates, guests, and students to the Poster Session and Reception, sponsored by Crop Production Services. This reception features viewing of posters and professional interactions and discussions in a casual setting. Enjoy hors d'oeuvres and your favorite beverage. Non-registered guests may purchase tickets at the meeting registration desk.

***Guest Tour:* Temple Square & Natural History Museum**, *Monday, July 23, 10:00 a.m. to 3:00 p.m. Meet in the Lobby of the Little America Hotel*
The APMS invites registered guests to the Temple Square & Natural History Museum Tour, sponsored by Applied Biochemists, A Lonza Business. Temple Square is a worldwide icon of the Church of Jesus Christ of Latter-day Saints. The massive granite edifice was constructed in a neo-gothic style during a 40-year period from 1853 – 1893. The pioneers who settled the valley sacrificed both time and material goods to build the temple, which stands as a testament to their faith and devotion. Guests will tour the grounds and admire workmanship of the building and the beauty of its immediate surroundings. The Salt Lake Tabernacle is home to the world-famous Mormon Tabernacle Choir. The Tabernacle organ contains 11,623 pipes, making it one of the largest and richest-sounding organs in the world. The building was constructed so that the drop of a pin at the front of the building can be heard at the back. This portion of the tour will be completed at the Visitors Center that houses a statue of Jesus Christ, known as The Christus, as well as exhibits and other works of art. The tour will then move to the new Natural History Museum. The Museum's design embodies its educational and scientific mission to inspire wonder and discovery of the natural world and the place of humans in it. The Lion House will host our lunch. The Guest Tour is open to registered guests (spouse, partner, or child over 12 years of age). Non-registered guests may purchase tickets for this event at the registration desk. Transportation will be provided from the hotel, but space is limited, so sign up early at the registration desk.

***Awards Reception and Banquet**, Tuesday, July 24, 6:00 p.m. to 10:00 p.m., Foyer A&B, Ballroom A*
The APMS cordially invites all registered delegates, guests and students to the APMS Awards Reception and Banquet, sponsored by United Phosphorus, Inc. Join us for a pre-banquet reception from 6:00 -7:00 p.m., with dinner served at 7:00 p.m. After dinner, we will recognize those who have served the Society, welcome new officers and directors, present awards to the student paper and poster participants, and announce the recipient of the 2013-2014 APMS Graduate Student Research Grant. Our evening will conclude with a new format for the raffle. Raffle tickets may be purchased at the meeting registration desk and during the Awards Banquet. Ticket sales promote APMS sponsorship of student initiatives.

**Spur-of-the-Moment Meeting Room**
Do you have a spur-of-the-moment meeting and need a room? We have a room set up conference style for 25 guests. For available times and location, please check at the meeting registration desk.

**Post-Conference Student Tour**
When the 2012 meeting adjourns on Wednesday July 25$^{th}$, rain or shine, students will embark on the now famous student tour for the 5$^{th}$ consecutive year! Larry Dalton, the Utah Department of Natural Resources Nuisance Aquatic Species Coordinator, will lead our tour to nearby Farmington Bay Waterfowl Management Area on the shore of Great Salt Lake. The 18,000-acre Farmington Bay WMA is part of the Western Hemispheric Shorebird Reserve Network. This reserve network is a premier birding destination and is a migratory stopover for more than 30 species and millions of individual shorebirds. The students will see tamarisk and phragmites control work and discuss *Dreissena* threat to waterfowl management on Great Salt Lake. For more information on the student tour or student affairs please contact Dr. Rebecca Haynie at hayniers@uga.edu.

# Agenda

## Sunday, July 22

### Sunday's Agenda-at-a-Glance

| | | | |
|---|---|---|---|
| 7:30 am | - | 5:00 pm | APMS Board of Directors Meeting *(Snowbasin)* |
| 12:00 pm | - | 5:00 pm | Exhibits Setup *(Ballroom C - Foyer C)* |
| 12:00 pm | - | 5:00 pm | Poster Setup *(Ballroom C - Foyer C)* |
| 1:00 pm | - | 5:00 pm | Registration *(Foyer A&B)* |
| 7:00 pm | - | 9:00 pm | President's Reception *(Ballroom B)* |
| | | | *Cosponsored by Syngenta Professional Products and Winfield Solutions, Inc.* |

## Monday, July 23

### Monday's Agenda-at-a-Glance

| | | | |
|---|---|---|---|
| 7:00 am | - | 8:00 am | Continental Breakfast *(Ballroom C - Foyer C)*<br>*Sponsored by Helena Chemical Company* |
| 7:00 am | - | 5:00 pm | Exhibits Open *(Ballroom C - Foyer C)* |
| 7:00 am | - | 5:00 pm | Posters Open *(Ballroom C - Foyer C)* |
| 7:30 am | - | 5:00 pm | Registration *(Foyer A&B)* |
| 8:00 am | - | 12:10 pm | Session I *(Ballroom A&B)* |
| 10:00 am | - | 3:00 pm | Guest Tour<br>*Sponsored by Applied Biochemists* |
| 10:00 am | - | 10:30 am | Refreshment Break *(Ballroom C - Foyer C)*<br>*Sponsored by Brewer International* |
| 12:10 pm | - | 1:40 pm | Lunch on your own |
| 12:10 pm | - | 1:40 pm | APMS Student Affairs Luncheon *(Flagstaff)*<br>*Sponsored by SePRO Corporation* |
| 12:10 pm | - | 1:40 pm | Aquatic Ecosystem Restoration Foundation Meeting *(Sawtooth)* |
| 1:40 pm | - | 4:30 pm | Session II *(Ballroom A&B)* |
| 3:00 pm | - | 3:30 pm | Refreshment Break *(Ballroom C - Foyer C)*<br>*Sponsored by Valent USA Corporation* |
| 4:30 pm | - | 5:00 pm | Annual Business Meeting *(Ballroom A&B)* |
| 6:00 pm | - | 7:30 pm | Poster Session and Reception *(Ballroom C - Foyer C)*<br>*Sponsored by Crop Production Services, Inc.* |

### Session I

8:00 am - 12:10 pm
*Ballroom A&B*

**Moderator: Mr. Terry L. Goldsby - Aqua Services, Incorporated**

8:00 am **Welcome, Opening Remarks and Announcements**

8:05 am **Presidential Address**
**Tyler Koschnick**
*SePRO Corporation, Carmel, IN*

8:20 am **Bridging Science to Policy - Keynote Address**
**Jill Schroeder**
*New Mexico State University, Las Cruces, NM*

8:40 am **An Ecosystem Services Approach to Management of Aquatic Invasive Species: Should APMS Take the Lead?**
**Lars Anderson** (Retired)
*U.S. Department of Agriculture, Agricultural Research Service, Davis, CA*

9:00 am **Idaho's Aquatics Program**
**Thomas Woolf**
*Idaho Department of Agriculture, Hayden, ID*

9:20 am **Distribution and Management of Aquatic Invasive Plants in Montana**
**Celestine Duncan**[1], Ray Beck[2], Dave Burch[3], and John Halpop[4]
[1]*Weed Management Services, Helena, MT*
[2]*Department of Natural Resources and Conservation, Helena, MT*
[3]*Montana Department of Agriculture, Helena, MT*
[4]*Montana State University Cooperative Extension Service, Helena, MT*

9:40 am **Henrys Lake Prevention Project - Idaho**
**Bryce Fowler**
*Fremont County Weed Control, Saint Anthony, ID*

10:00 am **Refreshment Break** *(Ballroom C - Foyer C)*

10:30 am **Assessment of the Distribution of Aquatic Invasive Plants in the Pacific Northwest: Five Years of Surveying**
**Ryan M. Wersal**[1], John D. Madsen[1], Jonathan P. Fleming[1] and Celestine Duncan[2]
[1]*Mississippi State University, Mississippi State, MS*
[2]*Weed Management Services, Helena, MT*

10:50 am **Products Available for Use in Irrigation Canals**
**Hugh McEachen** (Retired)
*Columbia Basin Project, Pasco, WA*

11:10 am **Twin Falls Canal Company Aquatic Weed and Algae Management**
**Brian Olmstead**
*Twin Falls Canal Company, Twin Falls, ID*

11:30 am **California & Nationwide NPDES Permit: "Deja Vu All over Again?"**
**Michael S. Blankinship**
*Blankinship & Associates, Incorporated, Davis, CA*

11:50 am ***Equisetum hyemale* (Scouringrush) Response to Sonar Genesis™ (a.i. Fluridone) and Clearcast™ (a.i. Imazamox)**
**Jill Schroeder**[1] and Mark A. Heilman[2]
[1]*New Mexico State University, Las Cruces, NM*
[2]*SePRO Corporation, Carmel, IN*

12:10 am **Lunch on your own**

## Session II
1:40 pm - 4:30 pm
*Ballroom A&B*

**Moderator: Dr. John Madsen - Mississippi State University**

1:40 pm **Pre-Emergent Use of the ALS Herbicide Galleon™ (Penoxsulam) in Aquatic Sites**
**Andrew Z. Skibo**[1], Mark A. Heilman[2], and Scott W. Shuler[2]
[1]*SePRO Corporation, Denver, CO*
[2]*SePRO Corporation, Carmel, IN*

2:00 pm **An Update on Flowering Rush Control Demonstration Projects for Infestations Spanning Watersheds between the Pacific Northwest and Great Lakes States**
**Thomas Moorhouse**[1], Thomas McNabb[2], Peter Rice[3], Virgil Dupuis[4], Alvin Mitchell[4], Jenifer Parsons[5], Thomas Woolf[6], and John D. Madsen[7]
[1]*Clean Lakes, Incorporated, Coeur d'Alene, ID*
[2]*Clean Lakes, Incorporated, Kissimmee, FL*
[3]*University of Montana, Missoula, MT*
[4]*Salish Kootenai College, Pablo, MT*
[5]*Washington Department of Ecology, Yakima, WA*
[6]*Idaho Department of Agriculture, Hayden, ID*
[7]*Mississippi State University, Mississippi State, MS*

2:20 pm **Evaluation of Non-Chemical Control Strategies for Common Aquatic Weeds in California**
**Michael S. Blankinship**
*Blankinship & Associates, Incorporated, Davis, CA*

2:40 pm **A Review of a Mechanical Control Project for Emergent Aquatic Vegetation Control in Coastal Southern California**
**Thomas Moorhouse**
*Clean Lakes, Incorporated, Coeur d'Alene, ID*

3:00 pm **Refreshment Break** *(Ballroom C - Foyer C)*

3:30 pm **Triploid Grass Carp Feeding Preferences for Two Novel Invasive Aquatic Plants *(Student Presentation)***
**Michael T. Neisch[1], Michael Masser[1], and Daniel Roelke[2]**
*[1]Texas A&M University / Texas AgriLife Extension Service, College Station, TX*
*[2]Texas A&M University, College Station, TX*

3:50 pm **Diagnosis of a Nuisance Aquatic Plant Problem on Lake Havasu, Arizona**
**John D. Madsen**, Ryan M. Wersal, Amanda L. Fernandez, and Gray Turnage
*Mississippi State University, Mississippi State, MS*

4:10 pm **Updates for AERF and NPDES**
**Carlton Layne**
*Aquatic Ecosystems Restoration Foundation, Marietta, GA*

4:30 pm **Annual Business Meeting**
**Tyler Koschnick**
*President, Aquatic Plant Management Society*

5:00 pm **Adjourn**

## Poster Session

6:00 pm - 7:30 pm
*Ballroom C - Foyer C*

**Monitoring Field Applications of Clipper Herbicide**
**Jason C. Fausey**
*Valent Professional Products, Fremont, OH*

**Effect of Water Depth and Sediment Composition on Vegetative Reproduction of the Invasive Aquatic Weeds Rotala [*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne] and Hygrophila [*Hygrophila polysperma* (Roxb.) T. Anders]**
**Lyn A. Gettys**, Warner Orozco Obando, and Francis C. Reed III
*University of Florida, Institute of Food and Agricultural Sciences, Fort Lauderdale Research and Education Center, Davie, FL*

**Evaluation of Liquid and Granular Tyiclopyr against Waterlily, Spatterdock, and Hardstem Bulrush**
**LeeAnn Glomski**[1] and Michael D. Netherland[2]
[1]*U.S. Army Engineer Research and Development Center, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

**Competition of Monoecious Hydrilla with Other Submersed Macrophytes *(Student Presentation)***
**Sarah T. Meadows** and Robert J. Richardson
*North Carolina State University, Raleigh, NC*

**Sago Pondweed Control in Irrigation Canals Using Endothall and Chelated Copper: Comparing Greenhouse and Field Results**
**Scott J. Nissen**[1], Joseph D. Vassios[2], William Ratajczyk[3], and Brian Lind[4]
[1]*Colorado State University, Fort Collins, CO*
[2]*United Phosphorus, Incorporated, Sacramento, CA*
[3]*Applied Biochemists, Germantown, WI*
[4]*Applied Biochemists, Scottsbluff, NE*

**Effects of Aquatic Weeds Biomass Soil Incorporation on Chemical Properties of a Degraded Soil**
**Robinson L. Pitelli**[1], Monicke O. Vieira[2], and Robinson A. Pitelli[3]
[1]*Ecosafe Agriculture and Environmental Sciences, Jaboticabal, Brazil*
[2]*Light Energy, Pirai, Brazil*
[3]*University of State of São Paulo, Jaboticabal, Brazil*

**What are Effective Treatments for Controlling Small, Dense Patches of *Phragmites australis* in Great Salt Lake Wetlands? *(Student Presentation)***
**Christine B. Rohal** and Karin M. Kettenring
*Utah State University, Logan, UT*

**Variations in Water Exchange Characteristics among Hydrilla Sites in the Ross Barnett Reservoir *(Student Presentation)***
**Bradley T. Sartain**, Ryan M. Wersal, and John D. Madsen
*Mississippi State University, Mississippi State, MS*

**Water Nutrient Removal from Mechanical Harvesting of Aquatic Weeds in a Eutrophic Reservoir in Brazil**
**Monicke O. Vieira**[1], Robinson A. Pitelli[2], and Robinson L. Pitelli[3]
[1]*Light Energy, Pirai, Brazil*
[2]*University of State of São Paulo, Jaboticabal, Brazil*
[3]*Ecosafe Agriculture and Environmental Sciences, Jaboticabal, Brazil*

**Is *Hygrophila polysperma* in Texas a Potential Threat? *(Student Presentation)***
**Casey R. Williams**
*Texas State University, San Marcos, TX*

**Ultrasonic Algae Control - How Does It Work?**

**Kirk Whatley**
*SonicSolutions, LLC, West Hatfield, MA*

## Tuesday, July 24

### Tuesday's Agenda-at-a-Glance

| | | | |
|---|---|---|---|
| 6:30 am | - | 8:00 am | APMS Regional Chapters Presidents' Breakfast *(Flagstaff)* |
| | | | *Sponsored by Red River Specialties* |
| 7:00 am | - | 8:00 am | Continental Breakfast *(Ballroom C - Foyer C)* |
| | | | *Sponsored by Helena Chemical Company* |
| 7:00 am | - | 5:00 pm | Exhibits Open *(Ballroom C - Foyer C)* |
| 7:00 am | - | 5:00 pm | Posters Open *(Ballroom C - Foyer C)* |
| 7:30 am | - | 5:00 pm | Registration *(Foyer A&B)* |
| 8:00 am | - | 12:10 pm | Session III *(Ballroom A&B)* |
| 10:00 am | - | 10:30 am | Refreshment Break *(Ballroom C - Foyer C)* |
| | | | *Sponsored by Valent USA Corporation* |
| 12:10 pm | - | 1:40 pm | Lunch on your own |
| 12:10 pm | - | 1:40 pm | APMS Past Presidents' Luncheon *(Flagstaff)* |
| | | | *Sponsored by Alligare, LLC* |
| 1:40 pm | - | 5:10 pm | Session IV *(Ballroom A&B)* |
| 3:00 pm | - | 3:30 pm | Refreshment Break *(Ballroom C - Foyer C)* |
| | | | *Sponsored by Valent USA Corporation* |
| 6:00 pm | - | 7:00 pm | Reception *(Foyer A&B)* |
| | | | *Sponsored by United Phosphorus, Incorporated* |
| 7:00 pm | - | 10:00 pm | Awards Banquet *(Ballroom A)* |
| | | | *Sponsored by United Phosphorus, Incorporated* |

### Session III

8:00 am - 12:10 pm
*Ballroom A&B*

**Moderator: Dr. Michael D. Netherland - U.S. Army Engineer Research and Development Center**

7:55 am **Opening Comments**

8:00 am **Deep Water Mechanical Harvesting of Hydrilla in West Lake Tohopekaliga, Florida**
**Dean Jones**[1], William T. Haller[2], and Mike Hulon[3]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Lake Alfred, FL*
[2]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[3]*Texas Aquatic Harvesting, Incorporated, Lake Wales, FL*

8:20 am **Evaluations and Results from the First Year Field Use of Flumioxazin (Clipper Herbicide)**
**James F. Petta**
*Valent Professional Products, Corpus Christi, TX*

8:40 am **Control of Water Lettuce and Water Hyacinth Using Low Doses of Imazamox and Penoxsulam Plus Contact Herbicides or Surfactants**
**Christopher R. Mudge**[1] and Michael D. Netherland[2]
[1]*U.S. Army Engineer Research and Development Center, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

9:00 am **Herbicide Efficacy on Cuban Bulrush (*Oxycaryum cubense* (Poeppe & Kunth) Palla) *(Student Presentation)***
**Amanda L. Fernandez** and John D. Madsen
*Mississippi State University, Mississippi State, MS*

9:20 am **Pre-emergent Control of Submersed Aquatic Weeds in Arkansas Baitfish Ponds: Year 3**
**George L. Selden**
*University of Arkansas at Pine Bluff, Jonesboro, AR*

9:40 am **Biology and Control of the Invasive Aquatic Plant, Crested Floating Heart (*Nymphoides cristata*) *(Student Presentation)***
**Leif N. Willey**[1] and Michael D. Netherland[2]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

10:00 am **Refreshment Break** *(Ballroom C - Foyer C)*

10:30 am **Investigating the Potential Role of Cyanobacteria in Intersex in Fish *(Student Presentation)***
**Jamie R. Morgan**, James A. Herrin, Rebecca S. Haynie, Kristen Kellock, Susan B. Wilde, and Robert Bringolf
*University of Georgia, Athens, GA*

10:50 am **Nuisance Aquatic Species Control: Implications for Wild Bird Health**
**Rebecca S. Haynie**[1], Robert Bahn[1], Deborah C. Harris[2], James A. Herrin[1], John R. Fischer[1], and Susan B. Wilde[1]
[1]*University of Georgia, Athens, GA*
[2]*U.S. Fish and Wildlife Service, Athens, GA*

11:10 am **Evidence for Novel Routes of Exposure to the Biotoxin Linked to Avian Vacuolar Myelinopathy (AVM) *(Student Presentation)***
**Shelley M. Robertson**, Rebecca S. Haynie, and Susan B. Wilde
*University of Georgia, Athens, GA*

11:30 am **Naming the Wilde Stig: Final Morphological and Molecular Characterization of Novel Cyanobacterial Epiphyte Associated with Avian Vacuolar Myelinopathy**
**Susan B. Wilde**[1], Peng Jiang[1], Henry D. Wilde[1], and Jeffrey R. Johansson[2]
[1]*University of Georgia, Athens, GA*
[2]*John Carroll University, University Heights, OH*

11:50 am **Satellite Remote Sensing of Submerged Aquatic Vegetation Status and Distribution in the Currituck Sound, North Carolina *(Student Presentation)***
**Brett M. Hartis** and Stacy A. Nelson
*North Carolina State University, Raleigh, NC*

12:10 pm **Lunch on your own**

## Session IV

1:40 pm - 5:10 pm
*Ballroom A&B*

**Moderator: Dr. Ryan Wersal - Mississippi State University**

1:40 pm **Evaluation of Enhanced Data Processing and Cloud Data Hosting of SONAR Based Surveys *(Student Presentation)***
**Justin J. Nawrocki**, Sarah T. Meadows, Robert J. Richardson, and Steve T. Hoyle
*North Carolina State University, Raleigh, NC*

2:00 pm **Release of SAVEWS Jr. Version 1.0 – Low-cost, Acoustic-based Aquatic Plant Mapping System**
**Bruce M. Sabol** and Eddie Melton
*U.S. Army Engineer Research and Development Center, Vicksburg, MS*

2:20 pm **Hybrid Watermilfoils Exhibit Reduced Sensitivity to 2,4-D in Comparison to Parental Eurasian Watermilfoil in a Laboratory Assay Experiment** ***(Student Presentation)***
**Elizabeth A. LaRue**[1], Matthew P. Zuellig[2], Michael D. Netherland[3], Mark A. Heilman[4], and Ryan A. Thum[1]
[1]*Grand Valley State University, Muskegon, MI*
[2]*University of Georgia, Athens, GA*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*
[4]*SePRO Corporation, Carmel, IN*

2:40 pm **Weeds in the Water: An Assessment of Florida Boater & Angler Awareness, Attitudes, and Behavior Relating to Aquatic Invasive Species Issues and Prevention** ***(Student Presentation)***
**Kate Wilson**, William Haller, and Tracy Irani
*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

3:00 pm **Refreshment Break** *(Ballroom C - Foyer C)*

3:30 pm **Monoecious Hydrilla Phenology on Two North Carolina Lakes** ***(Student Presentation)***
**Sarah T. Meadows** and Robert J. Richardson
*North Carolina State University, Raleigh, NC*

3:50 pm **Considering Monoecious Hydrilla Subterranean Turion Biology in Management Programs**
**Robert J. Richardson**
*North Carolina State University, Raleigh, NC*

4:10 pm **Factors that Influence Rapid Expansion of Hydrilla and the Implications for Management**
**Michael D. Netherland**
*U.S. Army Engineer Research and Development Center, Gainesville, FL*

4:30 pm **Effects of the Aquatic Herbicide Endothall on Survival of Salmon and Steelhead Smolts during Seawater Transition**
**Ian Courter**[1] and Lauren Courter[2]
[1]*Cramer Fish Sciences, Portland, OR*
[2]*Mount Hood Environmental, Portland, OR*

4:50 pm **Integrating Submerged Aquatic Vegetation Mapping with Aquatic Herbicide Treatments, Lake Tohopekaliga, Florida**
**Thomas J. McNabb**
*Clean Lakes, Incorporated, Kissimmee, FL*

5:10 pm **Adjourn**

## Wednesday, July 25

### Wednesday's Agenda-at-a-Glance

| | | | |
|---|---|---|---|
| 7:00 am | - | 8:00 am | Continental Breakfast *(Ballroom C- Foyer C)*<br>*Sponsored by Helena Chemical Company* |
| 7:00 am | - | 10:30 am | Exhibits Open *(Ballroom C- Foyer C)* |
| 7:00 am | - | 10:30 am | Posters Open *(Ballroom C- Foyer C)* |
| 7:30 am | - | 12:00 pm | Registration *(Foyer A&B)* |
| 8:00 am | - | 12:00 pm | Session V *(Ballroom A&B)* |
| 10:00 am | - | 10:30 am | Refreshment Break *(Ballroom C- Foyer C)*<br>*Sponsored by BioSafe Systems, LLC* |
| 10:30 am | - | 12:00 pm | Poster and Exhibit Breakdown *(Ballroom C- Foyer C)* |
| 12:30 pm | - | 5:00 pm | APMS Board of Directors Meeting *(Snowbasin)* |

### Session V

8:00 am - 12:00 pm
*Ballroom A&B*

**Moderator: Dr. Linda Nelson - U.S. Army Engineer Research and Development Center**

7:55 am **Opening Comments**

8:00 am **Targeted Algal Management: Some Case Studies**
**John H. Rodgers, Jr.**[1], Russell Brown[2], David Isaacs[3], William Ratajczyk[4], Keith Gazaille[5], and James Schmidt[4]
[1]*Clemson University, Clemson, SC*
[2]*City of Salem, Salem Water Works, Salem, IN*
[3]*Aquatic Control, Incorporated, Seymour, IN*
[4]*Applied Biochemists, Germantown, WI*
[5]*Aquatic Control Technologies, Sutton, MA*

8:20 am **Advanced Solutions for Combating Harmful Algal Infestations**
**West M. Bishop**[1], Mark A. Heilman[2], and Robert Johnson[2]
[1]*SePRO Corporation, Whitakers, NC*
[2]*SePRO Corporation, Carmel, IN*

8:40 am **Absorption and Translocation of Granular and Liquid Triclopyr Formulations by Eurasian Watermilfoil**
**Scott J. Nissen**[1], Joseph D. Vassios[2], Tyler J. Koschnick[3], and Mark A. Heilman[3]
[1]*Colorado State University, Fort Collins, CO*
[2]*United Phosphorus, Incorporated, Sacramento, CA*
[3]*SePRO Corporation, Carmel, IN*

9:00 am **Bispyribac, Quinclorac, and Topramezone Absorption from Roots and Shoots of *Hydrilla verticillata***
**Brett W. Bultemeier**[1] and William T. Haller[2]
[1]*Clarke Aquatic Services, Alachua, FL*
[2]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

9:20 am **Renovate™ (Triclopyr): A Decade of Selective Management and Continued Development**
**Mark A. Heilman**
*SePRO Corporation, Carmel, IN*

9:40 am **Plant Management in Florida Waters - Learn All about It...Online!**
**Karen Brown**
*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

10:00 am **Refreshment Break** *(Ballroom C- Foyer C)*

10:30 am **Assessment of a New Hydroacoustic Habitat Mapping System for Quantitative Identification of Aquatic Macrophytes and Substrate Composition and Bathymetric Surveying in Freshwater Lakes**
**Eric Munday**, Jannusz Burcyznski, and Brian Moore
*BioSonics, Incorporated, Seattle, WA*

10:50 am **Commercial Application of Tradewind Herbicide in Florida Lakes: First Year Results**
**Joseph R. Chamberlin**[1], Mike Riffle[2], and James F. Petta[3]
[1]*Valent Professional Products, Snellville, GA*
[2]*Valent Professional Products, Tallahassee, FL*
[3]*Valent Professional Products, Corpus Christie, TX*

11:10 am **How to Combat the Detrimental Effects of Eutrophication, Control Algae Blooms and Meet Water Quality Standards**
**Seva I. Iwinski**
*Applied Polymer Systems, Woodstock, GA*

11:30 am **Regional Chapter Updates - Moderator: Dr. Michael Netherland**
Western
Texas
South Carolina
Northeast
Midwest
MidSouth
Florida

12:00 pm **ADJOURN**

## NEXT YEAR

## 53rd Annual Meeting
## Westin Riverwalk
## San Antonio, Texas
## July 13-17, 2013

# Abstracts

Abstracts are printed as submitted by authors. Abstracts are listed alphabetically by presenting author. Presenting author appears in **bold.**

**Advanced Solutions for Combating Harmful Algal Infestations**
**West M. Bishop**[1], Mark A. Heilman[2], and Robert Johnson[2]
[1]*SePRO Corporation, Whitakers, NC*
[2]*SePRO Corporation, Carmel, IN*

With increased demand on our freshwaters, factors that threaten water quality elicit devastating ecological and economic consequences. Numerous types of algae that infest our critical water resources are resilient to conventional treatment methods. Other algae continually persist and re-grow following algaecide treatments resulting in minimal abatement of obviated water resource uses. Progressive solutions like Captain XTR, a chelated copper algaecide with a unique surfactant package, and SeClear, an algaecide and water quality enhancer, can alleviate the constraints imposed by nuisance algal infestations. The objectives of this presentation are: 1) to show responses of dense and robust algae to exposures of Captain XTR, and 2) to provide data on the efficiency of SeClear at controlling algae, removing phosphorus and preventing re-growth of harmful algae. Captain XTR was able to significantly decrease biomass (over 85% compared with initial values), plant height (60% decrease) and chlorophyll content of starry stonewort (*Nitellopsis obtusa*: Charophyta) in 3 weeks. Captain XTR also controlled *Lyngbya wollei*, Cyanophyta, in both laboratory and field studies. SeClear significantly decreased phosphorus levels in field management programs (30-90%), controlled a broad range of nuisance algae (Oedogonium, Pithophora, Chara), and selected for a beneficial algae assemblage that supported a healthy ecological system. By evaluating the immediate and long-term impacts of these advanced algae and water quality solutions, an efficient and effective management strategy can be implemented for a specific site.

**California & Nationwide NPDES Permit: "Deja Vu All over Again?"**
**Michael S. Blankinship**
*Blankinship & Associates, Incorporated, Davis, CA*

Since 2002, California has regulated use of aquatic pesticides in virtually all waters in the state. Now that the nationwide NPDES aquatic pesticide permit must be complied with, some of the lessons learned and tools used in California are applicable to those states using their own permit or using the Pesticide General Permit.

**Evaluation of Non-Chemical Control Strategies for Common Aquatic Weeds in California**
**Michael S. Blankinship**
*Blankinship & Associates, Incorporated, Davis, CA*

Little quantitative data exists for the aquatic weed management professional to compare nonchemical control techniques to the use of aquatic pesticides. The efficacy, cost-effectiveness and impacts to water quality when non-chemical control techniques are employed was studied and documented on aquatic emergent, floating and terrestrial weeds. Techniques evaluated were goats, mechanical removal, chemical treatment followed by mechanical removal, and manual removal by labor crews using power equipment. Water quality impacts including the presence of coliform and *E. coli* were noted. Significant differences in cost per acre treated and efficacy were noted in the study and may be useful for the practitioner evaluating the relative merits of chemical vs. non-chemical control techniques.

**Plant Management in Florida Waters - Learn All about It...Online!**
**Karen Brown**
*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

*Plant Management in Florida Waters – An Integrated Approach* is a newly revised website produced by the University of Florida's Center for Aquatic and Invasive Plants in conjunction with the state's lead agency for

aquatic plant management, the Florida Fish & Wildlife Conservation Commission (FWC). The website explains to citizens why and how aquatic plants are managed in Florida waters and covers major and minor topics related to their management. To help comply with NPDES permitting requirements, the website also assists in the completion of Comprehensive Management Strategies by identifying and explaining the attributes and limitations of each of the 60 aquatic plant management tools available. The launch of the new web site deliberately coincided with the new requirements of the EPA NPDES Permit Program, which includes the application of pesticides to waters of the United States as of October 31, 2011. Five sections guide the user through the many factors considered by FWC biologists when developing aquatic plant management plans for Florida waters. Throughout the website, the message is emphasized that FWC's priority is to manage invasive plants while also conserving and enhancing Florida's unique aquatic habitats and wildlife communities. **Section 1** describes Florida's aquatic plants including the 12 most invasive aquatic plants and why their management is so important. **Section 2** describes Florida's water chemistry and trophic states along with physical characteristics of the state's water bodies. Various uses and functions of these waters are described as well as potential conflicts among user groups with different objectives. **Section 3** introduces the tools and methods available to control Florida's aquatic plants in four general categories: biological, physical (or cultural), chemical, and mechanical. **Section 4** illustrates how this information is incorporated into comprehensive management strategies for water bodies managed by the FWC. Interactions among water uses, plant types, available technologies, current environmental conditions, and funding are used to illustrate integrated pest management. **Section 5** links to a database of more than 85,000 articles related to aquatic plants and their management at the Center for Aquatic and Invasive Plants. Other research activities and outreach tools are listed and described.

**Bispyribac, Quinclorac, and Topramezone Absorption from Roots and Shoots of *Hydrilla verticillata***

**Brett W. Bultemeier**[1] and William T. Haller[2]
[1]*Clarke Aquatic Services, Alachua, FL*
[2]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

The absorption and translocation of herbicides in submersed aquatic plant species has been limited and typically has focused on treating small fragments of plants, not the whole plant. Little is known about the absorption and translocation of the older herbicides used in aquatic plant management, and even less about the newer chemistries that are being developed for plant control. The objectives of the current research were to 1) identify a methodology that will separate the water surrounding the foliage of submersed plants from the water surrounding the roots while still allowing unimpeded plant growth, 2) to determine the absorption and translocation characteristics of bispyribac, quinclorac, and topramezone in whole plants of *Hydrilla verticillata*. Experiments were conducted with sterile plants, and exposures were conducted for 21 days with plant harvesting at 7, 14, and 21 days after treatment. In all three herbicides the highest uptake was found in plants that had the foliage treated, when compared to root only treated plants. In most cases the concentration inside the plant was less than or equal to the concentration in the water column, with the exception of bispyribac which had significantly higher concentrations inside the plant. The absorption and translocation of these herbicides in hydrilla is different from previous research with these compounds on terrestrial plants and raises many questions about how other herbicides will behave in hydrilla.

**Commercial Application of Tradewind Herbicide in Florida Lakes: First Year Results**

**Joseph R. Chamberlin**[1], Mike Riffle[2], and James F. Petta[3]
[1]*Valent Professional Products, Snellville, GA*
[2]*Valent Professional Products, Tallahassee, FL*
[3]*Valent Professional Products, Corpus Christie, TX*

A single application of Tradewind herbicide (bispyribac-sodium) at 45 ppb reduced hydrilla biomass in Thomas Lake, FL by 99% within 3 months after a July application and there was almost no sign of hydrilla recovery at 7 months after application. Tradewind had much less impact on Southern Naiad, reducing biomass by only about 30% at 3 months after application. Tradewind did not significantly impact other native plant species. ELISA analysis showed that bispyribac-sodium concentration remained stable for approximately 2 months after application and then began to decline. Efficacy, native plant tolerance and ELISA results from two additional lakes treated with Tradewind in March 2012 will also be presented.

**Effects of the Aquatic Herbicide Endothall on Survival of Salmon and Steelhead Smolts during Seawater Transition**

**Ian Courter**[1] and Lauren Courter[2]
[1]*Cramer Fish Sciences, Portland, OR*
[2]*Mount Hood Environmental, Portland, OR*

In the Pacific Northwest, salmon and steelhead protection and population recovery efforts have led to careful consideration of potential effects of chemical exposure on sensitive life-stages. In particular, delayed effects of herbicide exposure on anadromous species as they transition from freshwater to seawater has become a concern previously overlooked by standardized toxicity testing for chemical labeling. For example, the widely used aquatic herbicide endothall has relatively low toxicity to salmonids following initial exposure; however, it was unclear whether endothall exposure affects the survival of smolts (seagoing juveniles) during transition from freshwater to seawater. Previous studies relied on small sample sizes and inappropriate life-stages, and generated contradicting results. To resolve uncertainty about endothall effects on anadromous salmonids, coho (*Oncorhynchus kisutch*), fall Chinook (*Oncorhynchus tshawytscha*), and steelhead (*Oncorhynchus mykiss*) were exposed to a ten-day seawater challenge (30 ppt) following acute exposure to the herbicide Cascade®, which contains the acid equivalent of the dipotassium salt of endothall. Exposure concentrations ranged from 0 to 12 mg/L endothall for 96 hours. The seawater challenge yielded mean survival rates of 84%, 83%, and 57% for 0, 3-8, and 10-12 mg/L exposure groups, respectively. Toxicity results did not differ significantly between species, but steelhead were most sensitive to the seawater challenge in all treatments. Mean plasma sodium levels of surviving fish were the same for control and treatment groups, indicating that osmoregulatory processes were not impaired by endothall exposure. Results suggest that the threshold for effects of endothall (dipotassium salt) exposure on smolts during seawater transition is likely >8 mg/L, but <12 mg/L –far less than the LC50 of 230-450 mg/L for salmonids in freshwater. This finding emphasizes the importance of conducting seawater challenge experiments with species that migrate between freshwater and marine environments before defining chemical toxicity levels.

**Distribution and Management of Aquatic Invasive Plants in Montana**

**Celestine Duncan**[1], Ray Beck[2], Dave Burch[3], and John Halpop[4]
[1]*Weed Management Services, Helena, MT*
[2]*Department of Natural Resources and Conservation, Helena, MT*
[3]*Montana Department of Agriculture, Helena, MT*
[4]*Montana State University Cooperative Extension Service, Helena, MT*

Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus* L.), and flowering rush (*Butomus umbellatus*) are non-native, perennial plants established in Montana that threaten the ecological integrity of aquatic environments in the state. Eurasian watermilfoil (EWM) was first reported in Montana in 2007. The weed occupies about 400 acres in the lower Clark Fork reservoirs, less than an acre in Beaver Lake, and multiple sites in the lower Jefferson River, Missouri River headwaters, and Fort Peck Reservoir. Flowering rush was first reported in Montana in 1964 in Flathead Lake. The plant occupies about 2,200 acres in Flathead Lake and River and more than 75 acres in the lower Clark Fork reservoirs. Curly-leaf pondweed was first reported in Montana in 1974 and is known to infest more than 1,000 acres within major water bodies both east and west of the Continental Divide. All three plants are classified as Priority 1B noxious weeds in Montana. A task force was formed in 2007 to develop and implement an integrated management program on invasive aquatic plants in Montana. Management strategies include public education and outreach, prevention, inventory, research and demonstration, and long-term containment and control. Prevention efforts include designation of special management areas encompassing the lower Clark Fork reservoirs and Missouri River with establishment of seasonal inspection stations for watercraft. Survey for aquatic invasive plants has been expanded to quantify presence and distribution in high risk water bodies. An early detection rapid response reporting system was initiated through University of Montana Invaders Database that includes a statewide alert for invasive aquatic noxious weeds. Current management for Eurasian watermilfoil includes diver dredging, bottom barrier, prevention, public awareness and outreach programs. Herbicide research/demonstration field trials were conducted in 2009 and 2010 in the lower Clark Fork reservoirs to determine efficacy of herbicide treatments in flowing water systems, and impacts to non-target aquatic plants. Operational herbicide treatments are scheduled for 2012. Research trials are on-going on flowering rush to determine management options.

**Monitoring Field Applications of Clipper Herbicide**
**Jason C. Fausey**
*Valent Professional Products, Fremont, OH*

Vegetation management is a common issue in Michigan water bodies and Waumegah Lake near Flint, Michigan is no exception as this 110 acre lake contains several challenging and difficult to manage plants. Clipper is a new herbicide containing the active ingredient flumioxazin that has been developed by Valent Professional Products for use in aquatics. In research and Experimental Use Permit (EUP) trials, Clipper has shown the potential to be a valuable tool to manage unwanted vegetation in water bodies and provide a new option for control of difficult to manage plants such as fanwort (*Cabomba caroliniana*) and watermeal (*Wolffia* spp.). The objectives of these trials were to monitor the persistence of Clipper and evaluate the performance of this herbicide when applied to selected areas of Waumegah Lake. Over the past several years, a limited number of new active ingredients have been introduced in the aquatics market, leaving applicators with few management options once problems exist. A recent influx of fanwort and starry stonewort (*Nitellopsis obtusa*) has resulted in an increase in observations of these plants in Michigan water bodies, and based on this work in Waumegah Lake, Clipper appears to be a valuable tool to manage these plants. Without new tools and management practices the shift in plant communities towards certain weed species has become a challenge for applicators and in many cases successful management options for these plants has not existed. Residue, plant biomass, and visual data taken from these trials confirmed Clipper is a selective herbicide with a short-life in the water column that can be used as part of a successful management strategy for selected unwanted vegetation in Midwestern water bodies. Also, unexpected and unpredicted observations regarding the overall performance of Clipper herbicide in these applications will be discussed.

**Herbicide Efficacy on Cuban Bulrush (*Oxycaryum cubense* (Poeppe & Kunth) Palla) *(Student Presentation)***
**Amanda L. Fernandez** and John D. Madsen
*Mississippi State University, Mississippi State, MS*

Cuban bulrush (*Oxycaryum cubense* (Poepp & Kunth) Palla) is a floating, epiphytic, perennial, aquatic plant from South America and the West Indies that is sporadically distributed in Florida, Louisiana, southern Georgia, southern Alabama, Mississippi, and coastal Texas. Floating mats of Cuban bulrush impede navigation and recreational use by obstructing shorelines and access areas. It is also highly competitive and has been shown to overtake other aquatic vegetation such as water hyacinth. To date, there are no published studies documenting management techniques for control of Cuban bulrush. The objectives of this study were to determine the efficacy of ten aquatic-labeled herbicides applied at the maximum labeled rate on Cuban bulrush control, and to determine if there is a difference in control between pre-flowering herbicide applications and post flowering herbicide applications. The herbicides tested include glyphosate, carfentrazone, flumioxazin, 2,4-D, triclopyr, imazamox, imazapyr, penoxsulam, bispyribac-sodium, and diquat. Cuban bulrush control was significantly different ($p<.0001$) between pre-flowering and post flowering treatments. The biomass for all Cuban bulrush treated with any of the ten herbicides before flowering was significantly lower than the untreated reference. Diquat, imazapyr, imazamox, glyphosate, 2,4-D, and triclopyr resulted in 100% biomass reduction. Conversely, only seven of the ten herbicides applied after flowering significantly lowered Cuban bulrush biomass compared to the untreated reference. Post flowering, bispyribac-sodium, carfentrazone, and penoxsulam were least effective in reducing Cuban bulrush biomass. For best control treat Cuban bulrush before flowering occurs with diquat, imazapyr, imazamox, glyphosate, 2,4-D, or triclopyr. For populations that have flowered apply diquat.

**Henrys Lake Prevention Project – Idaho**
**Bryce Fowler**
*Fremont County Weed Control, Saint Anthony, ID*

The Henrys Lake prevention project was started in 2008 to protect Henrys Lake from invasive aquatic plants. This project is located in the north east corner of Idaho, in Fremont County (population 13,000), and has a world renowned fishery that brings in 50 million dollars a year to the County. Henrys Lake is surrounded by lakes that have Eurasian watermilfoil or curleyleaf pondweed yet Henrys Lake is one of the few lakes left in the area that is free from any invasive species. Henrys Lake has a variety of aquatic plants due to the high phosphorous levels. It is also a very shallow lake, with maximum depth of 20 feet, which would be the perfect habitat for any aquatic plant

to take over. This project's main focus is to keep all invasive aquatic plants out and is a joint venture funded by the Idaho State Department of Agriculture and operated by Fremont County. In this project we inspect and wash every boat and trailer that enters the lake. We also pull vegetation samples from all launching sites several times a year as well as 350 monitoring locations. We monitor all high impact areas where wind blows and collects vegetation. We survey and talk to all boat owners and recreationists around the shores and educate them on how important it is to protect Henrys Lake and how to help keep it invasive species free. This project has had great success and gained attention from organizations and agencies interested in the preservation of Henrys Lake and surrounding water bodies in Fremont County and we hope that it will continue to move forward.

**Effect of Water Depth and Sediment Composition on Vegetative Reproduction of the Invasive Aquatic Weeds Rotala [*Rotala rotundifolia* (Buch.-Ham. ex Roxb.) Koehne] and Hygrophila [*Hygrophila polysperma* (Roxb.) T. Anders]**

**Lyn A. Gettys,** Warner Orozco Obando, and Francis C. Reed III
*University of Florida, Institute of Food and Agricultural Sciences, Ft. Lauderdale Research and Education Center, Davie, FL*

Rotala and hygrophila are relative newcomers to Florida's aquatic ecosystems. Although both of these weedy species are known to reproduce via fragmentation, little information is available regarding the effect of water depth and sediment composition on vegetative propagation of these species. Unrooted apical cuttings were inserted into one of three sediments (topsoil, sand, or a 50/50 mix of topsoil and sand) and cultured for 8 weeks at one of four water depths (subirrigation or water held at 2.5,15 or 30 cm above the surface of the sediment). All treatment combinations were replicated and maintained in a single concrete tank. After 8 weeks of culture, the length of the longest shoot in each container was recorded and each cutting was scored for the presence or absence of adventitious root development. A destructive harvest was then employed to separate above-ground growth and below-ground roots at the sediment line. Plant tissue was washed clean of sediment and other debris and dried in a forced-air oven at 90° C until a constant weight was achieved. Raw data were subjected to analysis of variance and LSD separation of means. Treatment differences and their implications will be discussed in this poster.

**Evaluation of Liquid and Granular Tyiclopyr against Waterlily, Spatterdock, and Hardstem Bulrush**

**LeeAnn Glomski**[1] and Michael D. Netherland[2]
[1]*U.S. Army Engineer Research and Development Center, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

The use of herbicides for control of Eurasian watermilfoil (*Myriophyllum spicatum* L.) can result in a wide range of concentrations and exposures for both target and non-target vegetation. Recent field samplings suggest that some treatments of large areas with auxin mimic herbicides can result in exposures lasting from one week to several weeks. While this has proven an effective strategy for controlling Eurasian watermilfoil, there are questions regarding the response of native plants to sustained concentrations of auxin mimic herbicides. In particular, resource managers have expressed specific concern regarding the response of waterlily (*Nymphaea odorata* Aiton), spatterdock (*Nuphar lutea* (L.) Sm), and hardstem bulrush (*Schoenoplectus acutus* Muhl. Ex Bigelow) to these treatments. Therefore, an outdoor tank study was conducted to determine the effect of granular and liquid triclopyr formulations on waterlily, spatterdock and hardstem bulrush under a range of concentration and exposure time scenarios. Treatments included static exposures of 0.25 mg $L^{-1}$ liquid, 0.5 mg $L^{-1}$ liquid and granular, 1.0 mg $L^{-1}$ granular and 2.0 mg $L^{-1}$ granular. A 24-hour exposure of 1.0 mg $L^{-1}$ liquid and an untreated control were also included. Results indicate waterlily shows strong visual injury symptoms to triclopyr across a wide range of rates tested. While this injury did not translate to biomass reductions in shallow water mesocosms, there are practical implications to these results regarding the high visibility of damage to floating leaves across such a broad range of concentrations. Spatterdock showed a much greater tolerance to triclopyr and the limited visual injury symptoms were short-lived at concentrations ranging from 0.25 to 2.0 mg $L^{-1}$. Hardstem bulrush showed strong and rapid visual injury symptoms at triclopyr concentrations of 1.0 mg $L^{-1}$ and greater. The loss of entire shoots would suggest that any recovery would occur from underground storage tissue. This strong visual injury response of waterlily and bulrush to a range of triclopyr exposures suggests that caution should be exercised when using auxin mimics at higher rates. Future work will evaluate the role of water depth as a factor in recovery of waterlily and bulrush following exposure to auxin mimics.

**Satellite Remote Sensing of Submerged Aquatic Vegetation Status and Distribution in the Currituck Sound, North Carolina *(Student Presentation)***

**Brett M. Hartis** and Stacy A. Nelson
*North Carolina State University, Raleigh, NC*

In coastal regions with extensive, non-linear water bodies, large scale submerged aquatic vegetation (SAV) surveys are rarely done due to logistical difficulties and high costs. Our study examines whether remote sensing can be used for regional monitoring of SAV in the Currituck Sound of North Carolina. Currituck Sound supported a diverse assemblage of SAV which provided food and habitat for wintering waterfowl. In the past 30 years, SAV has rapidly decreased. Our study attempts to determine if levels of SAV cover, species or growth forms could be detected using high-resolution satellite sensors, and to determine if predictions of SAV abundance and distribution can be improved by including sediment type or measures of water clarity. The Currituck sound was sampled during peak plant biomass (June –September 2010). Two Quickbird and two Worldview II images were acquired between June and September, 2010 to coincide with in-situ sampled data. The littoral zone of the Sound was mapped using a geographic information system (GIS) and overlain with points which represented survey points. Plant cover was assessed at each point for an area of 10m x 10m. A variety of variables were measured at each point (depth, salinity, sediment type, secchi depth) and plant composition was assessed by recording plant presence and plant cover. Plant cover was split into four levels 0 (0–20% plant cover), 1 (21–40% plant cover), 2 (41–80% plant cover), and 3 (81–100% plant cover). Binomial and multinomial logistic regression models were developed to examine relationships between SAV measures and spectral values. Initial results suggest that depth and sediment type play a significant role in growth of SAV within the Sound. Models have demonstrated significant correlation with Band 4 (near- IR) spectral values. Difficulty in determination of relationships has occurred due to overwhelming amounts of sun glint and cloud cover in images.

**Nuisance Aquatic Species Control: Implications for Wild Bird Health**

**Rebecca S. Haynie**[1], Robert Bahn[1], Deborah C. Harris[2], James A. Herrin[1], John R. Fischer[1], and Susan B. Wilde[1]
[1]*University of Georgia, Athens, GA*
[2]*U.S. Fish and Wildlife Service, Athens, GA*

Nuisance aquatic species, including algae, mussels, fish and macrophytes, have been implicated in increasing wild bird mortality events in aquatic systems throughout the country. Controlling nuisance aquatic species that either produce, or facilitate toxin proliferation or trophic transfer, may restrict wild avifauna exposure and therefore reduce these mortality events. Avian vacuolar myelinopathy (AVM), an often lethal disease that affects waterbirds and raptors, has been linked to a toxin-producing cyanobacterium which grows as an epiphyte primarily on nonnative submerged aquatic vegetation (SAV). Nonnative SAV control has been initiated on several confirmed AVM positive reservoirs; however, intensive monitoring had not previously been conducted. We conducted a field study in a pair of large drinking water reservoirs southeast of Atlanta in Henry County, Georgia. Both reservoirs have heavy hydrilla (*Hydrilla verticillata*) infestations but only one reservoir has an active SAV management plan. Sterile grass carp (*Ctenopharyngodon idella*) were stocked (10 fish/vegetated ha) into the treatment reservoir in Spring 2011. We monitored hydrilla biovolume (using side-scan sonar), cyanobacterium density and AVM prevalence in the reservoirs from July 2011 to December 2011. We confirmed the toxin-producing cyanobacterium was present on SAV from both reservoirs using microscopic and genetic techniques. Cyanobacterium coverage peaked in November with leaf surface coverage exceeding 70% in both reservoirs. To evaluate AVM prevalence we released sentinel birds, wing-clipped, farm raised mallards (*Anas platyrhynchos*), onto the reservoirs in mid-November. We confirmed AVM, beginning in late November and lasting until mid-December, in both reservoirs in sentinel birds via histopathologic examination of brain tissues. AVM was prevalent in both systems but prevalence was not significantly different between treatment and control reservoirs. The present level of SAV control was not sufficient to reduce sentinel bird exposure, measured by disease prevalence, to the putative toxin. Additional grass carp stocking and chemical control measures have been implemented in the treatment reservoir. The effect of these activities on hydrilla biovolume, cyanobacterium presence and density and AVM prevalence will be evaluated in Year 2 of the study. Intensive management is likely to be necessary to detect a reduction in disease prevalence in large systems with severe nuisance aquatic species infestations.

**Renovate™ (Triclopyr): A Decade of Selective Management and Continued Development**
**Mark A. Heilman**
*SePRO Corporation, Carmel, IN*

First registered in 2003, triclopyr (Renovate™) was the second auxin-mimic herbicide registered for control of aquatic vegetation and the first new active ingredient at that time after a 16-year period without a new aquatic registration. Successful efforts by industry partners, the U.S. Army Corps of Engineers Aquatic Plant Control Research Program, the U.S. EPA, and countless cooperative universities and natural resource agencies in many ways established the model upon which other more recent aquatic herbicide active ingredients have been successfully registered. A brief retrospective highlighting the success of this collaborative research, development, and registration will be provided. In the last decade, on-going collaborative partnership has led to the introduction and adoption of new formulations and use patterns for Renovate triclopyr products such as the original OTF granular formulation, combination with 2,4-D and several other old and new aquatic products, and expanded scale of management for low-dose, lake-wide, selective milfoil control. Most recently, the utilization of new basic research into triclopyr uptake and translocation patterns and extensive field monitoring of herbicide dissipation has guided development of a new generation of granular auxin formulation technology for improved spatial targeting of selective submersed weed treatments. Bridging from a brief review of past research to the latest development work, a ten-year overview of this valued selective management technology will be presented.

**How to Combat the Detrimental Effects of Eutrophication, Control Algae Blooms and Meet Water Quality Standards**
**Seva I. Iwinski**
*Applied Polymer Systems, Woodstock, GA*

Turbidity has many negative effects when entering a water body from erosion and sedimentation. Sedimentation and excess nutrient loads, including phosphorous, entering our water bodies from erosion, fertilizers, manures, crop runoff, construction activities and other land disturbing activities, cause eutrophic conditions that lead to algal blooms and surface water quality degradation. Unpleasant aesthetic effects caused by eutrophication do not compare to detrimental effects that turbid ponds, lakes, and various water bodies can have on overall water quality, aquatic organisms, and other animal populations. Such negative effects include high nutrient levels, such as phosphorous, that produce algal blooms that die and decay, in turn using up available dissolved oxygen. Fish need oxygen to survive and if oxygen is depleted fish kills can result. Fine particulates in the water column are a point of attachment for contaminants of not only nutrients but also bacteria, heavy metals, pesticides, and endocrine disruptors. Through various studies it has been found that as low as 10-100 NTU's aquatic organism will begin to show signs of stress. This happens through decreased light, food and oxygen, mechanical effects, and temperature increases due to darker water. Using water soluble polymer technologies to enhance current Best Management Practices (BMPs) we are able to greatly reduce sediment and nutrients from leaving a site as well as reduce the amount of sediment and or nutrients in a given water body. Water treatment versions of PAM in the anionic form have shown very low to no aquatic toxicity potential to the environment. Through various research and tests using polymer enhancement in conjunction with known BMPs, a 70-95% reduction in phosphorous has been found as well as a 95% reduction in NTU's. Therefore Polymer Enhanced Best Management Practices (PEBMP's) including water clarification systems to reduce turbidity from a water column and soil stabilization used to control sedimentation at the source so that it is not transported into our waters will be discussed and illustrated. These include: soil stabilization including polymer enhanced soft armoring systems, de-watering systems, pond and lake clarification including nutrient reductions, de-mucking, and Sediment Retention Barriers (SRBs).

**Deep Water Mechanical Harvesting of Hydrilla in West Lake Tohopekaliga, Florida**
**Dean Jones**[1], William T. Haller[2], and Mike Hulon[3]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Lake Alfred, FL*
[2]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[3]*Texas Aquatic Harvesting, Incorporated, Lake Wales, FL*

The last major study of mechanical harvesting of hydrilla (*Hydrilla verticillata*) in Florida was conducted by the U.S. Army Corps of Engineers in Orange Lake in the mid-1970s. Development of large capacity harvesters

capable of harvesting in much deeper water and improved GPS technology make it feasible to harvest hydrilla in up to 3 m of water in early spring before the weeds are visible from the surface. A 40 ha plot containing hydrilla that was approximately 2 m tall was harvested in water 3 m deep in February, 2012. Water quality measurements before, during and at various times after harvesting showed only temporal (<12 hrs) elevated turbidity and no changes in other water quality parameters were noted. Fish by-catch was determined on 4, 150-300 kg hydrilla samples taken from the harvester. The by-catch, consisting of primarily juvenile sunfish (70%) was 299 fish/ha, compared to the Orange Lake study where surface matted hydrilla harvested in late summer (1976) captured 66,000 fish/ha. The harvester removed hydrilla at a rate of between 1.0 and 1.5 ha/hour. The factors which contributed to the low fish by-catch and much greater harvester efficiency of the Lake Tohopekaliga project will be discussed and compared to the conditions in the 1976 Orange Lake study.

**Hybrid Watermilfoils Exhibit Reduced Sensitivity to 2,4-D in Comparison to Parental Eurasian Watermilfoil in a Laboratory Assay Experiment *(Student Presentation)***

**Elizabeth A. LaRue**[1], Matthew P. Zuellig[2], Michael D. Netherland[3], Mark A. Heilman[4], and Ryan A. Thum[1]
[1]*Grand Valley State University, Muskegon, MI*
[2]*University of Georgia, Athens, GA*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*
[4]*SePro Corporation, Carmel, IN*

Several lake managers have noted a reduced herbicide response by some hybrid watermilfoil populations (*Myriophyllum spicatum* x *M. sibiricum*) in comparison to what was typically observed for pure Eurasian watermilfoil. However, it is unclear whether these observations represent bona fide reduced sensitivity or environmental factors impacting efficacy. If hybrids do exhibit reduced sensitivity, it is unclear whether it is isolated to certain, specific genotypes, or whether hybrids – as a group – tend to exhibit reduced sensitivities. In two experiments, we tested the relative sensitivities of Eurasian and hybrid watermilfoil genotypes to the commonly-used, systemic herbicide, 2,4-Dichlorophenoxyacetic acid (2,4-D). In total, we assayed 13 different Eurasian and 12 different hybrid watermilfoil populations. Hybrid watermilfoil genotypes were genetically diverse and represented several independent hybridization events. In both experiments, hybrids were significantly less sensitive to 2,4-D over the range of test concentrations (up to 500 mg $L^{-1}$), as demonstrated by their higher mean growth gains over the experiment (length and mass). Reduced sensitivity was consistent across hybrid populations, and was not isolated to one or a few genotypes. Our assay concentrations were lower than the label rate for 2,4-D. However, recent monitoring data suggest that populations may frequently experience 2,4-D concentrations within the range tested in our study. Therefore, hybrid watermilfoils may exhibit reduced efficacy in the field where the actual 2,4-D exposure is within the range tested in our experiments. Furthermore, because 2,4-D is often applied as a spot treatment within a waterbody, hybrid watermilfoils occurring in areas peripheral to treatment areas may have a competitive advantage in recolonizing treated areas following dissipation of the herbicide. This may lead to the replacement of parental Eurasian watermilfoil genotypes by hybrids, which is consistent with previous findings that hybrid watermilfoils occur more frequently in 2,4-D treated lakes compared to parental watermilfoils. Given the enormous potential implications for herbicide permitting and developing best management practices for hybrid watermilfoils, we recommend detailed field monitoring of 2,4-D applications (concentrations and exposures) and watermilfoil response on a sufficient number of lakes to determine the range of field conditions where hybrids are predicted to exhibit reduced efficacy.

**Guidance to Aquatic Plant Managers on Quantitative Methods to Monitor and Assess Nuisance Plants *(Alternate Presentation)***

**John D. Madsen** and Ryan M. Wersal
*Mississippi State University, Mississippi State, MS*

One of the requirements included in the federal NPDES pesticide general permit is for quantitative assessments of nuisance plant coverage to document that they exceed a nuisance threshold, and the use of quantitative methods to assess the effectiveness of management activities. In a white paper we are developing for the Aquatic Ecosystem Restoration Foundation, we are developing suggested methods and guidelines for assessing aquatic plants, as well as pointing out methods that are not effective for this purpose. Our guidelines will cover submersed, floating, and emergent plant species for lakes and flowing waters, as well as nuisance planktonic and periphytic algae. For

submersed plants, point intercept sampling consistently provides useful data on distribution and species composition. Since aerial and satellite remote sensing tend to underestimate plant distribution, hydroacoustic methods are recommended instead. For floating and emergent data, point and line intercept methods both provide beneficial data on species composition and distribution, while aerial or satellite data provide accurate mapping and total plant distribution information. Phytoplankton abundance can be accurately measured with portable fluorescence meters, determining Chlorophyll a concentrations in the water. Species composition of algae is somewhat more complex, but either differential spectrophotometry or microscopic enumeration can be employed. With some species, measuring toxic byproducts might be required. For periphytic algae, relatively little work has been done, but some techniques that are used for submersed plants can also be used for these species. Our goal is to equip natural resource managers and permit holders with the tools and justifications to address these requirements.

**Diagnosis of a Nuisance Aquatic Plant Problem on Lake Havasu, Arizona**
**John D. Madsen**, Ryan M. Wersal, Amanda L. Fernandez, and Gray Turnage
*Mississippi State University, Mississippi State, MS*

Lake Havasu, formed by a dam on the Colorado River, straddles the border of Arizona and California. Lake Havasu is a popular destination for power boating, fishing, and wildlife enthusiasts. Water from Lake Havasu is also used for the Central Arizona Project (CAP), which delivers water across central and southern Arizona. The Mark Wilmer pumping station, which hoists the water to the CAP, has had increasing problems with plants blocking the water intake structure over the past five years. We undertook studies of the distribution, diversity, and biomass of aquatic plants in this 20,400 acre reservoir. Submersed aquatic plants are found to a depth of 30 feet, with rooted plants founds to 27 feet. Plants were found rooted in water depths of up to 30 feet. Of the littoral points surveyed, approximately 51% were vegetated which represents 21% of the entire lake bottom. The most common plants in our September survey were spiny naiad (*Najas marina*, 27% of littoral points), followed by the macroalga chara (Chara sp., 13%), sago pondweed (*Stuckenia pectinata*, 9%), and southern naiad (*Najas guadalupensis*, 8%). The invasive submersed plants Eurasian watermilfoil (*Myriophyllum spicatum*, 3%) and curlyleaf pondweed (*Potamogeton crispus*, less than 1%) were also observed in the lake. Biomass production at four sites in the lake indicated a maximum biomass of 60 gDW/$m^2$ (that is, grams dry weight per square meter) for sago pondweed, 100 gDW/$m^2$ for southern naiad, and 70 gDW/$m^2$ for spiny naiad. Drift of dead plant mats were the major source of nuisance problems.

**Products Available for Use in Irrigation Canals**
**Hugh McEachen** (Retired)
*Columbia Basin Project, Pasco, WA*

Chemical weed control in irrigation systems of the western 17 United States presents challenges that are not found in classic lake and pond situations. The most significant factor is that the water is flowing. Herbicide contact with the target vegetation is limited to the period of application and subsequent transit of the chemical down gradient. Treated water is applied directly to agricultural crops, and must not impact plant physiology or marketability. Throw in endangered species, NPDES permitting, and other requirements for licensing, analysis, and reporting, and it becomes a full time job!

**Clipper Herbicide: A Review of Aquatic Herbicide Research Trials in California *(Alternate Presentation)***
**Thomas J. McNabb**[1], Thomas Moorhouse[2], Todd Mayhew[3]
[1]*Clean Lakes, Incorporated, Coeur d'Alene, ID*
[2]*Clean Lakes, Incorporated, Kissimmee, FL*
[3]*Valent Professional Products, Gilbert, AZ*

Over the years, few new active ingredients for vegetation management have been introduced in the aquatics market. Due to the recent increase in reports of herbicide resistant vegetation, aquatic applicators are looking for alternative vegetation control options and classes of chemistry/modes of action. Clipper Aquatic Herbicide, containing the active ingredient Flumioxazin, is a new product that was developed by Valent Corporation for use in aquatics. Clipper has shown to be a valuable tool to manage weeds in water bodies and provides options to control

several aggressive weeds such as hydrilla (*Hydrilla verticillata*), cabomba (*Cabomba caroliniana*), watermeal (*Wolffia* sp.), duckweed (*Lemna* sp.), water lettuce (*Pistia stratiotes*), giant salvinia (*Salvinia molesta*) and others. Experimental Use Permit (EUP) trials were established in 2007, 2008 and 2009 at several locations in the U.S. to evaluate the potential use of Clipper as an aquatic herbicide. In 2011, Clean Lakes, Inc. was issued a Pesticide Research Authorization by the California Department of Pesticide Registration to carry out efficacy trials on nuisance aquatic plants in various locations around the state. Data obtained from these trials confirmed Clipper is an effective management option for controlling aquatic vegetation and will be used to register Clipper in California.

**Integrating Submerged Aquatic Vegetation Mapping with Aquatic Herbicide Treatments, Lake Tohopekaliga, Florida**

**Thomas J. McNabb**
*Clean Lakes, Incorporated, Kissimmee, FL*

Lake Toho provides an example of the complexity associated with large-scale invasive hydrilla management in a multiple-use resource. This 19,000-acre impoundment in Osceola County, Florida serves a variety of uses and functions. It is a Federal Navigation and Flood Control project; it is an important recreational resource including a world renowned large-mouth bass fishery and ecotourism destination; it is home to a significant population of endangered Everglades snail kites; and additionally, it supports recreational boating and water fowl hunting. Hydrilla once covered as much as 15,000 acres of Lake Toho, with profound negative impacts on all of these uses. Hydrilla must be routinely managed on a large scale to prevent economic and environmental impairment (University of Florida website). In support of Evaluating Operational Tools and Strategies for Large Scale Hydrilla Management, Submerged Aquatic Vegetation (SAV) data was collected pre and post treatment at 30, 60, 90, 120, and 150 DAT, to support the evaluation of tools and strategies to determine the extent of hydrilla pre and post treatment, as well as to support efficacy evaluations. The data generated will be presented.

**Competition of Monoecious Hydrilla with Other Submersed Macrophytes *(Student Presentation)***

**Sarah T. Meadows** and Robert J. Richardson
*North Carolina State University, Raleigh, NC*

In order to assess the potential of monoecious hydrilla to invade existing aquatic plant communities, monoecious hydrilla was grown in competition with four submersed plant species: Eurasian watermilfoil (*Myriophyllum spicatum* L.; invasive), curly leaf pondweed (*Potamogeton crispus* L.; invasive), *Elodea canadensis* Michx. (native), and *Vallisneria americana* Michx. (native). Initial plant establishment occurred in fall 2010 in a glasshouse; plants were then moved to outdoor mesocosms, and the trial was initiated in March 2011. Competition treatments included all tested plant species alone, at two different densities, and in combination with sprouted monoecious hydrilla tubers, at two different introduction timings. Treatments were replicated three times and completely randomized. Stem lengths of the longest shoot of each plant were measured initially, and biweekly for 20 weeks. At the termination of the experiment, all plant biomass was separated by species and harvested, separating root mass from shoot mass for dry weight determination. Vegetative reproductive structures were counted when present, and fresh weight was taken. While the introduction of monoecious hydrilla at both timings lowered the shoot biomass dry weight for all plant species, the decrease was only significant for the early introduction of hydrilla with Elodea, curly leaf pondweed, and Vallisneria; not for Eurasian watermilfoil and not the late introduction of hydrilla. Hydrilla introduction had no effect on root biomass dry weight at either timing. Plant density had no effect on biomass dry weight for all naturalized species, with or without monoecious hydrilla. Elodea, at both densities, significantly hindered monoecious hydrilla shoot biomass for the late introduction only. No other plant tested, at either density, had an effect on hydrilla biomass at either introduction timing. This research illustrates what effects previous establishment of these four species may have on hindering monoecious hydrilla colonization.

**Monoecious Hydrilla Phenology on Two North Carolina Lakes *(Student Presentation)***
**Sarah T. Meadows** and Robert J. Richardson
*North Carolina State University, Raleigh, NC*

Monitoring stations were established in April 2010 to determine monoecious hydrilla growth and life stage as correlated to water temperature and light intensity. Five spatially separated locations were established on Lake Gaston, NC and VA to enable sampling across a gradient of conditions. Another study location as established on Lake Raleigh, North Carolina. All six locations were selected to avoid herbicide applications for hydrilla management. At Lake Gaston, fenced exclosures were built at the sample points, to allow hydrilla to mature without herbivory from grass carp. No grass carp have been historically stocked in Lake Raleigh; therefore, an exclosure was not necessary. Temperature and light pendant data loggers were placed at each location to record water temperature and light intensity values every six hours throughout the year. All sites were monitored biweekly from April 2010 until late fall 2010, after hydrilla senesced. Data collected included hydrilla life stage, hydrilla turion density, and hydrilla shoot length. Soil cores were collected and sifted to determine the number of tubers and turions. In addition, tuber or turion sprouting was noted and length of sprout was measured. Stations were reestablished at the same points in 2011, and monitoring continued until late fall 2011. On Lake Raleigh, monoecious hydrilla tubers were found sprouting from March through July, with mean water temperature 28.2ºC for sprouting. Newly formed tubers were found in September through mid-October in 2010, at mean water temperature 23.4ºC, and no newly formed tubers were found in 2011. On Lake Gaston, at the westernmost study location, monoecious hydrilla tubers were found sprouting from April through July, with mean water temperature 20.8 ºC. Newly formed tubers were found in mid-August through October, at mean water temperature 25.4ºC. This study will enable the generation of a 'story' of the monoecious hydrilla life cycle throughout the year. A predictive model will be generated to allow lake managers to better time management practices to the hydrilla life cycle based on environmental conditions. This information will be crucial in creating monoecious hydrilla management plans in North Carolina and elsewhere.

**An Update on Flowering Rush Control Demonstration Projects for Infestations Spanning Watersheds between the Pacific Northwest and Great Lakes States**
**Thomas Moorhouse**[1], Thomas McNabb[2], Peter Rice[3], Virgil Dupuis[4], Alvin Mitchell[4], Jenifer Parsons[5], Thomas Woolf[6], and John D. Madsen[7]
[1]*Clean Lakes, Incorporated, Coeur d'Alene, ID*
[2]*Clean Lakes, Incorporated, Kissimmee, FL*
[3]*University of Montana, Missoula, MT*
[4]*Salish Kootenai College, Pablo, MT*
[5]*Washington Department of Ecology, Yakima, WA*
[6]*Idaho Department of Agriculture, Hayden, ID*
[7]*Mississippi State University, Mississippi State, MS*

Flowering rush (*Butomus umbellatus*) is now present and expanding in the majority of North American states between the Pacific Northwest and the New England states, as well as many Canadian provinces. An update will review herbicide control research and development projects that have been completed or are in progress in Washington, Idaho, Montana and Wisconsin.

**A Review of a Mechanical Control Project for Emergent Aquatic Vegetation Control in Coastal Southern California**
**Thomas Moorhouse**
*Clean Lakes, Incorporated, Coeur d'Alene, ID*

Bulrush (*Schoeneoplectus californicus*) and cattail (*Typha domingensis*) can develop into nuisance populations in southern California causing impacts to water flow and conveyance, increased mosquito breeding habitat, and causing the loss of open water area. Clean Lakes, Inc. implemented a mechanical and manual control project on the 29-acre shallow brackish water lagoon at the Andree Clark Bird Refuge (City of Santa Barbara) utilizing a Tiger Cut (cookie cutter), harvester, trailer conveyor and other supporting equipment. The presence of the federally endangered Tidewater Goby (*Eucyclogobius newberryi*) and the state species of special concern, Southwestern

Pond Turtle (*Emysmarmorata pallida*), as well as other wildlife species had to be considered during the project. A review of the permits, regulations, and operations will be discussed.

**Investigating the Potential Role of Cyanobacteria in Intersex in Fish *(Student Presentation)***
**Jamie R. Morgan**, James A. Herrin, Rebecca S. Haynie, Kristen Kellock, Susan B. Wilde, and Robert Bringolf
*University of Georgia, Athens, GA*

Early-life exposure of male fish to estrogens such as natural and synthetic hormones in treated municipal wastewater is known to cause endocrine disruption, including intersex (oocytes in testicular tissue). Pilot studies conducted by our lab indicated that intersex bass (*Micropterus* sp.) are also found at a high rate in small impoundments and ponds that do not receive wastewater and have no other known source of estrogens. Recent studies suggested that the cyanobacterium (*Microcystis aeruginosa*) may produce estrogenic compounds. Cyanobacteria blooms are common in eutrophic ponds. Therefore our goal was to determine if compounds produced during these bloom events exert an estrogenic effect on fish. In a laboratory trial, we exposed juvenile fathead minnows (*Pimephales promelas*) to live and dead *M. aeruginosa*, *Selenastrum* sp. and *Anabaena flos-aquae* cells. Fish exposed to both live and dead *M. aeruginosa* were stimulated to produce vitellogenin, a protein biomarker of estrogen exposure. Vitellogenin production in fish exposed to *M. aeruginosa* was significantly different than responses measured in both *Selenastrum* sp. and *Anabaena flos-aquae*. We then measured vitellogenin in juvenile and adult male fathead minnows exposed to a range of *M. aeruginosa* concentrations to determine if a dose-response relationship existed. Our work indicates that environmentally relevant concentrations of *M. aeruginosa* will cause an estrogenic response in fish. This evidence may explain, in part, the elevated intersex levels measured in fish from small impoundments and ponds.

**Control of Water Lettuce and Water Hyacinth Using Low Doses of Imazamox and Penoxsulam Plus Contact Herbicides or Surfactants**
**Christopher R. Mudge**[1] and Michael D. Netherland[2]
[1]*U.S. Army Engineer Research and Development Center, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Water hyacinth (*Eichhornia crassipes* (Mart.) Solms) and water lettuce (*Pistia stratiotes* L.) are widespread problems in waterways throughout southern U.S. states. In many aquatic systems these floating plants can become established throughout emergent native plant beds, and left unmanaged can negatively impact native vegetation through competition or physical disruption. There are several aquatic herbicides that are efficacious against these floating invasive plants; however, the two most widely used products, 2,4-D and diquat, can be relatively non-selective when controlling water hyacinth and water lettuce especially when these plants are intermixed in stands of bulrush (Schoenoplectus spp.). The recently registered acetolactate synthase (ALS) inhibiting herbicides imazamox and penoxsulam are also efficacious against both invasive floating species at very low use rates (g a.i. ha-1) and have shown potential for providing selective control of non-target emergent species at low foliar use rates. Despite the high level of efficacy and selectivity, the development of visual injury symptoms can take an extended period of time. While the proposed low use rates may allow for cost-effective and selective control of floating plants, adoption of ALS herbicides for operational control of floating plants would be facilitated if visual injury symptoms on the floating plants were more rapid and pronounced. The addition of contact herbicides or surfactants to slow acting, systemic herbicides in a tank mix may increase the speed and/or efficacy of the herbicide treatment. Therefore, a mesocosm trial was conducted to determine if the addition of a low dose contact herbicide (carfentrazone-ethyl, endothall, or flumioxazin) or two surfactants (non-ionic + buffering agent and non-ionic organosilicone) could improve the speed and effectiveness of a low dose of imazamox or penoxsulam plus one surfactant for control of water hyacinth or water lettuce. All individual or combination imazamox and penoxsulam treatments reduced water hyacinth dry weight 30 to 100% compared to the non-treated control 8 wk after treatment (WAT). In terms of efficacy, there was no benefit to tank mixing a low dose of carfentrazone-ethyl, flumioxazin, or surfactant combination to imazamox or adding the surfactant combination to penoxsulam. However, the addition of a second herbicide was beneficial for penoxsulam efficacy compared to imazamox. The combination of endothall and the ALS herbicides were the most effective treatments, as these treatments completely eliminated plant biomass 4 to 5 WAT. Six of the ten individual or combination herbicide treatments evaluated against water lettuce were not efficacious. Although treated water lettuce plants exhibited chlorosis and

necrosis on the leaves by 1 WAT, regrowth was noted in all tanks by 2 or 3 WAT. The addition of carfentrazone-ethyl or flumioxazin to imazamox and penoxsulam resulted in 63 to 72% control. Despite the limited control, injury symptoms were more visibly noticeable and intense on water hyacinth and water lettuce 1 WAT when carfentrazone-ethyl, endothall, flumioxazin, or combination of surfactants were added to the spray solution compared to the ALS herbicides applied with one surfactant. Future studies will evaluate higher foliar rates of all products (alone and combination) as well as evaluate other tank mix partners. In addition, the impact of these combinations will be evaluated against non-target emergent aquatic plants.

**Assessment of a New Hydroacoustic Habitat Mapping System for Quantitative Identification of Aquatic Macrophytes and Substrate Composition, and Bathymetric Surveying in Freshwater Lakes**
**Eric Munday**, Jannusz Burcyznski, and Brian Moore
*BioSonics, Incorporated, Seattle, WA*

A hydroacoustic system designed specifically for the rapid assessment and mapping of aquatic habitat features including submerged macrophytes and various substrate types (sand, cobble, mud, etc.) has recently been developed and successfully tested in a fresh water environment by BioSonics, Inc. The system was used to map the cover and height of Eurasian watermilfoil (*Myriophyllum spicatum*) along with substrate composition, and bathymetry. This paper reports a test in Lake Washington, Seattle, WA, using a 200 kHz single beam echosounder (BioSonics MX) and post-processing analysis and mapping using unique software (BioSonics Visual Habitat). Hydroacoustic assessment of milfoil coverage, bathymetry and substrate composition showed high agreement with those recorded during a simultaneous survey using BioSonics DT-X scientific echosounder. Data collected using the MX echosounder system was processed using Visual Habitat software while data from the DT-X system were processed using BioSonics EcoSAV and VBT software. The use of Visual Habitat resulted in a 48% reduction in effort as compared to processing with EcoSAV and VBT to generate similar output files. In addition to the significant reduction in effort, the MX system with Visual Habitat provided data visualization tools in the form of a transect map view displaying user-defined color gradients for each data layer. Visual Habitat also provides the optional to export results in KML file format for viewing results in Google Earth.

**Evaluation of Enhanced Data Processing and Cloud Data Hosting of SONAR Based Surveys *(Student Presentation)***
**Justin J. Nawrocki**, Sarah T. Meadows, Robert J. Richardson, and Steve T. Hoyle
*North Carolina State University, Raleigh, NC*

A cornerstone of integrated aquatic plant management is an accurate survey to assess the location and abundance of weedy species as well as desirable plant species. Survey protocols historically focused on point intercept or diver based surveys, which may be time consuming and thus limit the number of points that can be surveyed on large systems. Aerial imagery is also used but estimating submersed plant acreages can be difficult especially in murky water or if the plants are low growing in the water column. Recently a new survey method has evolved out of an inexpensive depth finder (Lowrance ™). This unit was used by North Carolina State University to map aquatic vegetation on two lakes, Thaggards Lake (80 ha) and Kerr Lake (20,200 ha). A complete survey of the littoral zone of each lake was performed in the fall of 2011. The unit continuously recorded depth data at a rate of roughly one point per second. The effective area of coverage from the transducer is dependent on the water depth however the beam angle from the transducer is 20°. The data was then transferred for post-processing to a private company [Contour Innovations (CI), LLC] which was able to output variables such as water volume calculations, bathometric maps, vegetation bio-volume heat maps, and vegetation bio-volume statistical analysis. This data was calculated using custom algorithms and is centrally processed and stored providing “cloud” access. Data is continuously available on a web based platform that allows users to compile and catalog multiple survey trips. This is useful for tracking changes in vegetation over time or changes that result from active management. The true utility of a system like this is the ability to collect large amounts of data passively from either single outings or multiple outings over time. Water resource managers can install this equipment and collect vegetation data on every outing without deviating from their true purpose to be out on the lake.

**Triploid Grass Carp Feeding Preferences for Two Novel Invasive Aquatic Plants *(Student Presentation)***
**Michael T. Neisch[1], Michael Masser[1], and Daniel Roelke[2]**
*[1]Texas A&M University / Texas AgriLife Extension Service, College Station, TX*
*[2]Texas A&M University, College Station, TX*

Giant salvinia (*Salvinia molesta*) and hygrophila (*Hygrophila polysperma*) are both invasive, introduced macrophytes that have quickly become established in Texas waters. First identified in Texas in 1998 near Houston, giant salvinia is now found in Lake Conroe, Toledo Bend Reservoir, Caddo Lake, and at least eight other public Texas impoundments. Listed as one of the most problematic aquatic plants by the state, giant salvinia is a floating fern capable of doubling its spatial occupation in a week. It can displace native aquatic plants that provide food and habitat for invertebrates and fish and produces a floating mat that blocks sunlight and reduces dissolved oxygen concentrations to dangerously low levels. Hygrophila is a fast growing and spreading submerged macrophyte capable of occupying the entire water column and outcompeting native species. It was first documented in the San Marcos River in the 1960's, and has spread to many drainages and impoundments throughout the state, including Caddo Lake. This research evaluated the potential use of triploid grass carp (*Ctenopharyngodon idella*) as a biological control agent for these two novel invasive species. Using a controlled mesocosm experiment, maximum consumption rates and feeding preferences were measured. Giant salvinia and hygrophila were compared to six native and introduced species common in Texas and the Southern US.

**Factors That Influence Rapid Expansion of Hydrilla and the Implications for Management**
**Michael D. Netherland**
*U.S. Army Engineer Research and Development Center, Gainesville, FL*

The ability of hydrilla (*Hydrilla verticillata* L.f. Royle) to spread and cover hundreds to thousands of contiguous acres of formerly open water in Florida lakes and southern reservoirs is generally unique to this plant and has been attributed to rapid growth rates and various physiological adaptations. It is not uncommon for resource managers to report a sudden emergence of dense stands of hydrilla in between routine survey events. As vegetative biomass can remain substantial throughout the year in Florida waters, we evaluated growth rates of hydrilla under various mesocosm conditions at different times of the year to improve our understanding of seasonal growth patterns. Results showed that hydrilla fragments can establish and grow at any time of year in North Central Florida, yet studies initiated in mid-June resulted in a 7.9 fold increase in shoot biomass and 8.6 fold increase in shoot extension over a 35 day period when compared to studies initiated in late April. This discrepancy in the rates of growth was unexpected given the minimal differences in water temperatures observed between these trials (26.8 + 1.8 C vs. 29.2 + 0.9 C). It is important to note the hydrilla grew quite well in the studies initiated in April/May, yet the growth rates in June/July were exceptional. This difference in growth may help to explain the sudden appearance of dense clumps of hydrilla described by many resource managers, and it demonstrates the challenges associated with trying to predict potential hydrilla coverage based on an early spring assessment. There has not been much historical effort to link hydrilla growth rates to management, but the current results may help to explain why spot or small-scale herbicide treatments initiated in the fall through early spring tend to be so much more effective than management efforts initiated in the summer. In essence, the lack of observed control following a summer application may be better explained by the rate of plant recovery than in a failure to reduce initial biomass. There are numerous field observations to support this supposition. Field data and observations on hydrilla growth from Lake Tohopekaliga, Lake Harris, and Sandmine Lake, FL will be discussed in relation to the growth rate studies described above.

**Absorption and Translocation of Granular and Liquid Triclopyr Formulations by Eurasian Watermilfoil**
**Scott J. Nissen[1]**, Joseph D. Vassios[2], Tyler J. Koschnick[3], and Mark A. Heilman[3]
*[1]Colorado State University, Fort Collins, CO*
*[2]United Phosphorus, Incorporated, Sacramento, CA*
*[3]SePRO Corporation, Carmel, IN*

Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM) is a submersed, invasive species that occurs across much of the United States. One of the more common control strategies for EWM is the use of systemic herbicides like triclopyr (Renovate®). Ongoing research has focused on evaluating triclopyr absorption and translocation in EWM

using $^{14}$C-triclopyr. Rooted plants were treated with 1 ppm triclopyr plus radiolabeled herbicide and triclopyr absorption and shoot to root translocation were determined. Additional experiments evaluated translocation from roots to shoots following root exposure. For both studies, plants were harvested over a 192-hour time course. EWM absorbed more triclopyr than would have been predicted based on parameters like log Kow; however, translocation to roots following shoot exposure was limited to only 2.6% of the absorbed herbicide. Triclopyr absorption by EWM roots was low, but there was accumulation 1.6 times the external concentration. Approximately 25% of absorbed triclopyr translocated to shoots 192 HAT. This information provided the bases for evaluating triclopyr absorption and translocation following a granular triclopyr application. Granules were formulated with cold and radiolabeled triclopyr in a manner similar to Renovate OTF and applied to large, well-established, multi-stemmed EWM plants in 11 L cylindrical tanks. There was no significant difference in foliar accumulation between the two formulations; however, the amount of radiolabel accumulating in plant roots increased 6-fold with the granular formulation. For long-term control or for applications in areas with high water exchange, increasing root accumulation could improve control.

**Sago Pondweed Control in Irrigation Canals Using Endothall and Chelated Copper: Comparing Greenhouse and Field Results**

**Scott J. Nissen**[1], Joseph D. Vassios[2], William Ratajczyk[3], and Brian Lind[4]
[1]*Colorado State University, Fort Collins, CO*
[2]*United Phosphorus, Incorporated, Sacramento, CA*
[3]*Applied Biochemists, Germantown, WI*
[4]*Applied Biochemists, Scottsbluff, NE*

Sago pondweed (*Stuckenia pectinata*) is a native species and is generally considered desirable, except when it infests irrigation canals. It thrives in flowing water, reducing efficient water delivery in irrigation canals. Two herbicides commonly used for sago pondweed management are endothall (Cascade®, UPI) and chelated copper formulations. There are some indications from previous research that these herbicides can interact synergistically. The goal of this research was to evaluate sago pondweed control using combinations of endothall and chelated copper under greenhouse conditions. These results were then used to guide two field applications. For greenhouse studies, a single tuber was planted in a 3-inch diameter pot and grown for 14 days prior to herbicide treatment. Herbicide treatments included endothall (1 and 2 ppm), ethanolamine chelated copper (Cutrine Ultra) (0.75 and 1 ppm), ethanolamine chelated copper (Clearigate) (0.5 and 1 ppm), and combination treatments. Herbicide exposure times were 4, 8, and 12 hours. Reductions in sago biomass indicated that 1 ppm endothall + 0.5 ppm Clearigate resulted in the greatest control at all exposure times. Based on these results the first field site was treated with 0.75 ppm Clearigate + 1 ppm Cascade for 6 hours, which did not result in commercially acceptable control. Adjustments were made and the second field site was treated with 0.5 ppm Clearigate + 1 ppm Cascade with a bump treatment of 0.25 ppm Clearigate for 8 hours. Excellent sago pondweed control was achieved with this combination. Sago pondweed biomass was reduced by 90% 21 DAT.

**Twin Falls Canal Company Aquatic Weed and Algae Management**

**Brian Olmstead**
*Twin Falls Canal Company, Twin Falls, ID*

Twin Falls Canal Company (TFCC) first diverted water for irrigation from the Snake River in 1905. We currently deliver irrigation water to 202,000 acres of farmland through over 200 miles of main canals and 1200 miles of feeder laterals. This presentation will cover both historic and current aquatic weed and algae control methods used by Twin Falls Canal Company. Discussion will focus on the evolution from historic practices to modern procedures both in mechanical and chemical weed and algae control. In 2008, after receiving an EPA Section 18 Exemption, TFCC was the first Canal Company in the United States to make a large scale application of endothall to an irrigation canal. That successful application will be described in regards to how it has changed the operation of the TFCC system.

**Evaluations and Results from the First Year Field Use of Flumioxazin (Clipper Herbicide)**
**James F. Petta**
*Valent Professional Products, Corpus Christi, TX*

Clipper Herbicide (flumioxazin) received a U.S. EPA registration in November, 2010, followed by most state registrations within a few months. Since the registration, there have been numerous applications in aquatic field sites in various states across the U.S. Some of these applications involved testing under State protocols to meet the local registration requirements. These various field applications generated information on the use of flumioxazin in waters for the management programs of *Hydrilla verticillata*, *Cabomba caroliniana*, *Pistia stratiotes*, *Wolffia* spp., *Lemna* spp., *Hygrophila polysperma*, and others. In addition, field applications against such regional invasive species such as *Limnophila sessiliflora* have demonstrated highly promising results in controlling this species. Herbicide concentrations of 100-200 ppb flumioxazin were highly effective in controlling the target species with minimal impacts to non-target plants. This paper will attempt to summarize the results from public and private applications with levels of control as well as any observed non-target impacts.

**Effects of Aquatic Weeds Biomass Soil Incorporation on Chemical Proprieties of a Degraded Soil**
**Robinson L. Pitelli**[1], Monicke O. Vieira[2], and Robinson A. Pitelli[3]
[1]*Ecosafe Agriculture and Environmental Sciences, Jaboticabal, Brazil*
[2]*Light Energy, Pirai, Brazil*
[3]*University of State of São Paulo, Jaboticabal, Brazil*

Aiming to evaluate the changes of a degraded soil features by the incorporations of different aquatic weeds, a trial was carried in a factorial design with two biomass doses (20 and 40 t/ha of dry biomass) and ten macrophyte species (*Brachiaria subquadripara*, *Echinochloa polystachya*, *Eichhornia azurea*, *Eichhornia crassipes*, *Hymenachne amplexicaulis*, *Pistia stratiotes*, *Polygonum lapathifolium*, *Sagittaria montevidensis*, *Salvinia herzogii*, and *Typha latifolia*) and a control treatment without biomass incorporation. The plants were collected in Santana Reservoir, Rio de Janeiro State, dried and grounded before the soil incorporation. The incubation period was 30 days; the soil was maintained at 50-70% of field capacity, the temperature at 25±1ºC and the photoperiod 12 hours. The soil incorporation of the aquatic weeds improved the moisture retention and the soil heterotrophic activity. The increase of heterotrophic activity was more pronounced in marginal weeds, probably due to some sediments residues that could be sources of microbial inoculum. All the degraded soil chemical features were affected by the aquatic weeds incorporation, but the interaction with the doses was significant. The content of organic matter, K, P, Ca, Mg, Cu, Fe, Mn, Zn, Pb and soil pH, cation exchange capacity and base saturation were positively affected by the aquatic weeds incorporation, but the soil potential acidity was reduced. In general, the species that presented the most influence on soil chemical features were *P. stratiotes* and *S. montevidensis*.

**Considering Monoecious Hydrilla Subterranean Turion Biology in Management Programs**
**Robert J. Richardson**
*North Carolina State University, Raleigh, NC*

Subterranean turions (tubers) are a key challenge to long term monoecious hydrilla management. Tuber densities in situ may exceed 3,000 per square meter on individual sites. These tubers can remain viable for at least five years during intensive and successful management operations. Recent research has indicated that monoecious tubers have preformed axillary buds and can resprout following clipping of the terminal shoot after sprouting. Recently sprouted tubers may survive and elongate for at least 56 days in the complete absence of light. Young shoots can also withstand short term exposure to high salinity and long term exposure to low salinity levels. Management programs must overcome these biological challenges in order to reduce hydrilla infestation levels to low densities, or more rarely, eradicate monoecious hydrilla from a water body. Triploid grass carp have been an effective long term management tool for monoecious hydrilla in North Carolina. Triploid grass carp can live for over 15 years in Piedmont Reservoirs and have eradicated hydrilla from small lakes. Fluridone herbicide has been documented to reduce hydrilla tuber densities over time on sites where adequate concentrations can be maintained. Contact herbicides can also eliminate monoecious hydrilla biomass, but application timing must prevent new tuber formation. Other management options are available, but typically have greater limitations for long term monoecious population reductions.

**Evidence for Novel Routes of Exposure to the Biotoxin Linked to Avian Vacuolar Myelinopathy (AVM)** ***(Student Presentation)***

**Shelley M. Robertson**, Rebecca S. Haynie, and Susan B. Wilde
*University of Georgia, Athens, GA*

Avian Vacuolar Myelinopathy (AVM) is a neurologic disease that causes regular avian mortality events, particularly in bald eagles (*Haliaeetus leucocephalus*) and American coots (*Fulica americana*), at reservoirs in the southeastern United States. Since 1994, there have been over 150 bald eagle and thousands of American coot mortalities attributed to AVM, and the disease has been identified in several other wild birds species. Previous studies link AVM to an uncharacterized biotoxin that can transfer up the food chain: waterbirds that consume submerged aquatic vegetation (SAV) and a certain species of epiphytic cyanobacterium develop AVM and pass the toxin to their avian predators. This previously undescribed cyanobacterium (UCB) is in the Order Stigonematales and grows epiphytically on SAV in all reservoirs where AVM deaths have occurred. The UCB was recently identified growing abundantly on SAV in Lake Tohopekaliga (Lake Toho) in central Florida. Lake Toho supports a breeding population of a critically endangered raptor, the Florida snail kite (*Rostrhamus sociabilis*), and a dense infestation of an exotic herbivorous aquatic snail, the island apple snail (*Pomacea insularum*), a primary source of food for the resident snail kites. This study investigated the potential for AVM transmission in a new food chain: from apple snails fed SAV-UCB material to the Florida snail kite. In a 14-day laboratory feeding study, apple snails that ate SAV-UCB material were fed to domestic chickens (*Gallus gallus domesticus*). A control group of chickens were fed apple snails that ate SAV without the UCB. Only the chickens in the treatment group (3/5) displayed clinical signs and all five (5/5) developed AVM-diagnostic brain lesions. This is the first study to demonstrate AVM toxin transfer to birds through an invertebrate. The presence of the UCB in Lake Toho may present significant risk to the already diminished endangered Florida snail kite population.

**Targeted Algal Management: Some Case Studies**

**John H. Rodgers Jr.**[1], Russell Brown[2], David Isaacs[3], William Ratajczyk[4], Keith Gazaille[5], and James Schmidt[4]
[1]*Clemson University, Clemson, SC*
[2]*City of Salem, Salem Water Works, Salem, IN*
[3]*Aquatic Control, Incorporated, Seymour, IN*
[4]*Applied Biochemists, Germantown, WI*
[5]*Aquatic Control Technologies, Sutton, MA*

Targeted algal management has become a critical part of Adaptive Water Resource Management. Scientific studies involving both laboratory and field data have improved our abilities to use algaecides in critical situations. Algae (Cyanobacteria and Eukaryotes) producing taste-and-odor compounds as well as toxins can interfere with designated uses of waters as can algae achieving extreme densities. As pressures grow on fresh water resources, efficient and effective restoration of their uses becomes more pressing. Case studies involving water resources from drinking water supplies to irrigation canals illustrate strategies for targeted algal management and restoration of designated uses of these waters.

**What are Effective Treatments for Controlling Small, Dense Patches of *Phragmites australis* in Great Salt Lake Wetlands?** ***(Student Presentation)***

**Christine B. Rohal** and Karin M. Kettenring
*Utah State University, Logan, Utah*

*Phragmites australis* has been expanding rapidly in the wetlands of the Great Salt Lake (GSL). The dense and vigorous growth of this invasive plant make it inhospitable habitat for the waterfowl and shorebirds that rely on the hemispherically important GSL wetlands. Here we present our plan for a multi-year study that starts this year (2012) that will examine the effectiveness of six treatments for controlling dense, quarter-acre patches of Phragmites at six sites along the eastern shore of the GSL. A balanced incomplete block design will be employed across the six sites such that all treatments will be equally replicated. The treatments are 1) a summer mow, followed by a fall glyphosate spray, 2) a summer glyphosate spray, followed by a winter mow, 3) a fall glyphosate spray, followed by a winter mow, 4) a summer imazapyr spray, followed by a winter mow, 5) a summer mow immediately covered by heavy-duty black plastic, 6) an untreated control. Percent cover of Phragmites, density of

Phragmites, species richness, and vegetation structure will be measured to understand the response of Phragmites and native vegetation to treatments. Changes in the seed bank will also be measured using a greenhouse, seedling emergence method. Environmental conditions including soil moisture, soil nutrients, and soil salinity will be monitored for their potential impact on treatment effectiveness. The findings from this multi-year study will be used to develop Best Management Practices for controlling Phragmites in GSL wetlands.

**Release of SAVEWS Jr. Version 1.0 – Low-cost, Acoustic-based Aquatic Plant Mapping System**
**Bruce M. Sabol** and Eddie Melton
*U.S. Army Engineer Research and Development Center, Vicksburg, MS*

Digital signal processing software for detection and characterization of submersed aquatic vegetation, based on data collected with a low-cost echo sounder system, is now complete. This capability, referred to as SAVEWS Jr., was funded under the U.S. Army Corps of Engineers Aquatic Plant Control Research Program and is currently available to users at no cost. This free package consists of compiled signal processing software and a user's manual describing all equipment the user needs to acquire and the steps in set up, configuration, data collection and data processing. The software was written for data files produced by a Lowrance HDS echo sounder/GPS combination system, which costs in the $2,000 to $3,000 range depending on options selected. Equipment cost is about one tenth of that for the original SAVEWS which was based on a research-grade fisheries acoustics system and a separate GPS system. This low cost should put this capability within the financial means of anyone in the aquatic plant management community. We describe the system, its application, and internal workings. This initial release, version 1.0, has been based on a small but systematic collection of data from numerous locations. We continue to examine files from new and different conditions, and make fixes and improvements. Subsequent versions will be released as needed. User support is currently available in several forms. A 2-day hands-on class is planned in the New England region next week. Several slots are still available. Additional classes at other locations can be scheduled if demand warrants. We will provide remote technical support until the end of September 2012 by performing initial data processing and helping users determine the correct software parameter files to use for their locations. Additionally, we are seeking a licensee to market and support this technology long term.

**Variations in Water Exchange Characteristics among Hydrilla Sites in the Ross Barnett Reservoir *(Student Presentation)***
**Bradley T. Sartain**, Ryan M. Wersal, and John D. Madsen
*Mississippi State University, Mississippi State, MS*

The Ross Barnett Reservoir is a 33,000 acre water body located in Central Mississippi. It serves as the primary water supply for the state's capital city, as well as, many recreational water activities. The reservoir is home to a variety of both emergent and submersed aquatic plants, including hydrilla (*Hydrilla verticillata*). Management efforts have been implemented since 2006 in order to prevent the spread of hydrilla populations within the reservoir. During May 25-26, 2011, a point-intercept survey was conducted at 16 sites where hydrilla was previously found. Percentage of hydrilla occurrence was shown to be anywhere from 0% to 100% based on the points surveyed. Using management data from previous years, including herbicide selection and survey data, four hydrilla sites were chosen for water exchange studies. The four sites have exhibited inadequate control in previous years; however, little information regarding site characteristics is known, including bulk water exchange. Rhodamine dye was applied to each of the four sites at a target oncentration of 10 ppb and monitored at 0 hours after treatment (HAT), 1 HAT, and every 3 hours until dye concentrations were no longer detectable and a whole plot dye half-life could be determined. Dye half-lives varied between the four sites, with a minimum estimated half life of 2.0 hours and maximum estimated half-life of 14.3 hours. Water exchange information will be used to select herbicide active ingredients, treatment rates, and treatment methods based on anticipate contact time.

***Equisetum hyemale* (Scouringrush) Response to Sonar Genesis™ (a.i. Fluridone) and Clearcast™ (a.i. Imazamox)**

**Jill Schroeder**[1] and Mark A. Heilman[2]
[1]*New Mexico State University, Las Cruces, NM*
[2]*SePRO Corporation, Carmel, IN*

*Equisetum hyemale* (scouringrush) dominates the irrigation canals of southern New Mexico and causes significant water loss via ponding and evapotranspiration. Control of *E. hyemale* is difficult due to the weed's perennial characteristics and high silica content. We hypothesized that the spread of *E. hyemale* may be related to weed control practices such as glyphosate application, mowing and scraping of the banks, which have less impact on *E. hyemale* populations than other species. Results of previous research designed to determine the life cycle and rate of invasion of *E. hyemale* found that the herbicide mix currently used significantly increases *E. hyemale* coverage. Furthermore, results of a preliminary greenhouse study suggested that the currently used glyphosate plus 2,4-D mixture is not as effective as other auxinic herbicide candidates in providing initial suppression of scouringrush. Therefore, a greenhouse study was initiated to determine the effect of the new Sonar Genesis formulation of fluridone (60 g ai/L), imazamox as Clearcast (120 g ae/L), and their combination on *E. hyemale*. Treatments were applied to *E. hyemale* that had been previously established in 35.5 cm tall by 11.5 cm diameter pots in the greenhouse at two growth stages, dormant and early postemergence. *E. hyemale* was rated for visual symptoms, stems counted and fresh weights of above ground biomass harvested approximately one month after the post-emergence treatment. All Sonar Genesis (0.56-2.24 kg fluridone/ha) and Sonar Genesis (0.56-2.24) plus Clearcast (0.14-0.56 kg ae imazamox/ha) treatments applied to dormant *E. hyemale* reduced above ground biomass by 80 to 90% while Clearcast alone was less effective. The highest rates of Sonar Genesis (2.24 kg fluridone/ha), Clearcast (0.56 kg imazamox/ha), and their combination applied post-emergence reduced biomass similarly to the dormant treatments. Pots will be harvested and above and below ground biomass measured two months after post-emergence treatment.

**Pre-emergent Control of Submersed Aquatic Weeds in Arkansas Baitfish Ponds: Year 3**

**George L. Selden**
*University of Arkansas at Pine Bluff, Jonesboro, AR*

Submersed aquatic vegetation continues to be a significant problem in the Arkansas Baitfish Culture industry. It impacts profitability and the availability of fish for sale. Past demonstrations have tested using fluridone at low rates. This herbicide was added at the time of pond filling and acted as a pre-emergent herbicide. This year's project involved applying six different rice herbicides onto 10 feet strips of pond edge prior to pond filling. If any of these herbicides delays the growth of submersed weeds long enough for a phytoplankton bloom to become established, this has the potential to further reduce treatment costs and allow the rotation of herbicides to prevent resistance issues.

**Village Pond Park Water Quality Assessment Report *(Alternate Presentation)***

**Patrick A. Simmsgeiger**
*Diversified Waterscapes, Incorporated, Laguna Niguel, CA*

Diversified Waterscapes completed a water quality assessment over several days in November, 2011. The scope of work included hydrologic investigations and environmental analyses as follows: review the existing lake water pumps and water intake/outflow components; review the existing lake aeration system, air flow capacity, and distribution of the associated bubbler/diffusers; evaluate the nature of surface water movement by wind convection forces; select 3 discrete lake samples to be submitted to a lab for biological component testing and analysis; evaluate the temperature and dissolved oxygen content of the lake water, with particular attention to vertical changes/stratification throughout the water column; perform a lake water circulation analysis to identify the water flow patterns and evaluate areas of water stagnation; and preparation of a report with recommendations for improvement of lake water quality. Our report contains considerable data regarding unhealthy water condition. The analytical testing detected high levels of Coliform (both total and fecal) and high levels of Enterococcus in all samples collected from this investigation. Coliforms & Enterococcae are "indicator" bacteria that can be found in the aquatic environment. The presence of both Coliforms and Enterococcae indicates that other pathogenic

organisms of fecal origin may be present. The Biochemical Oxygen Demand (BOD) analysis indicated very high bacteria loading in the lake, and the greater part of the ORP readings were below 100 mV indicating an anaerobic environment. We recommended restoration of, and addition to, the current aeration system; addition of circulation compressor units to increase circulation and an increase of lake maintenance including microbial products to reduce sludge developing on the lake bottom. It was also recommended that a water quality monitoring program be implemented to continually evaluate lake health and progress. Our findings, conclusions, and general recommendations are presented in greater detail in the report.

**Pre-Emergent Use of the ALS Herbicide Galleon™ (Penoxsulam) in Aquatic Sites**

**Andrew Z. Skibo**[1], Mark A. Heilman[2], and Scott W. Shuler[2]
[1]*SePRO Corporation, Denver, CO*
[2]*SePRO Corporation, Carmel, IN*

Galleon™ Aquatic Herbicide (a.i. penoxsulam) received its U.S. EPA aquatic registration in 2007. When originally registered, this new ALS-inhibitor herbicide included labeled use patterns for pre-emergent application to drawdown or seasonal dry aquatic sites. Mesocosm evaluation has documented excellent pre-emergent activity on both American and Sago pondweed (*Potamogeton nodosus* and *Stuckenia pectinata*) among other species. In separate studies, ungerminated tubers of both species were treated at multiple rates at or below the maximum pre-emergent label rate of Galleon™ (11.2 fl oz/acre). At 30 days post flooding, American pondweed shoot height was reduced 65% and 88% at the 5.6 and 11.2 fl oz/acre rates respectively versus untreated controls. At 6.25 fl oz/acre of Galleon, sago pondweed shoot height was reduced by 94% and fresh shoot weight by 99% versus untreated controls. Field trials and operational treatments for the control of seasonally exposed but viable root crowns of Eurasian watermilfoil (*Myriophyllum spicatum*) utilizing 11.2 fl oz/acre of Galleon have proven to be effective. Recently, the use of Galleon in dry or dewatered irrigation canals in the western U.S. was approved by the U.S. EPA. Pre-emergent treatments of irrigation canals with Galleon at 11.2 fl oz/acre completed under EUP between 2009 and 2011 at sites in California, Washington, and Idaho showed excellent broad-spectrum performance with 90% or better season-long control in almost all treated sites. Laboratory and field results will be reviewed to support incorporation of Galleon into pre-emergent use patterns for irrigation canal management and other appropriate aquatic vegetation control strategies.

**Water Nutrient Removal from Mechanical Harvesting of Aquatic Weeds in a Eutrophic Reservoir in Brazil**

**Monicke O. Vieira**[1], Robinson A. Pitelli[2], and Robinson L. Pitelli[3]
[1]*Light Energy, Pirai, Brazil*
[2]*University of State of São Paulo, Jaboticabal, Brazil*
[3]*Ecosafe Agriculture and Environmental Sciences, Jaboticabal, Brazil*

In Brazil, the only method for aquatic weed control authorized by the government authorities is mechanical harvesting, but there are still major questions about the environmental impact of the disposal of harvested plants. A research project was developed with aquatic weeds collected in Santana Reservoir, Rio de Janeiro State, aiming to evaluate the chemical composition of the predominant species and assess the amount of nutrients removed from the water body by mechanical harvesting. The evaluations were carried out from March 2007 to June 2009 and the plants evaluated for chemical composition were collected in six different periods of time. The aquatic weeds evaluated were *Brachiaria subquadripara*, *Eichhornia azurea*, *Egeria densa*, *Pistia stratiotes*, *Polygonum lapathifolium*, *Sagittaria montevidensis*, and *Salvinia herzogii*. The highest concentrations of P, S, Cu, Mn, Zn, Ni, and Cb were observed in *E. densa*. The highest concentrations of Ca and Mg were observed in *P. stratiotes*, K in *S. montevidensis* and Fe in *S. herzogii*. Considering the two main elements that the most efforts are made to reduce water eutrofication, N and P, it is possible to extrapolate that the harvesting of one hectare of each of these macrophytes enables the removal of 22, 37, 49, 195 and 95 kg/ha of P-P2O5 by *E. crassipes*, *S. herzogii*, *P. stratiotes*, *P. lapathifolium* and *B. subquadripara*, respectively. For these same macrophytes the estimated removal of NO3-N were 630, 500, 593, 3383 and 2202 kg/ha, respectively. The removal of excessive amount of nutrients from the water body can be considered an environmental benefit of the mechanical harvest and it is also important to note that concentrations of heavy metals in the biomass were below the limits established by Brazilian legislation for organic fertilizers, enabling its use for crops fertilization.

**Assessment of the Distribution of Aquatic Invasive Plants in the Pacific Northwest: Five Years of Surveying**

**Ryan M. Wersal**[1], John D. Madsen[1], Jonathan P. Fleming[1], and Celestine Duncan[2]
[1]*Mississippi State University, Mississippi State, MS*
[2]*Weed Management Services, Helena, MT*

The spread of invasive aquatic plants is accelerating and monitoring this spread is becoming increasingly important for management of these species. A major component of any management program is to efficiently survey suspected areas for target species. Surveys should be conducted over time to track the distribution of target species and to quantify native plant community composition. Over the past five years we conducted point intercept surveys on 15 lakes in Idaho and Montana, and surveyed more than 30 miles of river in Montana. Results of the survey found two lakes in Idaho (Hayden and Pend Oreille) and three lakes in Montana (Noxon Rapids Reservoir, Cabinet Gorge Reservoir, and Toston Reservoir) positive for Eurasian watermilfoil. Other species of concern include curlyleaf pondweed observed in both lakes and rivers in Montana, and flowering rush in the Flathead and lower Clark Fork drainages. Multiple water bodies also had several native milfoils which may be problematic with respect to accurate identification and potential management of Eurasian watermilfoil where species co-occur. Future surveys should continue to monitor existing invasive aquatic plant populations and new surveys directed toward high risk water bodies in the region. These include aquatic sites directly associated with infested waters and water bodies with access points that support motorized boat traffic. Continued monitoring will assist in determining the spread of invasive aquatic plants, likely habitats for its infestation, and locations for active management.

**Flowering Rush Management Lake Pend Oreille, Idaho: Preliminary Summary on Mesocosm and Field Evaluations *(Alternate Presentation)***

**Ryan M. Wersal**[1], John D. Madsen[1], and Tomas Woolf[2]
[1]*Mississippi State University, Mississippi State, MS*
[2]*Idaho Department of Agriculture, Hayden, ID*

Flowering rush (*Butomus umbellatus*) was found north of the Clark's Fork River delta in Lake Pend Oreille in 2007. The majority of flowering rush occurs in this area of the lake, though small populations have begun to establish in other areas of Lake Pend Oreille, downstream of Albeni Falls Dam on the Pend Oreille River in Washington. Flowering rush is an expanding problem in this region and currently there are no proven tools to effectively control it. As part of the normal water management regime, Lake Pend Oreille undergoes a drawdown ($\geq$ 11 ft) every fall and winter for flood control and to help protect infrastructure from ice damage. During this time, flowering rush plants are exposed and are easily accessible to implement management techniques. Therefore, our objectives were to: 1) Evaluate bare ground herbicide applications under simulated drawdown conditions in a mesocosm facility; 2) verify mesocosm results with small plot bare ground herbicide applications in Lake Pend Oreille; and 3) Compare benthic barrier, digging, hand pulling, and bare ground herbicide application efficacy under field conditions in Lake Pend Oreille. Both the mesocosm (conducted in Mississippi) and field evaluations (Lake Pend Oreille) were conducted at the same time in an attempt to ensure plants were at a similar growth stage between sites. At 12 WAT in the mesocosm trial, fluridone (32 and 64 oz/acre), imazamox (32 and 64 oz/acre), imazapyr (48 and 96 oz/acre), penoxsulam (5.6 oz/acre), and triclopyr (256 oz/acre) resulted in a decrease ($p<0.01$) in aboveground biomass; though no difference ($p=0.53$) in belowground biomass was detected during this time. However, at 24 WAT, fluridone at both rates and triclopyr (256 oz/acre) reduced ($p=0.02$) belowground biomass. In the field trials, biomass was not reduced by any management technique (aboveground $p=0.46$, belowground $p=0.12$), as a result of high variability in plant densities and sampling times. When comparing the implementation of techniques, application of herbicides took on average 38 seconds for each plot, whereas the other techniques required 12-30 minutes per plot. If differences in efficacy were detected, the differences in implementation time could have implications for cost effectiveness and labor requirements, though we still need to find a reliable, effective method.

**Ultrasonic Algae Control - How Does It Work?**

**Kirk Whatley**
*SonicSolutions, LLC, West Hatfield, MA*

Ultrasonic algae control has been proven to be effective in a variety of water environments - from aquaculture to waste water and from drinking water to successful pond management. Ultrasonic technology is safe for fish, frogs, snakes, turtles and all other forms of aquatic life, except for algae. Ultrasonic algae control requires less than 0.5amps of electricity and is easy to power with a solar power system. Everything has a resonant (or resonance) frequency at which it naturally vibrates, or oscillates. By matching the resonant frequencies, even small periodic ultrasonic sound waves can produce large amplitude oscillations within the target. By matching that resonant frequency of glass, for example, singers can shatter a glass. Ultrasonic algae control targets very specific and key aspects of the algae cell. Specifically, ultrasonic algae control targets the gas vesicles in algae and the chemical bond that adheres the cytoplasm of the cell to the cell wall. The gas vesicles are popped inside the cell without popping the cell wall itself and when the chemical bond is broken the cytoplasm contracts away from the cell wall. By popping the gas vesicles, the algal cell sinks to the bottom of the body of water where it cannot photosynthesize and they starve to death without releasing any toxins. By breaking the chemical bond that adheres the cytoplasm to the cell wall, the cell is incapable of taking food in or getting waste out and the cell starves to death. The necessary contact time to be effective for alga with gas vesicles is 4 to 7 days to effectively sink the algae. The necessary contact time to be effective for alga without gas vesicles is 3 to 4 weeks before significant changes can be observed. Ultrasonic technology works on 90% to 95% of the algal.

**Naming the Wilde Stig: Final Morphological and Molecular Characterization of Novel Cyanobacterial Epiphyte Associated with Avian Vacuolar Myelinopathy**

**Susan B. Wilde**[1], Peng Jiang[1], Henry D. Wilde[1], and Jeffrey R. Johansson[2]
[1]*University of Georgia, Athens, GA*
[2]*John Carroll University, University Heights, OH*

Research into the taxonomy of the novel cyanobacterial epiphyte in locations where birds are dying from a neurologic impairment (Avian Vacuolar Myelinopathy—AVM) has been ongoing since 2001. This followed the discovery that all sites where birds were dying had extensive invasive vegetation with an unknown species of cyanobacteria growing on the leaves. The species was tentatively named *Hapolosiphon fontinalis*, but subsequent genetic and morphological evaluation of indicated that this was a unique species within the Stigonematales. The genetic sequence was submitted to GenBank and initial genetic profiling placed it close to the existing genus, Stigonema. Recent sequence analysis of 16S rRNA genes from additional species in the Stigonematales has resulted in a unique phylogenetic placement. This species now appears so distant from existing genera that it will require formation of a new genus and species. Additionally, a CAPS (cleaved amplified polymorphic sequence) assay was developed to ensure specificity of detection of the new Stigonematalan species. Specific RsaI restriction sites within the 16S rRNA gene identify the new Stigonematalan species. Transmission, confocal and scanning electron micrographs confirm the novel characteristics of this species, which is true-branching from uniseriate basal filaments. It is encased within a firm sheath and has heterocysts both within the filaments and at the tips of the branches, indicating that it is capable of nitrogen fixation. Current culture isolates now maintained for over nine months reveal that this novel species grows at lower light (<10µmol photons $m^{-2}$ $s^{-1}$), nutrient (10% BG11) and temperature (<10°C) than co-occurring cyanobacterial species. We propose that this species becomes the dominant late-season epiphyte due to its ability to survive in dense beds of senescing invasive plants when other epiphytes disappear due to low light, nutrients or temperature. Additionally, the neurotoxin it produces may deter the growth of other species. New hydrilla locations with AVM bird disease and dense colonies of the target cyanobacterium during 2011-2012 add additional confirmation of these species role in AVM and expanding concern for wildlife.

**Biology and Control of the Invasive Aquatic Plant, Crested Floating Heart (*Nymphoides cristata*) *(Student Presentation)***

**Leif N. Willey**[1] and Michael D. Netherland[2]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Crested floating heart (*Nymphoides cristata* hereby referred to as CFH) is a native to SE Asia and an expanding problem in the SE U.S. CFH produces long petioles with floating leaves and reproduces vegetatively. Peer reviewed literature on the biology and management of CFH is limited. We conducted a series of herbicide efficacy screens and growth studies to determine how environmental factors influence growth of CFH from vegetative propagules called "daughter plants". All labeled aquatic herbicides were evaluated. Differences between application types (submersed, granular, and foliar) were examined at maximum and ½ max label rates following 24 and 96 hour exposures. Fluridone and ALS inhibitors were evaluated using static exposures. Plants were harvested at 4 WAT and evaluated for change in biomass compared to pre-treatment values. Herbicide formulation had little impact on efficacy. Only four herbicides reduced biomass below pre-treatment values; foliar applications of imazamox and imazapyr and submersed applications of diquat and endothall (Hydrothol). Fluridone and the ALS herbicides inhibited growth at 4 weeks but longer term studies are required. In addition to herbicide screening we evaluated the influence of sediment type and fertility on plant growth. Four sediment types and three fertilizer regimes were evaluated and leaf number and biomass were measured 6 WAT. Growth increased with fertility and across fertility regimes growth was greater in higher sand soils and lowest in a clay soil. Results suggest that sediment pH may play a role in productivity. We also evaluated the influence of light on CFH growth. Five light intensities were evaluated; 1%, 5%, 25%, 50% and 100% ambient light. Number of leaves and biomass were assessed at 4 WAT. Shading influenced CFH growth, but the daughter plants produced floating leaves at just 1% ambient light. Competition of CFH in a replacement series with hydrilla was evaluated. At ratios of 2:4 and greater, CFH accumulated more biomass than hydrilla at 7 WAT; however, it did not exclude hydrilla from the study system or severely impact its' growth. In summary, herbicide use will be challenging and daughter plants of CFH present a complex management question due to potential for spread, periods of dormancy, and low light tolerance.

**Is *Hygrophila Polysperma* in Texas a Potential Threat? *(Student Presentation)***

**Casey R. Williams**
*Texas State University, San Marcos, TX*

Hygrophila, (*Hygrophila polysperma* (Roxb.) T. Anders (Acanthaceae)), is an Old World species native to Asia that has become well established in three spring run water bodies in Texas. These include the San Marcos River, Comal River, and San Felipe Creek. These spring systems each support a unique flora and fauna which may be threatened by hygrophila. In addition, these spring systems are located within two river basins which provide source water for irrigation of rice and other crops. As witnessed in Florida, hygrophila can invade these irrigation systems causing serious problems. Few effective control measures are available for management of hygrophila. Furthermore, recent discovery has proven that hygrophila in Texas can produce seed under the right conditions providing yet another means of spread across the state. Although listed as a Federal noxious weed, hygrophila is not listed in Texas as a prohibited aquatic species.

**Weeds in the Water: An Assessment of Florida Boater & Angler Awareness, Attitudes, and Behavior Relating to Aquatic Invasive Species Issues and Prevention *(Student Presentation)***

**Kate Wilson**, William Haller, and Tracy Irani
*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*

Invasive species are a problem world-wide, cited as one of the biggest threats for resource conservation. With people traveling more than ever for tourism and recreation, and increased conflicts over water resources, the issue continues to grow. Recreational boaters and anglers who travel present a high risk of spreading aquatic invasive species (AIS) from one waterbody to another. States that target outreach and educational campaigns regarding AIS issues towards boaters tend to have a greater chance of preventing introductions and secondary spread of AIS, as well as increasing public knowledge and understanding of AIS impacts and management. In Florida, $20-30

million is spent each year on the control of aquatic invasive species. Due to the subtropical climate, population, and vast number of freshwater resources, travelers and boaters in Florida, AIS present a monumental challenge. Although there are many possible vectors of introduction for AIS, recreational boaters are considered the most likely mode of introduction and secondary spread. Boaters and anglers are a user group intimately connected to the spread of AIS, yet have not been specifically targeted for AIS education/outreach in Florida. Not only does Florida top the charts as having the most registered boaters in the U.S., it also receives the most out-of-state traffic on its waters. Traveling boaters without an awareness or knowledge of AIS introductions and impacts present a high risk to all freshwater resources—not just in the state but also to other boater destination locations throughout North America. This study is a baseline assessment of Florida registered boaters and non-resident anglers perceptions and awareness of AIS spread, issues, and management. Data collected are a result of grant funding provided by the Florida Fish & Wildlife Conservation Commission and the University of Florida Center for Aquatic & Invasive Plants; a mail survey was sent to 4600 registered Florida boaters and anglers in 2012. With increasing user conflicts for water resources, this study is important in informing management agencies of the best ways to engage stakeholders. In a time of government deficits and reduced public spending, identifying effective means of communicating with stakeholders is crucial.

**Idaho's Aquatics Program**
**Thomas Woolf**
*Idaho Department of Agriculture, Hayden, ID*

Aquatic plant management is fairly new to Idaho, starting in earnest in 2006 with significant funding from the state legislature directed specifically to Eurasian watermilfoil. Significant reductions in milfoil have been observed state-wide following treatment; however, other species such as hydrilla and flowering rush have emerged to be even bigger threats to the waters of the region. Despite tough economic times, milfoil funding continues. Federal partners have stepped up to assist with other species. Many waterbodies in the state don’t have any invasive aquatic species so an aggressive prevention program using watercraft inspection is also in place to help protect Idaho waters from invasive aquatic species.