51st Annual Meeting of the Aquatic Plant Management Society

Program & Abstracts

Hyatt Regency
Baltimore Inner Harbor
Baltimore, Maryland
July 24-27, 2011

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.

Table of Contents

Board of Directors

Linda Nelson
President
U.S. Army Engineer R&D Center
Vicksburg, Mississippi

Greg MacDonald
Immediate Past President
University of Florida
Gainesville, Florida

Tyler Koschnick
President Elect
SePRO Corporation
Carmel, Indiana

Terry Goldsby
Vice President
Aqua Services, Inc.
Guntersville, Alabama

Sherry Whitaker
Treasurer
U.S. Army Engineer R&D Center
Vicksburg, Mississippi

Rob Richardson
Editor
North Carolina State University
Raleigh, North Carolina

Jeffrey Schardt
Secretary
Florida Fish and Wildlife
Conservation Commission
Tallahassee, Florida

Alan "Bo" Burns
Director
Crop Production Services
Raleigh, North Carolina

Susan B. Wilde
Director
University of Georgia
Athens, Georgia

John Gardner
Director
Aquatic Systems, Inc.
Pompano Beach, Florida

Cody Gray
Director
United Phosphorus, Inc.
Peyton, Colorado

Craig Aguillard
Director
Winfield Solutions, LLC
Ville Platte, Louisiana

John Madsen
Director
Mississippi State University
Mississippi State, Mississippi

Joseph Vassios
Student Director
Colorado State University
Fort Collins, Colorado

Committee Chairs

Awards	Don Doggett
Bylaws and Resolutions	Jim Schmidt
Education and Outreach	Susan B. Wilde
Exhibits	LeeAnn Glomski
Finance	Richard Hinterman
Legislative	John Madsen
Meeting Planning	Bob Gunkel/Tommy Bowen
Membership	John Madsen
Nominating	Greg MacDonald
Past President's Advisory	Greg MacDonald
Program	Tyler Koschnick
Publications	Rob Richardson
Regional Chapters	Terry Goldsby
Scholastic Endowment	John Gardner
Strategic Planning	John H. Rodgers, Jr.
Student Affairs	Rebecca Haynie
Website	Ryan Wersal

Special Representatives

AERF	Carlton Layne
BASS	Gerald Adrian
CAST	John Madsen
NALMS	Michael Netherland
RISE	Joe Bondra
Science Policy Director	Lee Van Wychen
Webmaster	Dave Petty
WSSA	Cody Gray

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

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

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	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. Myres	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

Outstanding Graduate Student Award (year of award)

Ryan Wersal	Mississippi State University	2010

Outstanding Research/Technical Contributor Award (year of award)

Michael D. Netherland, Dean Jones, Jeremy Slade 2010

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

The Aquatic Plant Management Society appreciates the valuable support of the following 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 closely with end users to identify market needs. We work 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 the state of Florida that include individuals, developers, homeowners associations, golf courses, mobile home communities, utilities, local, state and federal government agencies and industry. Our experienced professional applicator staff provides unique knowledge along with advanced equipment to manage all types of waterway, right-of-way, wetland, and upland systems.

Applied Biochemists®, a business of Arch Chemicals, Inc., is proud to have been an active, contributing member of the APMS for over 40 years. As a manufacturer of algaecides and aquatic herbicides, we place high value on the science and integrity the APMS and its members bring to our industry. We are part of a leading biocides company, dedicated to producing and supplying products meeting quality, regulatory and safety standards for improving the economic, recreational and functional value of water 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.

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, BASF, BioSafe Systems, Brewer International, SePRO, Syngenta, United Phosphorus Incorporated, AquaMaster, Kasco, and Otterbine. Aquatic Control, Inc. has three 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 has been a chemical manufacturer since 1973. Brewer is located in Vero Beach, Florida. 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 one of the only aquatic distributors 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 large-scale aquatic habitat mapping. Since 1999 ReMetrix has mapped over one 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.

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 17 years, SePRO established itself as the world's largest manufacturer of aquatic plant protection products and has grown into the largest dedicated sales, research and marketing organization in the aquatics industry. 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 endothall based aquatic herbicides and algaecides for lakes, ponds, and irrigation canals. These products are marketed as Aquathol®, Hydrothol®, Cascade®, and Teton®. 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 USA Corporation 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. **NEW 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 **NEW Tradewind™ Herbicide** - systemic and selective control of hydrilla, watermilfoil and other aquatic plants. www.valentpro.com

Get the Vertex Advantage! **Vertex Water Features** manufactures advanced diffused aeration systems for all sizes of lakes and ponds. Vertex aeration can help your aquatic management plan meet pending NPDES permitting "Best Management Practices" requirements. Reduce chemical costs by oxidizing suspended organic particulates that reduce efficacy of diquat, fluridone and other algaecides and herbicides. Aeration can eliminate low-oxygen fish kills and odors, reduce nutrients and digest bottom muck. **800-432-4302** ◆ www.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

Syngenta Professional Products
Greensboro, North Carolina

United Phosphorus, Inc.
King of Prussia, Pennsylvania

Gold

Aquatic Ecosystem Restoration Foundation
Atlanta, Georgia

Silver

Helena Chemical Company
Collierville, Tennessee

SePRO Corporation
Carmel, Indiana

Winfield Solutions, LLC
Ville Platte, Louisiana

Bronze

Alligare, LLC
Davidson, North Carolina

Applied Biochemists
Germantown, Wisconsin

Brewer International
Vero Beach, Florida

Crop Production Services, Inc.
Loveland, Colorado

Valent USA Corporation
Memphis, Tennessee

Vertex Water Features
Pompano Beach, Florida

Contributor

Aquatic Control, Inc.
Seymour, Indiana

Becker Underwood, Inc.
Ames, Iowa

Clarke Aquatic Services
Roselle, Illinois

Cygnet Enterprises, Inc.
Flint, Michigan

Scholastic Endowment Sponsors

The Aquatic Plant Management Society appreciates the generous support of the following scholastic endowment sponsors. Revenues generated through the Reverse Raffle 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.

Reverse Raffle Grand Prize

Cygnet Enterprises, Inc.
Flint, Michigan

Cygnet Enterprises, Inc. has graciously donated a $500 gift card and iPad2 for the Reverse Raffle

Silent Auction Contributors

Applied Aquatic Management, Inc.
Eagle Lake, Florida

AquaTechnex
Bellingham, Washington

Aquatic Control, Inc.
Seymour, Indiana

Aquatic Ecosystem Restoration Foundation
Marietta, Georgia

Aquatic Systems, Inc.
Pompano Beach, Florida

Brewer International
Vero Beach, Florida

Crop Production Services, Inc.
Loveland, Colorado

Cygnet Enterprises, Inc.
Flint, Michigan

Diversified Waterscapes, Inc.
Laguna Niguel, California

Future Horizons, Inc.
Hastings, Florida

Helena Chemical Company
Shawnee, Kansas

Phoenix Environmental Care, LLC
Wellington, Florida

PLM Lake and Land Management Corporation
Milford, Michigan

SePRO Corporation
Carmel, Indiana

Syngenta Professional Products
Orlando, Florida

Valent USA Corporation
Walnut Creek, California

Vertex Water Features
Pompano Beach, Florida

Winfield Solutions, LLC
Apopka, Florida

Exhibitors

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

Airmax Ecosystens, Inc.
Marine City, Michigan

Alligare, LLC
Opelika, Alabama

Applied Biochemists
Germantown, Wisconsin

Applied Polymer Systems
Woodstock, Georgia

AquaMaster Fountains and Aerators
Kiel, Wisconsin

Aquatic Control, Inc.
Seymour, Indiana

Aquatic Eco-Systems, Inc.
Apopka, Florida

BioSafe Systems, LLC
Canoga Park, California

Brewer International
Vero Beach, Florida

Clarke Aquatic Services
Roselle, Illinois

Clean Lakes, Inc.
Coeur d'Alene, Idaho

Contour Innovations, LLC
Minneapolis, Minnesota

Crop Production Services, Inc.
Loveland, Colorado

Cygnet Enterprises, Inc.
Flint, Michigan

Helena Chemical Company
Collierville, Tennessee

PP Systems International, Inc.
Amesbury, Massachusetts

Red River Specialists
Davenport, Florida

Remetrix, LLC
Carmel, Indiana

SePRO Corporation
Carmel, Indiana

Sonic Solutions, LLC
West Hatfield, Massachusetts

Syngenta Professional Products
Greensboro, North Carolina

United Phosphorus, Inc.
King of Prussia, Pennsylvania

Valent USA Corporation
Walnut Creek, California

Vertex Water Features
Pompano Beach, Florida

Winfield Solutions, LLC
Apopka, Florida

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 the Atrium on Sunday and move to the Foyer A Side located in front of the Constellation AB meeting rooms for the remainder 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 7:30 a.m. Monday to 10:30 a.m. Wednesday in Constellation AB.

Posters
Posters will be open for viewing from 7:30 a.m. Monday to 10:30 a.m. Wednesday in Constellation AB. A Poster Session and Reception will be held on Monday from 6:00 p.m. to 7:30 p.m. in Constellation AB. Poster presenters are required to attend the Poster Session to answer questions. In addition, presenters are requested to be in attendance during scheduled refreshment breaks. The Poster Reception is sponsored by Winfield Solutions, LLC.

Continental Breakfasts / Refreshment Breaks
Continental breakfasts and mid-morning and afternoon refreshment breaks, graciously sponsored by Brewer International, Crop Production Services, Inc., Helena Chemical Company, SePRO Corporation, Valent USA Corporation, and Vertex Water Features, will be served each day in Constellation AB. 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, 12:20 p.m. to 1:45 p.m. in the Pisces 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 will be the moderator. Please contact Rebecca by noon Sunday, July 24 to confirm your attendance. This luncheon is sponsored by SePRO Corporation.

APMS Annual Business Meeting
The APMS Annual Business Meeting will be held Monday, 4:25 p.m. to 5:00 p.m. in Constellation CD. 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 Pisces Room. Representatives from each APMS regional chapter are invited to attend this breakfast. Terry Goldsby, APMS Vice President and Regional Chapters Committee Chair, will be the moderator for discussions on aquatic plant management activities in each region. Please contact Terry by 8:00 a.m. Monday, July 25 to confirm your attendance. This breakfast is sponsored by Helena Chemical Company.

APMS Past Presidents' Luncheon
All APMS Past Presidents are invited to attend the Past Presidents' Luncheon on Tuesday, 12:00 p.m. to 1:30 p.m. in the Pisces Room. Greg MacDonald, Immediate Past President, will be the moderator. Please contact Greg by noon Monday, July 25 to confirm your attendance. The luncheon is sponsored by Valent USA Corporation.

APMS Special Events

***President's Reception**, Sunday, July 24, 7:00 p.m. to 9:00 p.m., Annapolis Room*

The APMS cordially invites all registered delegates, guests, and students to the President's Reception, graciously sponsored by United Phosphorus, 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 25, 6:00 p.m. to 7:30 p.m., Constellation AB*

The APMS cordially invites all registered delegates, guests, and students to the Poster Session and Reception, sponsored by Winfield Solutions, LLC. 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: "Foodies in Fells Point",** Monday, July 25, 10:00 a.m. to 3:00 p.m. Meet in the Hyatt Lobby*

It's all in the name. The APMS invites all registered guests of meeting delegates to the "Foodies in Fells Point" Guest Tour, graciously sponsored by Applied Biochemists. Our tour begins in the historic neighborhood of Fells Point with a leisurely stroll through the neighborhood, for all events and functions at the meeting stopping at the many eclectic stores and art galleries along its cobblestone streets. After a morning of shopping, guests will take part in a true culinary adventure. The Fells Point Food Tour explores parts of Baltimore's best-preserved historic district, founded nearly 280 years ago. The historic buildings house the greatest concentration of pubs and bars in the city, and also some of the city's best cuisine. On this guided walking tour, you will experience and learn the significance of this small town once separated from Baltimore. During the tour, you will sample specially made dishes at unique family-owned restaurants including: sausages from a 90-year-old family-run factory, traditional Polish Pierogi, smoked crab cakes from a long-standing family restaurant, 4th generation Greek family recipes, the city's best burger, and many other local delicacies. The Guest Tour is free to all registered guests. 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 26, 6:00 p.m. to 10:00 p.m., aboard the Spirit of Baltimore*

The APMS cordially invites all registered delegates, guests and students to the APMS Awards Banquet, sponsored by Syngenta Professional Products, aboard the *Spirit of Baltimore*. Take the crossover walkway from the Hyatt Atrium to the Inner Harbor. Boarding begins at 6:00 p.m. for a pre-banquet reception sponsored by Alligare, LLC. The *Spirit of Baltimore* casts off from the dock at 7:00 p.m. for a dinner cruise of the Inner Harbor until 10:00 p.m.. After dinner, we will recognize those who have served and contributed to the Society, welcome new officers and directors, and present awards to the student paper and poster participants. Our evening will conclude with the reverse raffle grand prize drawing, sponsored by Cygnet Enterprises, Inc. Non-registered guests may purchase raffle tickets at the meeting registration desk.

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 2011 meeting adjourns on Wednesday July 27, the student tour will get rolling! We are traveling to beautiful Susquehanna Flats in Northeast Maryland on the Chesapeake Bay. The Susquehanna Flats, a world-famous fishing and birding destination, boasts a teeming aquatic plant community. Biologists from Maryland Department of Natural Resources, led by Mark Lewandowski, will provide a boat and snorkeling tour of the flats. We will also visit the Northbay Environmental Center, located on the Elk Neck Peninsula at the northern end of the Chesapeake Bay. When the sun goes down, we will trade our flippers for flip flops and enjoy fresh Maryland seafood in the historic City of Havre de Grace located at the mouth of the Susquehanna River. For more information on the student tour or student affairs please contact Dr. Rebecca Haynie at hayniers@uga.edu.

Agenda

Sunday, July 24

Sunday's Agenda-at-a-Glance

7:30 am - 5:00 pm	APMS Board of Directors Meeting *(Conway Room)*
12:00 pm - 5:00 pm	Exhibits Setup *(Constellation AB)*
12:00 pm - 5:00 pm	Poster Setup *(Constellation AB)*
1:00 pm - 5:00 pm	Registration *(Atrium)*
7:00 pm - 9:00 pm	President's Reception *(Annapolis Room)* *Sponsored by United Phosphorus, Inc.*

Monday, July 25

Monday's Agenda-at-a-Glance

7:30 am - 8:00 am	Continental Breakfast *(Constellation AB)* *Sponsored by Brewer International*
7:30 am - 5:00 pm	Registration *(Foyer A Side)*
7:30 am - 5:00 pm	Exhibits Open *(Constellation AB)*
7:30 am - 5:00 pm	Posters Open *(Constellation AB)*
8:00 am - 12:20 pm	Session I *(Constellation CD)*
10:00 am - 3:00 pm	Guest Tour *Sponsored by Applied Biochemists*
10:10 am - 10:35 am	Refreshment Break *(Constellation AB)* *Sponsored by Helena Chemical Company*
12:20 pm - 1:45 pm	Lunch on your own
12:20 pm - 1:45 pm	APMS Student Affairs Luncheon *(Pisces)* *Sponsored by SePRO Corporation*
12:20 pm - 1:45 pm	Aquatic Ecosystem Restoration Foundation Meeting *(Pisces)*
1:45 pm - 5:00 pm	Session II *(Constellation CD)*
3:10 pm - 3:40 pm	Refreshment Break *(Constellation AB)* *Sponsored by Helena Chemical Company*
4:25 pm - 5:00 pm	Annual Business Meeting *(Constellation CD)*
6:00 pm - 7:30 pm	Poster Session and Reception *(Constellation AB)* *Sponsored by Winfield Solutions, LLC*

Session I
8:00 am - 12:20 pm
Constellation CD

Presidential and Keynote Address
Moderator: Tyler Koschnick, *APMS President Elect, SePRO Corporation, Carmel, IN*

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

8:05 am **Presidential Address**
Balancing Emerging Threats with Strategic Goals
Linda Nelson
U.S. Army Engineer Research and Development Center, Vicksburg, MS

8:20 am **Keynote Address**
Chesapeake Bay TMDL, an Invasive Species?
Aaron Hobbs
Responsible Industry for a Sound Environment (RISE), Washington, D.C.

Science and Regulatory Policy
Moderator: Tyler Koschnick, *APMS President Elect, SePRO Corporation, Carmel, IN*

8:45 am **Clean Water Act Permitting of Discharges from Pesticide Applications**
Allison Wiedeman
Office of Water, U.S. Environmental Protection Agency, Washington, D.C.

9:10 am **Square Pegs and Round Holes: Clean Water and NPDES**
Alexandra Dunn
Association of State and Interstate Water Pollution Control Administrators, Washington, D.C.

9:35 am **Update on Office of Pesticide Programs**
Dan Kenney
Herbicide Branch, U.S. Environmental Protection Agency, Washington, D.C.

9:55 am **The Corps of Engineers Aquatic Plant Control Research Program**
Al Cofrancesco
U.S. Army Engineer Research and Development Center, Vicksburg, MS

10:10 am **Refreshment Break** *(Constellation AB)*

Hydrilla and Ecological Services

Moderator: Michael D. Netherland, *APMS Editor 2003 - 2010, U.S. Army Engineer Research and Development Center, Gainesville, FL*

10:35 am **A Session to Provide Different Perspectives on Invasive Aquatic Plants and Potential for Ecosystem Services**
Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

10:50 am **Lack of Hydrilla Infestation on Plant, Fish and Aquatic Bird Community Measures**
Mark V. Hoyer
University of Florida, Gainesville, FL

11:05 am **Long-term Reductions in Anthropogenic Nutrients Link to Improvements in Chesapeake Bay Habitat**
Nancy B. Rybicki[1] and Henry A. Ruhl[2]
[1]*U.S. Geological Survey, Reston, VA*
[2]*National Oceanography Centre, Southhampton, UK*

11:20 am **To Manage or Not to Manage - That is the Question**
John D. Madsen
Mississippi State University, Starkville, MS

Herbicide Susceptibility and Resistance

Moderator: Michael D. Netherland, *APMS Editor 2003 - 2010, U.S. Army Engineer Research and Development Center, Gainesville, FL*

11:35 am **Herbicide Resistance in Aquatic Plant Management from 2000 - 2010: Changes and Challenges**
Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

11:50 am **Genetic Approaches to Studying Herbicide Response: Where We're at, and Where We Might Go**
Ryan Thum
Grand Valley State University, Annis Water Resource Institute, Muskegon, MI

12:05 pm **Molecular Approaches to Aquatic Plant Management**
Michael P. Shaner[1] and Tyler J. Koschnick[2]
[1]*SePRO Corporation, Whitakers, NC*
[2]*SePRO Corporation, Carmel, IN*

12:20 pm **Lunch on your own**

Session II

1:45 pm - 5:00 pm
Constellation CD

Emerging Threats

Moderator: Rob Richardson, *APMS Editor, North Carolina State University, Raleigh, NC*

1:45 pm	**Old Faces in New Places** **Rob Richardson** *North Carolina State University, Raleigh, NC*
1:55 pm	**Management Strategies for Water Chestnut (*Trapa natans*): A Historical Perspective** **Mark J. Lewandowski** *Maryland Department of Natural Resources, Annapolis, MD*
2:10 pm	**Flowering Rush (*Butomus umbellatus* L.): An Invader on the Move** **John D. Madsen** *Mississippi State University, Starkville, MS*
2:25 pm	**Another Bite from the Frogbit Family: South American Spongeplant (*Limnobium laevigatum*) Threatens Western Water Resources** **Lars W. J. Anderson** *U.S. Department of Agriculture - Agricultural Research Service, Davis, CA*
2:40 pm	**Santee Cooper Lakes - Aquatic Plant Management Program "Just When Things Were Going So Well"** **Richard (Larry) L. McCord** and Jefferson (Chip) M. Davis *Santee Cooper, Moncks Corner, SC*
2:55 pm	**Responding to Invasive Aquatic Plant Introductions in Florida** **Jeffrey D. Schardt** *Florida Fish and Wildlife Conservation Commission, Tallahassee, FL*
3:10 pm	**Refreshment Break** *(Constellation AB)*
3:40 pm	**Human Population and Climate Change, Anticipated Effects to Harmful Algal Blooms of Southcentral USA** **Daniel L. Roelke[1]**, Bryan W. Brooks[2] and James P. Grover[3] [1]*Texas A&M University, College Station, TX* [2]*Baylor University, Waco, TX* [3]*University of Texas, Arlington, TX*
3:55 pm	**Harmful Algae and Toxin Production: Knowledge to Focus Management** **West M. Bishop** *SePRO Corporation, Whitakers, NC*
4:10 pm	**Emerging Management and Regulatory Challenges of Invasive Starry Stonewort (*Nitellopsis obtusa*) in Michigan** **Lisa E. Huberty** *Michigan Department of Environmental Quality, East Lansing, MI*
4:25 pm	**Annual Business Meeting** **Linda Nelson** *President, Aquatic Plant Management Society*
5:00 pm	**Adjourn**

Poster Session

6:00 pm - 7:30 pm
Constellation AB

Suspected Endothall Tolerant Hydrilla (*Hydrilla verticillata*) in Florida *(Student Poster)*
Sarah Berger[1], Michael D. Netherland[2] and Greg MacDonald[1]
[1]*University of Florida, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Information on Cuban Bulrush (*Oxycaryum cubense* (Poeppe & Kunth) Palla) *(Student Poster)*
Amanda L. Fernandez, John D. Madsen, Ryan M. Wersal and Cheryl McLaurin
Mississippi State University, Starkville, MS

Development of a Small-scale Primary Screening Method to Determine Potential Impacts of the Protoporphyrinogen Oxidase Inhibiting Herbicides Flumioxazin and Carfentrazone-ethyl on Native and Non-native Submersed Plants
LeeAnn Glomski[1], Michael D. Netherland[2] and Christopher Mudge[3]
[1]*U.S. Army Engineer Research and Development Center, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Vicksburg, MS*

Search for New Management Techniques for Hydrilla and Hygrophila
Stacia Hetrick[1], Jim Cuda[2], William Haller[2], **Dean Jones**[1], Abhishek Mukherjee[2], Michael D. Netherland[3], and William Overholt[4]
[1]*University of Florida/IFAS Osceola County Extension Services, Kissimmee, FL*
[2]*University of Florida, Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*
[4]*University of Florida, Fort Pierce, FL*

The Effect of Weevil Stocking on Weevil and Milfoil Populations in Two Coastal Lakes *(Student Poster)*
Emily Lichte, Laura Brutscher and Michelle Marko
Concordia College, Moorhead, MN

Monoecious Hydrilla Phenology on Two North Carolina Lakes
Sarah True Meadows
North Carolina State University, Raleigh, NC

The San Marcos River: Section 206: River of Endangered Species and Invasive Aquatic Plants
Chetta S. Owens[1], Aaron Schad[2], LeeAnn Glomski[1], Lynde Dodd[2] and Jeff Tripe[3]
[1]*U.S. Army Engineer Research and Development Center, Lewisville, TX*
[2]*Univeristy of North Texas, Denton, TX*
[3]*U.S. Army Corps of Engineers, Fort Worth, TX*

Phenology of Flowering Rush and Hardstem Bulrush in Detroit Lakes *(Student Poster)*
Michelle Marko[1], Casey Olson[1], Samantha Dusek[1], **Emily Salo**[1] and John D. Madsen[2]
[1]*Concordia College, Moorhead, MN*
[2]*Mississippi State University, Starkville, MS*

Biosecurity Plan for Freshwater Aquatic Plants in Micronesia
Mark Sytsma[1], Rich Miller[1], Vanessa Morgan[1], Paul Champion[2] and John Clayton[2]
[1]*Portland State University, Portland, OR*
[2]*National Institute of Water and Atmospheric Research, Hamilton, New Zealand*

Comparative Response of Five Members of the Hydrocharitaceae Family to Varying Concentrations and Exposures of Aquathol K and Hydrothol 191 *(Student Poster)*
Leif N. Willey[1] and Michael D. Netherland[2]
[1]*University of Florida, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Tuesday, July 26

Tuesday's Agenda-at-a-Glance

6:30 am -	8:00 am	APMS Regional Chapters Presidents' Breakfast *(Pisces)*
		Sponsored by Helena Chemical Company
7:30 am -	8:00 am	Continental Breakfast *(Constellation AB)*
		Sponsored by Crop Production Services, Inc.
7:30 am -	5:00 pm	Registration *(Foyer A Side)*
7:30 am -	5:00 pm	Exhibits Open *(Constellation AB)*
7:30 am -	5:00 pm	Posters Open *(Constellation AB)*
8:00 am -	12:00 pm	Session III *(Constellation CD)*
9:35 am -	10:05 am	Refreshment Break *(Constellation AB)*
		Sponsored by SePRO Corporation
12:00 pm -	1:30 pm	Lunch on your own
12:00 pm -	1:30 pm	APMS Past Presidents' Luncheon *(Pisces)*
		Sponsored by Valent USA Corporation
1:30 pm -	5:00 pm	Session IV *(Constellation CD)*
3:15 pm -	3:45 pm	Refreshment Break *(Constellation AB)*
		Sponsored by SePRO Corporation
6:00 pm -	7:00 pm	Reception *(Spirit of Baltimore - Baltimore Inner Harbor)*
		Sponsored by Alligare, LLC
7:00 pm -	10:00 pm	Awards Banquet *(Spirit of Baltimore - Baltimore Inner Harbor)*
		Sponsored by Syngenta Professional Products

Session III
8:00 am - 12:00 am
Constellation CD

Algae Management
Moderator: Susan Wilde, *APMS Director, University of Georgia, Athens, GA*

8:00 am **Opening Comments**

8:05 am **Algae and Taste-and-Odor Issues in a Drinking Water Supply Lake: Intervention and Results**
John H. Rodgers[1], Russell Brown[2], David Issacs[3], Nathan Long[3], William A. Ratajczyk[4] and James C. Schmidt[4]
[1]*Clemson University, Clemson, SC*
[2]*Salem Water Works, Salem, IN*
[3]*Aquatic Control, Inc., Seymour, IN*
[4]*Applied Biochemists, Germantown, WI*

8:20 am **Cost of Different Pond Management Approaches and Effects on Trophic-Dynamics *(Student Presentation)***
Michael S. Sherman, Eric D. Dibble and John D. Madsen
Mississippi State University, Starkville, MS

8:35 am **Deep Water Mixing Prevents Harmful Algal Bloom Formation**
Natanya J. Hayden[1], **Daniel L. Roelke[1]**, Bryan W. Brooks[2] and James P. Grover[3]
[1]*Texas A&M University, College Station, TX*
[2]*Baylor University, Waco, TX*
[3]*University of Texas, Arlington, TX*

8:50 am **Investigating the Potential Transfer of an Unknown Algal Toxin from the Invasive Apple Snail, (*Pomacea insularum*) to the Florida Snail Kite (*Rostrhamus sociabilis*) *(Student Presentation)***
Shelley M. Robertson, Susan B. Wilde, Rebecca S. Haynie and James A. Herrin
University of Georgia, Athens, GA

9:05 am **Nutrient Fluctuations Induced through Manipulation of Aeration in a South Florida Retention Pond**
Amanda K. Quillen
Vertex Water Features, Pompano Beach, FL

9:20 am **Evaluating a Potential Link between a Known Neurotoxin, *beta*-N-methylamino-L-alanine (BMAA), and Avian Vacuolar Myelinopathy (AVM)**
Rebecca S. Haynie[1], Susan B. Wilde[1], James A. Herrin[1], Shelley Robertson[1], Robert R. Bidigare[2] and Stephanie Christensen[2]
[1]University of Georgia, Athens, GA
[2]University of Hawaii, Honolulu, HI

9:35 am **Refreshment Break** *(Constellation AB)*

Northeast APMS Sponsored Session

Moderator: JoAnn Dunlap, *President Elect NEAPMS, Cygnet Enterprises, Tunkhannock, PA*

10:05 am **The Costs of Aquatic Plant Management in New York State**
Charles W. Boylen[1], Nancy Mueller[2] and Scott A. Kishbaugh[3]
[1]Rensselaer Polytechnic Institute, Troy, NY
[2]New York State Federation of Lake Associations, Lafayette, NY
[3]New York State Department of Environmental Conservation, Albany, NY

10:30 am **Response of *Myriophyllum heterophyllum* and Non-Target Plants to Three Different Products: Navigate (2,4-D BEE Granular), Sculpin (2,4-D Amine Granular) and Renovate Max G (Triclopyr Amine and 2,4-D Amine Granular)**
Erika Haug[1], Marc Bellaud[1] and Amy Smagula[2]
[1]Aquatic Control Technology, Inc., Sutton, MA
[2]New Hampshire Department of Environmental Services, Concord, NH

10:45 am **The Successful Use of Sculpin G for the Targeted Control of Eurasian Water Milfoil (*Myriophyllum spicatum*) and Water Chestnut (*Trapa natans*), While Minimizing the Impacts on Protected Plants in Lake Musconetcong in New Jersey**
Chris Doyle
Allied Biological, Inc., Hackettstown, NJ

11:00 am **Phragmites Application Techniques for Sensitive Areas**
David L. Hardin
Restoration Ecological Services, Inc., Easton, MD

Hydrilla Management

Moderator: JoAnn Dunlap, *President Elect NEAPMS, Cygnet Enterprises, Tunkhannock, PA*

11:15 am **A New Molecular Tool for Rapid Detection of Fluridone Resistant Genotypes in *Hydrilla verticillata (Student Presentation)***
Lori K. Benoit and Donald H. Les
University of Connecticut, Storrs, CT

11:30 am **Nitrogen Exploitation and Its Role in the Explosive Growth of Hydrilla**
Michael Smart[1] and Dian Smith[2]
[1]U.S. Army Engineer Research and Development Center, Lewisville, TX
[2]University of North Texas, Denton, TX

11:45 am **Monoecious Hydrilla Subterranian Turion Sprouting Dynamics *(Student Presentation)***
Justin J. Nawrocki, Steve T. Hoyle, Jessica Scott and Robert J. Richardson
North Carolina State University, Raleigh, NC

12:00 pm **Lunch on your own**

Session IV
1:30 pm - 5:00 pm
Constellation CD

Chemical Control

Moderator: Craig Aguillard, *APMS Director, Winfield Solutions, Ville Platte, LA*

1:30 pm **Release Dynamics of Granular Herbicides in an Aquatic Environment *(Student Presentation)***
Brett W. Bultemeier and William T. Haller
University of Florida, Gainesville, FL

1:45 pm **Dissipation of Granular Triclopyr and Dye under High Water Exchange, Pend Oreille River, Idaho**
Toni Pennington[1], Harry Gibbons[1], Mark Heilman[2], Scott Shuler[2] and Terry McNabb[3]
[1]*Tetra Tech, Inc., Portland, OR*
[2]*SePRO Corporation, Carmel, IN*
[3]*AquaTechnex, Centralia, WA*

2:00 pm **Absorption and Translocation of ^{14}C-Aminocyclopyrachlor in Three Aquatic Species *(Student Presentation)***
Trevor D. Israel, Wesley Everman and Robert J. Richardson
North Carolina State University, Raleigh, NC

2:15 pm **Overview of Emerging Use Patterns for Management of Invasive Aquatic Vegetation with the ALS Herbicides Imazamox (Clearcast™) and Penoxsulam (Galleon™)**
Mark A. Heilman[1], John D. Madsen[2], Ryan M. Wersal[2] and Michael D. Netherland[3]
[1]*SePRO Corporation, Carmel, IN*
[2]*Mississippi State University, Starkville, MS*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

2:30 pm **Absorption and Translocation of Penoxsulam in Monoecious Hydrilla *(Student Presentation)***
Sarah True Meadows and Robert J. Richardson
North Carolina State University, Raleigh, NC

2:45 pm **Clipper Herbicide: Understanding New Management Options**
Jason C. Fausey
Valent USA Corporation, Green Springs, OH

3:00 pm **Fluridone, Penoxsulam, and Triclopyr Absorption by Eurasian Watermilfoil and Hydrilla *(Student Presentation)***
Joseph D. Vassios[1], Scott J. Nissen[1], Tyler J. Koschnick[2] and Mark A. Heilman[2]
[1]*Colorado State University, Fort Collins, CO*
[2]*SePRO Corporation, Carmel, IN*

3:15 pm **Refreshment Break** *(Constellation AB)*

Aquatic Ecology and Population Dynamics

Moderator: Joseph Vassios, *APMS Student Director, Colorado State University, Fort Collins, CO*

3:45 pm **Aquatic Community Responses to Different Plant Control Strategies in the Mississippi Alluvial Valley *(Student Presentation)***
Jonathan P. Fleming, Matthew R. Spickard, Eric D. Dibble and John D. Madsen
Mississippi State University, Starkville, MS

4:00 pm **Invasion Ecology of Eurasian Milfoil in Mobile Bay, AL: Factors Limiting Geographic Spread and Impacts on Higher Trophic Levels**
Charlie Martin and John Valentine
Dauphin Island Sea Lab, Dauphin Island, AL

4:15 pm **Distribution and Physical Habitat Characteristics of *Hygrophila polysperma* along the San Marcos River, Hays County, Texas *(Student Presentation)***
Casey R. Williams and Alan Groeger
Texas State University, San Marcos, TX

4:30 pm **Lake-wide Control of Invasive Aquatic Plants in Minnesota: Risks and Rewards**
Chip Welling
Minnesota Department of Natural Resources, Saint Paul, MN

4:45 pm **Invasion of *Alternanthera philoxeroides* - An Emerging Threat to the Wular Lake Integrity *(Student Presentation)***
Ather Masoodi and Fareed A. Khan
Aligarh Muslim University, Uttar Pradesh, India

5:00 pm **Adjourn**

Wednesday, July 27

Wednesday's Agenda-at-a-Glance

7:30 am - 8:15 am	Continental Breakfast *(Constellation AB)* *Sponsored by Vertex Water Features*
7:30 am - 12:00 am	Registration *(Foyer A Side)*
7:30 am - 10:30 am	Exhibits Open *(Constellation AB)*
7:30 am - 10:30 am	Posters Open *(Constellation AB)*
8:15 am - 12:00 pm	Session V *(Constellation CD)*
9:50 am - 10:20 am	Refreshment Break *(Constellation AB)* *Sponsored by Valent USA Corporation*
10:30 am - 12:00 pm	Poster and Exhibit Breakdown
1:00 pm - 4:00 pm	APMS Board of Directors Meeting *(Conway Room)*

Session V

8:15 am - 12:00 pm
Constellation CD

General Session
Moderator: Greg MacDonald, *APMS Past President, University of Florida, Gainesville, FL*

8:15 am **Opening Comments**

8:20 am **Tradewind Herbicide: Update on Laboratory and Field Studies**
Joe Chamberlin
Valent USA Corporation, Walnut Creek, CA

8:35 am **SAVEWS Jr. - A New Technique for Automated SAV Detection Using a Low-cost Acoustic Sounder**
Bruce M. Sabol and Wesley Johnson
U.S. Army Engineer Research and Development Center, Vicksburg, MS

8:50 am **Benefits and Limitations Using Fathometers to Monitor Herbicide Treatments for Submersed Plant Control**
Dean Jones[1], Jeremy Slade[2] and Michael D. Netherland[3]
[1]*University of Florida/IFAS Osceola County Extension Services, Kissimmee, FL*
[2]*United Phosphorus, Inc., Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

9:05 am **Evaluation of Herbicides for Control of Two Populations of the Submersed Growth Stage of Flowering Rush (*Butomus umbellatus* L.)**
Christopher R. Mudge, Angela G. Poovey and Kurt D. Getsinger
U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi

9:20 am **Selective Control of Water Hyacinth and Water Lettuce Growing among Bulrush**
Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

9:35 am **Attempts at Preventing the Growth of Submersed Aquatic Vegetation in Arkansas Bait and Ornamental Fish Culture Ponds: Year 2**
George Selden
University of Arkansas, Pine Bluff, AR

9:50 am **Refreshment Break** *(Constellation AB)*

General Session
Moderator: Terry Goldsby, *APMS Vice President, Aqua Services, Inc., Guntersville, AL*

10:20 am **3-Dimensional Outreach for Applicators, Citizens and Teachers: An Update from the Center for Aquatic and Invasive Plants**
Amy Richard and Karen Brown
University of Florida, Gainesville, FL

10:35 am **How to Control the Detrimental Effects of Eutrophication by Reducing Phosphorous and Therefore Reducing Algae Blooms to Help Meet Water Quality Standards and Control the Effects of Toxic Algae**
Seva Iwinski
Applied Polymer Systems, Woodstock, GA

10:50 am **Impacts of the Biocontrol Weevil, *Cyrtobagous salviniae* on the Decomposition of Kariba Weed, *Salvinia molesta* and Changes in Water Chemistry**
Naidu Kurugundla[1] and B. Mathangwane[2]
[1]*Water Affairs, Maun, Botswana*
[2]*Water Affairs, Gaborone, Botswana*

11:05 am **Science Policy Update**
Lee Van Wychen
Director of Science Policy, Weed Science Society of America, Washington, D.C.

11:20 am **AERF Update**
Carlton Layne
Executive Director, Aquatic Ecosystem Restoration Foundation, Marietta, GA

11:35 am **Regional Chapter Updates**
Northeast
Midwest
MidSouth
South Carolina
Texas
Western
Florida

12:00 pm **ADJOURN**

NEXT YEAR

52nd Annual Meeting
Little America Hotel
Salt Lake City, Utah
July 22-25, 2012

Abstracts

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

Another Bite from the Frogbit Family: South American Spongeplant (*Limnobium laevigatum*) Threatens Western Water Resources

Lars W. J. Anderson
U.S. Department of Agriculture - Agricultural Research Service, Davis, CA

The Hydrocharitaceae (aka "frogbit") family is well-known for including some of the most widespread and rapidly invasive submersed aquatic plants such as *Hydrilla verticillata*, *Egeria densa* and *Lagarosiphon major*. However, this family also contains some morphologically and distinctly different floating aquatic plants including native American Frogbit (*Limnobium spongia*) as well as the non-native, invasive Euopean Frogbit (*Hydrocharis morsus-ranae*). To this list of non-native invasive Hydrocharitaceae we can now add South American Sponge Plant (*Limnobium laevigatum*) thanks to relatively new introductions in California waterways. It had been found first in a small impoundment in Northern California in 2003, but in 2007, it was discovered in both the San Joaquin River, CA, which flows into the Sacramento-San Joaquin Delta, and in small colonies in the Delta-proper. Its rapid, clonal growth, prolific seed production, coupled with small, floating seedlings suggest that *L. laevigatum* has a very high potential for dispersal throughout the Delta system, which includes river flows as well as twice-daily tidal mixing. Dense mats can blanket large areas just as waterhyacinth does. Field observations and initial studies by USDA-ARS show this plant is quite cold tolerant and can produce net increases in cover even under short days (LD:12:12) at 12-14C. This new pest poses a serious threat to the commercial and recreational navigation in Delta waterways, and may impede water delivery to over 20 million Californians. If allowed to spread unchecked, it may further impair already compromised habitat needed to support endangered fish species in the Delta such as Delta smelt as well as waterfowl that depend on access to benthic organisms. USDA-ARS and California Department of Agriculture are taking rapid response actions, including physical removal of small colonies, and identifying effective herbicides. The California Department of Boating and Waterways water hyacinth control program personnel are also removing plants. Research to develop long-term management using biological control is planned by USDA-ARS through collaborations with its South American Biological Control Laboratory in Buenos Aires, Argentina. However, the most prudent approach is continued removal and application of effective herbicides, coupled with preventative measures to stop any sale and introductions in the U.S.

A New Molecular Tool for Rapid Detection of Fluridone Resistant Genotypes in *Hydrilla verticillata*

Lori K. Benoit and Donald H. Les
University of Connecticut, Storrs, CT

Florida *Hydrilla verticillata* (hydrilla) populations have shown an alarming increase in resistance to fluridone, the only herbicide available for systemic, whole-lake treatments. A rapid method to test for resistant hydrilla would be of great use to lake managers as resistant plants are spread to other waters, and new resistant populations continue to emerge. Previous work demonstrated that three different mutations in codon 304 of the phytoene desaturase (*pds*) gene confer resistance to the herbicide fluridone, while the wild type allele produces plants that are susceptible. We developed a rapid PCR and sequencing method to identify these resistant genotypes in hydrilla genomic DNA. An assortment of 88 hydrilla accessions was screened for fluridone resistant genotypes including 46 accessions from 17 different states and Washington, D.C. in the United States, as well as 42 accessions from 15 foreign countries. Polymorphisms at the first or second position of codon 304 indicated a heterozygous condition where both wild type and mutated alleles were present. In Florida, hydrilla from five of nine sites tested were herbicide resistant based on the *pds* mutations identified. Additionally, a new resistant population was identified from Lake Seminole in Georgia, the first molecular genetic confirmation of resistant hydrilla outside of Florida. All other samples of hydrilla tested possessed wild type alleles. Current testing methods to isolate fluridone-resistant hydrilla involve a time-consuming plant collection and herbicide testing procedure, or a cumbersome genetic method involving isolation of RNA, creation of cDNA, cloning and sequencing. Our new identification method efficiently replaces these methods, saving time, expense and effort while significantly increasing the accuracy to identify herbicide resistant strains.

Suspected Endothall Tolerant Hydrilla (*Hydrilla verticillata*) in Florida

Sarah Berger[1], Michael D. Netherland[2] and Greg MacDonald[1]
[1]*University of Florida, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Hydrilla verticillata (L.f.) Royle is the most managed aquatic weed in Florida. This submersed plant grows rapidly to overtake waterbodies, impeding flood control, inhibiting recreational use, and displacing native vegetation and wildlife. Hydrilla was previously controlled with fluridone herbicide until widespread resistance developed and was documented in the early 2000s. Endothall herbicide, a contact herbicide, is now the primary management option for public resource managers in Florida. The mechanism of action for endothall is unknown but increased cell leakage and subsequent necrosis have been documented. Aquathol™ (dipotassium salt) and Hydrothol™ (dimethylalkylamine salt) formulations of endothall are available with Aquathol™ accounting for the majority of endothall use in hydrilla control programs. In 2010, two lakes in Central Florida received large-scale Aquathol™ applications and a lack of hydrilla control was observed. As a result, hydrilla was collected from these lakes for more detailed analysis in mesocosm trials. The mesocosm trials suggested enhanced tolerance of this hydrilla compared to nine other strains of hydrilla collected in Florida. Given the time, space, and cost involved in conducting mesocosm trials, we sought to evaluate alternate analyses to determine if we could compare the response of different hydrilla populations to endothall at the laboratory scale. This analysis utilized ion leakage which proved to be a quick and relatively easy method for evaluating endothall tolerance. Plants were treated with Aquathol™ or Hydrothol™ formulations and conductivity was recorded for 7 days following treatment to quantify ion leakage for both the suspected tolerant hydrilla population and a known susceptible hydrilla population. Treatment rates for Aquathol™ and Hydrothol™ ranged from 0.25 to 8.33 ppm, which is up to two times the use rate of endothall. Major differences were observed between the two populations when exposed to Aquathol™. The tolerant hydrilla population showed only 12% leakage at rates two times the maximum label rate. The tolerant population also exhibited a differential response to the Hydrothol™ formulation, although the level was not as great as Aquathol™. The ion leakage method was able to quickly determine differences in cell leakage between accessions of hydrilla and will be a useful tool for future analysis of suspected endothall tolerant populations.

Harmful Algae and Toxin Production: Knowledge to Focus Management

West M. Bishop
SePRO Corporation, Whitakers, NC

Increased awareness of harmful algal blooms has spurred research to determine the likely causes and negative impacts associated therewith. Toxin producing cyanobacteria have received particular attention by the scientific community due to the ubiquitous distribution, number of genera that produce toxins, and diversity of toxins. The overall objectives of this presentation are: 1) to describe some recent revelations regarding harmful algae (specifically cyanobacteria) toxin production and competitive character; 2) to describe current toxins in terms of sources, exposures and resulting symptoms; 3) to evaluate key ecological components of cyanobacteria presence and toxin production; and 4) to review research associated with improved solutions to combat this growing problem. New findings indicated toxin production in more species and an array of toxin analogues with different functional impacts including endocrine disruption and central nervous system diseases. Environmental factors influence cyanobacteria intensity, though, understanding the critical or limiting factors (i.e. light, temperature, nutrients, flow) and applying to different cyanobacteria is ambiguous. As these toxins are produced for a purpose, the toxicological concerns are a vast and ever growing arena of research and management focus.

The Costs of Aquatic Plant Management in New York State

Charles W. Boylen[1], Nancy Mueller[2] and Scott A. Kishbaugh
[1]Rensselaer Polytechnic Institute, Troy, NY
[2]New York State Federation of Lake Associations, Lafayette, NY
[3]New York State Department of Environmental Conservation, Albany, NY

There are more than 7500 lakes and ponds in New York State greater than 2.4 hectares. Many are state owned and undergo little management. Because the introduction of invasive species has been mediated largely by human factors, the expense of aquatic plant control is borne by the public through lake associations. Getting a handle on the true cost of control measures statewide is difficult. The most definitive estimates come from members of the NYS Federation of Lake Associations (NYSFOLA). NYSFOLA was founded in 1983 and has a current membership of 200 lakes. A questionnaire sent to members has yielded responses from 60 lake association members. Data on methods of control, species targeted, direct and indirect costs (cost sharing on grants, volunteer labor), and years of management yielded a wide range of responses to be considered in this presentation. Currently a half dozen invasive species (the key species being Eurasian watermilfoil, curly-leaf pondweed and waterchestnut) are being managed by hand, mechanical and suction harvesting, herbicides and biological agents, either singly or in combination. Control is rarely achieved in 1-3 years of effort, often lakes have been managed for more than 20 years with recurring costs. There are upwards to 8-10 new aquatic plant species recently or near to introduction into the state, including frogbit, fanwort, Brazilian elodea and hydrilla. The number of lakes requiring management has increased yearly and costs have more than quadrupled in the past decade.

Release Dynamics of Granular Herbicides in an Aquatic Environment

Brett W. Bultemeier and William T. Haller
University of Florida, Gainesville, FL

Granular formulations of herbicides have been utilized in aquatics for many years and have been an essential part of many management strategies. There are approximately ten different granular formulations available for use in aquatics, ranging from shorter half-life contact herbicides, such as endothall, to the longer half-life systemic herbicides like fluridone. Many studies have been performed on herbicide dissipation, from granular and liquid formulations alike, but little work has been done to determine the factors that affect the release of the herbicide from the granule. Factors such as temperature, sediment type, and water movement potentially influence the release of herbicide from a granule. Under static conditions, in the laboratory, the amount of time required for 50% of the herbicide to release from the granule (ET_{50}) ranged from rapid, 12 h for Renovate OTF, to slow, 72 d for Sonar SRP. The four fluridone formulations tested varied significantly from each other requiring from 27 d to 72 d to release 50% of the herbicide, for Sonar Q and SRP respectively. Preliminary studies that were conducted similar to the static studies, but with the addition of gentle aeration to mix the water, yielded much different results. The addition of aeration (slight water movement) increased the ET_{50} of both Renovate OTF and Sonar SRP by >10x, and the other formulations to a lesser but still significant degree. Quantification of this water movement was achieved by exposing granules to flow rates of 0.00001 MPH and 0.001 MPH and comparing the release to static experiments. Triclopyr had increased release at 0.001 MPH requiring 3 h for 50% release, compared to 12 h under static conditions. The slowest flow was similar to static conditions, therefore greater than 0.00001 MPH is required to alter release from static conditions. Sediment interaction was also evaluated by repeating the procedures of the static experiments, but with the addition of a sediment layer. Although no binding to the sediment was identified, the addition of soil slowed the release of triclopyr from granules to 60 h for 50% release compared to 12 h under static conditions. Fluridone release on non-sterilized sediments was very minimal, with only 24% and 7% of the applied concentration, Sonar Q and SRP respectively, ever detected in the water column. Experiments with sterilized soil will be required to rule out degradation. Herbicide, granule type, water movement, and sediment all affected the release of herbicide from aquatic granules, and at the very least these results demonstrate a few of the factors that could impact herbicide availability for management purposes under field conditions.

Tradewind Herbicide: Update on Laboratory and Field Studies

Joe Chamberlin
Valent USA Corporation, Walnut Creek, CA

Tradewind Herbicide (bispyribac-sodium), from Valent USA Corporation, received EPA registration as an aquatic herbicide in early 2011. Tradewind is an ALS inhibitor, but is in a different chemical class than other ALS herbicides registered for aquatic use. Subsurface application of Tradewind at 30-45 ppb provides effective control of dioecious hydrilla for 4 months or more. Hydrilla biomass is significantly reduced when exposed to Tradewind at 45 ppb for as little as 2 weeks, but longer exposure times are more effective. As with other ALS inhibitors, combining Tradewind with a contact herbicide can improve the speed of hydrilla control. Based on mesocosm studies, a single foliar or subsurface application of Tradewind will suppress giant salvinia, but multiple applications or tank mixing with other herbicides will be required for effective control. Preliminary results from commercial application of Tradewind will be presented.

The Corps of Engineers Aquatic Plant Control Research Program

Al Cofrancesco
U.S. Army Engineer Research and Development Center, Vicksburg, MS

In 2012, the U.S. Army Corps of Engineers will eliminate funding for the Aquatic Plant Control Research Program. This program represents the last vestiges of activities funded under the Corps Aquatic Plant Control (APC) Program authorized by Section 104 of the River and Harbor Act of 1958. Over the last 53 years the Corps has worked with universities, state and federal agencies, and industry to promote the management of problematic aquatic plants. In 1996, the state cost share portion of this program was not funded by the administration, indicating it was the states responsibility to address management of problem aquatic plants. Over the last fifteen years many individuals and organizations have attempted to restore funding to the cost share portion of the program, but without success. The elimination of research funding in 2012 will remove all direct funding and virtually end the APC Program. This action will cause the Corps' research facilities in Mississippi, Texas, Florida, and Wisconsin to terminate all APC-funded research activities. If funding is not reinstated, the ability of the Corps of Engineers to conduct research on aquatic plant management will be greatly curtailed or eliminated. Many hope this does not occur however, it appears that Congress is not willing to intervene. This action will force states and communities to not only assume the expense for management of invasive aquatic plants but also fund research activities addressing these problems.

The Successful Use of Sculpin G for the Targeted Control of Eurasian Water Milfoil (*Myriophyllum spicatum*) and Water Chestnut (*Trapa natans*), while Minimizing the Impacts on Protected Plants in Lake Musconetcong in New Jersey

Chris Doyle
Allied Biological, Inc., Hackettstown, NJ

Lake Musconetcong is a 329 acre lake located in Morris County New Jersey. Since the 1950's, Eurasian water milfoil has been established throughout the lake. In 2008, an extensive water chestnut infestation was confirmed during a survey performed by Robyn Shannon, Ph.D. The 2008 survey also identified three New Jersey protected plants; Robbins pondweed (*Potamogeton robbinsii*), Flat-stem pondweed (*Potamogeton zosteriformis*) and white water lily (*Nymphaea odorata* ssp. *tuberosa*). In 2010, two Sculpin G applications were performed to target Eurasian water milfoil and water chestnut, respectively. Using the rake-toss methodology, the aquatic vegetation in the entire lake was surveyed at 225 GPS-referenced points both pre-treatment (May 5, 2010) and post-treatment (September 2, 2010). The aquatic vegetation survey results depicted control of the two invasive species with minimal impacts to the protected plants.

Clipper Herbicide: Understanding New Management Options
Jason C. Fausey
Valent USA Corporation, Green Springs, OH

Managing undesirable plants and vegetation growing in water is a challenge. Few new active ingredients for plant management have been introduced in the aquatics market in recent years. Clipper, which contains the active ingredient flumioxazin, is a new herbicide that was federally registered in December of 2010 by Valent USA Corporation for use in aquatics. Trials conducted by university researchers and the Army Corps of Engineers and 3 years of extensive Experimental Use Permit (EUP) studies have shown Clipper to be a valuable tool to selectively manage plants in water bodies. Clipper is a contact herbicide that blocks protoporphyrinogen oxidase (PROTOX), an enzyme of chlorophyll and heme biosynthesis. The speed of this reaction is rapid and influenced by several factors including temperature and sunlight, however under field conditions the results have been very predictable. Additional factors that determine the outcome following a Clipper application include placement of the herbicide (surface verses subsurface application) and application rate which the product is applied. Target species and stage of plant growth at application also are important factors to consider when applying this product. Clipper dissipates rapidly from the water column and does not accumulate in sediment. Clipper brings a new mode of action to the aquatics market and can be used to manage invasive and nuisance plants that applicators currently have few management options.

Information on Cuban Bulrush (*Oxycaryum cubense* (Poeppe & Kunth) Palla)
Amanda L. Fernandez, John D. Madsen, Ryan M. Wersal and Cheryl McLaurin
Mississippi State University, Starkville, MS

Cuban bulrush (*Oxycaryum cubense* (Poepp & Kunth) Palla) is a floating epiphytic perennial aquatic plant from South America and the West Indies. In the United States, Cuban bulrush is sporadically distributed in Florida, Louisiana, southern Georgia, southern Alabama, Mississippi, and coastal Texas. It forms floating mats that occur in freshwater ditches, marshes, ponds, lakes, rivers, and swamps. The mats impede navigation and recreational use by obstructing shorelines and access areas. Due to its tall epiphytic growth form, Cuban bulrush has been shown to overtake other aquatic vegetation such as water hyacinth. Beneath the mats, the habitat quality for aquatic organisms is degraded by increased organic matter and low dissolved oxygen. Research on control methods of Cuban bulrush is limited. The only herbicide recommended for control is 2,4-D at a rate of 4 quarts/acre. Although costly and labor intensive, shredders and harvesters can be used to remove large mats and tussocks of Cuban bulrush. There are no biological control options currently available. Since Cuban bulrush has the ability to overtake water hyacinth but further biological and ecological characteristics are unknown, future research should be conducted to better understand the basic biology and ecology of the plant, and develop effective management recommendations.

Aquatic Community Responses to Different Plant Control Strategies in the Mississippi Alluvial Valley
Jonathan P. Fleming, Matthew R. Spickard, Eric D. Dibble and John D. Madsen
Mississippi State University, Starkville, MS

Lakes in the Mississippi Aluvial Valley (MAV) in western Mississippi contain aquatic plant assemblages that provide essential habitat for fish and invertebrates. Unregulated plant assemblages and non-native invasive species, may be problematic for the overall fishery of these lakes if their densities exceed thresholds for maximum benefits. Although aquatic plant control strategies are diverse, ever changing, and increasingly more effective, the indirect impacts these control strategies may have on fish and invertebrate community structure are unknown or not well understood. In 2008, a series of lakes were subjected to two plant management regimes; herbicide (imazapyr) and biocontrol (grass carp). Fish (adult and juvenile) and invertebrate community along with physicochemical data were collected pre-treatment and then for two additional years post-treatment to assess any changes in aquatic faunal community structure and water quality among the treatment groups. Reference lakes were also used in this analysis to provide insights into the potential influences of each management strategy. Overall, the experiment has been problematic due to plant demographic and environmental stochasticity over the relatively short experimental period, making interpretation of results difficult and inconclusive. However, this study provides baseline information for future studies that attempt to assess the influences of different plant control strategies on the aquatic community.

Development of a Small-scale Primary Screening Method to Determine Potential Impacts of the Protoporphyrinogen oxidase Inhibiting Herbicides Flumioxazin and Carfentrazone-ethyl on Native and Non-native Submersed Plants

LeeAnn Glomski[1], Michael D. Netherland[2] and Christopher Mudge[3]
[1]U.S. Army Engineer Research and Development Center, Lewisville, TX
[2]U.S. Army Engineer Research and Development Center, Gainesville, FL
[3]U.S. Army Engineer Research and Development Center, Vicksburg, MS

During the process of evaluating potential use patterns of new aquatic herbicides, it is important to determine concentrations that impact target as well as non-target vegetation. There are currently several new herbicide modes of action being evaluated in the aquatic market, and determination of both efficacy and non-target plant selectivity is important in developing a use pattern. Conventional indoor walk-in growth chamber and mesocosm studies require large spaces, significant time (2 to 4 months) and labor resources, and study designs are typically limited by the number of aquaria or mesocosm tanks in the study space. Primary screens that provide data on the relative sensitivity of a species to a given herbicide can enhance the design of larger scale growth chamber and mesocosm studies. Given the cost, time, and limited number of replicates available in the larger systems, information that can improve study design is of significant value. Flumioxazin and carfentrazone-ethyl are protox inhibiting herbicides originally registered for broadleaf weed control in terrestrial systems; however, both have been registered by the USEPA for use in aquatic sites in recent years. Protox inhibitors such as flumioxazin and carfentrazone-ethyl disrupt chlorophyll synthesis by competing with protoporphyrinogen for binding sites on the protoporphyrinogen oxidase enzyme. Without available binding sites, protoporphyrinogen leaks into the cytoplasm and is converted to protoporphyrin IX when exposed to light. Protoporphyrin IX then reacts with oxygen to form singlet oxygen radicals that damage cell membranes causing them to leak. This leakage of electrolytes can be measured and used to determine herbicide injury of membrane disrupting and photosynthesis inhibiting herbicides. In our research, electrolyte leakage was measured for fifteen submersed aquatic plant species exposed to flumioxazin at 0, 200 and 400 µg ai L^{-1} and carfentrazone-ethyl at 0 and 200 µg ai L^{-1} in small-scale laboratory assays. In these assays, flumioxazin significantly increased electrolyte leakage for coontail (*Ceratophyllum demersum* L.), curly-leaf pondweed (*Potamogeton crispus*), Eurasian watermilfoil (*Myriophyllum spicatum* L.), fanwort (*Cabomba caroliniana* A. Gray), hydrilla (*Hydrilla verticillata* (L.f.) Royle), springtape (*Sagittaria kurziana* Glück), variable-leaf milfoil (*M. heterophyllum* Michx.) and water stargrass (*Heteranthera dubia* (Jacq.) MacMill.). Species that were not significantly impacted by flumioxazin included American pondweed (*P. nodosus* Poir.), elodea (*Elodea canadensis* Michx.), Illinois pondweed (*P. illinoensis* Morong), sago pondweed (*Stuckenia pectinata* (L.) Böerner), southern naiad (*Najas guadalupensis* (Spreng.) Morong), and wild celery (*Vallisneria americana* Michx.). Of the species tested, carfentrazone-ethyl only increased electrolyte leakage of coontail, Eurasian watermilfoil and variable-leaf milfoil.

Phragmites Application Techniques for Sensitive Areas

David L. Hardin
Restoration Ecological Services, Inc., Easton, MD

Restoration Ecological Services, Inc. was approached by the Maryland Department of Natural Resources in 2009 to control common reed, *Phragmites australis*, on a parcel of private property that contains a sea level fen. Sea level fens are a globally rare community type. This fen has been declared a Ecological Significant Area by the Maryland DNR due to its rarity as a community and also because it contains ten rare plant species including four that are listed as state threatened or endangered. Historically, the heart of the site was an Atlantic white cedar savanna and was the only known example of that community type in Maryland. The savanna area is currently an open marsh sea level fen. Much of the white cedar has died over the past 20 years due to brackish water intrusion from storms and sea level rise. This has also allowed phragmites stands of varying densities to invade much of the area, threatening the continued survival of the community type and the rare plant species. The site also contains a rose mallow/narrow-leaved cattail/swamp rose (*Hibiscus moscheutos - Typha angustifolia - Rosa palustris*) tidal marsh, Atlantic white cedar (*Chamaecyparis thyoides*) swamp and red maple/sweet bay magnolia (*Acer rubrum -*

Magnolia virginiana) swamp and red maple swamp. Phragmites has invaded all of these to varying degrees. Because of concerns with illegal plant collecting, the DNR has requested that site names, locations and names of the rare plant species not be used. Due to the number and unknown locations of the rare plant species, application methods that would minimize herbicide spread and drift were explored. These included use of the Thinvert ultra low volume system, wicking, and cut stem basal applications. Initial application within the fen occurred on August 10 and September 1, 2009. Thinvert applications were made to dense stands of phragmites using 8% Habitat (active ingredient imazapyr) in the thinvert carrier. Less dense stands were treated using a wick applicator filled with 33% Habitat and 2% methylated seed oil. Wick applications proved difficult due to the flexibility of the plants. Areas of individual scattered stems were treated by cutting the stem near the ground and applying 1-2 drops of 33% Habitat with 2% methylated seed oil. The fen was again treated in 2010 on May 19 using the Thinvert system and cut stem applications. Many of the stems at this time of year were too narrow to get good droplet application. As a result, short plants were treated using a 20% Habitat solution with 1% methylated seed oil in a hand spray bottle. While all areas treated have shown considerable reduction in live phragmites stems, those areas treated with Thinvert and cut stem applications appear to have the greatest reduction. None of the treated cut stems have resprouted. More importantly, the existing plant community does not show any signs of damage and is beginning to recolonize areas previous occupied by phragmites.

Response of *Myriophyllum heterophyllum* and Non-Target Plants to Three Different Products: Navigate (2,4-D BEE Granular), Sculpin (2,4-D Amine Granular) and Renovate Max G (Triclopyr Amine and 2,4-D Amine Granular)

Erika Haug[1], Marc Bellaud[1] and Amy Smagula[2]
[1]*Aquatic Control Technology, Inc., Sutton, MA*
[2]*New Hampshire Department of Environmental Services, Concord, NH*

Variable milfoil (*Myriophyllum heterophyllum* Michx) is considered to be the most problematic and widespread invasive aquatic plant in freshwater lakes and ponds in New Hampshire. Field studies conducted over the summer of 2010 sought to evaluate and statistically compare variations in the treatment efficacy of three different herbicides for the control of variable milfoil in New Hampshire waters. Two newly registered granular products, Sculpin (2,4-D amine granular) and Renovate Max G (triclopyr amine and 2,4-D amine granular) were compared with Navigate (2,4-D BEE granular), which is currently the preferred herbicide for variable milfoil control in New Hampshire. Experiments were conducted on Lake Winnisquam located in Laconia, New Hampshire. A single treatment plot for each of the products being tested and a single reference, no-treatment plot were established for the experiment. A point-intercept survey methodology was utilized to collect measurements within the four established plots of variable milfoil frequency of occurrence, relative abundance and biomass (fresh weight) and native species richness. Measurements were collected two weeks prior to treatment and again twelve weeks after treatment. No statistically significant difference in the control of variable milfoil was observed between the products tested for the measurements of variable milfoil frequency of occurrence, relative abundance or biomass. Native species richness data was inconclusive. For the three products tested, this experiment provides some empirical field-based evidence of similar product efficacy for the control of variable milfoil control in New Hampshire.

Deep Water Mixing Prevents Harmful Algal Bloom Formation

Natanya J. Hayden[1], **Daniel L. Roelke[1]**, Bryan W. Brooks[2] and James P. Grover[3]
[1]*Texas A&M University, College Station, TX*
[2]*Baylor University, Waco, TX*
[3]*University of Texas, Arlington, TX*

Inflows are linked to water quality, lower food web dynamics, and even the incidence of harmful algal blooms. It may be that inflows can be manipulated to improve water quality, especially in regards to toxic *Prymnesium parvum* blooms. However, water availability can sometimes be an issue limiting this approach to management, especially in arid climates. Utilizing source water from deeper depths to displace surface waters, however, might effectively mimic inflow events. We tested this notion by conducting in-lake mesocosm experiments with natural plankton communities where we manipulated hydraulic flushing. We found that *P. parvum* cell density can be reduced by 69% and ambient toxicity by 100% during pre-bloom conditions in the lake. During conditions of bloom development, population density was reduced by 53%, toxicity by 57%, and bloom proportions were never reached. Mechanisms that circumvented the formation and development of a bloom likely involved the alleviation of nutrient limitation and subsequent reduction in toxin production, hydraulic displacement of cells, creation of disturbances that disrupted phytoplankton succession, and enhanced zooplankton grazing.

Evaluating a Potential Link between a Known Neurotoxin, *beta*-N-methylamino-L-alanine (BMAA), and Avian Vacuolar Myelinopathy (AVM)

Rebecca S. Haynie[1], Susan B. Wilde[1], James A. Herrin[1], Shelley Robertson[1], Robert R. Bidigare[2] and Stephanie Christensen[2]
[1]*University of Georgia, Athens, GA*
[2]*University of Hawaii, Honolulu, HI*

Certain human neurological disorders may have an environmental component linked to cyanotoxins. Specifically, the neurotoxin *beta*-N-methylamino-L-alanine (BMAA), which is produced by wide genera of cyanobacteria, has been documented in brain tissues of victims of amyotrophic lateral sclerosis (ALS), Parkinsonism-dementia complex (PDC) and Alzheimer's. A recent study demonstrated that BMAA is produced by an unnamed cyanobacterium, in the Order Stigonematales, that has been linked to the wildlife disease Avian Vacuolar Myelinopathy (AVM). BMAA is capable of biomagnification in at least one terrestrial and several aquatic food chains. We collected samples representative of different trophic levels, including aquatic vegetation and associated alga, invertebrates, and waterbirds, from sites impacted by AVM and with no history of AVM to analyze for the presence of BMAA. The level of BMAA in these samples may indicate whether this toxin is the cause of AVM and if evaluation of potential human health risks in these systems is warranted.

Overview of Emerging Use Patterns for Management of Invasive Aquatic Vegetation with the ALS Herbicides Imazamox (Clearcast™) and Penoxsulam (Galleon™)

Mark A. Heilman[1], John D. Madsen[2], Ryan M. Wersal[2] and Michael D. Netherland[3]
[1]*SePRO Corporation, Carmel, IN*
[2]*Mississippi State University, Starkville, MS*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Starting in 2007, the first acetolactate synthase (ALS) inhibitor herbicides for in-water application to manage invasive aquatic plants were registered. The ALS herbicides imazamox (Clearcast™) and penoxsulam (Galleon™) were initially investigated for their ability to provide selective control of hydrilla in southern aquatic sites. Continued research and development of these herbicide technologies is demonstrating diverse use characteristics with potential technical benefits for management of many common invasive aquatic weeds including submersed species such as hydrilla and curly-leaf pondweed, problematic floating weeds such as hyacinth and salvinia, and emergent threats such as phragmites and flowering rush. While penoxsulam and imazamox share some common traits as aquatic herbicides including favorable toxicology and low use rates, they diverge in important ways with respect to herbicide uptake, metabolism, dissipation and plant response, which for some uses results in markedly different ways to utilize the two herbicides. Along with synthesis of past research, recent studies of concentration and exposure relationships and field performance, selectivity pertinent for different regional aquatic sites and application strategies, and general implications for long-term integration of these ALS herbicides into aquatic plant management programs will be discussed.

Lack of Hydrilla Infestation on Plant, Fish and Aquatic Bird Community Measures

Mark V. Hoyer
University of Florida, Gainesville, FL

The invasion of hydrilla into North America has provoked concern over loss of native flora and fauna and resulted in costly efforts to suppress hydrilla in lakes. We used two data sets to determine if common measures of ecosystem health; abundance, species richness, diversity and evenness were affected by the presence of hydrilla. Data Set 1 consisted of 27 Florida lakes, 11 of which had hydrilla present for approximately 4 to 8 years in varying abundances and 16 did not have hydrilla. Given the number of lakes, each was sampled only once in the summers of 1986-90 for community measures of aquatic plants, birds and fish. Data Set 2 consisted of 12 lakes, six with abundant hydrilla for over 23 years and six without hydrilla. These lakes were sampled every year (with a few exceptions due to weather conditions) between 1999 and 2006 for community measures of aquatic plants and fish. The results for both data sets show that presence of hydrilla had no statistically significant effect ($P > 0.05$) on all community measures tested (i.e., richness, diversity, abundance). These data suggest that hydrilla in these Florida lakes may occupy a mostly vacant ecological niche and has not affected the occurrence or relative composition of native species of aquatic plants, birds, and fish. These data will also open a general discussion of hydrilla management options. For example, do we ignore hydrilla, give hydrilla a green card and let it work or attempt to deport it as an illegal alien?

Absorption and Translocation of ^{14}C-Aminocyclopyrachlor in Three Aquatic Species

Trevor D. Israel, Wesley Everman and Robert J. Richardson
North Carolina State University, Raleigh, NC

Greenhouse studies were conducted to evaluate ^{14}C-aminocyclopyrachlor absorption and translocation in alligatorweed, water hyacinth, and water lettuce. Alligatorweed plants were treated at the seven-node stage, water hyacinth was treated at the five-leaf stage, while water lettuce was treated at the eight-leaf stage. All plants were oversprayed with non-labeled aminocyclopyrachlor at a rate of 0.14 kg ai/ha with 1% MSO. ^{14}C-aminocyclopyrachlor was then applied to a protected leaf, and plants were harvested at 1, 2, 4, 12, 24, and 96 HAT. Radioactivity was determined in the treated leaf, shoots above treated leaf, shoots below treated leaf, roots, and growing solution. Absorption was 17 and 79% in alligatorweed at 1 and 96 HAT, respectively. Absorption was 59% or greater at all harvest times for water hyacinth and water lettuce. In alligatorweed at 96 HAT, 43% of absorbed ^{14}C translocated to shoots above the treated leaf and 17% translocated to lower shoot tissue. Water hyacinth shoots above and below the treated leaf each contained 17% of absorbed ^{14}C at 96 HAT. For water lettuce at 96 HAT, 53 and 36% of absorbed radioactivity was located above the treated leaf and in the growing solution, respectively.

How to Control the Detrimental Effects of Eutrophication by Reducing Phosphorous and Therefore Reducing Algae Blooms to Help Meet Water Quality Standards and Control the Effects of Toxic Algae

Seva Iwinski
Applied Polymer System, Woodstock, GA

Eutrophication is caused by sources such as agricultural runoff, construction and other land disturbing activities, sewer overflows, and urban runoff. Runoff coming from these sources such as sedimentation and excess nutrient loads, including phosphorous, contribute to algal blooms and water quality impairment of Florida's water bodies. As aesthetic effects caused by Eutrophication may be unpleasant this does not even compare to the detrimental effects that turbid ponds, lakes and various water bodies can have on the health to humans living near the water body, aquatic organisms living within the water body and the overall ecosystem of the water body. Such negative effects include fine particulates that are a point of attachment for contaminants of not only nutrients but also bacteria, heavy metals, pesticides, and endocrine disruptors. These particulates make up turbidity which we measure in units called Nephelometric Turbidity Units (NTU's). Through various studies it has been found that as low as 10-100 Nephelometric Turbidity Units (NTU's) aquatic organisms will begin to show signs of stress. This happens through decreased light, food and oxygen, mechanical effects, and temperature increases due to darker water. Every pond and lake is its own separate ecosystem which organic turbidity such as algae and other aquatic plant life is a natural part of and can hold beneficial roles. If algae begin to grow exponentially due to cultural Eutrophication however and algae blooms occur or a pond holds a toxic algae it can threaten the health of the pond and the organisms that reside within it. High nutrient levels, such as phosphorous that produce algae blooms will eventually lead to vegetation that die and decay, which in turn use up available dissolved oxygen. Fish need oxygen to survive and if oxygen is depleted fish kills can result. Once we understand the effects turbidity has when it escapes into our waterways the next step is to determine what we can do to prevent this and if it has already occurred what we can do to remove it and clean the system up. The idea is to be proactive, not reactive. This is where Polymer Enhanced Best Management Practices (PEBMP's) come into play. Using anionic water soluble polymer technologies to enhance current best management practices (BMPs) we are able to greatly reduce sediment and nutrients (both organic and inorganic turbidity) from moving into a water body as well as reducing the amount of sediment and nutrients within a given water body. Two possible solutions are as follows: (1) capture or retain the sediment and nutrients before it can wash into a water body or (2) use polymer enhancement in conjunction with aeration systems, fountains, waterfalls, etc., to remove nutrients and turbidity from contaminated waters. Through various tests and case studies using polymer enhancement in conjunction with knows BMPs a 75-90 percent reduction in phosphorous has been found as well as a 95 percent reduction in total suspended solids (TSS) and NTU's. Therefore, what we will look at is common and effective Polymer Enhanced Best Management Practices (PEBMPs) that have been quantified and are currently being used across various geographical locations to control sedimentation at the source so that it is not transported into our waters and if it has been transported into our waters to perform water clarification to reduce turbidity. Such Polymer Enhanced systems will include: soil stabilization including polymer enhanced soft armoring applications, de-watering systems, pond and lake clarification including nutrient (primarily phosphorous) reductions, de-mucking, and SRBs (Sediment Retention Barriers).

Benefits and Limitations Using Fathometers to Monitor Herbicide Treatments for Submersed Plant Control

Dean Jones[1], Jeremy Slade[2] and Michael D. Netherland[3]
[1]*University of Florida/IFAS Osceola County Extension Services, Kissimmee, FL*
[2]*United Phosphorus, Inc., Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*

Monitoring short and long-term changes in submersed vegetation following large-scale herbicide applications for hydrilla control is important in determining efficacy, selectivity, and longevity of treatments. One low-cost method currently being used to evaluate efficacy and longevity of these treatments is data collection with a standard fishfinder (fathometer; Lowrance® HDS® 5 w/Lake Insight™ and StructureScan™). Data collection has been standardized and plant data can be collected on both short (<100 m) and long (>1000 m) transects through time. This recorded data can be analyzed to determine percent area covered (PAC) and percent volume infested (PVI) for submersed aquatic vegetation (SAV). PAC represents the number of soundings SAV is present and PVI is how much of the water column is occupied by those plants. While collecting data using this method is fairly quick and easy, analysis of the data is somewhat laborious and subjective. Therefore to determine similarity of data interpretation, we had 5 individuals (2 with experience analyzing fathometer data and 3 without) analyze the same randomized data and differently randomized data of the same transects. Transect data was collected from two treatment plots on Orange Lake (Marion Co.) prior to a herbicide treatment (May 20, 2010) and post treatment four consecutive months (June, July, August, September 2010). Results of comparative analyses suggest good similarity in interpretation of fathometer transects for both experienced and inexperienced users. Benefits of this method include the ability to rapidly capture data on a large spatial scale and to collect this information from the same areas through time. Limitations include the inability to distinguish submersed species, problems with collecting usable data when plants are dense and near the surface, and the labor associated with analyzing large numbers of transects. Collection of fathometer data is enhanced when it is combined with point intercept or plant biomass data.

Search for New Management Techniques for Hydrilla and Hygrophila

Stacia Hetrick[1], Jim Cuda[2], William Haller[2], **Dean Jones[1]**, Abhishek Mukherjee[2], Michael Netherland[3], and William Overholt[4]
[1]*University of Florida/IFAS Osceola County Extension Services, Kissimmee, FL*
[2]*University of Florida, Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Gainesville, FL*
[4]*University of Florida, Fort Pierce, FL*

Hydrilla and hygrophila are submersed aquatic weeds that can dominate water bodies, interfere with flood control, inhibit navigation, and alter plant communities if left unmanaged. They are both exotic, invasive plants that can cause serious environmental and economic impacts in Florida. In recent years, management of hydrilla has become more challenging due to the prevalence of a strain of hydrilla that is resistant to the herbicide fluridone (i.e., Sonar™). In 2006, a Demonstration Project on Hydrilla and Hygrophila was initiated in order to find new management techniques for hydrilla and hygrophila. Researchers have been evaluating new and existing herbicides for the effectiveness and searching for potential biological control agents as well as educating stakeholders. So far, this project has contributed to the registration of four new aquatic herbicides and several more are being evaluated for registration in the future. Monitoring of large-scale hydrilla treatments using registered herbicides has provided insight into the effectiveness of different combinations, application rates, and timing. In addition, several new potential natural enemies of hygrophila have been discovered and are being evaluated for host-specificity and effectiveness in controlling the plant. Researchers are also optimistic about the success of the hydrilla tip-mining midge, (*Cricotopus lebetis*), and it continues to be evaluated. Lastly, the results of the project are being communicated to the industry, public, and governmental partners through various demonstration and outreach strategies including a website, teacher workshops, field days, presentations for community groups and scientific meetings, exhibits at community events, and various publications.

Impacts of the Biocontrol Weevil, *Cyrtobagous salviniae* on the Decomposition of Kariba Weed, *Salvinia molesta* and Changes in Water Chemistry

Naidu Kurugundla[1] and B. Mathangwane[2]
[1]*Water Affairs, Maun, Botswana*
[2]*Water Affairs, Gaborone, Botswana*

The adult biocontrol weevil *Cyrtobagous salviniae* introduced in the fresh weed, *Salvinia molesta* infestations in the hippo pools along the Santantantadibe River in the Okavango Delta, Botswana were monitored and ascertained. The weevil successfully controlled the salvinia in hippo pools between 11 and 13 months. The abundance of weevils in kg fresh weight of the weed during the control process was in the range of 11 to 62 in number. The salvinia bud damage was between 87% and 92% at the time of sinking resulted in a significant relationship between the weed decomposition and the sediment accumulations, which was captured in the closed systems by setting up the plastic basins in one of the hippo pools. The leaching of nutrients into the water column determined during decomposition of salvinia indicate high content of TDS, EC, N, P, K, Na, Ca and Mg in the closed basin systems than in the open field water where they were neutralized. The restoration of wetlands with the indigenous vegetation as the result of successful biocontrol of salvinia in the area accelerated tourism and improved the water resources for the communities residing on the banks of the river.

Management Strategies for Water Chestnut (*Trapa natans*): A Historical Perspective

Mark J. Lewandowski
Maryland Department of Natural Resources, Annapolis, MD

Water chestnut *(Trapa natans)* is an aquatic plant native to Asia. Introduced to North America near Concord, Massachusetts in 1859, water chestnut became established in locations throughout the northeast and by the early 20th century was moving southward. Water chestnut first appeared in Maryland in the Potomac River near Washington, D.C. as a two-acre patch in 1923. The plant spread rapidly, covering 40 river miles within a few years. By 1933, 10,000 acres of dense beds extended from Washington, D.C. to just south of Quantico, VA. Water chestnut was recorded in the Bird River in Chesapeake Bay for the first time in 1955. The Maryland Department of Natural Resources (MD-DNR) used mechanical removal and an herbicide (2,4-D) to control the population. This effort was believed to have been successful, and no plants had been detected in vegetation surveys until summer 1997. Water chestnut was discovered on the Bird and the Sassafras Rivers during the summer of 1997. A massive mechanical and volunteer harvesting effort began on both rivers in 1999. Working from small vessels, canoes, and kayaks, approximately 100 volunteers worked for two weeks to remove 400,000 pounds of plants from the two rivers. Less than 1000 pounds of plants were removed from both rivers in 2000 with a much smaller work force, indicating that the 1999 removal efforts were successful in controlling the outbreak. Since 2001, the harvest effort decreased as the plant abundance declined. In 2010, after a record low harvest in 2009, biologists discovered large concentrations of plants interspersed with American lotus (*Nelumbo lutea*) on the Sassafras River. Large numbers of plants were discovered in remote areas, and given that the water chestnut seeds remain viable for years, it is likely to return for the next few years in these locations. The 2011 harvest efforts will focus mainly on harvesting from canoes and kayaks to remove the water chestnut among the lotus.

The Effect of Weevil Stocking on Weevil and Milfoil Populations in Two Coastal Lakes

Emily Lichte, Laura Brutscher and Michelle Marko
Concordia College, Moorhead, MN

Eurasian watermilfoil, *Myriophyllum spicatum*, is one of the most problematic invasive aquatic plants in North America. The milfoil weevil, *Euhrychiopsis lecontei*, is a native insect that lives both on exotic and native watermilfoils and can be used to control further spread of Eurasian watermilfoil if present in high enough densities. However, the effect of stocking milfoil weevil eggs and small larvae is unclear. We monitored weevil and watermilfoil populations in two lakes stocked with weevil eggs and larvae by EnviroScience, Inc. (Stow, Ohio). The East Mitigation Pond, a 1.4 ha pond located next to Capitol Lake in Olympia, WA was completely covered with Eurasian watermilfoil. It was stocked with approximately 12,000 weevils in August 2009. Indian Lake, a 79 ha lake in Sharon, CT plagued by many patches (often greater than 5 ha) of both Eurasian and/or variable-leaf watermilfoils (*Myriophyllum heterophyllum*). Eurasian watermilfoil patches already containing a healthy native weevil population were stocked from 2007 to 2009 with 31,500 weevils. The milfoil weevil was not found in the East Mitigation Pond prior to stocking and had a density of 0.321 +/- 0.064 weevils per stem one year after stocking. Milfoil density has decreased since stocking, but this may be due a salt water infusion that took place in March, 2010. In Indian Lake, weevil populations were higher on Eurasian than on variable-leaf watermilfoil ($F=34.32$, $p<0.0001$). The impact of weevil stocking in Indian Lake was confounded by many factors such as a healthy native weevil population, multiple stocking times and natural variation in watermilfoil densities.

Flowering Rush (*Butomus umbellatus* L.): An Invader on the Move
John D. Madsen
Mississippi State University, Starkville, MS

Flowering rush has been established in widely-spaced locations in North America since 1905, but has begun to spread beyond these longer-term populations in the past decade. Flowering rush can grow as both an emergent or submersed plant in habitats from moist soil flats to waters as deep as 10 feet. Flowering rush has both diploid and triploid populations. While diploid plants are capable of forming viable seed, thus far vegetative propagules are more important to spread than seed. Populations are scattered from Maine to the Saint Lawrence River, along the Great Lakes, and into the heartland of Wisconsin and Minnesota. Populations also occur in Flathead Lake, Montana downstream in the Flathead River, Lower Clark Fork River, and Pend Oreille Lake and River. Flowering rush is an herbaceous perennial plant, regrowing from rhizome buds. While a number of individuals have been working on tools to control flowering rush, no herbicide use patterns or protocols have been developed that are successful in controlling this plant. Flowering rush develops dense stands that exclude native vegetation, and may negatively impact fish spawning and survival of young-of-the-year fish. *Butomus umbellatus* is the only species in the genus *Butomus*, and is in the taxonomic family Butomaceae. Butomaceae is in the same order as arrowheads, and has only the one species.

To Manage or Not to Manage - That is the Question
John D. Madsen
Mississippi State University, Starkville, MS

The decision to manage populations of invasive plants have, in the past, mostly relied on the human-use impacts of these nuisance weed growths. Historically, we have relied on issues such as flood control, impairment of recreational and commercial navigation, disruption of hydropower generation, and other use issues. Taken alone, these are significant reasons to manage invasive aquatic plants. In the past two decades, the potential impacts of invasive plants on ecosystems and natural plant and animal communities have been considered in deciding on management. Often, natural resource management agencies are required to either permit the control of invasive plants, or undertake their control. Naturally, these agencies will be more concerned with the impacts of invasive plants on ecosystem services, plant and animal communities. While we have seen this trend coming, we have not answered the question of whether the management of these species is more beneficial than the potential loss of ecosystem services if selectivity is not achieved. I will examine three scenarios in which, based on the ecosystem services question alone, we should carefully evaluate management outcomes before proceeding: the presence of a federally-listed endangered species, management of weeds in a shallow, eutrophic lake, and management in systems without a suitable native replacement. While some research has been done on the impacts of invasive plants on native systems, more research is needed to address the concerns of natural resources management agencies.

Invasion Ecology of Eurasian Milfoil in Mobile Bay, AL: Factors Limiting Geographic Spread and Impacts on Higher Trophic Levels

Charlie Martin and John Valentine
Dauphin Island Sea Lab, Dauphin Island, AL

Biological invasions are among the most pervasive yet least understood of the consequences of the urbanization of estuarine ecosystems. In Mobile Bay, AL (USA), one invasive species of submerged aquatic vegetation (SAV), Eurasian milfoil (*Myriophyllum spicatum*), has proliferated to the point that it is reported to have triggered dramatic changes in ecosystem structure and function. Here, we present evidence of factors limiting its geographic spread and impacts on secondary production and fish and macroinvertebrate assemblages. The construction of a transportation corridor, locally known as the Mobile Bay Causeway, has been hypothesized to have reduced incidence of natural disturbances to the point that numerous milfoil persist in the upper reaches of this estuary. Here, we provide the results of field surveys and experiments designed to determine if the causeway facilitated the proliferation of milfoil throughout the Mobile-Tensaw Delta (MTD). Field surveys showed that the composition of SAV varies greatly with location in the MTD; SAV south of the causeway is dominated by a single native species, wild celery (*Vallisneria americana*), while milfoil, as well as other canopy-forming native species, dominates areas north of the causeway. We found no evidence that these differences in species composition were related to differences in salinity, sediment grain size composition along the causeway, nor competitive exclusion of the dominant native species by milfoil. We did, however, find a strong negative relationship between milfoil biomass and maximum wave force. These results suggest the causeway functions as a breakwater, reducing the penetration of large, wind-driven waves into oligohaline embayments north of the causeway. While biological invasions have been shown to trigger significant changes in the structure of some estuarine ecosystems, impacts of these invaders within the Mobile Bay estuary remain unstudied. To test this notion, we used field sampling to evaluate the extent to which milfoil has altered community structure of higher trophic levels via comparisons with two other native habitat-forming grasses, wild celery (*Vallisneria americana*) and water stargrass (*Heteranthera dubia*). While field distributions failed to detect differences in faunal composition between milfoil and stargrass habitats, significant differences between milfoil and wild celery habitats were found. These differences are likely related to the three-dimensional structurally complex habitat provided by milfoil and stargrass. Results from these studies provide important implications for the management of milfoil, as well as significant advances to our knowledge of the theoretical functioning of ecosystems invaded by this SAV.

Invasion of *Alternanthera philoxeroides* - An Emerging Threat to the Wular Lake Integrity

Ather Masoodi and Fareed A. Khan
Aligarh Muslim University, Uttar Pradesh, India

Biological invasions are already considered to be a vital threat to biodiversity. Freshwater bodies in Kashmir valley have already been introduced and naturalized with obnoxious fresh water plants. In the present research we report the diversity of macrophytic flora at multiple locations in Wular Lake. After three years of inventory and monitoring of the IVI of the species composition, we interestingly observe that *Alternanthera philoxeroides* had almost doubled in a span of two years. To our surprise *A. philoxeroides* is a very recent introduction in the region and reported first time from Wular Lake. Results indicate that with the invasion of *A. philoxeroides*, overall diversity of the lake increased initially in 2008, followed by decrease in 2010. Results from our study potentially point out that *A. philoxeroides* is a ‘high-risk’ invasive species that poses a significant threat to our aquatic biodiversity through its fast expansion. We warrant that urgent need for checking *A. philoxeroides* is needed and further monitoring of its expansion might give more clues regarding its management.

Santee Cooper Lakes - Aquatic Plant Management Program “Just When Things Were Going So Well”

Richard (Larry) L. McCord and Jefferson (Chip) M. Davis
Santee Cooper, Moncks Corner, SC

The Santee Cooper Lakes are man-made reservoirs constructed during the late 1930s to provide rural electrification and commercial navigation to the coastal plains of South Carolina. The system continues to provide hydro-electric generation and navigable passage from the capital city of Columbia to the port city of Charleston. The reservoirs total 160,000 surface acres with an average depth of fifteen (15) feet, excellent habitat for invasive

aquatic vegetation. Aquatic plant management operations, which began in the early 1940s, have targeted the usual invasive plants such as alligatorweed, water primrose, Brazilian elodea, water hyacinth, and hydrilla. By far the biggest success in the 70 year history of the program has been effective control of Hydrilla and establishment of native submersed vegetation throughout the system. In 2005 a new threat to native aquatic plant communities was identified in Lake Marion. Crested floating heart (*Nymphoides cristata*) was discovered growing in an isolated cove in the southeastern quadrant of the lake. Plant samples were sent to Dr. Colette C. Jacono, at the U.S. Geological Survey Center for Aquatic Resources Studies in Gainesville, FL for confirmation. This was the first occurrence of crested floating heart in the U.S., outside of Florida. After communications with researchers, chemical company representatives and applicators in Florida, control efforts began early in 2005 using several herbicides commonly applied to floating leaf vegetation. Results were very disappointing and created concern as to the potential spread of this invasive plant. Control efforts continued throughout 2006 with combinations of herbicides and surfactants producing only temporary control at best. In late summer of 2007, following several months of severe drought in the Southeast, the lake system experienced extremely low water levels. From early September of 2007 through March of 2008 nearly all infestations of crested floating heart were exposed to moist soil conditions at best. Lower than average winter temperatures while most of the plants were "high and dry" did little or no damage to infestations of this plant. Return of normal water levels in late 2008 showed increased spread of crested floating heart to new areas of the lake system. Although some positive results have been observed with tank mixes of systemic herbicides and adjuvants, this invasive plant continues to re-sprout from root crowns in treated areas and has spread to new areas around the system. In other efforts to combat the continued spread of crested floating heart within the reservoir system and beyond, Santee Cooper developed and distributed informational pamphlets, provided information for development of an EDRR Fact Sheet published by USGS, and requested, through SCDNR, that the plant be added to the South Carolina Noxious Weed List.

Monoecious Hydrilla Phenology on Two North Carolina Lakes

Sarah True Meadows
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 was 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 is ongoing.

Absorption and Translocation of Penoxsulam in Monoecious Hydrilla

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

Hydrilla (*Hydrilla verticillata* (L.f.) Royle) is a highly invasive aquatic weed that is continuing to spread across the United States, making new and improved control measures a priority. Penoxsulam (Galleon SC) is a selective systemic aquatic herbicide labeled for management of freshwater aquatic vegetation, but there has been little research on absorption or translocation in hydrilla, especially the monoecious biotype. In 2010 laboratory experiments were initiated to examine absorption and translocation of penoxsulam in monoecious hydrilla after shoot exposure to a treated water column. Tanks containing monoecious hydrilla plants were treated with 20 ppb ^{14}C-penoxsulam. Plants were then harvested, which consisted of separating above soil biomass from below soil biomass, at 6, 12, 24, 48, 96, and 192 hours after treatment (HAT). Harvested samples were processed and radioactivity of each sample was quantified. An additional set of monoecious hydrilla plants were pretreated with selected herbicides for either 24 or 48 hours prior to treatment with 20 ppb ^{14}C-penoxsulam. Pretreatments included 2.5 ppm endothall, 0.75 ppm copper, 0.5 ppm diquat, 10 ppb fluridone, or 100 ppb imazamox before ^{14}C-penoxsulam treatment. Plants from each pretreatment were harvested 48 HAT with ^{14}C-penoxsulam. Harvesting and data collection was the same as described above and each study was repeated once in time. In plants without pretreatment, penoxsulam absorption increased with time to 196 HAT, however, most absorption occurred within the first 48 HAT. Significantly more penoxsulam (~80%) remained in above ground tissue than was translocated to below ground tissue (~20%). For plants that were subjected to a pretreatment, herbicides applied prior to penoxsulam did not reduce absorption into above ground tissue from that of the no pretreatment control. Pretreatment with endothall resulted in greater absorption into above ground tissue than pretreatment with diquat or fluridone. Penoxsulam translocation to below ground tissue was lower with any pretreatment than from no pretreatment. Total penoxsulam recovered from plants was numerically greatest with endothall, although this did not differ from the control. Pretreatment with diquat or fluridone reduced penoxsulam recovery in plant tissue as compared to no pretreatment or endothall pretreatment. Additional research examines absorption of penoxsulam when applied in combination with endothall.

Evaluation of Herbicides for Control of Two Populations of the Submersed Growth Stage of Flowering Rush (*Butomus umbellatus* L.)

Christopher R. Mudge, Angela G. Poovey and Kurt D. Getsinger
U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi

Flowering rush, a perennial monocot introduced from Eurasia, has become invasive in the northern U.S. It grows as an emergent plant along shorelines and as a submersed plant in deeper water of lakes and rivers. Flowering rush can form monospecific stands, interfering with intended water uses and crowding out native plants. Aquatic herbicides may be an effective option to control flowering rush, yet little research on herbicide efficacy has been conducted. Since both emergent and submersed forms create nuisance conditions, both morphologies require independent control strategies. Therefore, three growth chamber trials were conducted at the U.S. Army Engineer Research and Development Center in Vicksburg, MS to determine the impact of subsurface herbicide applications on the submersed growth stage of flowering rush. In the initial trial, endothall (1500 and 3000 µg a.i. L^{-1}), diquat (370 µg a.i. L^{-1}), and flumioxazin (200 µg a.i. L^{-1}) were evaluated at various exposure times against subsurface growth stage of flowering rush plants collected in Minnesota. In the second trial, plants from Idaho were evaluated against flumioxazin (20 to 400 µg a.i. L^{-1}) for 12 or 24 hr exposures and endothall (3000 µg a.i. L^{-1}) for a 24 hr exposure. Both populations were exposed to 2,4-D (amine and ester) endothall, flumioxazin, triclopyr as well as combinations of triclopyr plus endothall, flumioxazin, and 2,4-D in the third trial. All diquat and endothall treatments resulted in a 75 to 95% reduction of Minnesota flowering rush shoots in the first trial, whereas none of the flumioxazin treatments provided control. None of the herbicide treatment significantly reduced root biomass. Endothall at 3000 µg a.i. L^{-1} (24 hr exposure) or flumioxazin at 400 µg a.i. L^{-1} (24 hr exposure) were the only herbicide treatments to reduce Idaho flowering rush biomass compared to the non-treated control. Combinations of triclopyr and flumioxazin provided 65% shoot biomass reduction of Idaho flowering rush and 82% shoot biomass reduction of Minnesota flowering rush, whereas flumioxazin alone provided 49% reductions of the Idaho plants and 63% reduction of the Minnesota plants. Endothall alone provided >70% biomass reduction of both populations; combinations of endothall with triclopyr boosted efficacy by 10% with biomass reductions >80% of both populations. Biomass reduction for the 2,4-D and triclopyr treatments ranged from 7 to 57% for the Idaho flowering rush and 27 to 52% for the Minnesota flowering rush. Triclopyr combined with 2,4-D amine in a 24 hr exposure reduced shoot biomass by 57% for Idaho plants and 35% for Minnesota plants. Results of these studies indicate many of these herbicides and herbicide combinations have potential to control flowering rush at the submersed growth stage.

Monoecious Hydrilla Subterranian Turion Sprouting Dynamics

Justin J. Nawrocki, Steve T. Hoyle, Jessica Scott and Robert J. Richardson
North Carolina State University, Raleigh, NC

Since the discovery of *Hydrilla verticillata* in the United States, much research has been conducted to find weaknesses in its life cycle. Most of this work has been done on the dioecious form, which has historically been the most prevalent and problematic. However, the monoecious form is rapidly expanding in range and significant differences may exist in the biology of the two biotypes. Recent research at North Carolina State University into the dynamics of monoecious hydrilla tuber sprouting has revealed interesting, and sometimes surprising results. Growth chamber trials have indicated similarities in sprouting of both biotypes under temperature and light manipulation. Research has also been conducted to determine the effect on tuber sprouting under exposure to a range of pH, salinity, or herbicides. Tubers sprouted in solutions with pH between 4.0 and 10.0 with few differences in initial growth. Tubers exposed to a salinity level of 24 part per thousand for 2 weeks sprouted when placed into a solution of deionized water, but did not sprout under constant salinity exposure. It was also observed that monoecious hydrilla tubers have multiple axillary buds preformed within dormant tubers that are capable of producing secondary shoots even when the terminal shoot is removed. These findings can help refine management plans to best exploit weaknesses in the biology of monoecious hydrilla.

A Session to Provide Different Perspectives on Invasive Aquatic Plants and Potential for Ecosystem Services

Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

Resource managers have been involved in a long-term and sometimes contentious debate with numerous stakeholder groups regarding the rationale for active management of invasive aquatic plants. There is also a history of tension between aquatic plant managers and fish and wildlife agencies concerning both the need for and scale of invasive plant management. Recently, the scientific debate on the justification for invasive plant management versus the potential for certain invasive aquatic plants to provide ecosystem services has gained momentum with numerous academic and agency scientists suggesting a potential positive role for invasive plants. This session has been organized to provide a range of perspectives to discuss the pros and cons of invasive plants in relation to their potential for providing site-specific ecosystem services. Aquatic plant management in the United States has evolved over the years and different regions and states often diverge in their views towards the need for aggressive invasive plant management and strategies for management. In some areas, proponents of invasive plants argue that these species are the only plants capable of providing habitat value in specific degraded systems or in many reservoir systems that are naturally lacking in native aquatic plants. Nonetheless, the benefit of an invasive plant to a given system must also be weighed in the context of the threat it may pose to surrounding water bodies in that region. In other situations, invasive plants can become established in systems of high native plant diversity and resource managers must weigh the potential negative impacts of the invasive versus the potential disturbance caused by the management activity. While numerous recent papers have been published showing a potential positive role for invasive plants in providing ecosystem services, there has been a comparatively sparse record of following up on earlier research that demonstrated the potential negative aspects of an invasive plant becoming established. While the members of APMS have a good record of developing strategies for managing invasive plants, there is a new need to focus on research that can support science-based decision making to justify management of invasive plants.

Herbicide Resistance in Aquatic Plant Management from 2000 to 2010: Changes and Challenges

Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

With the confirmation in 2000 of widespread fluridone resistance by hydrilla (*Hydrilla verticillata*) in Florida, a new chapter in aquatic plant management was opened. Initial research focus on the mechanism of resistance demonstrated that different somatic point mutations at a single in the phytoene desaturase (pds) gene were responsible for varying levels of tolerance to fluridone. While there were early predictions of these resistant plants spreading within and outside of Florida, fluridone resistance in hydrilla continues to be largely confined to large public waterbodies. Use patterns for hydrilla control in state waters changed abruptly in 2004, with a significant decline in fluridone use and a sharp increase in use of the contact herbicide endothall. In response to the fluridone resistance issue in Florida and reliance on a new single mode of action (endothall), there was a concerted effort by research, regulatory, and industry groups to bring new modes of action into aquatic plant management. Significant research efforts and regulatory studies were initiated in the mid 2000’s and by early 2011, there were 5 new active ingredients registered. The protoporphyrinogen oxidase (PPO) inhibitors carfentrazone and flumioxazin were registered in 2005 and 2010 respectively, and the acetolactate synthase (ALS) inhibitors penoxsulam, imazamox, and bispyribac were registered in 2007, 2008, and 2011 respectively. Paradoxically, it is unlikely that new herbicides would have been brought to the aquatic market without herbicide resistance occurring on an economically important invasive plant in the largest aquatic plant management program in the country. While bringing new modes of action into aquatics is a positive development, it is somewhat ironic that all of these new products target plant specific enzymes and are considered at an increased risk for resistance development. A third major development has been the discovery of hybrid watermilfoils and associated anecdotal accounts of increased herbicide tolerance. Recent research suggests some of these anecdotal observations may have a basis in fact as increased tolerance by hybrid watermilfoils to herbicides such as fluridone and auxin mimics is under active investigation. It is important that aquatic resource managers understand differences between terms such as resistance and tolerance, and also understand that molecular tools will likely play a role in future aquatic plant management activities.

Selective Control of Water Hyacinth and Water Lettuce Growing among Bulrush

Michael D. Netherland
U.S. Army Engineer Research and Development Center, Gainesville, FL

Use of herbicides for maintenance control of the invasive floating plants water hyacinth *(Eichhornia crassipes)* and water lettuce *(Pistia stratiotes)* in Florida water bodies has proven to be a successful and sustainable management strategy. Nonetheless, significant challenges remain in achieving selectivity when these plants are found intermixed in stands of bulrush (*Scirpus californicus* and *Scirpus validus*). Significant visual injury or control of large stands of bulrush can result in concerns from various stakeholder groups. Left unmanaged, the floating plants can result in serious damage to bulrush stands, so management in these zones is necessary. Given the recent registration of several new aquatic herbicides, we screened nine products (bispyribac, 2,4-D, diquat, endothall, glyphosate, imazamox, imazapyr, penoxsulam, and triclopyr) for their impact on hardstem and softstem bulrush to determine if any of the new registrations could provide improved selectivity in maintenance control programs. Key findings from this research include the following: 1) the current mainstays of the maintenance control program, 2,4-D and diquat, resulted in either significant visual injury or control of both species of bulrush at all rates evaluated; 2) the acetolactate synthase (ALS) inhibitors imazamox and penoxsulam showed strong activity on floating vegetation and good evidence of potential for selective use on hardstem bulrush at the lower end of the rate spectrum; and 3) water lettuce was hyper-sensitive to submersed concentrations of the protoporphyrinogen oxidase (protox) inhibitor flumioxazin. These results suggest that the ALS inhibitors show potential for selective control of floating vegetation that is intermixed in bulrush; however, the slow development of symptoms and extended time required to achieve control of floating vegetation would result in a challenge in incorporating these products into current maintenance control program. In large systems such as Lake Okeechobee, applicators rely on visual injury to determine plants that require treatment. Further research to improve visual symptoms on the target floating vegetation without increasing injury to bulrush is ongoing. The sensitivity of waterlettuce to flumioxazin at rates as low as 10 to 20 ppb, suggests a submersed approach may be economically feasible when targeting water lettuce growing intermixed in bulrush. This approach would require development of new application strategies and studies are currently ongoing to determine exposure requirements for control of water lettuce using a submersed approach.

The San Marcos River: Section 206: River of Endangered Species and Invasive Aquatic Plants

Chetta S. Owens[1], Aaron Schad[2], LeeAnn Glomski[1], Lynde Dodd[2] and Jeff Tripe[3]
[1]U.S. Army Engineer Research and Development Center, Lewisville, TX
[2]Univeristy of North Texas, Denton, TX
[3]U.S. Army Corps of Engineers, Fort Worth, TX

The San Marcos River (City of San Marco, Hays County, TX) is a spring-fed system, which originates from the Edwards Aquifer. Due to good water clarity, consistent temperatures and flows, a diverse community of native and nonnative aquatic plants has developed, including hydrilla (*Hydrilla verticillata* (L.f.) Royle), East Indian hygrophila (*Hygrophila polysperma* Nees. T. Anderson), and elephant ear (*Colocasia esculenta* (L.) Schott). It has been estimated that nearly 80% of native plants in the San Marcos have been replaced by introduced exotic species. In addition to impacts on native vegetation, there are five endangered or threatened species that live in Spring Lake and the upper end of the San Marcos River. These include the Texas blind salamander (*Typhlomolge rathbuni*), fountain darter (*Etheostoma fonticola*), San Marcos gambusia (*Gambusia goergei),* San Marcos salamander (*Eurycea nana*) and Texas wild rice (*Zizania texana*). Threats to the flora and fauna of San Marcos

River include decreased spring flow, urbanization, recreation, pollution, river alterations and nonnative species. The Section 206 San Marcos River Restoration Project is a cooperative partnership between the U.S. Army Corps of Engineers (SWF) and the City of San Marcos to incorporate various ecosystem restoration projects within and adjacent to the San Marcos River, Texas. These projects include, but are not limited to, riparian corridor restoration, in-stream aquatic ecosystem restoration, and wetland enhancement and creation. The Engineer Research and Development Center's Lewisville Aquatic Ecosystem Research Facility conducted a survey (August 2009) on the study site area of the San Marcos River to document location and areal coverage of introduced and native plants, including aquatic and riparian species. Ten exotic and fourteen native aquatic plant species were recorded on the San Marcos River. Introduced, exotic plant aquatic plants species occupied nearly three times as much area as native plant species (Exotic 40231 m^2, Native 14051 m^2). This survey was used to identify and quantify the San Marcos River's plant community in order to create a baseline for restoration efforts. Management of the invasive plants will require utilization of methods that do not harm existing native plant communities, particularly those listed as endangered.

Dissipation of Granular Triclopyr and Dye under High Water Exchange, Pend Oreille River, Idaho
Toni Pennington[1], Harry Gibbons[1], Mark Heilman[2], Scott Shuler[2] and Terry McNabb[3]
[1]*Tetra Tech, Inc., Portland, OR*
[2]*SePRO Corporation, Carmel, IN*
[3]*AquaTechnex, Centralia, WA*

The use of aquatic herbicides to control nuisance vegetation such as Eurasian watermilfoil (*Myriophyllum spicatum* L.) under high water exchange conditions (e.g., large river, run of the river reservoir, irrigation canals) can result in reduced efficacy due to rapid dissipation of the product from the target area. Granular formulations have been developed to prolong the effective contact and exposure time (CET) of herbicides near the target plant. A field demonstration was conducted in the Pend Oreille River, Idaho in August 2010 to compare the dissipation rates of concurrent applications of a granular formulation of triclopyr (3,5,6-trichloro-2-pyridinyloxyacetic acid, triethylamine salt) as Renovate™ OTF and the liquid inert dye Rhodamine WT. The inert dye was used as a surrogate for a liquid herbicide application. Two 4 ha plots were treated. Triclopyr was applied to both plots at 448 kg/ha (400 lbs/acre) with effective concentrations of 752 ppb and 962 ppb in Plots 1 and 2, respectively. Rhodamine dye was applied to both plots at 10 ppb. At 1, 4, 8, 12, 16, 24, 48, and 72 hours after treatment (HAT), 12 water samples were collected from the surface, middle, and bottom of each plot and measured for triclopyr and dye concentration. At the same time water samples were collected, acoustic Doppler current profiler (ADCP) technology was used to measure continuous three-dimensional velocity throughout the water column. Slightly higher water velocity was measured in Plot 1 (0.14 m/s) versus Plot 2 (0.12 m/s) with substantial eddy currents identified by ADCP in Plot 1. Results indicate that insufficient dye CET was observed in both plots. The half-life ($t_{½}$) of granular triclopyr in Plot 1 was 12h at the bottom of the water column and between 12 and 16h in Plot 2, also in the bottom of the water column. These data indicate that under the application rates and environmental conditions in the current study, liquid formulations lack sufficient CET and the granular formulation of triclopyr likely has moderate to sufficient CET at the bottom of the water column.

Nutrient Fluctuations Induced through Manipulation of Aeration in a South Florida Retention Pond
Amanda K. Quillen
Vertex Water Features, Pompano Beach, FL

With the goal of understanding how aeration may help control algae growth and otherwise benefit a lake, several water quality parameters were tracked following two startups and a shutdown of an aeration system in a 13-acre (5-hectare) retention pond. The existing system was turned off in the early spring of 2009, and the lake stratified normally as summer progressed. The system was restarted in June, after the lake had fully stratified. Water column BOD, ammonia and phosphates declined, which may be attributed to the measured increase in oxidation-reduction potential (ORP) at the sediment-water interface resulting from increasing dissolved oxygen. The system was turned off again in April 2010, and nutrients at the sediment-water interface began increasing immediately as the lake restratified. With another restart in late June 2010, the lake recovered even more quickly than the year before, suggesting that the duration of shutdown is an important factor in recovery time following startup. Proposals for future manipulation experiments and preliminary results from bacterial augmentation trials will also be discussed.

Three-Dimensional Outreach for Applicators, Citizens and Teachers: An Update from the Center for Aquatic and Invasive Plants

Amy Richard and Karen Brown
University of Florida, Gainesville, FL

Education and outreach is a long-term commitment involving constant attention and diligence. Since 1995, the UF/IFAS Center for Aquatic and Invasive Plants (CAIP) has been developing a variety of outreach strategies to reach a diverse, three-dimensional audience ranging from plant managers, to citizens, and educators throughout the state. Thanks to years of support from the FWC, Invasive Plant Management Section (formerly the DEP/BIPM), a strong public outreach component was established in the form of the *FWC-IFAS Plant Management in Florida Waters* website. Written, edited and served by UF-IFAS-CAIP, the newly upgraded site provides reliable information and easy access to invasive plant management resources for both plant managers (including applicators) and citizens. The new site also effectively communicates basic concepts about Integrated Plant Management, in compliance with new National Pollution Discharge Elimination System (NPDES) regulations proposed by the U.S. Environmental Protection Agency (USEPA). The third dimension of CAIP's outreach efforts involves an education initiative, launched in November 2005. The short-term goal is to inspire Florida educators to bring this important topic into their classroom and to provide the information and resources they need to teach the material with confidence. The long-term goal is to bolster the next generation with tools they need to become responsible environmental stewards. Toward this end, CAIP staff collaborated with dozens of teachers to develop curriculum about aquatic and upland invasive plants. The result was the production of several audio-visual presentations and a host of learning materials for use in the classroom. As well, an annual invasive plant teacher-training workshop, one of the first of its kind in the country, is hosted by CAIP and FWC each June. These PLANT CAMP workshops include field trips, hands-on plant identification activities, and classroom lectures—all designed to provide teachers with greater background knowledge and an opportunity to witness large-scale invasive plant infestations first-hand. To date, 160 teachers have been formally trained at the 5-day events. Recently, the CAIP outreach team developed an evaluation instrument to determine the effectiveness of these efforts. The results are encouraging: Nearly 85% of respondents have been teaching their students about invasive plants *since* they received training, representing a 47% gain from those who taught the subject *before* receiving training. The same gain was achieved with regard to teachers training fellow teachers. Participating teachers also expressed a greater awareness, understanding and acceptance of control methods including the use of herbicides. PLANT CAMP graduates have trained or introduced the topic of invasive plants to an estimated 1,169 teacher-colleagues and an estimated 17,679 students as a result of these efforts.

Investigating the Potential Transfer of an Unknown Algal Toxin from the Invasive Apple Snail, (*Pomacea insularum*) to the Florida Snail Kite (*Rostrhamus sociabilis*)

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

Invasive apple snails have been documented throughout 8 southeastern states. Based on recent morphological and genetic analyses, invasive apple snails collected in Florida have been identified as *Pomacea insularum,* the Island apple snail. Invasive apple snails disrupt aquatic food webs by outcompeting native snails and overgrazing aquatic ecosystems. The exotic snails may present an additional threat to southeastern aquatic ecosystems: the potential for accumulation and trophic transfer of cyanotoxins, which are common in systems the snails inhabit. The federally endangered Florida snail kite (*Rostrhamus sociabilis)* is particularly at risk in our proposed scenario. The Florida snail kite feeds almost exclusively on the native Florida apple snail, *P. paludosa*, but frequently feeds on *P. insularum* where native snails are unavailable. We investigated the the food-chain transfer of a cyanotoxin that has been linked to avian vacuolar myelinopathy (AVM), an often lethal neurologic disease that affects waterbirds and raptors. This cyanotoxin is produced by a previously undescribed cyanobacterium in the Order Stigonematales, which grows epiphytically on submerged aquatic vegetation (SAV), including the aquatic weed hydrilla (*Hydrilla verticillata*). Field-collected SAV, both with and without Stigonematales, was fed to apple snails in the laboratory. These snails were then fed to chickens, serving as a laboratory surrogate for the snail kite. The results of this study will indicate the potential for AVM transmission in a new food chain and inform managers of the risk to an already imperiled species, the Florida snail kite.

Algae and Taste-and-Odor Issues in a Drinking Water Supply Lake: Intervention and Results

John H. Rodgers[1], Russell Brown[2], David Issacs[3], Nathan Long[3], William A. Ratajczyk[4] and James C. Schmidt[4]
[1]*Clemson University, Clemson, SC*
[2]*Salem Water Works, Salem, IN*
[3]*Aquatic Control Inc., Seymour, IN*
[4]*Applied Biochemists, Germantown, WI*

Lake John Hay provides drinking water for the town of Salem, Indiana. This 200 acre reservoir is plagued by intermittent pulses of taste and odor (T&O) compounds that make treatment and production of potable water difficult. In 2010, the onset of T&O problems prompted a study regarding intervention. Samples were collected and potential algal producers of geosmin (*Planktothrix* and *Chrysochromulina*) were identified. A laboratory experiment (Algal Challenge Test) indicated that application of Algimycin - PWF at a concentration of ≥200 µg/L could significantly decrease the densities of the problematic algae. An initial application of Algimycin - PWF at 200 µg/L was made on May 4, 2010, and densities of *Planktothrix* and *Chrysochromulina* declined by approximately 90% based on results from pre- and post-application samples. Geosmin concentrations declined concomitantly from 55 ng/L to non-detectable levels post-application. The quality of water produced by the water treatment plant significantly improved and the difficulty treating the raw water from the lake declined after intervention with the algaecide. The number of complaint calls also decline post-application. Subsequent examination of algae distribution in the lake revealed elevated cyanobacteria densities and geosmin concentrations at depth (22 feet) near the water intake. An Algimycin – PWF application at depth using drop hoses reduced the cyanobacteria densities and geosmin concentrations. The amount of in-plant water treatment chemicals needed was reduced as were the number of complaint calls about T&O. Further study of the lake indicated that adaptive management of this water resource could be accomplished by monitoring geosmin concentrations and phytoplankton populations and initiating treatment prior to development of a problem prompting complaints. Strategic application of an algaecide can be an efficient and effective management option to suppress problematic algal infestations and restore water usage.

Human Population and Climate Change, Anticipated Effects to Harmful Algal Blooms of Southcentral USA

Daniel L. Roelke[1], Bryan W. Brooks[2] and James P. Grover[3]
[1]*Texas A&M University, College Station, TX*
[2]*Baylor University, Waco, TX*
[3]*University of Texas, Arlington, TX*

The effects of inflow on phytoplankton dynamics and assemblage structure have long been an interest of ecologists and resource managers, especially when they are linked to the incidence of harmful algal blooms. In the southcentral USA, *Prymnesium parvum* blooms have been linked to diminished inflows. Unfortunately, this region is predicted to get drier with climate change and human population growth, where inflows could be reduced by 60% in worse case scenarios. In this research, we employ data collected over many years from four lake systems (three impacted). Our findings show that such reductions in flow will result in a decrease in the number of inflow events above bloom thresholds ranging between 25% to 65% reduction. Furthermore, the occurrences of long duration inflow events, critical to lake flushing, will nearly disappear, e.g., inflow events lasting longer than 20 days decreased from 40 to 1. Our multivariate analyses of monitoring data from these lakes suggests that other factors might be harnessed to mitigate *P. parvum* blooms, which will likely be necessary in a drier future for this region. These include surface water flushing with deep waters, pH reductions, nutrient enrichment and altered ratio, and manipulation of foodweb structure.

Long-term Reductions in Anthropogenic Nutrients Link to Improvements in Chesapeake Bay Habitat

Nancy B. Rybicki[1] and Henry A. Ruhl[2]
[1]*U.S. Geological Survey, Reston, VA*
[2]*National Oceanography Centre, Southhampton, UK*

Submerged aquatic vegetation (SAV) is a critical habitat for invertebrates, fish and waterfowl, but SAV ecosystems are declining worldwide. Habitat restoration can improve biodiversity and ecosystem function, but recovery to pre-disturbance states is rare. The ability of environmental policy to address restoration is limited, in part, by uncertainty in the relationships between costly restoration and benefits. Here we present results from an

18-year field investigation (1990-2007) of SAV community dynamics and water quality in the Potomac River, a major tributary of the Chesapeake Bay. Light attenuation limits SAV abundance in Chesapeake Bay and other populated estuaries. River and anthropogenic discharges lower water clarity by introducing nutrients that stimulate phytoplankton and epiphyte growth, as well as suspended sediments. Efforts to restore Chesapeake Bay are often viewed as failing. Overall nutrient reduction and SAV restoration goals have not been met. In the Potomac River, however, reduced *in situ* nutrients, wastewater treatment effluent nitrogen, and total suspended solids were significantly correlated to increased SAV abundance and diversity. Species composition and relative abundance also correlated with nutrient and water quality conditions, indicating declining fitness of exotic species relative to native species during restoration. Our results suggest that environmental policies that reduce anthropogenic nutrient inputs do result in improved habitat quality, with increased diversity and native species abundances.

SAVEWS Jr. - A New Technique for Automated SAV Detection Using a Low-cost Acoustic Sounder

Bruce M. Sabol and Wesley Johnson
U.S. Army Engineer Research and Development Center, Vicksburg, MS

Previous work with a high-end calibrated acoustic sounder system and global positioning system (GPS) resulted in development of the Submersed Aquatic Vegetation Early Warning System (SAVEWS). This system demonstrated rapid and accurate detection and characterization of canopy height and coverage of rooted submersed aquatic vegetation (SAV); however, the high cost (over $20,000) of the hardware resulted in a limited user community. Since initial development, the cost of combined echosounder/GPS systems capable of generating digital output has fallen to less than $2,000. We have undertaken the task of developing a new processing algorithm to automate the characterization of SAV canopies using such a low-cost uncalibrated system. Fundamental differences in signal characteristics between the high- and low-cost acoustic systems have necessitated a very different algorithmic approach. We describe this approach and demonstrate some early processing results. The new algorithm (designated SAVEWS Jr.) is in beta testing by several organizations in different parts of the country. A final version will be implemented after this summer and made available to the aquatic plant management community next year.

Phenology of Flowering Rush and Hardstem Bulrush in Detroit Lakes

Michelle Marko[1], Casey Olson[1], Samantha Dusek[1], **Emily Salo[1]** and John D. Madsen[2]
[1]*Concordia College, Moorhead, MN*
[2]*Mississippi State University, Starkville, MS*

Flowering rush, *Butomus umbellatus,* is an invasive plant species that has been present in the Detroit Lakes system (Becker County, Minnesota) since the 1960's. It is an emergent plant present in the littoral zone that reproduces primarily by asexual budding of rhizomes. Past control efforts consisted of digging up flowering rush beds in the 1980's and herbicide application in the 1990's. We measured above- and below- ground biomass of flowering rush relative to growth of the native hardstem bulrush, *Schoenoplectus acutus,* in order to understand the phenological differences between the two species. This experiment consisted of four plots, corresponding to Big and Little Detroit Lakes, Lake Sallie, and Curfman Lake (Becker County). The site selection was made in conjunction with the Minnesota DNR Fisheries and Invasive Species programs to prevent damage to sensitive habitats, such as fish spawning sites. Every three weeks throughout the summer, samples were taken from each site using a 6" diameter corer. Samples were washed, and separated into: emergent leaves, submersed leaves, flowers and rhizomes. Both wet and dry biomass was recorded as well as the plant height and number of ramets, bulbils, and rhizome buds present in each sample. Understanding the timing of flowering rush plant emergence and carbohydrate allocation relative to water temperature and the growth of hardstem bulrush will be important to identifying effective treatment methods.

Responding to Invasive Aquatic Plant Introductions in Florida
Jeffrey D. Schardt
Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

Florida's subtropical climate provides ideal conditions to import and cultivate aquatic and wetland plants for horticultural and agricultural purposes. Other non-native plants have arrived in Florida unintentionally; for example in ship ballast or as propagules mixed with other plant material. While most plant introductions have proven benign, there are numerous examples of invasive plants establishing in Florida's aquatic and wetland sites. More than $18 million were spent managing 12 invasive aquatic plants in Florida's 1.25 million acres of public lakes and rivers during 2010. Among the most prolific of these species are floating water hyacinth (*Eichhornia crassipes*), submersed hydrilla (*Hydrilla verticillata*), and emergent torpedograss (*Panicum repens*). In Florida, federal agencies inspect imported plant shipments and state inspectors monitor aquatic plant nurseries for plants on the federal noxious weed list and state prohibited plant list. However, invasive plants still find their way into public waters. Florida's Fish and Wildlife Conservation Commission (FWC) field staff routinely monitors all public waters for known invasive aquatic plants and for new occurrences of any non-native aquatic plant. FWC also works closely with natural resource and water management agencies as well as university and not for profit organization personnel who monitor aquatic habitats and may have information on new plant sightings. FWC has the authority to enter upon private property to inspect or control aquatic plants and has contractors available to manage plants on short notice in all waters within the state. FWC initiates eradication efforts for new discoveries of known invasive plants in all Florida waters. For invasive plants like hydrilla or water hyacinth that are widespread throughout Florida, FWC initiates eradication efforts for newly discovered infestations in public lakes and rivers where these plants are not yet established.

Attempts at Preventing the Growth of Submersed Aquatic Vegetation in Arkansas Bait and Ornamental Fish Culture Ponds: Year 2
George Selden
University of Arkansas, Pine Bluff, AR

Submersed aquatic vegetation continues to be a major problem in the culture of bait and ornamental fish in Arkansas. Attempts to control their growth at the time of pond filling and fry stocking can be quite expensive and have a negative impact on the farms profitability. In 2010, low rates of fluridone were applied at the time of pond filling with some success. In 2011, the fluridone rate was reduced to below 5ppb, and two additional herbicides (2,4-D & triclopyr) were tested for effectiveness when low rates were added at the time of pond filling.

Molecular Approaches to Aquatic Plant Management
Michael P. Shaner[1] and Tyler J. Koschnick[2]
[1]*SePRO Corporation, Whitakers, NC*
[2]*SePRO Corporation, Carmel, IN*

The development of molecular techniques in other research fields is enabling better identification of plant species, research of molecular pathways necessary for plant survival, discovery of new herbicides and engineering of plants with desired traits. These techniques are often coupled with genomics that provide a powerful research and management tool. Such tools could provide a cogent comprehension of aquatic weed management, population biology of weeds, herbicide resistance mechanisms and herbicide modes of action. Additionally, molecular approaches allow identification of new herbicide target sites and potentially new herbicide modes of action. For instance, molecular methods are being utilized for identification of invasive and non-invasive weeds and determination of phylogenetic relationships. It is the selection of molecular markers that makes identification and phylogenetics possible. The selection of molecular markers requires variation, and this variation needs to be relevant to questions that are posed. Utilization of genetic based research could prove very useful in managing aquatic plants. As an example, genetic research has provided managers with evidence of hydrilla (*Hydrilla verticillata*) biotypes with differential response to the herbicide fluridone, revealing that the phytoene desaturase gene (pds) has multiple mutations within the 304th codon, causing amino acid substitutions. These pds gene mutations can serve as molecular markers for hydrilla management. A new molecular based tool (GenTEST*) will be discussed which accurately identifies hydrilla biotypes. The GenTEST* allows for rapid identification of hydrilla biotypes and the subsequent susceptibility to Sonar aquatic herbicide (a.i. fluridone). In this presentation, molecular techniques that could have significant implications for aquatic plant management will be reviewed and discussed.

Cost of Different Pond Management Approaches and Effects on Trophic-Dynamics

Michael S. Sherman, Eric D. Dibble and John D. Madsen
Mississippi State University, Starkville, MS

Mississippi has an abundance of ponds and small impoundments which provide a number of opportunities for anglers. Several enhancement strategies are used to improve fish production in ponds, including fertilizing and supplemental feeding. These strategies may ignore the potential ecological impacts that may unexpectedly arise such as prolific plant growth and potentially detrimental algal blooms. In addition, although these strategies are regularly applied they may overlook associated economic costs, such as algae and nuisance plant control. This ongoing study consists of two phases; first, a mesocosm experiment to investigate fertilizer application rates (mg/L) in relation to potential fish productivity, and second, a pond experiment consisting of four treatments to simulate commonly used pond management strategies. Ponds will be surveyed to assess treatment effects on abundance and species diversity of algae, macrophytes, zooplankton, and macroinvertebrates. The costs associated with each pond management strategy will be documented in order to relate the economical costs to the potential benefits for fish production and overall impact on the aquatic community. This research will be used to refine current pond management recommendations to maximize results while minimizing costs to landowners and ecosystems.

Nitrogen Exploitation and Its Role in the Explosive Growth of Hydrilla

Michael Smart[1] and Dian Smith[2]
[1]*U.S. Army Engineer Research and Development Center, Lewisville, TX*
[2]*University of North Texas, Denton, TX*

Hydrilla verticillata, a rooted submersed aquatic plant native to Southeast Asia, has spread throughout the southern U.S., continuing northward and westward. Hydrilla has been particularly successful in invading large, multipurpose, reservoirs – often occurring in large monospecific expanses. Man-made systems are susceptible to invasion because they generally lack competing native plants and often contain fertile sediments that have accumulated over many years. While hydrilla is quite efficient at nutrient uptake, it is not so well adapted for nutrient retention, and much of its accumulated store is lost during winter senescence. This profligate mode of growth should ultimately lead to hydrilla's replacement by more conservative species. Hydrilla often invades, spreads rapidly, grows to great excess, and then declines over a period of years. One possible explanation for this pattern is that accumulated nutrients, which fuel excessive early growth, ae rapidly depleted. Because nitrogen has been shown to be the most likely limiting nutrient, we studied the influence of sediment (and water) nitrogen supply on growth and nutrient uptake of hydrilla and determined "critical" (limiting) shoot nitrogen concentration as a diagnostic indicator of plant nutritional status. In greenhouse tank experiments, hydrilla growth was unresponsive to additions of nitrogen to either sediment or water, indicating that even ambient (low) levels of nitrogen were adequate to support problem-level growth. Shoot nitrogen concentrations did decrease to a critical level under the lowest levels of supply, but this did not adversely affect biomass production, indicating that other factor(s) limited growth. In an additional experiment, we show that availability of inorganic carbon limited hydrilla's ability to convert accumulated nitrogen into shoot biomass. Given adequate inorganic carbon, hydrilla readily exploits either sediment- or water-supplied nitrogen. Finally, in a pond experiment simulating a new infestation in which inorganic carbon should **not** have been limiting, growth of hydrilla was, yet again, largely unaffected by sediment nitrogen. While nitrogen supply should ultimately limit biomass development in hydrilla, efficient uptake mechanisms, a stoloniferous growth form, and a relatively low tissue nitrogen requirement enable this species to develop problem levels of biomass even under conditions of low nitrogen availability.

Biosecurity Plan for Freshwater Aquatic Plants in Micronesia

Mark Sytsma[1], Rich Miller[1], Vanessa Morgan[1], Paul Champion[2] and John Clayton[2]
[1]*Portland State University, Portland, OR*
[2]*National Institute of Water and Atmospheric Research, Hamilton, New Zealand*

Freshwater resources are extremely limited on small islands in Micronesia. We developed a biosecurity plan for freshwater aquatic plants in Micronesia as part of a larger effort to address the threat of invasive species to freshwater resources associated with a military buildup on Guam. Literature reviews and field surveys on islands with significant freshwater resources were conducted to develop weed risk assessments, current regulation were evaluated, pathways and vectors were assessed, and recommendations were made on prevention of new introductions and management of existing invasive freshwater aquatic plants. Weed Risk Assessment scores were calculated for 95 potential IAPS taxa using the Aquatic Weed Risk Assessment Model of Champion and Clayton (2000). The top 12 ranked scores were assigned to species that were already naturalized or native to Micronesia. Three native species were among the nine species with scores >100, including *Phragmites vallatoria*, a widespread and dominant wetland species, *Panicum repens* and *Ceratophyllum demersum*. The latter two species may be cryptogenic. They were of very limited distribution, with only one site of *P. repens* seen during the field visits. The remaining six species with scores >100 were limited in distribution, including the first naturalized record of *Monochoria vaginalis* in Micronesia and the first naturalized records of *E. crassipes* (the highest ranked species) and *Pistia stratiotes* (the third-highest ranked species) from Pohnpei. Of the 33 species scoring ≥80, ten were found or reported to be in cultivation in Micronesia, and either not naturalized or of limited distribution, including the first naturalized population of *Salvinia natans* in Guam. These results suggest that the greatest risk from potential invasive freshwater plants comes from species that have already arrived across the Micronesian border. These species represent an immediate economic, social and ecological risk and require management. Of the 33 species scoring ≥80, ten have not been recorded from Micronesia. These were (in decreasing order of risk) *Mimosa pigra, Azolla pinnata, Alternanthera philoxeroides, Salvinia molesta, Eichhornia azurea, Azolla filiculoides, Myriophyllum spicatum*, *Typha angustifolia*, *Limnocharis flava* and *T. latifolia*. Specific recommendations on coordination, prevention, early detection and rapid response, and education and outreach were included in the plan. These recommendations included, among other things, adoption of the informal “white list” of freshwater plants on Guam in rule or statute, support of ongoing invasive species management efforts across the region, and enhancement of the ability to detect and respond to freshwater plant invasions regionally.

Fluridone, Penoxsulam, and Triclopyr Absorption by Eurasian Watermilfoil and Hydrilla

Joseph D. Vassios[1], Scott J. Nissen[1], Tyler J. Koschnick[2] and Mark A. Heilman[2]
[1]*Colorado State University, Fort Collins, CO*
[2]*SePRO Corporation, Carmel, IN*

The invasive species Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM) and hydrilla (*Hydrilla verticillata*) are submersed species that are found across much of the United States. Both of these species are perennial, but exhibit an annual growth habit, forming dense mats that can impact water quality. An ongoing series of experiments have been examining herbicide absorption and translocation in these species using radiolabeled herbicides. Herbicides evaluated include fluridone, penoxsulam, and triclopyr. For the first experiments, translocation to the roots was examined following herbicide exposure in the water column. Plants were treated with 10 ppb fluridone, 10 ppb penoxsulam, or 1 ppm triclopyr plus radiolabeled herbicide. Plants were then harvested over a 192-hour time course. Experiments were also conducted to examine translocation to shoots following root exposure to the same three herbicides. Plants each received 200,000 dpm of radiolabeled herbicide, and were harvested over a 192-hour time course. Upon completion of all experiments, plants were harvested, dried, oxidized, and radioactivity quantified using liquid scintillation spectroscopy. Overall, herbicide absorption by EWM was two to four times greater than hydrilla. Shoot to root translocation of all herbicides was relatively limited with 97% and 87% or greater remaining in the shoots for EWM and hydrilla, respectively. For both species, triclopyr showed the greatest absorption over the 192-hour time course. Following root exposure, fluridone absorption was greatest, but translocation to shoots was greater for penoxsulam and triclopyr (approximately 20%).

Lake-wide Control of Invasive Aquatic Plants in Minnesota: Risks and Rewards

Chip Welling
Minnesota Department of Natural Resources, Saint Paul MN

Minnesota has a long history of partial lake treatments with herbicides done by lake-shore property owners to control aquatic plants to gain access to open water. For treatments like these, the role of the Minnesota Department of Natural Resources (MnDNR) has been to limit control to protect plants for benefits they provide to lake ecosystems. In 1987, Eurasian watermilfoil was discovered in Minnesota and soon became a serious problem in several heavily–used lakes. This led to the MnDNR to undertake lake-wide treatments with herbicides to control invasive aquatic plants. In some cases, these treatments have provided benefits including reductions in interference for users and increases in native plants. In other cases, lake-wide treatments have been followed by decreases in the water clarity and the amount of submersed vegetation in the lake. Examples of various outcomes on specific lakes will be discussed.

Comparative Response of Five Members of the Hydrocharitaceae Family to Varying Concentrations and Exposures of Aquathol K and Hydrothol 191

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

The Hydrocharitaceae or frog's-bit family contains several submersed monocotyledonous plants. The invasive plants hydrilla (*Hydrilla verticillata)* and Brazilian elodea (*Egeria densa)* have very similar morphology to the native plant elodea (*Elodea Canadensis)* and these species can often be difficult to distinguish. In contrast, vallisneria (*Vallisneria americana)* is a widespread native member of this family that grows from a basal rosette and therefore has a unique growth form compared to the species mentioned above. Despite the similar morphology, it has been noted that hydrilla is the only member of this family that shows a consistent response to Aquathol K™ (a dipotassium salt formulation containing the active ingredient endothall). In contrast, Hydrothol 191™ (a dimethylalkylamine salt formulation containing endothall) has been reported to be active on all members of this family. We evaluated the comparative activity of Aquathol K™ and Hydrothol 191™ on five members of the Hydrocharitacaeae family (egeria, elodea, dioecious hydrilla, monoecious hydrilla, and vallisneria) in a mesocosm trial. Research was conducted at the University of Florida Center for Aquatic and Invasive Plants, Gainesville, Florida in October 2010 to determine if there were significant differences between the two herbicides at varying concentrations and exposure times (CET). Plants were initially established in 60 ml culture tubes filled with potting soil and tubes were transferred to 95 L tanks for treatment. Each treatment was randomly assigned to a tank. Plants were treated with Aquathol K™ at rates of 1.5 and 3.0 ppm for exposure times of 0, 12, 24, 48, 96 hr. Plants were also treated with Hydrothol 191™ at 0.5 and 1.0 ppm for exposure times of 0, 6, 12, 24, 48 hr. After 4 weeks post treatment, all plants were harvested and dried to a constant weight. Results indicate that neither product produced a notable reduction in egeria biomass and only slight trends in reduction of elodea biomass was noted at 4 WAT. Egeria and elodea showed initial symptoms to treatment (e.g. translucent leaves), but plants were healthy and actively growing at the time of harvest. Monoecious hydrilla was generally sensitive to all treatments and CET relationships were generally weak. A similar trend in biomass reduction was noted for dioecious hydrilla; however, these plants showed a strong CET relationship following treatment with Aquathol K™. Both monoecious and dioecious hydrilla showed significant signs of stress compared to the untreated controls at the 4 week harvest with stems lacking turgor and stripped of leaves. Vallisneria data was variable; however, there was evidence of increased injury to both endothall formulations at the longer exposure periods. There was not strong evidence of visual injury to the vallisneria tissue at harvest. These small-scale studies suggest members of this family show significant response differences to both Aquathol K™ and Hydrothol™. The rapid activity of Hydrothol 191™ following short exposure periods was confirmed in these trials, yet the relative lack of response by egeria and elodea at all concentrations and exposures tested was not expected. Further research evaluating the role of treatment timing is suggested.

Distribution and Physical Habitat Characteristics of *Hygrophila polysperma* along the San Marcos River, Hays County, Texas

Casey R. Williams and Alan Groeger
Texas State University, San Marcos, TX

Hygrophila polysperma (Roxb.) T. Anders (Acanthaceae), is an old world species native to Asia that has become well established in the San Marcos River, Hays County, Texas. Little is known regarding the introduction and dispersal of the species in regards to the San Marcos River system. Characteristics such as fragmentation, auxiliary rooting and rapid growth allow *Hygrophila polysperma* to possibly displace native species such as *Ludwigia repens* and *Zizania texana*, an endangered species. *Hygrophila polysperma* has been labeled a Federal Noxious Weed by the USDA and is reportedly a major pest in Florida and Virginia. This research seeks to understand the suitable requirements for growth of *Hygrophila polysperma* in the San Marcos River system and its distribution along the upper reaches of the San Marcos River. Data were analyzed using Geographic Information Systems (GIS).