47th Annual Meeting of the Aquatic Plant Management Society

and

26th Annual Meeting of the MidSouth Aquatic Plant Management Society

PROGRAM

Gaylord Opryland Resort & Convention Center
Nashville, Tennessee
July 15-18, 2007

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RISE Representative	Joe Bondra
WSSA Representative	Gregory E. MacDonald

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

Past 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” Val Guerra (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)

President’s Award (year of honor)

T. O. “Dale” Robson (1984)
Gloria Rushing (1991)
William T. Haller (1999)
David Mitchell (1999)
Jeffrey D. Schardt (2002)
Jim Schmidt (2003)
Robert C. Gunkel, Jr. (2004)
Victor A. Ramey (2006)

Max McCowen Friendship Award (year of honor)

Judy McCowen (1995)
John Gallagher (1997)
Paul C. Myers (2000)
William T. Haller (2002)
Bill Moore (2006)

T. Wayne Miller Distinguished Service Award (year of honor)

Gerald Adrian (2005)

Sustaining Members

The Aquatic Plant Management Society appreciates the valuable support of the following Sustaining Members. Thank you, Sustaining Members!

Applied Aquatic Management, Inc.
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Carmel, Indiana

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Monticello, Arkansas

Meeting Sponsors

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

Platinum

BASF Professional Vegetation Management
Research Triangle Park, North Carolina

SePRO Corporation
Carmel, Indiana

Syngenta Professional Products
Greensboro, North Carolina

United Phosphorus, Inc.
King of Prussia, Pennsylvania

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

Bronze

Applied Biochemists
Germantown, Wisconsin

Aquatic Ecosystem Restoration Foundation
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Sturgis, Mississippi

UAP Distribution
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Brewer International
Vero Beach, Florida

Phoenix Environmental Care, LLC
Valdosta, Georgia

Scholastic Endowment Sponsors

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

Reverse Raffle Grand Prize

Cygnet Enterprises, Inc.
Flint, Michigan

Silent Auction

Applied Aquatic Management, Inc.
Eagle Lake, Florida

AquaTechnex, LLC
Centralia, Washington

Aquatic Vegetation Control
Riviera Beach, Florida

Brewer International
Vero Beach, Florida

Duke Energy
Huntersville, North Carolina

Professional Lake Management
Caledonia, Michigan

Syngenta Professional Products
Greensboro, North Carolina

United Phosphorus, Inc.
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Applied Biochemists
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Aquatic Control, Inc.
Seymour, Indiana

BASF Corporation
Research Triangle Park, North Carolina

Clean Lakes, Inc.
Martinez, California

Monterey Ag Resources
Fresno, California

SePRO Corporation
Carmel, Indiana

UAP Distribution
Monticello, Arkansas

Exhibitors

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

Applied Biochemists
Since 1968, Applied Biochemists has been dedicated to developing, manufacturing, and marketing a variety of algaecides, aquatic herbicides, and biological formulations for aquatic vegetation control and water quality improvement. Recognized brands include Aquashade, Cutrine-Plus, and Navigate. Recent achievements have been made in successful development of targeted algal management programs through our funded university research.

AquaMaster
AquaMaster is a worldwide industry leader in the manufacturing of equipment and products geared towards pond and lake water quality improvement and aesthetics. Products offered are fountains, aeration systems, and microbial bioaugmentation products.

Aquatic Control, Inc.
Since 1966, Aquatic Control, Inc. has been providing high quality products, services, and staff for managing lakes, ponds, and other water resources. Our professional staff includes: certified fisheries scientists, fisheries biologists, factory-trained fountain specialists, and licensed aquatic applicators. We supply quality products/services to companies and clients to fill their needs.

BASF Corporation
BASF Corporation is the world's leading chemical company, manufacturing a wide range of innovative products, including Habitat® herbicide for control of emerged, shoreline, and floating aquatic vegetation. With its proven expertise, BASF Corporation provides vegetation management resources to protect and restore land and waterways threatened by non-native, invasive species. For more information, visit www.vmanswers.com.

Becker Underwood
Leading manufacturer of specialty bioagronomic products to enhance the color, growth and quality of turf and ornamental landscape plantings, including colorants, biostimulants, and chelated nutrients.

BioSonics, Inc.
BioSonics, Inc. specializes in the manufacture of hardware and software that enables the assessment of underwater habitat, particularly bathymetry, distribution and abundance of submersed aquatic vegetation (SAV), and bottom substrate classification. Using advanced digital hydroacoustic equipment, specialized software (incorporating USACE developed analysis methodology), and over 25 years of experience in the field of hydroacoustics (SONAR), BioSonics, Inc. stands ready to work with both freshwater and marine resource managers.

Biosorb, Inc.
Biosorb, Inc. is a bioscience company developing and manufacturing natural based adjuvants (e.g., TopFilm™) used by aquatics, horticultural, golf/turf, and specialty industries. The natural adjuvants are made from patented microsponge (U.S. Patent #5,888,500) derived from agricultural grain and oil-seed processing materials. The natural microsponges (Biocar®) provide treatments with unique properties for absorption, adherence, rainfastness and weatherability.

Brewer International
Brewer International offers surfactants, drift control agents, defoamers, and basal diluents for the weed and brush control market. Spray adjuvants enhance the performance of pesticides. Brewer International also manufactures

a broad range of products used in the irrigation, industrial cleaning, and aquatic markets. Brewer is also a proud member of AERF, RISE, APMS, and regional aquatic plant management societies.

Cygnet Enterprises, Inc.

Cygnet Enterprises, Inc. and affiliates, is one of the largest distributors of aquatic herbicides, algaecides, and lake management devices in the United States. We are a distributor for all of the major manufacturers of aquatic products including Applied Biochemists, SePRO Corporation, United Phosphorus, Inc., Syngenta Professional Products, and many more. Our offices are located nation-wide in Michigan, California, Washington, Pennsylvania, Indiana, and North Carolina. For more information regarding our products and services, please feel free to contact us at 1-800-359-7531.

Helena Chemical Company

Helena Chemical Company is a national distributor of crop protection and crop production inputs. Helena has over 350 sales locations across the country that supply customers with crop protectants, fertilizer products, seed, and related services. In addition, the Helena Product Group develops and markets a number of products in the following categories: Adjuvants, Nutritionals, BioScience, Value-Added Products and Seed Treatments.

J I L Industries

J I L Industries is an established Mid-South Regional company, headquartered in Bowling Green, Kentucky, serving Kentucky, Tennessee, and Virginia specializing in environmentally friendly water products and services.

Phoenix Environmental Care, LLC

Phoenix Environmental Care manufactures a broad line of specialty products for the Turf, Nursery, Ornamental and Aquatic markets. Phoenix presently offers to the aquatics industry, Avocet Aquatic Glyphosate, Current Aquatic Herbicide, and Symmetry Aquatic Algaecide. Phoenix Environmental Care looks forward to additional aquatic product offerings starting late 2007 and 2008.

ReMetrix, LLC

ReMetrix, LLC is the nation's leading mapping firm focusing exclusively on assessing and monitoring invasive and aquatic vegetation. The company employs a small team of scientists expert in the use of various advanced mapping technologies such as hydroacoustics, GIS, and remote sensing. ReMetrix, LLC has mapped nearly a half million acres for submerged and invasive vegetation presence, species, and distribution. The company works in freshwater and tidal environments and is highly experienced with data collection and analyses.

SePRO Corporation

The industry leader in aquatic plant management, SePRO Corporation has provided professional focus on specialty markets since 1993. Current product line for the professional lake manager includes: Sonar* A.S. aquatic herbicide, Sonar SRP aquatic herbicide, Sonar PR Precision Release* aquatic herbicide, Sonar Q* Quick Release aquatic herbicide, Avast!® Aquatic Herbicide, FasTEST* immunoassay system, Nautique* aquatic herbicide, Captain* algaecide, K-Tea™ algaecide, Komeen® Aquatic Herbicide, AquaPro* aquatic herbicide, Revive* biological water quality enhancer, and Renovate® aquatic herbicide. *(*Trademark of SePRO Corporation ®Trademark of SePRO Corporation, ™Trademark of SePRO Corporation, ®Renovate is a Trademark of Dow AgroSciences, LLC, manufactured for SePRO Corporation)*

Syngenta Professional Products

Invasive weeds can devastate both natural and commercial habitats. Syngenta Professional Products provides high performance products to control these destructive weeds while helping to restore the habitat of aquatic environments. Proven herbicides for the weed control industry available from Syngenta include Reward® and Touchdown PRO®.

UAP Distribution

UAP Distribution supplies a complete product line for the aquatic market. Products include herbicides, algaecides, lake dyes and surfactants. Our professional sales staff offers expertise in developing very

Cost-effective and environmentally sound prescriptions for your aquatic weed, algae and aesthetic problems. UAP Distribution strives to bring the latest innovations in applied technology to the invasive/noxious vegetation management arena in a format consistent with an Integrated Pest Management (IPM) strategy. UAP Distribution is a nationwide distributor supplying the aquatics, vegetation management, forestry and invasive plant management markets. UAP Distribution has over 300 distribution facilities strategically located in the United States and Canada to better serve our customers needs.

United Phosphorus, Inc.

United Phosphorus, Inc. (UPI) is leading the value revolution as a premier supplier of trusted and proven post patent crop protection technologies for agricultural and specialty crops. As a worldwide leader in the development and manufacturer of post patent solutions, UPI is geared to provide growers with high-quality products built to defend crops and increase yields.

U.S. Army Engineer Research and Development Center

The U.S. Army Engineer Research and Development Center (ERDC) is one of the most diverse engineering and scientific research organizations in the world. The ERDC conducts R&D in support of the soldier, military installations, and the Corps of Engineers (CE) civil works mission, as well as for other federal agencies, state and municipal authorities, and with U.S. industry through innovative work agreements. The ERDC's Aquatic Plant Control Research Program (APCRP) is the Nation's only federally authorized research program providing the technology to manage invasive aquatic plant species. The objective of the program is to develop cost-effective, environmentally compatible aquatic plant management technologies, which address national needs and priorities in water resources management.

Vertex Water Features

Vertex Water Features is a customer-focused lake aeration and floating fountain manufacturer. We will cultivate long-term, mutually beneficial relationships with our customers and our employees. Success in our mission will promote enhancement of our customer's property and increased business opportunity for Vertex Water Features. With the introduction of the XL AirStation™ and AerationJet fountain, Vertex maintains its diffuser technology leadership and the ability to offer complete water quality solutions to golf courses, lake communities, marinas and other waterways seeking improved water quality. This reflects Vertex's strong commitment and vision to provide the best equipment for high efficiency and low-cost lake aeration systems.

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Director
Alabama Power Company
Birmingham, Alabama

John Madsen
Director
Mississippi State University
Mississippi State, Mississippi

Greg Reynolds
Director
Syngenta Professional Products
Tampa, Florida

MidSouth APMS Honorary Members

Angus Gholson, Jr. (1983)

John Lawrence (1989)

A. Leon Bates (1996)

J. Lewis Decell (1996)

Joe Kight (1997)

David Bayne (2006)

MidSouth APMS Presidents and Meeting Sites

1982	David Bayne	Guntersville, Alabama
1983	David Bayne	Bainbridge, Georgia
1984	Terry Goldsby	Mobile, Alabama
1985	Joe Zolczynski	Jackson, Mississippi
1986	David Franks	Gulf Shores, Alabama
1987	Joe Stephenson	Decatur, Alabama
1988	Leon Bates	Gulf Shores, Alabama
1989	Raymond Cooper	Montgomery, Alabama
1990	Barry Smith	Eufaula, Alabama
1991	Mike Eubanks	Auburn, Alabama
1992	Randell Goodman	Guntersville, Alabama
1993	Earl Burns	Gulf Shores, Alabama
1994	Fred Harders	Birmingham, Alabama
1995	Scott Lankford	Sheffield, Alabama
1996	David Webb	Gulf Shores, Alabama
1997	Stan Cook	Vicksburg, Mississippi
1998	Lewis Decell	Guntersville, Alabama
1999	Harry Knight	Gulf Shores, Alabama
2000	Mark Tow	Eufaula, Alabama
2001	Ken Weathers	Columbus, Mississippi
2002	David Franks	Gulf Shores, Alabama
2003	Tom Broadwell	Auburn, Alabama
2004	Eric Barkemeyer	Mobile, Alabama
2005	Joe Jernigan	Robinsonville, Mississippi
2006	Craig Aguillard	Orange Beach, Alabama
2007	Bob Gunkel	Nashville, Tennessee

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The MidSouth Aquatic Plant Management Society appreciates the generous support of the following meeting sponsors:

Alabama Power Company

Helena Chemical Company

Syngenta Professional Products

United Phosphorus, Inc.

U.S. Army Engineer Research and Development Center

General Information

Program Organization
The Agenda is organized by day and time. The Abstracts are organized in alphabetical order by presenting author and title. A detailed Author Index appears at the back of this Program to assist you in finding a particular author's work.

Name Badges
For all events and functions at the meeting, your name badge is your ticket. 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 Banquet at the meeting registration desk.

Meeting Registration Desk
The meeting registration desk is located in the Tennessee Section of the Gaylord Opryland Resort & Convention Center. For specific times, please see the Agenda in this Program. Messages will be posted on the message board at the meeting registration desk.

Speaker Ready Room
Need to check your PowerPoint presentation? The speaker ready room will be located in Belmont B in the Magnolia Section of the Gaylord Opryland Resort & Convention Center and will be equipped with a notebook computer, LCD projector, external zip drive, and an external CD writer. For specific times, please see the Agenda in this Program.

Exhibits
Exhibits will be open for viewing from 7:30 a.m. Monday to 12:00 p.m. Wednesday in Tennessee Ballroom A/B in the Tennessee Section of the Gaylord Opryland Resort & Convention Center.

Posters
Posters will be open for viewing from 7:30 a.m. Monday to 12:00 p.m. Wednesday in Tennessee Ballroom A/B in the Tennessee Section of the Gaylord Opryland Resort & Convention Center. A special Poster Session and Reception will be held on Monday from 5:30 p.m. to 7:00 p.m. in Tennessee Ballroom A/B. Presenters of posters are required to attend the special Poster Session and answer questions as needed. In addition, presenters are requested to be in attendance during scheduled refreshment breaks.

APMS Annual Business Meeting
The APMS Annual Business Meeting will be held Monday, 4:30 p.m. - 5:00 p.m. in Tennessee Ballroom D/E in the Tennessee Section of the Gaylord Opryland Resort & Convention Center. All APMS members are encouraged to attend.

APMS Student Luncheon
A student luncheon will be held Monday, 12:00 p.m. – 1:30 p.m. in Hermitage E in the Magnolia Section of the Gaylord Opryland Resort & Convention Center. All students that register 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.

Regional Chapters Presidents' Breakfast
The Regional Chapters Presidents' Breakfast will be held Tuesday, 6:30 a.m. - 8:00 a.m. in Belmont A in the Magnolia Section of the Gaylord Opryland Resort & Convention Center. Two representatives from each APMS regional chapter are invited to attend this breakfast. Carlton Layne, APMS Vice President and Regional Chapters Committee Chair, will be the moderator for discussions on aquatic plant management activities within each

region. Please contact Carlton by 12:00 p.m. Monday and confirm your attendance. This breakfast is graciously sponsored by Helena Chemical Company.

Past Presidents' Luncheon

The Past Presidents' Luncheon will be held Tuesday, 12:00 p.m. - 1:30 p.m. in Belmont A in the Magnolia Section of the Gaylord Opryland Resort & Convention Center. Past Presidents of the APMS are invited to attend this breakfast. Jeff Schardt, Immediate Past President, will be the moderator for discussions on affairs of the Society. Please contact Jeff by 12:00 p.m. Monday and confirm your attendance. This luncheon is graciously sponsored by Valent Professional Products.

MidSouth APMS Annual Business Meeting

The APMS Annual Business Meeting will be held Tuesday, 5:00 p.m. - 5:30 p.m. in Tennessee Ballroom D/E in the Tennessee Section of the Gaylord Opryland Resort & Convention Center. All MidSouth APMS members are encouraged to attend.

Refreshment Breaks

A continental breakfast, morning refreshment break, and afternoon refreshment break, graciously sponsored by BASF Professional Vegetation Management, will be served each day of the meeting in Tennessee Ballroom A/B in the Tennessee Section of the Gaylord Opryland Resort & Convention Center. For specific times, please see the Agenda in this Program.

APMS Special Events

***President's Reception**, Sunday, July 15, 7:00 p.m. – 9:00 p.m., Tennessee Ballroom D/E, Tennessee Section, Gaylord Opryland Resort & Convention Center.* The APMS cordially invites all registered delegates, guests, and students to the President's Reception, graciously sponsored by SePRO Corporation. Enjoy a casual gathering visiting with old friends and meeting new friends, while savoring delicious hors d'oeuvres and your favorite beverage. Non-registered guests may purchase tickets at the meeting registration desk.

***Poster Session and Reception**, Monday, July 16, 5:30 p.m. – 7:00 p.m., Tennessee Ballroom A/B, Tennessee Section, Gaylord Opryland Resort & Convention Center.* The APMS cordially invites all registered delegates, guests, and students to the Poster Session and Reception, with the reception graciously sponsored by Syngenta Professional Products. This reception will provide for the viewing of posters and professional interactions/discussions in a casual setting, while enjoying delicious hors d'oeuvres and your favorite beverage. Non-registered guests may purchase tickets at the meeting registration desk.

***Guest Tour**, Tuesday, July 17, 9:00 a.m. – 3:15 p.m., meet in Magnolia Lobby, Gaylord Opryland Resort & Convention Center.* The APMS cordially invites all registered guests to the Guest Tour, graciously sponsored by Applied Biochemists. This year's tour will take our guests to one of the most popular presidential homes in the nation. The visit to the Hermitage Plantation (home of Andrew Jackson) includes a tour of the Hermitage mansion itself along with the grounds, garden, Jackson's tomb, original cabins, Hermitage church, and the museum. After touring this famous landmark, guests will take a ride on the General Jackson showboat for lunch. The General Jackson cruises the scenic Cumberland River, providing fantastic sightseeing, musical entertainment and dining. Non-registered guests may purchase tickets at the meeting registration desk.

***Banquet**, Tuesday, July 17, 6:00 p.m. – 10:00 p.m., Governor's Ballroom B, Governor's Section, Gaylord Opryland Resort & Convention Center.* The APMS cordially invites all registered delegates, guests, and students to the APMS Banquet, graciously sponsored by United Phosphorus, Inc. This year's banquet will once again prove to be a memorable occasion. 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. A great night of entertainment is planned with "The Hits from the Hit Makers!" The entertainment will begin with a few songs from our very own Troy Goldsby, followed by some of country music's greatest songs and the stories behind them. These songs will be performed by the writers of the songs, and they are some of the best in the business. The trio will be headed by Walt Aldridge, writer of 7 number one hits including "I Loved Her First" (Heartland), and other great hits like "Leave Him Out Of This" (Steve Warriner), and "Modern Day Bonnie and Clyde" (Travis Tritt). Casey Kelly, writer of "Soon" (Tanya Tucker), "The Cowboy Rides Away" (George Strait), and "The Road Not Taken" (Joe Diffie), and Todd Cerney, writer of the number one hit “Good Morning Beautiful” (Steve Holy), “I’ll Still Be Loving You” (Restless Heart), and “Blues Is My Business” (Etta James) will also be performing. Prepare for a great night of music and the wonderful stories that will put you into the minds of the writers. Our evening will conclude with the reverse raffle grand prize drawing for the cruise, graciously sponsored by Cygnet Enterprises, Inc. Non-registered guests may purchase 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.

Membership Information

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.

Agenda

Sunday, July 15

Sunday's Agenda-at-a-Glance

7:30 am - 5:00 pm	APMS Board of Directors Meeting *(Belmont A)*
12:00 pm - 5:00 pm	Exhibits Setup *(Tennessee A/B)*
12:00 pm - 5:00 pm	Posters Setup *(Tennessee A/B)*
1:00 pm - 5:00 pm	Registration *(Tennessee Registration Desk)*
1:00 pm - 5:00 pm	Speaker Ready Room *(Belmont B)*
2:00 pm - 5:00 pm	MSAPMS Board of Directors Meeting *(Lincoln B)*
7:00 pm - 9:00 pm	President's Reception *(Tennessee D/E)* *Sponsored by SePRO Corporation*

Monday, July 16

Monday's Agenda-at-a-Glance

7:30 am - 8:00 am	Continental Breakfast *(Tennessee A/B)* *Sponsored by BASF Professional Vegetation Management*
7:30 am - 5:00 pm	Registration *(Tennessee Registration Desk)*
7:30 am - 5:00 pm	Speaker Ready Room *(Belmont B)*
7:30 am - 5:00 pm	Exhibits Open *(Tennessee A/B)*
7:30 am - 5:00 pm	Posters Open *(Tennessee A/B)*
8:00 am - 12:00 pm	Session I: Presidential Address and Special Session: Invasive and Protected Species Interactions *(Tennessee D/E)*
9:30 am - 10:00 am	Refreshment Break *(Tennessee A/B)* *Sponsored by BASF Professional Vegetation Management*
12:00 pm - 1:30 pm	Lunch
12:00 pm - 1:30 pm	Aquatic Ecosystem Restoration Foundation Meeting *(Hermitage A/B)*
12:00 pm - 1:30 pm	Student Affairs Luncheon *(Hermitage E)* *Sponsored by UAP Distribution*
1:30 pm - 4:30 pm	Session II: Management and Ecology of Nuisance and Invasive Plants *(Tennessee D/E)*
3:00 pm - 3:30 pm	Refreshment Break *(Tennessee A/B)* *Sponsored by BASF Professional Vegetation Management*
4:30 pm - 5:00 pm	APMS Annual Business Meeting *(Tennessee D/E)*
5:30 pm - 7:00 pm	Poster Session and Reception *(Tennessee A/B)* *Sponsored by Syngenta Professional Products*

Session I: Presidential Address and Special Session: Invasive and Protected Species Interactions

8:00 am - 12:00 pm
Tennessee D/E
Moderator: Donald W. Doggett, *Lee County Hyacinth Control District, Fort Myers, FL*

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

8:10 am **Presidential Address**
Donald W. Doggett
Lee County Hyacinth Control District, Fort Myers, FL

8:30 am **Invasive Species and Conflicts: Setting the Stage National Invasive Species Council**
Jennifer Vollmer
BASF Corporation, Laramie, WY

8:50 am **Managing for Biodiversity**
Barry A. Rice
The Nature Conservancy, Global Invasive Species Initiative, Davis, CA

9:10 am **Federal Research Perspective on the Interaction of Endangered and Invasive Species**
Rachel Claire Muir
U.S. Geological Survey, Reston, VA

9:30 am **Refreshment Break** *(Tennessee A/B)*

10:00 am **Managing Invasive Plants with Consideration for the Whole Plant Assemblage**
Ken Wagner
North American Lake Management Society (NALMS), Madison, WI

10:20 am **A View from the National Wildlife Refuge**
Michael Lusk
National Wildlife Refuge, Arlington, VA

10:40 am **Europe: A View from across the Pond**
Jonathan Newman
Centre for Aquatic Plant Management, Berkshire, UK

11:00 am **Regulating Biodiversity: a State View**
Misty-Anne R. Marold
Massachusetts Division of Fisheries and Wildlife, Westborough, MA

11:20 am **An Industry Perspective**
Jim Skillen
Responsible Industry for a Sound Environment (RISE), Washington, DC

11:40 am **Panel Discussion: All Session Presenters**
Please submit questions to the moderator during the morning break

12:00 pm **Lunch**

Session II: Management and Ecology of Nuisance and Invasive Plants
1:30 pm - 4:30 pm
Tennessee D/E
Moderator: John D. Madsen, *Mississippi State University, GeoResources Institute, Mississippi State, MS*

1:30 pm **A Pathogen for Control of Alligator Weed in the Australian Core Infestation *(Student Presentation)***
Ross L. Gilbert[1,2], G. M. Gurr[1], and M. J. Priest[2]
[1]*Charles Sturt University, School of Rural Management, NSW, Australia.*
[2]*NSW Department of Primary Industries, Orange Agricultural Institute, NSW, Australia*

1:45 pm **The Status of Fluridone-Resistant Hydrilla in Florida and Its Impact on Operations and Research**
Michael D. Netherland
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL

2:00 pm **Evaluation of Imazamox for Control of Eurasian Watermilfoil *(Student Presentation)***
Joseph D. Vassios, Scott J. Nissen, and Galen Brunk
Colorado State University, Fort Collins, CO

2:15 pm **Community Effects of Large-scale Changes in Plant Composition after a Lake-wide Herbicide Treatment *(Student Presentation)***
Katya E. Kovalenko[1], Eric D. Dibble[1], Rosemara Fugi[2], Jeremy G. Slade[1]
[1]*Mississippi State University, Department of Wildlife and Fisheries, Mississippi State, MS*
[2]*Universidade Estadual de Maringa, Brazil*

2:30 pm **Case Study: Selective Control of Eurasian Watermilfoil Using Diquat – Four Years of Results**
Marc Bellaud[1], **Jim Petta**[2], Gerald Smith[1] and Michael Lennon[1]
[1]*Aquatic Control Technology, Inc., Sutton, MA*
[2]*Syngenta Professional Products, Corpus Christi, TX*

2:45 pm **Effects of Adjuvants on Phytotoxicity of Diquat to Aquatic and Terrestrial Plants *(Student Presentation)***
Tomas F. Chiconela[1], William T. Haller[1], Gregory E. MacDonald[2], Michael D. Netherland[3], D. Wofford[2], and R. McGovern[4]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*University of Florida, Agronomy Department, Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*
[4] *University of Florida, Department of Plant Pathology, Gainesville, FL*

3:00 pm **Refreshment Break** *(Tennessee A/B)*

3:30 pm **Impact of Aquathol K Applications on Largemouth Bass Spawning Behavior and Production of Young Fish *(Student Presentation)***
Matthew Marshall, Michael Maceina, and Steven Sammons
Auburn University, Department of Fisheries, Auburn, AL

3:45 pm **Flumioxazin Development for Aquatic Weed Control *(Student Presentation)***
Christopher R. Mudge and William T. Haller
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

4:00 pm **Water Hyacinth Management**
M. Saeed[1] and M. Shafi[2]
[1]*Agricultural University, Department of Weed Science, Peshawar, Pakistan*
[2]*Agricultural University Faisalabad, Pakistan*

4:15 pm **J. Strom Thurmond Reservoir Avian Vacuolar Myelinopathy (AVM) Epizootic: Field Assessment and Management Plan *(Student Presentation)***
Rebecca S. Haynie
Clemson University, Institute of Environmental Toxicology, Clemson, SC

4:30 pm **Adjourn**

APMS Annual Business Meeting

4:30 pm - 5:00 pm
Tennessee D/E

Poster Session

5:30 pm - 7:00 pm
Tennessee A/B

A Temperate Lake Study of the Cyanobacterium *Cylindrospermopsis raciborskii (Student Poster)*
Clay H. Britton, Carole A. Lembi, and Robert E. Pruitt
Purdue University, Department of Botany and Plant Pathology, West Lafayette, IN

Digital Growth of Common Reed (*Phragmites australis* (Cav.) Trin. ex Steud) *(Student Poster)*
Joshua C. Cheshier[1], David F. Spencer[2], and John D. Madsen[1]
[1]*Mississippi State University, GeoResources Institute, Mississippi State, MS*
[2]*U.S. Department of Agriculture, Exotic and Invasive Weeds Research Unit, Davis, CA*

Development of an Overseas Biological Control Program for Eurasian Watermilfoil (*Myriophyllum spicatum*)
Mathew J. W. Cock, Hariet L. Hinz, Gitta Grosskopf, and Patrick Hafliger
CABI Europe Switzerland, Delémont, Switzerland

Glyphosate and Aterbane Acute Toxicities to South American Tropical Fishes

Claudinei da Cruz, Natalia Sayuri Shiogiri, Matheus Nicolino Peixoto Henares, Silvia Patricia Carraschi, and **Robinson Antonio Pitelli**
EcoSafe Agriculture and Environmental Sciences, Jaboticabal, Sao Paulo, Brazil

Herbicides for Variable Leaf Milfoil Control *(Student Poster)*

Adam Frank, Robert J. Richardson, and Andrew P. Gardner
North Carolina State University, Raleigh, NC

Hydrellia pakistanae Development on Monoecious Hydrilla under Greenhouse Mass-rearing Conditions

Jan E. Freedman and Michael J. Grodowitz
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Evaluation and Registration of New Aquatic Herbicides

Kurt D. Getsinger[1], Angela G. Poovey[1], Michael D. Netherland[2], and Jeremy G. Slade[3]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*
[3]*Mississippi State University, Department of Wildlife and Fisheries, Vicksburg, MS*

Current Status on the Use of Insect Biocontrol for the Management of Hydrilla on Lake Gaston

Michael J. Grodowitz
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

The Development of Management Strategies for the Control of *Salvinia* spp. Using the Biocontrol Agent *Cyrtobagous salviniae*: Lake Conroe, TX – a Case Study

Michael J. Grodowitz[1], Blake Kellum[2], Chetta S. Owens[3], Julie G. Nachtrieb[4], and Nathan E. Harms[4]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*San Jacinto River Authority, Conroe, TX*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[4]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Use of the *Hydrellia* Biocontrol Agents for Management of Hydrilla at Field Sites in the United States

Michael J. Grodowitz[1], Charlie E. Ashton[2], Julie G. Nachtrieb[3], Nathan E. Harms[3], and Chetta S. Owens[4]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL*
[3]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[4]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

A Survey of North American Macrophyte Invertebrate Enemies

Nathan Harms[1] and **Michael J. Grodowitz**[2]
[1]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

Acute Toxicity of Diquat to South American Tropical Fishes

Matheus Nicolino Peixoto Henares, Claudinei da Cruz, Gabriela Roncada Gomes, and **Robinson Antonio Pitelli**
UNESP/NEPEAM, Jaboticabal, Sao Paulo, Brazil

Sediment Nitrogen Depletion by *Hydrilla verticillata*

David Honnell[1], R. Michael Smart[2], and **Dian H. Smith**[1]
[1]*University of North Texas, Institute of Applied Science, Denton, TX*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Pilot-scale Production and Stabilization of Microsclerotia of the Potential Mycoherbicide *Mycoleptodiscus terrestris* Using Deep-tank Fermentation and Air-drying

Mark A. Jackson[1], Judy F. Shearer[2], and Mark A. Heilman[3]
[1]*U.S. Department of Agriculture, Agriculture Research Service, Peoria, IL*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[3]*SePRO Corporation, Whitakers, NC*

Endothall Combinations with 2,4-D and Triclopyr for Control of Eurasian Watermilfoil

John D. Madsen[1], Kurt D. Getsinger[2], and Ryan M. Wersal[1]
[1]*Mississippi State University, GeoResources Institute, Mississippi State, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

Wild Rice (*Zizania aquatica* L.) Susceptibility to the Aquatic Herbicide Triclopyr

John D. Madsen[1], Kurt D. Getsinger[2], and Ryan M. Wersal[1]
[1]*Mississippi State University, GeoResources Institute, Mississippi State, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

Initial Mapping of Hydrilla and Other Submerged Vegetation in Lake Manitou, Indiana

Jeffrey Myers[1] and Bob Johnson[2]
[1]*ReMetrix LLC, Carmel, IN*
[2]*SePRO Corporation, Brownstown, IN*

Mesocosm Evaluation of Fluridone and *Mycoleptodiscus terrestris* for Control of Hydrilla

Linda S. Nelson and Judy F. Shearer
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Impact of Insect Herbivory on Dispersal in *Hydrilla verticillata* (L.f.) Royle

Chetta S. Owens[1], Michael J. Grodowitz[2], and R. Michael Smart[1]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

***Salvinia molesta* – A Review of Past Research and What's Coming Up!**

Chetta S. Owens, R. Michael Smart, and Gary O. Dick
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX

Multivariate Studies in a Macrophyte Community Colonizing the Santana Reservoir, Rio de Janeiro, Brazil

Robinson Luiz de Campos Machado Pitelli[1], Claudia Maria Toffanelli Fiorillo[2], Edivaldo Domingues Velini[3], Antonio Sergio Ferraudo[2], and **Robinson Antonio Pitelli**[2]
[1]*EcoSafe Agriculture and Environmental Sciences, Jaboticabal, Sao Paulo, Brazil*
[2]*UNESP/NEPEAM, Jaboticabal, Sao Paulo, Brazil*
[3]*UNESP/NUPAM, Fazenda Lageado, Brazil*

Seasonal Biomass Detection of Waterhyacinth Using Normalized Difference Vegetation Index Derived From Landsat 5 TM Simulated Data *(Student Poster)*

Wilfredo Robles and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

Giant Salvinia Response to Submersion and Herbicides *(Student Poster)*

Rory L. Roten, Robert J. Richardson, and Andrew P. Gardner
North Carolina State University, Raleigh, NC

Three-year Summary of Monitoring Invasive Brazilian Waterweed in the Sacramento-San Joaquin Bay-Delta, CA

Scott A. Ruch[1] and Kurt A. Shanayda[2]
[1]*ReMetrix LLC, Berkeley, CA*
[2]*ReMetrix LLC, Carmel, IN*

Sonar for Duckweed Control in Madison County, Arkansas

George Selden[1] and Darrin Henderson[2]
[1]*University of Arkansas at Pine Bluff, Newport, AR*
[2]*University of Arkansas, Huntsville, AR*

Effects of Scaling-up on Mycoherbicide Characteristics

Judy F. Shearer[1], Mark A. Jackson[2], and Mark A. Heilman[3]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*U.S. Department of Agriculture, Agriculture Research Service, Peoria, IL*
[3]*SePRO Corporation, Whitakers, NC*

Impact of Biological Control Agents on Fluridone-Resistant and Susceptible Hydrilla Biotypes

Judy F. Shearer, Jan E. Freedman, and Michael J. Grodowitz
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

The Potential Role of Endophytic Fungi on *Myriophyllum spicatum* Senescence

Judy F. Shearer
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Influence of Water Exchange and Temperature on Controlling Sago Pondweed with Endothall

Jeremy G. Slade[1], Kurt D. Getsinger[2], and Angela G. Poovey[2]
[1]*Mississippi State University, Department of Wildlife and Fisheries, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

Lake Gaston (NC-VA) Ecological Studies: 2006

R. Michael Smart
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX

Alternative Algae Control in California Rice Fields: Evaluation of Barley Straw

David F. Spencer[1] and Carole A. Lembi[2]
[1]*U.S. Department of Agriculture, Exotic and Invasive Weeds Research Unit, Davis, CA*
[2]*Purdue University, Department of Botany and Plant Pathology, West Lafayette, IN*

Phragmites Control with Imazapyr, Glyphosate, and Triclopyr *(Student Poster)*

Sarah L. True[1], Lloyd Hipkins[2], Robert J. Richardson[1], and Andrew P. Gardner[1]
[1]*Virginia Tech, Blacksburg, VA*
[2]*North Carolina State University, Raleigh, NC*

Comparison of Imazapyr and Imazamox for Control of Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc.) *(Student Poster)*

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

Alligatorweed Control with Herbicides *(Student Poster)*

Amanda M. West, Robert J. Richardson, and Andrew P. Gardner
North Carolina State University, Raleigh, NC

Point-intercept and Surface Observation Geographic Positioning Systems (SOG) Surveys: A Comparison of Survey Methods – Lake Gaston, NC/VA

Lynde L. Williams[1], R. Michael Smart[2], and Chetta S. Owens[2]
[1]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Future Research and Management Objectives for Avian Vacuolar Myelinopathy

Sarah Williams[1], Michael Hook[2], and Susan B. Wilde[3]
[1]*South Carolina Department of Natural Resources, Charleston, SC*
[2]*University of South Carolina, Columbia, SC*
[3]*University of South Carolina-Belle Baruch Institute, South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC*

Tuesday, July 17

Tuesday's Agenda-at-a-Glance

6:30 am - 8:00 am	Regional Chapters Presidents' Breakfast *(Belmont A)*
	Sponsored by Helena Chemical Company
7:30 am - 8:00 am	Continental Breakfast *(Tennessee A/B)*
	Sponsored by BASF Professional Vegetation Management
7:30 am - 5:00 pm	Registration *(Tennessee Registration Desk)*
7:30 am - 5:00 pm	Speaker Ready Room *(Belmont B)*
7:30 am - 5:00 pm	Exhibits Open *(Tennessee A/B)*
7:30 am - 5:00 pm	Posters Open *(Tennessee A/B)*
8:00 am - 12:00 pm	Session III: Invasive and Nuisance Plant Monitoring, Physiology, and Management *(Tennessee D/E)*
9:00 am - 3:15 pm	Guest Tour *(Meet in Magnolia Lobby)*
	Sponsored by Applied Biochemists
9:30 am - 10:00 am	Refreshment Break *(Tennessee A/B)*
	Sponsored by BASF Professional Vegetation Management
12:00 pm - 1:30 pm	Lunch
12:00 pm - 1:30 pm	Past Presidents' Luncheon *(Belmont A)*
	Sponsored by Valent Professional Products
1:30 pm - 5:00 pm	Session IV: Invasive Plant Species, Aquatic Habitat Management, and Special Session: MidSouth Issues *(Tennessee D/E)*
3:00 pm - 3:30 pm	Refreshment Break *(Tennessee A/B)*
	Sponsored by BASF Professional Vegetation Management
5:00 pm - 5:30 pm	MSAPMS Annual Business Meeting *(Tennessee D/E)*
6:00 pm - 10:00 pm	Banquet *(Governor's B)*
	Sponsored by United Phosphorus, Inc.

Session III: Invasive and Nuisance Plant Monitoring, Physiology, and Management

8:00 am - 12:00 pm
Tennessee D/E
Moderator: Judy F. Shearer, *U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

8:00 am **High-accuracy Mapping of *Egeria densa* Using Satellite Imagery**
Catherine Huybrechts
Endpoint Environmental, San Francisco, CA

8:15 am **Common Reed: *Phragmites australis* (Cav.) Trin. ex Steud: Life History in the Mobile River Delta, Alabama *(Student Presentation)***
Joshua C. Cheshier and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

8:30 am **Growth Response of *Potamogeton crispus* to Lime Application in Experimental Mesocosms**
William F. James
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Spring Valley, WI

8:45 am **Influences of Light Intensity Variations on Growth Characteristics of Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc.) *(Student Presentation)***
Ryan M. Wersal and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

9:00 am **Watermeal Response to Fluridone and Other Herbicides**
Andrew P. Gardner and Robert J. Richardson
North Carolina State University, Raleigh, NC

9:15 am **Detection of Herbicide Injury on Waterhyacinth Using Landsat 5 TM Simulated Data *(Student Presentation)***
Wilfredo Robles and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

9:30 am **Refreshment Break** *(Tennessee A/B)*

10:00 am **Exposure of Native American's to Fluridone through the Ingestion of Tules from Clear Lake, California - Exposure and Risk**
Susan G. Monheit[1], Robert C. Leavitt[1], Elaine Wong[2], and P. Akers[2]
[1]*California Department of Food and Agriculture, Sacramento, CA*
[2]*California Department of Food and Agriculture, Center for Analytical Chemistry, Sacramento, CA*

10:15 am **The Impact of Fluridone on Target and Non-target Plant Species: Data from Monitoring of Actual Lake Treatments**
Ken Wagner
ENSR Water Resources, Willington, CT

10:30 am **Home Sweet Home: Macroinvertebrate Assemblages in Beds of Monotypic Hydrilla, Diverse Native Aquatic Plants, and a Plantless Habitat *(Student Presentation)***
Heather J. Theel and Eric D. Dibble
Mississippi State University, Department of Wildlife and Fisheries, Mississippi State, MS

10:45 am **Integrating Acoustic Mapping into Operational Aquatic Plant Management: A Case Study in Wisconsin**
Bruce Sabol[1], Jim Kannenberg[2], and John Skogerboe[3]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*Marine Biochemists, Inc., Germantown, WI*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Spring Valley, WI*

11:00 am **Sexual Preference and Alternative Life Cycles in *Hydrilla*: Monecious and Dioecious**
Chetta S. Owens and R. Michael Smart
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX

11:15 am **Laboratory Experiments with Algimycin® PWF and Copper Sulfate Pentahydrate to Predict Risks for Non-target Species *(Student Presentation)***
Brenda M. Johnson, Matthew M. Chao, O'Niell R. Tedrow, and John H. Rodgers, Jr.
Clemson University, Department of Forestry and Natural Resources, Clemson, SC

11:30 am **An Integrated Approach to Invasive Plant Management: Biocontrol and Native Plant Interactions**
Julie G. Nachtrieb[1], Michael J. Grodowitz[2], R. Michael Smart[3], and Chetta S. Owens[3]
[1]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

11:45 am **Response of Three Populations of Cabomba to Different Herbicides and Environmental Variables *(Student Presentation)***
Brett W. Bultemeier[1], Michael D. Netherland[2], and William T. Haller[1]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*

12:00 pm **Lunch**

Session IV: Invasive Plant Species, Aquatic Habitat Management, and Special Session: MidSouth Issues
1:30 pm - 5:00 pm
Tennessee D/E
Moderator: Bryan Goldsby, *AquaServices, Inc., Guntersville, AL*

1:30 pm **Collaborative Study of New Production Methods and Related Efficacy on Target Submersed Weeds to Support Development of the Potential Bioherbicide *Mycoleptodiscus terrestris***
Mark A. Heilman[1], Mark A. Jackson[2], Judy F. Shearer[3], and Linda S. Nelson[3]
[1]*SePRO Corporation, Whitakers, NC*
[2]*U.S. Department of Agriculture, Agriculture Research Service, Peoria, IL*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

1:45 pm **Intensive Grass Carp Stocking Effects on Reservoir Invasive Plants and Native Fish Populations *(Student Presentation)***
A. Brad Garner[1], Thomas J. Kwak[1], Kenneth L. Manuel[2], and D. Hugh Barwick[3]
[1]*North Carolina State University, Cooperative Fish and Wildlife Research Unit, Raleigh, NC*
[2]*Duke Energy Environmental Center, Huntersville, NC*
[3]*Duke Energy Carolinas, Charlotte, NC*

2:00 pm **Use of Multi-attribute Utility Analysis for the Identification of Aquatic Plant Restoration Sites**
Michael J. Grodowitz[1], R. Michael Smart[2], Joe Snow[3], Gary O. Dick[2], and Jeffery A. Stokes[4]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[3]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*
[4]*Bowhead Information Technology Services, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

2:15 pm **Houghton Lake: Submerged Vegetation Response Five-years after a Large-scale, Low-dose, Whole-lake Sonar® Treatment**
Doug Henderson[1] and Paul Hausler[2]
[1]*ReMetrix LLC, Carmel, IN*
[2]*Progressive AE, Grand Rapids, MI*

2:30 pm **Effects of Aquatic Vegetation Management on the Ecology of Small Impoundments *(Student Presentation)***
Trevor J. Knight and Michael P. Masser
Texas A&M University, Texas Cooperative Extension, College Station, TX

2:45pm **Integrating Plant Management within Ongoing Field and Laboratory Research on Avian Vacuolar Myelinopathy**
Susan B. Wilde[1], Sarah Williams[2], Rebecca S. Haynie[3], Jessica Alexander[4], Faith Wiley[3,5], Charlotte Hope[2], Tom Murphy[2], William Bowerman[3], and Fran Van Dolah[5]
[1]*University of South Carolina-Belle Baruch Institute, South Carolina Department of Natural Resources, Marine Resources Division, Charleston, SC*
[2]*South Carolina Department of Natural Resources, Charleston, SC*
[3]*Clemson University, Institute of Environmental Toxicology, Clemson, SC*
[4]*University of South Carolina, Marine Science Department, Columbia, SC*
[5]*NOAA National Ocean Service, Charleston, SC*

3:00 pm **Refreshment Break** *(Tennessee A/B)*

3:30 pm **Invasive Species Information Systems and Technology Transfer**

Jeffery A. Stokes[1], Sherry G. Whitaker[2], Michael J. Grodowitz[2], and Lavon Jeffers[1]
[1]Bowhead Information Technology Services, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS
[2]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

3:45 pm **Predicting Invasive Plant Species**

Alison M. Fox[1], Doria R. Gordon[2], Randall Stocker[1], and Daphne Onderdonk[1]
[1]University of Florida, Agronomy Department, Gainesville, FL
[2]The Nature Conservancy, University of Florida, Botany Department, Gainesville, FL

4:00 pm **Problematic Aquatic Plants of the MidSouth**

John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

4:15 pm **Efforts to Control *Lyngbya wollei* on the Coosa River System in Alabama**

Jason C. Carlee
Alabama Power Company, Birmingham, AL

4:30 pm **What's the Worst that Can Happen? An Applicator's Guide to Safety**

Carlton Layne
Aquatic Ecosystem Restoration Foundation, Marietta, GA

5:00 pm **Adjourn**

MSAPMS Annual Business Meeting
5:00 pm - 5:30 pm
Tennessee D/E

Wednesday, July 18

Wednesday's Agenda-at-a-Glance

6:30 am - 8:00 am	MSAPMS Board of Directors Meeting *(Ryman Studio D/E)*
7:30 am - 8:00 am	Continental Breakfast *(Tennessee A/B)* *Sponsored by BASF Professional Vegetation Management*
7:30 am - 12:00 pm	Registration *(Tennessee Registration Desk)*
7:30 am - 12:00 pm	Speaker Ready Room *(Belmont B)*
7:30 am - 12:00 pm	Exhibits Open *(Tennessee A/B)*
7:30 am - 12:00 pm	Posters Open *(Tennessee A/B)*
8:00 am - 12:00 pm	Session V: Herbicide Developments, Invasive and Nuisance Plants and Algae *(Tennessee D/E)*
9:30 am - 10:00 am	Refreshment Break *(Tennessee A/B)* *Sponsored by BASF Professional Vegetation Management*
12:00 pm - 5:00 pm	APMS Board of Directors Meeting *(Belmont A)*
12:00 pm - 5:00 pm	Exhibits Teardown *(Tennessee A/B)*
12:00 pm - 5:00 pm	Posters Teardown *(Tennessee A/B)*
1:30 pm - 5:00 pm	Aquatic Plant Control Research Program Review - Corps of Engineers Only *(Belmont C)*

Session V: Herbicide Developments, Invasive and Nuisance Plants and Algae
8:00 am - 12:00 pm
Tennessee D/E
Moderator: Ryan Wersal, *Mississippi State University, GeoResources Institute, Mississippi State, MS*

8:00 am **Preemptive Early Detection and Rapid Response Planning for *Lagarosiphon major* and *Trapa natans* Introductions in the Western United States**
Lars W.J. Anderson[1] and Mark D. Sytsma[2]
[1]*U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA*
[2]*Portland State University, Center for Lakes and Reservoirs, Portland, OR*

8:15 am **Sago Pondweed Response to Soil Applied Imazamox and Imazapyr**
Scott J. Nissen, Joe Vassios, and Galen Brunk
Colorado State University, Ft. Collins, CO

8:30 am **Early Spring Application of Endothall Combined with 2,4-D for Selective Control of Eurasian Watermilfoil and Curly-leaf Pondweed**
John G. Skogerboe[1] and Kurt D. Getsinger[2]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Spring Valley, WI*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

8:45 am ***Eichhornia crassipes* Control with Diquat and Its Effect on Periphytic Community, under Mesocosm Conditions**
Andre T. Martins and **Robinson Antonio Pitelli**
UNESP/NEPEAM, Jaboticabal, Sao Paulo, Brazil

9:00 am **Responses of Invasive Strains of *Lyngbya* to Algaecide Exposures**
John H. Rodgers, Jr. and Brenda M. Johnson
Clemson University, Department of Forestry and Natural Resources, Clemson, SC

9:15 am **Penoxsulam: A New Aquatic Herbicide for Large-scale Aquatic Plant Management**
Tyler Koschnick[1], Mark A. Heilman[2], and Sarah Miller[2]
[1]*SePRO Corporation, Carmel, IN*
[2]*SePRO Corporation, Whitakers, NC*

9:30 am **Refreshment Break** *(Tennessee A/B)*

10:00 am **Evaluation of 2,4-D Ester and Triclopyr against Waterlily and Spatterdock**
LeeAnn M. Glomski[1] and Linda S. Nelson[2]
[1]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX
[2]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

10:15 am **Microsponge Technology for Rainfastness and Weatherability**
Lucy Marshall and Rick Lowe
Biosorb, Inc., Saint Charles, MO

10:30 am **Effects of Imazamox Treated Irrigation Water on Selected Agronomic and Horticultural Crops**
Dearl Sanders[1], Bert McCarty[2], Daniel Beran[3], Todd Horton[3], and Joe Vollmer[3]
[1]Louisiana State University Agricultural Center, Idlewild Research Station, Clinton, LA
[2]Clemson University, Clemson, SC
[3]BASF Corporation, Raleigh, NC

10:45 am **What's New at the Center for Aquatic and Invasive Plants' Information Office**
Karen Brown
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

11:00 am **Effects of the ALS Inhibitors on Algae**
Carole A. Lembi[1], Michael D. Netherland[2], and Debra D. Lubelski[1]
[1]Purdue University, Department of Botany and Plant Pathology, West Lafayette, IN
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*

11:15 am **Response of Selected Weed Species to Imazamox**
Robert J. Richardson and Andrew P. Gardner
North Carolina State University, Raleigh, NC

11:30 am **APMS Chapter Updates**
Brazil, Florida, MidSouth, Midwest, Nile Basin, Northeast, South Carolina, Texas, Western

12:00 pm **Closing Remarks and Adjourn 47th Annual Meeting**
Donald W. Doggett, *Lee County Hyacinth Control District, Fort Myers, FL*

NEXT YEAR
48th Annual Meeting
July 13-16, 2008
The Mills House Hotel
Charleston, SC

Abstracts

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

Preemptive Early Detection and Rapid Response Planning for *Lagarosiphon major* and *Trapa natans* Introductions in the Western United States

Lars W.J. Anderson[1] and Mark D. Sytsma[2]
[1]*U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA*
[2]*Portland State University, Center for Lakes and Reservoirs, Portland, OR*

Trapa natans (waterchestnut) and *Lagarosiphon major* (oxygen weed) are not known to be present in natural aquatic ecosystems or constructed reservoirs, lakes or irrigation systems in the Western U.S. *T. natans* is a serious weed in several northeastern states and eastern Canada and yet is readily available and often "recommended" for use in aquascapes. *T. natans* is not on the Federal Noxious Weed List (FNWL). *L. major*, which is available via the Internet trade, is listed on the FNWL, and is an invasive weed in New Zealand where it has infested lakes and reservoirs. Since both species pose threats to the vast and highly distributed water systems in the U.S., the Western Regional Panel (under the auspices of the Aquatic Nuisance Task Force) and the Aquatic Plant Management Society sponsored an exercise to identify pathways, susceptible sites and potential eradication strategies and resources needed to respond to potential invasions. A bibliography was completed for both species, and a 2-day workshop was held in the fall of 2006 to discuss specific threats from these target plants, identify expertise and the actions needed for detection, containment and eradication. This process will be summarized and specific recommendations will be discussed, including gaps in research that were identified. Overall conclusions were: (1) both species are likely to enter western state waters; (2) *T. natans* will be relatively easy to detect at early stages; *L. major* will not; (3) *T. natans* could be eradicated through already proven management methods and appropriate monitoring; (4) eradication of *L. major* will require early detection (along pathways and likely susceptible aquatic sites), and more information on efficacy of registered aquatic herbicides and other removal methods, and more information on environmental tolerances. For both species, a contingency fund is essential to insure an adequately rapid and effective response to introductions.

A Temperate Lake Study of the Cyanobacterium *Cylindrospermopsis raciborskii (Student Poster)*

Clay H. Britton, Carole A. Lembi, and Robert E. Pruitt
Purdue University, Department of Botany and Plant Pathology, West Lafayette, IN

The invasive cyanobacterium *Cylindrospermopsis raciborskii* is traditionally thought of as a tropical species. However, its growth characteristics, global warming, nutrient enrichment over time, or some combination of factors has facilitated its establishment in temperate lakes in Indiana. First reported in Ball Lake, IN in 2001, *C. raciborskii* has now been documented in numerous lakes in IN and other parts of the midwest. Since June 2005 we have conducted monthly sampling of Lake Lemon, IN at two locations at various depths. *C. raciborskii* populations peaked in the month of August of 2005 and 2006, and low concentrations remained during winter months. Along with monthly cell counts, light and temperature readings were recorded. Temperature and cell counts showed statistically significant relationships at both locations on the lake, suggesting that the seasonal growth of *C. raciborskii* is regulated by water temperatures. To determine if temperate populations respond differently to water temperatures than strains from southern states, an isolate from Lake Lemon and two isolates from Lakes Yale and Griffin, FL were exposed to a sequence of water temperatures that mimicked the light/temperature regimes in Lake Lemon over a full year. Although the tropical isolates yielded higher average cell numbers than the temperate isolate at all water temperatures, the temperate isolate recovered at a faster rate when the cells were taken from cold to warm temperatures. Also, there appeared to be higher akinete (an overwintering structure) production in the temperate isolate than the tropical isolates. The data suggests that the Lake Lemon isolate may have growth characteristics that have facilitated its success in temperate climates. These results warrant additional morphological and genetic analyses to determine whether temperate strains originated in the south and moved north (either unchanged or as a result of genetic variation) or are derived from native strains of *C. raciborskii.*

What's New at the Center for Aquatic and Invasive Plants' Information Office

Karen Brown
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

The University of Florida / IFAS Center for Aquatic and Invasive Plants has been providing information about aquatic and invasive plants to researchers, managers, field personnel and others for over twenty years. The forms of this information have ranged from the APIRS bibliographic database of scientific literature in this field, to tools such as educational videotapes for field personnel, interested citizens and others, identification decks, plant recognition guides, posters, photomurals, and a comprehensive web site that has been online since 1995 when web sites were just starting to appear on people's personal computers. The purpose of this presentation is to describe some of our new endeavors and to review some of the materials that are still available and useful to the aquatic plant management community. The Education Initiative and Curricula is a joint project with the Florida Department of Environmental Protection Bureau of Invasive Plant Management. The goal of this initiative is to inform teachers and students about the impacts of non-native, invasive plants as they spread through natural areas, and to provide ready-made curricula that meets state standards in order to teach this important topic. The project also provides workshops that take educators out into the field to learn about invasive plants firsthand. The Plant Management in Florida Waters project is an online encyclopedic guide to this important topic in Florida. All manner of information can be found using a list of topics and keywords. The guide provides a ready source of reliable information to concerned citizens, students and others. The Aquatic and Invasive Plant Information Retrieval System (APIRS) has recently undergone an extensive reformatting and now allows users to mark bibliographic records for printing and emailing. The database now holds more than 65,000 annotated records for scientific publications in this field. The balance of this presentation will include a quick review of other educational tools available to researchers, managers, field personnel, teachers, students, and the public at large.

Response of Three Populations of Cabomba to Different Herbicides and Environmental Variables *(Student Presentation)*

Brett W. Bultemeier[1], Michael D. Netherland[2], and William T. Haller[1]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*

Cabomba is a submersed aquatic dicot considered invasive in the northern portions of the United States and southern Canada. There are five described species that comprise the genus Cabomba, however some taxonomic classifications describe nine. Cabomba is found throughout the Americas (Latin, South and North America) and although *Cabomba caroliniania* is native to the S.E. United States the taxonomic classification of cabomba is vague and incomplete. While cabomba represents a sporadic management problem in the south, the populations found in the northern US are considered invasive and present significant management challenges. Plants found in the north are bright green in color with robust leaves, whereas southern plants have red to purple stems and leaves that are finely divided. Plants purchased from aquarium dealers in Florida represent a blend of characteristics of these two populations. There is renewed interest in the taxonomy of various cabomba populations, but previous research suggests that differences in color and morphology were environmentally induced and it was surmised that populations would respond similarly to management techniques. To identify potential physiological differences in three populations of cabomba, herbicide screens were performed on all registered and experimental aquatic herbicides. Beyond identifying physiological differences between populations, the secondary goal is to find potential chemical control options for the northern cabomba. Initial screens have identified four herbicides that reduced northern cabomba photosynthetic rates more than 50% of untreated control plants in static growth chamber conditions. These compounds were diquat, diquat + copper, flumioxizan and endothall (dimethylalkylamine salt) which were all tested at the maximum labeled rate. Our screening supports the reported lack of efficacy of 2,4-D and triclopyr as none of the biotypes had significant depression of photosynthesis. Responses have differed among the biotypes with the northern being the most tolerant to herbicides. Environmental conditions such as pH and temperature are also being evaluated to compare the response of the three populations of cabomba. Our studies suggest that response differences between the three populations of cabomba are not easily explained by simple color and morphological differences.

Efforts to Control *Lyngbya wollei* on the Coosa River System in Alabama

Jason C. Carlee
Alabama Power Company, Birmingham, AL

Lyngbya wollei forms dense benthic mats that displace native vegetation and interfere with fish spawning as well as surface mats that interfere with normal recreational activities including boating, swimming, and fishing. Potential economic impacts include decreased property values, decreased utilization of the resource, as well as the potential for floating mats to interfere with hydroelectric power generation. This presentation will highlight efforts undertaken by Alabama Power Company to control *Lyngbya* in its reservoirs based on a treatment regimen developed by Clemson University.

Common Reed: *Phragmites australis* (Cav.) Trin. ex Steud: Life History in the Mobile River Delta, Alabama *(Student Presentation)*

Joshua C. Cheshier and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

Common reed (*Phragmites australis*) is a non-native invasive perennial grass that is a nuisance in aquatic and riparian environments across the United States. The ability of common reed to reproduce quickly combined with its ability to cycle nutrients has made it an aggressive invader of aquatic environments. Common reed often forms monotypic stands that displace native vegetation which provide food and cover for wildlife. In order to help maintain native habitats and manage and populations of common reed in the United States, a complete understanding of its life cycle is needed. Twelve samples were taken from four sites throughout the Mobile River delta, in southern Alabama every month from January to December 2006. Relative chlorophyll content was taken in field using a Konica Minolta SPAD 502 meter. Samples were then separated into aboveground and belowground biomass, dried and weighed. Above ground biomass peaked from September through December at 3398.7 g/m^2 whereas the below ground biomass (2522.1 g/m^2) as well as chlorophyll content (35.2 SPAD units/ site) stayed constant throughout the entire year. This understanding will provide insights into the relationships between common reed and the environment as well as to guide management strategies.

Digital Growth of Common Reed (*Phragmites australis* (Cav.) Trin. ex Steud) *(Student Poster)*

Joshua C. Cheshier, David F. Spencer, and John D. Madsen,
Mississippi State University, GeoResources Institute, Mississippi State, MS

Common reed (*Phragmites australis*) is a non-native invasive perennial grass that has widely colonized aquatic environments throughout the United States. Most of the invasions in the US are by two genetically different haplotypes; haplotypes I and M. Haplotype I is native to South America and Asia and is found primarily along the Gulf coast. Haplotype M is native to Europe and Western Asia as well as Africa and is the dominant haplotype in the Northeast and Midwest US. An understanding of their growth is a key component in implementing proper and effective management protocols. A tool to aid in this is a digital growth model of these two haplotypes of common reed. This model used data derived from a 3-dimensional digitizing process to quantify morphological characters such as stem height, internode distance, stem number, node number, leaf length, leaf width and leaf area. Measurements were taken bi-weekly from emergence to senescence of two haplotypes of common reed; haplotypes I and M. Common reed was planted in 1.2 m x 1.2 m x 1.1 m tanks in Starkville, MS. Haplotypes I and M differed significantly ($p \leq 0.05$) in stem height 273.1 mm and 118.8 mm respectively ($p<0.0001$). Internode distance also differed between haplotypes I and M (19.3 & 12.4; $p < 0.0001$). Leaf length (85.6 vs. 42.1), leaf width (7.9 vs. 4.1) and leaf area (8.0 vs. 1.2) all differed significantly ($p<0.0001$) between haplotypes I and M. However the number of nodes (8.0 vs. 8.8; $p=0.1391$) and in the number of stems (4.5 vs. 4.8; $p=0.1364$) were not significantly different. Preliminary data indicates that haplotypes I and M differ in some growth forms

Effects of Adjuvants on Phytotoxicity of Diquat to Aquatic and Terrestrial Plants *(Student Presentation)*

Tomas F. Chiconela[1], William T. Haller[1], Gregory E. MacDonald[2], Michael D. Netherland[3], D. Wofford[2], and R. McGovern[4]
[1]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[2]*University of Florida, Agronomy Department, Gainesville, FL*
[3]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*
[4]*University of Florida, Department of Plant Pathology, Gainesville, FL*

Diquat dibromide is a contact herbicide used for non-selective weed control in aquatic and terrestrial settings. When applied in water, it has a very short half-life due to adsorption by sediments and aquatic plant uptake. Diquat and copper have been used in combination due to increased diquat uptake when both compounds are applied together than diquat applied alone. However, due to copper persistence in the environment and toxicity to non-target organisms, its use has been restricted in public waters in Florida. This has stimulated the search for potential new synergists to combine with diquat. Adjuvants are often chemicals applied in combination with pesticides to improve foliar coverage and leaf absorption. In the 1980's adjuvants started to be used with contact herbicides to enhance their effectiveness on submersed aquatic weeds. However, the surfactant rate used for terrestrial weed control is 400-1600 times higher than the one suggested for aquatic use due to dilution before reaching the target. Therefore, this study was conducted to determine the effect of four adjuvants (Cygnet Plus, Sil Energy, Stabiltrol and Timberland 90) when applied at aquatic (1-2 gals/100 gals of water in 1 Acre ft of water) and terrestrial rates (1-2 qt/100 gals of water) on diquat phytotoxicity either alone or in combination on duckweed, hydrilla, petunias and begonias in greenhouse and laboratory studies. Applications of adjuvants alone did not have any effect on petunias and begonias. Conversely, adjuvants alone at rates greater than 100 ppm inhibited the growth of duckweed and hydrilla. Also, surfactant toxicity to hydrilla was as low as 10 ppm with Stabiltrol and as high as > 5,000 ppm for all surfactants on petunias and begonias.

Development of an Overseas Biological Control Program for Eurasian Watermilfoil (*Myriophyllum spicatum*)

Mathew J. W. Cock, Hariet L. Hinz, Gitta Grosskopf, and Patrick Hafliger
CABI Europe Switzerland, Delémont, Switzerland

In the context of possible biological control of Eurasian watermilfoil (*Myriophyllum spicatum*), available information is summarised on the distribution of *M. spicatum* and closely related species, and the known insect natural enemies recorded from Europe. Research gaps identified include (1) lack of adequate understanding of frequency, distribution and ecological differences resulting from hybridisation between *M. spicatum* and other *Myriophyllum* spp., (2) that surveys to date have been limited geographically and temporally, and have neglected organisms attacking the roots, and (3) preliminary studies to date on potentially useful biological control agents have not considered potential impact on non target indigenous species.

Predicting Invasive Plant Species

Alison M. Fox[1], Doria R. Gordon[2], Randall Stocker[1], and Daphne Onderdonk[1]
[1]*University of Florida, Agronomy Department, Gainesville, FL*
[2]*The Nature Conservancy, University of Florida, Botany Department, Gainesville, FL*

The Australia government has been using a 49-question Weed Risk Assessment (WRA) since 1997 to determine which species can be introduced. We tested the effectiveness of this WRA in identifying invasive plant species in Florida. At least 10 questions related to climate matching, ecology, reproduction, and weedy behavior elsewhere must be answered per species. Scores from these answers determine whether a species is rejected (high score = predicted invasive), accepted (low = non-invasive), or evaluated further (intermediate score). Species tested in Florida were pre-categorized as “not escaped cultivation”, “naturalized”, and “invaders”. Unlike earlier tests of the WRA in New Zealand, Hawaii, the Pacific, and the Czech Republic, we matched families and life-forms across these categories with species from 52 families in 27 orders. All non-invaders had been in Florida for over 50 years. A secondary screen developed in Hawaii reduced the proportion of species requiring further evaluation from 20% to 8%. The WRA correctly rejected 92% of the invaders in Florida and correctly accepted 79% of the not escaped species. Fifty-eight percent of the naturalized species were rejected and 35% were accepted. We conclude that the WRA is as precise for Florida as it is in Australia and in other tests. The Australian thresholds for rejection and acceptance were apparently designed to preclude introduction of most species likely to become naturalized as well as invasive. These thresholds could be adjusted if less precautionary policies are demanded. Our test included only one aquatic species because we were not able to identify aquatics that had been in Florida for 50 years and are not considered invasive. Also the existing score-weighting in the WRA makes it very likely that aquatic plants will be rejected. We strongly recommend that a separate project be conducted to investigate whether the prevalence rate of invasion among introduced aquatic plants is higher than for terrestrial plants. These results could be used to evaluate whether predictions for aquatic plants are appropriately influenced by the current scoring of the WRA.

Herbicides for Variable Leaf Milfoil Control *(Student Poster)*

Adam Frank, Robert J. Richardson, and Andrew P. Gardner
North Carolina State University, Raleigh, NC

Field studies were conducted in 2006 and 2007 in North Carolina to determine the response of variable leaf milfoil to in-water herbicide applications. Ponds ranging in size from 0.2 to 1.5 A were treated with 2,4-D ester (2 ppm), carfentrazone (200 ppb), diquat (2 gal/A), endothall (5 ppm), penoxsulam (15 ppb), and triclopyr (2 ppm). Control was visually rated at various intervals after application on a 0 to 100% scale with 0% equal to no control and 100% equal to complete plant death. Water samples were also collected for analysis to determine herbicide concentration at specific points after application. Results from each trial will be presented.

Hydrellia pakistanae Development on Monoecious Hydrilla under Greenhouse Mass-rearing Conditions

Jan E. Freedman and Michael J. Grodowitz
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

While *Hydrellia pakistanae* is well established and apparently impacting hydrilla in the US, its distribution is primarily confined to the dioecious biotype found in the more southern latitudes. Although sources believed that hydrilla growing in tropical climates tended to be monoecious and hydrilla of temperate zones dioecious, the distribution in North America is contrary to this observation. The dioecious strain was first reported in south Florida in the late 1950's, while the monoecious strain was first reported in the Potomac River in the mid 1980s. With the expanding range of the monoecious biotype in the more northern latitudes of the US, researchers were prompted to examine the use of *H. pakistanae* for management. For example, releases of *H. pakistanae* were made on the monoecious biotype in Lake Gaston, NC beginning in 2004; however, establishment is tentative at best. Bioassays examining short-term development on monoecious hydrilla have shown only minor differences relative to the dioecious biotype indicating that establishment should occur. To better understand the lack of establishment and subsequent impact on the monoecious biotype, a greenhouse colony of *H. pakistanae* reared exclusively on monoecious hydrilla was initiated in March 2007. The colony consists of a series of 3.5 L jars containing 50 g of monoecious hydrilla inoculated with 150 *H. pakistanae* eggs. Adults are collected from each jar for 39 days to assess generational changes. As an indication of success and to ascertain if genetic shifts are occurring indicating higher success with successive generations, a variety of parameters are being measured including percent total emergence, sex ratio, days to first emergence, female weight, and eggs per female. Obtaining this information is an important first step in understanding factors affecting *H. pakistanae* establishment and associated impact on the monoecious biotype.

Watermeal Response to Fluridone and Other Herbicides

Andrew P. Gardner and Robert J. Richardson
North Carolina State University, Raleigh, NC

Watermeal is one of the most common and troublesome aquatic weeds in North Carolina. Of the 10 registered active ingredients for aquatic plant management in North Carolina, only fluridone and carfentrazone are labeled for watermeal control. However, fluridone may not be used on all sites due to irrigation restrictions and watermeal response to carfentrazone has not been previously reported. Therefore, research was conducted to evaluate watermeal control with carfentrazone, diquat, herbicide mixtures containing low fluridone rates, and other selected herbicides. In 2006 field research, 11 ponds ranging in size from 0.3 to 1.5 A were treated with selected aquatic herbicides including fluridone (Sonar AS; 30 and 90 ppb), carfentrazone (Stingray; 0.1 and 0.2 lb ai/A), diquat (Reward; 1.5 lb ai/A), glyphosate (Touchdown Pro; 1.5 lb ae/A), fluridone (30 ppb) plus diquat, fluridone (45 ppb) plus carfentrazone (0.1 lb/A), and diquat (2 lb ai/A) plus copper (Cutrine Ultra; 0.5 ppm). Surface application volume was 30 gal/A. All ponds were rated for visual control on a 0 to 100% scale at several intervals during the growing season. Late-season control was at least 98% with all treatments containing fluridone, except the treatments of fluridone plus carfentrazone and fluridone plus diquat. Control in those ponds was 30 and 65%, respectively. Watermeal was controlled 50 to 65% by diquat and diquat plus copper within 3 weeks of treatment, but control was 0% by 12 weeks after treatment. Control of watermeal was not observed with carfentrazone or glyphosate. Low control with the two fluridone mixtures may be due to rain events diluting fluridone concentration in those ponds. A repeated greenhouse trial was also conducted to determine watermeal response to various diquat-based treatments. Control with all diquat treatments was at least 98%.

Intensive Grass Carp Stocking Effects on Reservoir Invasive Plants and Native Fish Populations *(Student Presentation)*

A. Brad Garner[1], Thomas J. Kwak[1], Kenneth L. Manuel[2], and D. Hugh Barwick[3]
[1]*North Carolina State University, Cooperative Fish and Wildlife Research Unit, Raleigh, NC*
[2]*Duke Energy Environmental Center, Huntersville, NC*
[3]*Duke Energy Carolinas, Charlotte, NC*

Grass carp are a common biological control agent for invasive aquatic vegetation. Effective control depends on the stocking rate and the fish's preference for consuming the target vegetation. Our research evaluates the efficacy of using high grass carp stocking rates to control non-preferred vegetation and effects on native fishes. Lookout Shoals Lake, North Carolina, was stocked with triploid grass carp (*Ctenopharyngodon idella*) at a rate of 100 fish per vegetated hectare to assess control of parrot-feather (*Myriophyllum aquaticum*). Analysis of parrot-feather abundance using in-situ exclosures indicated significant reduction four months after grass carp were stocked. We evaluated fish population distributions in the lake using seasonal shoreline electrofishing prior to, and after, grass carp stocking. Total catch for all fish species at shoreline transects during spring was significantly different after grass carp stocking by number, but we found no significant difference in biomass. Catch rates of largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and redbreast sunfish (*Lepomis auritus*) were not significantly different after grass carp stocking. Catch rates of yellow perch (*Perca flavescens*) were significantly lower after grass carp stocking. Our initial results demonstrate that intensive grass carp stocking can control an invasive, non-preferred plant and suggest associated changes in fish distributions. The biological significance of the fish distribution changes and long-term effects on lake biota remain undetermined.

Evaluation and Registration of New Aquatic Herbicides

Kurt D. Getsinger[1], Angela G. Poovey[1], Michael D. Netherland[2], and Jeremy G. Slade[3]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL*
[3]*Mississippi State University, Department of Wildlife and Fisheries, Vicksburg, MS*

There are less than ten active ingredients registered by the U.S. Environmental Protection Agency (USEPA) for use as herbicides in aquatic sites on a national basis (Section 3 Label). Of these products, seven received labels prior to 1986 and are considered old chemistry. With the introduction of new invasive species and the onset of resistance in some aquatic plants to certain herbicides, it is imperative that new chemistries be developed and registered to provide the necessary tools required for controlling the full range of weeds infesting public waters. In collaboration with herbicide registrants, government agencies and academic research groups, we are evaluating active ingredients for efficacy against the most problematic aquatic invasive plants on a national and regional basis. Particular emphasis is placed on new products to control species that have developed resistance or tolerance to the most widely used aquatic herbicides. Some of these new molecules include acetolactate synthase (ALS) inhibitors, penoxsulam, imazamox, and bispyribac-sodium, and a protoporphyrinogen oxidase inhibitor, flumioxazin. Studies are conducted through a multi-leveled approach utilizing growth chambers, outdoor mesocosms, experimental ponds, and field trials. Stewardship plans are also under development to mitigate herbicide resistance issues and extend the life-span of new products. Interaction and coordination with the USEPA Office of Pesticide Programs and key state regulatory agencies is ongoing to ensure a timely and cost-effective process for securing product registration for the most promising compounds. Results from this work area will provide new, environmentally compatible herbicides for controlling aquatic invasive species in public water bodies. In addition, guidance for the cost-effective and efficacious use of these compounds will be provided to water resource managers.

A Pathogen for Control of Alligator Weed in the Australian Core Infestation *(Student Presentation)*

Ross L. Gilbert[1,2], G. M. Gurr[1], and M. J. Priest[2]
[1]*Charles Sturt University, School of Rural Management, NSW, Australia.*
[2]*NSW Department of Primary Industries, Orange Agricultural Institute, NSW, Australia*

Alligator weed (*Alternanthera philoxeroides*) is a major weed of riparian ecosystems throughout the world and one of the twenty "Weeds of National Significance" in Australia. The major (core) infestation is situated in temperate New South Wales (NSW) where it spreads from 34º10´S to 32º25´S throughout rural and urban environments on the eastern seaboard. Although biological control of the weed is the preferred alternative to chemical control in this urban landscape, introduced insect agents have been less effective here than in the USA. The fungus *Nimbya alternantherae* has been cited as a possible agent for inundative biological control (mycoherbicide) of alligator weed in China, Brazil and the USA, but had not been reported on the weed in Australia. A survey of diseases on alligator weed in NSW was instigated to determine the mycoflora of alligator weed and to test for the presence of *Nimbya alternantherae*. Weeds were surveyed for disease on up to five occasions and candidate biological control agents sampled from all sites. Some 71 species of fungi and one nematode were isolated from alligator weed lesions. *Nimbya* spp. were isolated from purple, leaf and stem, lesions. Although no isolates matched the type culture of *N. alternantherae*, there appear to be at least 3 other *Nimbya* spp. on alligator weed in NSW. In pathogenicity tests, lesions appeared on leaves within 3 days with severity ranging from (a) chlorosis followed by complete defoliation by day 8, then death of stems by day 12, to (b) 3 mm necrotic lesions on green leaves without apparent stress to the host. The severe pathogenicity of some *Nimbya* isolates to alligator weed in NSW, and interest in the fungus elsewhere, highlights the priority for further research with this pathosystem. The 90 isolates of *Nimbya* collected in the survey are undergoing selective evaluation for suitability as a mycoherbicide. Morphologic and molecular determination is underway to identify the Australian isolates found on alligator weed and other surveyed *Alternanthera* species.

Evaluation of 2,4-D Ester and Triclopyr against Waterlily and Spatterdock

LeeAnn M. Glomski[1] and Linda S. Nelson[2]
[1]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX
[2]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Waterlily (*Nymphaea odorata* Ait.) and spatterdock (*Nuphar lutea* (L.) Sm.) are two important native shoreline plants found in numerous Midwestern lakes. Many of these lakes are also heavily infested with the non-native submersed plant, Eurasian watermilfoil (*Myriophyllum spicatum* L.). Submersed applications of 2,4-D and triclopyr are typically used to control Eurasian watermilfoil but there is concern that dispersion of herbicides from these applications may cause significant damage to off-target waterlily and spatterdock populations. Therefore an outdoor tank study was conducted at the Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX, to determine the effects of different use rates of 2,4-D ester (0.25 to 2.50 ppm) and triclopyr (0.25 to 2.00 ppm) on waterlily and spatterdock. Plants were exposed to all treatments for 24 hr. Results indicated that a 24-hour exposure to 1.50 and 2.50 ppm 2,4-D ester decreased waterlily shoot biomass by 51 and 90 percent, respectively, compared to untreated plants. Waterlily root biomass was also significantly reduced by these treatments. Although spatterdock shoot biomass was inhibited by an averaged 47 percent following treatment with 1.50 ppm 2,4-D and higher, root biomass was not affected by 2,4-D. Triclopyr had no effect on waterlily at the rates tested, and only inhibited spatterdock shoot biomass at the highest treatment rate (2.00 ppm). The data indicate that higher use rates of 2,4-D ester ($\geq$ 1.50 ppm) or triclopyr (2.00 ppm) can significantly injure and reduce biomass of waterlilies and spatterdock, while lower concentrations associated with drift of these herbicides ($\leq$ 0.50 ppm) will not injure these species. Results of this study suggest that triclopyr was less phytotoxic than 2,4-D to both waterlily and spatterdock at rates sufficient to control milfoil.

A Survey of North American Macrophyte Invertebrate Enemies

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Submersed aquatic plants contribute substantial energy to freshwater ecosystems by primary production and as detritus. Additionally they offer competition for resources with exotic species. Reservoirs in the south generally lack developed aquatic plant communities, as they are often impounded in areas removed from potential source populations of native aquatic plants. In an attempt to rectify this, the U.S. Army Engineers is making efforts to establish beneficial native plants in some systems to preempt establishment of introduced exotic plant species. Although herbivory is known to influence plant competition in terrestrial systems, its effects on the competitive ability of native aquatic plants is not well documented. Herbivory may reduce competitive ability of native plants by slowing or stunting growth and has been shown to reduce viability of plant fragments. This reduced viability may hinder natural spread of native plants, reducing competition for resources. Yet while generally considered beneficial, native plants can, in some instances, take on the role of a traditional weed. Through a better understanding of pressures exerted on these native plants by natural enemies, this survey provides information useful to several areas of aquatic plant management, including restoration and biological control. We hope to provide new records of herbivore-host relationships as well as report additional invertebrate-plant relationships that appear to be detrimental to plant health.

Current Status on the Use of Insect Biocontrol for the Management of Hydrilla on Lake Gaston

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The major objective of the Lake Gaston research was to develop a monoecious hydrilla rearing facility for the hydrilla leaf-mining flies and establish the agents at Lake Gaston field locations with subsequent determination of the flies' effectiveness. Release of the flies was accomplished by introducing dioecious hydrilla containing large numbers of the immature flies into specially designed cages in four newly constructed ponds containing monoecious hydrilla at the North Carolina Department of Correction, Caledonia Farms (i.e., rearing facility) and at two field sites located directly on Lake Gaston. At the Caledonia Farms two releases were made during the summer of 2006 with over 350,000 insects introduced. Insect releases were made at each of the two Lake Gaston field locations beginning in 2004 for a total of over 1,7,000,000 immature flies. Initial monitoring of the Caledonia Farms rearing ponds indicated tentative establishment with immatures and damage detected some distance from the release cages. Monitoring is continuing to confirm establishment and evaluate overwintering success. Monitoring at field locations indicated weak but tentative establishment with the collection of small numbers of immatures and adults throughout the 2006 growing season through stem sampling and Berlese funnel extractions. Monitoring is continuing with additional releases scheduled for the summer of 2007 using modified techniques.

The Development of Management Strategies for the Control of *Salvinia* spp. Using the Biocontrol Agent *Cyrtobagous salviniae*: Lake Conroe, TX – a Case Study

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Cyrtobagous salviniae is an insect biocontrol agent used extensively for the management of *Salvinia* spp. throughout the world with documented success reported on three continents and twelve countries including Australia, Fiji, India, South Africa, Sri Lanka, among others. It is black and small ranging in size from 1.5 mm to 2.0 mm. Adults feed on buds and to some extent fronds while the larvae feed almost entirely on the stolons. The species is highly host-specific feeding only on plants in the genus *Salvinia*. Mass-rearing in the U.S. has been successful using both greenhouse/tank-based systems (USDA, APHIS) and outdoor ponds (LAERF). Development of pond-based mass-rearing has included various forms of manipulations to ensure vigorous plant growth including fertilization amendments and pH adjustments using muratic acid and hay. Manipulations were successful in producing higher weevil numbers with nearly 600 adults per m^2 occurring in ponds with the highest fertilization levels (i.e., 100 lbs ammonium sulfate per ¾ acre) with three fold lower numbers found in ponds with only 10 lbs per ¾ acre added. Over 150,000 larvae were released from the ponds during 2005 in various sites in Texas. Releases of weevils from tank and pond-based rearing in Lake Conroe in 2005 resulted in large-scale impacts observed by June 2006 with means of 80,000 weevils/acre and maximums exceeding 800,000 weevils per acre. Much of the salvinia in the original release area had turned brown and the mats were starting to break-up and sink. Many areas originally covered with salvinia contained only minimal infestations. As part of an integrated program chemical applications are being used to limit movement of the salvinia into previously uninfected areas of the lake. High water in 2007 allowed the salvinia to move to many areas of the lake. This has necessitated increases in chemical applications especially in areas of waterhyacinth and salvinia mixes. Weevil impacts are being evaluated in light of the salvinia break-up and subsequent movement and to assess overwintering success. Additional releases may be needed to augment existing populations.

Use of the *Hydrellia* Biocontrol Agents for Management of Hydrilla at Field Sites in the United States

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Hydrilla (*Hydrilla verticillata* (L.f.) Royle) is an invasive, nonindigenous aquatic plant that was first discovered in the United States in the 1950's. Two introduced host-specific leaf-mining flies have shown success in the U.S. for long-term management of hydrilla in controlled experimentation and at field sites. The two introduced agents include the Australian leaf-mining fly (*Hydrellia balciunasi* Bock) and the Asian leaf-mining fly (*H. pakistanae* Deonier). Unlike previous APMS presentations that have focused on controlled experiments, this paper will focus on field releases in the southern U.S. Using mass rearing technologies developed at the USACE-LAERF, over 24 million leaf-mining flies have been released at over 30 sites in 6 states since 2000. These sites include but are not limited to 15 sites in Texas, 3 in Florida, 1 in NC/VA, 1 in GA, and 3 in Arkansas. Nearly all field sites have established populations of the leaf-mining flies and several have resultant decreases in hydrilla infestations. Decreases in hydrilla have been found in Sheldon Lake, TX where fly releases were made at 3 sites in 2004, and high larval damage was observed in 2005. By 2006, only small amounts of hydrilla remained in release locations. A similar example was shown in Choke Canyon Reservoir, TX. Releases were made in 2004 at 4 sites. One site, a swimming area at Callahan Park was dominated by hydrilla in 2004 and 2005. By 2006, monitoring found high numbers of leaf-mining larvae and a 50% reduction in hydrilla throughout the swimming area. Several release sites on Lake Seminole, GA/FL have had substantial reductions in hydrilla after releases and a return of a more diverse native plant community in those areas.

Use of Multi-attribute Utility Analysis for the Identification of Aquatic Plant Restoration Sites

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Presence of a diverse native plant community has been shown to enhance weed management especially in the presence of a capable herbivore. Therefore, an important consideration when designing weed biocontrol projects is the implementation of well-designed re-vegetation programs. Such is the case for the management of submersed aquatic plants; e.g., greatest hydrilla declines occur in the presence of both native plants and sustained fly herbivory. While progress has been made in developing techniques for native aquatic plant culturing/planting only limited information is available that allows non-technical personnel the ability to select suitable sites for re-vegetation efforts. To solve this problem, a decision support model was developed using multi-attribute utility analysis (MAU) where re-vegetation experts identified eleven important site characteristics ranging from shoreline gradient to sediment type. For each characteristic, utility functions were developed which incorporate probabilities for site selection across a wide range of site characteristic values. Once the information is collected and entered, the system provides an instantaneous, prioritized listing of sites suitable for re-vegetation based on expert opinion and facts. A web-based version has been developed allowing non-technical personnel easy and efficient access to this important aquatic plant revegetation site selection tool.

J. Strom Thurmond Reservoir Avian Vacuolar Myelinopathy (AVM) Epizootic: Field Assessment and Management Plan *(Student Presentation)*

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The introduction of invasive exotic plants into reservoirs has caused numerous direct and indirect problems in these systems. Avian Vacuolar Myelinopathy (AVM) is a neurological disease affecting waterfowl and their avian predators in the southeastern United States. Although the etiology is not entirely understood, the suspect culprit is an epiphytic toxin-producing cyanobacterium growing primarily on hydrilla (*Hydrilla verticillata*). AVM has been responsible for over 100 bald eagle (*Haliaeetus leucocephalus*) deaths and thousands of American coots (*Fulica americana*). A high proportion of asymptomatic coots collected from AVM affected reservoirs have been documented with characteristic brain lesions. Although we know that there is a high mortality rate in the relatively uncommon symptomatic coots, mortality rates of the more abundant asymptomatic birds had not been documented. A banding study was conducted during on J. Strom Thurmond Reservoir (JSTL 33°42'N 82°20W**)** during a 2006-2007 epizootic to better elucidate the AVM-attributed mortality rate. 12 of 19 bald eagle territories have become inactive since AVM was first diagnosed on JSTL in 1998. Flight and boat surveys were conducted throughout the season to monitor bald eagle numbers and nest success. A carcass recovery study complemented the banding and monitoring efforts by illustrating how quickly remains are scavenged (and thus not recovered) along the reservoir's rugged 1200 mile shoreline. The results from the field assessment illustrated the severity of AVM on this reservoir and the need for management strategy development. Reduction of the substrate material, primarily exotic aquatic plant, would decrease exposure to the toxin and truncate the food-chain disease transfer model. Biological control options have been explored in a suite of triploid grass carp (*Ctenopharyngodon idella*) susceptibility and vector potential trials. Herbicide, algaecide and water level fluctuations are management options under consideration. Before implementation, each of these options must be investigated to assess cost, effectiveness, and environmental impacts.

Collaborative Study of New Production Methods and Related Efficacy on Target Submersed Weeds to Support Development of the Potential Bioherbicide *Mycoleptodiscus terrestris*

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Mycoleptodiscus terrestris (Mt) has been studied for over 20 years as an aquatic plant pathogen with potential management uses on various invasive submersed aquatic plants including *Hydrilla verticillata* and *Myriophyllum spicatum*. Since 2002, collaborative research effort by the US Department of Agriculture, the US Army Engineer Research and Development Center, and SePRO Corporation have been investigating new ways to produce Mt to improve storage stability and virulence that have historically prevented the pathogen from being fully optimized as an aquatic bioherbicide. New fermentation protocols have created stable propagules termed microsclerotia, and bioherbicidal formulations based on microsclerotia are under development. External grant support from multiple state and federal sources is allowing expanded evaluation of new bioherbicidal materials. Laboratory activities are focused on determining attachment properties and comparative control performance of new formulations. Field demonstration trials are correlating laboratory-scale results with activity under more realistic use conditions.

A full overview of current collaborative activities will be provided, and results of recent mesocosm and field efficacy testing of new Mt materials will be reviewed with a focus on hydrilla.

Houghton Lake: Submerged Vegetation Response Five-years after a Large-scale, Low-dose, Whole-lake Sonar® Treatment

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A low-dose, whole-lake Sonar® treatment was performed at 20,000-acre Houghton Lake, Michigan, in May and June of 2002. The purpose of the treatment was to manage over 7,700-acres of dense Eurasian watermilfoil (*Myriophyllum spicatum*). Seven years of detailed submerged vegetation data have been collected at the lake; one year immediately before the treatment, the year of treatment, and the five years since. The vegetation data include species presence/absence, species density, representative biocover and biovolume, and diver surveys. The purpose of the data collection is to observe the lake-wide treatment response of all submerged species. In particular, investigators are interested in the longer-term trajectory of species diversity following the treatment. Over 30 species have been documented in the lake since the treatment. This presentation summarizes the findings from data collected during 2001-2007. Overall the data indicate ongoing control of the target species and an increase in species diversity over the sampling period. Treatment responses of specific species will be highlighted. A discussion of plant biovolume and biocover as related to species composition will also be included.

High-accuracy Mapping of *Egeria densa* Using Satellite Imagery

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An economizing means of mapping *Egeria densa* is with the use of commercially-available satellite imagery. However, traditional image processing techniques can be time-consuming and are subject to variable rates of accuracy due to differences in training-levels between image interpreters. To address the challenges associated with interpreting satellite imagery to map *Egeria densa*, San Francisco-based Endpoint Environmental created a semi-automated image-processing algorithm called the EDIPA (*Egeria densa* Image Processing Algorithm) Model. The EPIDA Model is capable of identifying 90 percent of *Egeria densa* coverage in high-resolution satellite imagery. The EDIPA Model, a quick-response mapping algorithm, is not empirically-derived but alternately uses an iterative adaptive strategy. Quick-response mapping algorithms are useful tools in the repository of image-processing methods. Managers and stakeholders who desire a reduction in the resources traditionally required to accurately map *Egeria densa* coverage, leverage the EDIPA Model.

Pilot-scale Production and Stabilization of Microsclerotia of the Potential Mycoherbicide *Mycoleptodiscus terrestris* Using Deep-tank Fermentation and Air-drying

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The fungus *Mycoleptodiscus terrestris* (Mt) is being developed as a bioherbicide for control of various invasive submersed aquatic plants including *Hydrilla verticillata* and *Myriophyllum spicatum*. A constraint to the commercial use of Mt as a bioherbicide is the development of an economic method for producing stable propagules of the fungus. Our previous studies with Mt identified novel nutritional conditions that supported the liquid-culture production of high concentrations of microsclerotia. Microsclerotia are compact, hyphal aggregates that often serve as overwintering structures for fungi. In order to scale the production process to commercial levels, pilot-plant fermentations have been conducted in 100 L fermentors using a basal salts medium supplemented with 6% glucose and 3% corn steep liquor powder. Four day fermentations yielded ~30 g Mt biomass/L with 65% of the biomass being well-formed microsclerotia. The microsclerotia-containing biomass was separated from the fermentation broth with a rotary drum vacuum filter, granulated and air-dried on shallow trays to less than 5% moisture. Ninety percent of the dried microsclerotia germinated hyphally after 24 hours incubation on water agar plates and produced ~3×10^7 conidia/g dried Mt microsclerotia after 8 days incubation at 28C. Dried microsclerotia produced and stabilized under pilot-scale conditions were shown to infect and kill hydrilla. Studies continue on optimizing fermentation conditions and drying protocols, and on identifying formulations for improving the biocontrol efficacy of Mt microsclerotia against hydrilla.

Growth Response of *Potamogeton crispus* to Lime Application in Experimental Mesocosms

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Lime application to aquatic systems causes a temporary increase in pH, shifts in dissolved inorganic carbon (DIC) equilibrium to carbonate dominance, and precipitation of DIC as calcite. These changes may act as an environmental stressor to growth and propagation of nuisance species like *Potamogeton crispus.* The objectives of this research were to examine biomass and turion production response of *P. crispus* to lime application using experimental outdoor mesocosms. Lime as $Ca(OH)_2$ applied to the experimental mesocosm at a concentration of 100 $mg{\cdot}L^{-1}$ resulted in a rapid 95, 50, 60, and 40 % decline in free CO_2, DIC, bicarbonate alkalinity, and total alkalinity, respectively, and an increase in pH from 8.8 to a maximum of 10.0 relative to the control. DIC remained below 20 $mg{\cdot}L^{-1}$ and near the carbon compensation point in the experimental mesocosm throughout the post-treatment period. Although some net shoot, turion, and root growth occurred in the experimental mesocosm, it was suppressed relative to the control. The post-treatment relative growth rate ratio was only 49, 46, and 61 % for shoots, turions, and roots, respectively. *P. crispus* produced similar numbers of turions per plant in the control and experimental mesocosm. However, individual mass was 60 % less in the experimental mesocosm versus the control, suggesting suppressed turion development. These patterns indicated *P. crispus* growth and propagation was susceptible to lime application.

Laboratory Experiments with Algimycin® PWF and Copper Sulfate Pentahydrate to Predict Risks for Non-target Species *(Student Presentation)*

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In order to better understand potential risks of algaecide applications for non-target species, information regarding responses of sentinel non-target species to algaecide exposures is needed. To discern potential effects of algaecide applications, responses of freshwater fish *Pimephales promelas* Rafinesque (fathead minnow) and *Lepomis macrochirus* Rafinesque (bluegill) as well invertebrates *Daphnia magna* Straus (water flea), *Ceriodaphnia dubia* Richard (water flea), and *Hyalella azteca* Saussure (amphipod) to aqueous exposures of Algimycin® PWF and copper sulfate pentahydrate were measured in moderately hard water. Mortality of organisms exposed to a range of concentrations of each algaecide was measured after 96 hours. Responses of *P. promelas*, *D. magna*, *C. dubia,* and *H. azteca* to Algimycin®PWF and copper sulfate pentahydrate exposures were not significantly different. The microcrustaceans, *D. magna* and *C. duhia*, were sensitive to Algimycin® PWF and copper sulfate pentahydrate exposures. *Hyalella azteca* and *P. promelas* responded similarly to both algaecides. Of the species tested, *L. macrochirus* was the least sensitive species. However, copper sulfate pentahydrate was about thirty times more toxic to *L. macrochirus* than Algimycin® PWF. In practical applications, water resource managers consider factors such as timing of algaecide applications in terms of extent of target species infestation, spawning seasons, partial treatments, duration of exposures, availability of refugia, as well as fecundity of the non-target species in the aquatic system.

Effects of Aquatic Vegetation Management on the Ecology of Small Impoundments *(Student Presentation)*

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Aquatic vegetation management and fisheries management are inseparable, however, conflicts are often perceived between the two. We investigated the effects of biological, chemical, and no vegetation control on the ecology of private impoundments stocked with largemouth bass and bluegill sunfish. Nine ¼ acre ponds were obtained at the Aquaculture Research & Teaching Facility of Texas A&M University near Snook, TX in the fall of 2005. Southern naiad (*Najas guadalupenis*) was transplanted into each pond at a stocking rate of one ton per surface acre. The vegetation was allowed to grow and colonize the ponds over the winter so that southern naiad could become established. One of three treatments was then randomly assigned to each pond. The treatments were replicated three times and consisted of: an herbicide treatment using Reward and Cutrine, a triploid grass carp treatment, and an unmanaged control treatment. Fathead minnows (*Pimephales* promelas), bluegill sunfish (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*) fingerlings were stocked in each pond. The treatments were initiated on May 31, 2006. Prior to the initiation of the treatments, sampling of each pond occurred for hardness, total phosphorus, nitrite, nitrate, ammonia-nitrogen, dissolved oxygen, turbidity, pH, and temperature. Phytoplankton, zooplankton, and macroinvertebrate samples were collected from each pond. Post-treatment sampling was conducted on the Reward treatment and the control at day 2, day 7, day 14, day 28, and monthly there after. Post-treatment sampling on the triploid grass carp treatment was conducted at day 14, day 28, and monthly there after. Upon preliminary analysis of the water quality data, there appear to be no significant differences between treatments. Preliminary analysis of the bass and bluegill electro-shocking data does not show any significant differences in average length or average weight for bass or bluegill between the three treatments. Analysis of limnological data will begin in the summer of 2007. The collection of additional data is needed to determine if there are any significant differences or impacts between the treatments. Sampling over the course of the summer and fall of 2007 will provide the necessary data to determine the ecological impacts of vegetation management on ponds.

Penoxsulam: A New Aquatic Herbicide for Large-scale Aquatic Plant Management

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Penoxsulam is a new acetolactate synthase inhibiting (ALS) herbicide for management of submersed, floating, and emergent nuisance aquatic plants. Penoxsulam has demonstrated good activity on the submersed weeds *Hydrilla verticillata (*hydrilla*)*, *Myriophyllum spicatum* (Eurasian watermilfoil), *Cabomba caroliniana* (cabomba), and *Egeria densa* (Brazilian elodea). At typical in-water use rates of 5 - 20 µg L^{-1} (ppb), penoxsulam inhibits elongation and growth of target weeds and produces slow death of existing tissues—characteristics that allow for use of the product at a large scale with minimal risk to water quality parameters. Characterizing impacts on potential non-target vegetation has paralleled the development of penoxsulam for submersed weed control. Although certain emergent plant species exhibit visual injury to aqueous exposures, many species quickly recover after the exposure is removed under field conditions [e.g. *Scirpus validus* (soft-stem bulrush), *Pontederia cordata* (pickerelweed), and *Eleocharis interstincta* (jointed spikerush)]. Penoxsulam controls many free floating weed species—including *Eichhornia crassipes* (water hyacinth), *Pistia stratiotes* (water lettuce), *Limnobium spongia* (frog's bit), various duckweed spp., and *Salvinia* species (e.g. *S. molesta* (giant salvinia)) - through either in-water (aqueous) or foliar treatments. Typical foliar use rates are between 18 – 70 g ha^{-1} (1 to 4 oz $acre^{-1}$). Potential drawdown use as a pre-emergent herbicide in seasonally-flooded sites is also being examined. Various product-specific monitoring technologies—including a penoxsulam immunoassay—are being developed to support operational use. Penoxsulam registration for aquatic uses was pending EPA approval at the time of preparation of this abstract. Penoxsulam is classified as a reduced-risk alternative for aquatic plant control. Efficacy data will be reviewed from field and greenhouse scale trials for both target and non-target species.

Community Effects of Large-scale Changes in Plant Composition after a Lake-wide Herbicide Treatment *(Student Presentation)*

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Eurasian watermilfoil *(Myriophyllum spicatum)* is an invasive macrophyte that creates dense monotypic habitat and displaces native aquatic plants. Currently, herbicide treatment appears to be the only effective way of controlling this problem; however, there are no long-term studies of the effects of lake-scale eradication of invasive vegetation on fish and macroinvertebrate communities. We conducted a 5-year study to evaluate effects of a low-dose 2,4-D and endothall application on aquatic community in Minnesota lakes. After eradication of milfoil, we observed a successful restoration of the native plant community: abundance and diversity of native plants increased in the two treated lakes as compared to the reference lakes. We hypothesized that a lag in reestablishment of native vegetation and/or a change in structural complexity of the habitat would affect resident fish and invertebrate communities and their interactions. However, our results show that fish diversity, biomass, and relative weight did not change significantly in response to the herbicide treatment. There was a significant year by treatment interaction for the relative abundance of invertebrate prey. We discuss macroinvertebrate abundance and fish diet selectivity as a function of changing plant communities and implications of these findings for invasive plant management in lakes.

Effects of the ALS Inhibitors on Algae

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The acetolactate synthethase (ALS) inhibitor herbicides are widely used on terrestrial crops. Because they inhibit the formation of the branched-chain amino acids valine, leucine, and isoleucine, they reduce protein synthesis, thus stopping root and shoot growth. As a rule, each compound controls its own suite of weed species (sometimes only one or two) and leaves the others. Several of the ALS inhibitors are being developed as herbicides for aquatic vascular weed control. Another major component of

aquatic systems is the algae; their effects range from positive (e.g., the green algae and diatoms are the base of the aquatic food chain) to negative (e.g., blue-green algal blooms can cause oxygen depletion and toxin production). This study was initiated to determine the effects of the ALS inhibitors on a broad range of algal genera. In particular, given their highly selective characteristics, would they effectively control blue-greens but not greens or diatoms? Using a laboratory bioassay (unialgal cultures grown in sterile inorganic media), actively growing algae were exposed to bispyribac, CE-110, imazamox, and penoxsulam at 100 to 500 ppb ai. Lower and higher doses were used to determine end points of sensitivity. The herbicides were not selective by taxonomic group. Penoxsulam, however, effectively controlled several potential target blue-greens, including *Cylindrospermopsis* (toxin producer) and *Pseudanabaena* (taste and odor producer), and CE-110 was effective on *Cylindrospermopsis* and *Microcystis* (a common bloom-former) at concentrations as low as 5 ppb ai. Among green algae, *Ankistrodesmus* and *Selenastrum* were unaffected, but *Scenedesmus* was sensitive to bispyribac, CE-110, and penoxsulam. In general, the use of ALS inhibitors in water will probably have little effect on most algal communities but penoxsulam and CE-110 may have the potential to reduce some target blue-green populations.

Endothall Combinations with 2,4-D and Triclopyr for Control of Eurasian Watermilfoil

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Eurasian watermilfoil (*Myriophyllum spicatum* L.) is a widespread submersed aquatic plant that causes nuisance problems in the continental United States. While both contact and systemic herbicides are available to control Eurasian watermilfoil, each class of herbicide has its drawbacks. Contact herbicides are fast acting, relieving nuisance problems quickly, but may allow regrowth of nuisance plants by not killing the entire plant. Systemic herbicides will often kill the entire plant, but are slower acting and limited by short contact times. We examined whether combinations of contact (endothall) and systemic (2,4-D and triclopyr) herbicides might exploit the strengths of each herbicide class, and minimize their weaknesses. Eurasian watermilfoil was treated with combinations of endothall (Aquathol-K) with either 2,4-D (DMA-4 IVM) or triclopyr (Renovate 3). Our goal was to determine if there is a potential additive or synergistic effect with these two compounds, or screen for potential interference. The liquid formulation of endothall was evaluated alone (at either 1.5 or 1 ppm with a 24-hour exposure) and in combination with 2,4-D or triclopyr at a rate of 1 ppm endothall with 0.5 ppm of 2,4-D or triclopyr at both 12 and 24 hours of exposure. Each treatment, and a reference were replicated in four tanks, for a total of 36 - 100 gallon tanks. Each tank had seven 1-gallon pots containing “supersoil” growth medium and planted with two sprigs of Eurasian watermilfoil. Plants were allowed to grow for four weeks prior to treatment. One pot per tank was harvested for pretreatment biomass values. Each week, tanks were rated for percent control on a 0-100% scale. Four weeks after treatment, plants were harvested and sorted to shoot biomass. Plants were dried at 70C and weighed for biomass determination. After four weeks, all treatments showed equal control of plant shoot mass, based on a one-way analysis of variance. Analysis of visual ratings indicated that endothall alone provided control the first week after treatment, but percent control was rated at 60%. Triclopyr and 2,4-D alone provided 100% control after two to three weeks, but initial control was less than 20%. All treatments with endothall and a systemic herbicide provided at least 50% control in the first week of treatment, and 100% control after four weeks. Combinations of endothall with either 2,4-D or triclopyr provided the benefits of immediate action in and complete control within four weeks.

Problematic Aquatic Plants of the MidSouth

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As elsewhere in the United States, problematic aquatic plants are increasing in the MidSouth. Traditionally, nuisance-forming native plants were the most common problems, such as duckweed, watermeal, and southern naiad. The introduction of nonnative plants has changed this, particularly on large waterbodies. Waterhyacinth has been a significant nuisance in the Tennessee-Tombigbee Waterway, Ross Barnett Reservoir, and elsewhere. Hydrilla was found in numerous systems in the midsouth, including the Ross Barnett Reservoir and the TVA system. Giant salvinia was found in the Pascagoula River drainage, and populations have been found within this drainage despite management. Other invasive aquatic plant species in the midsouth include alligatorweed, common salvinia, Eurasian watermilfoil, waterprimrose, parrotfeather, Cuban bulrush, and common reed.

Wild Rice (*Zizania aquatica* L.) Susceptibility to the Aquatic Herbicide Triclopyr

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A primary goal of managing invasive aquatic plants is to selectively control the target plant without impacting desirable native plant species. Eurasian watermilfoil (*Myriophyllum spicatum* L.) often infests the littoral zone of lakes, even into the emergent plant zone, competing with the desirable emergent plant wild rice (*Zizania aquatica* L.). Wild rice is an excellent habitat for fish and wildlife and an outstanding food source for migratory waterfowl. Natural resource agencies are concerned not to damage wild rice while managing invasive Eurasian watermilfoil. Pursuant to this goal, we examined the sensitivity of wild rice to the herbicide triclopyr, which can be efficacious on Eurasian watermilfoil at application rates as low as 0.25 mg L^{-1}. Three life stages of wild rice were evaluated: seedling (floating leaf stage), young (an emergent culm with one leaf), and mature (flowering head beginning to form). For each stage, we had four treatments: 0.0, 0.75, 1.5, and 2.5 mg L^{-1} aqeuous concentrations of triclopyr (Renovate 3). For each life stage and treatment, we replicated the treatment in four tanks, and each tank had fourteen 3.8L pots, with each pot containing one plant. Each treatment was exposed for 72 hours, then the herbicide treated water was replaced with untreated water, and plants were allowed to grow for four weeks. Plants in all tanks were rated for phytotoxicity on a 0-100% scale each week after treatment. At four weeks post treatment all plants were harvested, measured for height (cm), and the number of seedheads and tillers, and dried at 70 C for 48 hours to determine biomass. Within two weeks of treatment, seedling stage plants exhibited statistically significant herbicide damage at the 1.5 and 2.5 mg L^{-1} rates, but not at the lowest rate. By four weeks after treatment, seedlings under the highest concentration of herbicide exhibited 80% herbicide damage, and at the second highest rate herbicide damage was almost 60%. While herbicidal damage was statistically significant for the two highest rates in both young and mature stage plants, in all cases damage ratings were less than 20%. After four weeks, plants at all life stages exposed to the highest rate of herbicide exhibited reduced height, mass, seedhead production, and tiller formation. The seedling stage of wild rice exhibited the greatest sensitivity to triclopyr, while other stages were much less sensitive. At all stages, the lowest concentration (0.75 mg L^{-1}) had no significant impact, and the intermediate rate (1.5 mg L^{-1}) had minimal response to the herbicide at the young and mature stages.

Microsponge Technology for Rainfastness and Weatherability

Lucy Marshall and Rick Lowe
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Rainfastness and weatherability are important in the application of products in all weather conditions. New results received from cooperators is demonstrating that the microsponge technology in TopFilm™ is assisting vegetation managers in arid conditions and in hot humid conditions. Operational work by helicopter applicators in the Rio Grande Valley and by government agencies in the Orlando lakes area will be presented showing methods to keep exotic/invasive plants away from beneficial vegetation.

Impact of Aquathol K Applications on Largemouth Bass Spawning Behavior and Production of Young Fish *(Student Presentation)*

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In this study, we evaluated the direct application of Aquathol K on nesting largemouth bass (Micropterus salmoides) and examined the impacts on the subsequent reproductive success of these fish. Aquathol K was applied at the approved rate of 3 ppm in three 0.1 hectare ponds in March 2005, 2006, and 2007 as largemouth bass initiated spawning and spawning activity was monitored over 14 days. Water was applied in a similar fashion to three other 0.1 hectare ponds. For all three years; Aquathol K did not impact largemouth bass nesting activity or spawning behavior and nest fidelity was similar to ponds treated with water. In 2005, concentrations of Aquathol K declined three to six fold in the ponds during the observed spawning period, but was still persistent in the water during spawning. Abundance and growth of young largemouth bass produced after spawning were similar among ponds treated with Aquathol K and control ponds, although young largemouth bass production was much greater in 2006 compared to 2005. Larval bluegill (Lepomis macrochirus) abundance varied between 2005 and 2006, but no effects of Aquathol K were detected on production of these fish. In September 2005 and 2006 all fish were recovered with rotenone, density and biomass of age-0 bluegill and largemouth bass varied between years, but differences in ponds treated with Aquathol K were not detected.

Exposure of Native American's to Fluridone through the Ingestion of Tules from Clear Lake, California - Exposure and Risk

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This study addresses concerns expressed by Native Americans living near Clear Lake, California, regarding exposure via the consumption of aquatic vegetation, to the herbicide fluridone (active ingredient), used by the California Department of Food and Agriculture (CDFA) Hydrilla Eradication Program to control weeds in Clear Lake. In response, the CDFA monitored vegetation, water and sediment around Clear Lake, before and after seasonal applications of fluridone. Sub-chronic and chronic exposures were evaluated, and risk calculations performed for a realistic (CTE) and worst-case (WCE) scenario. Exposure factors were developed through interviews with Tribal members. Edible-tule data, average sample concentrations and average consumption habits were used to evaluate the "realistic" exposure scenario. Conservative estimates, and high range sampling values were used to evaluate a "worst-case" scenario. Of fourteen edible-tule samples, LC/MS measurements detected fluridone only once, at 2.2 ppb. Of sixteen whole-tulle samples, fluridone was detected twice, (2.9 ppb and 3.4 ppb). Although the average daily dose (ADD) for sub-chronic exposures were four times greater than the ADD for chronic scenarios, the risks were less due to the twenty-five fold larger reference dose (RfD) used for sub-chronic calculations: 2.0 mg/kg-day chronic RfD, 0.08 mg/kg-day Sub-chronic RfD. Hazard quotients (HQ) or risk, for the adult receptor (CTE scenario) were 1.8×10^{-6} (sub-chronic) and 1.2×10^{-5} (chronic). HQs for the adult receptor (WCE scenario) were 1.8×10^{-5} (sub-chronic) and 1.1×10^{-4} (chronic). Evaluation of HQs for all scenarios and receptors evaluated indicate that there is extremely little to no risk of adverse effects from exposure to fluridone from the ingestion of tules out of Clear Lake.

Flumioxazin Development for Aquatic Weed Control *(Student Presentation)*

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The exotic submersed aquatic weed hydrilla (*Hydrilla verticillata*) has spread throughout Florida and the Southeastern U.S. and has hindered navigation, recreation, and displaced native vegetation. Fluridone has been widely used to control large scale hydrilla infestations in Florida at low use rates with a minimum impact to the environment. However, after repeated use without rotation, fluridone resistant hydrilla was discovered in numerous large water bodies by 2000. The lack of alternative herbicides for large scale control has resulted in screening of herbicides at the Center for Aquatic and Invasive Plants (CAIP) in Gainesville, FL. Flumioxazin is one of five herbicides to receive an Experimental Use Permit (EUP) from the EPA for aquatic weed control in Florida. Flumioxazin is a contact herbicide which inhibits chlorophyll production by inhibiting the enzyme protoporphyrinogen oxidase in addition to causing membrane disruption. It is primarily broken down by hydrolysis with a half-life of 4 days, 17 hrs, and 17 minutes at pH 5, 7, and 9, respectively. The rapid breakdown of this product is a major concern as pH of most lakes infested with hydrilla is between 7 and 9. Hydrilla efficacy studies determined flumioxazin to be effective at rates as low as 33 $\mu g\ L^{-1}$. Despite rapid visual symptoms and knockdown, re-growth occurred within 2 weeks after treatment. In order to determine the direct impact of pH, the net photosynthetic rates of hydrilla treated with flumioxazin (100-1600 $\mu g\ L^{-1}$) were evaluated at a high (>9.0) and low (6.0) pH by measuring oxygen evolution. At rates of 200 $\mu g\ L^{-1}$and greater, pH did not have any effect on the ability of flumioxazin to halt photosynthesis. Additionally, the selectivity of several submersed and emergent native aquatic plants were evaluated for sensitivity to flumioxazin at rates of 50 to 1600 $\mu g\ L^{-1}$. Those species evaluated were coontail (*Ceratophyllum demersum*), southern naiad (*Najas guadalupensis*), egeria (*Egeria densa*), tape grass (*Vallisneria amaericana*), sagittaria (*Sagittaria lancifolia*), maidencane (*Panicul hemitomon*), jointed spikerush (*Eleocharis interstinta*), and pickerelweed (*Pontederia cordata*). In addition to hydrilla control, flumioxazin is being screened for efficacy on other invasive species including duckweed, water lettuce and water hyacinth.

Initial Mapping of Hydrilla and Other Submerged Vegetation in Lake Manitou, Indiana

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The 2006 discovery of hydrilla in Lake Manitou, IN, initiated a rapid-response effort to understand the scope of the infestation. Knowing the scope of the infestation is critical to planning response actions that limit the spread of this highly invasive species. This poster shows a series of GIS-based maps depicting the location and density of hydrilla and all submerged vegetation in Lake Manitou in early October, 2006. The data were collected using both hydroacoustic plant sampling and physical point sampling. An overview of the data collection methodologies is also provided.

An Integrated Approach to Invasive Plant Management: Biocontrol and Native Plant Interactions

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Native aquatic macrophytes are known as effective competitors against invasive aquatic plants. Yet, the invasives have an inherent competitive edge due to a lack of herbivores. Hence, the presence of diverse native plant assemblages coupled with sustained herbivory should hasten declines. To test this hypothesis in the aquatic environment, several experiments were conducted with and without plant competition and herbivory using insecticides to eliminate herbivores. In a two year study combining hydrilla biocontrol with native plant competition overall tuber production was reduced 2-fold by native plant competition and 1.3-fold by herbivory alone. However, even more substantial decreases of > 5-fold were demonstrated when both were combined stressing the importance of plant competition when found in conjunction with herbivory. Throughout this and other studies, native plants exhibited significant levels of damage due to invertebrate herbivory. However, little information is available that quantifies the impact of herbivores on native plants. In a second study examining native herbivore impacts to submersed and floating leaf species, only the two floating-leaved species, *Potamogeton nodosus* and *P. illinoensis* exhibited a 37 and 72 % decrease in biomass in the presence of herbivory, respectively. Hence, competitive edge in native plants is apparently curtailed significantly due to herbivory.

Mesocosm Evaluation of Fluridone and *Mycoleptodiscus terrestris* for Control of Hydrilla

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In laboratory studies, we have shown that combining low rates and short contact times of fluridone with the native fungal pathogen, *Mycoleptodiscus terrestris* (Gerd.) Ostazeski, or Mt, provides excellent control of hydrilla (*Hydrilla verticillata* (L.f.) Royle). To verify these results under outdoor growing conditions, we conducted a mesocosm study at the Lewisville Aquatic Ecosystem Research Facility in Lewisville, TX, using fluridone and Mt against hydrilla and two non-target plant species, wildcelery (*Vallisneria americana* Michx.) and Illinois pondweed (*Potamogeton illinoensis* Morong). Treatments included 5.0 µg L^{-1} fluridone at contact times of 21 and 35 days; 0.05 g L^{-1} Mt as a dry inoculum; 0.05 ml L^{-1} Mt as a liquid inoculum; all combinations of both agents at each rate and contact time; and an untreated control. Compared to untreated plants, a 21- and 35-day exposure of 5.0 µg L^{-1} fluridone combined with either liquid or dry Mt inoculum reduced hydrilla by $\geq$ 90%, 30 days after treatment (DAT). Fluridone and pathogen applied as single agents were less effective. By 60 DAT, a 21-day exposure to fluridone + Mt reduced hydrilla by 78%, while pathogen alone (both liquid and dry) showed no impact on hydrilla biomass and fluridone alone for 21 and 35-days increased biomass by 30%. A 35-day exposure to fluridone + Mt as a dry inoculum was the most effective treatment, controlling 96% hydrilla 60 DAT. None of the treatments inhibited Illinois pondweed; however wildcelery was suppressed by Mt applied as both liquid or dry inoculum and all herbicide-pathogen combinations. Results compare favorably with small-scale laboratory studies and showed improved hydrilla control with a short contact time (35 days) when fluridone and Mt were applied as a simultaneous treatment. Both agents applied alone at these rates and contact times did not provide long-term control of hydrilla. The results also showed that wildcelery was sensitive to all Mt inoculum used in this test and indicate further evaluation of Mt on native plant species is warranted.

The Status of Fluridone-Resistant Hydrilla in Florida and Its Impact on Operations and Research

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The topic of fluridone resistant hydrilla (*Hydrilla verticillata* L.f. Royle) was addressed during a Special Symposium at the 44th Annual APMS meeting in Tampa, Florida. Following this 2004 Symposium, Florida was hit by 3 major hurricanes in succession, and the resultant severe winds and wave action provided environmental control of hydrilla in many large systems. Sustained high water levels and significant decreases in water clarity inhibited hydrilla recovery through 2005. During this period of reduced hydrilla, two multi-agency workshops were held in December 2004 and 2005 to address numerous issues related to hydrilla and hydrilla management. While fluridone resistant hydrilla (FRH) was the impetus for holding these meetings, all current forms of management were discussed. A white paper was produced that included 13 recommendations related to hydrilla management in Florida. Operational control of hydrilla at both the large and small scale has shifted principally to the contact herbicide endothall. State personnel maintain aggressive detection and response programs in lakes that have limited hydrilla infestations. Recent research on endothall has focused on treatment timing for large-scale applications,

residue dispersion and longevity, and combinations with the contact herbicide diquat. The current heavy reliance on endothall and continued spread of FRH has promoted increased screening activity for new herbicide modes of action. As of early 2007, the USEPA had granted special labels or permits for 3 acetolactate synthase inhibitors, 1 protoporphyrinogen oxidase inhibitor, and 1 auxin-type inhibitor for control of hydrilla. The number of herbicides being evaluated is unprecedented in aquatics. Recent biological control research seeks to quantify inundative techniques with hydrellia flies, and there is a renewed effort to search Africa for novel insects. Innovative research with grass carp is focusing on the use of chemical implants to control the lifespan of the fish and minimize long-term impacts to native plants. As of early 2007, many large Florida lakes support significant infestations of FRH. Barring widespread environmental disturbance, the continued low water levels and improved water clarity will support intra-lake spread of hydrilla. Significant expansion of FRH in combination with a limited number of tools will continue to challenge aquatic plant managers.

Sago Pondweed Response to Soil Applied Imazamox and Imazapyr

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The native, sago pondweed (*Potamogeton pectinatus* L.), is a recurring problem in irrigation canals along the Front Range and the eastern plains of Colorado. Irrigation districts are currently using backhoes to dredge canals in order to maintain water flow. Acrolein applications are also used to control sago pondweed top growth. Both of these methods are costly and do not provide long-term solutions to sago pondweed infestations. Greenhouse studies were conducted to evaluate soil applied imazamox and imazapyr as possible alternative strategies for sago pondweed control. Soil was collected from an irrigation canal near Gilcrest, CO for use in all greenhouse experiments. This soil was a sandy loam with 1.1 % OM and a pH of 6.1. Pots were filled with canal soil and a single sago pondweed tuber was planted in each pot. Imazamox and imazapyr were applied using an overhead track sprayer calibrated to deliver 20 gal/ac. Imazamox and imazapyr were applied at 32, 48 and 64 oz product/ac and 64 and 96 oz product/ac, respectively. Following herbicide applications half the pots received 0.3 inches of overhead irrigation, while the remaining pots were keep dry. All pots were then maintained at 35F in the dark for two weeks before being submerged in 20 gallon plastic tanks and allow to grow under greenhouse conditions. Sago pondweed biomass was harvested 30 days after being submerged, oven dried and weighed. All rates of imazamox and imazapyr reduced sago pondweed biomass by more then 86% and there was no increase in control with incorporation. Based on plant symptoms, these herbicides were absorbed by below ground shoot tissue and translocated to shoot meristems. Imazamox and imazapyr strongly inhibited sago pondweed root growth when compared to the untreated controls. Applying imazamox or imazapyr in the fall or early spring to dry irrigation canals appears to have potential as a new method for sago pondweed management.

Impact of Insect Herbivory on Dispersal in *Hydrilla verticillata* (L.f.) Royle

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Hydrilla is an invasive aquatic plant that spreads through a variety of vegetative structures. Fragments, long distance dispersal and vegetative reproductive propagules, increase the ability of hydrilla to colonize new and distant locations. Sustained levels of herbivory by leaf-mining flies (*Hydrellia pakistanae* and *H. balciunasi*) can reduce biomass and impact the ability of hydrilla to photosynthesize. Impacts from herbivory apparently can increase fragmentation at points of feeding. If greater fragmentation occurs due to increased fly damage, how viable are these fragments? To answer this question, viability of fragments with low (0-30%), medium (40-60%), and high (70-100%) leaf damage were compared. Fragments with high levels of leaf damage produced 3-times less biomass when compared to hydrilla fragments with low leaf damage. Fragment establishment was also studied based on settling, rooting and anchoring success of individual fragments. Results indicate that no highly damaged fragments settled, produced roots or anchored. However > 80% of the control fragments produced roots and anchored as compared to only 20 % by low and medium damaged fragments. Herbivory apparently has great impact, significantly reducing fragment viability.

Salvinia molesta – A Review of Past Research and What's Coming Up!

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Giant salvinia (*Salvinia molesta*), an introduced, free-floating fern native to Brazil, is invading the US. In order to predict its ultimate distribution in the United States, studies conducted by the USACE-Lewisville Aquatic Ecosystem Research Facility focused on identifying environmental factors that may affect the susceptibility of aquatic ecosystems to invasion. These studies were conducted to determine the effects of low temperatures, and pH on the growth of giant salvinia and the effects of drying and bud size on viability of giant salvinia affected by dessication. The temperature studies demonstrated that acute low temperature exposure and formation of ice results in a decrease in percent survival of giant salvinia. All giant salvinia plants exposed to air temperatures of –16C (48hr) were killed while those exposed to –3C (48hr) survived due to incomplete ice formation in the surface water of the container. The pH research established that giant salvinia grew to completely cover a research pond over a 15-week period when pH was less than 7.5. Growth was reduced in a second pond maintained at higher pH (greater than 8 units). Tank studies found that significantly greater giant salvinia biomass was produced at lower pH and that water chemistry of tanks changed when completely covered by the resultant mat. The desiccation studies found that viability of giant salvinia buds was unaffected until tissue moisture content was below 30%. These studies have provided the foundation for a 2007 container study addressing nutrients, conductivity and pH. The three nutrient treatments: (high (10mg NH_4-N/L &1mg PO_4-P/L), medium (2mg NH_4-N/L & .01 mg PO_4-P/L), and low (.05mg NH_4-N/L & .001mg PO_4-P/L); conductivity (approximately 100, 350, 750 1500 µhmos); and pH (approximately 6.5, 8-8.5, +9 units).

Sexual Preference and Alternative Life Cycles in *Hydrilla*: Monecious and Dioecious

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Two biotypes of hydrilla exist in Lake Gaston, NC/VA: dioecious (plants are either male or female) and monoecious (plants have both male and female flowers on the same plant). Both biotypes are problematic, forming dense surface canopies which can impede navigation, degrade habitat and water quality, and interfere with recreational activities. While the dioecious biotype has been intensively studied, much less is known about monoecious hydrilla. Anecdotal information and personal observations in Lake Gaston (Snow and Owens) suggested that the two biotypes differ in their overwintering strategies. In order to effectively manage the growth of monoecious hydrilla and its tuberbank, we need to understand the life cycle of the plant. An outdoor mesocosm study of the of the two hydrilla biotypes was initiated at the LAERF in July 2006, to compare the phenology of the biotypes in a controlled, outdoor setting. Primary interest was focused on aboveground biomass dynamics and tuber/turion production and sprouting in relation to natural changes in temperature and photoperiod over a 15-month study period. Harvests were conducted every 6 weeks starting in October 2006. While the study is ongoing, initial results (through December 2006) indicate that monoecious hydrilla behaves as an herbaceous perennial, completely dying back to tuber or turion by December. In contrast, the dioecious biotype acts as an evergreen perennial – overwintering as an intact plant or semi-dormant rootcrown. Results to date found no significant differences in aboveground biomass between the biotypes until December, 2006, when the monoecious biotype senesced, resulting in an almost 10-fold difference in shoot biomass between the two biotypes. Over the three harvest dates monoecious hydrilla produced nearly twice as many tubers as did the dioecious biotype. By the November harvest monoecious had produced 60 times more turions than the dioecious. The implications of an herbaceous perennial life cycle on management of monoecious hydrilla will be discussed.

Case Study: Selective Control of Eurasian Watermilfoil Using Diquat - Four Years of Results

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Eurasian watermilfoil (*Myriophyllum spicatum* L.) infested the majority of the littoral zone of the 800-acre Twin Lakes system located in Salisbury, Connecticut. These lakes are in an ecologically sensitive region and support several state protected aquatic plant species in addition to a prized warm water and cold water fishery. Annual mechanical harvesting efforts were no longer providing acceptable levels of EWM control during the summer recreation season. Through close collaboration with state regulatory agencies, a partial-lake diquat (REWARD) herbicide treatment program was developed and commenced during the 2003 season. Treatment of 75 acres along developed shorelines and high-use areas in two of the three major lake basins was permitted. No-treatment buffers were established between documented beds of state listed species, and the middle basin was left as an untreated refuge area. EWM was successfully controlled and no adverse impacts were documented. The treatment program continued during 2004, 2005 and 2006 seasons. Results of the annual comprehensive monitoring program have been favorable. No significant changes to water quality, phytoplankton, zooplankton, or state protected plant populations have occurred. The diquat treatments have shown a high selectivity for EWM. Native aquatic plants have recolonized areas previously dominated by EWM, as shown by the consistency and increase in measured indices such as plant cover, plant biomass, species richness, while EWM cover has declined and it does not interfere with recreational use of the lake in managed areas.

Acute Toxicity of Diquat to South American Tropical Fishes

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The macrophytes are very important members of the aquatic biocenosis, contributing with high vegetal biomass, providing protection sites for young fishes and other aquatic organisms and promoting spatial and temporal heterogeneity that contribute to biodiversity. In water bodies under antropic influence, some aquatic plants are favored and raise dramatically its population densities and geographic occupation and its control are fundamental to maintain the human activities and suitable environmental conditions. In Brazil the herbicide Diquat is in registration process and some ecoltoxicologial data are required. So, this research was carried out aiming to evaluate the acute toxicity of Diquat in the tropical fihes *Leporinus macrocephalus*, *Piaractus mesopotamicus,* and *Oreochromis niloticus*) and the possible hystopathological effects on the liver and gills of surviving fishes. The $LC_{(50-96\ h)}$ determined were 26,22 mg/L for L. macrocephallus, 83,5 mg/L for P. mesopotamicus, and 37,28 mg/L for O. niloticus. The hystopathological effects in the gills were similar but in the livers the effects were different for each species and no pattern could be defined. The herbide Diquat under the recommended doses for aquatic weeds control is very safe for the evaluated fishes.

Eichhornia crassipes Control with Diquat and Its Effect on Periphytic Community, under Mesocosm Conditions

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A mesocosm trial was carried out aiming to evaluate the impact of the waterhyacinth (WH) control with diquat (7,0 L/ha of Reward) on the periphytic community, under mesocosms conditions (1,68m of diameter and 0,40m deep). The substrate for periphyton colonization was glass slides located 15cm deep. Five situations were elected as treatments: (i) Mesocosm colonized by WH without control; (ii), Mesocosm where the WH control was done by freezing, (iii) mesocosm with WH control using diquat, (iv) mesocosm without WH and diquat sprayed on the water surface and (v) mesocosm without WH and no herbicide spraying. The mesocosms were arranged in a complete randomized block experimental design. The slides were colleted in different times after the WH control. The multivariate analysis showed a clear distinction between colonized and WH free mesocosms, suggesting that the plant presence was the more important factor influencing the specific composition of periphytic community. Considering only the colonized mesocosms, the date of sampling was more important than the WH control method. There was a segregation involving samples taken before and after 14 days after the WH control, regardless the control method used. Comparing no colonized and WH colonized mesocosm there was a increase in the diversity and equitability index.

Glyphosate and Aterbane Acute Toxicities to South American Tropical Fishes

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In Brazil there is great difficulty for registration of herbicides for the control of aquatic weeds. The environmental regulation is very rigorous and requires ecotoxicological tests with native organisms. Glyphosate is being registered for use in aquatic environments, but there are many doubts about the toxicological effects of the recommended surfactant Aterbane, alone or combined with the herbicide. So, the objective of this work was to evaluate the acute toxicity ($CL\ (I)_{50\text{-}96h}$) of the glyphosate (Rodeo®) and the surfactant Aterbane® BR to three neotropical fishes: *Piaractus mesopotamicus*; *Hyphessobrycon eques* and *Phallocerus caudimaculatus*. As international stands, the fish *Brachydanio rerio* also was evaluated. The bioassays were carried out in a climatized room (27°C and 12 hours of light). Before the bioassays, the fishes were acclimatized for 10 days in the room. The assays were conducted in the static system, without replacing the water. The fishes were exposed to glyphosate concentrations of 0,0; 900; 925; 950; and 975 mg/L, and to Aterbane® BR concentrations of 0,0; 4,0; 6,0; 8,0; 10,0; and 12,0 mg/L. After 96 hours of exposition to glyphosate the LC50 was > 975 mg/L for the three native species and *Brachydanio rerio*. The determined LC50 of Aterbane were the following to the respective fishes: 9,45 mg/L for *P. mesopotamicus*, 8,21 mg/L for *H. eques*, 8,21 mg/L for *B. rerio*, and 5,81 mg/L for *P. caudimaculatus*. The evaluation of the same concentrations of glyphosate added with Aterbane (1%) showed the following values for LC50: > 975 mg/L for *B. rerio* and *P. caudimaculatus*, 528,5 mg/L for *P. mesopotamicus*, and 411,91 mg/L for *H. eques*. The more important conclusions were (i) the LC50 values for international stand were similar to Brazilian fish species under this condition of bioassay study and (ii) the glyphosate is practically non-toxic to these fish species and the addition of Aterbane did not increased expressively the toxicity of the herbicide solution.

Multivariate Studies in a Macrophyte Community Colonizing the Santana Reservoir, Rio de Janeiro, Brazil

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The aquatic weeds are essentially important in water bodies under strong antropic influence, especially in hydropower water reservoirs near highly urbanized regions. The studies reservoir, Santana (Piraí, Rio de Janeiro, Brazil), historically has many problems with aquatic weeds. Aiming to solve these problems the company periodically promotes a mechanical harvesting cleaning up the reservoir, but after some time it is completely re-colonized by the macrophytes and the problems are back. Aiming to understand the macrophytes re-colonization dynamics, fields surveys were done monthly, identifying and quantifying the aquatic weed populations in 91 sampling sites. The weeds quantification was done by means of a colonization scale changing from 0 (no plants) to 4 (high colonization, more than 40% of the sampling site). The evolution of colonization area and the geographic distribution pattern were studied for aquatic weed populations, while diversity and equitability coefficients, several similarity index and multivariate analysis were applied to study the macrophyte communities between sampling times. There was a well defined colonization succession process, characterized by variation in the relative size of the different populations and some seral stages could be established, at least for mechanical harvesting planning and some biotic conditions of the macrophyte community. The predominant species were exotic and the more important were *Egeria densa* and *Brachiaria arrecta*. For some species, like as *Eichhornia crassipes* and *Myriophyllum aquaticum*, the biotic pressure, due to natural enemies, probably have decisive effect to keep low density colonizations in the reservoir. The multivariate analyses produced two groups of communities, samplings from first and second semester of 2004, probably defined by long a period of sediment exposure during July. Besides, the multivariate analysis was useful to evaluate the communities' tendencies and supported the election of succession stages in the macrophyte colonization evolution.

Response of Selected Weed Species to Imazamox

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Imazamox is currently under development for use in aquatic plant management. Field and greenhouse trials were conducted in 2006 and 2007 to determine the response of selected problematic aquatic plant species to imazamox. In field research, imazamox was applied to water hyacinth as a spray to wet application with rates of 1 to 16% v/v and in comparison to 0.3% v/v triclopyr and an untreated control. Non-ionic surfactant at 0.25% v/v was included with each treatment. In greenhouse trials, imazamox was applied as an in-water treatment to hydrilla and Eurasian watermilfoil at 0 to 200 ppb in comparison to 10 ppb fluridone and an untreated control. In all trials, weed control was visually rated on a 0 to 100% scale with 0% equal to no control and 100% equal to complete plant death. Greenhouse trials were also harvested for dry weight determination at approximately 5 weeks after treatment (WAT). In the field trial, each herbicide treatment controlled water hyacinth at least 98% by 4 WAT. In the greenhouse trial, Eurasian watermilfoil control was 37 to 65% at 12 WAT, while hydrilla control was 77 to 96%.

Detection of Herbicide Injury on Waterhyacinth Using Landsat 5 TM Simulated Data *(Student Presentation)*

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Many large-scale nuisance aquatic plant control programs are based on herbicide applications. Implementation of large-scale control programs requires accurate detection of herbicide injury in order to determine efficacy. Satellite remote sensing (Landsat 5 TM) may be a tool for large-scale detection of herbicide injury. Studies were conducted in fall 2006 on the R.R. Foil Plant Research Facility in mesocosm tank facility, Mississippi State University to detect herbicide injury on waterhyacinth affected by four different rates of imazapyr (Habitat®), glyphosate (AquaPro®), and fluridone (Sonar® AS). Imazapyr and glyphosate were applied at recommended rates (2 pints and 6 pints per acre respectively) and 3 sub-lethal rates using a CO_2 backpack sprayer. Fluridone was applied directly to the water at 20, 10, 5, and 2.5 ppb. Each treatment was replicated in three tanks. Phytotoxicity and control visual ratings as well as reflectance measurements using an Analytical Spectral Device were taken every week across 6 weeks after treatment (WAT). Living plant material was harvested at the end of the study to determine biomass. Reflectance measurements were transformed into a Landsat 5 TM simulated data set using MatLab® software. Significant

differences in biomass were detected in all treatments (p=<0.0001). The recommended rates of imazapyr and glyphosate effectively controlled (>94%) waterhyacinth by 6 WAT. Phytotoxicity visual ratings and reflectance in the near-infrared region from the simulated data set were significantly correlated ($r^2 = 0.60$). However, significant differences in herbicide-injured plants were detected earlier in the simulated data set than visual phytotoxicity ratings. Therefore the near-infrared region (Band 4) from Landsat 5 TM may be a tool to detect herbicide injury in waterhyacinth before herbicide symptoms are visible.

Seasonal Biomass Detection of Waterhyacinth Using Normalized Difference Vegetation Index Derived From Landsat 5 TM Simulated Data *(Student Poster)*

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Detection of seasonal biomass patterns is useful for making accurate decisions and selecting the best timing to apply any control methods used in an aquatic plant control program. Large waterbodies require significant amounts of labor to perform ground-truth surveys. However, this problem may be addressed with the use of remote sensing which provides both temporal and spatial information from a target area. Studies were conducted at Lakes Columbus and Aberdeen (Mississippi) during the growing seasons of 2005 and 2006 to detect seasonal biomass patterns of waterhyacinth and correlate it with the normalized difference vegetation index (NDVI) derived from Landsat 5 TM simulated data. A quadrat (0.10 m^2) placed 25 times at each site was used to collect and determine monthly biomass. Reflectance measurements using an Analytical Spectral Device were taken every month. All statistical analysis was conducted in SAS. Reflectance measurements were transformed into a Landsat 5 TM simulated data set using MatLab® software. A significant correlation ($r^2 = 0.31$) exists between biomass and NDVI values from the simulated data set. Maximum biomass was reached between July and September in both growing seasons which corresponds with maximum NDVI values of 0.93-0.94. The opposite pattern occurred between October and May. Therefore, waterhyacinth seasonal biomass patterns may be tracked with an NDVI composite from Landsat 5 TM.

Responses of Invasive Strains of *Lyngbya* to Algaecide Exposures

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The filamentous cyanobacterium, *Lyngbya* has achieved problematic densities in numerous water resources throughout the United States. There are at least three toxins that *Lyngbya* may produce: a dermatitis toxin, an ichthyotoxin, and an invertebrate toxin.·When *Lyngbya* interferes with critical water resource usages, managers often seek to mitigate the situation. For some situations, an algaecide application is the most environmentally sound and economically viable tactic to alleviate the problem and restore critical water resource usages. We have developed a benthic algal challenge test (laboratory algal toxicity experiment) that predicts responses of nuisance algae in the field. Field applications in a variety of water resources (from Louisiana to North Carolina) have confirmed the utility of this approach for determining efficacious treatments and minimizing impacts on non-target species.

Giant Salvinia Response to Submersion and Herbicides *(Student Poster)*

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Giant salvinia (*Salvinia molesta* Mitchell) is an invasive aquatic fern regulated as a federal noxious weed. Infestations may completely cover slow-moving bodies of water causing oxygen depletion and salvinia mats may reach thicknesses of one meter. Research was conducted to evaluate giant salvinia control with multiple herbicides. In addition, trials were also conducted to determine giant salvinia tolerance to submersion and to evaluate whether submersion may increase the ability of giant salvina to survive the short-term freezing events typical of the Mid-Atlantic region of the United States. In herbicide trials, giant salvinia was controlled with diquat (1 and 2 lb ai/A), fluridone (0.25 lb ai/A), and glyphosate (8 lb ai/A); but was not controlled with elemental copper (0.9 and 3 gal/A) or triclopyr (2 lb ai/A). In preliminary submersion trials, giant salvinia growth was not affected by constant submersion for several days in the greenhouse. Research currently underway includes salvinia response to submersion under freezing temperatures and salvinia response to experimental aquatic herbicides.

Three-year Summary of Monitoring Invasive Brazilian Waterweed in the Sacramento-San Joaquin Bay-Delta, CA

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Understanding how and why submerged macrophyte cultures of Brazilian waterweed (*Egeria densa*) react to management efforts throughout growing seasons in the Sacramento-San Joaquin Delta (SSJD) is key to realizing the best methodology to regulate and/or eradicate invasive growth. The tidal flux and significant turbidity of SSJD waters has historically rendered empirical measurements of *Egeria* coverage and biovolume unreliable. Hydroacoustic plant mapping technology, applied in SSJD waters since 2003, has helped provide a breakthrough in solving this problem. Hydroacoustic measurements of *Egeria* coverage and biovolume have proved instrumental in evaluating efficacy. A key asset of the technology is that it yields a very rapid, verifiable characterization of the entire water column beneath the transducer. Combining hydroacoustic transects with traditional physical point sampling techniques and underwater photographic surveillance provides the most complete picture to date of submerged vegetation conditions in the SSJD. Eighteen sites in the central SSJD have been monitored since 2003 for submerged vegetation species, health, biomass, biocover, and biovolume. The goal of this ongoing monitoring approach is to better measure actual efficacy and the factors that influence efficacy on Brazilian waterweed. During the past three years, fifteen sites were treated with aquatic herbicides and three sites served as non-treatment controls. Each was visited three-to-seven times per year. Efficacy is determined by comparing the aggregation of acoustic-based plant-coverage and biovolume models, photographs, and physical data at each treated site with control sites. Highlights of three years of monitoring results will be displayed and compared.

Integrating Acoustic Mapping into Operational Aquatic Plant Management: A Case Study in Wisconsin

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Efficient planning, execution, and post-treatment monitoring of a submersed aquatic plant management operation requires early detection and detailed information on the distribution of target and non-target species within the treated waterbody. This requirement was the motivation behind the development of the acoustic-based Submersed Aquatic Vegetation Early Warning System (SAVEWS) at ERDC. After initial development of SAVEWS in the late 1990's, the associated processing software was licensed to Biosonics, Inc., and is currently marketed as EcoSAV™, along with the required hardware for conducting acoustic plant surveys. Since becoming commercially available in 2001 approximately 50 systems have been sold world wide. While the system is used by a number of aquatic plant management researchers and operators, by far a greater amount of usage has been found in other fields – primarily ecological and applied studies of estuarine vegetation and coastal hydrography. While usage in any form is considered good, it appears that a significant potential for operational usage within the aquatic plant management field has gone unrealized. Discussions with various aquatic plant management personnel identified concerns related to using the system operationally; these include system acquisition and operations cost, data processing complexity, data accuracy and acceptance by regulatory agencies. To address these concerns, a mapping demonstration was performed in conjunction with a chemical control application to treat Eurasian watermilfoil in a 500-acre Wisconsin lake. One pre-treatment and two post-treatment surveys were conducted. A ground truth sampling effort was performed as part of the first post-treatment survey. The cost of conducting the mapping survey is broken out in terms of equipment costs, and labor for planning, execution, and data analysis. Techniques for data analysis and summarization are presented. Accuracy of acoustic mapping output is assessed. The added value to the overall management operation of information provided by acoustic mapping is evaluated.

Water Hyacinth Management

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Water hyacinth management with a mycoherbicide from Fusarium pallidoroseum and cashew nut shell liquid was tried in glass house and natural lake conditions. In glass house trial 97.78 and 82.22 per cent damages were recorded on applying wettable powder (40 %) formulation of the fungus at 5 per cent and 10 per cent concentrations respectively on the weed presprayed with CNSL. In infected lake, application of 5 per cent concentration of wettable powder (WP) formulation (presprayed with 5 % CNSL) developed typical blighting symptom on the fourth day and recorded 83.4 to 94.5 % damage by 7DAS

Effects of Imazamox Treated Irrigation Water on Selected Agronomic and Horticultural Crops

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Imazamox herbicide is currently labeled for use on conventional alfalfa, dry edible beans, chicory, peas, soybeans, Clearfield® canola, Clearfield® sunflower and Clearfield® wheat. Little information is available on the possibly negative effects of irrigation water treated with imazamox (Clearcast®) for the control of aquatic vegetation on various agronomic and horticultural crops. Several trials were conducted across the US and Puerto Rico in 2006 and 2007 to determine the effects of using irrigation water containing known concentrations of imazamox on corn, cotton, rice, conventional sunflowers, sugarbeets, soybeans and creeping bent grass. Rates and timing of irrigation applications varied with crop and locations. Rates of imazamox in water ranged across studies from 10 to 300 PPB as either single or sequential applications. Rates were selected to represent amounts assumed to be present in irrigation water at various intervals after treatment. Agronomic crops were rated for visual injury and harvested for yield in comparison to checks irrigated with imazamox free water. Horticultural crops were rated for visual injury only. Corn, sunflowers, soybeans and cotton were unaffected at all rates and timings tested. Rice was unaffected at all rates and timings below the 100 PPB level. Creeping bent grass exhibited noticeable injury at all rates above the 100 PPB levels and minor injury at sequential irrigations containing 50 PPB followed by 50 PPB. Imazamox at the 100 and 200 PPB levels caused chlorosis and stunting in sugarbeets. No injury was observed at levels below 100 PPB. The data suggests that irrigation water containing residual levels of imazamox will produce little or no negative effects on certain crops but may be deleterious to others. With an effective half life of 7-14 days restrictions on treated water used for irrigation should be minimal.

Sonar for Duckweed Control in Madison County, Arkansas

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Duckweed (*Lemna sp.*) is a small, floating aquatic plant that is very common in Arkansas. It frequently colonizes ponds, and other quiet areas with little or no water current, that possess adequate nutrients. Its ability to reproduce both sexually and asexually allows it to grow and and spread quickly under optimal conditions. This can lead to the formation of dense mats of duckweed that can entirely cover small ponds. At present, only two herbicides currently legal in .Arkansas have a response rating as either good (diquat; brand name Reward or Weedtrine) or excellent (floridone; brand name Sonar). Sonar is classified as a systemic herbicide, meaning that the herbicide is absorbed by the plant and moved to other areas of the plant. The herbicide works by preventing the formation of carotene pigments which protect the chlorophyll. Sunlight then causes the rapid degradation of the chlorophyll. leading to starvation of the plant. Sonar requires a minimum of 45 days of contact for maximum effectiveness, and it typical1y takes 30 to 90 days to achieve control. This makes it an impractical herbicide to flowing waters, but ideal for ponds that have no outflow. Cattle watering ponds tend to be small (1/4 acre or less) and nutrient loaded, making them ideal duckweed habitat. During the summer of2006, three ponds were selected in Madison County for a demonstration project involving Sonar A.S for duckweed control. Ponds were randomly selected for treatment at the highest labeled rate (90 ppb active ingredient (AI), the lowest labeled rate (45 ppb AI), or for no treatment as a control pond. All ponds were located in pastures and used by cattle throughout the summer. A GPS unit was measured to determine the surface area of each pond and the depth estimated. From this the application rates were calculated. The herbicide was measured using a graduated cylinder, mixed with water in a handheld pump sprayer, and then applied while walking around the ponds perimeter. The ponds were treated on April 19th, 2006. At both the low rate and high rate, the ponds stayed clear of duckweed all summer. During the same period, the control pond had abundant duckweed.

Effects of Scaling-up on Mycoherbicide Characteristics

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One of the challenges to mycoherbicide development is duplicating pathogen viability and virulence when making the jump from small to larger scale production. To compare pathogen characteristics during scale-up, the biocontrol fungus, *Mycoleptodiscus terrestris* (Gerd.) Ostazeski (Mt) was grown in 250 liter flasks in the laboratory and in a 100-L fermentor in a pilot plant. Liquid cultures were analyzed following 4, 5 and 6 day fermentations. Parameters that were compared included dry weights, pH, colony forming units, microsclerotial and spore production, and efficacy on hydrilla. Following drying of the fungus, parameters that were compared included microsclerotia germination, spore production, and efficacy on hydrilla. In both shaker flask and fermentor cultures, fungal dry weights measured in mg/ml increased from day 4 to day 5 however by day 6 additional increases were recorded only for fermentor cultures. Microsclerotial and spore count trends were very similar in that they peaked at day 5 followed by decreasing numbers on day 6. At all application rates tested, liquid cultures from day 5 provided the best efficacy on hydrilla. Dried microsclerotia from all runs had 100% germination following 24 hours incubation in the dark at 28 C. Sporogenic germination of the microsclerotia from all dry preparations exceeded 4 x 10^6 spores/g dried microslcerotia. Efficacy varied depending on harvest date, drying method, and rate of application.

Impact of Biological Control Agents on Fluridone-Resistant and Susceptible Hydrilla Biotypes

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Fluridone resistant and susceptible *Hydrilla verticillata* (L.f) Royle plants were challenged by two biological control agents to ascertain any differences in agent response to the two biotypes. To evaluate the ephydrid fly, *Hydrellia pakistanae,* a series of 3.5 L jars containing 50 g of either fluridone resistant or susceptible hydrilla was inoculated with 50 *H. pakistanae* eggs. Adults were collected from each jar for approximately 40 days to assess developmental time and % survival. The bioassays indicated no significant differences in days to first adult emergence (an indication of developmental time) and % survival to adult. Flies that emerged appeared healthy with no obvious change in general behavior or feeding ability. Resistant and susceptible hydrilla plants grown in 55 L aquaria were inoculated with liquid or dry inoculum of the fungal pathogen, *Mycoleptodiscus terrestris* (Mt). Four weeks post inoculation with both liquid and dry Mt, shoot biomass of both hydrilla biotypes was significantly different compared to untreated controls. Greater than 90% control was achieved at the higher inoculation rates.

The Potential Role of Endophytic Fungi on *Myriophyllum spicatum* Senescence

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Endophytes have only recently been documented in aquatic plants. Three common endophytes *Plectosphaerella cucumerina, Mycoleptodiscus terrestris*, and *Colletotrichum gloeosporioides* occur with high frequency in certain populations of the submersed macrophyte, *Myriophyllum spicatum* (Eurasian watermilfoil). The presence of one endophytic fungus apparently does not exclude another in the same plant tissues as they often co-occur in roots, root crowns, stems, leaves, and inflorescences. Plants usually remain asymptomatic to their presence however certain conditions can induce these benign organisms to pathogenicity. Often, stress induced by environmental or nutritional conditions or the state of maturity of the host or pathogen can prompt latent infection and then disease symptoms appear in the host. Endophytic and non endophytic *M. spicatum* plants were maintained in a greenhouse for approximately 5 months or the equivalent of one field season to evaluate endophytic presence or absence on host senescence. Plant biomass was then harvested, analyzed for endophytic presence or absence, dried to a constant temperature and weighed. At the end of the study, non endophytic plants remained green and healthy and disease free. In contrast, the endophytic infected plants were stunted, turning brown and rapidly senescing. Shoot biomass of non endophytic plants was approximately 4 fold higher than biomass of endophytic plants. This may have implications in plant declines because latent infections may affect plant vigor and survivability over time.

Early Spring Application of Endothall Combined with 2,4-D for Selective Control of Eurasian Watermilfoil and Curly-leaf Pondweed

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Curly-leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) have become wide spread problems in many northern lakes. Both plants begin growing in early spring when ice cover first disappears from lakes, forming dense canopies before many native aquatic plants begin to grow later in the spring. Previous mesocosm and greenhouse studies demonstrated that applying 1 mg active ingredient [ai]/L endothall combined with 0.5 mg ai/L 2,4-D, when water temperatures were 12 to 18^{o}C, resulted in better control of Eurasian watermilfoil and curlyleaf pondweed with less post treatment re-growth and recovery. Based on these small-scale results, a multi-year field study was initiated to verify selective, long-term control of curly-leaf pondweed and Eurasian watermilfoil using early spring applications of endothall combined with 2,4-D. Four lakes infested with curlyleaf pondweed and Eurasian watermilfoil in the Minneapolis/St. Paul, MN area were selected for the field study sites. Pretreatment plant surveys were conducted in June and August of 2003. All Eurasian watermilfoil and curlyleaf pondweed populations in two lakes were treated with the combination of endothall (1 mg ai/L) and 2,4-D (0.5 mg ai/L) in April 2004, 2005, and 2006. The two lakes that were not treated served as references. Post treatment evaluations were conducted in June and August, 2004 through 2006. Herbicide applications were successful at reducing curlyleaf pondweed and Eurasian watermilfoil densities by more than 95% throughout the lakes. Herbicide treatments resulted in no significant changes in native plant abundance or diversity during the first year post treatment, but native plant diversity and abundance did increase in treated lakes during the second and third year post treatment. Water clarity was not reduced following removal of Eurasian watermilfoil and curlyleaf pondweed. Populations of curly-leaf pondweed, Eurasian watermilfoil, and native plants did not significantly change in untreated reference lakes. Early spring applications of endothall combined with 2,4-D effectively controlled both curly-leaf pondweed and Eurasian watermilfoil allowing native plants to increase in diversity and abundance. These methods are being further tested in operational herbicide treatments in MN and WI.

Influence of Water Exchange and Temperature on Controlling Sago Pondweed with Endothall

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Sago pondweed (*Stuckenia pectinata* (L.) Böerner) is a submersed macrophyte that can reach nuisance levels in lakes, reservoirs, rivers, and water conveyance systems. Sago pondweed can grow in these systems at water temperatures well below 25 C. There is little published information on the effectiveness of herbicides when used at cool water temperatures to control submersed aquatic weeds. Therefore, two separate small-scale studies were performed to evaluate efficacy of endothall on sago pondweed at 17 and 21 C. A total of 20 endothall concentration and exposure time (CET) combinations were evaluated. Using the liquid formulation Aquathol® K, herbicide concentrations ranged from 1 to 10 mg endothall ai/L, while exposure times ranged from 3 to 24 hr. All CET combinations, except 1 mg endothall ai/L for 6 hr at 17 C, significantly reduced biomass compared to the untreated reference 4 weeks after treatment. Overall, biomass reductions ranged from 26 to 99% and sago pondweed responded similarly to endothall at both temperatures. Once endothall CET relationships are established for a range of water temperatures, guidance can be developed for improved control of nuisance populations of sago pondweed in areas where herbicide contact times are restricted.

Lake Gaston (NC-VA) Ecological Studies: 2006

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The USDA APHIS and the Corps of Engineers' ERDC initiated a joint agency project in 2005, aimed at developing and implementing a holistic, integrated ecological approach to long-term aquatic plant problems in Lake Gaston, NC-VA. Federally-funded research efforts related to chemical and biological control as well as ecological assessment and ecosystem management/restoration were conducted. Technology transfer was a major component of the joint-agency project with the goal that Federal capabilities, largely developed under the Corps' Aquatic Plant Control Research Program (APCRP), would be transferred to state and local entities for implementation. Within the ecological assessment/ecosystem restoration area, several in-lake and off-site activities were conducted. Point-intercept (2005) and surface observation GPS mapping surveys (2005 and 2006) were conducted to provide a baseline and a metric for assessing progress of the plant management project. Exclosures were constructed and placed in 12 locations to gauge the effects of grass carp (or other large herbivore) feeding on submersed vegetation. In order to evaluate the potential for natural re-establishment of native aquatic plants following control of nuisance species in Lake Gaston, sediment samples were collected for analysis of the sedimentary seedbank. Test plantings of a variety of native aquatic plant species were initiated at four sites. Growth of several species was favorable, indicating potential for restoration; in some cases, however, growth of hydrilla within exclosures was problematical. Production of native aquatic plants for lake restoration was initiated at the Caledonia Prison Farm near Tillery, NC. Field observations in the spring suggested that monoecious hydrilla in Lake Gaston regrows from tubers and turions rather than root crowns. This is in contrast with the dioecious biotype, which overwinters as a root crown. Because this has implications for biological control, chemical control, and restoration of a native-dominated plant community, an outdoor mesocosm study comparing the phenology of monoecious and dioecious hydrilla was initiated. Preliminary results of these efforts will be presented.

Sediment Nitrogen Depletion by *Hydrilla verticillata*

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Observations have been made of *Hydrilla verticillata* growing for many years in a system followed by a population collapse. Sediment nitrogen depletion by the species may explain this phenomenon. To examine the uptake and release of nitrogen (as NH_4-N) by hydrilla, sediment and overlying water concentrations were monitored utilizing 2-cell interstitial water samplers (peepers). The study was conducted in four 100-gallon tanks: two tanks planted with hydrilla and two unplanted controls. Ten peepers were deployed in and retrieved from each tank on a monthly basis from July 2005 through June 2006. The study began with a mean sediment nitrogen concentration of 1.12 mg N/L and water concentration of 0.085 mg N/L. Within the first month of growth, uptake by hydrilla significantly reduced the sediment concentration to 0.29 mg N/L, whereas control tanks averaged 1.32 mg N/L. After one year, the average sediment concentration in hydrilla tanks had dropped to 0.06 mg N/L, whereas the control tanks retained 0.83 mg N/L. The average water nitrogen concentration in hydrilla tanks remained low at 0.05 mg N/L, whereas control tanks water concentration averaged 0.01 mg N/L. No apparent release of nitrogen into either water column or sediment during the semi-dormant winter period was observed. These results suggested that the growth of hydrilla may ultimately be limited by sediment nitrogen availability. Thus, the continued rapid growth of the species may be dependant on a continual supply of nitrogen.

Alternative Algae Control in California Rice Fields: Evaluation of Barley Straw

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California rice fields are shallow water systems with depths usually less than 15 cm. Excessive algal growth often characterizes a significant proportion of them. Especially troublesome are species of green algae and cyanobacteria which interfere with rice growth by becoming entangled with the seedlings and subsequently uprooting them when the algal mats dislodge from the sediment. We sought to determine if barley straw would reduce excessive algal biomass during the crucial 30-day period of seedling establishment following initial flooding of the field. We conducted experiments in 2005 and 2006 in northern California rice fields. Algae dry weight varied considerably ranging from 0 to 286 g m^{-2}. Relative to controls, mean dry weight of algae was not affected by barley straw in either of the experiments. Measured water temperatures in the 2006 and 2006 experiments were greater than the 20 C threshold for decomposition of the barley straw and production of a hypothesized growth-inhibiting chemical, for a considerable portion of the experimental period.

Invasive Species Information Systems and Technology Transfer

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Devising an effective aquatic plant management plan requires access to information that is oftentimes difficult and time consuming to obtain. This is due in part to the vast amount of available information and its wide dissemination in books, journal articles, technical notes, reports, etc. Researchers at the U.S. Army Engineering Research and Development Center (ERDC) have developed computer information systems to help resolve this problem. These systems allow users easy and rapid access to critical information such as plant biology, ecology, and descriptive characteristics on nearly 200 invasive plant species. They also contain information on mechanical, biological, and chemical control options for each plant species. Currently two systems dealing with invasive plant species, the Aquatic Plant Information System (APIS™) and the Noxious and Nuisance Plant Management Information System (PMIS™) are available on CD as well as the Web. A handheld version of APIS™ for use on Windows-based PDA's/Smart phones is being developed and will be available in the near future.

Home Sweet Home: Macroinvertebrate Assemblages in Beds of Monotypic Hydrilla, Diverse Native Aquatic Plants, and a Plantless Habitat *(Student Presentation)*

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Aquatic plants influence ecological processes that mediate food web dynamics. Macroinvertebrate colonization and availability are directly and indirectly influenced by structural substrate, interstitial space, and surface complexity. Exotic invasive plant species, such as *hydrilla verticillata*, may alter this heterogeneity in aquatic habitat by creating a shift to a homogeneous habitat thus affecting the structure of the macroinvertebrate community. Since macroinvertebrates provide a food base for aquatic organisms (e.g. fishes, and waterfowl), changes in their density and abundance may alter food webs. We investigated the hypothesis that macroinvertebrate assemblage and community structure would differ between a heterogeneous native aquatic plant bed, homogenous hydrilla plant bed, and habitat with no plants. Studies were conducted at the pond level with the following experimental treatments: 1) monotypic bed of hydrilla, 2) diverse native plants, and 3) no plants. Aquatic plants, regardless of species, supported greater macroinvertebrate abundance, richness, and biomass. Macroinvertebrate abundance, richness, and biomass in a hydrilla-dominated habitat did not differ significantly from a diverse plant habitat, except for richness in October. Indicator taxa did differ significantly between respective treatments, suggesting a change in species composition. However no significant effect of fish predation on macroinvertebrate populations and/or community structure was documented. Therefore, our data suggest that a shift from a natural mosaic of vegetated habitat to a highly complex monotypic one (e.g. exotic hydrilla) may reduce spatial heterogeneity important in structuring macroinvertebrate assemblages important to food webs.

Phragmites Control with Imazapyr, Glyphosate, and Triclopyr *(Student Poster)*

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Research was conducted in 2006 and 2007 in both North Carolina and Virginia to determine the response of Phragmites to selected herbicide applications. In North Carolina, treatments included imazapyr (160, 320, and 480 oz / 100 gal), glyphosate (160, 320, and 640 oz / 100 gal), triclopyr (640 and 1920 oz / 100 gal), and penoxsulam (7.1, 14.3, 28.6, and 57 oz / 100 gal) applied as spray to wet applications. In Virginia, treatments included imazapyr (0.5, 1.0, and 1.5 lb ai/A), glyphosate (1, 2, and 4 lb ai/A), triclopyr (3 and 9 lb ai/A), and penoxsulam (25, 50, and 100 g ai/A) applied as broadcast applications. Non-ionic surfactant at 0.25% v/v was included with each treatment and certain herbicide mixtures were also applied. Results from each trial will be presented.

Evaluation of Imazamox for Control of Eurasian Watermilfoil *(Student Presentation)*

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The invasive Eurasian watermilfoil (*Myriophyllum specatum*) currently infests 45 states including Colorado, and negatively impacts recreation, wildlife habitat and the efficiency of water delivery systems. Several studies were conducted to evaluate Eurasian watermilfoil (EWM) response to the herbicide, imazamox, under field and laboratory conditions. In the field, imazamox was used to treat a 22 acre lake heavily infested with Eurasian watermilfoil. The lake was treated twice at a concentration of 100 ppb imazamox, once on May 19^{th} and again on July 5, 2006. Weed control and imazamox dissipation were monitored on a weekly basis from mid-May through the end of August. The influence of external concentration on absorption was evaluated over a concentration range of 200 to 800 ppb using ^{14}C-imazamox. The whole lake treatment (two applications of 100 ppb) completely eliminated EWM growth by August. The first application appeared to suppress weed growth, but plants began to re-grow from axiallry meristems in early July. The second imazamox application caused a dramatic collapse in the EWM canopy by early August, keeping the lake completely open the entire summer. The imazamox concentration decreased rapidly after application due to photodegradation. The half-life of imazamox in this environment was approximately 4 days. Imazamox absorption was directly related to external concentration. The amount of imazamox on a µg/plant basis increased from 0.5 to 3.0 µg/plant over the concentration range of 200-800 ppb; however, total absorption was only 0.35% of the herbicide applied 24 hours after treatment. Imazamox can provide significant reductions in EWM growth in whole lake applications, even though absorption appears to be less than 1% of the herbicide applied.

Managing Invasive Plants with Consideration for the Whole Plant Assemblage

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Addressing invasive or exotic plant issues has turned out to be far more complicated than one might imagine. There are laws in most states and at the federal level that accord certain species endangered or threatened status and protect them, but there are very few statutes that require action against invasive species. Not all introduced species are invasive, and not all native species are harmless. Some fish-focused agencies and organizations are interested in habitat, and don't seem to make a distinction between native and invasive species as long as habitat is provided. Actual eradication of invasive species is elusive unless the infestation is promptly addressed, but not enough effort is put into monitoring to detect invasions quickly enough to apply rapid response plans when they exist. Yet there is ample evidence that the native plant assemblage of a lake is threatened by invading species, and very little evidence that ignoring an invasion will result in eventual assimilation of the invader as a non-dominant member of the plant community. Consequently, hard choices have to be made when managing plant communities, and these are not always driven by the best science or an open minded process.
NALMS has a position statement on invasive species that concludes:

1. NALMS supports international and national efforts to restrict, control, monitor and mitigate exotic species movement.
2. NALMS supports research in new control methods for exotic species.
3. NALMS encourages and supports local efforts to protect lakes. This includes monitoring, inspection, education and mitigation programs.

Because NALMS has strong member factions on all sides of the plant management issue, this is not as strong a statement as some of us would like to have, and it is being reworked by a committee now to see if we can't be more prescriptive. However, one can conclude that there is strong support for prevention of invasions and rapid action to eliminate invaders when detected early. If such elimination efforts result in incidental damage to protected species, this is acceptable both under existing regulations and from a holistic lake management perspective. If invasive species are to be addressed on a whole lake basis, careful consideration of the complete biological resources of the lake is needed to make informed management decisions on a case by case basis. "One size fits all" policies by resource management agencies are rarely appropriate and hinder sound management.

The Impact of Fluridone on Target and Non-target Plant Species: Data from Monitoring of Actual Lake Treatments

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Fluridone, the active ingredient in the herbicide SONAR, is a systemic compound that is less acutely toxic that most other herbicides. This creates some challenges for maintaining adequate exposure, but also creates opportunity for managing plants selectively. Data from plant monitoring programs associated with field treatments have been used to evaluate the impact on individual plant species of each of four treatment classes based on initial dose and duration of exposure. Some species are more susceptible than others, some recover more rapidly, some are very opportunistic after treatment, and some respond with such variability that prediction of impact is difficult. Factors that govern the impact of fluridone on target and non-target plant species include dose, duration of exposure, reliance on carotene auxiliary pigments, method of propagation, depth of growth, and hydrologic features of the lake. Treatment considerations essential to planning will be discussed. Foremost is knowledge of the plant community that allows an assessment of the likely progression of assemblage composition and density after treatment based on the field data now available. Continued collection of such data will be essential to improved understanding and treatment designs.

Comparison of Imazapyr and Imazamox for Control of Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc.) *(Student Poster)*

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Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc) is a nonnative aquatic plant from South America. *Myriophyllum aquaticum* infestations impede navigation, stream flow, and runoff to such an extent that flooding of adjacent lands occurs. *Myriophyllum aquaticum* also provides mosquito larvae a refuge from predation indirectly aiding in the spread of insect born diseases. *Myriophyllum aquaticum* is difficult to control and usually persists in spite of variations in the environment and the deployment of management techniques. Techniques often include the use of contact herbicides resulting in significant regrowth of *M. aquaticum* after treatment. Therefore, the use of a systemic herbicide may offer greater efficacy in controlling *M. aquaticum* growth. The objective of this study was to evaluate the efficacy of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1-methylethyl)5-oxo-1H-imazol-2-yl]-3-pyridinecarboxylic acid) and imazamox, 2-(4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid) on the growth of *M. aquaticum*. The herbicide trial was conducted as a randomized complete block design with three treatment rates of imazapyr (1.123, 0.584, 0.281 kg ai ha^{-1}), three treatment rates of imazamox (0.561, 0.281, 0.140 kg ai ha^{-1}), and an untreated reference in 21, 378 L tanks. *Myriophyllum aquaticum* was allowed to grow for approximately 6 weeks until the emergent growth covered the water surface of each tank prior to herbicide applications. Foliar herbicide treatments were made using a CO_2 pressurized backpack sprayer at a rate of 187 L ha^{-1}. A non-ionic surfactant was added to the spray mixture at a rate of 0.25% v:v. At the conclusion 10 weeks, *M. aquaticum* biomass was significantly ($F = 32.7$, d.f. = 62, $p \leq 0.001$) reduced when treated with rates of 1.123 and 0.584 kg ai ha^{-1} of imazapyr and 0.561 and 0.281 kg ai ha^{-1} rates of imazamox. *Myriophyllum aquaticum* treated with rates of 1.123 and 0.584 kg ai ha^{-1} of imazapyr had percent control ratings of 100.0 percent. *Myriophyllum aquaticum* treated with rates of 0.561 and 0.281 kg ai ha^{-1} of imazamox had ratings of 53.3 and 46.7 percent respectively, but were still different from the untreated control. Our study indicates that imazapyr was most effective at controlling *M. aquaticum* after ten weeks, imazamox activity was observed; however, regrowth was evident.

Influences of Light Intensity Variations on Growth Characteristics of Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc.) *(Student Presentation)*

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Parrotfeather (*Myriophyllum aquaticum* (Vell.) Verdc) is a nonnative aquatic heterophyllous plant. Having both a submersed and emergent growth form may allow *M. aquaticum* to invade and colonize highly disturbed or less than optimal environments through changes in growth habit. The reallocation of resources to emergent or submersed growth likely allows *M. aquaticum* to overcome changes in light availability. Currently, little is known regarding the ecological and biological responses of *M. aquaticum* to perturbations in environmental factors. The objective of this study was to quantify *M. aquaticum* growth under different shading regimes. We hypothesized that *M. aquaticum* growth would increase as shading levels increased to a maximum of 70% of full sun light. The study was conducted using potted *M. aquaticum* plants growing in 24, 1100-liter tanks. Light treatments consisted of full sun, 30% shade, 50% shade, and 70% shade achieved using shade cloth with each treatment replicated six times. Biomass was harvested in two-week intervals for 12 weeks. Two pots from each tank were collected and both the roots and shoots of *M. aquaticum* were harvested. Measurements were taken of total plant length, emergent shoot length, submersed shoot length, and the total of number of emergent and submersed shoots were recorded. Plants were sorted to emergent shoots, submersed shoots, roots, stolons, and dried at 70 °C to a constant mass then weighed. *Myriophyllum aquaticum* biomass was significantly different ($F = 18.1$, d.f. = 47, $p < 0.0001$) at the conclusion of 12 weeks between shade treatments. Difference in biomass were a result of greater emergent shoot growth in the 50% shade treatment and a reduction in the 70% shade treatment. Total plant length was also significantly different ($F = 7.44$, d.f. = 95, $p = 0.0002$). The greatest plant length was observed in the 50% shade treatment with reductions in overall plant length observed in full sunlight. Both emergent and submersed shoot lengths were greatest in the 70% shade treatments. The total number of emergent and submersed shoots were not different between shade treatments. Our data suggests that intermediate light availability may be optimal for *M. aquaticum* growth.

Alligatorweed Control with Herbicides *(Student Poster)*

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Field studies were conducted in 2006 and 2007 to evaluate the efficacy of glyphosate, imazamox, imazapyr, penoxsulam, triclopyr, and mixtures of imazapyr plus glyphosate, imazapyr plus triclopyr, and triclopyr plus 2,4-D applied postemergence on alligatorweed [*Alternanthera philoxeroides* (Mart.) Griseb.]. In 2006 trials at 5 WAT (weeks after treatment), alligatorweed was controlled at least 92% by imazapyr (0.5% v/v) and triclopyr (1.5, 3.0 and 4.5% v/v) applied alone. Herbicide mixtures of triclopyr (1.5% v/v) plus either 2,4-D (1.2% v/v) or imazapyr, and glyphosate (1.0% v/v) plus imazapyr also controlled alligatorweed. At 9 WAT, imazapyr and triclopyr applied alone as well as mixtures of imazapyr plus glyphosate or imazapyr plus triclopyr controlled alligatorweed at least 86%. Glyphosate applied alone at 1.0% v/v controlled alligatorweed 92% at 2 WAT but control decreased to 74 and 35% at 5 and 9 WAT, respectively, due to regrowth.

Integrating Plant Management within Ongoing Field and Laboratory Research on Avian Vacuolar Myelinopathy

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Aquatic invasive species can cause unexpected ecological consequences. One example of the complexity some ecological impacts is illustrated by the relationship of some invasive aquatic plant species and the deadly brain lesion disease, avian vacuolar myelinopathy (AVM), in coots and bald eagles. Experimental and field surveys point to a naturally produced neurotoxin that is transmitted from aquatic vegetation to waterfowl and then to bald eagles have confirmed that this food chain is the transfer mechanism for AVM in both waterfowl and eagles. The disease agent appears to be an uncharacterized neurotoxin produced by a novel cyanobacterial epiphyte in the order Stigonematales. It covers up to 95% of the surface area of hydrilla leaves in reservoirs where AVM deaths have occurred. The suspect Stigonematales species is found on hydrilla, Brazilian elodea (*Egeria densa*), and Eurasian watermilfoil (*Myriophylum spicatum*) and several native aquatic plants at AVM sites. Methanol extractions of hydrilla containing the suspect agent produced AVM lesions in laboratory mallards. Cell lines exposed to the positive extract exhibited unique morphological changes and consistent shifts in cell cycle dynamics. This cell line screening tool will open research avenues to purify and characterize the neurotoxin. Plant collections from Texas to North Carolina indicate the range of the suspect cyanobacteria is expanding with the new invasions of these problematic aquatic plants especially in close proximity to existing sites. Cell line screening indicates the relative toxicity of sites and provides guidance for laboratory research and management strategies. Control of invasive plants, primarily hydrilla**,** is being initiated at AVM disease sites, and evidence suggests that it eliminates bird mortality.

Point-intercept and Surface Observation Geographic Positioning Systems (SOG) Surveys: A Comparison of Survey Methods – Lake Gaston, NC/VA

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A key component of any aquatic vegetation management project is collection of accurate and timely information on aquatic plant community composition and distribution. Knowledge of nuisance plant distribution is obviously required for selection of the most appropriate sites for treatment. Further, if the goal of the project is to restore a beneficial aquatic plant community dominated by native species, regular surveys are needed to evaluate progress toward that goal. As a part of a USDA APHIS-funded effort to develop a holistic, ecological approach to managing the problem of nonindigenous aquatic vegetation in Lake Gaston, North Carolina/Virginia, we conducted two types of vegetation surveys: point-intercept and surface observation GPS (SOG). Surveys were conducted simultaneously in September 2005, focusing on aquatic vegetation (native and non-native) identification, distribution, and abundance and yielded similar overall results. However, while the point intercept survey appeared suitable for measuring quantitative data of aquatic plant populations (identification, distribution, and species frequency), and included the ability to perform statistical analyses of data collected, the SOG survey recorded more species and provided finer distribution resolution due to the aspect of whole-lake, continuous visual observations. Additionally, the use of a depth finder and rake toss sampling incorporated into SOG during this study improved identification and quantification of continuous submersed plant populations not visualized from the water's surface. Current drawbacks of SOG include increased post-production processing of data, increased GPS equipment costs, and random rake toss sampling, compared to point-intercept's short post-production and regularly spaced rake toss sampling. Point-intercept surveys are most appropriate for data analysis, including statistical comparisons of species diversity, while the advantage of SOG provides a visual representation (detailed maps) of calculable aquatic plant communities in the lake.

Future Research and Management Objectives for Avian Vacuolar Myelinopathy

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Avian vacuolar myelinopathy (AVM) is a neurological disease of unknown origin, primarily affecting bald eagles (*Haliaeetus leucocephalus*) and American coots (*Fulica americana*) in the southeastern U.S. Field and laboratory studies have linked AVM to the ingestion of aquatic vegetation and an associated cyanobacterial epiphyte. Future research regarding this avian disease is crucial for waterfowl and raptor populations. Several research objectives will be addressed in a collaborative effort between university, state agencies and the Army Corps of Engineers. Previously developed putative toxin extraction procedures will be used in conjunction with a novel cell-line assay. This assay will allow for efficient screening of cyanobacterial cultures and other possible sources of the toxin. Vegetation samples from potential and existing sites have been screened with the cell-line assay in order to determine if the potential AVM toxin is present. A second objective is to investigate the distribution of the suspect cyanobacteria in sites free of invasive aquatic vegetation. Real-time PCR genetic screening will be conducted and nutrient rich agar plates will be deployed to test for the prevalence of the suspect cyanobacterium. Presence of the cyanobacterium on the plates would indicate the potential for AVM to occur if abundant aquatic plants invade these new sites. A third research objective will use GIS technology to analyze spatial, temporal and biotic characteristics of systems affected by AVM. These analyses will be compared to systems unaffected by the disease to elucidate environmental conditions conducive to AVM events.

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