The Aquatic Plant Management Society, Inc.

46th Annual Meeting

PROGRAM

July 16 - 19, 2006
Portland Marriott Downtown Waterfront Hotel
Portland, Oregon

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Regional Chapters	Jim Petta
Scholastic Endowment	Shaun Hyde
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BASS Representative	Gerald Adrian
CAST Representative	Jim Petta
NALMS Representative	Mark Mongin
RISE Representative	Terence M. McNabb
WSSA Representative	Gregory E. MacDonald

Past 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

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)

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)

Max McCowen Friendship Award (year of honor)

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

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!

Alligare, LLC
Opelika, Alabama

Applied Aquatic Management, Inc.
Eagle Lake, Florida

Applied Biochemists
Germantown, Wisconsin

Aquarius Systems
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Aquatic Control, Inc.
Seymour, Indiana

BioSafe Systems, LLC
Glastonbury, Connecticut

BioSonics, Inc.
Seattle, Washington

Brewer International
Vero Beach, Florida

Cerexagri-Nisso, LLC
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Cygnet Enterprises, Inc.
Flint, Michigan

Dow AgroSciences, LLC
Indianapolis, Indiana

Jenson Technologies
San Marcos, Texas

Peroxygen Solutions
Jamestown, North Carolina

ReMetrix, LLC
Carmel, Indiana

SePRO Corporation
Carmel, Indiana

SolarBee
Dickinson, North Dakota

Syngenta Professional Products
Greensboro, North Carolina

UAP Distribution
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 Corporation
Research Triangle Park, North Carolina

Cerexagri-Nisso, LLC
King of Prussia, Pennsylvania

SePRO Corporation
Carmel, Indiana

Syngenta Professional Products
Greensboro, North Carolina

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

Bronze

Applied Biochemists
Germantown, Wisconsin

Aquatic Ecosystem Restoration Foundation
Flint, Michigan

Helena Chemical Company
Collierville, Tennessee

Phoenix Environmental Care, LLC
Valdosta, Georgia

Valent U.S.A. Corporation
Memphis, Tennessee

Vegetation Management, LLC
Seattle, Washington

Contributor

Applied Aquatic Management, Inc.
Eagle Lake, Florida

Aquatic Control, Inc.
Seymour, Indiana

BioSafe Systems, LLC
Glastonbury, Connecticut

Brewer International
Vero Beach, Florida

Clean Lakes, Inc.
Martinez, California

UAP Distribution
Monticello, Arkansas

Western Aquatic Plant Management Society
Sacramento, California

Wilbur-Ellis Company
San Francisco, California

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

Applied Biochemists
Germantown, Wisconsin

AquaTechnex, LLC
Centralia, Washington

Aquatic Control, Inc.
Seymour, Indiana

Aquatic Vegetation Control
Riviera Beach, Florida

BASF Corporation
Research Triangle Park, North Carolina

Brewer International
Vero Beach, Florida

Cerexagri-Nisso, LLC
King of Prussia, Pennsylvania

Clean Lakes, Inc.
Martinez, California

Portland State Univ-Center for Lakes & Reservoirs
Portland, Oregon

Professional Lake Management
Caledonia, Michigan

SePRO Corporation
Carmel, Indiana

Syngenta Professional Products
Greensboro, North Carolina

UAP Distribution
Monticello, Arkansas

Exhibitors

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

Alligare, LLC
Alligare, LLC develops new and reintroduces legacy chemistry into the specialty pesticide markets. We start at the end user level and ask our customers: "What do you need?" Then we find a solution! Alligare, LLC provides superior services and products for the aquatics, vegetation management and forestry markets. For more information visit www.Alligarellc.com.

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.

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.

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.

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.

Cerexagri-Nisso, LLC
Cerexagri-Nisso, LLC is a leader in the marketing and manufacturing of aquatic herbicides and algaecides and has been involved in the development and sale of these products for over 40 years. The current product line includes various formulations of Aquathol, Hydrothol, and AquaKleen. Committed to the aquatic plant management industry, Cerexagri-Nisso, LLC supports aquatic research in cooperation with universities, and federal and state agencies. This research is dedicated to better aquatic plant management techniques resulting in improved aquatic habitat and enhancing future use of aquatic resources.

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, Cerexagri-Nisso, LLC, 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.

International Water Screens

International Water Screens Company specializes in designing and manufacturing traveling screens and self-cleaning fish screens for debris removal from your canal, cooling tower, water intake, river or reservoir. If you have debris in your water… we can remove it!

Phoenix Environmental Care, LLC

Phoenix Environmental Care, LLC provides a full line of aquatic products including Current™, Symmetry™ and aquatic glyphosate. The company is known for its industry support, product stewardship and unique, quality post-patent formulations that meet the needs of today's professional applicator.

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)*

SolarBee

SolarBee is a division of Pump Systems, Inc., the world leader in solar-powered long distance circulation. The SolarBee is a floating, up-flow, solar-powered pump that circulates 10,000 gpm from any depth. It eliminates HAB's and some invasive aquatic weed species. Multi-year success has been recorded with Eurasian watermilfoil and several other invasive plant species in more than a dozen lakes.

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. With over 300 distribution facilities strategically located in the United States and Canada to better serve our customers needs.

Wilbur-Ellis Company

Wilbur-Ellis Company is a family owned company established in 1921. We are a major supplier of aquatic vegetation management products, including our surfactant, Competitor. Competitor is a very effective surfactant that has been used extensively with the herbicide Habitat® or with an aquatic glyphosate for the control of Spartina species.

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 Oregon Ballroom Foyer of the Portland Marriott Downtown Waterfront Hotel. For specific times, please see the Agenda in this Program. Messages will be posted on the message board at the meeting registration desk.

Presenter's Preview Room
Need to check your PowerPoint presentation? The preview room will be located in the Eugene Room of the Portland Marriott Downtown Waterfront Hotel 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 8:00 a.m. Monday to 12:00 p.m. Wednesday in the Oregon Ballroom, Salon A-E of the Portland Marriott Downtown Waterfront Hotel.

Posters
Posters will be open for viewing from 8:00 a.m. Monday to 12:00 p.m. Wednesday in the Oregon Ballroom, Salons A-E of the Portland Marriott Downtown Waterfront Hotel. A special Poster Session and Reception will be held on Monday from 5:30 p.m. to 7:00 p.m. in Oregon Ballroom, Salons A-E. 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 the Oregon Ballroom, Salon F of the Portland Marriott Downtown Waterfront Hotel. All APMS members are encouraged to attend.

Regional Chapters Presidents' Breakfast
The Regional Chapters Presidents' Breakfast will be held Tuesday, 6:30 a.m. - 8:00 a.m. in the Columbia Room of the Portland Marriott Downtown Waterfront Hotel. Two representatives from each APMS regional chapter are invited to attend this breakfast. Jim Petta, APMS Vice President and Regional Chapters Committee Chair, will be the moderator for discussions on aquatic plant management activities within each region. This breakfast is graciously sponsored by Vegetation Management, LLC.

Past Presidents'Luncheon
The Past Presidents'Luncheon will be held Tuesday, 12:00 p.m. - 1:30 p.m. in the Columbia Room of the Portland Marriott Downtown Waterfront Hotel. Past Presidents of the APMS are invited to attend this breakfast. Eric P. Barkemeyer, Immediate Past President, will be the moderator for discussions on affairs of the Society. Please contact Eric by 12:00 p.m. Monday and confirm your attendance. This luncheon is graciously sponsored by Vegetation Management, LLC.

Refreshment Breaks

A continental breakfast, morning refreshment break, and afternoon refreshment break, graciously sponsored by Cerexagri-Nisso, LLC will be served each day of the meeting in the Oregon Ballroom, Salons A-E of the Portland Marriott Downtown Waterfront Hotel. For specific times, please see the Agenda in this program.

APMS Special Events

***President's Reception**, Sunday, July 16, 7:00 p.m. – 9:00 p.m., Mt. Hood Room, Portland Marriott Downtown Waterfront Hotel.* 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 on Sunday afternoon.

***Guest Tour**, Monday, July 17, 9:00 a.m. – 3:00 p.m., meet in Lobby, Portland Marriott Downtown Waterfront Hotel.* The APMS cordially invites all registered guests to the Guest Tour, graciously sponsored by Applied Biochemists. The tour begins winding through the streets of Old Town, Chinatown, and downtown learning the humble beginnings of Portland. The first stop is at the world-renowned International Rose Test Garden. You will enjoy the ride through the tree-lined streets of the Portland Heights residential area as you head out of town toward the Columbia Gorge National Scenic Area. This scenic area is a place of wonder and majesty (towering waterfalls, verdant basalt cliffs, legend and lore) holding some of the regions most scenic vistas. Lunch is included at beautiful Multnomah Falls Lodge. Non-registered guests may purchase tickets at the meeting registration desk on Sunday afternoon.

***Poster Session and Reception**, Monday, July 17, 5:30 p.m. – 7:00 p.m., Oregon Ballroom, Salons A-E, Portland Marriott Downtown Waterfront Hotel.* The APMS cordially invites all registered delegates, guests, and students to the Poster Session and Reception, with the reception graciously sponsored by BASF Corporation. 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 on Sunday afternoon.

***Banquet**, Tuesday, July 18, 6:00 p.m. – 10:00 p.m., Oregon Ballroom, Salons F and I, Portland Marriott Downtown Waterfront Hotel.* The APMS cordially invites all registered delegates, guests, and students to the APMS Banquet, graciously sponsored by Syngenta Professional Products, with a hosted bar sponsored by Helena Chemical Company, Phoenix Environmental Care, LLC, and Valent U.S.A. Corporation. 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. Our evening will conclude with the reverse raffle grand prize drawing for the $1,200 cash award, graciously sponsored by Cygnet Enterprises, Inc. Non-registered guests may purchase tickets at the meeting registration desk on Sunday afternoon.

The Portland Room

Do you have a spur-of-the-moment meeting and need a room? The Portland Room is set conference style for 20 guests. For available times, 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 16

Sunday's Agenda-at-a-Glance

7:30 am - 5:00 pm	Board of Directors Meeting *(Meadowlark/Douglas Fir)*
10:00 am - 5:00 pm	Exhibits Setup *(Oregon Ballroom, Salons A-E)*
10:00 am - 5:00 pm	Posters Setup *(Oregon Ballroom, Salons A-E)*
1:00 pm - 5:00 pm	Meeting Registration *(Oregon Ballroom Foyer)*
1:00 pm - 5:00 pm	Presenter's Preview Room *(Eugene)*
7:00 pm - 9:00 pm	President's Reception *(Mt. Hood)*
	Sponsored by SePRO Corporation

Monday, July 17

Monday's Agenda-at-a-Glance

7:30 am - 8:00 am	Continental Breakfast *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
7:30 am - 5:00 pm	Meeting Registration *(Oregon Ballroom Foyer)*
7:30 am - 5:00 pm	Presenter's Preview Room *(Eugene)*
7:30 am - 5:00 pm	Exhibits Open *(Oregon Ballroom, Salons A-E)*
7:30 am - 5:00 pm	Posters Open *(Oregon Ballroom, Salons A-E)*
8:00 am - 11:30 am	Session I: Presidential Address and Special Session: Pesticide Regulatory Issues *(Oregon Ballroom, Salon F)*
9:00 am - 3:00 pm	Guest Tour *(Meet in Lobby)* *Sponsored by Applied Biochemists*
9:40 am - 10:10 am	Refreshment Break *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
11:30 am - 1:00 pm	Lunch
1:00 pm - 4:30 pm	Session II: West Side Story: Vegetation Challenges in the Pacific Coast States *(Oregon Ballroom, Salon F)*
3:00 pm - 3:30 pm	Refreshment Break *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
4:30 pm - 5:00 pm	APMS Annual Business Meeting - APMS Members *(Oregon Ballroom, Salon F)*
5:30 pm - 7:00 pm	Poster Session and Reception *(Oregon Ballroom, Salons A-E)* *Sponsored by BASF Corporation*

Session I: Presidential Address and Special Session: Pesticide Regulatory Issues

8:00 am - 11:30 am
Oregon Ballroom, Salon F
Moderator: Jeffrey D. Schardt, *Florida Department of Environmental Protection, Tallahassee, FL*

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

8:10 am **Presidential Address**
Jeffrey D. Schardt
Florida Department of Environmental Protection, Tallahassee, FL

8:30 am **Registration of Pesticides in Water**
Donald R. Stubbs
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

8:45 am **Collaboration - Key to Registration of Aquatic Pesticides**
Kurt D. Getsinger
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

9:00 am **Ecological Effects Assessments - Extrapolation Uncertainties**
Thomas Steeger
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

9:20 am **Assessing Exposure to Aquatic Plant Pesticides**
Nelson Thurman
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

9:40 am **Refreshment Break** *(Oregon Ballroom, Salons A-E)*

10:10 am **EPA Ecological Risk Assessment for Aquatic Plant Pesticides: Coordination between Office of Water and Office of Pesticide Programs**
Elizabeth Behl
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington DC

10:30 am **Aquatic Plant Control: NPDES Permitting in Washington State**
Kelly McLain
Washington Department of Ecology, Olympia, WA

10:45 am **Monitoring Data Collected under Washington's Noxious Weed NPDES Permit**
Kathy Hamel
Washington Department of Ecology, Olympia, WA

11:00 am **The IR-4 Project: New Opportunity - Aquatic Herbicide Registration**
Marija Arsenovic[1], R. E. Holm[1], J. J. Baron[1], D. L. Kunkel[1], J. A. Norton[1], K. D. Getsinger[2], J. Parochetti[3], W. T. Haller[4], L. W. J. Anderson[5], and D. R. Stubbs[6]
[1]*Rutgers University, IR-4 Project, North Brunswick, NJ*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[3]*U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service, Washington, DC*
[4]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[5]*U.S. Department of Agriculture, Agriculture Research Service, Davis, CA*
[6]*U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC*

11:15 am **Aquatic Pesticide Regulation in California**
Erin Mustain[1] and Emily Alejandrino[2]
[1]*California State Water Resources Control Board, Sacramento, CA*
[2]*Central Valley Regional Water Quality Control Board, Rancho Cordova, CA*

11:30 am **Lunch**

Session II: West Side Story: Vegetation Challenges in the Pacific Coast States
1:00 pm - 4:30 pm
Oregon Ballroom, Salon F
Moderator: Mark D. Sytsma, *Portland State University, Center for Lakes and Reservoirs, Portland, OR*

1:00 pm **Rapid Response for Spartina Management in Oregon**
Mark D. Sytsma, Vanessa Howard, and Mary Pfauth
Portland State University, Center for Lakes and Reservoirs, Portland, OR

1:15 pm **A New Aerial Imaging Technique for Aquatic Plant Surveys**
Terence M. McNabb
AquaTechnex, LLC, Bellingham, WA

1:30 pm **Spartina Control in Willapa Bay, Washington – A Success Story**
Kim Patten
Washington State University, Long Beach, WA

1:45 pm **Assessment of Eutrophication in the Lower Yakima River Basin, Washington**
Daniel Wise
U.S. Geological Survey, Portland Water Science Center, Portland, OR

2:00 pm **The Impact of Diquat on Macrophytes and Water Quality in Battle Ground Lake, Washington**
Jenifer Parsons[1], Kathy Hamel[2], and Ron Wierenga[3]
[1]*Washington Department of Ecology, Yakima, WA*
[2]*Washington Department of Ecology, Olympia, WA*
[3]*Clark County Public Works, Vancouver, WA*

2:15 pm **Evidence for Phosphorus Limited Growth of Eurasian Watermilfoil in the Truckee River (California)**
David F. Spencer[1], Gregory Ksander[1], and Bob Blank[2]
[1]*U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weeds Research Unit, Davis CA*
[2]*U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weeds Research Unit, Reno, NV*

2:30 pm **Knotweed Suppression with Herbicides**
Chase Metzger and Kim Patten
Washington State University, Long Beach, WA

2:45 pm **Effect of Light Levels on Growth and Canopy Formation in *Egeria densa***
Lars W. J. Anderson and Amy Klug
U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA

3:00 pm **Refreshment Break** *(Oregon Ballroom, Salons A-E)*

Session II (continued): West Side Story: Vegetation Challenges in the Pacific Coast States
Moderator: Toni G. Pennington, *Portland State University, Center for Lakes and Reservoirs, Portland, OR*

3:30 pm **Photosynthetic Responses of *Egeria densa* to Light and Temperature**
Toni G. Pennington and Mark D. Sytsma
Portland State University, Center for Lakes and Reservoirs, Portland, OR

3:45 pm **Three-Year Summary of Results from Monitoring Brazilian Waterweed Treatment Efficacy in the Sacramento-San Joaquin Delta, California**
Scott A. Ruch[1] and Aquatic Weed Unit[2]
[1]*ReMetrix, LLC, Berkeley, CA*
[2]*California Department of Boating and Waterways, Sacramento, CA*

4:00 pm **Spatial Distribution of Egeria (*Egeria densa*) in the Sacramento-San Joaquin Delta Region**
Sepalika S. Rajapakse, Erin Hestir, Shruti Khanna, Susan Ustin, Maria Santos, Margaret Andrew, and Mui Lay
University of California Davis, CalSpace Center of Excellence, Davis, CA

4:15 pm **Comparative Growth of Giant Reed from Florida, Texas, and California**
David F.Spencer[1], Pui-Sze Liow[1], Gregory Ksander[1], Randall K. Stocker[2], Alison M. Fox[2], and Jim H. Everitt[3]
[1]*U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA*
[2]*University of Florida, Agronomy Department and Center for Aquatic and Invasive Plants, Gainesville, FL*
[3]*U.S. Department of Agriculture, Agricultural Research Service, Integrated Farming and Natural Resources Unit, Weslaco, TX*

4:30 pm **Annual Business Meeting**

5:00 pm **Adjourn**

Poster Session
5:30 pm - 7:00 pm
Oregon Ballroom, Salons A-E

Efficacy of Three Aquatic Herbicides for Control of Swamp Smartweed *(Student Poster)*
Joshua C. Cheshier, Ryan M. Wersal, and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

Effects of Diquat in Irrigation Water on Different Growth Stages of Rice and Other Agronomic Crops
Tomas Chiconela and William T. Haller
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

Impact of Insect Herbivory and Plant Competition on the Growth of Hydrilla: Small Scale Studies
Michael J. Grodowitz[1], Robert Doyle[2], and Chetta S. Owens[3]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*Baylor University, Waco, TX*
[3]*SpecPro, Inc., U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Parasitism and Host-Selection Behavior of the Parasitic Wasp, *Trichopria columbiana*, and its Effect on Establishment and Population Dynamics of *Hydrellia* spp.
Michael J. Grodowitz[1], **Julie G. Nachtrieb**[2], and Nathan Harms[2]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Physiological Age-Grading Techniques to Assess Reproductive Status and Nutritional Requirements of Insect Biocontrol Agents of Aquatic Plants
Michael J. Grodowitz[1] and Jennifer Lenz[2]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*University of North Texas, Denton, TX*

Mass Rearing of *Hydrellia* spp. and *Cyrtobagous salviniae* for the Management of Hydrilla and Salvinia, Respectively
Nathan Harms[1], Michael J. Grodowitz[2], and Julie G. Nachtrieb[1]
[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*

Overwintering of *Hydrellia* spp. (Diptera: Ephydridae) Introduced for Biological Control of *Hydrilla verticillata*
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*

Effect of Glyphosate Rate, Spray Volume, and Adjuvant Addition for Control of Giant Salvinia
Linda S. Nelson[1] and Lee Ann M. Glomski[2]
[1]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[2]*SpecPro, Inc., U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Effects of Seasonality and Light Intensity on Fragment Viability and Establishment of *Hydrilla verticillata* (L.f.) Royle
Chetta S. Owens[1], R. Michael Smart[2], and Gary O. Dick[3]
[1]*SpecPro, Inc., 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*
[3]*University of North Texas, U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

Viability of Hydrilla Fragments Exposed to Different Levels of Insect Herbivory
Chetta S. Owens[1], Michael J. Grodowitz[2], and R. Michael Smart[3]
[1]*SpecPro, Inc., 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*

Monitoring the Efficacy of Aquatic Herbicides on Brazilian Waterweed in the Sacramento-San Joaquin Delta: An Example from Frank's Tract
Kurt Shanayda[1], Scott A. Ruch[2], Aquatic Weed Unit[3]
[1]*ReMetrix, LLC, Carmel, IN*
[2]*ReMetrix, LLC, Berkeley, CA*
[3]*California Department of Boating and Waterways, Sacramento, CA*

Pathogen Biocontrol Research on the Submersed Macrophytes, Hydrilla and Eurasian Watermilfoil
Judy F. Shearer
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

Research Assistance in Management of Aquatic Plants in the Midwestern States
John Skogerboe[1], **Kurt D. Getsinger**[2], and Angela Poovey[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*

Aquatic Macrophytes in the Cacota Lagoon *(Student Poster)*
Gina Suescun, Roberto Sanchez, and Tomas Castillo
Universidad de Pamplona, Pamplona, Norte de Santander, Colombia

Developing a Detailed View of Milfoil Growth and Nutrient Acquisition *(Student Poster)*
Mark Swinton and Charles Boylen
Rensselaer Polytechnic Institute, Troy, NY

Using Point Intercept Surveys to Map Aquatic Plants in the Ross Barnett Reservoir, Mississippi *(Student Poster)*
Ryan M. Wersal, John D. Madsen, and Mary Love Tagert
Mississippi State University, GeoResources Institute, Mississippi State, MS

Tuesday, July 18

Tuesday's Agenda-at-a-Glance

6:30 am - 8:00 am	Regional Chapters Presidents' Breakfast *(Columbia)*
7:30 am - 8:00 am	Continental Breakfast *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
7:30 am - 5:00 pm	Meeting Registration *(Oregon Ballroom Foyer)*
7:30 am - 5:00 pm	Presenter's Preview Room *(Eugene)*
7:30 am - 5:00 pm	Exhibits Open *(Oregon Ballroom, Salons A-E)*
7:30 am - 5:00 pm	Posters Open *(Oregon Ballroom, Salons A-E)*
8:00 am - 12:00 pm	Session III: Invasive Plant Monitoring, Physiology, and Management *(Oregon Ballroom, Salon F)*
10:00 am - 10:30 am	Refreshment Break *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
12:00 pm - 1:30 pm	Lunch
12:00 pm - 1:30 pm	Past Presidents' Luncheon *(Columbia)*
1:30 pm - 5:00 pm	Session IV: Invasive Species and Aquatic Habitat Management *(Oregon Ballroom, Salon F)*
3:00 pm - 3:30 pm	Refreshment Break *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
6:00 pm - 10:00 pm	Banquet *(Oregon Ballroom, Salons F-I)* *Sponsored by Syngenta Professional Products* Hosted Bar *Sponsored by Helena Chemical Company, Phoenix Environmental Care, LLC, and Valent U.S.A. Corporation*

Session III: Invasive Plant Monitoring, Physiology, and Management

8:00 am - 12:00 pm
Oregon Ballroom, Salon F
Moderator: Lars W. J. Anderson, *U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA*

8:00 am **Analysis of Hyperspectral Field-Level Data for Identifying Invasive Aquatic Plant Species**
Nathan Torbick[1], Jiagui Qi[1], Brian Becker[2], and David Lusch[1]
[1]Michigan State University, East Lansing, MI
[2]Central Michigan University, Mount Pleasant, MI

8:15 am **Characteristics of Hygrophila (*Hygrophila polysperma*) Establishment in South Florida**
Cody J. Gray
University of Florida-IFAS, Research and Education Center, Fort Lauderdale, FL

8:30 am **A Molecular Approach Using Microsatellite Markers to Better Understand Population Level Dynamics of Eurasian Watermilfoil and Invasive Hybrid Watermilfoil**
Michael Moody
Indiana University, Bloomington, IN

8:45 am **Using Landsat TM Imagery to Monitor Spatial Changes of Waterhyacinth after Broadcast Herbicide Application** *(Student Presentation)*
Wilfredo Robles and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

9:00 am **Aquatic Weed Problems in Arkansas: The View from the Specialist's Office**
George Selden
University of Arkansas at Pine Bluff, Newport, AR

9:15 am **Activity of Microorganisms Isolated from *Limnobium laevigatum* on Benzene** *(Student Presentation)*
Gina Suescun[1], Jaime Bernal[2], and Patricia Martinez[2]
[1]Pontificia Universidad Javeriana, Bucaramanga, Santander, Columbia
[2]Pontificia Universidad Javeriana, Bogota, Colombia

9:30 am **Activities at the University of Florida Center for Aquatic and Invasive Plants**
William T. Haller
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

9:45 am **Phenology of *Potamogeton crispus* (Curlyleaf Pondweed) in Blue Lake, Oregon: Formation and Sprouting of Turions in the Pacific Northwest and Comparisons to North American Studies** *(Student Presentation)*
Steven W. Wells and Mark D. Sytsma
Portland State University, Center for Lakes and Reservoirs, Portland, OR

10:00 am **Refreshment Break** *(Oregon Ballroom, Salons A-E)*

Session III (continued): Invasive Plant Monitoring, Physiology, and Management
Moderator: Chetta S. Owens, *SpecPro, Inc., U.S. Army Engineer Research and Development Center, Environmental Laboratory, Lewisville, TX*

10:30 am **Habitat Alteration by Hydrilla and its Impact on Fish Foraging and Macroinvertebrate Colonization** *(Student Presentation)*
Heather J. Theel and Eric D. Dibble
Mississippi State University, Department of Wildlife and Fisheries, Mississippi State, MS

10:45 am **Progress Towards Biological Control of Common Salvinia in Louisiana**
Seth Johnson[1], Sunil Tewari[1], and Dearl Sanders[2]
[1]Louisiana State University Agricultural Center, Department of Entomology, Baton Rouge, LA
[2]Louisiana State University Agricultural Center, Idlewild Research Station, Clinton, LA

11:00 am **Molecular Characterization and Genetic Variability of Fluridone Resistant Hydrilla Biotypes** *(Student Presentation)*
Atul Puri, Gregory E. MacDonald, and William T. Haller
University of Florida, Agronomy Department and Center for Aquatic and Invasive Plants, Gainesville, FL

11:15 am **Current Status of Giant Salvinia in North Carolina and Virginia**
Andrew P. Gardner[1], C. Wayne Batten[1], Robert J. Richardson[1], and David S. Cutlip[2]
[1]North Carolina State University, Raleigh, NC
[2]DSC Aquatic Solutions, Springfield, VA

11:30 am **Dispersal of Invasive Cordgrass (*Spartina* spp.) Propagules** *(Student Presentation)*
Vanessa M. Howard and Mark D. Sytsma
Portland State University, Center for Lakes and Reservoirs, Portland, OR

11:45 am **Biology and Management of Cabomba in the Northern U.S.** *(Student Presentation)*
Brett Bultemeier[1], William T. Haller[1], and Michael D. Netherland[2]
[1]University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL
[2]U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL

12:00 pm **Lunch**

Session IV: Invasive Species and Aquatic Habitat Management
1:30 pm - 5:00 pm
Oregon Ballroom, Salon F
Moderator: Donald W. Doggett, *Lee County Hyacinth Control District, Fort Myers, FL*

1:30 pm **Giant Salvinia (*Salvinia molesta* Mitchell) Growth as Regulated by pH and Available Nutrients** *(Student Presentation)*
Ryan M. Wersal and John D. Madsen
Mississippi State University, GeoResources Institute, Mississippi State, MS

1:45 pm **Another Invasive Aquatic Plant in South Florida: *Rotala rotundifolia***
Cody J. Gray
University of Florida-IFAS, Research and Education Center, Fort Lauderdale, FL

2:00 pm **Effects of the Use of Copper Sulfate in Double-Cropped Aquaculture Ponds** *(Student Presentation)*
Annie Philip Jacob, D. A. Culver, R. P. Lanno, and A. Voigt
Ohio State University, Columbus, OH

2:15 pm **Cooperative Phragmites Control Programming in the Winyah Bay Focus Area, South Carolina**
Jack M. Whetstone[1], M. C. Nespeca[2], and C. L. Page[3]
[1]Clemson University, South Carolina Sea Grant, South Carolina Department of Natural Resources, Georgetown, SC
[2]The Nature Conservancy, Georgetown, SC
[3]South Carolina Department of Natural Resources, West Columbia, SC

2:30 pm **Flumioxazin: A New EUP for Aquatic Weed Control** *(Student Presentation)*
Christopher R. Mudge and William T. Haller
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

2:45 pm **The Channelized Apple Snail, A Potential Biocontrol of Hydrilla or a Grass Carp Wearing a Helmet?** *(Student Presentation)*
Eileen Ketterer, William T. Haller, L. A. Gettys, and Tomas Chiconela
University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL

3:00 pm **Refreshment Break** *(Oregon Ballroom, Salons A-E)*

Session IV (continued): Invasive Species and Aquatic Habitat Management
Moderator: Terence M. McNabb, *AquaTechnex, LLC, Bellingham, WA*

3:30pm **Effect of Copper-Containing Immobilized Ligands on *Lyngbya majuscula*** *(Student Presentation)*
Derek A. Guenther[1] and Dean F. Martin[2]
[1]University of South Florida, Institute for Environmental Studies, Tampa, FL

3:45 pm **What is Idaho Doing about Eurasian Watermilfoil?**
Matthew K. Voile
Idaho State Department of Agriculture, Boise, ID

4:00 pm **The Impact of Invertebrate Herbivory on Native Aquatic Macrophyte Biomass**
(Student Presentation)
Julie G. Nachtrieb[1], Michael J. Grodowitz[2], and R. Michael Smart[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*

4:15 pm **Salvinia Weevil (*Cyrtobagous salviniae*) Populations in North Florida and Their Potential for Control Activities on Common Salvinia (*Salvinia minima*)**
Charles E. Ashton
U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL

4:30 pm **Washington DC Update**
Lee Van Wychen
WSSA Science Policy Director, Washington, DC

4:40 pm **APMS Chapter Updates**
Brazil, Florida, Midsouth, Midwest, Nile Basin, Northeast, South Carolina, Texas, Western

5:00 pm **Adjourn**

Wednesday, July 19

Wednesday's Agenda-at-a-Glance

7:30 am - 8:00 am	Continental Breakfast *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
7:30 am - 12:00 pm	Meeting Registration *(Oregon Ballroom Foyer)*
7:30 am - 12:00 pm	Presenter's Preview Room *(Eugene)*
7:30 am - 12:00 pm	Exhibits Open *(Oregon Ballroom, Salons A-E)*
7:30 am - 12:00 pm	Posters Open *(Oregon Ballroom, Salons A-E)*
8:00 am - 12:00 pm	Session V: Herbicide Developments and Invasive Plant and Algae Issues *(Oregon Ballroom, Salon F)*
10:00 am - 10:30 am	Refreshment Break *(Oregon Ballroom, Salons A-E)* *Sponsored by Cerexagri-Nisso, LLC*
12:00 pm - 5:00 pm	APMS Board of Directors Meeting *(Meadowlark/Douglas Fir)*
12:00 pm - 5:00 pm	Exhibits Teardown *(Oregon Ballroom, Salons A-E)*
12:00 pm - 5:00 pm	Posters Teardown *(Oregon Ballroom, Salons A-E)*

Session V: Herbicide Developments and Invasive Plant and Algae Issues

8:00 am - 12:00 pm
Oregon Ballroom, Salon F
Moderator: Judy F. Shearer, *U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*

8:00 am **Review of Clearcast™ (Imazamox) Aquatic EUP and Research Results for the Western U.S.**
Joseph G. Vollmer[1] and Kim D. Patten[2]
[1]*BASF Corporation, Laramie, WY*
[2]*Washington State University, Long Beach, WA*

8:15 am **Herbicide Resistance Issues in Aquatic Plant Management: Investigating Variable Efficacy and the Potential Role of Resistance**
Michael D. Netherland
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Gainesville, FL

8:30 am **Aquatic Plant Community Evaluations Following Three Years of Management Using Triclopyr (Renovate Aquatic Herbicide®)**
Scott Shuler
SePRO Corporation, Folsom, CA

8:45 am **Interactive Effects of Diquat and *Mycoleptodiscus terrestris* on Hydrilla**
Linda S. Nelson and Judy F. Shearer
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS

9:00 am **Field and Laboratory Research Overview for Galleon SC (Penoxsulam), A Potential New Aquatic Herbicide**
Mark A. Heilman
SePRO Corporation, Whitakers, NC

9:15 am **Evaluation of Penoxsulam on Water Hyacinth and Giant Salvinia**
Robert J. Richardson, Len R. Swain, and Andrew P. Gardner
North Carolina State University, Raleigh, NC

9:30 am **Effects of Lime Application on Aquatic Macrophyte Growth**
William F. James
U.S. Army Engineer Research and Development Center, Environmental Laboratory, Spring Valley, WI

9:45 am **Assessing the Hazards Aquatic Herbicides Pose to Salmonids in the Northwest**
Christian Grue[1], C. A. Curran[1], K. A. King[1], J. M. Grassley[1], S. A. Bonar[2], D. A. Beauchamp[1], and N. C. Overman[1]
[1]*University of Washington, Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, Seattle, WA*
[2]*University of Arizona, Arizona Cooperative Fish and Wildlife Research Unit, School of Renewable Natural Resources, Tucson, AZ*

10:00 am **Refreshment Break** *(Oregon Ballroom, Salons A-E)*

Session V (continued): Herbicide Developments and Invasive Plant and Algae Issues
Moderator: Carlton Layne, *Aquatic Ecosystem Restoration Foundation, Marietta, GA*

10:30 am **Affect of Hurricanes Katrina and Rita on the Increase and Reduction of Invasive Aquatic Weeds**
Dearl Sanders and Keith Whitehead
Louisiana State University Agricultural Center, Idlewild Research Station, Clinton, LA

10:45 am **Management of Curlyleaf Pondweed for Ecological Benefits in Minnesota**
Charles Welling
Minnesota Department of Natural Resources, Saint Paul, MN

11:00 am **Do Algae Spill Their Guts after Treatment with Algaecides? A Test of the Leaky Cell Hypothesis**
John H. Rodgers, Jr., O'Niell Tedrow, and Maurice Duke
Clemson University, Department of Forestry and Natural Resources, Clemson, SC

11:15 am **Avian Vacuolar Myelinopathy: Investigating Ecosystem Effects in Southeastern Reservoirs**
R. S. Haynie[1], W. W. Bowerman[1], S. W. Wilde[2], Sara Habrun[2], C. P. Hope[3], T. M. Murphy[3], J. J. Hains[4], R. L. McCord[5], J. R. Morrison[5], J. Grizzle[6], J. Fischer[7]
[1]*Clemson University, Department of Forestry and Natural Resources, Institute of Environmental Toxicology, Pendleton, SC*
[2]*Belle Baruch Institute, University of South Carolina and Marine Resources Division, South Carolina Department of Natural Resources, Charleston, SC*
[3]*South Carolina Department of Natural Resources, Green Pond, SC*
[4]*U.S. Army Corps of Engineers, Calhoun Falls, SC*
[5]*Environmental Services, Santee Cooper Power, Monks Corner, SC*
[6]*Auburn University, Department of Allied Fisheries and Aquaculture, Auburn, AL*
[7]*University of Georgia, Southeastern Cooperative Wildlife Disease Study, Athens, GA*

11:30 am **Avian Vacuolar Myelinopathy (AVM): Ongoing Research**
Sarah Williams[1], Faith Wiley[2], and Jessica Alexander[3]
[1]*South Carolina Department of Natural Resources, Charleston, SC*
[2]*Clemson University, Pendleton, SC*
[3]*University of South Carolina, Columbia, SC*

11:45 am **Empirical Evidence of Eurasian Watermilfoil Supression via Ammonia-N Limitation Promoted by Sediment Oxidation through Long-Distance Circulation**
Christopher F. Knud-Hansen
SolarBee Division of Pump Systems, Inc., Westminster, CO

12:00 pm **Closing Remarks and Adjourn 46th Annual Meeting**
Jeffrey D. Schardt, *Florida Department of Environmental Protection, Tallahassee, FL*

NEXT YEAR
47th Annual Meeting
July 15 - 18, 2007
Gaylord Opryland Resort & Convention Center
Nashville, Tennessee

Abstracts

Abstracts are listed alphabetically by presenting author and title. Presenting author appears in **bold.**

Effect of Light Levels on Growth and Canopy Formation in *Egeria densa*

Lars W. J. Anderson and Amy Klug
U.S. Department of Agriculture, Agricultural Research Service, Exotic and Invasive Weed Research, Davis, CA

Egeria densa, an exotic submersed weed native to South America currently infests approximately 7,000 acres in the Sacramento-San Joaquin Delta, California. Seasonal and tidal fluctuations in the delta system lead to highly variable turbidity and PAR. We examined the effects of four water-level regimes that created PAR levels (via metal halide lamps) from ca. 500 µmols/m^2/sec to ca. 50 µmols/m^2/sec in replicated, recirculating culture columns (0.4 m to 1.6 m deep). Apical cuttings (15 cm) planted in native Delta sediments were allowed to grow under these conditions for 90 days. Aboveground biomass was highest and varied little among 0.4, 0.8, and 1.2 m planting depths, but was significantly reduced (ca. 70%) in plants initiated at 1.6 m. Root and rootcrown biomass was highest for plants initiated at 0.4 m (ca. 300 µmols/m^2/sec) and was reduced by over 85% in plants started at 1.6 m. However, *E. densa* planted at 1.6 m (ca. 50 µmols/m^2/sec) appeared to partially compensate by producing nearly as much total shoot length as plants initiated at the other depths (ca. 200 cm per potting container), but had least rootcrown biomass. Progressive growth of *E. densa* canopy also shifted the irradiance profiles to lower levels in all planting conditions. These data suggest that sustained PAR below 50 µmols/m^2/sec would severely impair overwintering capacity due to greatly reduced reserves in rootcrowns.

The IR-4 Project: New Opportunity – Aquatic Herbicide Registration

Marija Arsenovic[1], R. E. Holm[1], J. J. Baron[1], D. L. Kunkel[1], J. A. Norton[1], K. D. Getsinger[2], J. Parochetti[3], W. T. Haller[4], L. W. J. Anderson[5], and D. R. Stubbs[6]
[1]*Rutgers University, IR-4 Project, North Brunswick, NJ*
[2]*U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS*
[3]*U.S. Department of Agriculture, Cooperative State Research, Education, and Extension Service, Washington, DC*
[4]*University of Florida, Center for Aquatic and Invasive Plants, Gainesville, FL*
[5]*U.S. Department of Agriculture, Agriculture Research Service, Davis, CA*
[6]*U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC*

The IR-4 Project is a publicly funded effort to support the registration of pest control products on minor or specialty crops. Its historic mission has been to provide pest management solutions to the growers of vegetables, fruits, ornamentals, and herbs. The IR-4 Program develops data for submission to the U.S. Environmental Protection Agency (USEPA) to support the regulatory clearance of new crop protection chemicals on specialty crops and assists in the maintenance of existing product registrations. The IR-4 also provides aid in the development and registration of biopesticides and expedites new pest control technology, such as seed technology and methyl bromide alternatives. Concerned about increasing invasive aquatic weeds problems, experts from the USEPA, the U.S. Department of Agriculture, the U.S. Army Corps of Engineers, land grant universities, scientific groups, and IR-4 joined together to form the Aquatic Herbicide Working Group. A white paper entitled "New Missions for the IR-4 Project-Weed Control in Aquatic Sites and Irrigation Canals" was completed and approved by the IR-4 Project Management Committee. Stakeholder support for the concept was obtained in February, 2005, at the IR-4 Strategic Planning Conference. If resources are made available from sources outside current program funding, IR-4 will work with stakeholders to obtain registration of herbicides for use in irrigation canals and water bodies that supply irrigation water for production agriculture. Opportunities for collaborative projects will be discussed.

Salvinia Weevil (*Cyrtobagous salviniae*) Populations in North Florida and Their Potential for Control Activities on Common Salvinia (*Salvinia minima*)

Charles E. Ashton
U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL

The waterfern (*Salvinia minima*) is naturalized in Florida and has become problematic in certain slow moving water bodies and canal systems along the St. Johns River. Prior to funding reductions in 1996, the District controlled this species with herbicides. In 2000, it was noted that *S. minima* populations seemed to cycle in some of these areas. Upon further examination, adult salvinia weevils (*Cyrtobagous salviniae*) were collected from *S. minima* samples from these areas. The

weevil appears to contribute to the cycling of *S. minima* populations. Adult weevil populations were monitored monthly at four locations on the St. Johns River in north Florida. The sampling areas included two undeveloped natural creeks, one creek with residential development, and one canal system surrounded by residential development. The potential for augmenting weevil populations to assist in the control of *S. minima* will be discussed.

EPA Ecological Risk Assessment for Aquatic Plant Pesticides: Coordination between Office of Water and Office of Pesticide Programs

Elizabeth Behl
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

The U.S. Environmental Protection Agency conducts ecological risk assessments for aquatic plant pesticides to determine the likelihood of effects on non-target species. To enhance efficiencies and coordinate activities related to pesticides, the Office of Pesticide Programs increasingly coordinates its ecological risk assessment activities with the Office of Water. For example, the two Offices share aquatic toxicity studies and evaluations of these studies, benchmark (e.g., aquatic life criteria) information, pesticide usage information, and monitoring data. This talk will provide some specific examples of activities at a national level designed to increase coordination, integration, and efficiencies between these two Programs to ensure the continued protection of the aquatic environment.

Biology and Management of Cabomba in the Northern U.S.

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

Cabomba (*Cabomba caroliniana*) is a submersed aquatic plant that is native to the Southeastern U.S. but is considered invasive to the Northern U.S., Canada, Holland, and Australia. The species found in the genus *Cabomba* exist throughout the Americas (North, Latin, and South) and they are popular aquarium plants. It is widely believed that the recent spread of cabomba outside it's native range is due in large part to discarded aquarium plants. There are many phenological differences, chiefly color, that have led to debate as to the origin, and taxonomic classification of the *Cabomba* in the northern U.S. Native southern cabomba has stems and leaves that are red to purple in color with flowers that are red to purple. The northern cabomba has bright green stems and leaves, with flowers that are white to yellow. Both cabombas are typically found in low alkalinity/pH waters where little flow occurs. The invasive northern cabomba is of particular interest because it has proven to be tolerant to many herbicide treatments that are typically effective for control of southern cabomba. The current literature and recommendations for cabomba management are rather incomplete, and current management is largely limited to applicator uses of herbicides at maximum label use rates. In order to determine the comparative response of cabomba to aquatic herbicides, several small-scale mesocosm studies have been carried out to screen for compounds that have activity on the northern cabomba. Trials are being run on registered and EUP herbicides for aquatics with emphasis placed on rates and timing of application. These results will be presented with a focus on management of the northern cabomba, and also to document any response differences between the northern and southern cabomba.

Efficacy of Three Aquatic Herbicides for Control of Swamp Smartweed

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To assess the efficacy of imazapyr, glyphosate, and triclopyr on swamp smartweed (*Polygonum hydropiperoides*), 21, 1 m^2-plots were randomly assigned in an infested pond. Each plot was treated with either half of the maximum label rate (0.5 MLR) or the maximum label rate (MLR) of the three herbicides: imazapyr (Habitat) (6 pints/ac), triclopyr (Garlon 3A) (16 pints/ac), and glyphosate (Rodeo) (3 pints/ac). The application was done using a 2-gallon backpack sprayer calibrated to deliver 26 gallons per acre. A 1% v/v of Dyne-amic, a non-ionic surfactant, was added to each treatment. Greater than or equal to 90% control was considered acceptable control for this study. Imazapyr at the 0.5 MLR provided the most effective control throughout the study while the MLR provided acceptable control beyond 4 weeks after treatment. Glyphosate at MLR provided acceptable control throughout the study whereas the 0.5 MLR provided acceptable control 4 weeks after treatment. Triclopyr efficacy was statistically different between the MLR and 0.5 MLR. Triclopyr did not provide acceptable control ($\geq$ 90% control) of swamp smartweed. Therefore, imazapyr at a rate of 0.66 gallons per acre and glyphosate at a rate of 2.1 gallons per acre are recommended for control of swamp smartweed. Triclopyr is not recommended for control of swamp smartweed.

Effects of Diquat in Irrigation Water on Different Growth Stages of Rice and Other Agronomic Crops

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Diquat is a contact herbicide that has been widely used for both submersed and floating macrophyte control. It is rapidly absorbed by target plants and has been used successfully by injecting into flowing drainage and flood control canals to control submersed weeds. In order to be used successfully in irrigation canals in agricultural areas, food tolerances have to be obtained from EPA and the manufacturer needs to be aware of any potential phyto-toxicity to irrigated crops. Rice is a semi-aquatic crop and data shows that germinating rice and young plants germinating under water are very sensitive to diquat in the flood waters, however, the longer the rice matures, the greater the tolerance for diquat in the flood water. Also, several other crops have been overhead irrigated with diquat containing irrigation water and also show greater tolerance to diquat. Based upon these preliminary studies it would appear that diquat containing irrigation water should be restricted from use on newly planted rice fields.

Current Status of Giant Salvinia in North Carolina and Virginia

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Over-wintering populations of giant salvinia (*Salvinia molesta* D.S. Mitchell) have become established in North Carolina and Virginia in recent years. In North Carolina, the Southeast North Carolina Giant Salvinia Task Force was formed to develop and implement an eradication program. Herbicide treatments have reduced the infestation to two sites of approximately 30 acres from a high of ten sites and about 40 acres. The salvinia weevil (*Cyrtobagous salviniae* Calder & Sands) has been released and has established in a pond adjacent to a swamp with the largest infestation. However, control with the weevil alone has not been acceptable and salvinia continues to move from the pond into the swamp under high water levels. In Virginia, giant salvinia was introduced into a single pond near Strasburg in 2003. The weed was identified in 2004 and herbicide treatments were conducted in 2005. The site will be monitored and treated as needed in 2006. Strasburg, VA is located in USDA Plant Hardiness Zone 6b, outside of the maximum predicted range of giant salvinia.

Collaboration - Key to Registration of Aquatic Pesticides

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There are less than ten active ingredients registered by the U.S. Environmental Protection Agency (USEPA) for use as aquatic herbicides on a national basis (Section 3 Label). Of these products, seven received labels prior to 1986 and are considered old chemistry. Some uses of old chemicals may be lost during the USEPA re-registration process that is currently underway (and the future registration review process) and, at a minimum, more restrictive uses of old products are likely. With these factors, combined with the introduction of new invasive species and the onset of herbicide resistance (e.g. hydrilla to fluridone, duckweed to diquat, and milfoil to 2,4-D), it is imperative that new chemistries be developed and registered to provide the necessary tools required for controlling the full range of invasive plants infesting U.S. waters. The commercial market for aquatic herbicides is < 10% of its terrestrial counterpart, and low return on investment for registering aquatic products severely limits private industry's interest and capabilities for developing new chemistries for controlling nuisance vegetation in public water bodies. Without collaboration among Federal research and development groups, university researchers, and the Federal and state regulatory community, it is doubtful that industry will fully support re-registration activities, or the registration of new products for use in aquatic sites.

Research Assistance in Management of Aquatic Plants in the Midwestern States

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The U.S. Army Engineer's Chemical Control Technology Team (CCTT) is partnering with the Minnesota Department of Natural Resources (MNDNR), the Wisconsin Department of Natral resources (WIDNR), the U.S. Forest Service (USFS), the Aquatic Ecosystem Restoration Foundation and others in research and demonstration projects to improve control of invasive plants in northern lakes. Results from greenhouse and mesocosm studies indicated the potential of endothall, and

combinations of endothall + 2,4-D, applied at cool water temperatures (12-15 C) to selectively control curlyleaf pondweed (Potamogeton crispus) and Eurasian watermilfoil (Myriophyllum spicatum). From these, multi-year field demonstrations were designed using early spring, low-dose, whole lake applications of endothall alone, or endothall + 2,4-D on four lakes in the Twin Cities (MN) metro area. Results showed that invasive plants could be reduced to non-nuisance levels (> 95% reduction) and native plant populations could be increased significantly, or maintained at pretreatment levels. Based on these results, local agencies have initiated operational management plans on several lakes in the Twin Cities area, and MNDNR has initiated grants for cities and lake associations to develop whole lake management plans for invasive plants. Other CCTT/MNDNR projects include studies on whole lake fluridone applications against curlyleaf pondweed, leading to operational treatments, and planning and implementation of demonstrations on Lake Minnetonka for large treatments of triclopyr, 2,4-D, and endothall combined with 2,4-D. CCTT/WIDNR projects include the restoration of Eagle Lake (WI), where assistance is being provided on herbicide selection, timing of applications, and data collection for controlling Eurasian watermilfoil, and development of management plans for water bodies in the Madison (WI) area. CCTT/USFS projects involve controlling pioneer infestations of Eurasian watermilfoil to prevent their establishment.

Another Invasive Aquatic Plant in South Florida: *Rotala rotundifolia*

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Rotala rotundifolia (Buch.-Ham. ex Roxb.) Koehne is a herbaceous perennial species native to southern Asia including the countries of Nepal and India to China and Japan. It is a member of the loosestrife family (Lythraceae) with other common weeds including the non-native, invasive purple loosestrife (*Lythrum salicaria* L.) and the native purple ammannia (*Ammannia coccinea* Rottb.). *Rotala rotundifolia* will take on different leaf forms depending upon growing conditions. When growing as an emerged plant, leaves are opposite in pairs, rarely in whorls of three, round to egg-shaped, approximately 2 to 2.5 cm wide, and hairless. In the submerged form, leaves are much longer then wide approximately 2 to 3 cm in length and 0.5 cm wide. Leaves receiving high amounts of sunlight turn a reddish color. The leaves tend to be greener on the top of the leaf and redder on the underside of the leaf with very reddish-pink veins prominent. If lower leaves do not receive much sunlight, they remain green in color. Flowers form on terminal emergent spikes from November to June. Flowers are bright rose to pink in color with 4 petals, 4 sepals, and 4-valve capsules. Stems are creeping or floating, rooting at the nodes, red-tinged in color with internodes longer at basal portions than subtending stems. *Rotala rotundifolia* is becoming an increasing problem in south Florida canal systems. *Rotala rotundifolia* has been in the aquarium trade for over 30 years now, and is commonly referred to as ‘dwarf rotala’. The first known established infestation of *R. rotundifolia* was documented in 1996 in a residential neighborhood canal in Coral Springs, Florida. It has now become established in several counties in southern Florida.

Characteristics of Hygrophila (*Hygrophila polysperma*) Establishment in South Florida

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Hygrophila [*Hygrophila polysperma* (Roxb.) T. Anderson] is a serious non-native, invasive weed causing problems in south Florida canals. The first introduction of hygrophila to south Florida was during the 1950s. Hygrophila has since naturalized and is commonly found in gentle flowing streams, creeks, and canal systems throughout central and south Florida, and is also found in the Comal and San Marcos River systems in central Texas. Two experiments were implemented to evaluate the establishment of hygrophila with multiple flowing water conditions and water depths. The first experiment was designed to evaluate four water regimes: static, aerated, circulated, and flushing the experimental tanks twice per week for 24 hours. Hygrophila was allowed to grow for 8 weeks under these water regimes at which time internode length, leaf width and length, and shoot and root biomass were collected. No significant differences were found between root biomass; however, shoot biomass, leaf length, and leaf width were significantly greater for the flushing treatment compared to all other treatments, while internode length was greatest for the static and aerated treatments. A second experiment was conducted to evaluate the establishment of hygrophila at differing water depths. The following four water depths were established: sub-irrigation, water level equal to soil substrate height, and two submersed depths at 27 and 54 cm. Plants were allowed to grow for 10 weeks and then harvested to obtain shoot and root biomass. Results conclude shoot and root biomass were significantly greater for the sub-irrigated treatment. The water level equal to soil substrate height treatment was significantly greater than the remaining submersed treatments. In summary, these experiments conclude hygrophila growth is increased if there is a water exchange at least twice per week. In addition, initial hygrophila establishment is greater when newly transplanted shoots are exposed to the atmosphere.

Impact of Insect Herbivory and Plant Competition on the Growth of Hydrilla: Small Scale Studies

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Over the last several years several small-scale experiments were initiated at the LAERF using small and large tanks, and small ponds to determine the impacts of insect herbivory by two species of leaf-mining flies and plant competition on the growth and reproductive capability of *Hydrilla verticillata*. For example, a two-year large tank study was initiated to evaluate native plant competition with and without insect herbivory. Both competition and herbivory impacted the growth of hydrilla. Hydrilla grown in the presence of *V. americana* developed less total biomass, had fewer total basal stems, had fewer tubers and less tuber mass per tank, and produced significantly smaller tubers relative to control plants. Herbivory also suppressed hydrilla biomass accumulation and tended to suppress the number and total mass of tubers produced in each tank. Both factors showed a 30-40% reduction of total *H. verticillata* biomass, although the mechanism of impact was different. Competition suppressed expansion of *H. verticillata* into adjoining pots but had little impact on its growth in pots where it was originally planted. Herbivory resulted in a general suppression of growth of hydrilla in all pots. Similarly, hydrilla grown for short time periods in small tanks with and without fly herbivory also exhibited similar reductions in biomass, tuber production, and changes in branching levels. In these experiments, plants under high levels of herbivory produced 30% less mass and twice the number of branches. Plants under an intermediate or high level of herbivory produced fewer than 15% of the number of pistillate flowers and smaller tubers than control tanks. For small ponds experiments, non-herbivory ponds averaged greater than 260 g DW m^{-2} aboveground biomass when compared to ponds with sustained herbivory that averaged only about 150 g DW m^{-2}; a reduction of over 55%. In addition, approximate 2-fold increases in turions were recorded in the non-herbivory ponds.

Physiological Age-Grading Techniques to Assess Reproductive Status and Nutritional Requirements of Insect Biocontrol Agents of Aquatic Plants

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Physiological age-grading has been used to assess reproductive status of insect species typically utilizing ovarian morphology to ascertain reproductive status, reproductive history, and number of eggs oviposited. However, rarely have such techniques been used for insect biocontrol agents of aquatic plants. To date three age-grading systems have been developed for agents of aquatic plants including two weevil species; *Neochetina eichhorniae* (waterhyacinth) and *Euhrychiopsis lecontei* (Eurasian watermilfoil), and most recently, the leaf-mining fly *Hydrellia pakistanae* (hydrilla). All three systems utilize changes in morphological structures of the ovaries and fat body as the basis to determine changes in reproductive condition. The two weevil species have similar ovarian development/morphology and thereby utilize almost identical systems where changes in fat body, cuticular hardness, and follicular relics give rise to three nulliparous (prior to egg deposition) and three parous stages (after egg deposition). *Hydrellia pakistanae* has a different ovarian structure/development and uses characteristics of follicular relics to develop an age-grading system containing seven physiological ages; i.e., three nulliparous and four parous classes. Changes occurring in the morphology of the fat body were used to assist in classification of female flies in the nulliparous classes and those individuals that have just begun ovipositing. Strategies of ovarian development differ between the two weevil species and the fly. The weevils are relatively long-lived and mature and deposit eggs individually throughout most of their adult life. The fly is short-lived and only oviposits when an entire batch of eggs are mature. Several egg batches are developed over the course of their adult life. Interestingly, the fly emerges as an adult with a mature batch ready for oviposition as soon as mating is complete; another strategy to maximize egg production over a short life span.

Assessing the Hazards Aquatic Herbicides Pose to Salmonids in the Pacific Northwest

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Utilization of herbicides to control aquatic weeds has been hampered by court injunctions directed at the non-target toxicity of active herbicidal ingredients. Declines in several species/stocks of salmon in the Pacific Northwest and efforts to restore these populations heighten concerns. We review the existing data on the direct and indirect effects of aquatic herbicides on

the salmonids and their habitats in the Pacific Northwest with an emphasis on western Washington State and the herbicides most frequently used; active ingredients diquat, fluridone, triclopyr, and 2,4-D. We will then combine these data with existing information on salmon life history and habitat use, seasonal changes in water quality, growth of aquatic weeds, and the timing of the application of aquatic herbicides. The resulting synthesis will help regulators and lake management associations address concerns about the adverse effects aquatic herbicides may pose to adult and juvenile salmonids by identifying the potential for exposure to the herbicides, management strategies to reduce exposure, and research needs.

Effect of Copper-Containing Immobilized Ligands on *Lyngbya majuscula*

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Silica-based IMmobilized-LIGands used as a slow-release vehicle of aqueous copper were tested on samples of the aquatic nuisance algae *Lyngbya majuscula*. This species, obtained from Crystal River, FL, has long caused problems including 'swimmer's itch', disflavoring of fish and water, putrid odors, and is connected with neurodegenerative disorders studied in Guam. By refluxing a mixture of mercaptoethanol and inert toluene with common silica gel, the resulting granular solid compound is capable of accepting aqueous metal ions bonding to the mercaptan group. When shaken with aqueous cupric sulfate, a copper-containing IMLIG is formed. This compound, when scattered over the surface of the *Lyngbya*, is able to steadily release the copper back into solution, and acts as a targeting algaecide. The extent of this effect was measured by chlorophyll *a* concentration in samples exposed between one and two weeks. The compound was shown to be effective in hindering the growth of the species.

Activities at the University of Florida Center for Aquatic and Invasive Plants

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The faculty and staff that oversee and conduct research, extension, and teaching programs involving invasive plants in Florida and other areas have been put to the test this year. The development of fluridone resistant hydrilla has prompted major efforts in screening and selectivity studies for potential new herbicides for use against hydrilla. In the meantime, renewed searches are being undertaken for effective biocontrol agents in previously little searched East Africa. University entomologists have found several locations of hydrilla growing in the area, and cooperative agreements have been developed with international institutions in Kenya and other countries in the area. Old world climbing fern continues to expand rapidly across southern Florida and up the peninsula to the Orlando area. A new plant, *Rotala rotundifolia*, has been found growing in south Florida canals, and giant salvinia has been found in a lake in north central Florida near Ocala. So it goes!!!! In the interim we have started working on the food consumption of exotic snails, and even won an NCAA basketball championship. The public information office has geared up to put into place one (of many) of the favorite projects of the late Vic Ramey, that is the "teach the teacher" program and yes, even the "teach the park ranger" program about invasive species so that they can spread the word not only to students in science classes, but park visitors as well. We have initiated several new activities this year, including attending National Invasive Weed Awareness Week in Washington, DC, and have entered into internship agreements on invasive plants with the World Bank. We certainly appreciate all the support from governmental agencies and other private and corporate entities that have allowed us to serve the industry.

Monitoring Data Collected under Washington's Noxious Weed NPDES Permit

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Washington's Noxious Weed NPDES general permit for the application of aquatic herbicides has been in place since 2002. The permit calls for herbicide residue and other monitoring after aquatic herbicide application to lakes, tidelands, and river shores. Not all treatments are monitored, but a subset of the applications has been monitored since 2002. This has resulted in a dataset of herbicide concentration, water quality, and plant biomass data from Washington waters after treatment with the various herbicides allowed under the permit. The data has been used to develop permit mitigations after herbicide use and to support EPA requests for actual use data after herbicide treatments. This presentation will present the results from monitoring after treatments for spartina, purple loosestrife, milfoil, and other noxious weeds.

Mass Rearing of *Hydrellia* spp. and *Cyrtobagous salviniae* for the Management of Hydrilla and Salvinia, Respectively

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Rearing of insects for use in biological control programs has often been time and cost-ineffective. It has been shown that while laboratory/greenhouse rearing techniques produce quality insects, the cost involved is prohibitively high. *Hydrellia pakistanae* and *H. balciunasi* were mass reared for the control of *Hydrilla verticillata* (L.f.) Royle in small ponds at the Lewisville Aquatic Ecosystem Research Facility (LAERF), Lewisville, TX, beginning in 1998. Releases have been made at 11 sites in Texas, with documented establishment at a number of the sites. As well, significant population increases have been observed in several release areas along with documented hydrilla declines. Pond rearing has proven to be highly successful as demonstrated by the release of over 12.7 million immature *Hydrellia* spp. during 2005 at a cost of only $0.0018/fly. Compare this to published costs of over $0.50/fly using more conventional greenhouse rearing techniques. Techniques used to increase pond rearing capacity include nominal fertilization regimes and tilling techniques to ensure the production of high quality hydrilla during different periods of the growing season. *Cyrtobagous salviniae*, a curculionid weevil, was also mass-reared for release as a control agent of *Salvinia molesta* Mitchell at the LAERF in small research ponds during 2004 and 2005. Although rearing of the salvinia weevil is essentially in its infancy in the United States, over 115,000 weevils were released at sites in Texas at a cost of only $0.03/weevil. As shown for hydrilla fly production, increasing fertilization as well as decreasing pH aided in the production of high quality plant material and subsequent weevil production.

Overwintering of *Hydrellia* spp. (Diptera: Ephydridae) Introduced for Biological Control of *Hydrilla verticillata*

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Since 1987, two leaf-mining ephydrid flies (*Hydrellia pakistanae* and *H. balciunasi*) have been released in the United States for the management of *Hydrilla verticillata* (L.f) Royle. While the general biology of these leaf-mining flies has been fairly well documented, the overwintering habits have eluded researchers. In an attempt to better understand the overwintering behavior of the introduced *Hydrellia* spp., preliminary observations were made during the winter of 2005-06 in *Hydrellia*-rearing ponds at the Lewisville Aquatic Ecosystem Research Facility (LAERF), in Lewisville, Texas. Both hydrilla and organic debris from the ponds' edge (i.e., leaves and other plant material) were sampled monthly to determine presence of the flies using both microscopic observations and a Berlese funnel extraction technique. In late fall, larvae were extracted from hydrilla, which corresponded to the observed presence of larvae in the leaves of the plant. By mid to late-winter, all larvae had disappeared from the leaves of hydrilla, and were no longer collected via extraction techniques or observationally. At no point did organic debris from the ponds' edge result in the collection of adult flies. Once larvae were no longer found in the leaves, stems were examined microscopically. Several stems exhibited signs of damage in the form of tunneling and were subsequently dissected. In many tunnels ephydrid larvae were identified. Since larval identification is not possible stems containing no mined leaves were placed in rearing containers to obtain adult flies. Adult *H. pakistanae* emerged from these stems, leading to the preliminary conclusion that *H. pakistanae* tunnel into the stem of hydrilla during the winter months as part of its overwintering strategy.

Avian Vacuolar Myelinopathy: Investigating Ecosystem Effects in Southeastern Reservoirs

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Avian Vacuolar Myelinopathy (AVM) is a lethal disease of birds causing lesions in brain and spinal cord tissues. These lesions were first observed in bald eagles (*Haliaeetus leucocephalus*) and coots (*Fulica americana*) in western Arkansas in 1994. Since then, AVM has been diagnosed in several avian species that frequent surface water impoundments in the southeastern United States. Previous investigations have found no association with likely neurotoxins, infectious agents, pesticides, herbicides, or heavy metals. Feeding studies performed at Clemson University established a link between lake vegetation and AVM. Our working hypothesis is that an epiphytic toxin-producing *Stigonematalen* cyanobacterium, growing primarily on *Hydrilla verticillata,* is the etiologic agent. In a 2005 experiment, triploid Chinese grass carp (*Ctenopharyngodon idella*), commonly used for biological control of aquatic plants, developed brain lesions similar to AVM-affected mallards after feeding exclusively on vegetative material containing the suspect cyanobacterium. However, a feeding study using treatment and control carp tissues failed to transmit the disease to chickens. A subsequent trial using domestic swine evaluated the potential for mammals to contract AVM when fed aquatic vegetation containing the suspect etiologic agent. Because of declining midwinter counts and known susceptibility, our current research will concentrate on quantifying the AVM mortality and infection rate of American coots on a southeastern reservoir. A coot banding study combined with an intensive disease surveillance program will better elucidate the relationship between vector potential provided by diseased and dead coots and avian predators, primarily nesting bald eagles.

Field and Laboratory Research Overview for Galleon SC (Penoxsulam), A Potential New Aquatic Herbicide

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Galleon SC (active ingredient: penoxsulam) is under development as a new aquatic herbicide for control of submersed, floating, and emergent problem aquatic plants. Since 2002, this new ALS chemistry has been under intensive laboratory and field Experimental Use for control of key weed species including *Hydrilla verticillata* (hydrilla), *Myriophyllum spicatum* (Eurasian watermilfoil), *Egeria densa* (egeria), *Eichhornia crassipes* (water hyacinth), and several other significant invasive aquatic weeds. In 2005, EUP studies and other trials documented the ability to use Galleon SC for large-scale in-water treatments with unique properties to simultaneously control submersed weeds like hydrilla, and floating invasive weeds such as water hyacinth, water lettuce, giant salvinia, and duckweeds through in-water treatment. Foliar spray uses of Galleon for control of water hyacinth and other susceptible floating and emergent weeds also show promise. Results of EUP testing, including one-year post-treatment assessments, and other laboratory evaluations will be summarized with discussion of spectrum of activity, selectivity patterns, duration of control, and other aspects of multiple potential use patterns for this new aquatic herbicide.

Dispersal of Invasive Cordgrass (*Spartina* spp.) Propagules

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Only six estuaries on the west coast of North America have known populations of non-native *Spartina* species, while over thirty estuaries are considered at risk for invasion. We conducted two studies exploring viability of vegetative propagules and potential dispersal patterns. We investigated *Spartina alterniflora* rhizome fragments as potential propagules for local and long-distance dispersal by examining the effects of rhizome length, shoot attachment, salinity, and floating duration on survival and growth. A second study utilized monthly releases of drift cards to better understand potential seed dispersal patterns from three infested west coast estuaries (Humboldt and San Francisco Bays in California, and Willapa Bay in Washington). The fragment viability study suggested a low probability for rhizomes to survive long-distance ocean dispersal between estuaries; however, ocean transport of viable *Spartina* seed is still likely. Drift card recoveries occurred over a wide geographic range – Alaska, British Columbia, and much of the Washington, Oregon, and California coastlines – and indicate near-shore currents from each release location could serve as potential vectors to both local and distant susceptible habitats.

Effects of the Use of Copper Sulfate in Double-Cropped Aquaculture Ponds

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Copper sulfate is routinely applied during catfish culture in summer to eliminate nuisance algal blooms. Since copper is persistent, multiple treatments over the years can result in the accumulation of high levels of copper in the sediment. Persistent copper may negatively affect the culture of larval, planktivorous saugeye (hybrid walleye) in the same pond (double-cropped) the following spring. Historical data reveal that algal productivity, zooplankton density, and overall saugeye production have declined in double-cropped ponds at the State Fish Hatchery in Senecaville, OH, over the years. We hypothesize that sediment bound copper is resuspended into the water column during saugeye culture, becoming directly toxic to fish, zooplankton and phytoplankton, or decreasing fish production indirectly by affecting algal production and community composition. Preliminary studies conducted in 2005 at Senecaville State Fish Hatchery, OH, indicate high copper concentrations in the sediments (~300 mg/kg) and elevated levels of total copper (4-9 µg/L) in the pond water column compared to the pond source water from Seneca Lake (<1 µg/L). Furthermore, we found that algal biomass did not increase even after the weekly addition of 30 µg/L of phosphorus. Zooplankton egg densities were lower in the ponds compared to Seneca Lake. We are currently examining the speciation of particulate copper by analyzing possible sorption phases in the sediment including acid volatile sulfide, oxides, carbonates, and organic matter. We are also quantifying the resuspended copper by characterizing copper speciation in the water column. The biomass of phytoplankton and zooplankton and overall fish survival are being monitored to assess the potential toxicity of copper. Results of this study will help formulate best algaecide mangement practices for enivronmental mangers wishing to avoid an anthropogenic copper overload.

Effects of Lime Application on Aquatic Macrophyte Growth

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Lime application to aquatic systems may be an effective means of stressing aquatic macrophyte growth and promoting changes in species assemblage by inducing temporary dissolved inorganic carbon (DIC) limitation. Macrophyte shoot and root growth (expressed as relative growth rate ratio; RGRR) response to lime (as $Ca(OH)_2$) application was investigated for five macrophyte species (*Elodea canadensis*, *Myriophyllum spicatum*, *Potamogeton crispus*, *Stuckenia pectinata*, and *Vallisnaria americana*) using experimental mesocosms. Lime was applied to mesocosms containing replicate planted containers at different treatment levels to maintain pH for one week at ~ 9.8-10.0 (100-150 mg lime L^{-1}), 10.3-10.5 (at the bicarbonate-carbonate equivalence point; 200-250 mg lime L^{-1}), and 10.8-11.0 (300-325 mg lime L^{-1}). During the first week of treatment, bicarbonate (HCO_3^-) alkalinity and DIC declined by 58, 92, and 91% and 53, 86, and 84%, respectively, as a function of increasing lime application rate. Carbonate (CO_3^{-2}) alkalinity increased by 300% at the highest lime application rate. Although pH recovered to control levels in all lime-treated mesocoms ~ 20 days after lime application, DIC and HCO_3^- alkalinity remained substantially lower in lime-treated mesocosms versus the control throughout the post-treatment period. Differential macrophyte growth response was observed at the moderate and low lime application rates, suggesting differing species-specific tolerances to both total DIC concentration and the form of DIC that was available for uptake. *Potamogeton crispus* exhibited net shoot and root growth suppression, negative RGRR, and a significant decline in turion production relative to the control at the lowest lime application rate. *Myriophyllum spicatum* and *V. americana* growth suppression occurred at the moderate application rate while *S. pectinata* and *E. canadensis* exhibited some net shoot and root growth (although significantly lower than controls) at all but the highest lime application rate.

Progress Towards Biological Control of Common Salvinia in Louisiana

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Common salvinia, *Salvinia minima*, an aquatic free-floating fern, is considered one of the six most troublesome non-native aquatic species in Louisiana. It infests hundreds of thousands of still and slow moving water bodies in Louisiana. A population of the salvinia weevil, *Cyrtobagous salviniae*, has apparently kept common salvinia under biological control in Florida for over 40 years. This paper will present results of efforts to release and establish the Florida population of *C. salviniae* in south Louisiana over the last three years.

The Channelized Apple Snail, A Potential Biocontrol of Hydrilla or a Grass Carp Wearing a Helmet?

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The South American channelized apple snail (*Pomacea caniculata*) has become widely naturalized in Florida waters where it is believed to compete with the native apple snail (*P. pludosa*) which is the primary food source for the endangered Everglades kite. Few food preference studies have been conducted with the exotic apple snail despite it having become a serious pest in rice fields in Asia. We have compared consumption of several submersed aquatic plants by the exotic snail to that of the native snail and find that both are very general herbivores, but do have different food preferences. They both consume about 500 g fresh weight/kg/day, but while the exotic snails may eat more cabomba than the native snails, the native snails consume more *Nitella* than the exotic snails, thus providing evidence of different food preferences. These exotic snails are widely sold in the aquarium trade and populations have become very high in some Florida waters in recent years. While the environmental impacts of these snails is not well known, we suggest caution in allowing these exotic snails to become established in natural waterways in the warmer regions of the U.S.

Empirical Evidence of Eurasian Watermilfoil Supression via Ammonia-N Limitation Promoted by Sediment Oxidation through Long-Distance Circulation

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Eurasian watermilfoil (EWM, *Myriophyllum spicatum*) is a submerged aquatic macrophyte well-suited for invasion and rapid colonization in lakes. Eurasian watermilfoil can regenerate from small fragments, gaining a lightly-rooted foothold in lake sediments. Conventional experience with chemical herbicide applications has led to the belief that EWM growth in lakes is primarily limited by light availability. This conclusion comes from the typical scenario of killing harmful algal blooms (HABs) with algaecides, seeing water clarity improve as the dead HAB settles to the sediments, and then seeing EWM take off under favorable growth conditions. However, several independent investigations have shown that EWM gets its nitrogen (N) primarily as ammonia-N taken in through the roots. Furthermore, spatial distributions of EWM have been positively correlated to ammonia-N concentrations in the sediments, and reducing ammonia-N in the sediments can in turn reduce EWM growth. On the other hand, dead HABs decomposing on lake sediments can provide high inputs of ammonia-N available for EWM uptake, thus stimulating EWM growth. This paper presents empirical evidence independently collected from over 130 lakes since 2000, that long-distance, up-flow circulation used to prevent HABs through habitat disturbance can effectively oxidize littoral sediments. In nearly a dozen lakes where EWM was also a problem, lake owners reported significant reductions in EWM even as water clarity significantly improved following the elimination of HABs. The apparent oxidation of ammonia to nitrate is supported by the fact that remaining plants typically appear yellow and sickly, consistent with nitrogen deficiency. The amount of EWM reduction in a given year appears to be related to the intensity of circulation (i.e., sediment oxidation), and lake owners report further reductions with each subsequent year. Equally notable is that in the 130+ lakes where these circulators have been installed over the last six years, and where water clarity has consistently improved, no species of submerged aquatic macrophytes has ever invaded or colonized open areas of the lake. Although owners of lakes utilizing these circulators have reported similar reductions with other invasive species (e.g., various pondweed species, including curlyleaf pondweed (*Potamogeton crispus*)), reductions of more deeply-rooted, rhizome-growing native species have not been reported. This presentation will summarize independent observations made over the past six years, discuss current testing in about ten other lakes, and evaluate the working hypothesis that long-distance circulation can effectively oxidize littoral sediments to promote ammonia-N limitation of EWM growth.

Aquatic Plant Control: NPDES Permitting in Washington State

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Since 2002, Washington State has been issuing NPDES permit coverage for government entities and individuals wishing to control aquatic plants in lakes, streams, rivers, reservoirs, and irrigation ditches. Aquatic plant control has been placed into three different categories: nuisance weeds, noxious weeds, and weed control in irrigation systems. Washington is now beginning the process of updating these permits before they expire in 2007. A brand new lakes permit was issued on March 1, 2006. This new permit is issued under both state law and the Federal Clean Water Act. As Washington State rewrites these permits, they will continue to evaluate the changing views of EPA and the courts on the issue of NPDES permitting.

A New Aerial Imaging Technique for Aquatic Plant Surveys

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Eurasian watermilfoil is a rapidly expanding problem in Pacific Northwest waters. This weed poses a threat to water users and can cause significant degradation of the aquatic environment. Managers have come to realize that there is a significant geographic component to Eurasian watermilfoil control programs. A key first step is to identify the location and scope of infestations. Selection of management strategies can then be effectively selected and deployed in a systematic manner. Tools that help managers better understand the geographic nature of the infestation should be an integral part of any program. A new survey/reconnaissance technique has been developed by AquaTechnex biologists to rapidly and cost effectively survey large lake or river systems. This system includes the use of an aerial DGPS camera system that links the collected imagery to ArcView GIS at the location it was collected. Imagery analysis is then performed to locate known or suspected infestations. These can then be "ground truthed" to fine tune the maps. A case study on Pend Oreille Lake will be presented.

Knotweed Suppression with Herbicides

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Hybrid knotweed (*Fallopia* x *bohemica*) has invaded and become well established in many of the riparian zones in the Pacific Northwest. Traditional chemical control utilized broadcast applications of glyphosate or imazapyr. Summer applications however, are encumbered by the sheer size (4-6 m) and denseness of the canopy. To minimize concerns relating to canopy size, experiments on herbicide efficacy were conducted with dormant and early spring timing. Basal bud/soil application of triclopyr and aminopyralid in December or March markedly reduced stem density the following growing season. Efficacy varied depending on surfactant, spray volume, timing, and herbicide. December timing of triclopyr and aminopyralid were the most effective treatments at suppressing shoot emergence. Basal bud applications of triclopyr 2.7 kg ae ha^{-1} to 27 kg ae ha^{-1} and aminopyralid 0.12 kg ae ha^{-1} or 0.23 kg ae ha^{-1} in March appeared to be more effective than December. Dormant season applications of these herbicides may have promise as a control tool. May application of glyphosate 46.8 kg ae ha^{-1}, imazapyr 2.2 to 4.4 kg ae ha^{-1}, triclopyr 13.32 kg ae ha^{-1}, or imazapyr 2.2 kg ae ha^{-1} with glyphosate 18.5 kg ae ha^{-1} were all effective in providing 95 or 100% stem density reduction 1 year after treatment. Efficacy trials of imazamox 1.0 kg ae ha^{-1}, aminopyralid 0.35 kg ae ha^{-1}, imazapyr 0.53 kg ae ha^{-1}, glyphosate 46.8 kg ae ha^{-1}, triclopyr 13.32 kg ae ha^{-1}, and imazapyr 2.2 kg ae ha^{-1} with glyphosate 18.5 kg ae ha^{-1} were made in August. Comparable efficacy was achieved with all herbicides.

A Molecular Approach Using Microsatellite Markers to Better Understand Population Level Dynamics of Eurasian Watermilfoil and Invasive Hybrid Watermilfoil

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Eurasian watermilfoil was first recorded in North America almost 60 years ago. It has gradually increased its range from the eastern seaboard until now being officially reported in 48 states and 3 Canadian Provinces. The first hybrid populations between Eurasian watermilfoil and the native Northern watermilfoil were verified in 2002. While Eurasian watermilfoil has long been a priority for invasive aquatic plant managers, little is known about the population level dynamics of this species. While terrestial weed science has long been developing molecular tools to understand the specific invasive "biotypes" with variable physiological responses to the environment and herbicide resistance, studies utilizing these molecular tools among invasive aquatic plants is just beginning. I have developed a microsatellite library for Eurasian watermilfoil which provides high quantity and quality molecular markers to examine plant dispersal, breeding sytems, hybrid origins, and "biotype" diversity. Data describing the utility of the these markers in uncovering diversity within and among populations of Eurasian watermilfoil and invasive hybrids has been determined.

Flumioxazin: A New EUP for Aquatic Weed Control

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Hydrilla (*Hydrilla verticillata* (L.f.) Royle) is a submersed aquatic plant that was introduced into Florida in the 1950's and has become a serious weed problem in the United States. This weed is very problematic due to its ability to rapidly re-grow

from vegetative propagules, form dense mats at the surface, and is efficient at low light levels and grows rapidly in Florida's naturally shallow and nutrient rich waters. Due to a lack of aquatic herbicides that effectively control hydrilla, along with fluridone resistant biotypes of hydrilla emerging in the waterways of Florida, a recent search for new hydrilla herbicides has begun. In the past year, scientists have determined that flumioxazin effectively controls hydrilla at low use rates, is relatively non toxic, and has a short half-life in water. Preliminary greenhouse studies indicated hydrilla dry weight was reduced by 63% and 99% in statistical tests when treated with 50 and 400 µg/L a.i. (ppb), respectively. As a result, an experimental use permit (EUP) was applied for by Valent BioScience Corporation and was approved by the U.S. Environmental Protection Agency (USEPA) and the Florida Department of Agriculture and Consumer Services (FDACS) for large-scale testing of flumioxazin on hydrilla at a maximum use rate of 400 ppb. Flumioxazin degrades rapidly by hydrolysis at higher pH's, such that the half-life decreases from 4 days at pH 5.0 to 17 minutes at pH 9.0. Studies are being conducted to determine the influence of pH on the efficacy of this herbicide. In addition, greenhouse, field, and laboratory studies are currently being conducted to determine use rates, selectivity on native plants, phytotoxicity on non-target plants (turf, ornamental, and crop species), and dissipation in lakes. Flumioxazin will also be evaluated for control of other invasive plants such as water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), and duckweed (*Landoltia punctata*).

Aquatic Pesticide Regulation in California

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On March 12, 2001, the Ninth Circuit Court of Appeals held in Headwaters, Inc. v. Talent Irrigation District that discharges of aquatic pesticides to waters of the United States require coverage under an NPDES permit. The Talent decision was issued just prior to the pesticide application season. Because of the health, safety, and economic implications of delaying aquatic pesticide applications, the California State Water Board adopted an interim NPDES general permit on an emergency basis. The permit covered discharges related to both vector (pest) and weed control and granted an exception to the Board's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California. WaterKeepers challenged the permit claiming it was inadequate to protect water quality, but dismissed the suit as part of a $2.6 million settlement with the Board. The settlement included an aquatic pesticide monitoring program to assess receiving water toxicity and evaluate less toxic alternatives to aquatic pesticides use. The study and the resulting report was completed in 2005. The interim permit expired on January 31, 2004, and was replaced by two general permits: one for vector control and the other for weed control. The weed control permit was litigated but the lawsuit was dropped. In response to the Fairhurst v. Hagener (9th Cir. 2005) decision, the Board issued a memorandum stating that an NPDES permit is necessary if the application of the aquatic pesticide leaves a residue or has an unintended effect. In my presentation I will discuss the process of obtaining coverage under the weed control permit and its requirements. I will also address recent modifications to the permit.

Parasitism and Host-Selection Behavior of the Parasitic Wasp, *Trichopria columbiana*, and its Effect on Establishment and Population Dynamics of *Hydrellia* spp.

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While *Hydrellia pakistanae* and *H. balciunasi* have been used since 1987 as control agents for *Hydrilla verticillata* management, in many instances populations and associated damage have been low. Parasitism by *Trichopria columbiana* has been suggested as one possible factor which may hinder population growth. Parasitism impacts to emergence and population size were examined at the Lewisville Aquatic Ecosystem Research Facility (LAERF) during 1999 and 2001. *Hydrilla verticillata* stems were collected to determine numbers of *Hydrellia* spp. immatures and percent leaf damage. Concurrently, *Hydrellia* spp. pupae were collected and incubated individually to measure percent parasitism. Leaf damage approached 36% and *Hydrellia* spp. populations became established and increased to almost 6000 immatures/kg without supplementation despite parasitism levels of almost 30% during the later part of the growing season. Host selection behavior of *T. columbiana* was observed and four distinct behavioral categories were identified. These included grooming/resting, stem examination, searching, and ovipositioning. *Trichopria columbiana* spent the greatest percentage of time searching for prey, the least examining stems, and time spent ovipositing doubled in wasps prepared to oviposit. Oviposition choice experiments were performed to address ovipositing preference of *T. columbiana* to specific life stages and percent survivorship in each parasitized life stage. It was concluded that *T. columbiana* not only prefers the intermediate pupal stage for ovipositioning, but also has the highest percent survivorship in this stage.

The Impact of Invertebrate Herbivory on Native Aquatic Macrophyte Biomass

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A study was conducted in three 0.3 ha ponds in Lewisville, Texas, during the summer of 2005 to determine the impact invertebrate herbivores have on native macrophyte biomass. The ponds were divided lengthwise by a fence covered in pond liner, providing two treatment areas per pond; an insecticide treatment of Temephos (Abate) to remove invertebrate herbivores and a control. In May, *Vallisneria americana*, *Potamogeton nodosus*, *P. illinoensis*, and *Nymphaea mexicana*, were planted in cages. Dry biomass was compared between the herbivore and non-herbivore treatments at four harvests, beginning in June and ending in September. Plant tissue damage in the non-herbivore treatments was rare, while most plants included in the herbivore treatments exhibited significant levels of damage due to invertebrates, primarily insect feeding, ovipositioning, and case making. When herbivores were eliminated, mean biomass of *P. nodosus* exhibited a 1.6 to 1.9 fold increase at the third and final harvests and *P. illinoensis* exhibited a 3.6 fold increase at the final harvest. For both species, mean biomass displayed trends of a steady rise in plant biomass in both treatments until the second harvest when the non-herbivore treatments exhibited significant decreases. Although not significant, *N. mexicana* displayed a 16 to 35 percent reduction in biomass when herbivores were eliminated at the third and final harvest. This reduction may be due to the inability of Abate to control the longhorned leaf beetle, *Donacia* spp., which was readily observed in both treatment areas. In addition, significant differences were not attained for *V. americana* at any harvest. Previous studies suggest that *Chara vulgaris*, a submersed macroalga, may compete for nutrients and may limit light penetration. Consistent with those results, *V. americana* dry weights were significantly lower in samples at the final harvest that contained higher amounts of *C. vulgaris*.

Effect of Glyphosate Rate, Spray Volume, and Adjuvant Addition for Control of Giant Salvinia

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Glyphosate is an effective herbicide for controlling giant salvinia (*Salvinia molesta* D.S. Mitchell), however, few studies have examined the effect of rate, adjuvant addition, and spray volume on glyphosate performance. Multiple outdoor tank studies were conducted to compare glyphosate rate (0, 2.2, 4.5, 6.7, 8.9, and 17.9 kg ae ha^{-1}), adjuvant type (non-ionic, organosilicone, and combinations), and spray volume (935 and 1870 L water ha^{-1}). In all studies, glyphosate reduced giant salvinia biomass $\geq$ 95% compared to untreated plants by 28 to 42 days after treatment. All rates were equally effective. There were no statistical differences in treatment performance when glyphosate was applied in 935 versus 1879 L water ha^{-1}. Type of adjuvant addition also did not impact glyphosate performance in these studies. Results indicate that glyphosate is effective against giant salvinia over a wide range of application rates (2.2 to 17.9 kg ae ha^{-1}). Using lower chemical rates and carrier volume would be more economical, minimize chemical input into the environment, and may reduce impacts to nearby non-target vegetation.

Interactive Effects of Diquat and *Mycoleptodiscus terrestris* on Hydrilla

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The contact herbicide diquat, is effective for controlling hydrilla when combined with various copper compounds. However, when diquat is applied alone, inconsistencies in performance can occur; often as the result of insufficient herbicide contact time with the target plant. Growth chamber studies were conducted to evaluate the potential for combining diquat with *Mycoleptodiscus terrestris* (Mt), a native fungal pathogen currently under development as a mycoherbicide, as a strategy to reduce contact time requirements and improve hydrilla control. Treatments included 0.370 mg L^{-1} diquat at contact times of 2, 4, and 8 hrs; 0.185 mg L^{-1} diquat for 8 hrs; 0.014, 0.028, and 0.042 g L^{-1} Mt; all combinations of both agents at each rate and contact time; and an untreated control. Compared to untreated plants, a 2-hr exposure to 0.370 mg L^{-1} diquat combined with 0.042 g Mt L^{-1} reduced hydrilla by 99.6%, 6 weeks after treatment. A 2-hr contact with diquat and Mt applied alone at these rates only controlled plants by 70 and 41%, respectively. Similar synergistic interactions were noted with treatment combinations of 0.370 mg L^{-1} diquat with either 0.028 or 0.042 g Mt L^{-1} for a 4-hr contact time. An 8-hr exposure to 0.185 mg diquat L^{-1} applied with all rates of Mt was also effective, reducing hydrilla by 91%, whereas diquat alone at this

rate and exposure controlled only 52% hydrilla. The results demonstrated that combining diquat with Mt improved hydrilla control. Rate and contact time requirements were reduced when herbicide and pathogen were applied as an integrated treatment.

Herbicide Resistance Issues in Aquatic Plant Management: Investigating Variable Efficacy and the Potential Role of Resistance

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The confirmed resistance of hydrilla (*Hydrilla verticillata* L.f. Royle) to fluridone in numerous Florida lakes has stimulated a great deal of technical, management, and anecdotal discussion in the aquatic plant management community. The approval of 3 Experimental Use Permits by the USEPA for acetolactate synthase (ALS) inhibitors will keep scientists and managers focused on this issue due to the proven ability of hydrilla to develop resistance to an enzyme inhibitor via somatic mutation. Moreover, numerous terrestrial plant species (including wetland species in rice) have shown an affinity for developing resistance to the ALS mode of action. While resistance issues in aquatics are real and deserve serious attention, there is also a danger of attributing operational failures to resistance in lieu of focusing on other variables that impact treatment efficacy. This presentation summarizes results of four research projects initiated to determine if resistance or tolerance can explain field results. The projects include: 1) a screening program to determine the efficacy of three herbicides on hybrid milfoil and the parental species (*Myriophyllum spicatum* and *M. sibiricum*); 2) impact of diquat and carfentrazone on *M. heterophyllum* and *M. spicatum*; 3) response of hydrilla populations that had various treatment histories with the contact herbicide endothall; and 4) the concentration and exposure time relationships necessary for three ALS inhibitors to provide control of hydrilla.

Effects of Seasonality and Light Intensity on Fragment Viability and Establishment of *Hydrilla verticillata* (L.f.) Royle

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Hydrilla fragments (apical and subapical) for two sampling periods (July, October) had significantly greater settling, root production, and anchoring rates (2 to 3-fold) under low light conditions versus full sunlight. No differences were observed between apical and subapical fragments within the same treatment. For July, under low light conditions, between 70 to 80% of all hydrilla fragments settled within thirty days and of these settled fragments, approximately half developed roots and anchored in the substrate. In comparison, under full light, between 30 to 45% of the hydrilla fragments settled, with less than 10% producing roots and anchoring. New growth was produced between 80 and 99% of all fragments for the July treatment and ranged in length from 13 to 49 cm with 100% survival. For October, however approximately 40% of the fragments grown under low light settled, rooted, and anchored compared to less than 20% of fragments grown under full light. Of the fragments that did settle, most produced roots, anchored, and produced new growth. Survival rates for fragments used in the October study ranged from 27 to 68%. New growth however ranged from 1.5 to 12 cm in length. More fragments settled under low light than full light suggesting that gas exchange due to photosynthesis could help with fragment buoyancy. Hydrilla fragments are produced solely by environmental factors, however fragments are viable long distance dispersal and reproductive propagules.

Viability of Hydrilla Fragments Exposed to Different Levels of Insect Herbivory

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Previous research has shown that sustained levels of insect herbivory by the hydrilla leaf-mining flies (*Hydrellia pakistanae* Deonier and *H. balciunasi* Bock) can reduce hydrilla biomass by 30%, reduce tuber/turion production, and impact the ability of hydrilla to photosynthesize. Furthermore, based upon observations of field damaged hydrilla stems, fragmentation also appears to be higher in hydrilla stems heavily damaged by fly mining. This study evaluated hydrilla fragment establishment following leaf mining that resulted in low (0-30%), medium (40-60%) and high (70-100%) leaf damage. Thirty fragments

per treatment (low, medium, high) were allowed 4 weeks of growth, then were harvested and dried. Results indicate that fragments with high levels of leaf damage produced nearly 3 times less aboveground and belowground biomass when compared to hydrilla fragments with low leaf damage.

The Impact of Diquat on Macrophytes and Water Quality in Battle Ground Lake, Washington

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A nearly monotypic population of egeria (*Egeria densa* Planch.) was interfering with recreation in a popular state park in southwest Washington State. In June 2003 the littoral zone was treated with the contact herbicide diquat (6,7-dihydro-dipyrido [1,2-α:2',1'-*c*]pyrazinediium dibromide). Aquatic plant frequency and biomass data were collected on all submersed species before treatment, and eight weeks, one year, and two years after treatment. Water quality and herbicide dissipation data were also collected before and one season after treatment. Results from the aquatic plant data showed a significant reduction in egeria frequency and biomass after the herbicide treatment, although the species did not disappear entirely. Two native submersed plants, water moss (*Fontinalis antipyretica* L.) and stonewort (*Nitella* sp. Agardh.) increased significantly after treatment. However their increase was not enough to offset the egeria die-off as total plant abundance was significantly reduced after treatment. The herbicide dissipation data showed that diquat spread throughout the lake and persisted at low levels in the water column for at least two weeks after treatment. Water quality data demonstrated a slight decrease in dissolved oxygen and water transparency following the herbicide treatment, potentially due to plant die-off and subsequent decomposition of plant material.

Spartina Control in Willapa Bay, Washington – A Success Story

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Outside its native range, spartina is an aquatic noxious weed in estuaries throughout the world. Over the past 100 years it has spread over 10,000 ha of tidal mudflats in Willapa Bay, Washington. Impacts have included a dramatic decline in shorebird and waterfowl usage, marked losses of habitat and shellfish bed productivity, and major changes in mudflat bathymetry. Delays in initial control efforts due to regulatory constraints and lack of effective chemical or mechanical control tools resulted in exponential expansion between 1990 and 2003, despite expenditures in the millions of dollars. Research to develop effective management tools resulted in the registration and use of imazapyr (1.68 kg ai/ha) in 2004 to 2006. Initial research and recent extensive use by federal and state natural resources agencies have shown imazapyr to be effective across a wide range of dry times (4 to >12 hr), timings (May to October), spray volumes (3 to 200 gpa), water qualities, and application delivery methods (aerial, broadcast, backpack). Applicators most commonly include the addition of glyphosate (3-5% v/v) in the tank mix to aid in detection of missed plants two weeks after treatment. Risk assessments for the estuarine use of imazapyr indicate minimal impact and short half-life. Two million dollars per year is being spent on the control effort and all infested areas in Willapa Bay are projected to be treated by fall 2006. Because of the lack of new infestations, short-lived seeds, and low fecundity, eradication appears realistic within a decade. Restoration of spartina-affected tideland post-control, however will remain problematic. Although shorebird usage of affected sites has increased markedly post-control, spartina-induced rises in mudflat elevation is resulting in native marsh succession into what was premium shorebird habitat.

Photosynthetic Responses of *Egeria densa* to Light and Temperature

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Photosynthetic responses of *Egeria densa* Planch. (Hydrocharitaceae) to various light and temperature regimes were examined under field and greenhouse conditions. Stem tips were incubated in 300-ml biological oxygen demand (BOD) bottles covered with neutral density shade filters. Inorganic carbon assimilation (µmol/g DW/h) and oxygen release rates (µmol O_2/g DW/h) were measured along with plant nitrogen concentration. Field experiments were conducted monthly for 18 months in the Sacramento-San Joaquin Delta where the temperature ranged from 8 to 25ºC. In the greenhouse, plants were similarly evaluated at 10, 20, and 30ºC in a 0.85 meq/L incubation media under 588 µE/m^2/sec of light provided by power compact fluorescent bulbs. Photosynthesis versus irradiance (P v I) curves were modelled using field and greenhouse data according to the Michaelis-Mention equation (a rectangular hyperbola). The maximum photosynthetic response rate (Pmax) of *E. densa* increased linearly with temperature ($y = 7.8266x + 33.573$, $F17=12.57$, $P=0.003$, $r^2=0.46$). Under field

conditions Pmax was 329 µmol O_2/g DW/h in July (25ºC) and the half-saturation constant ranged from 25 to 213 µE m^2/sec (average 142 µE m^2/sec). Under greenhouse conditions, Pmax was 290 µmol O_2/g DW/h at 30ºC and the half-saturation constant ranged from 82 to 272 µE m^2/sec (average 155 µE m^2/sec). Nitrogen concentration of stems from both experiments was negatively correlated with surface irradiance (r^2=-0.7, P<0.001); however, nitrogen concentration was never below the critical level determined for other submersed macrophytes. Results from this study are compared to similar research on *E. densa* and other invasive macrophytes.

Molecular Characterization and Genetic Variability of Fluridone Resistant Hydrilla Biotypes

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Hydrilla (*Hydrilla verticillata*) is one of the most serious aquatic weed problems in the United States. Fluridone is the only USEPA approved herbicide that provides persistent control of hydrilla in large lakes. Fluridone disrupts the carotenoid biosynthetic pathway in plants by non-competitive inhibition of the enzyme phytoene desaturase (PDS). During the last 4 to 5 years, there has been a decrease in fluridone efficacy for hydrilla in many Florida lakes. This lead to the discovery of fluridone resistant hydrilla biotypes, with two to seven-folds resistance. To characterize resistance at a molecular level, hydrilla biotypes were collected from different Florida lakes with known fluridone application history. Alleles for the pds gene were amplified via PCR using Platinum Taq Polymerase High Fidelity and the primers PDS-start (5'ATGACTGTTGCTAGGTCGGTCGTT3') and AtPDS-1849 (5' TACCCTT TGC TTGCTGATG 3′) on cDNA from fluridone susceptible and resistant hydrilla plants. A PCR amplified pds gene from different biotypes was cloned into pCR4-TOPO vector, verified for presence of pds allele, and sent for sequencing. Two independent somatic mutations at the arginine 304 codon of pds were found in the resistant hydrilla plants. The codon usage for arginine 304 is CGT and a single point mutation yielding either serine (AGT) or histidine (CAT) was identified in different resistant hydrilla biotypes. Several other mutations were also found in resistant pds alleles, though their possible role in herbicide resistance is unclear. To correlate varying levels of fluridone resistance to ploidy in hydrilla, flow cytometric analysis was performed. Differential ploidy levels (diploid 2n= 2x= 16; triploid 2n= 3x= 24; and tetraploid 2n= 4x= 32), along with endoreduplication patterns were observed among different hydrilla biotypes, and plants within each biotype. The differences in ploidy are thought to be correlated to the varying resistance levels due to multiple pds alleles in hydrilla.

Spatial Distribution of Egeria (*Egeria densa*) in the Sacramento-San Joaquin Delta Region

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Submersed invasive species assemblages within aquatic ecosystems pose a significant threat to ecosystem functioning and biodiversity. Therefore detection and control of submersed invasive species is a pressing need in aquatic ecosystem management. Remote sensing is an important and valuable tool for mapping and monitoring aquatic vegetation. Hyperspectral images acquired using the HyMap sensor at 3 m spatial resolution and 0.4 to 2.5 µm spectral resolution were used to identify locations of egeria (*Egeria densa*) infestation in the Sacramento-San Joaquin Delta region in California's Central Valley. Sixty four flight-lines acquired over the study site were classified using a decision tree which incorporates linear spectral mixture analysis (SMA) and spectral angle mapper (SAM) algorithms and absorption feature parameters of target species spectrum. Egeria was successfully classified using the proposed method with 0.76 Kappa statistic (κ value). Normalized difference vegetation index (NDVI) was calculated for classified egeria class to map bio-volume of egeria species. It was found that egeria invades areas with low light availability, but is found at highest density in areas of high secchi depth (clearer water).

Evaluation of Penoxsulam on Water Hyacinth and Giant Salvinia

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Greenhouse trials were conducted to evaluate water hyacinth and giant salvinia control with penoxsulam applied in-water or as a foliar application. With in-water treatments, control of both weeds was 41 to 95% across treatments. Dry weight, root length, and plant number with penoxsulam treatments were reduced from that of the untreated control with three of the four rates evaluated. Giant salvinia dry weight was reduced with all penoxsulam in-water rates to no more than 44% of untreated weights. Results from foliar applications and penoxsulam rates will be presented.

Using Landsat TM Imagery to Monitor Spatial Changes of Waterhyacinth after Broadcast Herbicide Application

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Waterhyacinth is an invasive aquatic species that chokes water bodies and affects ecological interactions. Chemical control has been the most commonly used tool in successful management of this plant. However, the evaluation of herbicide efficacy has always required ground-truth data to confirm if areas covered by waterhyacinth have been controlled after herbicide application. In order to measure spatial changes of waterhyacinth, two satellite images from Landsat 5 TM (900 m^2 pixels) were acquired before and after herbicide application over Lake Columbus, MS, in 2005. The herbicide used was 2,4-D amine applied by helicopter at a rate of 1 gallon/acre. Sprayed areas were digitized from an aerial image taken previously and used as ground-truth data. An unsupervised classification of each satellite image was performed in ERDAS – Imagine software to separate vegetated areas from non-vegetated areas. The remaining analytical procedures were performed in ArcMap-ArcGIS software with Spatial Analyst. The evaluation of waterhyacinth coverage was performed pixel by pixel using a Boolean operator. Sprayed areas (waterhyacinth coverage) were converted in pixels of 900 m^2 and reclassified into 0 = non-sprayed and 1 = sprayed in order to evaluate them against non-vegetated areas = 0 and vegetated areas = 1 from the pre-herbicide application classified satellite image. The analysis of each output consisted in total pixel counts per class multiplied by 900 m^2 and dividing it by 4,046 to get acreage cover. The total acreage of pre-herbicide application coverage (PreHAC) for the waterhyacinth coverage class was 88 acres. A total reduction of 31 acres was detected on post-herbicide application coverage (PostHAC). As a result, a 35% of waterhyacinth cover was diminished by a broadcast application of 2,4-D. These results suggest that the use of Landsat imagery to evaluate the efficacy of large-scale herbicide applications and track aquatic plants spatial changes is feasible.

Do Algae Spill Their Guts after Treatment with Algaecides?: A Test of the Leaky Cell Hypothesis

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Microcystis aeruginosa, a planktonic cyanobacterium, produces microcystin which is a potent toxin affecting mammals and fish at relatively low concentrations (≥1µg/L). In order to mitigate risks from this harmful alga in water resources, copper-containing algaecides and other materials are applied as treatments in critical situations such as potable water supplies, recreational areas, and livestock watering. These treatments reportedly cause the treated *Microcystis* to "leak" toxin to the surrounding water resulting in a local increase in microcystin concentration. We investigated the "leaky cell" hypothesis under controlled conditions in the laboratory. Water from Pawnee Reservoir (Lancaster County, Nebraska) containing a "bloom" of *Microcystis* was exposed to a series of concentrations (0.1 – 1.0 mg/L) of Cutrine Ultra, Clearigate and Algimycin PWF, and copper sulfate. Concentrations of microcystin in post-treatment samples were compared with concentrations in pre-treatment samples and untreated controls. No statistically significant increase in toxin production was observed in post-treatment samples after a 96-h exposure period. Observation of toxin release which is widely cited in instances where algaecides are considered as temporary solutions for mitigating risks of toxin production may be limited to situations where excessive applications of algaecides are used or unusual strains of *Microcystis* are present. In this case, growth of *Microcystis* in Pawnee Reservoir water was controlled with an application of 200 µg Cu/L as Cutrine-Ultra.

Three-Year Summary of Results from Monitoring Brazilian Waterweed Treatment Efficacy in the Sacramento-San Joaquin Delta, California

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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 (Delta) is key to realizing the best methodology to use in regulating and/or eradicating invasive growth. The tidal flux and significant turbidity of Delta waters has historically rendered empirical measurements of egeria coverage and biovolume unreliable. Hydroacoustic plant mapping technology, applied in Delta 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 underwater photographic surveillance and traditional physical point sampling techniques provides the most complete picture to date of submerged vegetation conditions in the Delta. Eighteen sites in the central Delta 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 was determined by comparing the aggregation of acoustic-based plant-coverage and biovolume models, photographs, and physical data at each treated site with control sites. The 2003-2005 monitoring results will be reviewed and compared.

Affect of Hurricanes Katrina and Rita on the Increase and Reduction of Invasive Aquatic Weeds

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Rescue and recovery efforts following Hurricanes Katrina and Rita have potentially increased the spread of invasive aquatic weeds from the affected areas of Louisiana, Mississippi, and Texas to other parts of the country while markedly reducing the infestation levels of certain troublesome weeds in Louisiana and Mississippi. Approximately fifty thousand vehicles from outside the storm damaged area participated in rescue and recovery efforts following the storms. Many of these vehicles operated almost entirely within the flooded coastal zone inhabited by many of our most troublesome invasive aquatic weeds. Surveys of vehicles returning to staging areas indicate that most were not decontaminated prior to leaving the area and potentially transported weed seed to their home bases. Concurrently, high salinity flood waters appear to have eliminated or greatly reduced existing populations of giant salvinia, *Salvinia molesta*, and Peruvian watergrass, *Luziola peruviana*.

Aquatic Weed Problems in Arkansas: The View from the Specialist's Office

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Like many southern states, Arkansas has the combination of ample sunshine, warm temperatures, and water that can lead to growth of aquatic vegetation. Add to this over 60,000 acres of aquaculture ponds, thousands of private ponds, and many ditches used to drain water from agricultural and residential land, and the potential for problems are numerous. Problem weeds range from filamentous algae to pondweeds to water meal to populations of water hyacinth that now survive year round. With increasing numbers of calls from pond owners and county agents, the UAPB Aquaculture and Fisheries Center is making efforts to hold training classes for cooperative extension and Arkansas Game and Fish Commission personnel. We are also conducting demonstrations and research, while educating pond owners on management strategies for problem weeds. This is one agent's perspective on the issues and future direction of aquatic weed control in Arkansas

Monitoring the Efficacy of Aquatic Herbicides on Brazilian Waterweed in the Sacramento-San Joaquin Delta: An Example from Frank's Tract

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Control of Brazilian waterweed (*Egeria densa*) in the complex waterways of the Sacramento-San Joaquin Delta (SSJD) presents many challenges. A tidal flux of 2-4 feet per day, varying and often strong current patterns, sediment composition, changing water temperature and turbidity, and a host of other factors can all influence the efficacy of aquatic herbicide treatment regimes. Treatment timing is yet another key factor that influences the success of Brazilian waterweed control. Monitoring studies of priority Brazilian waterweed control sites in the SSJD since 2003 have contributed to an increased understanding of how these factors affect the desired results. This poster highlights results from Frank's Tract Site 173, a 160-acre treatment site within the central SSJD. Maps and statistics illustrate the pre- and post-treatment cover and volume of vegetation at high-tide during 2005. Also shown are data depicting meticulous species composition and health measurements at dozens of sample locations within the site. The 2005 results from Frank's Tract 173 are set within the larger context of the poster, whereby the methodologies and goals of the overall Brazilian waterweed management program are described.

Pathogen Biocontrol Research on the Submersed Macrophytes, Hydrilla and Eurasian Watermilfoil

Judy F. Shearer
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Pathogen biocontrol research at the Engineer Research and Development Center has two primary focus areas 1) development of mycoherbicides for hydrilla and Eurasian watermilfoil management and 2) affect of endophytic fungi on the growth and survival of Eurasian watermilfoil. Mass production of the biocontrol pathogen, *Mycoleptodiscus terrestris*, has largely been automated with the exception of the drying process. Once a drying device is installed, temperature and humidity can be controlled providing consistency in granule drying time. Slow drying of the granules appears to improve product performance. Recent research has shown that the dry granules remain viable and efficacious after 6 months in storage. Dry granules begin to germinate within 8 hours on water agar plates and by 14 hours germination nears 100%. Inoculated onto hydrilla sprigs, severe disease symptoms were observed within two weeks post inoculation. Disease ratings were between 3 and 4 on a scale from 0-4 where a 4 rating equals plant death. Endophytic research has focused on the relationship between plant stress, endophytes, and disease. Stressed Eurasian watermilfoil plants appear more susceptible to disease induced by specific endophytes in their tissues than either non stressed plants or plants that are endophyte free. After 4 weeks growth, shoot biomass of endophyte infected plants grown in used sediments was approximately 2 fold less than endophyte infected or endophyte free plants grown in fertilized sediments and approximately 1.7 fold less than endophyte free plants grown in used sediments.

Aquatic Plant Community Evaluations Following Three Years of Management Using Triclopyr (Renovate Aquatic Herbicide®)

Scott Shuler
SePRO Corporation, Folsom, CA

Renovate is a selective broadleaf herbicide that can be used to systemically control a variety of nuisance and exotic aquatic plant species. In addition to controlling unwanted exotics, Renovate allows many native monocots and less susceptible dicots to thrive following treatment. Therefore, this product can be used as an ecosystem restoration tool in lakes, ponds, reservoirs, and wetlands. Field development work conducted by the Army Corps of Engineers in the 1990's, SePRO's Experimental Use Permit evaluations from 1997 to 2000, and aquatic applicator evaluations during the 2003 -2005 management seasons have documented control of many nuisance and exotic broadleaf species while having minimal impact on many desirable monocots. This unique selective herbicide activity continues to be developed on a variety of emergent, floating, and submersed aquatic weed species. A review of this new herbicide technology will be provided with results and discussion of the data from recent trials and field development work.

Comparative Growth of Giant Reed from Florida, Texas, and California

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Giant reed (*Arundo donax*) occurs throughout the southern half of the U.S. from California to Maryland. It is considered an invasive plant in some parts of this range but not others. In order to test the hypothesis that plants from these different regions represented different ecotypes, we grew plants from stem cuttings collected at two sites in Florida, one site in Texas, and two sites in California in a "common garden experiment" in Davis, California. Plants were grown outdoors in top soil or a 50:50 mix of topsoil and sand, in large plastic containers beginning in summer 2004. All plants survived winter conditions during 2004. Plant characteristics were measured at bi-weekly intervals (February–September, 2005) and dry weight was determined after harvest (September, 2005). The number of stems produced per plant was not affected by substrate or plant origin, but did change over time. In contrast, stem height was influenced by time, substrate type, and plant origin. Dry weight differed depending on plant origin and substrate type. However, when data from a variegated form were excluded there were no differences in total biomass due to these treatments. Results, from this single experiment, indicate that plants from disparate geographic locations grew equally well under similar conditions.

Evidence for Phosphorus Limited Growth of Eurasian Watermilfoil in the Truckee River (California)

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Understanding the roles that nutrients play in regulating the growth and distribution of rooted aquatic macrophytes would aid in predicting which aquatic systems may be susceptible to invasion by weedy species such as Eurasian watermilfoil (*Myriophyllum spicatum* L). There is considerable evidence that sediment-available nitrogen limits the growth of rooted aquatic macrophytes. As part of a multi-year examination of Eurasian watermilfoil growth in the Truckee River, in the Sierra Nevada mountain range, we measured tissue levels of nitrogen and phosphorus in Eurasian watermilfoil stems, the availability of nutrients in sediments, and performed a nutrient enrichment experiment with Truckee River sediments. The results of these studies indicate that, phosphorus may limit the growth of this rooted aquatic macrophyte. These results have implications for the spread of this invasive species in other alpine systems.

Ecological Effects Assessments - Extrapolation Uncertainties

Thomas Steeger
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

In a screening-level ecological risk assessment, the U.S. Environmental Protection Agency (USEPA) uses a deterministic approach or quotient method to compare toxicity to environmental exposure. Pesticide ecological effects assessments, as a component of ecological risk assessments, are conducted by the USEPA based on guideline toxicity data from a limited number of test species that serve as surrogates for broad taxa. Test species do not always represent the most sensitive species and may be selected based on other factors such as the animal's ability to thrive under laboratory conditions. For this reason, extrapolation of laboratory test results from a limited number of test species is a source of considerable uncertainty for estimating effects of pesticides on non-target organisms. This talk will discuss the assumptions and limitations of relying on limited data to estimate potential ecological risks at a national level.

Registration of Pesticides in Water

Donald R. Stubbs
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All pesticides must be registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) prior to use. If the use will result in residues of the pesticide in food or feed, a tolerance must be established under the Federal Food Drug and Cosmetic Act. The U.S. Environmental Protection Agency (USEPA) is responsible for the registration of pesticides in the United States and establishing tolerances for residues of pesticides. Pesticides must be used in accordance with their labeling. The USEPA reviews an extensive data base dealing with acute, subchronic, chronic, oncogenicity, developmental and reproductive animal toxicity, ecotoxicity, and fate of the chemical in the environment. These data are used to select endpoints of concern and carry out risk assessments to man and the environment. Risk assessments are used to develop label mitigation as well as use limitations (restrictions) that are required on labeling. Aquatic pesticides represent a unique challenge in registration because the chemical is applied directly to drinking water, and residues of the pesticide can end up in fish and shellfish as well as in irrigation waters.

Activity of Microorganisms Isolated from *Limnobium laevigatum* on Benzene

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[1]*Pontificia Universidad Javeriana, Bucaramanga, Santander, Colombia*
[2]*Pontificia Universidad Javeriana, Bogota, Colombia*

Synergistic relations among an aquatic macrophyte *Limnobium laevigatum* and rizosphere microorganims were used to evaluate the degradation capacity of the organims on benzene. Fifty one bacterial strains were isolated; twenty one of which were identified. The capacity of degradation was evaluated *in vitro* for 49 strains, showing reduction of the aromatic compound. The synergistic action on the benzene molecule by the plant-microorganims association in the 4^{th} and 8^{th} hour period was the most productive lapse to degrade benzene dispersed in water (significance level of 0.05). This effectiveness was higher than those obtained by any of the separated two factors.

Aquatic Macrophytes in the Cacota Lagoon

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Universidad de Pamplona, Pamplona, Norte de Santander, Colombia

The Cacota Lagoon is located 3200 meters above sea level within the province of Pamplona in the state of Norte de Santander (Colombia, South America). A substantial reduction of the entire ecological system of the lagoon is taking place due to a combination of geological, environmental, and anthropogenic factors. A preliminary study showed the site to have a high percentage of endemic species. The following plants were found to be present in the lagoon edge vegetation *Typha*, *Ranunculus*, *Rhynchospora* and *Sphagnum*. With regards to algae, several phytoplactonic species were identified belonging to these predominant groups: Bacillariophyceae; Chlorophyceae; and Euglenophyceae. The investigation methodology consists of using samples of the lagoon water and testing for pH, conductivity, temperature, solids, and oligoelements. A multivariate analysis will also be carried out to determine the relationship between physicochemical and biological factors. The project will formulate conservation strategies to preserve the limnetic ecosystem that can be used as a model for further study in the region.

Developing a Detailed View of Milfoil Growth and Nutrient Acquisition

Mark Swinton and Charles Boylen
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The invasion of Eurasian watermilfoil into North American lakes has been rapid allowing little opportunity for detailed studies of the structural and nutrient alterations that are responsible for the trophic changes associated with such invasions. In 2003, four well-developed milfoil beds in Lake George were selected for study: two small and secluded, and two larger and open. For each site, submerged aquatic vegetation (SAV) biomass, height, and density of the milfoil beds, transition zones, and native communities were analyzed. Within the beds, milfoil dominance was near 100% while the natives consisted of 5 to 6 species. Plant height and density were 3 and 4 times that of the native communities, respectively. While these were measured with traditional methods, we are now developing a detailed view of the bathymetry, plant growth, and sediment composition that has not been possible in the past by employing the use of BioSonics' splitbeam sonar transducer and a DT-X surface integrator. A consistent sampling protocol of the milfoil beds and native areas will show growth differences between the non-native, invasive milfoil and the natural plant communities. While water nutrients have not shown a persistent trend, porewater and sediment nutrients have upon preliminary analysis shown that milfoil pulls nutrients, measured as ammonium, nitrate, and orthophosphate from the sediment below 4 cm while the natives obtain their nutrients from the top 4 cm. Also, the percentage carbon, nitrogen, and organics were all higher in the sediments of milfoil beds and were consistent throughout the 8-cm section analyzed; the percentage carbon, nitrogen, and organics in the native sediment varied throughout. The percent water of both milfoil sediment and native sediment decreased with depth, but the milfoil sediment ranged from 69-75%, and the native ranged from 62-68%. Upon the start of the 2006 sampling, additional samples will be taken to determine the validity of these initial tests.

Rapid Response for Spartina Management in Oregon

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Spartina species pose a significant ecological and economic threat to Oregon estuaries and early detection and rapid response are critical for preventing *Spartina* establishment and spread. The Oregon Spartina Response Plan was developed in 2003 to eradicate and control the spread of *S. patens* and to prevent the establishment of *S. alterniflora*, *S. anglica*, and *S. densiflora* in Oregon. The Plan includes public education and outreach, detection surveys, rapid response protocol, and research components. Boat and aerial surveys of Oregon estuaries are conducted annually. In 2005, a small stand of *S. alterniflora* was detected in Coos Bay and a single plant was found in the Siuslaw Estuary. Both infestations were eradicated by hand digging. In addition, with the cooperation of The Nature Conservancy, the established population of *S. patens* in Oregon was completely covered with landscape fabric, with the goal of eradication. Research conducted in support of the Plan has focused on dispersal of *Spartina*. Understanding dispersal is critical for management in Oregon because large, established populations of *S. alterniflora* and *S. densiflora* are present nearby in Washington and California. Additional surveys, follow-up on the Coos Bay and Siuslaw populations removed in 2005, and adaptation of the Plan to incorporate research and management findings since 2003 are planned for 2006. The success of the Oregon Spartina Response Plan illustrates the utility of an organized approach for addressing invasions of plant species that are known threats.

Habitat Alteration by Hydrilla and its Impact on Fish Foraging and Macroinvertebrate Colonization

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Aquatic plants mediate ecological processes in aquatic habitats, specifically predator-prey (bluegill (*Lepomis macrochirus*)-macroinvertebrate) interactions. Macroinvertebrate colonization is directly and indirectly influenced by substrate heterogeneity, interstitial space, and surface complexity. Feeding and individual growth rates of many fish species are positively related to the abundance of macroinvertebrates. Exotic invasive plant species can alter the available structure in aquatic habitats thus affecting foraging fishes and the macroinvertebrate community. Since macroinvertebrates provide a food base for young phytophilic fishes, changes in their density and abundance may alter food webs. We investigate the hypothesis that a shift from a heterogeneous native aquatic plant bed to a homogenous invasive plant bed would directly alter bluegill foraging and indirectly invertebrate colonization by conducting a multi-scale experiment (ponds and aquaria). Experimental treatments include: (i) intermediate densities of native-mixed plants; (ii) 50% native, 50% hydrilla; (iii) hydrilla; (iv) high density of hydrilla; and (v) no plants. We observed treatment effects on macroinvertebrate colonization and bluegill foraging. Aquatic plants, regardless of species, supported a 2.3-fold increase in taxonomic richness compared to the no plant treatment. Macroinvertebrate abundance was two times greater in hydrilla dominated ponds than native plant ponds. Bluegill recognized 75% more food items in native mixed habitat versus a hydrilla dominated habitat. We suggest that when plant density and complexity rise above a moderate level due to a habitat shift to a homogeneous invasive plant bed, prey abundance increases, but predator recognition of available prey items decrease.

Assessing Exposure to Aquatic Plant Pesticides

Nelson Thurman
U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington, DC

In evaluating the potential exposure of plants, animals, and water resources to pesticide residues in the environment, the U.S. Environmental Protection Agency scientists review a wide range of laboratory and field studies that measure how the pesticide interacts with soils, air, surface water, and ground water. The data generated by these studies are developed according to established Guidelines and Good Laboratory Practices (GLP) and are used in peer-reviewed models to estimate exposure to aquatic organisms such as plants, fish, aquatic-phase amphibians, and invertebrates. Available reliable monitoring data are also used to assess pesticide impacts on water quality. This talk will discuss a conceptual model for evaluating aquatic exposure resulting from aquatic plant pesticides as well as data and tools for generating aquatic exposure estimates in national-level ecological risk assessments.

Analysis of Hyperspectral Field-Level Data for Identifying Invasive Aquatic Plant Species

Nathan Torbick[1], Jiaguo Qi[1], Brian Becker[2], and David Lusch[1]
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[2]*Central Michigan University, Mount Pleasant, MI*

Multispectral remote sensing is a useful tool in monitoring and mapping wetlands and stressors; however, the information provided is limited in achievable detail by sensor resolutions. In aquatic ecosystems, bioindicators such as condition of macrophtyes and presence of invasive species can provide more meaningful information regarding ecosystem integrity and health conditions. Hyperspectral remote sensing technologies that capture narrow spectral and spatial resolution data can advance assessment techniques for addressing complex aquatic health questions. The objectives in this study were to identify optimal spectral wavelengths for discriminating the dominant fresh-water wetland plant species, quantify reflectance variability, and identify species of interest using a characteristic spectral shape filter. Results show variation in the red-edge and shortwave portions of the spectrum were the most useful in identifying purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), cattail (*Typha latifolia*), and arrowhead (*Sagittaria latifolia*).

What is Idaho Doing About Eurasian Watermilfoil?

Matthew K. Voile
Idaho State Department of Agriculture, Boise, ID

PowerPoint presentation:
* Eurasian watermilfoil projects in Idaho
* Work done by statewide Eurasian Watermilfoil Task Force/Idaho Invasive Species Council
* Problems with Eurasian watermilfoil, various approaches and control techniques

* What Idaho is doing to combat this aquatic noxious weed
* Overview of new grant program ($4 million approved by Idaho Legislature in 2006) and total projects underway for 2006
* Cooperative efforts among state and federal agencies to address water permits, juridictional boundaries, tribal involvement, and other issues
* Effectiveness of educational and public awareness media spots

Review of Clearcast™ (Imazamox) Aquatic EUP and Research Results for the Western U.S.

Joseph G. Vollmer[1] and Kim D. Patten[2]
[1]*BASF Corporation, Laramie, WY*
[2]*Washington State University, Long Beach, WA*

The U.S. Environmental Protection Agency granted imazamox an Experimental Use Permit in spring of 2005 for several states including the western states of Oregon, Washington, and Texas. Field trial results indicate that Clearcast (registered trademark of BASF Corporation) has activity on submersed, floating, and emergent vegetation. Selectivity to avoid injury to desirable vegetation was found through application technique (foliar spray compared to sub-surface injection) and the Clearcast rate. Hydrilla, coontail, pondweeds, and milfoils elicited effects dependant on ppb of Clearcast used. Foliar applications to *Marsilea*, primrose, water hyacinth, parrotfeather milfoil, pennywort, cattail, water lily, and phragmites showed selective efficacy when treating the emerged foliage. Foliar treatment on parrotfeather milfoil efficacy was directly related to the amount of exposed canopy. Parrotfeather with the bulk of canopy exposed above water responded more favorable to foliar treatments than with only 10 to 20 cm of canopy exposure above the water. Mexican water lily was susceptible when treated foliarly, whereas in contrast, subsurface injection treatments showed selectivity by rate. Lilies were tolerant to 50 ppb of Clearcast and controlled with 100 ppb concentrations. Clearcast had little to no effect on non-target vegetation such as warm and cool season shoreline grasses and willow.

Management of Curlyleaf Pondweed for Ecological Benefits in Minnesota

Charles Welling
Minnesota Department of Natural Resources, Saint Paul, MN

Curlyleaf pondweed, *Potamogeton crispus*, is an invasive, non-native aquatic plant, which was first reported in Minnesota in about 1910. At present, it is known to occur in 729 lakes in 67 of the 87 counties in Minnesota. Curlyleaf pondweed grows like a winter annual. The plant produces summer-dormant apices, which are commonly called turions. Turions sprout in fall to produce plants, which over-winter under ice. In spring, curlyleaf pondweed can produce extensive mats at the water's surface, which cause nuisances for users of lakes. The mats usually disappear by the fourth of July in Minnesota when the plant senesces. For most of the past century, lake residents in the state generally engaged in only limited control of the plant. The discovery of Eurasian watermilfoil, *Myriophyllum spicatum*, in Minnesota during 1987 and the subsequent decision to manage this plant increased awareness of other invasive species. For this reason, new efforts to evaluate the potential to manage curlyleaf pondweed have begun in Minnesota. These efforts include several projects intended to determine whether long-term reductions in the abundance of the plant can be produced by lake-wide control of curlyleaf pondweed with herbicides. Herbicides used include endothall and fluridone. It is hypothesized that providing long-term control will require substantial reductions in production of turions. Current research includes monitoring of populations of turions, in addition to distribution and abundance of plants in study lakes. In addition to providing relief from nuisances caused by matted curlyleaf pondweed, it is hoped that control might also provide ecological benefits. These include increases in the abundance of native species of submersed plants and increases in water clarity. More research is necessary to evaluate the efficacy of control of curlyleaf pondweed, as well as the potential of control to provide ecological benefits.

Phenology of *Potamogeton crispus* (Curlyleaf Pondweed) in Blue Lake, Oregon: Formation and Sprouting of Turions in the Pacific Northwest and Comparisons to North American Studies

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Potamogeton crispus (curlyleaf pondweed) is a widespread, introduced plant in the western USA. It creates nuisance conditions in Blue Lake, which lies within the metropolitan area of Portland, Oregon. *Potamogeton crispus* propagates primarily vegetatively via turions, which are condensed stem apices with four to eight dormant buds in the leaf axils. It also propagates vegetatively from shoot and rhizome fragments as well as sexually via seed. Management focuses on preventing

new turion formation, exhausting the existing turion bank and controlling the plant biomass. We investigated turion formation and sprouting in Blue Lake, Oregon, by sampling biweekly using a rake and dredge over a one year period (11/6/03 to 1/11/05). Data on stem and turion mass, length, and number of leaves and buds were collected. New turion formation initiated in early April and continued through January, peaking on 21 May 2004. Turion sprouting initiated in October and continued throughout the fall, winter and into the spring. Sprouting peaked on 24 February 2004. In Blue Lake, denticulate-type turions were more important for propagation than the spicular-type turions. Additionally, turions that formed in a lateral-stem position were more important for propagation than turions that formed at the stem apex. These data in conjunction with other North American studies suggest management in mid-March to early April, with subsequent additional management in October to early November, is necessary to optimize control of *P. crispus* while minimizing effects upon desirable monocots and other organisms.

Giant Salvinia (*Salvinia molesta* Mitchell) Growth as Regulated by pH and Available Nutrients

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Giant salvinia (*Salvinia molesta* Mitchell), a native of South America, is an invasive, floating aquatic fern. Giant salvinia has been a detrimental noxious pest in Australia, Africa, South America, and the Caribbean. Giant salvinia was first reported to have escaped cultivation in South Carolina in 1995, and has since been reported in Texas, Louisiana, Mississippi, Alabama, Florida, North Carolina, Arizona, California, and Hawaii. Previous studies have reported that giant salvinia is dependent on dissolved nutrients in the water for growth and has optimal growth at circumneutral to slightly acid (pH of 6) water. We examined giant salvinia growth in a three-by-three factorial experiment, with pH levels of 5, 6.5, and 8 and low (no addition of nutrients), medium (30 mg/L), and high (45 mg/L) concentrations of nitrogen. Plants were grown in 378 L tanks, with each treatment replicated three times. At two-week intervals, two samples per tank were collected using a 0.01 m^2 quadrat and dried to a constant mass. A two-way analysis of variance with repeated measures using pH, nutrient level, and time was used for the end-point analysis. Our results indicate that pH was not a significant factor in giant salvinia biomass ($p=0.12$), while nutrient level significantly affected growth ($p<0.001$). While pH may not be a factor controlling giant salvinia growth, giant salvinia modifies water pH through decomposition of plant material and disruption of the water-air interface. Giant salvinia will likely succeed best in waters with high nutrient loading rates, and may not survive or compete in waters of low nutrient loading rates.

Using Point Intercept Surveys to Map Aquatic Plants in the Ross Barnett Reservoir, Mississippi

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Invasive aquatic plants are an increasing problem in waterways within Mississippi and throughout the United States. Invasive species directly impact navigation, drainage, commercial and sport fishing, drinking water quality, fish and wildlife habitat, and the overall aesthetics of an area. Indirectly, these species can impact aquatic ecosystems through the depletion of oxygen in the water column, alteration of water nutrient cycling, changes in water pH, and reductions in light availability to native plant species. The presence of invasive species in the Ross Barnett Reservoir is a major concern because it is the largest surface water impoundment in Mississippi and the primary source of potable water for the city of Jackson. We initiated a five-year study of the plant community by mapping the current distribution of aquatic plants in the reservoir. A point intercept survey was conducted using a 300-meter grid during June 2005. A hand-held computer enabled with GPS technology and Farm Site Mate® software was used for navigation and data entry. A total of 1423 points were sampled for the presence of aquatic plants by deploying an aquatic plant rake. Light intensity profiles were measured in 0.5-meter intervals from the water surface to the bottom sediments at six locations in the reservoir. We observed 19 species of aquatic or riparian plants during the survey. Of those species, 14 were strictly aquatic species and 3 are considered non-native species. Alligatorweed (a non-native) was observed most often during the survey (10.0%). Plant occurrence was primarily located in the upper reservoir, along the eastern shoreline, and in Pelahatchie Bay where water depths were shallower and light could penetrate to the bottom. Light profiles indicated that more than 80% of light is attenuated in the upper 1 meter of the water column. Rooted plant growth is subsequently restricted to those shallow water areas where light can penetrate to the bottom.

Cooperative Phragmites Control Programming in the Winyah Bay Focus Area, South Carolina

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The Winyah Bay Focus Area Task Force, a coalition of public and private partners working to sustain the ecological integrity of the third largest watershed on the East Coast, is the leading local force in protecting this important coastal wetland complex. The 525,000-acre Winyah Bay Focus Area covers the lower drainage of the Black, Great Pee Dee, Little Pee Dee, Sampit, and Waccamaw Rivers and their confluence into Winyah Bay. The Winyah Bay Focus Area boasts the largest contiguous block of tidal freshwater wetlands in South Carolina. Although originally managed for rice production, the area is now managed primarily for waterfowl. The Winyah Bay Focus Area Task Force has formed an Invasive Species Subcommittee composed of representatives of the Task Force, Clemson University, The Nature Conservancy, SC DNR, University of South Carolina, private industry, and landowners to address the threat of invasive species in the Winyah Bay Focus Area. The Subcommittee has identified five major invasive species: common reed, beach vitex, giant reed, alligatorweed, and water hyacinth. Action plans and cooperative control programs for phragmites, identified as the primary invasive species of concern, have been developed. Grants have been obtained through public-private partnerships to determine the extent of coverage of the invasive species, conduct demonstrations of potential control methods, develop a cost-share program for private landowners to conduct control programs, and conduct symposia on the latest biology and control information on the invasive species. Control demonstrations on several plantations comparing the efficacy of glyphosate and imazapyr have been established and are in year two of post application evaluation. A grant from the National Fish and Wildlife Foundation along with additional cost-share funding from state, federal, and environmental organizations have been obtained to conduct *Phragmites australis* cost-share control programs.

Avian Vacuolar Myelinopathy (AVM): Ongoing Research

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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. The current working hypothesis is that the causative agent of AVM is a neurotoxin produced by the cyanobacteria. Several studies are being conducted in order to test this hypothesis. One goal of the ongoing research was to develop a method of extracting this putative toxin from the vegetative-cyanobacterial matrix, in an attempt to begin toxin characterization, as well as working toward confirmation of the cyanobacteria as the source. Vegetation containing the suspect cyanobacteria was extracted using an elutropic solvent series of increasing polarity. Extracts were then tested for toxicity using an avian bioassay. Birds exposed to a methanol extract developed the characteristic AVM brain lesions, revealing that the toxin is fairly polar and water-soluble, is efficiently extracted with methanol, and is sufficiently stable to survive the extraction process. This knowledge is now being used in the development of a cell-based bioassay for toxin detection. The combination of an extraction procedure and cell-based assay will allow for efficient screening of cyanobacterial cultures or other possible sources of the toxin. Secondly, a matrix-growth study is being conducted to determine Stigonematales persistence in tubers, soil, and water at AVM positive sites. Hydrilla is being grown in soils from AVM positive and negative locations to determine the role soil may play on the disease.

Assessment of Eutrophication in the Lower Yakima River Basin, Washington

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The Yakima River drains a semiarid, agricultural and forested basin in eastern Washington. The lower basin contains intensive agricultural activity and a supporting irrigation network. As a consequence, some of the nutrients applied to the fields are transported to the river by way of natural tributaries, agricultural return drains, and ground water, leading to nutrient enrichment (eutrophication) of the river. Since the year 2000, dense aquatic plant growth (mostly water star grass, *Heteranthera dubia*) has been spreading within the lower Yakima River. While this plant is native to the region, it has never been as abundant in the river as it is now. Since 2004, the USGS, in cooperation with the South Yakima Conservation District and Benton Conservation District, has been studying eutrophication in the lower Yakima Basin. The goals of this

5-year study are to understand why the recent plant growth has occurred, assess the impacts of eutrophication on the water quality of the river and, if possible, evaluate management options for reducing those impacts. Since 1999, sediment loading from the river's tributaries has been reduced substantially, leading to clearer water in the river and greater light penetration (until the year 2000, the median summertime turbidity in the lower river was consistently around 8 NTU; now it is always near 0 NTU). The results from the first 2 years of the study showed that high pH and low dissolved oxygen levels are common throughout the growing season (March–September). However, the longest and most severe periods of low dissolved oxygen have been measured in a reach dominated by water star grass (in 2005, the minimum dissolved oxygen concentration was below 8 mg/L every day during June–August, and below 4 mg/L on 14% of those days). This presentation will focus on this reach. Our goal is to understand the mechanisms of nutrient uptake by the plants (i.e., roots verses shoots) and the importance of the different components of stream metaboli.

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