28th Annual
Western Aquatic Plant Management Society
Conference

March 29 – April 1, 2009
Moana Surfrider Hotel ~ Honolulu, Hawaii

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The Purpose of the WAPMS is to:

- Promote the management of non-native and nuisance aquatic vegetation.
- Encourage scientific research.
- Promote student scholarships.
- Provide scientific advancement and knowledge to its members.
- Extend and develop public interest in aquatic plant management activities.

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PROGRAM

Sunday, March 29th

2:00 – 6:00 Exhibitor Setup

4:00 – 5:30 Board Meeting (Lani Kai Room)

6:00 – 8:00 **President's Reception**, Sheraton Moana Surfrider, Lani Kai Room

Monday, March 30th

7:30 – 8:30 **Coffee and Pastries (Ballroom Two)**

General Session I: Conference Welcome, Keynote Speaker, and Regulatory. Moderator: Pat Akers, California Department of Food and Agriculture

8:35 - 8:45 Conference Welcome: Thomas J. McNabb, President, WAPMS

8:45 – 9:25 Keynote Speaker: Coral Reef Ecology and Alien Invasive Species in Hawaii. Dr. Celia Smith, Botany Department, University of Hawaii, Manoa, HI

9:25 – 9:45 APMS/AERF Update. Carlton Layne, President, Aquatic Plant Management Society and Executive Director, Aquatic Ecosystem Research Foundation, Marietta, GA

9:45 – 10:05 Update on U.S. EPA Registration of Aquatic Herbicides and Inert Ingredients. Carlton Layne, President, Aquatic Plant Management Society and Executive Director, Aquatic Ecosystem Research Foundation, Marietta, GA

10:05 – 10:25 Aquatic Plants in the USGS Nonindigenous Aquatic Species (NAS) Database. Vanessa Howard Morgan and Mark D. Sytsma, Aquatic Bioinvasion Research and Policy Institute, Center for Lakes and Reservoirs, Portland State University, Portland, OR

10:25 – 10:45 Break

General Session II: Eurasian Watermilfoil Control. Moderator: Thomas G. Moorhouse, Clean Lakes, Inc.

10:45 – 11:05 Advances in Technology for Control of Eurasian Watermilfoil (*Myriophyllum spicatum*) and other Submersed Plants. Tyler Koschnick, Hamid Ullah, Cole Hulon, Sarah Miller, and Scott Shuler, SePRO Corporation, Carmel, IN

11:05 – 11:25 Eurasian Watermilfoil Weevil in California: Status and Update. Baldo Villegas, Michael Pitcairn and Patrick Akers. California Department of Food and Agriculture, Sacramento, CA

11:25 – 11:45 Efficacy of Combinations of Endothall with 2,4-D and Triclopyr for Enhanced Control of Eurasian Watermilfoil with Low Contact Time. John D. Madsen[1], Ryan M. Wersal[1], and Kurt D. Getsinger[2], [1]Geosystems Research Institute, Mississippi State University, Mississippi, MS, and [2]U.S. Army Engineer Research and Development Center, Vicksburg, MS

11:45 – 1:25 **Lunch On Your Own**

General Session III: Aquatic Plant Control on a Large Scale Reservoir Systems, an Adaptive and Prescriptive Management Approach (The Pend Oreille System, Idaho). Moderator: Mark Sytsma, Portland State University

1:25 – 1:45 Overview of Aquatic Invasive Species Program Goals and Accomplishments from a Legislative Standpoint. Idaho State Representative Honorable Eric Anderson, Spirit Lake, ID

1:45 – 2:05 Aquatic Ecosystem Restoration Foundation, the Role of the Foundation in Supporting Idaho's Eurasian Watermilfoil Program Development and Evaluation Process. Carlton Layne, Aquatic Ecosystem Research Foundation, Marietta, GA

2:05 – 2:25 Idaho State Department of Agriculture Eurasian Watermilfoil Program Review, EWM Grant Process. Thomas Woolf, Idaho State Department of Agriculture, Boise, ID

2:25 – 2:45 An Adaptive and Prescriptive Aquatic Vegetation Management Approach. Public Sensitization, Preprogram Evaluations, Data Incorporation into Field Operations, Treatment Documentation, Post Treatment Reviews and Evaluations. Thomas J. McNabb, Clean Lakes, Inc., Coeur d'Alene, ID

2:45 – 3:05 **Break**

General Session III Continued: Moderator: Thomas Woolf, Idaho State Department of Agriculture

3:05 – 3:25 Eurasian Watermilfoil Monitoring and Management Assessment in the Pend Oreille Lake and River System, Idaho. John D. Madsen[1], Ryan Wersal[1], and Thomas E. Woolf[2]; [1]Mississippi State University, Mississippi State, MS and [2]Idaho State Department of Agriculture, Boise, ID

3:25 – 3:45 Pre Treatment Water Exchange Evaluations Overview. Thomas J. McNabb, Clean Lakes, Inc., Coeur d'Alene Idaho

3:45 – 4:05 The 2007-2008 Pend Oreille Eurasian Watermilfoil Operational Control Program. Thomas G. Moorhouse and Thomas J. McNabb, Clean Lakes, Inc., Coeur d'Alene, ID

4:05 – 4:25 Three Years of Aquatic Plant Management on Lake Pend Oreille. Brad Bluemer, Bonner County Weed Department, Bonner County, ID

4:25 – 4:45 Progress on the Pend Oreille, A Summary of Six Years of Treatments Targeting Eurasian Watermilfoil. Terry McNabb, Aquatechnex, Bellevue, WA

Tuesday, March 31st

7:15 – 8:30 **Coffee and Pastries (Ballroom Two)**

General Session IV: Aquatic Weed Biology and Control. Moderator: Scott Shuler, SePRO

8:30-8:35 Welcome: Robert Leavitt, Vice President, WAPMS

8:35 – 8:55 Seasonal Changes in Carbohydrate and Nitrogen Concentrations in Oregon and California Populations of Brazilian Elodea (*Egeria densa*). Toni Pennington[1] and Mark Sytsma[2], [1]Tetra Tech Inc., Portland OR, [2]Center for Lakes and Reservoirs, Portland State University, Portland, OR

8:55 – 9:15 Hydrilla (*Hydrilla verticillata*) Control Project, Bruneau River, Idaho: First Infestation of Hydrilla in Idaho. Doug Freeland, A.C.E. Diving, Spirit Lake, ID

9:15 – 9:35 Update on Hydrilla (*Hydrilla verticillata*) in California. Patrick Akers, California Department of Food and Agriculture, Sacramento, CA

9:35 – 9:55 Using Transplants to Determine Post-Season Residual Effects of Fluridone Applications for Control *Egeria densa* in the Sacramento-San Joaquin Delta. Lars W.J. Anderson, Doreen Gee and Thomas Barr, USDA-ARS Exotic and Invasive Weed Research Davis, CA

9:55 – 10:15 Controlling Sago Pondweed (*Stuckenia pectinatus*) in Irrigation Canals with Endothall. Cody J. Gray[1] and Gerald Adrian[2], [1]United Phosphorus, Inc. Peton, CO, [2]United Phosphorous, King of Prussia, PA

10:15 – 10:30 **Break**

General Session IV: Continued. Moderator: Jill Winfield, Cygnet Enterprises

10:30 – 10:50 Evaluation of Pre-Emergence Herbicides for Sago Pondweed (*Stuckenia pectinatus*) Control. Joseph D. Vassios, Scott J. Nissen, and Galen R. Brunk, Colorado State University, Fort Collins, CO

10:50 – 11:10 Spartina (*Spartina* sp.) Management in Oregon and Coast-Wide through the West Coast Governors' Agreement on Ocean Health. Mark D. Sytsma and Vanessa Howard Morgan. Center for Lakes and Reservoirs, Portland State University, Portland, OR

11:10 – 11:30 Control of Shoreline Weeds around Golf Course Ponds and Canals. Bruce E. Kidd, Dow AgroSciences, Murrieta, CA

11:30 – 1:10 **Lunch On Your Own**

General Session IV: Continued. Moderator: Toni Pennington, Tetra Tech, Inc.

1:10 – 1:30 Control of Benthic Cyanobacteria. Paul Westcott, Applied Biochemists, Phoenix, AZ

1:30 – 1:50 NPDES Permit Review and Update; Possible Effects of the Sixth District Court Ruling, Robert Leavitt, California Department of Food and Agriculture, Sacramento, CA

1:50 – 2:10 Managing Invasive Species by Eliminating Vehicle Transfer. Sheilah Kennedy, S-K Environmental, Okanogan, WA

2:10 – 2:30 Aquatic Herbicide Dissipation Following the Application of a Granule vs. Liquid Formulation. Tyler Koschnick[1], Robert Johnson[1], Cole Hulon[1], Scott Shuler[1], and Richard Dirks[2], [1]SePRO Corporation, Carmel IN, [2]ReMetrix LLC, Carmel IN

2:30 – 2:45 **Break**

General Session V: Lake Restoration and Management. Moderator: Lars W. J. Anderson, USDA-ARS.

2:45 – 3:05 Rehabilitation of Duck Lake, Ocean Shores, WA. Doug Dorling[1] and Jill Winfield[2], [1]North West Aquatic Eco Systems, Tumwater, WA and [2]Cygnet Enterprises North West, Spokane, WA

3:05 – 3:25 Lake and Pond Management in the Upper Midwest. Kevin Kretsch, Lake Restoration, Rogers, MN

3:25 – 3:45 Development of the Lake Tahoe Region Aquatic Invasive Species Management Plan. Toni Pennington[1], Steve Chilton[2], Phillip Brozek[3], and Lars Anderson[4]. [1]Tetra Tech, Inc., Portland, OR 97205; [2]USFWS, Stateline, NV 89449; [3]USACE, Sacramento, CA 95817; [4]USDA-ARS, Davis, CA 95616

3:45 – 4:15 Annual Business Meeting

6:00 – 8:30 **WAPMS Annual Banquet**

Wednesday, April 1st

7:15 – 8:30 **Coffee and Pastries (Ballroom Two)**

General Session VI: Invasive Seaweeds and Invasive Algae and Higher Plants in Hawaii. Jeff Herod, U.S. Fish and Wildlife Service

8:35 – 9:55 Control of Invasive Seaweeds: Summary of 2008 Asilomar Workshop. Lars W.J. Anderson, USDA-ARS Exotic and Invasive Weed Research, Davis CA

9:55 – 9:15 Lake Wilson *Salvinia molesta* Control Program, Hawaii. Anthony Montgomery, Division of Aquatic Resources, Hawaii Department of Land and Natural Resources, Honolulu, HI

9:15 – 9:35 Alien Algae in Hawaii. Brian Hauk, Division of Aquatic Resources, Hawaii Department of Land and Natural Resources, Honolulu, HI

9:35 – 9:55 Invasive Species Control in the Kawainui/Hamakua Wetlands, a Ramsar Wetlands of International Importance is Hawaii's Largest Marsh Ecosystem. Chuck Burrows, President of Ahahui Malama I ka Lokahi, Honolulu, HI

9:55 – 10:25 Kawainui Marsh, Oahu: Challenges in Controlling One Square Mile of Non-native Aquatic Vegetation. Tobias Koehler, Oceanit Laboratories, Honolulu, HI

10:25 – 10:45 Mangrove, Removal and Control Techniques in Hawaii. Robert Bourke, Oceanit Laboratories, Honolulu, HI

10:45 – 11:05 **Break**

11:05 – 11:40 Panel Discussion and Q & A on the Issues Associated with Area-Wide Aquatic Vegetation Control Programs. Panel: Idaho State Representative Honorable Eric Anderson, Thomas McNabb, John Madsen, Robert Leavitt, Thomas Woolf, Carlton Layne

11:40: MEETING ADJOURNED (Potential Field Trip Option TBD)

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ABSTRACTS
Oral Presentations
In Alphabetical Order by Author

UPDATE ON HYDRILLA IN CALIFORNIA

Patrick Akers, California Department of Food and Agriculture, Integrated Pest Control Branch, 1220 N Street, Room 341, Sacramento, CA 95814, pakers@cdfa.ca.gov

Since 1976, hydrilla has infested approximately 31 distinct sites in California. The CDFA hydrilla program has eradicated the plant from 21 of those sites. Progress is good in many of the remaining sites, with no hydrilla found this year in seven of them. Four of the sites have had no hydrilla for four or more years, and this year the Chowchilla River project reached its sixth year with no finds. Of the three sites that produced plants this year, populations are under good control in two of them. The infestation in Clear Lake, however, continued to present a challenge this year. Hydrilla first returned to Clear Lake in 2007, when the crew found 72 spots with plants, leading to 248 acres needing treatment. This year the crews found another 196 spots, adding 325 acres requiring treatment.

CONTROL OF INVASIVE SEAWEEDS: SUMMARY OF 2008 ASILOMAR WORKSHOP

Lars W.J. Anderson**,** USDA- ARS Exotic and Invasive Weed Research Davis, CA 95616

Infestations of non-native marine algae (seaweeds) and non-native marine flowering plants have increased dramatically over the past 20 years in the world oceans and US coastal and estuarine ecosystems (Botanica Marina Vol 50, 2007; Williams 2007). The most well known example is the incursion of the green alga *Caulerpa taxifolia* along the coasts of seven Mediterranean countries beginning in the 1984, which spread to more than 40,000 acres. Although the 2000 infestation of *C. taxifolia* in California was successfully eradicated by 2006, the cost was over $7 million. Other species such as the brown alga *Undaria pinnatifida* have become established off the US Pacific Coast, while other *Caulerpa* species are expanding off the Florida coast. Hawaii has also experienced increases in nuisance marine algae, some of which threaten the fragile corrals and their delicate ecosystems. These marine algae and plant invasions can interfere with near-shore oyster production; fish and invertebrate diversity and can also introduce toxins in the food web. However, with the exception of the herbicide imazapyr (registered for control of

Spartina alterniflora/ *Spartina* hybrids via foliar applications), there are no EPA registered products for management marina algae or marine angiosperms. Moreover, in contrast to a long history and well-focused research effort directed to management of freshwater weeds there are no similar research programs aimed at development strategies and methods for these marine invaders. To identify potential detection methods, management approaches and research needs, aquatic weeds scientists and marine resource managers participated in a 2-day workshop in April 2008. Results of discussions and informal ranking identified gaps in information and provided relative target species priorities for research potential for inter-agency coordination. The information from this workshop points to the urgent need to develop of inter-agency and private research programs that can lead to safe and effective early detection and control methods for marine macro algae and flowering plants.

USING TRANSPLANTS TO DETERMINE POST-SEASON RESIDUAL EFFECTS OF FLURIDONE APPLICATIONS FOR CONTROL *EGERIA DENSA* IN THE SACRAMENTO-SAN JOAQUIN DELTA

Lars W.J. Anderson, Doreen Gee and Thomas Barr, USDA-ARS Exotic and Invasive Weed Research Davis, CA

Egeria densa occupies approximately 10,000 to 12, 000 acres in the Sacramento-San Joaquin Delta system and its growth impedes key activities and ecosystems services including navigation (commercial and recreational), angling, water transport and delivery, habitat for native fish and plants. The California Department of Boating and Waterways conducted an *Egeria densa* Control Program (EDCP) that focused on a 2,700 acre open water site (Franks Tract) in 2007, and 2008, which included spring applications of fluridone (both liquid and pelleted formulations). We assessed residual effects by removing and transplanting washed *E. densa* from selected sites in Franks Tract and from sites in an untreated (control) site (Fisherman's Cut) in the late fall of 2007 and 2008, several months posttreatment. Transplants were established on sieved Delta sediment derived from untreated areas, and allowed to grow for up to 65 days under controlled light (ca. 300-350µmols/m2/sec PAR from metal halide lamps and L:D 14:12 photoperiod) and temperature (17 to 20C). Transplants from the control sites generally produced longer and more prolifically branched plants than did those from Franks Tract; however some plants from Franks Tract recovered sufficiently to produce robust stands. The results suggest that while the applications were extremely effective in reducing cover and biomass throughout the growing season, there remained some plants that are capable of re-growth and population maintenance over winter. The results suggest that careful, localized applications during early fall may provide longer-lasting control.

THREE YEARS OF AQUATIC MANAGEMENT ON LAKE PEND O'REILLE

Brad Bluemer, Bonner County Weed Department, 4100 McGhee Rd. Suite-C Sandpoint, ID 83864, bbluemer@co.bonner.id.us

Eurasian watermilfoil (*Myriophyllum spicatum*) has been the primary project target for management in this system since primary funding became available in 2006. The Idaho State Department of Agriculture was authorized by the legislature to begin an eradication program to eliminate all waters of Idaho of aquatic noxious weed as soon as possible. Twelve million dollars

was allocated for that purpose for the next three years. Although other aquatic weeds were found in the state, Eurasian watermilfoil remained the primary target and for Lake Pend O'reille starting out with nearly 5,000 acres infested. Limited local resources prior to 2006 provided partial lake aerial photography surveys backed up by boat inspections prior to treatments as projects were developed and implemented. Contractors and technical advisors assisted in providing GIS-GPS mapping technologies as the program developed each year. The lake levels are control by a USACOE hydro-electric dam regulating flows of a massive river system. These flows cause unpredictable control issues that vary from year to year and site to site. The uses of various products, timing, recreational public concerns, private properties, and regulations have made any degree of success a challenge. The help of the AERF, USACOE, and all their associated partners have helped this program and the aquatics industry learn so much more about weed control. Current surveys show dramatic reductions with infestations involving less than 900 acres today. These current infestations range from scattered to dense populations which will be managed according to remaining funding and priority. The biggest challenge at hand is finding adequate funding for future years. A photographic presentation of what the lake was, what the lake is now, and an overview of key educational points will be provided.

REHABILITATION OF DUCK LAKE, OCEAN SHORES, WA

Doug Dorling, North West Aquatic Eco Systems, Tumwater, WA Presented by: Jill Winfield, Cygnet Enterprises North West Inc.

How and why a City changed its policy, from using a variety of biological controls, to the use of aquatic herbicides, for the control of aquatic weeds.

HYDRILLA (*HYDRILLA VERTICILLATA*) CONTROL PROJECT, BRUNEAU RIVER, IDAHO. FIRST INFESTATION OF HYDRILLA IN IDAHO

Doug Freeland, A.C.E. Diving, project contractor, PO Box 840 Spirit Lake, Idaho 83869, acediving@hotmail.com

Idaho State has discovered its first infestation of Hydrilla **(***Hydrilla verticillata***)** in the Bruneau River in southern Idaho. The infestation was found by an employee of the State Dept. of Agriculture. Tom Wolff discovered the infestation in late 2007 and realized the need to implement a quick response effort to control the infestation. Within weeks surveys and volunteer efforts had been put into action. Options for control were evaluated and decisions were made. The fast moving river offers many obstacles for this type of control program. Physical removal using hand pulling and diver assisted vacuuming was implemented in July of 2008. Later in 2008 experiments using bottom barrier began and are currently being evaluated. Early surveys show that although infestation has been diminished further efforts will be necessary to gain complete control of the potentially dangerous infestation. This presentation will cover control strategies, results to date, and future plans.

CONTROLLING SAGO PONDWEED IN IRRIGATION CANALS WITH ENDOTHALL

Cody J. Gray[1] and Gerald Adrian[2]. [1]United Phosphorus, Inc., Peyton, CO 80831; [2] United Phosphorus, Inc., King Of Prussia, PA 19406, cody.gray@uniphos.com

Controlling aquatic vegetation in irrigation canals is an extremely important venture in the United States. The waters supplied by these canals are typically the primary source of water for irrigating agronomic crops. Therefore, the control of aquatic weeds in these canals is critical. Unfortunately, the tools available for aquatic weed control are limited. Grass carp (*Ctenopharyngodon idella*) are used in some locations, but their use is limited, as they create another set of unique issues. Mechanical means, such as dredging and chaining canals, can be employed for weed removal; however, these methods are labor intensive, expensive, and offer only a temporary solution to the problem. The final option is the use of herbicides for weed control. Herbicides currently labeled for use in irrigation canals are acrolein, xylene, and copper formulations. Endothall has been used since the 1960's for controlling aquatic vegetation in ponds, lakes and reservoirs. In recent months, residue trials have been conducted for endothall as required for an EPA approved FIFRA Section 3 label to allow treated water to be used on irrigated crops during herbicide applications. This would eliminate any holding period for treated water that is to be used to irrigate agronomic crops. Sago pondweed [*Stuckenia pectinatus* (L.) Börner] is a native aquatic perennial that forms dense troublesome infestations in irrigation canals and drainage ditches. In 2007 and 2008, irrigation experimental trials were conducted to evaluate endothall efficacy for sago pondweed control. Treatments resulted in greater than 95% sago pondweed control for up to 16 weeks after treatment. Additional trials resulted in endothall residues traveling up to 20 miles from the initial injection site providing extended downstream sago pondweed control. Results from these trials indicate endothall will provide an alternative that is more effective for aquatic weed control in irrigation canals.

MANAGING INVASIVE SPECIES BY ELIMINATING VEHICLE TRANSFER

Sheilah Kennedy, Owner/Operator S-K Environmental, 219 Rodeo Trail Road, Okanogan, Washington 98840, shekennedy@hotmail.com http://s-k-enviro.com.

S-K Environmental utilizing the WB 500 has participated in several studies including University of Notre Dame Aquatic Study rinsing off boats and boat trailers, USFS, San Demas Research and Development Center, comparing rinse off systems to assist in the development of standards, working with local County Weeds Cross Borders project between Okanogan County and British Columbia, Canada, Hunters Education Day, Opening Fishing Day and several fires. The key to any successful integrated management plan is to incorporate strong prevention tools such as; certified weed free forage, certified weed free gravel, (North American Weed Management Association Standards), (NAWMA) or invasive species rinse off and reclaim systems. There are several tools available to treat established infestations however more emphasis addressing preventing new infestations from being introduced through vehicles, recreational activities or ground disturbance projects is needed.

LAKE AND POND MANAGEMENT IN THE UPPER MIDWEST

Kevin Kretsch, President, Lake Restoration 12425 Ironwood Circle Rogers, MN 55374
kevink@lakerestoration.com

The use of various lake and pond management techniques including: herbicidal treatments targeting invasive species, alum treatments, and mechanical means will be presented. The section on invasive species treatments will be focused on *Potamogeton crispus* and *Myriophyllum spicatum*. Herbicides applied included: endothall, 2,4-D, and triclopyr. Applications were made at various times during the growing season including early season applications. Alum treatments have been utilized to limit the amount of phosphorus that leaches from the sediments. Application techniques and results from alum treatments will be discussed. Mechanical means of aquatic plant control provide effective results in small high use areas. The benefits and costs of mechanical aquatic plant control will be covered. Because the climate, use, and regulatory environment combine to make the management of lakes and ponds in the upper Midwest a challenging task, numerous management techniques are needed to provide the desired level of aquatic plant control.

AQUATIC HERBICIDE DISSIPATION FOLLOWING THE APPLICATION OF A GRANULE VS. LIQUID FORMULATION

Tyler Koschnick[1], Robert Johnson[1], Cole Hulon[1], Scott Shuler[1] and Richard Dirks[2]: [1]SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032, scotts@sepro.com and [2]ReMetrix LLC, 11550 North Meridian Street, Suite 600, Carmel, IN 46032, rich@remetrix.com

Age old questions remain in aquatic plant management related to delivering herbicides into a three dimensional environment. Rapid dilution of residues is likely a primary reason for poor submersed weed control in many situations. For decades, applicators customized sub-surface injection systems to deliver herbicides into deeper water in attempts to get maximum efficacy (with no two systems being “equal”). Granule and pelletized formulations of aquatic herbicides have also been developed to assist delivery and maximize exposure times (Aquathol Super K, Navigate, and Sonar Q, PR, and SRP; more recently Renovate OTF (2006) and Sonar ONE (2008). Concentration exposure times have provided a general understanding of the requirements for herbicide effectiveness following aqueous exposure, but a void remains understanding which application technique or formulation maximizes retention and exposure time and in which situations. A study was designed to compare the retention and vertical distribution of residues following a simultaneous application of a liquid (Rhodamine WT dye) and granule (Renovate OTF) formulation to a 10 acre area in a 325 acre lake. Rhodamine WT dye was injected through 45 foot trailing hoses to simulate a deep injection; Renovate OTF (granule) was applied through forced air systems. Residues were collected from 5 depths at 20 different times (from 0.5 to 96 hours after treatment) in 15 feet of water. Dilution from untreated water (edge effect) and internal currents generally had a dramatic effect on retention and apparent redistribution of residues. Residues resulting from the granule application were higher in c.a. 80% of all the samples and averaged c.a. 4 times greater than the liquid. The granule also resulted in greater retention of residues at all 4 stations. This paper will detail the results of this study and discuss implications for submersed plant management.

ADVANCES IN TECHNOLOGY FOR CONTROL OF EURASIAN WATERMILFOIL (*MYRIOPHYLLUM SPICATUM*) AND OTHER SUBMERSED PLANTS

Tyler Koschnick, Hamid Ullah, Cole Hulon, Sarah Miller, and Scott Shuler: SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032, scotts@sepro.com

Auxin herbicides have been used extensively for aquatic plant management. 2,4-d was first registered in 1945 and recently completed the EPA re-registration process with the amine, ester, and acid (a.e.) formulations supported for aquatic use. Triclopyr (Renovate) was registered more recently in 2002. A granule formulation of triclopyr (Renovate OTF) was registered in 2006. Studies were conducted to evaluate combinations of these two active ingredients to determine potential for positive interaction when applied together at various ratios. Combinations of triclopyr+2,4-d resulted in positive interactions and enhanced efficacy of Eurasian watermilfoil. This paper will discuss results from these studies and describe development of a new 2,4-d formulation (Sculpin G) and advanced triclopyr+2,4-d formulation (Renovate MAX G) submitted for aquatic registration. In addition, emphasis has been placed on finding alternative herbicides for hydrilla control over the past several years. Research with some of these new active ingredients could have utility for plant management in Northern tier states that will be discussed.

EFFICACY OF COMBINATIONS OF ENDOTHALL WITH 2,4-D AND TRICLOPYR FOR ENHANCED CONTROL OF EURASIAN WATERMILFOIL WITH LOW CONTACT TIME

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

Eurasian watermilfoil (*Myriophyllum spicatum* L.) is a widespread nuisance problem in the United States, which is manageable in most aquatic systems with a suite of approaches. One remaining problematic habitat for managing Eurasian watermilfoil is those areas with high water exchange rates, which results in low potential contact time for herbicides. Over the past several years, we have been examining the use of herbicide combinations. By combining a contact herbicide (endothall) with systemic herbicides (either 2,4-D or triclopyr), the efficacy and long-term control of the contact herbicide is enhanced while the required contact time for the systemic herbicides are reduced. We performed mesocosm tank studies that demonstrated enhanced control of Eurasian watermilfoil using endothall with 2,4-D or triclopyr under varying contact times. In the first study, we observed 90% control in treatments of 2ppm 2,4-D and 1ppm endothall at both 48 and 24 hours, and better than 70% control with concentrations as low as 0.5ppm 2,4-d with 0.25ppm endothall at 24 hours. In the second study, we found enhanced control at 1ppm endothall and 0.5 to 0.125ppm triclopyr with 12 to 24 hours exposure, as compared to triclopyr alone at those concentrations. Treatments with 6 hours exposure resulted in poor control. Initial field trials in Pend Oreille Lake, Idaho resulted in significant reductions in Eurasian watermilfoil after treatment. Combinations of a contact herbicide (endothall) with a systemic herbicide (2,4-D or triclopyr) will results in enhanced control of Eurasian watermilfoil in environments with low exposure time or high water exchange rates.

EURASIAN WATERMILFOIL MONITORING AND MANAGEMENT ASSESSMENT IN THE PEND O'REILLE LAKE AND RIVER SYSTEM, IDAHO

John D. Madsen[1], Ryan Wersal[1], and Thomas E. Woolf[2]; [1]Mississippi State University, Mississippi State, MS 39762-9652, jmadsen@gri.msstate.edu and [2]Idaho State Department of Agriculture, Boise, ID

The Pend Oreille Lake and River system is the largest freshwater body in the State of Idaho, encompassing 92,000 acres. Eurasian watermilfoil (*Myriophyllum spicatum* L.) has spread throughout much of the systems littoral zone, reducing native plant growth and diversity. We surveyed the entire littoral zone of the lake and river using a point intercept survey covering almost 1700 points in June and August of 2007 and August 2008, in a uniform grid with points 250 m apart in waters of less than 45' deep. Eurasian watermilfoil distribution throughout the lake declined from 12.5% in 2007 to 7.9% in 2008 ($p<0.01$). The only significant changes in native plants were an increase in northern watermilfoil (*Myriophyllum sibiricum* Komarov) from 2.0% in 2007 to 4.2% in 2008 ($p<0.01$), and a decrease in muskgrass (*Chara* sp.) from 29.4% in 2007 to 22.0% in 2008. We also surveyed almost 2000 points in June and August/September of 2007 in locations selected for management. Eurasian watermilfoil declined significantly at these points, from 64.5% in 2007 to 23.6% in 2008 ($p<0.01$). Most native species were unchanged, but native dicots northern watermilfoil, whorled watermilfoil (*Myriophyllum verticillatum* L.) and white water-buttercup (*Ranunculus aquatilus* L.) also decreased at these points. Curlyleaf pondweed (*Potamogeton crispus* L.) increased from 6.2% in 2007 to 20.1% in 2008 ($p<0.01$). Sites treated with 2,4-D, triclopyr, and combinations of endothall with either 2,4-D or triclopyr were also evaluated. We also re-evaluated sites treated in 2007 with fluridone. Overall, progress is being made toward the goal of eradicating Eurasian watermilfoil in Pend Oreille Lake.

AN ADAPTIVE AND PRESCRIPTIVE AQUATIC VEGETATION MANAGEMENT APPROACH

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To effectively incorporate the various issues associated with the large scale aquatic vegetation management program on the Pend Oreille Lake and River System in Northern Idaho, an Adaptive and Prescriptive Aquatic Vegetation Management Approach was implemented during the summer of 2008. Program related issues included public awareness on the selected treatment methods, when applications would be performed in specific areas, and associated environmental use restrictions. Public awareness was effectively handled through the creation of a project web site and an information office www.pendoreillemilfoil.com. Pre Treatment area surveys were conducted with staff from the aquatic herbicide manufacturers to determine their comfort levels for the use of specific products in specific areas that included areas of high water flows. To properly document areas of Eurasian Watermilfoil within the system, research scientists from Mississippi State University performed pre and post treatment 2007 aquatic vegetation surveys, and 2008 pre treatment surveys. The survey data was utilized to develop shape files for the aquatic herbicide treatments. At times, real time vegetation growth data was supplied to the aquatic herbicide application vessels so that treatment shape files could be modified in the field to reflect current growth area conditions. To properly understand water

exchange rates, and thus herbicide contact and exposure time relationships within areas of the system, Water Exchange Evaluations were conducted by the US Army Corps of Engineers using a Rhodamine WT dye. Data obtained through the Water Exchange Evaluations provided the approximate contact times within treatment sites, and allowed for the modification of treatment plans to meet site conditions. Through the implementation of an "Adaptive and Prescriptive Management Approach", program activities can adapt to real time site conditions, and a prescriptive site specific control strategy can be implemented. Post treatment vegetation survey data compiled by the Mississippi State University research team documented an increase in control efficacy in some areas, compared to average efficacy in prior years before the adoption of this management approach. In addition to control efficacy enhancement, aquatic herbicide costs were significantly reduced.

PRE TREATMENT WATER EXCHANGE EVALUATIONS OVERVIEW

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Pre treatment water exchange evaluations were carried out during the summer of 2008 in specific sites within the Pend Oreille Lake and River system using Rhodamine WT dye. The water exchange evaluations were carried out to determine aquatic herbicide contact and exposure time relationships, so that treatments could be prescribed based on water movement within the sites. The Water Exchange Evaluations were conducted through a Cooperative Research and Development Agreement between the Aquatic Ecosystem Restoration Foundation and the U.S. Army Engineer Research and Development Center, Vicksburg, MS. Funding for the program was provided by the project sponsors, Applied Biochemists, Inc., Clean Lakes, Inc., and United Phosphorus, Inc. The process and some initial program benefits will be reviewed. Data will be published in 2009.

The 2007-2008 PEND OREILLE EURASIAN WATERMILFOIL OPERATIONAL CONTROL PROGRAM

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Lake Pend Oreille, located in Northern Idaho is a 85,960 surface acre reservoir that is the headwaters to the Pend Oreille River system. Eurasian Milfoil (*Myriophyllum spicatum*) has been impacting the beneficial uses of the Lake and River system. The Bonner County Department of Public Works, through Grant Funding from the Idaho State Department of Agriculture (ISDA), implemented large scale treatments in an effort to eradicate Eurasian Milfoil from the system in 2006. This presentation will review the 2007 and 2008 herbicide application requirements and processes, as well as the new application technologies that were developed to increase efficiencies on the project.

AQUATIC PLANTS IN THE USGS NONINDIGENOUS AQUATIC SPECIES (NAS) DATABASE

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The Aquatic Bioinvasions Research and Policy Institute in the Center for Lakes and Reservoirs at Portland State University (PSU) collaborates with the US Geological Survey (USGS) on a national database of freshwater aquatic invasive species. The NAS database is the central repository of accurate and spatially referenced biogeographic accounts of freshwater nonindigenous aquatic animals and plants in the USA, permitting scientists and managers to better understand invasion pathways and to identify areas potentially vulnerable to invasion. Under the collaboration, PSU maintains the aquatic plant section of the NAS database, adding new specimen records nationwide. The program's website (http://nas.er.usgs.gov) allows viewing of interactive maps; data queries by state or hydrologic drainage; access to general fact sheets and photographs; reporting of new sightings and sign-up for automatic alerts by species group or specific states of interest. Input and feedback from users will help to keep the information housed in the database current, accurate and useful for all those interested in the spread and management of invasive plants.

DEVELOPMENT OF THE LAKE TAHOE REGION AQUATIC INVASIVE SPECIES MANAGEMENT PLAN

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Lake Tahoe is designated under the Clean Water Act as an Outstanding National Resource Water due to its extraordinary clarity. The valuable natural and economic resources in the Region, however are threatened by the potential for introduction and further spread of aquatic invasive species (AIS). Invasive aquatic plants (e.g., Eurasian watermilfoil and curlyleaf pondweed), warm water fish (e.g. largemouth bass and bluegill), invertebrates (Asian clams), and amphibians (bullfrogs) are present in Lake Tahoe and their populations are expanding. These introductions, coupled with the discovery of quagga mussels in Lake Mead, NV in 2007, initiated the development of a strategic integrated AIS management plan for the Tahoe Region. Plan development began early 2008 following guidelines provided by the Aquatic Nuisance Species Task Force. The purpose of the Lake Tahoe Region AIS Management Plan (the Plan) is to facilitate coordination of regional, bi-state, state, and federal programs and guide implementation of AIS prevention and management actions in the region. Additionally, the Plan provides mechanisms to prioritize prevention, research, and management activities. Numerous regional, state, and federal stakeholders have been involved in its development. Their involvement ensures cohesive partnerships are formed to facilitate mutually agreeable prevention and control measures and to provide the tools and expertise to rapidly respond to new introductions.

SEASONAL CHANGES IN CARBOHYDRATE AND NITROGEN CONCENTRATIONS IN OREGON AND CALIFORNIA POPULATIONS OF BRAZILIAN ELODEA (*EGERIA DENSA)*

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Total nonstructural carbohydrate (TNC) reserves support growth, formation of reproductive structures, and sprouting of plant tissues and nitrogen (N) is essential for amino acid synthesis and photosynthetic enzyme production. Timing of weed management to periods when these critical resources are most limiting may improve efficacy. We examined seasonal changes in carbohydrate and nitrogen concentrations in Brazilian elodea, a common submersed aquatic weed, from two locations in the USA. Plants were collected from a coastal Oregon reservoir and from California's Central Valley in the Sacramento-San Joaquin Delta. Starch comprised between 35 to 51% of the TNC in lower stems and root crowns. Seasonal changes in resource concentrations were not consistent between years within a population or for the same plant part between different populations. Lowest TNC concentrations were observed earlier in the growing season (March) in Disappointment Slough than in Big Creek (May to June). Conversely, highest concentrations were observed in October in Disappointment Sough and from August to March in Big Creek. Nitrogen concentrations were highest in stem tips in both populations, with more distinct seasonal changes in the California population. These data suggest western populations of Brazilian elodea, *Egeria densa*, may exhibit less discernible low points in root crown and lower stem energy storage for targeting management activities to vulnerable phenological stages. Brazilian elodea has high phenological plasticity despite its low genetic diversity and lack of specialized reproductive and perennating structures, which allows the plant to invade and dominate submersed plant communities in areas with mild winters.

MANAGEMENT OF CURLYLEAF PONDWEED WITH AQUATIC HERBICIDES

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A nuisance throughout the northern US, curlyleaf pondweed (*Potamogeton crispus* L.) is an exotic submersed plant that forms dense monotypic stands, restricting recreation, suppressing native plant populations, and increasing internal nutrient cycling. Long-term control could be achieved by managing curlyleaf pondweed in the spring or fall to suppress growth of young plants and prevent new turion formation. Moreover, timing management during these seasons may improve the herbicide selectivity since many native plant species are still dormant or have senescenced. Research has shown that aquatic herbicides have been effective in selectively managing curlyleaf pondweed using a cool water application strategy. Low rates of endothall maintained for 24 to 96 h remove curlyleaf pondweed in water temperatures of 15°C. Similarly, cool water applications of fluridone reduce curlyleaf pondweed growth and limit turion production. Spot treatments of diquat are effective against curlyleaf pondweed in areas with short contact times (<12 h) after water temperatures have warmed to 20°C. Field demonstrations of spring herbicide applications have verified small-scale research results and proven effective for curlyleaf pondweed management; however, fall applications demand further study. Cool

water applications in the fall would be an important strategy for management of curlyleaf pondweed in salmon-bearing waters, as aquatic herbicides are restricted during the spring when fish spawn.

SPARTINA MANAGEMENT IN OREGON AND COAST-WIDE THROUGH THE WEST COAST GOVERNORS' AGREEMENT ON OCEAN HEALTH

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Oregon has an early detection and rapid response program focused on new infestations of spartina as well as ongoing eradication of *Spartina patens* at one site. Regular surveys of susceptible sites, as well as monitoring of previous infestations, are conducted by air, ground and boat in both the summer and winter. To date, four infestations of spartina (*S. patens* and *S. alterniflora*) have been recorded within the state. Treatments used to control spartina in Oregon include covering, digging, and herbicide applications. Effective spartina control in California and Washington are critical to preventing new infestations in Oregon. The Spartina Action Team of the West Coast Governors' Agreement on Ocean Health provides an opportunity to manage spartina using a coordinated, coast-wide strategy with a goal of eradication of invasive spartina on the West Coast by 2018.

EVALUATION OF PRE-EMERGENCE HERBICIDES FOR SAGO PONDWEED (*STUCKENIA PECTINATUS*) CONTROL

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Sago pondweed (*Stuckinia pectinatus*) is widespread across the United States and is native to Colorado. It infests irrigation canals across Colorado's Front Range and West Slope, reducing the efficient deliver of water. Two control methods commonly used in Colorado include dredging or multiple acrolein applications; however, these methods only provide temporary control. The goal of this project was to determine if pre-emergence herbicides applied to dewatered irrigation canals could control sago pondweed. A series of greenhouse and field experiments were conducted using imazamox, imazapyr, flumioxazin, fluridone, penoxsulam, dimethenamid, metolachlor and KIH-485. Sago pondweed tubers and soil were collected from a canal near Lucerne, CO. A single tuber was planted in each 3x3x3 inch pot containing about 1.5 lbs of canal soil and this was our experimental unit for all greenhouse studies. Herbicides were applied using an overhead track sprayer and incorporated with 1 cm of water. Plants were then placed in cold storage for two weeks and then submerged in 20 gallon, plastic tanks. Plants were allowed to grow for 30 days. At the end of the grow-out period biomass was harvested, dried and dry biomass was determined. Field studies were conducted in irrigation canals along Colorado's Front Range with the same herbicides. We evaluated different herbicide rates and application timings (fall vs. spring). Under greenhouse conditions all herbicides evaluated reduced dry biomass by >80% and eliminated root and secondary tuber development; however, when applied to irrigation canals little to no control was observed.

CONTROL OF BENTHIC CYANOBACTERIA

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Cyanobacteria (Blue-green algae) can achieve densities or produce secondary compounds (i.e. toxins, taste, and/or odor) that restrict critical water resource usages and require immediate intervention. In many situations, algaecides are the preferred management option due to rapid activity and their ability to at least temporarily alleviate the problem. For these situations, selection of an efficacious algaecide is crucial, since application of an ineffective algaecide or excessive amounts can be costly in terms of time, resources, as well as ecological risks. The laboratory Algal Challenge Test (ACT) identifies an efficacious algaecide and application rate that controls the targeted algal species for a specific site. Responses of *Lyngbya wollei* (a well-known, difficult-to-control, filamentous benthic cyanobacteria) from sites throughout the United States have varied widely to algaecide exposures. Based upon the data in the Algal Challenge Test database *Lyngbya* found in basic waters with high hardness responded to Clearigate® whereas Algimycin®-PWF proved more effective in moderately hard waters. Of the sites we have studied to date, the most complicated and difficult to control required sequential applications of sodium carbonate peroxyhydrate (Phycomycin-SCP®) and copper (Algimycin®-PWF) with an adjuvant.

IDAHO STATE DEPARTMENT OF AGRICULTURE'S EURASIAN WATERMILFOIL PROGRAM

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Idaho's Aquatic plant program is entering the fourth year of aggressive Eurasian watermilfoil treatment. Treatments have resulted in significant reductions in Eurasian watermilfoil populations state-wide. Education and prevention programs are also growing around the state to confront the threat of invasive aquatic species in an effort to protect Idaho's unique water resources. Expanded survey and education programs have improved early detection and have led to the identification of a number of invasive aquatic species that are new to the state.

Notes