29th Annual
Western Aquatic Plant
Management Society Annual Conference

March 28 – March 31, 2010

Sheraton Seattle Hotel ~ Seattle, Washington
1400 Sixth Avenue, Seattle, WA 98101
Phone: (206) 621-9000
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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.

The Western Aquatic Plant Management Society geographic region includes the states of:
Alaska, Arizona, California, Colorado, Hawaii, Idaho, Oregon, Nevada, New Mexico, Montana, Utah, Washington, and Wyoming.

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PROGRAM

Sunday, March 28^{th}

2:00 - 6:00 Exhibitor Setup (Grand Ballroom D)

4:00 - 5:00 Board Meeting (Cedar Room)

6:00 - 8:00 **President's Reception**, Seattle Sheraton Hotel, hosted by Robert Leavitt, President, WAPMS. (Willow Room)

Monday, March 29th

7:30 - 8:00 **Coffee and Pastries (**Grand Ballroom D**)**

General Session I (Willow Room): Conference Welcome, AERF & State Updates. Moderator: Kim Patten, Washington State University.

8:00 - 8:10 Conference Welcome: Robert Leavitt, President, WAPMS.

8:10 - 8:30 An Update from the Aquatic Ecosystem Restoration Foundation. Carlton Layne, Executive Director, Aquatic Ecosystem Restoration Foundation.

8:30 - 8:50 Washington State Update – Aquatic Weeds. Jenifer Parsons, Aquatic Plant Specialist, Washington State Department of Ecology.

8:50 - 9:10 The Invasive Species Council of California and the California Invasive Species Advisory Committee and Aquatic Invasive Plants. Robert Leavitt, Acting Director, Plant Health Services**,** California Department of Food and Agriculture, Sacramento, CA.

9:10 - 9:30 State of Oregon - Aquatic Invasive Species Update. Mark D. Sytsma; Center for Lakes and Reservoirs, Department of Environmental Science and Management, Portland State University, Portland, OR.

9:30 - 9:50 Idaho State Update - Idaho Invasive Species Prevention/Survey Program. Thomas Woolf, Aquatic Plant Program Manager, Idaho State Department of Agriculture.

9:50 - 10:10 Aquatic Weed Control Activities in the Clark Fork and Pend Oreille River Basins**.** Thomas McNabb, Clean Lakes, Inc.

10:10 - 10:40 **Break (**Grand Ballroom D**)**

General Session II (Willow Room): NPDES, Legislative, and Regulatory Updates. Moderator: Carlton Layne, Aquatic Ecosystem Restoration Foundation

10:40 - 11:00 Update on National Pollution Discharge Elimination System (NPDES) permit – Aquatic Weed Control. Kathy Hamel, Washington State Department of Ecology, Olympia, WA.

11:00 - 11:20 A Pesticide Investigation/Compliance Perspective in Relation to Aquatic Pesticide Use and Permitting. Robin Schoen-Nessa, Area Manager Compliance, Western Washington. Washington State Department of Agriculture**,** Pesticide Management Division.

11:20 - 11:40 Aquatic Invasive Species, a Legislator's Perspective. State Senator Ken Jacobsen, Washington State Senate, 46th District, Seattle.

11:40 - 1:15 **Lunch on Own**

General Session III (Willow Room): Keynote Speaker & Flowering Rush, Spartina and other Emerging Nuisance Plants. Moderator: Thomas McNabb, Clean Lakes, Inc.

1:15 - 1:45 Keynote Address: Assessing the Impacts of Harmful Algal Blooms on Seabirds. Julia Parrish, Professor/Associate Director, Aquatic & Fishery Sciences, University of Washington.

1:45 - 1:55 Flowering Rush: An Invasive Aquatic Macrophyte Infesting The Headwaters Of The Columbia River System. Peter M. Rice, University of Montana & Virgil Dupuis, Salish Kootenai College.

1:55 - 2:15 Status of Flowering Rush (*Butomus umbellatus*) Control in Washington State. Timothy Miller[1], Alison Halpern[2], Laurel Baldwin[3], and Jenifer Parsons[4]; [1]Associate Professor, Washington State University; [2]Executive Secretary, Washington State Noxious Weed Control Board; [3]Coordinator, Whatcom County Noxious Weed Control Board; [4]Aquatic Plant Specialist, Washington Department of Ecology.

2:15 - 2:35 Screening Herbicides for the Suppression of Flowering Rush. Peter M. Rice, University of Montana; Virgil Dupuis and Alvin Mitchell, Salish Kootenai College.

2:35 – 3:00 **Break (**Grand Ballroom D**)**

General Session III (Willow Room Continued): Flowering Rush, Spartina and other Emerging Nuisance Plants. Moderator: Jill Winfield, Cygnet Enterprises, North West, Inc.

3:00- 3:20 Streamlining the Eradication of Invasive Spartina. Kim D. Patten and David Milne, Washington State University, Long Beach Research and Extension Unit.

3:20 - 3:40 Plan to Eradicate Invasive Spartina from the West Coast. Mark D. Sytsma, Center for Lakes and Reservoirs, Department of Environmental Science and Management, Portland State University.

3:40 – 4:00 South American Spongeplant Invades California. Florence Maly and Patrick Akers, California Department of Food and Agriculture.

4:00 - 4:20 Invasive Seaweed Control: Can We Stop *Undaria pinnatifida* on the North American West Coast? Lars Anderson; USDA-ARS Exotic and Invasive Weed Research

Dinner on Own

Tuesday, March 30th

7:00 - 7:55 **Coffee and Pastries (**Grand Ballroom D**)**

General Session IV (Willow Room): Aquatic Plants and Control in Irrigation and Croplands. Moderator: Robert Leavitt, California Department of Food and Agriculture.

7:55 - 8:00 Welcome: Thomas Moorhouse, Vice President, WAPMS.

8:00 - 8:20 Ensuring that Legislation Meets Practical Needs of Irrigation Districts in Washington. Tom Myrum, Executive Director. Washington State Water Resources Association.

8:20 - 8:40 An Overview of Irrigation in the Pacific Northwest, the Columbia Basin Irrigation Project, Aquatic Weed Control, and Washington State NPDES Compliance. Hugh McEachen, Agronomist, Columbia Basin Irrigation Project, WA.

8:40 - 9:00 Endothall Use in Irrigation Canals for Sago Pondweed Control. Cody J. Gray, Ph.D., Field Development, Aquatics Specialist, United Phosphorus, Inc.

9:00 - 9:20 The Future is Here: Proven Solutions for Aquatic Weed Management in Canals. Shaun Hyde[1], Scott Shuler [2], Mark Heilman, Ph.D[3]. [1]SePRO Corporation, Carmel, IN , [2]SePRO Corporation, Coeur d'Alene, ID, [3]SePRO Corporation, SePRO Research and Technology Campus, Whitakers, NC

9:20 - 9:40 Managing Algae and Cyanobacteria in California Rice Fields. D. Spencer, P.-S. Liow, and G. Ksander, USDA ARS Exotic & Invasive Weeds Research Unit, Department of Plant Sciences, Davis, California.

9:40 - 10:00 **Break (**Grand Ballroom D**)**

General Session V (Willow Room): Hydrilla and Egeria Biology and Control. Moderator: Lars Anderson, USDA-ARS

10:00 - 10:20 The Battle for Clear Lake: Hydrilla's Resurgence and Suppression. Patrick Akers, California Department of Food and Agriculture.

10:20 - 10:40 Eradicating Hydrilla in Washington State. Elizabeth S. Cullen, King County Water and Land Resources, WA.

10:40 - 11:00 Hydrilla Eradication: Technical Overview and Potential Future Strategy. Mark A. Heilman, SePRO Corporation; Tyler J. Koschnick, SePRO Corporation.

11:00 - 11:20 Fluridone, Penoxsulam and Triclopyr Absorption by Eurasian Watermilfoil and Hydrilla. Joseph D. Vassios[1], Scott J. Nissen[1], and Tyler J. Koschnick[2]. [1]Colorado State University – Department of Bioagricultural Sciences and Pest Management, [2]SePRO Corporation, Carmel, IN.

11:20 - 11:40 Hydrilla Control – Idaho Update. Thomas Woolf, Aquatic Plant Program Manager, Idaho State Department of Agriculture.

11:40 - 12:00 Using Aquathol for Season-Long Hydrilla Control. Cody J. Gray, Field Development, Aquatics Specialist, United Phosphorus, Inc.

12:00 - 1:00 **Lunch on Own**

General Session VI (Willow Room): Control Technologies. Moderator: Mark Systma, Portland State University.

1:00 - 1:20 Operational Monitoring of Herbicide Dissipation following Applications of Renovate OTF (granular triclopyr) in Multiple Northern Lakes. Mark A. Heilman[1], Cole Hulon[1], Tyler J. Koschnick[2], Bob Johnson[3], Sarah Miller[4]; [1]SePRO Research and Technology Campus, 16013; [2]SePRO Corporation; [3]SePRO Corporation; [4]SePRO Corporation.

1:20 - 1:40 Evaluation of Simulated Herbicide Application Techniques in Two Large Reservoirs. Justin J. Nawrocki[1], Kurt D. Getsinger[2], Michael D. Netherland[3] and Robert J. Richardson[4]. [1]North Carolina State Univ., Raleigh, NC. [2] U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS. [3] U.S. Army Engineer Research and Development Center, Environmental Laboratory, [4] Univ. of Florida, Gainesville, FL.

1:40 - 2:10 Research and Testing of a System for Precision Littoral Zone Application of Aquatic Herbicides**.** Thomas McNabb[1], Thomas Moorhouse [1], and Bruce Sabol [2]. [1] Clean Lakes, Inc., [2] US Army Engineer Research and Development Center, Environmental Laboratory (ERDC-EL), Vicksburg, MS.

2:10 - 2:30 New Technology for Algae Control and Aquatic Management, Paul Westcott; Applied Biochemists, Phoenix, AZ.

2:30 - 3:00 **Break (**Grand Ballroom D**)**

General Session VII (Willow Room): Detection and Monitoring Methods: Moderator: Kathy Hamel, Washington Department of Ecology.

3:00 - 3:20 Monitoring and Responding to Toxic Cyanobacterial Blooms in Snohomish County, Washington. Marisa Burghdoff, Snohomish County Public Works – Surface Water Management.

3:20 - 3:40 Bioeconomic Impacts of Eurasian Milfoil on Lakeshore Property Values in Washington. Mariana Tamayo, Julian D. Olden; School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA.

3:40 - 4:00 Particle Analysis for Detecting and Enumerating Mussel Veligers and Planktonic Algae Utilizing the FlowCAM®. Leif Elgethun, Clean Lakes, Inc., Boise, ID.

4:00 - 4:30 Annual Business Meeting

6:00 - 8:30 **WAPMS Annual Banquet (**Willow Room**)**

Wednesday, March 31st

7:00 - 8:00 **Coffee and Pastries (**Grand Ballroom D**)**

General Session VIII (Willow Room): Aquatic Plant Management Potpourri. Moderator: Patrick Akers, California Department of Agriculture.

8:00 - 8:20 Which Aeration Style Should I Use as an Effective Lake Management Tool? A Review of all Aeration Types**.** Bob Robinson, Fisheries Biologist, Kasco Marine.

8:20 – 8:40 Biological Control as a Management Tool for Hydroelectric Power Reservoirs. Cushing, Nancy L., Martin Hilovsky, and Cortney Marquette. EnviroScience, Inc., Stow, OH.

8:40 – 9:00 Mostly Failures, A Few Successes: Our Research Forays to Control Aquatic Weeds. Kim D. Patten and Chase Metzger, Washington State University Long Beach Research and Extension Unit, Long Beach WA.

9:20 – 9:40 Shoreline Planting Guide: Devils Lake, Oregon**.** Toni Pennington[1] and Harry Gibbons[2]. [1]Aquatic Biologist, Tetra Tech, Surface Water Group, [2]Environmental Services Lead, Surface Water Group, Tetra Tech.

9:40 - 10:00 **Break (**Grand Ballroom D**)**

10:00 - 10:20 Effects of Chronic Exposure to Mixtures of Herbicides and Other Pesticides on Coho Salmon Reproduction. Christian Grue[1], Associate Professor, University of Washington, Aquatic & Fishery Sciences, Washington Cooperative Fish & Wildlife Research Unit, Seattle, WA. Kerensa King, [1]Christian Grue, James Grassley, James Hearsey and Robert Fisk.

10:20 - 10:40 Nutrient Reduction and Oxygenation in a South Florida Borrow Pit Lake Using Artificial Destratification Aeration. Amanda Quillen, Ph.D. Limnologist, Vertex Water Features.

10:40 - MEETING ADJOURNED

11:00 - 11:30 Board Meeting (Willow Room)

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ABSTRACTS
Oral Presentations
In Alphabetical Order by Author

The Battle for Clear Lake: Hydrilla's Resurgence and Suppression. Patrick Akers, California Department of Food and Agriculture, 1220 N St, Rm. 341, Sacramento, CA 85914

Over the last three years, hydrilla at Clear Lake took advantage of a major assumption in the original eradication protocol to make a spirited attempt at reclaiming the lake for itself. Fortunately, the tide appears to be turning once again in favor of saving the lake from this pest. Clear Lake is the first project in California that depended exclusively on herbicides for eradication. The original eradication protocol called for continuing treatment until plants disappeared from the lake, followed by three additional years of treatment at zero plants, followed by three additional years of finding no plants before considering eradication possibly achieved. Hydrilla appeared in Clear Lake in 1994. Treatments brought the infestation to zero plants by the outset of 2003, and treating continued for three more seasons until they were stopped for the 2006 season. Plants re-appeared in 2007, with 72 finds. Despite resuming treatments, there were 196 finds in 2008, many were dangerously close to the outlet of the lake, and many plants were large and healthy. Fortunately, the treatments seemed to start taking effect in 2009. Only 75 plants were found, nearly all were small and poorly developed, and none were near the outlet. The talk will cover the history of the eradication effort and some of the lessons that will be applied in the future.

Invasive Seaweed Control: Can We Stop *Undaria pinnatifida* on the North American West Coast? Lars Anderson; USDA-ARS Exotic and Invasive Weed Research, One Shields Ave. Mail Stop #4, Davis, CA 95616.

The brown alga (kelp) *Undaria pinnatifida*, native to the shores of Japan and Korea is commonly known as "wakami"and is used in various foods such as salads and miso soup. Unfortunately, over the past 10 years, this large kelp, which can grow over 6 ft long (ca. 2 m) has become established in several California coastal harbors from Catalina to Santa Barbara. This kelp anchors itself with "holdfasts" and establishes mainly on floating structures (docks, boats, warf pilngs). In addition to replacing native alga species and altering habitat, it poses a threat to oyster production. There are currently no EPA-registered algaecides for use in these environments, so attempts at control have relied physical removal by hand pulling, with only moderate success to date. Last year (2009) it was discovered in two marinas in San Francisco Bay and one harbor near Half Moon Bay. The new finds have led to coordinated removal efforts and outreach to marina managers, but timing is critical to prevent the successful release of microscopic spores that can easily spread populations. Given the potential for dispersal from existing infestations, and the suitable habitats that probably extend northward to Southern Alaska, development of effective preventative actions, containment and control methods are urgently needed to thwart continued northward movement of *Undaria*. USDA-ARS, in cooperation with state, federal and private stakeholders will investigate a range of possible control methods including freshwater jacketing, EPA- registered algaecides/herbicides, and improved physical removal methods.

Monitoring and Responding to Toxic Cyanobacterial Blooms in Snohomish County, Washington. Marisa Burghdoff, Snohomish County Public Works – Surface Water Management. 3000 Rockefeller Ave, M/S 607, Everettt, WA 98201, Ph. 425-388-3464 X 4639, marisa.burghdoff@snoco.org.

Certain species of cyanobacteria (commonly called blue-green algae) have the potential to produce toxins that pose health threats to people and animals that play in or drink affected water. In Snohomish County, Lakes Cassidy, Ketchum, and Loma have had documented toxic cyanobacteria events. In 2007, Snohomish County Surface Water Management (SWM) received a grant from the Department of Ecology's freshwater algae program to focus on these lakes to 1) reduce the risk to human and animal health through early bloom detection and citizen notification; 2) increase public understanding of algal problems and their causes; and 3) reduce the incidence of blue-green algal blooms by reducing residential nutrient inputs. Weekly monitoring was conducted in 2008 and 2009 for algal scums and the presences of either microcystin (a liver toxin) or anotoxin-a (a neurotoxin). Environmental parameters including *in-situ* chlorophyll *a*, phycocyanin (a cyanobacterial pigment), water transparency, and temperature/dissolved oxygen were also measured. All three lakes experienced at least one or more cyanobacterial blooms with toxin levels above the recreational standard set by the Washington State Department of Health in 2008 or 2009. This presentation will discuss the methodology and lessons learned for tracking scums and toxins, the relationship between environmental factors and scums/toxins, and the procedures employed for educating and warning the public of toxic algal blooms. In addition, a brief summary will be provided of the first year results of the "Regional Examination of Harmful Algal Blooms" project which includes monitoring for toxic algae in 30 lakes in Pierce, King, and Snohomish Counties.

Eradicating Hydrilla in Washington State. Elizabeth S Cullen, King County Water and Land Resources, Water Quality Planner 201 S. Jackson Street, Ste 600 Seattle, WA 98104 beth.cullen@kingcounty.gov

Hydrilla verticillata (hydrilla) was discovered in 1994 in two connected King County lakes, Pipe and Lucerne in Western Washington. This discovery has been the first and only infestation of hydrilla in Washington State. Since it is listed in Washington as a Class A Noxious weed, the goal is total eradication, with the King County Water and Land Resources managing the project. In 2003, a new treatment strategy was adopted in consultation with the Washington Department of Ecology using applications of the slow release pellet form of the herbicide fluridone, coupled with frequent assessment surveys performed by divers and snorkelers. In 2005 no plants were found in Lake Lucerne and in 2007 no plants were found in either lake. This marked the beginning of the 3 year countdown to declaration of eradication. As of the summer of 2009, no new hydrilla (*Hydrilla verticillata*) plants were found in either lake for at least 3 years, and the plant is considered eradicated. This marks the beginning of a new chapter of work to be done on Pipe and Lucerne Lakes and the focus will change to surveys to map the revegetation of the lakes, while confirming that hydrilla, *Hydrilla verticillata*, has truly been eradicated in the lakes.

Biological Control as a Management Tool for Hydroelectric Power Reservoirs. Cushing, Nancy L., Martin Hilovsky, and Cortney Marquette. EnviroScience, Inc, 3781 Darrow Road, Stow, OH 44224, (330)688-0111, Fax: (330)688-3858, ncushing@enviroscienceinc.com

Damming a river creates a suitable environment for increased aquatic plant growth. Many reservoirs that were formed by hydroelectric dams during the 20th century are experiencing invasions of Eurasian watermilfoil (*Myriophyllum spicatum*) and other exotic aquatic plants. Eurasian watermilfoil negatively impacts water quality, fisheries, recreation, and property values, among other problems. Hydroelectric power companies are required to comply with Federal Regulatory Energy Commission (FERC) guidelines for invasive species management. EnviroScience Inc. and We Energies, Milwaukee, Wisconsin, are collaborating on a multi-year project to develop a management strategy for Eurasian watermilfoil (EWM) in the Menominee River system. The Menominee River drains rural forested parts of Wisconsin and Michigan, eventually flowing into Lake Michigan. We Energies maintains 12 hydroelectric dams and reservoirs along the river and EWM is found in nine of the reservoirs. The milfoil weevil (*Euhrychiopsis lecontei*), a native beetle and milfoil specialist, was found in all reservoirs with EWM. The indigenous weevil population in three of the reservoirs was augmented in June 2007. Positive trends in weevil populations and visible impacts to the EWM canopy were observed from two of the reservoirs in the follow-up survey performed two months later. Long-term results from further augmentation and surveys of the weevil populations and EWM conducted in 2008 and 2009 will be presented. Data from multiple years provides insight into annual oscillations of weevils and EWM between reservoirs in the same watershed. This study offers long-term implications for the use of biological control in managing EWM in reservoirs.

Image Particle Analysis for Detecting and Enumerating Mussel Veligers and Planktonic Algae Utilizing the FlowCAM®. Leif Elgethun, Clean Lakes, Inc., Boise, ID. lelgethun@cleanlake.com

FlowCAM® detects and measures marine and freshwater plankton, mussel veligers, and particles in a continuous fluid flow. Scientists, researchers and technicians can obtain size, shape, fluorescence and concentration statistics in a fraction of the time required by traditional microscopy. The high speed imaging particle analyzer also provides the capabilities of a flow cytometer. A wealth of information is derived from the microscopic images. By acquiring and storing a digital image of each particle detected, different particle types in a heterogeneous sample can be automatically identified, differentiated and quantified. FlowCAM® acquires high resolution microscopic images at a very rapid rate; typically up to 10,000 images/minute. The intuitive VisualSpreadsheet© analysis software uses proprietary methods that allow the user to sort, filter and classify particle images interactively.

Endothall Use in Irrigation Canals for Sago Pondweed Control. Cody J. Gray, Ph.D., Field Development, Aquatics Specialist, United Phosphorus, Inc., 11417 Cranston Drive, Peyton, CO 80831. cody.gray@uniphos.com

The task of controlling aquatic vegetation in irrigation canals is an extremely important venture, especially in the western United States. The waters supplied by these canals are the primary, and in some locations the only, source of water for irrigating agronomic crops. In other locations, these waters supply industrial water users as well. Therefore, aquatic weed control in irrigation canals becomes extremely critical; however, the tools available to canal managers for weed control are limited. Sago pondweed [*Stuckenia pectinatus* (L.) Börner] is a native aquatic perennial that forms dense troublesome infestations in irrigation canals and drainage ditches; thereby, not allowing for proper water delivery or flow. On June 16, 2009, the Twin Falls Canal Company applied endothall to their main canal to control sago pondweed. An initial application was made for 2 ppm endothall for 12 hrs followed by a secondary application of 1 ppm endothall for 12 hrs approximately 40 km from the initial application, when the initial application had reached the location; thereby, providing a total treatment of 3 ppm endothall for 12 hrs. Endothall concentrations moved throughout the entire canal system (2.8 to 3.1 ppm at 107 km from the initial application site) at concentrations targeted to achieve sago pondweed control. Sago pondweed control 11 weeks after treatment is greater than 90% for the entire system. At 15 weeks after treatment, sago pondweed control had decreased to approximately 75% throughout the system. Results from these trials indicate endothall will provide a safer, more effective tool for controlling aquatic weeds in irrigation canals compared to other alternative control methods.

Using Aquathol for Season-Long Hydrilla Control. Cody J. Gray, Ph.D., Field Development, Aquatics Specialist, United Phosphorus, Inc., 11417 Cranston Drive, Peyton, CO 80831. cody.gray@uniphos.com

Hydrilla [*Hydrilla verticillata* (L.F.) Royle] is a troublesome non-native aquatic plant that commonly forms dense surface canopies in many types of water bodies. Hydrilla infestations minimize recreational activities such as boating, water skiing, fishing, hunting, etc. Therefore, controlling hydrilla in these waters is of extreme importance. In recent years, the use of endothall has been used extensively in Florida waters where fluridone-resistant hydrilla has become the dominant hydrilla strain. Application timings and techniques for endothall has changed to applications being made during periods where water temperatures a cooler i.e. less than 70^{o} F; therefore, resulting in season-long hydrilla control. The presentation will outline cool-season endothall applications for season-long hydrilla control.

Effects of Chronic Exposure to Mixtures of Herbicides and Other Pesticides on Coho Salmon Reproduction. Kerensa King, Christian Grue[1], James Grassley, James Hearsey and Robert Fisk Associate. [1]Professor, Aquatic & Fishery Sciences, Unit Leader, Washington Cooperative Fish & Wildlife Research Unit, Seattle, WA, 98195-5020.. cgrue@u.washington.edu, Telephone: 206-543-6475

The research presented represents the culmination of a five-year effort to determine the effects of a pesticide cocktail, present in urban streams in Western Washington, on different life stages of Coho salmon (*Oncorhynchus kisutch*). The cocktail consisted of 8 herbicides, 2 insecticides, a fungicide, and a common breakdown product; nominal concentrations were the maximums reported after storm-water events in fall. With the exception of the fungicide and breakdown product, formulated products (single AI) were used, and if possible were selected from those available at retail outlets. In 2004-05 and 2005-06, research focused on adult Coho; recent monitoring efforts had suggested that pre-spawn mortality of Coho salmon had increased in natural waters, particularly urban streams in Western Washington. We found no effects on time to death, brain cholinesterase activity, sperm motility, or hatching success and growth of fry (from exposed adults) for 35 d. In 2006-07, our objective was to determine if there were effects on fertilization and eggs/sac fry to 35 days after swim-up as a result of a pulsed exposure to the chemical cocktail, simulating storm flows. In 2007-2009, we examined the effects of the pulsed exposure on fertilization through smoltification followed by the release of exposed and unexposed smolts to compare return rates. To date, results suggest that there were no effects on the endpoints examined and that other factors (general water quality, habitat, or other contaminants) may be responsible for the reproductive effects observed in coho within urban streams in Western Washington.

Update on National Pollution Discharge Elimination System (NPDES) permit – Aquatic Weed Control. Kathy Hamel, Aquatic Plant Specialist, Washington State Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600

The state of Washington, Department of Ecology (Ecology), Water Quality Program, is delegated by the U.S. EPA as the state water pollution control agency, responsible for implementing all federal and state water pollution control laws and regulations. Ecology is issues state waste discharge general permits for the management of aquatic plants and algae in water bodies, for control of aquatic weeds in irrigation water and conveyance systems, for the control of mosquitoes and mosquito larvae by mosquito control districts and government entities, for the control noxious and quarantine list weeds along lake and river shorelines, in rivers, wetlands, and estuaries. These permits only coves chemical control of plants and algae. The use of products not regulated under FIFRA is allowed under this permit, if the product or active ingredient has been reviewed and approved by Ecology. Other permits may be necessary if the plant or algae control activities are conducted using manual, mechanical, or biological methods. An update on NPDES permit status will be provided.

Operational Monitoring of Herbicide Dissipation following Applications of Renovate OTF (granular triclopyr) in Multiple Northern Lakes. Mark A. Heilman[1], Cole Hulon[1], Tyler J. Koschnick[2], Bob Johnson[3], Sarah Miller[4]; [1]SePRO Research and Technology Campus, 16013 Watson Seed Farm Rd., Whitakers, NC, 27981, email: markh@sepro.com, coleh@sepro.com; [2]SePRO Corporation, 11550 N. Meridian Street # 600, Carmel, IN 46032, email: tylerk@sepro.com; [3]SePRO Corporation, Brownstown, IN, email: bobj@sepro.com; SePRO Corporation, Knightdale, NC, email: sarahm@sepro.com.

In 2008-2009, intensive field sample collection of treated water across multiple locations and water depths from 0.5 to 96 hours following Renovate OTF granular triclopyr application was performed as a component of the monitoring protocols for representative treatments of Eurasian watermilfoil (*Myriophyllum spicatum*) in several northern US lakes. Data from four lake treatments will be presented: Grandview Lake (IN) – 4 ha bay treated in 132 ha lake, Lake Morey (VT) – 8 shoreline zones ranging from 2.2 to 3.6 ha in 218 ha lake, Lake Minnetonka (MN) – 48.6 and 49 ha bays treated in 5,879 ha lake, and Houghton Lake (MI) – 3 open water plots totaling 365 ha in 8,112 ha lake. For Grandview Lake treatment, liquid rhodomine dye was also simultaneously applied via subsurface injection through weighted trailing hoses to compare with granular herbicide dissipation. Grandview results indicated a 26.7 hour half-life for triclopyr and 12.4 hours for the dye (2.2x longer exposure time for herbicide released off granular formulation), with notably higher nominal herbicide levels compared to dye in deeper water samples. For Morey application, average triclopyr concentrations were 1.6 – 2.2x higher in samples taken 0.3 m above the bottom compared to those taken 0.9, 1.8, and 3.5 m above bottom (3.65 m total depth). For Houghton and Minnetonka treatments, triclopyr levels in near-bottom water samples were between 1.2 – 2.5x higher than surface samples. Overall, operational field sampling confirms improved contact with target milfoil, particularly in deeper water, with implications for optimizing future submersed aquatic plant management.

The Future is Here: Proven Solutions for Aquatic Weed Management in Canals. Shaun Hyde[1], Scott Shuler [2], Mark Heilman, Ph.D[3]. [1]SePRO Corporation, Carmel, IN , [2]SePRO Corporation, Coeur d'Alene, ID, [3]SePRO Corporation, SePRO Research and Technology Campus, Whitakers, NC

Aquatic weed management in western irrigation canals has been conducted using various techniques for over 100 years. As with any industry, product and technology advancements allow for improvement management practices. Over the past twelve years, SePRO Corporation has been conducting research and development efforts to provide innovative solutions for canal districts managers. This presentation will focus on the development and operational implementation of proactive, off-season, submersed weed treatment solutions with Sonar aquatic herbicide and development of a custom solution based program for comprehensive management of submersed aquatic weeds and algae in canals. Discussion will also include an update on the use of Clearcast and Galleon aquatic herbicides for dewatered canals and continued evaluation of other compounds for use in controlling aquatic weeds and algae in western irrigation canals.

Hydrilla Eradication: Technical Overview and Potential Future Strategy. Mark A. Heilman, SePRO Corporation, SePRO Research and Technology Campus, 16013 Watson Seed Farm Rd., Whitakers, NC, 27981, email: markh@sepro.com**;** Tyler J. Koschnick, SePRO Corporation, 11550 N. Meridian Street # 600, Carmel, IN 46032, email: tylerk@sepro.com

Hydrilla (*Hydrilla verticillata*) can produce large numbers of subterranean turions (hereinafter referred to as tubers) that can remain dormant in the sediment for several years. Quiescent tubers are generally not directly impacted by many control techniques, with a few exceptions (e.g. freezing). This makes attempts at eradication difficult, but not impossible. As eradication programs are enacted with recent hydrilla discoveries (ME, NY, KS, WI, IN, etc.), a better understanding of hydrilla tuber attrition rates is refining expectations for program managers and funding agencies. Several recently established management programs attempting eradication or other aggressive long-term control have attempted to better quantify management progress by close monitoring of hydrilla tuber banks. Multiple-year treatment programs using Sonar (fluridone) are providing excellent initial tuber bank reductions with a trend of reduced tuber bank attrition with increasing time period since initial hydrilla infestation. Models of attrition are being refined annually and documenting in general that predictions of time to reach eradication levels of tuber bank reduction tend to increase with successive years of management. This paper will review actions and progress taken to eradicate hydrilla from several US lakes and reservoirs, and discuss methods used to assess associated tuber banks attrition. General technical considerations for long-term hydrilla assessment and management will be discussed with focus on potential future strategies for both new and established infestations.

An Update from the Aquatic Ecosystem Restoration Foundation. Carlton Layne, Executive Director, Aquatic Ecosystem Restoration Foundation, 3272 Sherman Ridge Dr., Marietta, GA 30064.

The Aquatic Ecosystem Restoration Foundation (AERF) mission is to support research and development that provides strategies and techniques for the environmentally sound management, conservation, and restoration of aquatic ecosystems. To accomplish this mission, the AERF supports research on the biology and ecology of nuisance aquatic and wetland plants, particularly exotic species. The AERF also provides public information concerning the benefits and value of conserving aquatic ecosystems' promotes cooperation among federal, state, and local natural resource and regulatory agencies, as well as between the public and private sectors; and funds graduate stipends in applied aquatic plant management research at major universities. An update on AERF activities and issues of importance to aquatic ecosystem restoration will be discussed.

The Invasive Species Council of California and the California Invasive Species Advisory Committee and Aquatic Invasive Plants. Robert Leavitt, Acting Director, Plant Health Services, California Department of Food and Agriculture, Sacramento, CA.

The Invasive Species Council of California (ISCC) is a voluntary group made of the agency Secretaries of six California agencies. They came together because of a common interest in keeping invasive species, including aquatic weeds and pests, out of California. The six agencies are as follows: California Department of Food and Agriculture, California Natural Resources Agency, California Environmental Protection Agency, California Health and Human Services Agency, California Business, Transportation, and Housing Agency, and California Emergency Management Agency. The ISCC is supported by the California Invasive Species Advisory Committee (CISAC) and associated working groups. The CISAC is made of 24 non-state specialists in invasive species and advises the ISCC. The CISAC includes aquatic specialists from the aqua culture (fish) industry, the US Fish and Wildlife Service, and the San Francisco Bay Area Partnership. Several national environmental groups with interest in aquatic weeds and pests are also represented. The first work product of the CISAC will be a list of the greatest invasive weed, insect, vertebrate and disease pests threatening California's environment, agriculture, forest, and water resources. This will be followed with invasive weed and pest management plans, including freshwater and marine weeds. The working groups are providing informal support to the CISAC on weeds and pests, including aquatics. The working groups are looking for volunteers. WAPMS members are encouraged to volunteer.

South American Spongeplant Invades California. Florence Maly and Patrick Akers, Calif. Dept. of Food and Agriculture, 1220 N St, Rm. 341, Sacramento, CA 85914, fmaly@cdfa.ca.gov

In the last two or three years, South American spongeplant (*Limnobium laevigatum*) has made a serious attempt at establishing itself in California, especially in the Central Valley. Spongeplant first appeared in 2002, in a single 5-acre pond at the northern edge of the Valley. The plant was easily controlled with diquat, but it reproduced readily from seed. Beginning in 2007, spongeplant began to pop up in well-separated locations in the southern Central Valley, centered around the city of Fresno, and including the San Joaquin River. Infestations in any one location are relatively easy to suppress, but the plant's mobility and ability to reproduce present challenges to eradicating it from the state. The talk will describe the spread of the plant and some of the efforts at control.

An Overview of Irrigation in the Pacific Northwest, the Columbia Basin Irrigation Project, Aquatic Weed Control, and Washington State NPDES Compliance. Hugh McEachen, Agronomist, Columbia Basin Irrigation Project, WA.

A brief overview of irrigation in the pacific northwest will be discussed, followed by a more detailed focus on The Columbia Basin Irrigation Project, managed by the U.S. Bureau of Reclamation. The Irrigation Project was started in the early 1930's in an effort to provide irrigation water to the fertile but arid lands of the Columbia River Basin in Central Washington.
The extensive network of canals, tunnels, reservoirs, and pumping plants which make up the project currently provide water to over half a million acres. Without aquatic plant and algae control it is believed that the entire system would falter within days, thereby dramatically affecting the economy of the not only the Columbia Basin, but the State of Washington.
The importance of aquatic plant and algae control is an essential element in the success of the project. To date, more than 70% of control has involved the use of the active ingredient, acrolein, but recent market changes are leading many irrigation managers to look in new directions. An overview of how irrigation managers and their teams of applicators comply with the Washington State N.P.D.E.S. when applying aquatic herbicides and algaecides to their canals will be covered.

Aquatic Weed Control Activities in the Clark Fork and Pend Oreille River Basins. Thomas McNabb, Clean Lakes, Inc., PO Box 3548, Coeur d'Alene, ID 83816. tmcnabb@cleanlake.com

The Clark Fork and Pend Oreille River Basins are experiencing the invasion of aquatic invasive species (AIS) that include Eurasian watermilfoil (*Myriophyllum spicatum*), Curlyleaf Pondweed (*Potamogeton crispus)* and Flowering Rush (*Butomus umbellatus*). The potential impacts from AIS infestations within these basins has the potential to spread through the Clark Fork and Pend Oreille River systems and into the Columbia River that empties into the Pacific Ocean in northern Oregon. The Flowering Rush infestation was first documented in Flathead Lake Montana which is located in the upper reaches of the Flathead River, and drains into the Clark Fork River in Montana. Eurasian watermilfoil has spread upstream from the Pend Oreille River in Washington State, through the Pend Oreille Lake system (Idaho), and up the Clark Fork River into Columbia Gorge and Noxon Rapids Reservoirs. A review of aquatic vegetation control activities to combat the spread of these AIS will be reviewed.

Research and Testing of a System for Precision Littoral Zone Application of Aquatic Herbicides. Thomas McNabb[1], Thomas Moorhouse [1], and Bruce Sabol [2]. [1] Clean Lakes, Inc., [2]U.S. Army Engineer Research and Development Center, Environmental Laboratory (ERDC-EL), Vicksburg, MS.

The US Army Engineer Research and Development Center, Environmental Laboratory (ERDC-EL), and Clean Lakes, Inc. entered into a Cooperative Research and Development Agreement for the "Research and Testing of a System for Precision Littoral Zone Application of Aquatic Herbicides". The Scope of the Cooperative Research and Development Program is to provide for the joint conduct of research and development investigations related to coupling the LittLine® System (Littoral Zone Treatment Technology) with ERDC-EL Hydroacoustic Submersed Plant Mapping capabilities (SAVEWS™ and related developments). The technologies will be used together to achieve precision application of herbicide to submerged, nuisance aquatic vegetation. The Project Objective is to design a LittLine® System that utilizes SAVEWS™ or variations of that technology in an optimized system for automated aquatic herbicide applications. Field testing and modifications will yield a new real-time application system capable of delivering excellent plant control with a reduction in the amount of herbicide required by conventional delivery methods. The research team began the initial CRADA investigations in Florida during the period of January 5 through January 12, 2010 within Hydrilla control zones within Lake Tohopekaliga**,** or Lake Toho. Lake Toho is an 18800 acre lake in Osceola County known as one of the best lakes in Florida for bass fishing, and is located within the Kissimmee Chain of Lakes. For the initial investigations, aquatic herbicide treatments were mock treatments using water rather than aquatic herbicides. Through the initial research investigations, the abilities of combining the two systems was demonstrated, and an update on the efforts will be presented.

Status of Flowering Rush (*Butomus umbellatus*) Control in Washington State. Timothy Miller[1], Alison Halpern[2], Laurel Baldwin[3], and Jenifer Parsons[4]; [1]Associate Professor, Washington State University, 16650 State Route 536, Mount Vernon, WA 98273 twmiller@wsu.edu; [2]Executive Secretary, Washington State Noxious Weed Control Board, 1111 Washington Street, Olympia, WA 98504-2560 AHalpern@agr.wa.gov; [3]Coordinator, Whatcom County Noxious Weed Control Board, 901 Smith Road, Bellingham, WA 98226 LBaldwin@co.whatcom.wa.us; [4]Aquatic Plant Specialist, Washington Department of Ecology, 15 West Yakima Avenue, Suite 200, Yakima, WA 98902 jenp461@ecy.wa.gov.

Flowering rush, *Butomus umbellatus*, currently infests approximately two miles of shoreline of Silver Lake in northwestern Washington State and some fourteen miles along the banks of the Yakima River in southcentral Washington State. These are the only known infestations of this species in the state, and both are slated for control efforts to begin in 2010. A herbicide trial was conducted at Silver Lake during 2008-2009 in which three herbicides were tested for efficacy on this species. Approximately two feet of leaf material was sprayed with glyphosate at either 3 or 5%, imazapyr at 1%, or triclopyr amine at 6.7% using a CO2-pressurized backpack sprayer equipped with an eight-foot boom and flat-fan nozzles. At 1 month after treatment (MAT), triclopyr was providing 81% defoliation of flowering rush, significantly more control than the other treatments, which ranged from 29 to 35% defoliation. Control by 12 MAT was similar with either 5% glyphosate or imazapyr (61 and 74%, respectively), but only 56% for triclopyr and 44% for 3% glyphosate. There did not appear to be a significant reduction in flowering rush density in any treated plots, however, only a reduction in leaf growth. Foliar herbicide applications should be possible for the entire Yakima River flowering rush infestation. But because the Silver Lake flowering rush population contains an appreciable number of completely submersed plants, foliar herbicide treatments will not fully control this species at this site.

Ensuring that Legislation Meets Practical Needs of Irrigation Districts in Washington.
Tom Myrum, Executive Director. Washington State Water Resources Association, 606 Columbia Street, NW, Suite 100, Olympia, WA 98501.

It is the mission of the Washington State Water Resources Association (WSWRA) to promote the responsible stewardship of the water resources of the State; to protect irrigated lands for present and future generations; and to ensure the continuation of services and the coordination of state and federal agencies dealing with water resources. Recently, WSWRA has been a key player in ensuring the aquatic weed and algae control legislation is able to meet the practical needs of irrigation districts. WSWRA role in state level negotiations will be discussed.

Evaluation of Simulated Herbicide Application Techniques in Two Large Reservoirs.
Justin J. Nawrocki[1], Kurt D. Getsinger[2], Michael D. Netherland[3] and Robert J. Richardson[1]
[1]North Carolina State Univ., Raleigh, NC. [2] U.S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS. [3] U.S. Army Engineer Research and Development Center, Environmental Laboratory, Univ. of Florida, Gainesville, FL

Controlling submersed invasive plants in large, complex reservoirs can be challenging with respect to influences of environmental conditions on water-exchange processes. These processes can drive aqueous herbicide concentration/exposure time relationships and thereby impact control of target plants. To better understand water movement in chemical treatment scenarios on large reservoirs, water exchange studies were performed to evaluate the retention time of rhodamine WT (RWT), and inert tracer dye, applied by two liquid aquatic herbicide application methods, under site- and time-specific conditions. On Lake Gaston, NC, two areas were treated with RWT from a boat using a shallow subsurface application technique applied by boat through 1.8m weighted trailing hoses. On Lake Pend Oreille, ID, a variable length hose injection technology was evaluated in four sites, again applying by boat using RWT dye. The variable length hose technology is controlled by the applicator on the boat and hose length is selected based on water depth and growth stage of plants in the water column. Permanent sampling stations inside the treatment areas were established to track the dissipation and calculate dye half-life as an estimate of water exchange within the plots. Fluorometer readings were taken at predetermined time intervals and at multiple depths in the water column to measure dye concentrations over time. With Lake Gaston applications, dye concentrations were initially high at the surface, but dropped rapidly with whole-plot half lives of 17 and 31 hr in the two treatment areas. However, a majority of applied dye stayed at or near the surface with minimal dye detected at the lake bottom, indicating that an observed thermocline and water-exchange patterns limited vertical mixing. On Lake Pend Oreille, whole-plot dye half-lives ranged from 2 to 14 hr across treatment sites, but up to 90% of measured dye remained in the bottom half of the water column. Information developed through the measurement of bulk water-exchange processes may be useful in appropriate selection of herbicide, formulation, and application technique.

A Pesticide Investigation/Compliance Perspective in Relation to Aquatic Pesticide Use and Permitting in Washington State. Robin Schoen-Nessa, Area Manager Compliance, Western Washington, Washington State Department of Agriculture, Pesticide Management Division, P.O. Box 42589, Olympia, WA 98505-2589.

Washington State Department of Agriculture enforces FIFRA in Washington and has many laws and rules beyond federal ones for aquatic pesticide use and distribution. Compliance and Registration issues related to aquatic herbicides and their use will be discussed.

Keynote Address: Assessing the Impacts of Harmful Algal Blooms on Seabirds. Julia Parrish, Professor/Associate Director, Aquatic & Fishery Sciences, University of Washington, PO Box 355020, Seattle, WA 98195-5020.

In 2009, the dinoflagellate Akashiwo sanguinea bloomed off the Washington and northern Oregon coasts from September through mid-November in densities reaching 1.5 million cells per liter. Within days of the first major storm of the season, hundreds of seabirds washed ashore dead and dying, the victims of a persistent, sticky foam that matted their feathers, causing immediate and severe hypothermia. The origin of the foam was lysed Akashiwo cells. Over the next several weeks two major seabird mortality events unfolded as a consequence of Akashiwo lysate, eventually resulting in the largest documented seabird mortality due to a harmful algal bloom (HAB). Many studies have indicated that HABs are on the rise in coastal environments worldwide. Although the vast majority of recorded HAB affect wildlife via toxicity, Akashiwo impacts - during this event and a prior incident in Monterey Bay, CA in 2007 - can be large, and Akashiwo blooms may also be on the rise. The conditions leading to persistent blooms, as well as to cell breakage, are currently unknown, as are the consequences to fish and invertebrate marine resources

Washington State Update – Aquatic Weeds. Jenifer Parsons, Aquatic Plant Specialist, Washington State Department of Ecology, 15 West Yakima Ave -- Suite 200 Yakima, WA 98902-3452. Tel: (509) 457-7136. E-mail: jenp461@ecy.wa.gov.

Mostly Failures, A Few Successes: Our Research Forays to Control Aquatic Weeds. Kim D. Patten and Chase Metzger, Washington State University, Long Beach Research and Extension Unit, Long Beach WA, 98361. pattenk@wsu.edu.

The paucity of western researchers working on in-situ aquatic weed control is not without reason. Obtaining funding and navigating the rigorous permitting system is easy compared to obtaining control consistent enough over time to be applicable as a management tool. Three failures and one success will be presented. 1) Over a four year period post-drawdown treatments of various rates and timings of imazapyr, imazamox, penoxsulam and fluridone were applied to irrigation canals to assess alternatives to acrolein for control of sago pondweed *(Potamogeton pectinatus)*. Results were all unremarkable. 2) Over a five-year period numerous in-water and foliar-applied herbicides were assessed for control of a monoculture of parrotfeather milfoil (*Myriophyllum aquaticum*) in drainage ditches. Although several herbicides, especially imazapyr, provided good suppression of parrotfeather, none resulted in permanent control when their use was implemented on a large scale by resource managers. 3) In a large drainage canal containing impenetrable mats of submergent (*Egeria densa, Myriophyllum spicatum, and Cabomba carolinian)* and emergent *(Myriophyllum aquaticum and Ludwigia hexapetala*) species, dredging and numerous in-water and foliar-applied herbicides were assessed as management tools. None worked. 4) Multi-year herbicide trials were conducted on Bohemian knotweed, *Polygonum x bohemicum*. Utilizing mid-season herbicide timing, imazapyr provided the most consistent long-term control, but large plants occasionally displayed dwarfed small *epinastic shoots in years following treatment.* For trials focused on spring treatments, prior to plants reaching their full 3 to 5 m height, only aminopyralid showed promise.

Streamlining the Eradication of Invasive Spartina. Kim D. Patten and David Milne, Washington State University, Long Beach Research and Extension Unit, Long Beach WA, 98361. pattenk@wsu.edu.

Willapa Bay is the most productive and pristine estuary in the United States. Its $60 million aquaculture industry and premier shorebird habitat has hung in precarious balance, due to the spread of *Spartina alterniflora*. Over the past 100 years it has covered >4,000 Ha of Willapa Bay's tideflats. Research to develop effective management tools resulted in the registration and use of imazapyr. Its use over the past 6 years has resulted in reduction of *Spartina* to fewer than ~ 10 Ha. Because of the lack of new infestations, short-lived seeds, and low fecundity of the isolated remaining plants, eradication appears realistic. However, finding, treating and killing the many thousands of remaining outliers hidden over many hundreds of miles of remote native salt marsh terrain has been a challenge. With any given pass over this terrain, applicators normally fail to find ~1/3rd of the plants. Detection success can be improved to 90% using a systematic grid and same-day backtracking to detect and mark skips. The majority of previously undetected outliers have been found outside normally-searched terrain. Once sprayed, the likelihood of complete control of a plant ranges from 70 to 90 %. Methods to increase that probability of kill to 90% include optimizing timing, herbicide concentration and spray volume. Using binomial search theory, Poisson distribution and Bayesian probability, we determined the number of search/spray passes needed to result in > 95% Spartina-free ground will range from 2 for a plant density of 20/ha with a 90% find and 90% kill rate to 10 for a plant density of 40/ha with a 63% find and 75% kill rate. Long-term cost efficiencies of various eradication strategies will be discussed.

Shoreline Planting Guide: Devils Lake, Oregon. Toni Pennington[1] and Harry Gibbons[2]. [1]Aquatic Biologist, Tetra Tech, Surface Water Group, 1020 SW Taylor Street, Suite 530, Portland, OR 97205, toni.pennington@tetratech.com. [2]Environmental Services Lead, Surface Water Group, Tetra Tech, 1420 Fifth Avenue, Suite 550, Seattle, WA 98101, harry.gibbons@tetratech.com.

Devils Lake is a naturally shallow lake located along the north central Pacific Coast in Lincoln City, Oregon. Dense growth of Brazilian egeria (*Egeria densa*) and Eurasian watermilfoil (*Myriophyllum spicatum*) dominated Devils Lake from the early 1960s until 1986 when Chinese grass carp were introduced as a biocontrol agent. Twenty-two years later, the lake is essentially void of submersed vegetation and prolific and sometimes toxic algae blooms have increased. The remaining carp are not expected to survive the next five years, providing an opportunity for the return of aquatic macrophytes. Additionally, shoreline property owners and the local jurisdiction are concerned about shoreline erosion caused by lack of stabilizing vegetation coupled with high wind-driven wave action. Establishing submersed and shoreline vegetation prior to the loss of grass carp may reduce the likelihood of dominance by non-native plant species and provide needed shoreline stabilization. The presence of a biocontrol agent; however, requires installation of exclosures to prevent grazing on newly established plants. The purpose of this guide is to provide lakefront property owners at Devils Lake with a foundation of tools and resources to improve water quality and shoreline stabilization on their property through revegetation. This guide provides information on selecting native submersed and shoreline vegetation, planting instructions, lists of local nurseries, and additional resources.

Nutrient reduction and Oxygenation in a South Florida Borrow Pit Lake Using Artificial Destratification Aeration, Amanda Quillen, Ph.D. Limnologist, Vertex Water Features, 2100 NW 33rd St., Pompano Beach, FL 33029, amanda@vertexwaterfeatures.com

An aeration system previously turned off for herbicide treatments was restarted in June, after the lake had stratified. Several water quality parameters were examined during and following startup in order to further our understanding of how aeration may help control algae growth. Water column ammonia and phosphates declined over the study period, which can be attributed to the measured increase in oxidation-reduction potential at the sediment-water interface resulting from increasing dissolved oxygen. Considerations before installing aeration, proposals for future investigations, and application of bubble aeration to lakes with cold-water fisheries will also be discussed.

Flowering Rush: An Invasive Aquatic Macrophyte Infesting The Headwaters Of The Columbia River System. Peter M. Rice, University of Montana, 32 Campus Drive #4824, Missoula MT 59812-4824 peter.rice@umontana.edu & Virgil Dupuis, Salish Kootenai College, PO Box 70, Pablo, MT 59855 virgil_dupuis@SKC.edu.

Flowering rush (*Butomus umbellatus*) is an invasive Eurasian aquatic macrophyte with emerged and fully submerged phenotypes that can dominate irrigation systems, wetlands, littoral zone of lakes, river edges and sloughs. Mapping in Flathead Lake delineated ~ 2,000 acres. It has passed through Kerr Dam and infested the Flathead and Clarks Fork Rivers 165 miles downriver into Lake Pend Oreille in north Idaho. There is also a large infestation near the headwaters of the southern reach of the Columbia Rivers System in an irrigation system that spills into American Falls Reservoir on the Snake River. These large infestations at the headwaters of the Columbia will continue to spread downstream and infest much of the main stem of the system. The Flathead Lake hydroelectric facility is operated to reach low pool in early spring, whereas an unregulated natural lake would reach low pool in late summer. This unnatural late summer through winter high pool with spring drawdown creates conditions that are favorable for establishment of flowering rush infestations and disadvantages to native macrophytes evolved to a hydrologic cycle with a late summer low pool. It colonizes previously unvegetated portions of variable drawdown zones. These monotypic colonies in previously open water littoral zones are likely to induce cascading ecosystem and trophic effects on the Columbia River System. However higher order impact have not yet been studied. They are likely to include alteration of sediment transport and deposition, and formation of new habitat favorable to introduced fish and disadvantages to native trout and salmon.

Screening Herbicides for the Suppression of Flowering Rush. Peter M. Rice, University of Montana, 32 Campus Drive #4824, Missoula MT 59812-4824 peter.rice@umontana.edu , Virgil Dupuis and Alvin Mitchell, Salish Kootenai College, PO Box 70, Pablo, MT 59855 virgil_dupuis@SKC.edu and alvin_mitchell@skc.edu.

Options for mechanical removal of flowering rush (*Butomus umbellatus*) are limited as the primary means of dispersal/reproduction are by rhizome fragmentation. The emerged phenotype may be controllable on some sites with foliar applications. The fully submersed phenotype would require water column injection. Kerr Dam on Flathead Lake Montana is operated to obtain low pool in late winter/early spring. This unnatural hydrograph allows bare ground and/or early emergent foliar treatment. Imazapyr and imazamox applied in May provided season-long topgrowth suppression. These plots filled in the second growing season as there was insufficient rhizome kill. Full pool herbicide treatments provided little suppression. At full pool only 6-18 inches of leaf was above the water and 4.5-5.5 feet was below. A greenhouse "bucket" trial is being conducted to screen 8 water column injection herbicides for activity. Diquat was very rapid and highly efficacious at all three rates. The dipotassium salt (Aquathol K) and dimethylalkylamine formulations (Hydrothol 191) of endothall showed high activity at the mid and maximum rates with symptom development being more rapid for Hydrothol 191. Imazamox quickly stopped leaf elongation, but the leaves remained green until about 6 weeks after treatment. Fluridone at the mid and high labeled rates evidenced symptoms in 10 to 15 days. Granular triclopyr and granular triclopyr plus 2,4-D were highly efficacious at the mid and high rates. Copper carbonate did not induce a response. At the end of the initial topgrowth testing period there were indications of regrowth for the diquat and two endothall formulations.

Which Aeration Style Should I Use as an Effective Lake Management Tool? A Review of all Aeration Types. Bob Robinson, Fisheries Biologist, Kasco Marine, 800 Deere Rd, Prescott, WI 54021, bob.r@kascomarine.com

Aeration should not be viewed as a panacea to all of your lakes problems but instead it should be viewed as one of the tools in the toolbox to effectively manage bodies of water. Oxygen is THE most important water quality parameter as it relates to overall water quality. Pros and cons of all aeration types will be discussed and include but are not limited to; Pure oxygen, hypolimnetic aeration, surface aeration, aspirators, diffused air, fountains, and pumps. Aeration and it's affect on the benthic community, destratification, prevention of fish kills, algae control, binding of phosphorus, elimination of ammonia, carbon dioxide, hydrogen sulfide and reduction of iron will all be addressed. Horsepower application rates will be discussed. Keep in mind that all lakes should be viewed as individual organism within themselves so each lakes response to management will be slightly different.

Managing Algae and Cyanobacteria in California Rice Fields. D. Spencer, P.-S. Liow, and G. Ksander, USDA ARS Exotic & Invasive Weeds Research Unit, Department of Plant Sciences, Mail Stop 4, 1 Shields Avenue, Davis, California 95616, david.spencer@ars.usda.gov of dfspencer@ucdavis.edu

The results of outdoor and laboratory experiments indicate that Hydrothol 191 did not consistently kill *Nostoc spongiaeforme* (black algae) even at concentrations greater than the maximum permissible rate, 5 parts per million. Its effect on the green algae, *Hydrodictyon* sp.

(water net) was more pronounced and lasting. It appears that rice field water quality including the abundance of bacteria may impact the effect of Hydrothol 191 these species. At present this algaecide is not labeled for use in California rice fields and it is not clear how it may fit into algal control strategies for them. Results from field studies comparing two phosphorus fertilizer application methods (P fertilizer applied 19 to 30 days after flooding, or surface applied liquid phosphate fertilizer followed by a roller) indicate that phosphate water concentrations were lower in fields where P fertilizer application was delayed either 19 or 30 days after sowing. In most cases, algal abundance was also lowest for fields which received the delayed P fertilizer treatment. These fields had less "algae" than fields which received the conventional phosphate application, i.e., surface application of a liquid phosphate fertilizer followed by a roller. The results of these measurements clearly show that phosphate water concentrations and algal abundance were reduced by the delayed P fertilizer application method. Delaying P fertilizer application until rice seedlings have emerged from the water may be an alternative "algae" management method for some growers.

State of Oregon - Aquatic Invasive Species Update. Mark D. Sytsma; Center for Lakes and Reservoirs, Department of Environmental Science and Management, Portland State University, Portland, OR 97207-0751, sytsmam@pdx.edu

Plan to Eradicate Invasive Spartina from the West Coast. Mark D. Sytsma; Center for Lakes and Reservoirs, Department of Environmental Science and Management, Portland State University, Portland, OR 97207-0751, sytsmam@pdx.edu

Four species of non-native cordgrasses (genus *Spartina*) are found along the West Coast of the United States and Canada. Where established, these invaders convert estuarine mudflats and salt-marsh ecosystems into uniform Spartina meadows and alter estuarine hydrology through sediment accretion. Drift card studies suggest that widespread dispersal of seeds and fragments can occur along the West Coast. Therefore, eradication efforts in one area may be negated by propagule pressure from outside the area. Through the West Coast Governors' Agreement on Ocean Health, the Governors of Washington, California, and Oregon committed to work cooperatively to eradicate non-native *Spartina* by 2018. An Action Coordination Team (ACT), or workgroup, was been formed to develop a strategy to meet the 2018 goal. The ACT included representatives from the three states, federal government, tribal governments, non-governmental organizations, and the Province of British Columbia. The Plan is divided into six elements: prevention, early detection, rapid response, eradication, restoration, and communication/public outreach. The successful eradication efforts in San Francisco Bay and Willapa Bay have required significant funding. Ongoing efforts to eradicate *Spartina* in Willapa Bay and San Francisco Bay have cost $12 million. Early detection of new infestations is critical to economical eradication of *Spartina* on the West Coast, and the Plan focuses on early detection and rapid response as well as support of ongoing efforts. The cost of Plan implementation over the first three years was estimated at approximately $8 million. The total new funding required to meet the 2018 eradication goal is $25 million. The ACT will pursue this funding through a variety of sources, including state, federal, and non-governmental organizations.

Bioeconomic Impacts of Eurasian Milfoil on Lakeshore Property Values in Washington.
Mariana Tamayo[1], Julian D. Olden[2]; School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195 [1]mtamayo@uw.edu, [2]olden@uw.edu

The ecological impacts of Eurasian milfoil (*Myriophyllum spicatum*) invasions are well recognized and include displacing native plants, changing water chemistry, increasing sedimentation, and interfering with navigation. However, our understanding of the potential economic impacts of this invasive species, with the exception of control costs, is still incomplete. In the present study, we apply a hedonic framework to quantify the effect of Eurasian milfoil presence on lake property values. Specifically, we compare 1,900 lakeshore property sales of single family homes in King County, WA over a 12-year period (1995-2006) for 40 lakes of which 16 support Eurasian milfoil. Factors related to property characteristics (e.g., lot size, number of bedrooms, assessed value) and lake attributes (e.g., lake area, Secchi depth, public boat access) are included in the analysis. Results from the hedonic analysis provide the first insight in the potential bioeconomic effects of milfoil invasions on waterfront properties in Washington State.

Fluridone, Penoxsulam and Triclopyr Absorption by Eurasian Watermilfoil and Hydrilla.
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Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM) and hydrilla (*Hydrilla verticillata*) are both invasive aquatic species that occur across much of the United States. Both are submersed species that form dense monocultures and impact recreational and ecological value. During the summer of 2009 a series of laboratory experiments were initiated to examine fluridone (Sonar™), penoxsulam (Galleon™), and triclopyr (Renovate™) absorption by EWM and hydrilla. Plants were propagated using shoot tips but were allowed enough time to produce roots. Plants were treated with 10 ppb fluridone, 10 ppb penoxsulam, or 1,000 ppb triclopyr plus radiolabeled herbicide. Plants were harvested at 6, 12, 24, 48, 96, and 192 hours after treatment (HAT) and separated into aboveground and belowground sections. After harvest, plants were dried, oxidized, and radioactivity quantified using liquid scintillation spectroscopy. EWM accumulated two to four times more herbicide than hydrilla when compared on the basis of internal concentration. For EWM, the internal concentration was significantly higher than the concentration in the water column with all herbicides. Fluridone, reached an internal concentration of 180 and 90 ppb for EWM and hydrilla, respectively. Compared to the concentration in the water column this represents an 18 and 9 fold accumulation. Penoxsulam accumulated the least in both species. Surprisingly, the greatest accumulation occurred with triclopyr and EWM. The concentration in the plant was 32 times the external concentration of 1,000 ppb. Based on chemical properties we expected fluridone to have the greatest absorption.

New Technology for Algae Control and Aquatic Management. Paul Westcott; Applied Biochemists. 15420 N 29th Ave., Phoenix, AZ 85053

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. Applied Biochemists in conjunction with Clemson University and other researchers have cooperated with public and private stakeholders over the past 8 years in advancing the science of algae control and aquatic management. A key focus and objective has been to optimize the use of U.S. EPA Registered Algaecides to manage algal problems within acceptable margins of safety to both man and environment. This Targeted Algal Management has involved development of effective algaecide screening protocols; corresponding algal toxin measurements; determination of impacts on non-target organisms; post-treatment residue levels; field trials to verify laboratory results and establishment of successful operational treatment programs. Applied Biochemists continues to develop and produce specific algaecide and aquatic herbicide formulations to optimize the control of problematic aquatic species.

Hydrilla Control – Idaho Update. Thomas Woolf, Aquatic Plant Program Manager, Idaho State Department of Agriculture, 2270 Old Penitentiary Road, Boise, ID 83701

Hydrilla was identified in Idaho for the first time in December 2007. Eradication operations were initiated quickly and treatments have continued through 2009. A number of issues have complicated eradication operations in the area and a variety of treatment methods have been employed. The distribution and frequency of hydrilla has been significantly reduced, but persistence and vigilance will be required to achieve the goal of eradication. Efforts to date will be presented.

Idaho State Update - Idaho Invasive Species Prevention/Survey Program. Thomas Woolf, Aquatic Plant Program Manager, Idaho State Department of Agriculture, 2270 Old Penitentiary Road, Boise, ID 83701

Idaho has instituted an Invasive Species Prevention and Survey Program designed to provide early detection and rapid response for invasive species that threaten to impact Idaho's waterways. A discussion of those efforts will be presented.

Poster Presentations

Timing Glyphosate Treatments for Giant Reed (*Arundo donax*) Control. D. Spencer, G. Ksander, W. Tan, and P-S Liow, USDA ARS Exotic & Invasive Weeds Research Unit, Department of Plant Sciences, Mail Stop 4, 1 Shields Avenue, Davis, California 95616, dfspencer@ucdavis.edu or david.spencer@ars.usda.gov

We performed two experiments, in which glyphosate (1.5%) was applied at different times in the growing season for giant reed control. In an experiment with container-grown plants conducted at Davis, California, applications of a 1.5% solution of glyphosate were made in September, October, November, 2006, April, June and August, 2007. In a field experiment conducted near Fresno, California, similar treatments were applied in September, October 2006 and June, August 2007. For both of these experiments we monitored growth and survivorship of treated and control plants for one year after treatment. For the container-grown plants, leaf chlorophyll values declined the month following treatment and did not recover. The proportion of living stems displayed a similar response. By one year post treatment all treated plants appeared to be dead. For the larger plants in the field experiment, leaf chlorophyll values declined the month following treatment but recovered, except for plants treated in September, 2006. Plants treated in September had statistically significant lower values than untreated plants while plants treated in the other months did not. The proportion of living stems m^{-2} displayed similar results. Plants treated in September and October had the lowest proportion of living stems m^{-2} one year after treatment. The lowest number of new stems produced in the growing seasons following treatment was for plants treated in September. These results imply that treating giant reed in fall with glyphosate would be more effective than similar treatments made in spring or mid-summer. These findings are also consistent with information from studies of other perennial weeds.

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