24th Annual
Western Aquatic Plant Management Society Meeting
March 10-11, 2005
Denver, CO

ABSTRACTS
Oral Presentations

(Alphabetized by first author's last name)

Preliminary evaluation of SolarBee effects on water quality at Lake Tahoe. Lars Anderson, Wailun Tan, and Chris Mallek; USDA-ARS Exotic and Invasive Weed Research, UCDavis One Shields Ave Davis, CA 95616
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The SolarBee Corporation installed four water circulation systems at Tahoe Keys in the early summer of 2004. Subsequently, this study was begun to assess impacts of the systems on water quality, sediments, plant quality (CHN) and ability of adjacent sediments to support growth of Eurasian watermilfoil (*Myriophyllum spicatum*). During July, 2004, transects were established at three of the SolarBee stations and at three "control" stations in the West Tahoe Keys marina (West Basin) areas where no SolarBee systems were installed. Sampling stations were established at 4, 12, 36 and 100 meters from the SolarBee systems. During each sampling period (July, August, September (twice), November), light levels (at 20 cm-intervals) and water quality measurements (temp, DO, turbidity, pH) were recorded mid-depth and 20cm from the bottom. Triplicate samples of sediments were taken along the transects using an Ekman dredge (15cm x 15cm x15cm) and combined to form one sediment sample at each station (point) along each transect. Sediments were distributed into triplicate 1.5 l containers and each container was planted with three 15 cm apical shoots of *M. spicatum* obtained from the Tahoe Keys Marina. Planted containers were placed in a randomized pattern in temperature-controlled fiberglass tanks, 1 m deep, with recirculating deionized water and exposed to ca. 150-200 µmol/m^2/sec irradiance (at plant height) from three metal halide lamps set on a 14:10 L: D regime. Turbidity was generally more variable along transect where SolarBees were deployed compared to control sites, but there was no consistent pattern, or gradient, along transects' stations to 100 m from the devices. Similarly, no distinct gradient in light attenuation coefficient (K_d) was apparent along the transects. Other variables show little influence from the presence of the SolarBee systems compared to control areas. Growth responses of *M. spicatum* planted in sediments that were removed along the transects are being determined.

California's New NPDES Permit for Aquatic Herbicide Use. Michael Blankinship, Blankinship & Associates, Inc.Agricultural & Environmental Consultants, 2940 Spafford St., Ste 110 Davis, CA 95616
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After the 2001 Talent decision, California began regulating the use of aquatic pesticides in virtually all waters in the state. During the initial emergency permit put in place in 2002, and in spite of data suggesting that no adverse impact has been caused by these uses, aquatic weed specialists working for drinking water, flood control, irrigation interests continue to be regulated under a new permit created in 2004. The presentation will cover the significant changes since the last permit, compliance requirements, and the unique issues related to the use of copper and acrolein.

Environmental limitations on biological control of water hyacinth in the Sacramento-San Joaquin Delta. Jason Brennan (student) and Lars Anderson; USDA-ARS Exotic and Invasive Weed Research, UCDavis One Shields Ave Davis, CA 95616
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Three water hyacinth biological control agents (the weevils *Neochetina eicchorniae* and *N. bruchi* and a moth *Sameodes albiguttalis*) were released into the Sacramento-San Joaquin Delta over twenty years ago. Despite initial surveys indicating successful establishment of the weevils, only *N. bruchi* became established based upon surveys in 2003. Although the tropical *N. bruchi* is capable of surviving the temperate climate of the Delta, environmental factors and a lack of beneficial plant pathogens appear to severely limit any successful reductions in biomass of water hyacinth. Broad environmental tolerance by water hyacinth, in conjunction with other factors, appears to limit the efficacy of *N. bruchi.* This two-year study demonstrated that releases of high numbers of *N. bruchi* adults (5 weevils/plant) on recovering frost-damaged plants in the Delta are ineffective in reducing ramet production, flowering, and canopy height and area. In addition, *in situ* measurements of temperature and humidity within water hyacinth canopies revealed conditions that probably deter weevil activity as well as the secondary establishment of plant pathogens, which are common occurrences in more humid, southeastern US environments. Taken together, these data suggest the need for searches in cooler and drier habitats in South America where populations of this species, or other insects, may be found that are more suited to the Sacramento-San Joaquin Delta.

Impacts of invasive species on water quality. Joan Cabreza; EPA Region 10, 1200 Sixth Seattle WA 98101
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Invasive species have become one of the main environmental threats of the 21st century, and they are widely considered to be second only to habitat destruction as the major cause of biodiversity loss. They can have tremendous economic impacts, but more

importantly, they often have the ability to change structure and function of entire ecosystems. But because most control or restoration efforts focus only on a single species or two, it is easy to lose the larger picture. This presentation provides a broad brush overview of the various ways invasive terrestrial, aquatic and marine species impact water quality, often changing whole ecosystems in the process. It will provide examples of how a single species may set a cascade of other impacts in motion, shifting structure and function of an entire ecosystem, how a species may have multiple direct impacts, have synergistic effects with other invaders, or sometimes facilitate invasions of other species, causing "invasional meltdown".

The efficacy of a biological control (*Cyrtobagous salviniae*) agent on giant Salvinia in the Lower Colorado River. Sangho Choi (student), Earl Andress, Dewey Murray, and Kevin Fitzsimmons; 2601 Airport Dr. Environmental Research Lab (University of Arizona) Tucson, AZ., 85706
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The Lower Colorado River Giant Salvinia Task Force has tried a series of activities to control and eradicate giant salvinia (*Salvinia molesta*), an invasive aquatic weed, since 1999. As these efforts have not been satisfactory, biological control using the weevil *Cyrtobagous salviniae* (Coleoptera: Curculionidae) has been approved for the lower Colorado River by APHIS USDA offices in California and Arizona. They released the weevil at four sites in the summer of 2003 and additional four sites in 2004. We have monitored physico-chemical and biological parameters at release and near release sites (10m and 1km down stream). We have also conducted experiments on the low temperature resistance and survival rates of the biological agent under 3 different temperature ranges (5 - 15 C ^{o}, 10 - 20 C ^{o}, and 15 - 25 C ^{o}) and 2 different salvinia densities. Even though this biological agent has a successful history in some tropical countries, we need to clarify appropriateness of this agent before further application in areas with giant salvinia infestations in U.S. (temperate or semi-tropical weather). At a water temperature of 5 C ^{o}, the survival rate of the weevil was sharply decreased whereas a significantly higher survival rate was observed at 10 C ^{o} and 15 C ^{o}. The density of Salvinia plants did not show a significant effect on the temperature resistance of the weevil.
The success of natural dispersal and establishment of a colony has still not been determined. An Integrated Pest Management Plan (physical, chemical, and biological methods) will be essential for successful control of salvinia in the Lower Colorado River.

Divers and aquatic nuisance species control. Doug Freeland; Aquatic Consulting and Evaluation (A.C.E.) Diving, P.O. Box 840, Spirit Lake, ID 83869
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Control of Eurasian watermilfoil (*Myriophyllum spicatum*) by hand pulling using scuba divers has not been extremely successful in the past. Over the last few years we have made improvements in equipment and training such that we are successfully controlling

Eurasian milfoil and Brazilian elodea (*Egeria densa*) in many different waterways. Diver surveys can detect aquatic invasive species infestations and help coordinate control efforts earlier than other methods. We also have improved the way bottom barriers are used so they are more practical now. These advantages of using divers to compliment other methods will be discussed.

Development of a research program to support *Ludwigia hexapetala* management and wetland restoration. Brenda J. Grewell, PhD[1], Anna L. W. Sears[2], Lily N. Verdone[3]; [1]USDA-ARS Invasive Weeds Research- UC Davis Plant Sciences Dept. Mail Stop 4, University of California Davis, One Shields Ave. Davis, CA 95616; [2]Laguna de Santa Rosa Foundation, Santa Rosa, CA; [3]Sonoma State University, Rohnert Park, CA
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Ludwigia hexapetala (Uruguayan primrose-willow) is a robust, rapidly growing, perennial aquatic herb that has been introduced to the United States and Europe from South America, and is recognized as a noxious invasive plant. Although herbarium specimens indicate its presence in California since 1945, there is growing concern about recent aggressive spread in sensitive wetlands. Many aquatic *Ludwigia* species are phenotypically plastic in response to environmental conditions, and variable growth forms of *Ludwigia hexapetala* complicate species identification.

Ludwigia hexapetala has recently invaded the Russian River watershed in Sonoma County, California. This invader poses a public health threat as it creates preferred habitat for mosquitoes that carry West Nile Virus, and inhibits effective mosquito control. *Ludwigia* also reduces native species diversity through competition, elimination of open-water habitat, and reduction of oxygen levels critical for fish survival. Its woody biomass accumulation may increase flooding through reduction of flood control channel capacity. We have initiated a research program for restoration-based management of *Ludwigia*. Our experimental approach includes an identification of *Ludwigia* growth responses to biotic and abiotic factors, life cycle vulnerability, and the effects of *Ludwigia* growth and control strategies on native plant community restoration.

Monitoring required under Washington's Noxious Weed NPDES Permit. Kathy Hamel; Washington State Department of Ecology, M.S 4600 Olympia, WA 98504
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Washington's Noxious Weed NPDES general permit for the application of aquatic herbicides has been in place since 2002. The permit calls for herbicide residue and other monitoring after aquatic herbicide application to lakes, tidelands, and river shores. Not all treatments are monitored, but a subset of the applications has been monitored since 2002. This has resulted in a dataset of herbicide concentration, water quality, and plant biomass data from Washington waters after treatment with the various herbicides allowed under the permit. The data has been used to develop permit mitigations after the herbicide's use and to support EPA requests for actual use data after herbicide treatments. This presentation will present the results from monitoring after treatments for spartina, purple loosestrife, Eurasian milfoil, and other noxious weeds.

Lower Colorado River region herbicide trials to determine the effective control of *Salvinia molesta* Mitchell. Denise Hosler; US Bureau of Reclamation, P.O. Box 25007 D-8220, Denver, CO 80225-0007
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Native to Brazil, *Salvinia molesta* Mitchell (giant salvinia) was first discovered outside of its native range in Sri Lanka in 1939 (Williams, 1956) and has been inadvertently introduced throughout the world as an ornamental for ponds and aquariums. Thriving in slow moving rivers, canals, and still water, it is a major nuisance to water managers; obstructing irrigation canals, impeding dam operations, and recreational activities. Reproducing vegetatively, it crowds to form dense, thick, mats that can double in size in as little one week. The mats shade native macrophytes, reduce oxygen content and water quality, affecting fish and other aquatic organisms.

In 1999, *S. molesta* was found in the Palo Verde Irrigation Drain and Lower Colorado River to Yuma, Arizona. Documentation revealed the two most successful herbicides for the control of *S. molesta* were diquat and glyphosate. Both are deactivated by sediment contact (Fairchild et al., 2003, Nelson et al., 2001). Lower Colorado River conditions include high sediment, salinity, and nutrient loading indicating that herbicide performance could be compromised. Research trials were implemented to determine the most effective herbicide concentrations for the control of *S. molesta* in the Lower Colorado River system. The methods, materials, and results of these studies will be discussed.

The Cygnet Pro Applicator ^{R}: John P. (Jay) Kasheta III and Thomas J. McNabb; Clean Lakes, Inc., 2150 Franklin Canyon Road, Martinez, CA 94553

The Pro Applicator is a new state-of-the-art aquatic pesticide application boat. The spray system is controlled by an on-board microprocessor that uses a GPS to track the spray path. The rate control module compensates for boat speed, so the end result is a uniformed application. When the job is completed, the information can be downloaded to a PC and a map generated showing exactly where the product was applied and how much. These maps can be used to monitor weed growth from year to year, support development of long term treatment strategies, as well as ensure compliance with new BMP (Best Management Practices) and BAT (Best Available Technology) requirements of the NPDES permit here in the West.

Is garden loosestrife (*Lysimachia vulgaris*) a serious wetland threat in the West that is being overlooked? Drew Kerr; Aquatic Noxious Weed Specialist King County Noxious Weed Control Program 201 S. Jackson St., Suite 600 Seattle, WA 98104-3855
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Garden loosestrife (*Lysimachia vulgaris*) is a rhizomatous perennial native to Eurasia that is already widely distributed across the United States. It thrives in wetland and riparian areas with its long, red rhizomes that can be seen extending 10 feet or more into the water. Considered naturalized in areas like New England, it may be their cold winters that are the only factor keeping it in check. In King County, Washington in the Puget Sound lowlands, this invasive weed has established a number of large infestations that may give us some indication of its real potential in the West, and the challenges in controlling it. The most extensive of these includes a hydrologically-connected infestation along the shoreline of 4,897 acre Lake Sammamish, the 14 mile riparian corridor of the Sammamish River, and the northern half of 21,500 acre Lake Washington. Despite this evidence as to its invasive potential, Washington is the only western state with this plant on its noxious weed list; it is not even listed in Oregon or California where the climate should not limit its dispersal or establishment.

Cusick (1986) reports that in the Ohio Valley, it may remain in the vegetative state for some time prior to blooming, making early detection essential. Along with infestation shots to illustrate its potential, information on the identification of *Lysimachia vulgaris* will be provided, as well as recent experience with different control techniques.

Up-flow circulation as a bio-manipulation strategy for preventing cyanobacteria blooms and improving lake ecology. Christopher F. Knud-Hansen, PhD;
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Water circulation devices have been long appreciated for their ability to improve water quality in ponds, lakes, and reservoirs. This presentation focuses on six years of empirical results from dozens of lake systems where up-flow circulators have been installed for water quality improvement. Observed beneficial impacts include preventing cyanobacteria (blue-green algae) blooms through surface water turbulence and transport, efficient dissolved oxygen distribution throughout the water column, improved water clarity through enhanced trophic relationships, increased fish spawning and survival, and reduction of submerged macrophyte communities - particularly Eurasian watermilfoil (EWM). Although the exact mechanism behind observed EWM reductions has not yet been demonstrated experimentally (the US Army Corps of Engineers is currently designing the necessary experiments), it appears to be related to the circulation-induced sediment oxidation of ammonia to nitrate and/or the physical removal of ammonia-rich interstitial waters as oxygenated waters flow over the sediments. Because EWM strongly favors ammonia uptake, and not nitrate, the circulation of oxygen-rich water across the sediments reduces ammonia-N availability and thus promotes N-limitation of EWM growth. This hypothesis is supported by consistent observations of EWM reductions even as water clarity improved, with few remaining plants often yellowish and sickly - typical of N-deficiency. More broadly, the numerous ecological benefits associated with up-flow circulation are direct consequences of 1) preventing blue-green algal blooms, and 2) transporting oxygen-rich epilimnetic waters throughout the water column and across bottom sediments.

Evaluation of revegetation strategies and technologies for restoration of bull trout habitat and shoreline woody vegetation Hungry Horse Reservoir, Hungry Horse, Montana. Kenneth Lair, Ph.D.[1], Stephen Grabowski, Ph.D.[2], Brian Marotz[3]; [1]Bureau of Reclamation, USDI Bureau of Reclamation Building 56, Room 2010 P.O. Box 25007 (D-8220) Denver, CO 80225-0007; [2]Bureau of Reclamation, Boise, ID; [3]Montana Fish, Wildlife and Parks, Kalispell, MT
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Hungry Horse Reservoir is a Bureau of Reclamation (BOR) hydropower project, operated in conjunction with the Bonneville Power Administration in the upper Columbia River Basin. The principal fish species of concern in the reservoir and tributaries is the federally listed bull trout, *Salvelinus confluentus*. Recent changes in federal protocols that regulate reservoir levels for flood control, power generation, and minimum flows for anadromous fisheries result in frequent drafts, including high-volume releases during the spring refill period. Repeated annual draft-and-fill regimes have depleted native woody vegetation in littoral shoreline habitats, reducing hiding cover for juvenile bull trout entering the reservoir from spawning tributaries. The BOR is leading an interagency research effort to assess the feasibility of re-establishing diverse, native woody species under these environmental constraints.

Field trials were initiated in October, 2004 to evaluate a suite of native woody plant materials, shoreline siting, planting techniques and plant supplementation for shoreline revegetation. The research encompasses use of direct cuttings and containerized materials; comparison of inundation depths and duration within the upper littoral zone; and augmentation of plants with tailored combinations of nutrients, mycorrhizae and polyacrylamide polymer. Study objectives, hypotheses, experimental design and first year (spring reservoir pre-fill) results will be discussed.

Purple loosestrife distribution in California after five years of survey and control. Robert Leavitt, David Kratville, Baldo Villegas and Carri Pirosko; California Department of Food and Agriculture, 1220 N Street, Rm. A-357, Sacramento, CA 95814
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The California Department of Food and Agriculture (CDFA) is the lead agency for survey and control of purple loosestrife (*Lythrum salicaria*) in California. The CDFA purple loosestrife surveys utilize innovative GIS mapping techniques including Hyperspectral Analysis. In 1999 there was one known location in the state, as of 2004 there are 93 operable units known to be infested with purple loosestrife. Only seven units were added in 2004, most of which were expansions of previously known infestations. This suggests that most purple loosestrife occurring in California has been accounted for. The CDFA Purple Loosestrife Control Project uses an integrated pest management approach. Control measures include two applications of herbicide per year, a combination of biological control agents (*Galerucella* spp., *Hylobius transversovittatus*, and

Nanophyes marmoratus) or physical removal and seed-head clipping. The CDFA Purple Loosestrife Control Project is a collaborative effort with assistance from numerous public and private organizations.

Ecology, life history, phenology, and management of curlyleaf pondweed in Minnesota. John D. Madsen[1], Thomas E. Woolf[2]; [1]GeoResources Institute, Mississippi State University, Mississippi State, MS 39759; [2]USDA-ARS, Northwest Watershed Research Center, Boise, ID 83712-7716
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Curlyleaf pondweed is the most widespread nonnative invasive aquatic plant in Minnesota, and is a common nuisance in lakes of the northern tier states. Four southern Minnesota populations of curlyleaf pondweed were sampled monthly from January 2001 to November 2002 to determine phenological and carbohydrate allocation patterns. Samples were separated into shoots, roots, inflorescence, and turions; and then dried. Biomass (g m^{-2}) and percent total nonstructural carbohydrates (TNC) were determined for each plant component. Total plant biomass was highest in all four lakes in late May and early June, ranging from 122 to 190 g m^{-2}. Turion formation and flowering were observed to coincide with maximum biomass. Maximum turion TNC concentrations ranged from 44 to 66%. The low point of turion carbohydrate storage in all four lakes occurred between January and April 2002, suggesting that early spring may be the best time to initiate management. Long-term management of curlyleaf pondweed requires depletion of the turion bank by repeated annual treatments timed to occur before turion formation. Management techniques that match these criteria include early spring treatment with contact herbicides, harvesting initiated early in the spring, and winter drawdown.

Successes and failures of the nuisance weed and irrigation NPDES Permits in Washington. Kelly McLain; Aquatic Pesticide / Water Quality Program, Washington Department of Ecology, M.S. 4600, Olympia, WA 98504
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Since 2002, Washington State has been issuing NPDES permit coverage for government entities and individuals wishing to control aquatic plants in lakes, streams, rivers, reservoirs, and irrigation ditches. Aquatic plant control has been placed into three different categories: nuisance weeds, noxious weeds, and weed control in irrigation systems. With three years under our belt, Washington is now beginning the process of updating these permits before they expire in 2007. The nuisance weed and irrigation permits have worked with varying degrees of success. In starting the reissuance process, Ecology has begun evaluating the things that have worked well, and those things that have not worked well during this permit cycle. The purpose of this talk is to provide other state agencies with information about the successes and failures of these two permits, and

the changes in aquatic plant management in Washington State since the 2001 *Talent* decision.

The evolution of chemical control strategies for Eurasian milfoil control. Terry McNabb; Aquatic Biologist, Aquatechnex, LLC, PO Box 30824 Bellingham, WA 98228 www.aquatechnex.com

Eurasian milfoil is a harmful non-indigenous species that has caused severe problems in lake and river systems across the Northern United States and Canada. The plant is extremely invasive and rapidly colonizes the littoral area of a lake upon introduction. As the plant spread primarily by fragments on boat trailers, it can be highly mobile. Once established, the weed forms dense surface mats and fills the water column, impacting recreation, fisheries and water quality.

There are a number of control technologies that have been developed to target this weed. Chemical control technologies for this weed have evolved over the past two decades with the introduction of new US EPA approved aquatic herbicides, and methods of applications. The technology now exists to selectively target this noxious weed and remove it from infested lakes while protecting native aquatic plants.

This paper will discuss this evolution and demonstrate through case studies how prescriptions can be developed to selectively target this weed.

Recent research on distribution, growth and identification of invasive hybrid watermilfoil. Michael Moody, PhD; University of Indiana, Bloomington, IN e-mail: michael.moody@uconn.edu

Invasive Hybrid watermilfoil (*M. spicatum* x *M. sibiricum*) was first recognized in 2001 from three populations in Minnesota and Wisconsin. Subsequently, with the aid of aquatic plant management agencies, 27 hybrid watermilfoil populations have been identified in five states (Idaho, Michigan, Minnesota, Washington and Wisconsin) across the Northern United States. Wisconsin (16 populations), by far, has the most currently identified hybrid populations, but this may be due more to the active interest the Wisconsin DNR has shown in identifying these aberrant taxa rather than truly having the largest infestation. While we continue to find new populations, little has yet been discovered about the biology of these hybrid taxa. Preliminary greenhouse research has now shown that both *M. spicatum* and hybrid watermilfoil have similar patterns of growth. Fragmentation and spread of hybrid watermilfoil through vegetative propagules may prove much more prominent than found in Eurasian watermilfoil. Morphological characteristics delimiting Eurasian watermilfoil from hybrid watermilfoil prove difficult if not impossible to define. Molecular techniques continue to be the only way to

determine unequivocally the identification of hybrid watermilfoil, but some general morphological traits can be used in determining potential hybrid populations from Eurasian watermilfoil. Much more research is needed on the biology of these hybrid taxa to determine management techniques best suited to curb its spread.

Mechanical control of water hyacinth in an irrigation slough. George P. Forni; President, Aquatic Environments, Inc., P.O. Box 1406 Alamo, CA 94507.
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Water Hyacinth (*Eichhornia crassipes*) growing in ponds, sloughs, channels, streams, and lakes creates slow moving water and stagnant conditions which not only affect irrigation but also pose a serious health threat (West Nile Virus). This affects sensitive habitats and communities within the United States, and especially in the Tom Paine Slough (TPS) in Tracy, California. The use of highly specialized equipment for control and remediation has proved viable in the management and long-term control of growth. Work is typically performed over the water with no peripheral site damage. As the balance between habitat preservation and growth management intensifies, the use of alternative methods will become increasingly more viable.

Preliminary assessments on the control of parrotfeather milfoil with Habitat and Renovate, and large-scale control of *Spartina* with Habitat. Kim Patten PhD; Washington State University Long Beach Research and Extension Unit, 2907 Pioneer Road, Long Beach, WA 98631
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Research was done on control of Parrotfeather Milfoil (PM) *(Myriophyllum aquaticum)* by aquatic herbicides. Drainage canals in Longview, the Julia Butler Hanson National Wildlife Refuge, and Seaview, Washington, which were clogged with PM were treated with a range of herbicides, with varying rates, timings, application methods and herbicide combinations. No herbicide provided 100% control with one application. A single application of Habitat at 6 pt/ac was the most effective herbicide. Renovate treatments required a second application regardless of rate. The differences in efficacy between a combination of Renovate and Habitat compared to Habitat alone were subtle. Due to the thick canopy mat and slow flow, sub-surface injection of herbicide for PM control was problematic.

Approximately 6000 acres of *Spartina* in Willapa Bay were treated with Habitat in 2004 by state and federal agencies. Efficacy of these control efforts was evaluated as a function of application methods (aerial, ground broadcast, hand spray), rates (4, 5 and 6 pt/ac), and timings (June to September). Overall efficacy was excellent, with aerial application of 6pt/ac in June superlative. Late timings were problematic owing to a failure to totally prevent seed production. Follow-up treatments of Habitat-treated *Spartina* were difficult

due to the lack of visual brown down. A full evaluation of all experiments won't be available until spring regrowth in 2005.

Productivity and growth rates of *Egeria densa* in the Sacramento-San Joaquin Delta, California. Toni G. Pennington (student) and Mark D. Sytsma; Center for Lakes and Reservoirs, Portland State University, PO Box 751/ESR, Portland, OR 97207-0751. email: toni@pdx.edu

Invasion of lakes and reservoirs by non-native submersed aquatic plants degrades water quality, limits navigability, and is aesthetically displeasing. *Egeria densa* is one of the most problematic aquatic plants in the Sacramento-San Joaquin Delta of California. The purpose of this ongoing research is to improve the understanding of the life history of *E. densa* in an effort to improve management efficacy in the Delta. Growth and photosynthetic response to light was measured monthly in Disappointment Slough in the Delta beginning December 2003. Photosynthetic response to light was determined by incubating plant tips in 300-ml bottles at five light levels using neutral density shade cloth. Changes in pH and dissolved oxygen concentration were measured before and after 4h at ambient surface water temperature. Bicarbonate (HCO_3^-) use by *E. densa* was suggested by growth at pH of 10.18 after 4h incubation. To date, maximum photosynthetic rate was observed summer 2004 at ~6 mg $O_2 \cdot$ mg $DW^{-1} \cdot h^{-1}$ when surface water was 25C. Minimum photosynthetic rate was observed January 2004 at 1.2 mg $O_2 \cdot$ mg $DW^{-1} \cdot h^{-1}$ when surface water was 9.2C. Photosynthetic efficiency (α) was positively correlated with %N in plant tips ($p = 0.008$) and negatively correlated with light compensation (Ik) ($p = 0.02$). Growth rates were determined by tagging plants and measuring changes in apical growth and stem elongation after approximately three weeks. Average maximum apical growth of 0.7 ($\pm$0.09 SE) cm d^{-1} and stem elongation of 0.25 ($\pm$0.04 SE) cm d^{-1} was observed in April 2004 when water temperature was 23C.

Western Regional Panel on Aquatic Nuisance Species, an update. Tina Proctor; Western Regional Panel Coordinator, US Fish and Wildlife Service, P.O. Box 25486, DFC, Denver, CO 80225
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WAPMS is the newest member of the Western Regional Panel on Aquatic Nuisance Species, a 50-member partnership consisting of Federal agencies, States, Tribes, private associations and NGO's. The WRP is a regional advisory panel to the federal Aquatic Nuisance Species Task Force and regularly provides policy and issue reports. Tina Proctor, WRP Coordinator, will present information about the most recent projects which include among others, a Spartina control project in the Washington and British Columbia boundary waters, an estuarine database for the West Coast and plans for a pre-invasion rapid response team for freshwater aquatic plants.

Economic impacts of invasive aquatic plants: Houghton Lake Case Study and implications for the aquatic plant management industry. Scott Shuler; Western Aquatic Specialist, Mark Mongin, Business Manager Aquatic Specialty Products, SePRO Corporation 11550 N. Meridian Street, Ste. 600 Carmel, IN 46032-4565
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It is common knowledge throughout the aquatic field that an exotic plant infestation on a lake can have serious detrimental consequences to the ecology of the water body. We often discuss the logical significant economic impact that degraded water quality from excessive exotic plant growth, can have on the local businesses and commerce connected with a given lake. It is, however, not very easy to quantify many of the economic values associated with the lake community, making even an extensive economic study, still incomplete. The purpose of this report will be to explain the documented impacts of the 2002 Sonar treatment of Houghton Lake. Through personal interviews, local economic data research and the analysis of an extensively distributed survey, the outcome of the Sonar treatment of Houghton Lake will be critically looked at both in terms of personal/communal satisfaction and overall satisfaction of project results for the property owners who paid for the treatment. In addition, other examples from the literature will be discussed and an overview presented of what we know now about economic impacts of invasive aquatic plants and what we need to learn.

Evaluation of water hyacinth survival and growth following cutting. D. F. Spencer[1], G. G. Ksander[1], M. J. Donovan[1], P. S. Liow[1], W. K. Chan[1], B. K. Greenfield[2], S. B. Shonkoff[2], and S. Andrews[3]. [1]USDA ARS Exotic & Invasive Weeds Research Unit, Department of Plant Sciences, Mail Stop 4, One Shields Avenue, Davis, CA 95616 [2]San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621 [3]Environmental Sciences Teaching Program, 301 Campbell Hall, UC Berkeley, Berkeley, CA 94720
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Water hyacinth (*Eichhornia crassipes* (Mart.) Solms), is a serious problem in the Sacramento Delta, currently managed with herbicides and to a lesser extent biological control insects. The purpose of this study was to test the hypothesis that water hyacinth would not survive treatments made by three types of cutting machines mounted on boats and thus result in open water areas. Water hyacinth mats were treated by machines 1 and 2 during September, 2003 at Lambert Slough, south of Sacramento, California and at the Dow Wetlands, near Antioch, California. In June 2004, machine 3 cut plants in the Dow Wetlands. Machine 1 sheared off the leaves resulting in many plant fragments and plants that consisted of floating stem bases with intact root systems. The cutting motions of Machines 2 and 3 differed and these machines produced numerous plant fragments along with ramets that had been split along a vertical axis into nearly intact ramets with broken

leaves. Plants collected immediately after the treatments and grown either *in situ* or in tubs in Davis, California began to produce new leaves within one week of treatment. Leaf production rates were higher for cut than for un-cut plants. Similarly, plant dry weight increased over the course of the experiments. All of the plants survived in the tub experiments and 65% of them survived in field enclosures for at least six weeks. At Lambert Slough, > 50% of the surface was covered by floating plant debris (2446 g dry weight m^{-2} and 1589 g dry weight m^{-2}) after four and six weeks even though the expectation was that the material would sink and decompose within three weeks. Cutting water hyacinth with the three machines evaluated in this study did not immediately (i.e., within six months) produce large weed free areas of open water in habitats typical of those found in the Sacramento / San Joaquin Delta.

Spartina management in Oregon. Mark Sytsma PhD, V. Howard; Center for Lakes & Reservoirs, Environmental Sciences and Resources, Portland State University, Portland, OR 97207-0751.
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Four species of *Spartina* are considered invasive on the west coast. Oregon has one small infestation of *S. patens* that is targeted for eradication. A spartina response plan was prepared to prevent spread and establishment of spartina in Oregon. The plan includes surveys, public education, and research on dispersal.

Commonly used mechanical control methods for *Spartina alterniflora* involve varying levels of disturbance to rhizomes and roots. We examined the viability of rhizome fragments and their potential role in dispersal. Survivorship of *S. alterniflora* rhizome fragments from Willapa Bay and San Francisco Bay populations was investigated. Large rhizomes had higher survivorship than small rhizomes. The length of time the rhizome fragments were immersed prior to planting had variable effect on survivorship. Results suggest rototilling for control of *Spartina* may spread the infestation within an estuary but is unlikely to result in spread to other estuaries by ocean transport. Thus, tilling should be used with caution in estuaries with small, isolated populations of *Spartina*.

Although ocean transport of rhizome fragments appears to be a small risk, ocean transport of wrack and viable *S. alterniflora* seed is likely. A drift card study was begun in late September 2004 with the goal of better understanding potential dispersal from invaded west coast estuaries. Monthly releases of cards from Humboldt and San Francisco bays in California, as well as Willapa Bay, Washington will aid identification of wrack deposition sites. Data from the first two months of this year-long study indicate that long-distance dispersal up to 270 km over a four-week period can occur.

Mapping invasive plant species in the Sacramento-San Joaquin Delta region using hyperspectral imagery. Susan L. Ustin PhD[1], Emma C. Underwood PhD[1], Melinda J. Mulitsch[1], Jonathan A. Greenberg PhD[1], Shawn C. Kefauver[1], Michael L. Whiting PhD[1], Carlos A. Rueda[1], Carlos M. Ramirez[1], Marcia Carlock[2], and Dr. Robert C. Leavitt[3].

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The University of California, Davis, the California Department of Boating and Waterways, and the California Department of Food and Agriculture cooperated on a project to evaluate the use of hyperspectral imagery for detecting invasive aquatic and riparian species in the Sacramento-San Joaquin Delta in California using HyMap hyperspectral imagery. Hyperspectral imagery (126 spectral bands, 3 m pixel size) was acquired over a 400 km^2 area in July 2003 and a 3,400 km^2 area in July 2004, to map the invasive aquatic weed water hyacinth (*Eichhornia crassipes*), the submerged Brazilian waterweed (*Egeria densa*), and the riparian weeds purple loosestrife (*Lythrum salicaria*) and perennial pepperweed (*Lepidium latifolium*). Our analyses capitalized on differences in the spectral signatures of the target invasives and used a decision tree approach to map their distributions. Results from 2003 showed a classification accuracy of 90.6%, while mapping accuracy in 2004 was somewhat less. Preliminary findings at a finer scale also showed that Brazilian waterweed can be distinguished from other submerged aquatics such as Coontail (*Ceratophyllum demersum*), American pondweed (*Potamogeton nodosus*), and Common waterweed (*Elodea canadensis*). The findings of this study can provide critical information for controlling and monitoring the target species within the Sacramento-San Joaquin Delta.

Phenology of *Potamogeton crispus* in Blue Lake, Oregon: Management implications of timing of turion formation and germination. Steven W. Wells (student), Mark D. Sytsma, PhD; Center for Lakes and Reservoirs, Portland State University, PO Box 751/ESR, Portland, OR 97207-0751,
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Potamogeton crispus (Curlyleaf pondweed) is a widespread, introduced plant in the western USA. It creates nuisance conditions in Blue Lake, which lies within the metropolitan area of Portland, Oregon. *P. crispus* propagates vegetatively via turions (compressed shoot apices), shoot and rhizome fragments, and sexually via seed. Turions are produced from spring to late summer. Turions germinate in fall and develop into a winter-form plants that form turions the following spring.
The phenology (turion formation and germination) of *P. crispus* in Blue Lake was investigated by sampling bimonthly using a rake and dredge over a one year period (11/6/03 to 1/11/05). Data on stem and turion mass, length, and number of leaves and buds were collected.
Turions germinated in Blue Lake, Oregon between October and the end of April. New turions were present on plants from early April trhough early September. These data suggest that management prior to mid March may inhibit new turion formation and provide long-term benefits for *P. crispus* control in Blue Lake.

Don't let algae ruin your day. Paul Westcott, James C. Schmidt. Applied Biochemists
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From farm ponds to drinking water reservoirs, algae and cyanobacteria plague our aquatic ecosystems with an array of problems ranging from aesthetics to use impairment. While those of us in the lake and pond management business realize their importance in the overall aquatic ecology of these sites, control efforts are often needed to balance the ecosystem, improve appearance, restore functional water use, bring water quality into acceptable regulatory compliance or alleviate public concerns and complaints. A strong focus on research and monitoring of toxic and taste & odor (T & O) producing algal species continues to mount with their increased nationwide occurrence. Recent studies on interrelationships between exotics such as Zebra Mussels, phytoplankton and nutrient budgets have shown some interesting shifts in dominant species. Toxic epiphytic and T & O producing benthic species have been recently discovered. Further work has gone into classifying algal toxins based upon their sources and physiological impacts. A database is in process of being compiled from laboratory studies on different species and biomasses utilizing varying algaecide rates and formulations. Work is on-gong in expanding this "Targeted Algal Management" approach. Observations and data gathered following large-scale operational algaecide treatments conflict with assumptions related to "leaky" cells and "spilling" of these cellular materials post-application. New studies are underway to determine impacts from commonly used algaecide products at the cellular level with respect to production and potential release of toxins / T & O compounds.

ABSTRACTS – POSTERS

Evaluation of Non-Chemical Control Strategies for Common Aquatic Weeds in California. Michael Blankinship, Blankinship & Associates, Inc.Agricultural & Environmental Consultants, 2940 Spafford St., Ste 110 Davis, CA 95616
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Little or no quantitative data exists for the aquatic weed management professional to compare non-chemical control techniques to the use of aquatic pesticides. The efficacy, cost-effectiveness and impacts to water quality when non-chemical control techniques are employed was studied and documented on aquatic emergent, floating and terrestrial weeds. Techniques evaluated were goats, mechanical removal, chemical treatment followed by mechanical removal, and manual removal by labor crews using power equipment. Water quality impacts including the presence of coliform and E. coli were noted. Significant differences in cost per acre treated and efficacy were noted in the study and may be useful for the practitioner evaluating the relative merits of chemical vs. non-chemical control techniques.

Developing a state invasive species alliance for Mississippi. John D. Madsen[1], John D. Byrd, Jr.[1], David R. Shaw[1], and Randy G. Westbrooks[2]; [1]Mississippi State University, GeoResources Institute, Mississippi State, MS; [2] U.S. Geological Survey, Biological Resources Discipline, Reston, VA.
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Invasive species are a multi-billion dollar problem in the mid-south states. While a number of federal, state, and local agencies have responded with small programs to manage these problems, cost-effective management requires early detection and management. The proliferation of programs lacks effective communication and coordination between states and agencies. Individual development of tracking new infestations and data sharing would be wasteful duplication of funds. We are developing a task force of federal, state, and local government agencies, nongovernmental organizations and concerned citizens focused on the early detection and management of invasive noxious species in Mississippi, the Mississippi Invasive Species Alliance (MS-ISA). The organization will be tiered, having an executive council of decision-makers from each state, a technical steering committee, and an advisory council composed of those interested in participating. The MS-ISA will coordinate the sharing of data, act as a clearing house for locations of invasive species in the region, facilitate information exchange at the appropriate federal level, and act to coordinate regional management efforts.