The Western Aquatic Plant Management Society

ABSTRACTS
20th Annual
Western Aquatic Plant Management Society Meeting
March 29-30, 2001

Keynote Address: The Aquatic Plant Management Society – The Next Forty Years. James C. Schmidt. APMS President. Applied Biochemists.

The Aquatic Plant Management Society, Inc. (APMS) celebrated its fortieth year of existence at its 2000 Annual Conference held in San Diego, CA this past July. This meeting had an international scope with participants from around the world. We thank the Western Chapter for its assistance in co-hosting this event. The APMS is a multi-disciplinary organization made up of individuals from government, universities and private industry. We are affiliated with various other National Societies who share our common interests. Eight chapters have evolved from the APMS to address concerns on a state and regional basis. As we look towards the future of the Society and the business of aquatic of aquatic plant management, the APMS is taking a number of initiatives to carry out its goals and objectives. This includes paying closer attention to the desires of our membership; furthering efforts in education and outreach; making changes in our Annual meeting as may be called for; increasing communication and synergy with Regional Chapters; and ensuring that we administer our monies through sound financial planning. I want to encourage your membership and participation in the APMS including your attendance at our 41st Annual Conference July 15-18, 2001 in Minneapolis, MN. Further information can be obtained through our website www.apms.org.

Salvinia Molesta in the Lower Colorado River. Bob Pitman. US Fish and Wildlife Service, Albuquerque, NM.

Giant salvinia was first collected from the Colorado River on the Imperial National Wildlife Refuge near Martinez Lake, AZ, in August 1999. A multi-agency response team was quickly formed to locate the source and define specific agency actions. Organizational meetings identified a Steering Committee to meet regularly and develop an Action Plan. This Plan lists priority actions and responsibilities for agencies and offices involved in efforts to control and eradicate this aquatic invasive plant. Biological Evaluations were quickly drafted to allow treatments of federal lands. The Palo Verde Irrigation District (PVID) has supported efforts to eradicate giant salvinia from their drainage ditch near Blythe, CA. Plant buds from this source flow downstream with agriculture runoff for about 20 miles where the drain returns to the Colorado River near Walters Camp, CA. *Salvinia molesta* is established throughout the Colorado from Walters Camp downstream to Yuma, AZ, in low levels but has not exhibited characteristic explosive growth rates. Low level of floating plants and fragments are regularly found in the Imperial Irrigation District supply canals and flowing into Mexico but have not caused a problem. Funding and efforts have increased to eradicate this invasive species in the PVID drain in 2001.

Giant Salvinia (*Salvinia Molesta* Mitchell) in Texas: Status and Response. Rhandy J. Helton. Texas Parks and Wildlife Department, Jasper, Texas.

Giant salvinia (*Salvinia molesta* Mitchell) is an invasive aquatic fern that has been widely distributed around the world for use in aquariums and watergardens. In the wild it can form dense, fast growing, floating surface mats that create all manner of environmental conflict.

Irrigation, drainage, navigation and recreational uses are impacted and overall water quality is seriously degraded. Native plant communities will be quickly and adversely affected. An otherwise healthy aquatic ecosystem can be destroyed, justifying giant salvinia being labeled "the world's worst aquatic weed". Giant salvinia is native to southeastern Brazil and is on the U.S. Federal Noxious Weed List. In Texas, the plant was first identified in Houston in April 1998. Since that time the plant has been verified in four public reservoirs (Toledo Bend, Texana, Conroe and Sheldon), 5 streams, 27 private lakes/ponds and 10 commercial nurseries. Proposals in a Giant Salvinia Task Force action plan recommended an aggressive public education campaign and the implementation of an integrated pest management strategy. Affected agencies have responded with the publication and distribution of the giant salvinia fact sheet in Texas and across the southern U.S. Aquatic herbicide applications have begun on the public reservoir sites in Texas. These applications have effectively contained the infestations. More importantly, accelerated biological control research led by the U.S. Department of Agriculture is proceeding. Once further host-range studies are complete, the Australian strain of the salvinia weevil, *Crytobagous* sp., will be released into selected sites within the state. Biologists are cautiously optimistic, that once established, this insect will achieve and maintain control of giant salvinia just as it has elsewhere worldwide.

***Salvinia Molesta* and Its Control: An Update.** Dan H. Wickham. Syngenta, Rancho Santa Margarita, Ca.

Salvinia molesta is one of several noxious weeds to achieve notoriety in the aquatic weed management area. This weed has been found from coast to coast in the USA as well as in its home region of Asia. Control of this pest has included significant scouting and mapping programs along with timely herbicide applications. Reward herbicide has been demonstrated to be one of the key herbicides in the control of *S. molesta*. Mapping and timely applications of Reward at the proper use rates and volumes are the key to successful control and maintenance of this noxious pest.

Small-Scale Evaluations of Herbicides Against Giant Salvinia. John Slogerboe and Linda Nelson. US Army Engineer Research and Development Center, Vicksburg, MS.
Giant salvinia (*Salvinia molesta* D.S. Mitchell) is a free-floating aquatic fern native to Brazil that has recently established and become a nuisance in many lakes, rivers and reservoirs in the United States. Giant salvinia is considered one of the world's worst weeds due to its prolific growth habit, effective means of distribution and difficulty of control. Current information and experience on the use of herbicides to manage this exotic weed is limited. Two outdoor tank studies were conducted at the Lewisville Aquatic Ecosystem Research Facility, Lewisville TX to assess the efficacy of several available aquatic herbicides including glyphosate, diquat, copper, and endothall for use against giant salvinia. Herbicide rates and herbicides in combination with surfactants and other herbicides were evaluated in this investigation. The results of these treatments and subsequent guidance for chemically managing giant salvinia in U.S. waterways will be discussed.

Update of Nevada Aquatic Weed Programs. John O'Brien. Nevada Department of Agriculture, Reno, NV.

The Department of Agriculture, for the first time ever, hired a weed specialist – Dawn Rafferty! Three aquatic weeds were added to the Nevada noxious weed list in 2000: purple loosestrife, hydrilla and Eurasian watermilfoil.

Purple loosestrife is not widely distributed in Nevada. Found along some ditches in the Reno-Sparks area and along the Truckee River from Sparks to Nixon. Distribution increased dramatically after a February '97 flood. U.S. Fish & Wildlife Service flood recovery money is being used for a cooperative survey/treatment program. Rodeo was utilized in 98', 99', and 00'. Reduction varied from 40% to 90%. Largest infestations were found on Nixon Paiute tribal lands along the Truckee River.

Eurasian water milfoil was found in protected areas of Lake Tahoe in Nevada. It was also found in a small water containment area in Verdi – the water is from and empties into the Truckee River about 10 mi. upstream from Reno. Surveys were initiated downstream in Fallon – Truckee/Carson Irrigation District, Stillwater National Wildlife Refuge.
A giant salvinia survey planned for the Colorado River around August 2001 is contingent on funding from the USDA-APHIS.
Eurasian Watermilfoil in Idaho. Glen M. Secrist. Idaho Department of Agriculture, Boise, ID. Eurasian milfoil (*Myriophyllum spicatum*) is relatively new to Idaho. It was likely transported by boaters into lakes and rivers into Idaho's Panhandle area from western Washington in the early 1990's. By 1998, it had become a significant enough problem in Idaho's Spirit and Hayden Lakes to cause lakeshore landowners and recreationalists to request that local, state and federal agencies take action. In 1998, Kootenai County, in conjunction with four other State agencies, formed a cooperative to attack the problem. The outcome of this cooperative effort has been the development of some innovative mechanical control techniques for reducing the impacts of Eurasian milfoil. In the fall of 2000, the presence of Eurasian milfoil was verified in scenic Payette Lake near McCall, nearly 300 miles south of the Panhandle infestations. A task force has been hastily formed and is developing an eradication plan for this field season. Additionally, a statewide reconnaissance effort is also planned. In February, the Idaho Legislature added Eurasian milfoil to the Idaho Noxious Weed list making it the first aquatic nuisance species to be so designated.

Nuisance Aquatic Vegetation Management in Texas' Public Waters. Earl W. Chilton II. Texas Department of Parks and Wildlife, Austin, TX.

House Bill 3079 of the 76th Texas Legislature required Texas Parks and Wildlife Department (TPWD) to develop and adopt by rule a State Aquatic Vegetation Management Plan (SAVMP). The plan was developed in coordination with the Texas Department of Agriculture (TDA) and the Texas Natural Resources Conservation Commission (TNRCC). As mandated by the Legislature, the plan had to incorporate generally accepted principles of Integrated Pest Management, establish minimum standards for local governing entities that regulate public water, require herbicide applications to comply with U.S. EPA approved label rates, ensure that public drinking water providers are notified in advance of all herbicide treatments conducted within two miles of an intake, provide for coordination, oversight, public notification, and law enforcement of herbicide use, and ensure herbicide concentrations during application do not exceed Maximum Contaminant levels or EPA approved label rates. Additionally, the SAVMP had to allow the development of Local Plans by local water authorities. Local Plans must be approved by TPWD, TDA, and TNRCC.

Biological Control of Saltcedar: A Cooperative Project. Raymond I. Carruthers. US Department of Agriculture - Agricultural Research Service, Albany, CA.

USDA-ARS worked with a number of state and federal cooperators to acquire $3,000,000 of funding for a research, development, and implementation project for the management of saltcedar and two other invasive weed species. This group of Agencies formed a Consortium that is composed of over 30 federal, state, and private members, including those with strong agricultural (e.g. the California Cattlemens Association) and environmental (e.g. the Nature Conservancy) perspectives. This Consortium has worked to develop research objectives, operational protocols, and methods of conducting biological control, as they all believe that action must be taken to stop the spread and destruction caused by saltcedar. The Consortium plans to address three major tasks that are important for both the management of saltcedar and other invasive weed control projects of the future.

The three major Tasks associated with this project are:

1. The development and evaluation of improved benefit/risk assessment methods for invasive species infestations and their control using biologically-based technologies;
2. The gathering of critical supporting ecological data that characterizes the biology, distribution, and impacts of saltcedar, the biology and ecology of potential biological control agents, and the development of new re-vegetation technologies for area-wide implementation; and
3. The extension delivery and evaluation of new biologically-based technologies for control of exotic saltcedar in several western ecosystems from Colorado to California and from Mexico north to Canada.

The project centers around a six-state effort to release and evaluate natural enemies for the long-term control of saltcedar and detailed experimental studies to determine mechanisms allowing or impeding control. To accomplish this, the project plans to study ecosystem level consequences of invasive species attack and the effects of management actions and re-vegetation efforts across major agricultural and natural habitats. In addition, this project will demonstrate new methods of interagency cooperation and decision making on program actions and regulatory processes that require the safe use of exotic biological control agents.

Effectiveness of Purple Loosestrife Biocontrol at Four Western Sites. Debra Eberts. US Bureau of Reclamation, Denver CO.

Biological control of purple loosestrife using the leaf-feeding beetles *Galerucella calmariensis* and *Galerucella pusilla* was attempted at four sites in Colorado and Washington. These sites ranged in size from a thin ring of loosestrife around a small pond to a vast wetland monoculture over 30 miles long. The projects were begun in 1994 and 1995, and significant impacts were seen within 2-3 years at all sites. Ground-based monitoring and aerial photography were used to document the impact of the insects. After several years of increasing beetle populations, differences are seen at the various sites, and are likely related to the initial size of the loosestrife infestations and specific site conditions.

Weevils and Eurasian Watermilfoil. Mariana Tamayo, Christian E. Grue. University of Washington, Seattle, WA., and Kathy Hamel. Washington Department of Ecology, Olympia, WA. Eurasian watermilfoil (*Myriophyllum spicatum*) has become a nuisance in many lakes and rivers in Washington. Herbicides, among other methods, are being used to control this invasive plant. We have been evaluating the milfoil weevil (*Euhrychiopsis lecontei*) since 1996, as a potential biological control for Eurasian watermilfoil. To date, we have detected the weevil in 23 lakes and rivers in Washington, particularly in eastern Washington (20 waterbodies). The weevil occurs on both Eurasian and northern watermilfoil (*M. sibiricum*). Our data suggest that in Washington, the weevil is more prevalent in waterbodies with pH ≥ 8.2 and specific conductance ≥ 0.2 mS cm^{-1}.

Abundance estimates have ranged from 0.6 weevils/stem to undetectable levels. Last year we conducted a set of experiments, to determine whether weevils from eastern and western Washington could be reared on watermilfoil plants (Eurasian and northern) from different lakes. Preliminary results from the latter will be presented.

Aquatic Weed Control in Salt River Project Canals. David C. Maldonado. Salt River Project, Phoenix, AZ.

Salt River Project (SRP) delivers a million acre ft (1200 million cubic meters) of water annually to 250,000 acres (100,000 ha) in central Arizona through approximately 130 miles (210 km) of canals and 1200 miles (1930 km) of laterals. Water usage in the SRP system has shifted from primarily agricultural use to use as a drinking water source. Environmental regulations prohibit the use of most chemical herbicides. SRP has used white amur (*Ctenopharyngodon idella*) to control extensive aquatic weed growth in most of the canal system for ten years and has found them to be environmentally friendly and cost effective. Environmental regulations require the fish to be sterile (triploid) and be physically contained within the canal system to avoid migration into natural rivers and streams. To qualify as a closed system, the canal system has been modified to include electric and physical fish barriers. Methods have been developed to economically and safely move the fish to different reaches of the system for maintenance purposes or to relocate fish that have moved downstream. Weed growth and fish population are monitored and fish are moved to maintain effective weed control throughout the system. The fish grow to as large as 4 feet (>1m) long and 50 lbs (22kg), and have a life expectancy of 15 years. White amur are stocked at a rate of 35 fish per surface acre and are restocked at approximately 20% per year. Fish losses occur due to injuries caused by relocation activities, angling, and occasional chemical contamination. The use of white amur limits the use of chemical algaecides for taste and odor control. White amur have been shown to adequately control aquatic weed growth. SRP continues to expand reaches stocked with fish and to improve safety and efficiency of fish management. Types of Aquatic Herbicides used are Magnacide H (Acrolein) and Chelated Elemental Copper.

Hydrilla Eradication in California. Ross A. O'Connell. California Department of Food and Agriculture, Sacramento, CA.

Since hydrilla (*Hydrilla verticillata*) was first identified in California, in 1976, a total of 17 counties have been found to have infestations, some have had multiple infestations. Hydrilla has been eradicated from the following nine counties: Los Angeles, Monterey, Riverside, San Bernardino, San Diego, San Francisco, Santa Barbara, Sonoma and Sutter. The following eight counties have infestations under eradication: Calaveras, Imperial, Lake, Madera, Mariposa, Shasta, Tulare and Yuba.

Many methods have been used to eradicate these various infestations, including physical removal, suction dredges, mudpumps, sterile triploid grass carp, various aquatic herbicides including copper based contact herbicides, Komeen and Nautique, Reward (diquat), Sonar, and also the soil fumigant Vapam. In addition, lowering the water level in one large lake was used to expose plants and prevent further tuber formation and kill top growth. Plants found growing up through the expansion joints in canals in Imperial County were problematic until someone thought to try epoxy to block the plants from growing. An infestation in San Francisco in a two acre asphalt lined reservoir required the use of jackhammers to remove sections where hydrilla tubers were imbedded in the asphalt. The discovery of incipient infestations occur through detection surveys of high hazard water bodies and through educational brochure distribution and training of other agency personnel. Quarantine of water bodies is often used to prevent movement of plants to new areas.

Changes in Hydrilla Tuber Abundance Following Repeated Herbicide Treatments in the Oregon House Canal, California. Ross A. O'Connell, Ed Finley, Frank Zarate, California Department of Food and Agriculture, Sacramento, CA; Tyler Koschnick, SePRO Corporation/University of Florida, Gainesville, FL; Greg G. Ksander and David F. Spencer, US Department of Agriculture - Agricultural Research Service, Davis, CA.

Hydrilla [*Hydrilla verticillata* (L.f) Royle] is an invasive aquatic weed in the US. It reproduces by fragmentation, stolons, production of axillary turions, and underground tubers. Like other aquatic weeds, the underground propagules are particularly important to its long-term survival in a given habitat. To date there have been few attempts to manage this important life cycle stage. Though, some have suggested that it may be possible to disrupt tuber formation. Hydrilla plants were discovered in the lower 5.3 km of the Oregon House Canal in August, 1997. The canal is located in Yuba County, California, about 32 km (20 miles) north of Marysville. It is a shallow canal that typically conveys water between mid-April and mid-October with flows of approximately 5 cubic feet per second. The purpose of this study was to determine the impact of repeated herbicide applications on hydrilla tuber abundance in the Oregon House Canal. On September 17, 1998 we started at the upstream end of the canal and collected two 15-cm diameter cores every 100 m for a total of 98 cores. Cores were placed in plastic bags, returned to the lab and washed over 2mm mesh screens to remove the sediment. During the 2000 growing season, the canal was repeatedly treated with a copper based herbicide at two- or three-week intervals. An additional set of 156 cores (similar to the first except that a 5-cm diameter corer was used and three cores were collected at each sample location) was collected on October 24, 2000. Cores were processed as above. Tuber abundance decreased approximately 73% between the sampling dates, from 315 m^{-2} in 1998 to 85 m^{-2} in 2000 (t-test, $P<0.0005$).

Control of Hydrilla and Restoration of Native Aquatic Plants and Gamefish at Lake Bellwood: A Work in Progress. Richard Ott. Texas Parks and Wildlife Department, Austin, TX. Prior to establishment of hydrilla at Lake Bellwood, Texas, in the mid 1990's, the largemouth bass (*Micropterus salmoides*) population was characterized as a high quality fishery, with a proportional stock density (PSD) in the 40-60% range. By 1998, when hydrilla covered over 80% of the lake area, largemouth bass PSD had fallen to 28% in the spring and 16% by the fall. Both of these values are below the recommended range and are indicative of a population dominated by small fish (recruits less than 12 inches long). Average growth rates (both as back-calculated length and length at age of capture) were below the average for the Pineywoods ecological area. Following herbicide treatment of hydrilla in summer 1998, the structure of the largemouth bass population changed significantly by spring 1999. Where the largemouth bass population was dominated by small fish in spring 1998, the density of small fish had decreased (presumably a result of increased predation by large fish) and the size distribution of large fish had improved greatly. PSD of largemouth bass in spring 1999 was back into the 40-60% range. This improved size distribution carried over to fall of 1999 and was still present in spring and fall 2000. Growth rates in fall 1999 and 2000 showed improvement over 1998 with young fish approaching the ecological region average and large fish exceeding the average.

Retractable Fencing as a Goose Deterrent. Dick Steensland, Lake Restoration Inc., Rogers, MN.

Topics to be covered in this presentation include: Past and present goose populations; Common factors to all flyways; Personal health and water quality issues; Types of goose control preventions used; Why Lake Restoration is interested in goose deterrents; Development of fencing systems; and Pictures and discussion on how it works on different bodies of water.

Caulerpa Taxifolia in California. Lars Anderson. US Department of Agriculture - Agricultural Research Service, Davis, CA.

June 12th, 2000, the notoriously invasive and destructive marine alga – *Caulerpa taxifolia* – was discovered in Carlsbad, just 30 miles north of San Diego, California, in a small, protected lagoon called Aqua Hedionda. This tropical alga, recently placed on the Federal Noxious Weed List, can grow very rapidly and dominate a variety of benthic and lower intertidal habitats as evidenced from its rapid spread in the Mediterranean areas, since the mid-1980’s. Fortunately, the reaction to the first introduction in the US was swift: A multi-agency Southern California Caulerpa Action Team (SCCAT) was formed, options were discussed and the first treatments (chlorine injected under tarps) for eradication were made less that a month after discovery. Results so far very encouraging, but another site was found in Huntington Harbor several months ago – these populations are also being treated with chlorine (solid "pucks") placed under tarps. Over the past year, a range of public education, outreach actions have helped spread the word about this serious invader, and plans for research and coastal surveillance have been developed. This seriousness of the introduction cannot be understated because a large portion of the US and Mexican coastal waters are vulnerable to invasion, which can displace native algae, seagrasses and essentially obliterate habitat for many marine invertebrates.

Biology of <u>Egeria Densa</u> in Oregon: Implications for Management and Drinking Water. Toni Pennington and Mark Sytsma. Portland State University, Portland, OR.

Egeria densa has become naturalized in Australia, New Zealand, Japan, and the United States due in large part to the aquarium trade industry and extensive use in plant physiological studies. *E. densa* has created biological, aesthetic, and monetary problems in these areas as well as in its native range of South America. Information on its basic biology is regional and no detailed research has been conducted in the Western USA where its impacts are extensive from Washington to California. Additionally, submersed aquatic macrophytes may contribute to the formation of trihalomethanes (THMs) in finished drinking water. THMs are carcinogenic compounds produced when organic carbon combines with chlorine during disinfection. The potential for *E. densa* to contribute to the formation of THMs is a critical bridge between aquatic plant research and human health concerns that must be addressed. A three-year project researching *Egeria densa* in Oregon, including carbohydrate and nutrient allocation patterns, biomass, and its potential to form trihalomethane precursors will be discussed. Information elucidated from this research may be used to improve management efforts and emphasize the importance of aquatic weed management in drinking water.

Using Barrier Curtains to Isolate Eurasian Milfoil Treatment Areas during a Sonar Herbicide Application. Terry McNabb. Aquatechnex, Olympia, WA.

Eurasian Milfoil is a major problem in Western US waters. The federal government has classified this plant as a "Harmful non-indigenous species" and most states recognize the threat this weed poses to the aquatic environment.

Sonar Aquatic Herbicide has proven to be a highly effective tool in restoring lake and river systems that have been impacted by Eurasian Milfoil. Whole lake treatments using protocols developed by Aquatechnex biologists have resulted in the eradication of this noxious weed from a number of large lake systems in the Western States.

Sonar Aquatic Herbicide has a proven track record of controlling and in some cases eradicating Eurasian Milfoil from our nation's waterways. In some situations however, Sonar has not been considered because of the long contact exposure time requirement. In order to provide this control, the plant must be exposed to low doses of the herbicide for an extended period of time, up to 8 weeks in some studies. As herbicides tend to dilute out of treatment areas, this technology has been most effective when used as a whole lake treatment. Under that type of application, the concentrations remain within the proper range throughout the lake. In large lake systems, this is a cost prohibitive approach in some cases.

During the summer of 2000, Aquatechnex biologists deployed a unique barrier curtain technology to segment a 167 acre lake into treatment and non-treatment areas. Eurasian Milfoil was present in the lake and dominated the north and south coves. The remainder of the shoreline had not yet been infested. The barrier curtain was designed to be non permeable. Two curtains were deployed. The north barrier was approximately 900 feet in length and isolated a treatment area of about 5 acres. The south barrier was approximately 2,300 feet in length and isolated just over 20 acres. Sonar was applied and maintained behind these barriers using 5 split applications spaced at two week intervals.

Over 200 FasTEST samples were collected both in and outside the treatment areas from 13 sampling sites. The FasTest data was used to monitor conditions and maintain Sonar levels in the treatment areas. It also was used to document the levels outside the curtain.

This project resulted in excellent control of Eurasian Milfoil in these isolated areas of the lake. The FasTEST data confirmed these barriers could be used to segment the lake into treatment and non treatment areas. These was little or no Sonar detected outside these isolation areas and no impact on aquatic vegetation outside the treatment areas.

This technology will allow lake mangers to target Eurasian Milfoil in large lake and river systems or protect native aquatic plants in the non target portion of the lake. When combined with SePRO's new PlanTEST and EffecTEST technologies, the potential now exists to determine that the barrier could be removed earlier if the target plants show fatal symptoms.

Chemical Toxicity and Environmental Fate: an Evaluation of Pesticide Use in Aquatics.
Jim F. Petta. Syngenta, New Braunfals, TX.

The use of pesticides to control invasive weeds in aquatics raises levels of concern due to the inherent fears of introducing possible contaminants into the environment. Prior to the approval by EPA and State regulatory agencies, aquatic pesticides must undergo a stringent and costly investigative process to assess the possible environmental impact of the use of these products in aquatic systems. Using Reward (diquat) as an example, manufacturers and registrants must complete this process and keep the information up to date on each individual product. The complete profile of the pesticide must be well understood and its impact or potential impact to aquatic organisms and man. Safe and proper use of aquatic pesticides is critical to keeping these products in the IPM program for effective weed control.

Heavy Metal Phytoremediation by Aquatic Plants. Harold Ornes. Southern Utah University, Cedar City, UT.

While much time, effort, and money go into control of aquatic plants, certain species offer potential to help cleanup both eutrophic waters and heavy metals contamination. Six floating species (*Azolla*, *Eichhornia*, *Salvinia*, *Wolffia*, *Lemna*, and *Spirodella*), two submersed species (*Ceratophyllum*, and *Myriophyllum*); and one emergent species (*Juncus*) have been evaluated for uptake of metals Al, Cd, Fe, and Mn.

Heavy metal uptake potential was estimated by calculating Concentration Factors (CF) for each species and each metal. Concentration Factors range from 200 to 2000. This may be interpreted to mean that a plant with a CF of 200 for Cadmium, growing in 1ppm Cadmium-polluted water could accumulate 200pm Cd in its tissues.

The requirement for year round warm climate and sunshine make such "green technologies" problematic in many parts of the world, but for warmer regions, aquatic "weeds" may hold potential for cost effective clean up of heavy metals.

National Pollutant Discharge Elimination System (NPDES): New Permits Needed for Aquatic Herbicide Use? Lars W. Anderson. US Department of Agriculture - Agricultural Research Service, Davis, CA. and Pat Thalken, California Department of Boating and Waterways.

On March 7, 2001, the California State Water Resources Control Board approved the issuance of an NPDES permit to the California Dept. of Boating and Waterways (BWW) for its Waterhyacinth Control program in the Sacramento-San Joaquin Delta. This action was a direct result of a lawsuit filed against BWW by Delta keeper, a non-profit organization. A few days later on March 12th, the United States Court of Appeals for the 9th District issued a ruling on another case involving the Talent Irrigation District (Oregon) (Case No. 99-35373); this decision overturned a lower court's ruling which had declared that FIFRA (Federal Insecticide, Fungicide and Rodenticide Act), under which EPA approves(1.2. "registers") pesticide products and labeling, precluded the need for an NPDES permit. In its March 12th ruling, the Appeals Court distinguished between the authority and purpose of FIFRA, as amended – to provide uniform national labeling/use for pesticides – but does not specify permitting or other requirements for local conditions. In contrast, the Federal Clean Water Act, under which NPDES' are granted, does establish conditions for discharges of waste to water of the US, and does focus on local conditions. It further stated that residuals of the herbicide (acrolein) are "waste chemicals", even if the intended use of the herbicide was beneficial and within the scope of the EPA labeling. Although these two cases arose from different situations, the issuance of the NPDES permit by the California State Water Control Board and March 12 Appeals Court ruling suggest that nearly any applications of aquatic herbicides (or other pesticides) on, in or near water may trigger a requirement for an NPDES permit. NPDES permits have heretofore been issued almost exclusively for "end of the pipe", point sources such as industrial or municipal discharges. They require extensive sampling, monitoring, toxicity testing and reporting. Implications for implementing chemical (herbicide) and integrated aquatic weed control are far-reaching.

Have We Over Regulated This Industry? M.C. McLeod. Griffing LLC, Valdosta, GA.

Have we over regulated this industry? Are we using "real" science in making our decisions or what some refer to as "junk" science. I will give you examples of using what I refer to as a misuse of good science.

Sediment Accumulation Disrupts Natural Regeneration of Horned Pondweed in Fall River, California. David F. Spencer and Greg G. Ksander. US Department of Agriculture - Agricultural Research Service, Davis, CA.

Submersed aquatic plants play important roles in aquatic ecosystems. Sandy sediments have accumulated (from 0.6 to 1.2 m deep) in portions of Fall River (Shasta County, California) previously inhabited by aquatic plants. We sought to determine the impact of sediment accumulation on horned pondweed (*Zannichellia palustris* L.), one of the most abundant aquatic plants in the river. We assessed the abundance on horned pondweed seeds in the seed bank, and performed experiments to determine the effect of sediment accumulation on germination and emergence of horned pondweed seedlings. In 1996 and 1997, sediment cores were collected from the upper 15 m of Fall River. Cores were placed in a greenhouse and germination monitored for the next 30 to 40 days. Number of seedlings present at the end of this period was used to estimate viable seeds m^{-2}. Horned pondweed seeds were present in 67% of the 1996-cores. Horned pondweed seed density was 1219 seeds m^{-2} on average and ranged from 0 to 5920 seeds m^{-2}. Horned pondweed seed abundance did not differ between the upper (<11 cm) and lower portions (>11cm) of cores collected in 1996 or 1997. We conducted four experiments in which horned pondweed seeds and natural sediments containing horned pondweed seeds were buried at various depths under sand. Results indicated that burial by more than 2 cm of sand inhibited germination and emergence. This implies that significant sediment accumulation in Fall River may disrupt natural regeneration of horned pondweed from seeds. Given the importance of aquatic plants as habitat for insect larvae and other animals, and their role in nutrient cycling, loss of this dominant plant will have consequences for other Fall River ecosystem components.

Biological Control of Aquatic Vegetation Using Triploid Grass Carp (*Ctenopharyngodon idella*) North of the 49th Parallel. Ron Beck. Alberta Agriculture, Food, and Rural Development and Agriculture Centre, Lethbridge, Alberta, Canada.

Extensive seasonal weed growth occurs in irrigation canals and farm ponds (dugouts) at the northern latitudes of Canada. Weed densities in canals and ponds have been reported at densities of 590 g/m^2 and 4125 g/m^2 respectively (dry weight). Triploid grass carp were first introduced into Alberta, Canada in 1987 to evaluate the potential for aquatic weed control in the greater than 8000 km of irrigation canals and over 60,000 farm ponds that exist in the province. Over the past 13 years, studies have been conducted on the management and impact of grass carp on aquatic weed control in irrigation canals, farm ponds, and golf course water hazards. Research concentrated on fish growth and survival, weed control efficacy, aquatic weed preferences, fish impact on water quality, fish containment and barrier systems, fish production and marketing. Studies have concluded that 225 mm triploid grass carp, stocked under colder environments of northern climates, achieve growth of 22–70% over one season. During that period, pond and canal temperatures exceed the optimum feeding temperatures of >18C for 75-80 days. Under the shorter growing season at northern latitudes, 225-250 mm grass carp are effective in reducing aquatic weed densities by 20-84% in irrigation canals when stocked at densities of 25 kg/ha and 85 kg/ha respectively. In ponds, 73% - 80% weed control was achieved with 225-250 mm grass carp stocked at densities of 335 kg/ha and 360 kg/ha respectively. Winter fish survival in aerated ponds was 67-80%, summer survival was 91-97% and 0-99% survival was reported for fish in irrigation canals. Field and laboratory studies revealed high fish feeding preferences for *Chara* spp., *Elodea canadensis* and the Potomogeton species, whereas *Myrophyllum sibericum* and *Rannuculus trichophylllus* were least preferred. Grass carp > 225 mm are effectively contained in irrigation canals by vertical bar screening with 25 mm spacing. All grass carp currently used in biological weed control programs in Canada are triploid certified, disease tested and produced in closed recirculating aquaculture systems in southern Alberta.

Lake Lytle Milfoil Control Project. Rupa Shrestha and Mark Sytsma. Portland State University, Portland, OR.

Eurasian watermilfoil (*Myriophyllum spicatum*), a noxious, non-indigenous aquatic weed invaded Lake Lytle about forty years ago and degraded the overall quality of the lake, displaced native plants, and impaired recreational activities. Sonar AS aquatic herbicide was applied to the lake as part of a three-year integrated aquatic vegetation management plan. The target Sonar concentration in the lake was 7 to 10 ppb with a contact time of 60 days. An intensive vegetation survey indicated a 95% decline of milfoil in the lake following Sonar treatment. Milfoil present in the lake following treatment did not survive when grown in greenhouse culture. The only native plant to exhibit a decline in abundance in the lake was *Najas flexilis*. *Potomogeton richardsonii*, a native plant not previously reported in the lake, appeared following Sonar treatment. Physical and chemical characteristics of the lake during the treatment period did not differ from pretreatment conditions. Spring sampling will determine whether milfoil in the lake survived the first year of the integrated management program. A second year of herbicide application may be necessary for the complete control of milfoil and restoration of native plant community.

Use of Plant Assay Techniques to Screen for Tolerance and to Improve Selection of Fluridone Use Rates. Michael D. Netherland, Alicia Staddon, SePRO Corporation, Carmel, IN; Carole A. Lembi and Debbie Lubelski, Purdue University, West Lafayette, IN.

The herbicide Sonar (active ingredient fluridone) is a valuable tool for controlling exotic aquatic plants such as hydrilla (*Hydrilla verticillata* (L.f.) Royle), Eurasian watermilfoil (*Myriophyllum spicatum* L.) and Egeria (*Egeria densa*). Recent evidence from Florida suggests that prior use history of fluridone may result in a differential response of hydrilla to subsequent treatments. While increased tolerance has been suspected by some lake managers, quantitative laboratory evidence now substantiates a differential susceptibility of hydrilla to fluridone in several aquatic systems in the state of Florida. A plant assay originally developed for research purposes has been modified and proven to be an excellent predictive tool for quantifying the response of hydrilla, Eurasian watermilfoil, and Egeria to various concentrations of fluridone. This assay called the PlanTEST™ can be used proactively to screen for populations with increased tolerance and to determine the level of fluridone likely to elicit a phytotoxic response for a range of aquatic plants. In addition, the use of biochemical monitoring of the vegetation (called the EffecTEST™) in conjunction with the FasTEST immunoassay provides a mechanism for evaluating the status of an ongoing treatment over time. Use of PlanTEST and EffecTEST data for several aquatic systems with varying Sonar use histories will be presented.

The Hydrilla Eradication Program in Mexicali Valley, Mexico. Ricardo Hernandez and Fausto Valle. US Department of Agriculture - Animal Plant Health Inspection Service – International Services NACR, Area I, Mexicali, Mexico.

Hydrilla was first detected in the Mexicali Valley in 1985. The hydrilla eradication program was initiated in 1987 and consisted of members from the Rio Colorado Irrigation District #14 with the participation of the Mexican Government, Comission Nacional de Agua, the USDA-APHIS, CDFA, and the Imperial Irrigation District.

The Mexicali Program is currently using Triploid Grass Carp as its main control to eradicate hydrilla. The grass carp are provided by the Bio Control Unit of the Imperial Irrigation District. The

Mexicali Program is also using a combination of mechanical clean up (backhoe, excavator) and the "mud pump" which has provided excellent results. As of this date, we are detecting individual plants which are immediately extracted from the irrigation canals and deliveries.