THE AQUATIC PLANT MANAGEMENT SOCIETY, INC.

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ABSTRACTS

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Protecting and Enhancing Lakes and Reservoirs in the West

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The Bureau of Reclamation plans, constructs, and operates reservoirs in the 17 contiguous western United States. To date, the Bureau has constructed 245 reservoirs for irrigation, power generation, municipal and industrial water, flood control, and recreation. Four lake/reservoirs are presented as examples to illustrate some of the ecological challenges, past and present, of lake reservoir management. Lake Casitas, a 2,700 surface acre reservoir in Southern California, suffered water quality problems resulting from summer stagnation. Twin Lakes, a pair of montane lakes in Central Colorado, have been further impounded and presently are used as an afterbay for a pumped storage powerplant scheme. Lake Mead, a 160,000 surface acre impoundment of the Colorado River, is a very complex ecosystem due to its size and variability of inflows. The uneven distribution of nutrients has resulted in controversy over how to best manage the resource. Lake Texana, an 11,000 surface acre reservoir in Southcentral Texas, is currently suffering from severe infestations of aquatic weeds for which no management program has yet been developed. Management techniques for U.S. and foreign lake/reservoirs will be summarized.

Aquatic Plant Management in TVA Reservoirs: Reconciling Competing and Often Conflicting Water Resource Needs

Herbert Jones
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The Tennessee Valley Authority has responsibility for managing 637,000 acres of impounded reservoirs for multiple uses. Approximately 25 percent of the area is in storage reservoirs where deep drawdowns prohibit aquatic plant problems. The mainstem reservoirs contain about 100,000 acres of habitat less than 10 feet in depth which is suitable for colonization by aquatic plants. Currently, aquatic plants, mainly Eurasian watermilfoil, naiads, and hydrilla, colonize 41,000 acres compared to 24,000 acres in 1984. For the mainstem reservoirs, flood control, navigation, and hydropower have the highest priorities; however, the public is becoming increasingly vocal in demanding higher priority be given water level stabilization, fisheries, recreation, and water quality. Management of the large and expanding aquatic plant problem is discussed in terms of management strategies, opportunities, and competing and conflicting water resource uses.

Water Quality in Urban Lakes

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The University Lakes, a system of six hypereutrophic lakes, are located approximately 4 km southeast of downtown Baton Rouge, Louisiana, adjacent to the Louisiana State University campus. These urban lakes range in size from 1.2 to 89.2 ha and are typically shallow, unstratified, and highly productive. Random and short-term variability in water quality data indicates that these lakes are extremely sensitive to changes in the physical environment as well as the phytoplankton community. Consequently, under optimum weather conditions, algal populations rapidly expand and collapse, dissolved oxygen levels are depleted, and fish kills result. Following a five-year cooperative restoration effort between the USEPA, the State of Louisiana, and the City-Parish of East Baton Rouge, four of the six lakes exhibited a gradual recovery in water quality and an elimination of fish kills. Two lakes (College and Campus), however, were still relatively unstable as indicated by two years of post-restoration data. Total phosphorus and dissolved oxygen data collected on College Lake indicated the re-establishment of high benthic demand and internal recycling patterns. While Campus Lake initially responded well to mechanical dredging and runoff diversion, total phosphorus and chlorophyll a data collected during postrestoration indicated a decrease in water quality as a result of elevated turbidity levels induced by polluted runoff in the watershed.

A Comparison of Management Impacts on Aquatic Plant Communities in Regulated Lakes in Northern Europe and North Africa

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Despite the contrasting climatic conditions prevailing in Northern Europe and North Africa, and the major differences in size of the water bodies compared in the two regions, there are interesting similarities in aquatic plant community responses to the management regimes operating in regulated lakes in Egypt, Norway and Scotland. There is a common core of species occurring in these lakes, together with additional species found only in one or other of the two regions. The relative importance of anthropogenic pressures (e.g., water level fluctuations, aquatic weed control measures, changing nutrient or pH status of the system) versus natural environmental factors (e.g., grazing by herbivorous fish, factors influencing underwater light regime, ice-scour in Northern European lakes), in influencing the plant communities of selected lakes in the two regions is discussed. The findings are related to some general principles of aquatic plant strategies for survival of environmental stress and disturbance pressures, leading to an outline of the practical implications for lake management.

Brief Facts Regarding Mimosa pigra

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Mimosa pigra L. is one of the noxious weeds in many parts of the tropical area of the world, especially Thailand. The main problem created by Mimosa pigra is obstruction of the water flow and building up of sediment. The effective control of Mimosa pigra is integrated control i.e., cutting, burning and allowing the cut stumps to regrow and the new seedlings, germinated from seeds, treated with herbicides.

Management of Lakes for Wild Rice Production in Canada

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Shallow lakes are being seeded with wild rice in the boreal region of Canada. Commercial production of wild rice is influenced by water depth, sediment fertility, plant competition, and seed genetics. Management techniques are being developed to optimize yields. The ideal situation is a lake that is 20-60 cm in depth, an organic soil with high concentrations of phosphorus and nitrogen, no competing emergent macrophytes, and a high yielding, early maturing, wild rice variety.

Variation in Production Characteristics Among Ontario Wild Rice Populations: Implications for Lake Management and Plant Breeding

Rebecca L. Counts and Peter F. Lee
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Six distinct "types" of Ontario wild rice were identified by greenhouse and field studies. These types differ in characteristics influencing stand productivity (maturation rate and yield components), and in degree of plasticity observed with varying growth conditions. Individual populations that appear to be adapted to deep water and poor soil conditions have also been identified. These observations have applications for the development of new wild rice stands and for breeding lake wild rice.

Cultivation and Scarification in the Management of Lake-Grown Wild Rice (Zizania aquatica L.)

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Thunder Bay, Ontario, Canada

Nutrient cycling problems have been associated with accumulation and translocation of wild rice straw in productive shallow boreal lakes managed for wild rice production. An experimental cultivator/scarifier was built to prevent mass movement of straw and to accelerate its decomposition. Modifications permit the machine to inject pelletized slow-release fertilizer into the sediment of unproductive lakes. Its suitability for eradicating existing stands of wild rice prior to genetic swamping with superior strains was tested.

Validation of the Model "INSECT" Under Southeastern Texas Conditions

Michael Jay Grodowitz
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Vicksburg, Mississippi

This paper describes the validation procedures used to test the waterhyacinth/insect biocontrol agent model, INSECT, under southeastern Texas conditions. Primary focus will be on dynamics of both the insect and plant populations and corresponding model simulations. Suggested improvements to the model initialization procedures will be presented. This will include the presentation of aging techniques for adult Neochetina eichhorniae for the assessment of adult population structures important in accurate model initialization.

Impact of the Endangered Species Act on Pesticide Usage

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The EPA is currently dealing with the potential impacts of pesticides on endangered species. Additions and changes to pesticide labels warning applicators about endangered species are in progress. In addition, county (parish) maps are being prepared showing areas which will be subject to restrictions on/or prohibition of pesticide usage. The U.S. Fish and Wildlife Service is assisting in this process.

Recent Studies of the Buoyant Potential of Benthic Barriers

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The term buoyant potential is used to describe the possibility that a particular benthic barrier might become buoyant, balloon, or become displaced from the application site. A number of factors contribute to the buoyant potential of a device. These factors include the ion permeability, gas permeability, specific gravity, and shading efficiency of the device. Aufwuchs community impacts, and a variety of lake factors such as the quantity and quality of sediment organic matter, availability of electron acceptors, current, and benthos activity also contribute to the characterization of benthic barrier buoyant potential.

A method was devised to quickly evaluate the relative buoyant potential of Aquascreen™, Dartek™, Texel™ TAC 150, and a new silicone benthic barrier manufactured by Dow Corning Corporation. A portion of a benthic barrier was affixed to the open end of a "cup-like" device that contained an organic substrate. The change in the submersed weight of the device was plotted over time and the slope of that line was used as a relative measure of buoyant potential. Aquascreen™ performed significantly better ($P > F$, 0.90) than the other benthic barriers in an experiment performed in the absence of light and aufwuchs community development. However, the Dow Corning silicone benthic barrier performed significantly better than the other benthic barriers when the experiment was performed in the light and when aufwuchs were permitted to colonize the upper surface of the various benthic barrier treatments.

Comparison of Three Methods for the Non-Destructive Estimation of Biomass in Three Aquatic Weeds

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A weight method, a volume, and a shoot length x plant count method were used in an attempt to non-destructively estimate fresh weight biomass in sago pondweed (Potamogeton pectinatus), Eurasian watermilfoil (Myriophyllum spicatum), and American pondweed (P. nodosus). The shoot length x plant count method gave the highest coefficients of determination, giving 0.83, 0.86, and 0.93 with sago, milfoil, and American, respectively.

The Potential for Contamination of Shallow Near-Shore Aquifers by Aquatic Herbicides

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A study was initiated to evaluate the potential for contamination of near-shore, shallow, wells by aquatic herbicides applied to an area in hydraulic communication with the well sites. A private, sand-lined pond, located near Clare, Michigan, was selected for this study because it would exaggerate the conditions that would favor the migration of aquatic herbicides across a hydraulic gradient. A ten cm "pumping" well was drilled approximately 4.5 meters from the shore-line of the pond and was pumped continuously to maintain a steady hydraulic gradient from the lake water column to the well site. A five cm monitoring well was located equidistant between the pumping well and the shore-line within the cone of depression formed by the larger pumping well. Granular endothall (Hydrothol 191, Pennwalt Corporation) and 2,4-D (Aquakleen, Rhone Poulenc Chemical Co.) formulations were applied to the pond on separate occasions at twice the maximum label-recommended rates. Pond water and monitor well samples were taken from 18 to 24 hours after the herbicides were applied, every day for six days after treatment, and once every week for the following four weeks. Endothall and 2,4-D concentrations never exceeded detection limits (0.1 mg l^{-1}) in any of the water column or monitoring well samples.

Impact of Diquat on Non-Target Crop, Wetland and Aquatic Plants

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Diquat, a commonly used aquatic herbicide, was soil applied at maximum label rate (8.4 kg/ha) to evaluate preemergent activity to seeds and seedlings of 6 crops and 4 terrestrial weed species. None of the plants studied exhibited any detrimental effects due to the soil applied treatments. Postemergence activity of diquat was also investigated by rate titrations on 5 crop species, yellow nutsedge, slash pine and two species of ferns. Soybean and cotton plants were most susceptible and yellow nutsedge and onions were least affected by the foliar sprays. Seven additional aquatic and wetland plants were treated with various rates of diquat by foliar and/or root zone exposures. The LC 50's of diquat to duckweed and azolla were much lower than similar treatments to brasenia and torpedograss. Factors affecting the toxicity of diquat to vegetation will also be discussed.

Fluridone and NMF Residue in Two Sonar Treated Ponds

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Two central Florida ponds were treated with sufficient Sonar SRP or Sonar AS for a theoretical fluridone concentration of .15 ppm. Pondwater was analyzed for fluridone and N-methyl formamide residues until fluridone residues were below detectable limits (0.002 ppm). Five months after application fluridone concentration was 0.027 ppm in the Sonar SRP treated pond and 0.041 ppm in the Sonar AS treated pond, while NMF was not detected during that period of time.

Problem and Control of Aquatic Weed in Irrigation Systems in Thailand

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Aquatic weeds causing problems in irrigation systems in Thailand are mostly exotic species. Conditions for excessive development of aquatic weed growth are usually favorable in this region. A list of aquatic weeds that cause problems in the irrigation systems are presented. The control methods that are used in Thailand, and the problems associated with these are described.

Growth Characteristics and Carbohydrates in Waterhyacinth

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The growth characteristics and carbohydrate allocation of waterhyacinth were evaluated to identify the weak points during the growth cycle. Thick stands of short plants (bulbous leaf) appeared to have the best winter survival. Flowering during the fall curtailed the ability of waterhyacinths to produce ramets and growth. The highest carbohydrate level was in the rachis of inflorescences. Mid-October appears to be the time when waterhyacinth stores the maximum carbohydrate levels in stembases.

Effect of N, P or K in the Culture Medium on the Biomass and the Nutrient Uptake and Storage by Eichhornia crassipes

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The effect of nitrogen (0.5 - 50.5 mg N ℓ^{-1}), phosphorus (0.06 - 10.06 mg P ℓ^{-1}) or potassium (2 - 202 mg K ℓ^{-1}) concentrations in the culture medium on the biomass of waterhyacinth (Eichhornia crassipes (Mart.) Solms) plants as well as on the uptake and the plant tissue storage of those three major plant nutrients, was investigated. Response of the biomass of waterhyacinth to different concentrations of N, P or K was reported up to 5.5 mg N ℓ^{-1}, 1.06 mg P ℓ^{-1}, and 12 mg K ℓ^{-1}; higher concentrations did not increase the biomass. However, the N, P or K uptake and storage in the plant tissue was in good correlation with the N, P or K level loaded to the culture medium. The implications of these results are discussed.

Do You Know Your Lyngbya?: Notes on the Distribution and Taxonomy of a Mat-Forming Macrocyanophyte

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Exceptionally large-celled blue-green algae, usually identified as Lyngbya, have formed massive nuisance infestations in recent years. The history and distribution of these infestations is discussed, with reference to potential contributing factors.

The taxonomy of the causative agent is currently unresolved. The organism has been identified as at least four different species, and two genera. Morphological features of these taxa are discussed. A preliminary survey of species distributions, as obtained from herbarium specimens, is compared to that of field-collected samples.

Management of Lyngbya Infestations: Can Diquat be Delivered to Benthic Mats?

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Previous experiments established the effectiveness of diquat for management of Lyngbya infestations. Although Diquat activity is enhanced by full sunlight, considerable action is elicited against this prokaryote under low light intensities. Diquat effectiveness in dim light led to a search for amending agents and/or techniques to enhance herbicide delivery to the low light environment of pre-infestation benthic mats.

Laboratory, greenhouse, and field experiments were performed to evaluate benthic delivery methods. Evaluations compared: commercial settling agents; novel biocolloids; treatment techniques; and herbicidal synergisms.

Use of a Fluorescent Dye to Predict Herbicide Dilution in Flowing Water

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Inconsistent control of hydrilla by herbicides in four dead end canals in the Crystal River, Florida prompted the initiation of a study to characterize water movement and exchange in hydrilla stands in this freshwater, tidal system. Use of Rhodamine WT dye has shown that water temperature, vegetation density, and tidal amplitude influenced herbicide dilution and resulted in prediction of successful herbicide applications. The use of dyes to predict herbicide movement in other flowing water habitats is also discussed.

2,4-D Concentration and Exposure Time Relationships for the Control of Eurasian Watermilfoil

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Herbicide concentration and exposure time relationships were developed under laboratory conditions, for 2,4-D and the control of Eurasian watermilfoil (Myriophyllum spicatum L.). Plant injury increased with increasing concentrations and exposure times, to a threshold above which control was achieved. Severe Eurasian watermilfoil injury occurred in the 0.5 mg ae/l for 72-hour, 1.0 mg ae/l for 36-hour, and 2.0 mg ae/l for 24-hour exposures. Eurasian watermilfoil control was established in the 1.0 mg ae/l for 48-hour, and 2.0 mg ae/l for 36- and 48-hour exposures.

Glyphosate Efficacy in Torpedograss (Panicum repens L.) as Influenced by the Interaction of Carrier pH and Calcium Content

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Torpedograss is a perennial aquatic weed that has been shown to be difficult to control. Glyphosate is primarily used for the control of torpedograss, but results have been variable. Ion content and pH of carrier water have previously been shown to influence glyphosate efficacy. Therefore, studies were conducted to determine the potential interaction of pH and calcium on glyphosate efficacy in torpedograss. Results from these studies will be presented and possibilities for improved glyphosate efficacy discussed.

Aquatic Plant Management From a Large Program Perspective

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The Jacksonville District, U.S. Army Corps of Engineers, manages one of the largest Federally funded Aquatic Plant Control Programs in the United States. In cooperation with the Florida Department of Natural Resources, the Corps is responsible for managing aquatic plants in Federal Navigation Projects and other public waterbodies within Florida. The annual total budget for the program is in excess of 5 million dollars. Because of Florida's unique environment a variety of control methodologies (i.e. mechanical, biological, chemical, and integrated) are used to protect fish and wildlife habitat, endangered species, and water quality.

Aquatic Plant Management Operations from a Small Program Perspective

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Game and Fish Division
Spanish Fort, Alabama

The Alabama Department of Conservation and Natural Resources Game and Fish Division in cooperation with the U.S. Army Corps of Engineers Mobile District manages aquatic plants in the Alabama and Tombigbee River drainages of Alabama. Most of the work involves management of Eurasian watermilfoil, Myriophyllum spicatum, and hydrilla, Hydrilla verticillata. Even though our work area is large, the program remains small due to limited funds. The problems that aquatic plants cause are similar to those in other areas; however, due to our limited funds and manpower, the equipment and techniques used to transport and apply herbicides may differ significantly from those used by large operations.

An Update on the Corps Aquatic Plant Control in Florida

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Natural Resources Project Office
Palatka, Florida

The Corps of Engineers maintains the St. Johns River for aquatic plants from Jacksonville to Melbourne, Florida with four in-house spray crews. Being the largest river within the state, it holds a variety of noxious aquatic plants from hyacinths to hydrilla.

Over the years, aquatic plant control operational technology has evolved from simple 2,4-D and water mixed in a fifty-five gallon drum (complete with a boat oar for occasional agitation) to the more sophisticated automatic metering systems. These changes have reflected a positive and determined intent for more efficient ways to control noxious aquatic plants.

The Corps is responsible for maintaining navigation on the St. Johns. This river has a record of past history that held a tremendous amount of waterhyacinths (Eichhornia crassipes). As recently as 1973 navigation was halted in major areas due to a prolific growth of plants in the upper river basin. With added help from updated technologies, the river is presently under maintenance control, with a free and unobstructed flow making for diverse recreational activities from fishing to water skiing.

Hydrilla (Hydrilla verticillata) remains the most noxious submerged species of aquatic plants. The method of control is quite different. Trailing hoses and above surface injection have proven to be the most efficient means used by Corps crews.

Several species of minor plants have caused problems. Frogsbit (Limnobium spongia), has been treated in the upper river basin. This native plant is very difficult to control. A combination of 2,4-D and Diquat appears to be the best solution for control at present. Rodeo is presently being monitored for effectiveness on frogsbit.
FOOTNOTE - The 15 minute talk will elaborate on more of the Corps methods of in-house aquatic plant control, discussing approximately six species of plants and methods of control. Slides will be used for the presentation.

The South Carolina Aquatic Plant Management Program

Steven J. de Kozlowski
South Carolina Water Resources Commission
Columbia, South Carolina

The South Carolina Aquatic Plant Management Program is administered by the South Carolina Water Resources Commission in conjunction with the South Carolina Aquatic Plant Management Council. The development and public review of annual management plans and interagency coordination via Council representatives helps assure a successful program. Control operations are planned for 26 water bodies during 1988 at a total cost of about $688,000 in local, State, and Federal funds. Unsuccessful herbicidal control of hydrilla in flowing waters has encouraged the use of alternate management strategies.

Large-Scale Sonar Application at Lake Seminole, Florida

Joe Kight
U.S. Army Engineer District, Mobile
Lake Seminole Resource Management Office
Chattahoochee, Florida

During May 4, 5, and 7, 1987, twenty-eight plots totaling 998 surface acres were treated with a total of 44,000 pounds of SONAR pellets. Plots were inspected in June and October 1987, and in April 1988. A rating system was devised to compare plots. EWAGS are offered as to the causes of lack of control on certain plots.

Mechanical Harvesting for Nutrient Removal

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International Science and Technology, Inc.
Reston, Virginia

A six month demonstration project was conducted on Lake Okeechobee, Florida to evaluate the efficacy of mechanical harvesting for nutrient removal. Two 10 foot harvesters, two trailer conveyors, and a high speed transport barge were used in the operation. Over 9,000 tons of weeds, predominantly Hydrilla, were harvested from the 500 acre study area. Mean phosphorus content of the harvested material was 0.32 mg/g, or 0.6 lbs/ton of weeds. Performance data and cost information will be presented.

New Tools for Mechanical Aquatic Plant Management

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Aquatics Unlimited, Inc.
Kent, Washington

Mechanical aquatic plant management has long relied on aquatic plant harvesting systems to cut and remove problem vegetation. There are many benefits to this type of control operation including removal of nutrients and limitation of chemical use for control. A new mechanical system has been developed that provides operations personnel with a number of control options.

The Aquamog MPAR 160 Series equipment has been introduced in the last two years to the aquatic plant management field. This system is comprised of a self powered barge with a number of attachments that are added to a working arm on the front of the unit to perform specific aquatic plant management tasks. The Mog has applications for submerged aquatic plant control with both rotovation and harvesting attachments, for emergent vegetation control with rotovation, flail mower, aquatic weed rake, and various bucket attachments, and for dredging with bucket, clamshell, or submersible cutterhead hydraulic dredge systems.

A review of the Pend Orielle River Eurasian Milfoil Control Program, the Big Bear Lake Eurasian Milfoil Control Program, and the Santee Lake Emergent Vegetation Control Program will be presented.

New Biocontrol Agents for Submersed Aquatic Plants

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Vicksburg, Mississippi

Biological agents are being examined and tested to evaluate their impact on submersed aquatic plants. In 1987 two exotic insect species that specifically feed on hydrilla were released in Florida. In addition, quarantine host specificity studies are being conducted on two hydrilla feeding insects from Australia. Research is also being conducted on several pathogens that may assist in the management of hydrilla and Eurasian watermilfoil.

Grass Carp in Western Irrigation Systems - Questions of Management and Sterility

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[2]Coachella Valley Water District, Coachella, California

The need to have a continuously available supply of disease free certified triploid grass carp has prompted the construction and operation of a grass carp hatchery in the Imperial Valley. Fish produced at this facility will supplement approximately 65,000 grass carp stocked in the hydrilla-infested portions of the irrigation system. Results of these operational stockings have lead to the development of management guidelines for operational use of grass carp in flowing water canals. Additional investigations are being made to determine if small grass carp can survive shallow water canals and drains. During sterility verification trials in 1987, eggs were dropped by one triploid female grass carp. Replication of these trials in 1988 did not result in any further development of the triploid grass carp eggs.

An Evaluation of the "AMUR" Grass Carp Stocking Rate Model

John Cassani and David Maloney
Lee County Hyacinth Control District
Fort Myers, Florida

The "AMUR" grass carp stocking rate model, developed at the Waterways Experiment Station, U.S. Army Corps of Engineers, was used to simulate actual changes in aquatic plant biomass in lakes ranging in size from several to over 100 acres having a variety of plant communities.

Environmental Impacts of Fluridone Application in Lake Okeechobee, Florida

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Gainesville, Florida

Effects of fluridone on non-target aquatic plants and water quality were measured following application of the herbicide for hydrilla control in Lake Okeechobee. Excellent hydrilla control was observed seven months after application while no detrimental impacts to populations of American lotus, spatterdock, Illinois pondweed, eelgrass, or southern naiad or water quality could be attributed to the fluridone.

Lake Okeechobee - A Lesson in Maintenance Control

Joseph C. Joyce and Kenneth A. Langeland
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Fifty years of experience and numerous scientific investigations indicate that the best management practice is to manage waterhyacinths on a continuous basis in order to maintain plant populations at the lowest feasible level. However, policy changes, public perceptions, and other factors sometimes hinder these efforts and reduce the effectiveness of the overall aquatic plant management program. Data will be presented which describes such a situation which occurred in 1986 when aquatic weed management on Lake Okeechobee was halted due to concerns over environmental conditions of the lake and suggested relationships of water quality to aquatic plants and their management.

Natural History and Impacts of Hydrilla verticillata

Lars W. J. Anderson
USDA/ARS Aquatic Weed Research
University of California, Davis

Though the precise time of hydrilla's introduction into the U.S. is not known, from the late 1950's until the present time this exotic pest has created losses in excess of 150 million dollars. The multiplicity of highly efficient reproductive structures produced by this plant, coupled with its ability to disperse via fragments and specialized propagules have enabled hydrilla to spread, invade and dominate a wide range of aquatic habitats. Impacts need to be better identified, assessed from a monetary standpoint so that management programs are supported on a long-term basis.

Electrophoretic Evidence for Two Varieties of Monoecious Hydrilla in North Carolina

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University of California, Davis

Hydrilla tubers were collected from four lakes in North Carolina and subjected to isoenzymnic analysis. Four isoenzymes were visualized and analysis of the entire collection was conducted twice. Two varieties of hydrilla were apparent. The relative distribution of the varieties was different at each site, suggesting two clonally reproducing populations. Analysis of turions from three sites in the Washington, D.C. area, indicated only a single variety, apparently identical to one of those from North Carolina.

Karyotypes of Hydrilla Populations in the United States

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Eleven hydrilla (Hydrilla verticillata L.F.) populations located in the United States were karyotyped. All populations were found to have the triploid chromosome number of 24, and chromosomes within groups were not significantly different among populations with respect to standardized length and arm ratio. The idiogram, which was common to all the populations, was similar to previously published idiograms. Chromosomes ranged 1.67-5.54 µm in length and were represented by acrocentric, metacentric and submetacentric homologues.

Autecological Characteristics of Different Hydrilla Strains

W. Van Vierssen
Department of Nature Conservation,
Agricultural University, The Netherlands

Four different hydrilla strains were cultured at different NO_3 and HCO_3 levels to study the influence of these environmental factors on the growth of these strains and to see whether differences between the strains occur. The four strains originated from India, Indonesia, USA and Burundi. Clear differences exist between the strains. The strain from Indonesia appeared to be the most productive, the strain from Burundi the least productive. NO_3 considerably increased production as did the HCO_3 concentration, but the strains responded differently. The differences between the productivity of the strains in the experiment could not be explained by differences in P/I curves.

Competitive Interactions Between Monoecious Hydrilla and Sago Pondweed and Their Implications for Changes in Macrophyte Community Structure

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University of California, Davis

Hydrilla (H. verticillata, monoecious) and sago pondweed (P. pectinatus) were grown in monocultures and mixtures in greenhouse cultures. Results indicated that hydrilla was a more aggressive competitor when grown under warmer water conditions (22-28 C). When experiments were performed under cooler water conditions (19-21 C), the competitive abilities of monoecious hydrilla and sago pondweed were about equal. These findings concur with single-species growth responses to temperature. In additional experiments, hydrilla (from turions) was able to successfully produce plants which produced new tubers when grown in existing beds of sago pondweed. From these experiments it appears that hydrilla can invade existing macrophyte beds, water temperature may regulate the outcome of the competitive interactions between resident plants and hydrilla.

Competition Between Hydrilla verticillata and Vallisneria americana for Light, Sediment Nutrients, and Inorganic Carbon

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In an attempt to determine the relative competitive abilities of Hydrilla and Vallisneria, we conducted replacement series experiments under different light, fertility and inorganic carbon regimes in greenhouse tanks. In spite of its lesser elongation potential, Vallisneria was an effective competitor under low light conditions, while Hydrilla was more competitive under the higher light level. Higher sediment fertility favored Vallisneria. The effect of inorganic carbon supply was species-neutral. The results of these short-term experiments indicate that Hydrilla and Vallisneria are evenly matched competitors.

Carbohydrate Partitioning in Hydrilla Biotypes

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Vicksburg, Mississippi

Two biotypes of hydrilla were evaluated under controlled photoperiod and water temperatures to compare growth characteristics and carbohydrate distribution. Carbohydrates were depleted in dioecious, but not in monoecious hydrilla tubers, when grown at 32° C for 8 weeks. Starch content increased in shoots of both biotypes when exposed to short days while only monoecious plants produced tubers and turions. Dioecious hydrilla grown at 32° C produced more shoot mass than monoecious hydrilla.

The Presence in Leaf Tissue of the Major Tuber Proteins of Hydrilla

Frederick J. Ryan
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One and two dimensional gel electrophoresis of extracts of dioecious tubers indicates that there are several major proteins of molecular weight near 58,000 D. A different pattern of proteins is seen for monoecious tubers. Antibodies have been raised against the major protein of the dioecious biotype and have been used to demonstrate the presence of this protein in leaf tissue. The response of this protein to tuber-inducing photoperiods is being investigated.

Herbicidal Metabolites as Indicators of Biological Control Efficacy of Microorganisms Against Hydrilla verticillata

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Fungi, bacteria, and actinomycetes have been screened for production of biocidal metabolites which may be used for chemical control of pests, but not as indicators of biological control potential. This program outlines a system we have developed for screening potential biological control agents of Hydrilla verticillata, using toxicity of metabolites as indicative of activity. The relationship between biocidal activity of metabolites and biological control efficacy of the organism, and the advantages of this type of system are discussed.

Influence of Substituted Phenols on the Growth of Hydrilla

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Solutions (10^{-5} M) of known allelopathic compounds were tested for their ability to inhibit the growth of hydrilla. Various properties of the phenolic acids were considered to account for the effect. Chelation appears not to be a factor, but a negative correlation was found between the inhibitory effect of an acid and its acidity (expressed as pK_a). Implications will be described.

Current Status of the Hydrilla Eradication Program for Northern California

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Since September of 1985, Hydrilla Verticillata Royle has infested small northern California ponds which are adjacent to the Sacramento River. The eradication program conducted in 1987 involved the application of fluridone to six ponds. A seventh pond was treated with Komeen (ethylenediamine complex of copper) followed by an application of dichlobenil three weeks later. Fluridone provided season long control of hydrilla, while the pond treated with dichlobenil had to be treated with Komeen in the fall to remove regrowth. Data pertaining to the dissipation of the herbicides will be presented.

Competitive Interaction Between Monoecious Hydrilla and Vallisneria on Soils of Varying Fertility

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Monoecious hydrilla from the Potomac River and Vallisneria were grown separately and in combination, in outside aquaria, on aquatic sediments of decreasing fertility to assess their ability to compete for nutrients. Biomass production was compared as were soil and tissue nutrient levels in response to soil treatments. The relationship between growth, tissue nutrient concentrations, nutrient accumulation in tissues and nutrient reserves in soil were examined and will be discussed.

An Overview of Simulation Technology Development in the APCRP

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Under the Aquatic Plant Control Research Program (APCRP), computer-based simulation models are being developed to provide systematic simulation procedures for commonly used aquatic plant control techniques. Simulation procedures developed under the APCRP that are available for operational use are HARVEST and STOCK. Research is underway to develop simulation models for biological and chemical control techniques applicable to waterhyacinth, hydrilla, Eurasian watermilfoil, and waterlettuce. First-generation models have been developed and are being tested.

The Aquatic Plant Information Retrieval System: An Aid in Aquatic Plant Management

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The Aquatic Plant Information Retrieval System at the University of Florida contains a computerized data base with more than 25,000 items. Both published journal articles and unpublished information from unusual sources are contained in the data base. Numerous subscribers have used the system to obtain information ranging from environmental tolerance of aquatic plant species to herbicide characteristics. The system is also a major source of support for research programs around the world and current information is disseminated through the newsletter, "Aquaphyte."

Computer Processing for Aerial Aquatic Plant Surveys

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Aerial photography has been utilized for over the years to provide aquatic plant managers and researchers with an accurate picture of environments of concern. Obtaining data from the aerial perspective is useful because many patterns are visible that are not evident from the ground perspective or from on the water.

A recent addition to the tools available for analysis is the calibration of the EnviroScan Pollution Imaging System Computer (PIMS) to read and false color areas of common aquatic plant communities. The PIMS computer based system includes an aerial video camera system for collection of data, and an IBM based computer to process and color enhance video images. The enhancement is based on the computers ability to process VHS formatted video images.

The PIMS applications provide aquatic plant managers with a wide range of data rapidly that would not normally be available. The computer improves the quality of analysis and provides results fast. The use of this system will improve the aquatic plant manager's ability to manage the aquatic environment.

INSECT: A Computer-Aided Tool for Simulation of Waterhyacinth and Its Biological Control Agents

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INSECT is a computer-based simulation model of the population dynamics and interactions of waterhyacinth and its associated insect biocontrol agents, Neochetina eichhorniae and N. bruchi. INSECT is dynamic and provides daily simulations under specified weather conditions. In addition to providing simulations of long-term (3-year time period) biological control, interpretation of INSECT simulation results may aid in the development of new control methodologies that enhance compatibility between Neochetina and other waterhyacinth controls.

Herbicide Fate, Target Plant Species Effects, and Population Response Computer Simulations: An Integrated Approach

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A computer simulation that couples models for aquatic herbicide fate, target plant species effects, and population response following treatment (F.A.T.E. - Fate and Targer Effects) is currently being developed. This decision support system is intended to allow water resource management personnel to select and simulate the most efficacious herbicide treatment strategy for a series of herbicides and aquatic plant species. The simulation predicts required herbicide concentrations, percent control achieved, and plant regrowth following treatment for a wide spectrum of environmental conditions. The model currently simulates 2,4-D (DMA) and waterhyacinth (Eichhornia crassipes (Mart.) Solms), but addition of other herbicides and aquatic plant species is anticipated.