

THE AQUATIC PLANT MANAGEMENT SOCIETY, INC.

**25th ANNUAL MEETING
ABSTRACTS**



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The Effects of Acid and Ammonium Deposition on Aquatic Vegetations
in The Netherlands

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The effect of acid precipitation on aquatic ecosystems is most spectacular in the poorly buffered soft waters on mineral sand bottoms which are practically devoid of lime. These waters are normally characterized by dominance of isoetids, particularly Littorella uniflora, but under influence of a decreasing pH, the inorganic carbon budget becomes disturbed, leading to suppression of Littorella and its companion species by Juncus bulbosus and/or Sphagnum species, and finally to the total disappearance of all submerged macrophytes. This succession becomes markedly accelerated, if the deposition contains a considerable amount of ammonia. Although the pH of the precipitation rises, under aerobic conditions NH_4^+ becomes nitrified by the activity of certain bacteria to nitrate, a process that also produces 2H^+ -ions per NO_3^- -ion. Nitrification proceeds until the pH of the receiving water has reached 3.8. A further decrease of the pH can take place by direct H^+ -input, and e.g. by sulphate reduction in the sediment. The lowest pH observed in The Netherlands was 2.8.

The effect of acid precipitation on hard water systems is still poorly known. In general the acid will be neutralized and the NH_4^+ -input will contribute to the eutrophication. However, in some dune pools "hardening" of the water has been observed, due to dissolution of CaCO_3 from the bottom and the surrounding slopes. The recent appearance of Potamogeton coloratus in several dune pools may be a result of this water hardening.

A Strategy for Integrated Control of Waterhyacinth
Using Neochetina and an Herbicide

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The surface of a sinkhole pond completely covered with large hyacinths was sprayed with 2,4-D in monthly increments of 25%. The final 20% of the pond surface was not sprayed. Waterhyacinth weevils migrated from sprayed plants to the area of unsprayed plants. Numbers of weevils increased in this area from prespray densities of less than 1 weevil/plant to densities of 7 weevils/plant. Very heavy feeding damage has caused many plants to drop out.

Predictable Control of Waterhyacinth with Biocontrol Agents

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Biocontrol agents have achieved significant reductions of waterhyacinth in Florida, Louisiana and Texas. The timing and level of reduction are dependent upon the population of insect agents per unit mass of waterhyacinth in the spring and require a sustained population level throughout the growing season. A computer model of the waterhyacinth/biocontrol agent system is being developed to provide operational elements with a tool for better management of the biocontrol agents.

Effect of Various Waterhyacinth Management Schedules on
Organic Sedimentation Rates

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Organic sedimentation rates resulting from seven different herbicide management strategies ranging from zero coverage to 100 percent coverage with no control were monitored for one year. Organic sedimentation and total herbicide usage was significantly lower when waterhyacinths were maintained at low levels. The highest amounts of sedimentation resulted from complete coverage with no control, whereas the highest total herbicide usage occurred when the plants were allowed to expand beyond acceptable limits.

Significance of Detritus Plant Tissue Decomposition
in Aquatic Systems

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Detritus from aquatic macrophytes and planktonic organisms play a significant role in the productivity of the ecosystem. A field study was conducted to determine the production and decomposition of water hyacinth detritus [Eichhornia crassipes (Mart) Solms] in eutrophic lake water. Nutrient release from the detritus tissue was related to the microbial respiration in the rhizosphere (root zone), water, and underlying sediment.

Influence of Temperature and Phosphate Supply on the Growth,
Nutrition and Phosphorus Uptake of Azolla Species

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When five species of Azolla (collected from various locations representing different climatic regions) were grown in batch culture at 1 μ M (0.03 ppm) or 500 μ M (15 ppm) P to evaluate tolerance to high temperature (37 C), significant differences were found between species. Biomass yields of Azolla ranged from 1.31 to 2.40 g (dw) m^{-2} day^{-1} when grown on 500 μ M P; tissue content (dw basis) ranged from 4.12 to 5.24% N and 1.18 to 1.45% P. On 1 μ M P biomass yields of species ranged from 0.70 to 1.20 g m^{-2} day^{-1} while tissue content was 3.24 to 4.30% N and 0.13 to 0.22% P. Phosphate accumulation ranged from 11.8 to 14.5 mg P g^{-1} (dw) plant tissue when plants were grown at 500 μ M P. In a separate study at 15 C the yields increased from 0.33 to 2.04 g (dw) m^{-2} day^{-1} when the phosphate levels (renewed daily) ranged from 0 to 1.6 ppm P, % N ranged from 4.33 to 4.59 and % P was 0.80. One population exhibited greater biomass accumulation under these fall-winter conditions, suggesting that limits to environmental constraints can be overcome by using Azolla material growing in climatic and edaphic conditions similar to those where Azolla is to be used.

A Model for Predicting Total Phosphorus Concentration
in Lakes With Aquatic Macrophytes

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Recent work in empirical lake modeling and error analysis has expanded the range of these techniques. Originally developed for north temperate lakes, these models use regional data bases to predict local variations in phosphorus concentrations. A model was developed to predict total phosphorus concentrations for lakes and reservoirs in the Southeastern United States, which includes contributions from aquatic macrophyte release, as well as land-use and precipitation inputs. With the recent introduction of exotic aquatic macrophytes to this region, these types of analyses are useful as management tools for aquatic systems.

Mechanical, Hydrodynamic and Aerodynamic
Properties of Waterhyacinth Mats

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Several populations of waterhyacinth, characterized by height, root length, plant mass and stand density, were tested to determine mechanical, hydrodynamic and aerodynamic properties. Elastic moduli and strengths in compression, tension and shear of two mat sizes and hydrodynamic and aerodynamic drags of five mat sizes were found. Characteristics varied with plant and mat size. Results will be applied to design of harvesting and containment systems.

Overview of the Use of Triploid Grass Carp (Ctenopharyngodon idella)
as a Biocontrol for Macrophytes in Washington State

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To date Washington State has banned the use of the white amur or grass carp because of the reproductive potential and possible impact on the various sport fish and wildlife in the state. An extensive five-year study is under way to evaluate the impact of the newly developed triploid grass carp strain, which is thought to be sterile, upon the fish and their ecosystem in several small lakes. Baseline and experimental data and subsequent field stocking studies will determine if the grass carp are likely to interact with the existing biota and ecosystem through either direct competition or in an indirect manner.

Evaluation of Ploidy and Separation Techniques with the Grass Carp
(Ctenopharyngodon idella), a Potential Biological Control
for Aquatic Macrophytes in Washington State

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Separation techniques for diploid and triploid grass carp have been developed and are elevated in this study: (1) flow cytometry, a method of measuring the fluorescence in DNA stained erythrocytes and other cells; (2) coulter counter technique, a method of measuring erythrocyte volume, and (3) direct measurement of erythrocytes using light microscopy. These methods are compared as to cost per sample, time to prepare the sample and difficulty of application of the techniques on 50 triploid and 50 diploid grass carp. Accuracy of each technique is evaluated by comparing results to fish karyotypes. Other new methods showing promise in ploidy determination are discussed in relation to both their biological and economical feasibility.

Ecological Effects of Vegetation Control by Grass Carp in Lake Conroe

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Grass carp (*Ctenopharyngodon idella*) were introduced into Lake Conroe, Texas, in 1981-82 to control submergent macrophytes, principally hydrilla (*Hydrilla verticillata*), which infested 46% of the reservoir's 8,000 ha. Stocked at 75 fish (200 mm minimum) per vegetated hectare, the grass carp reduced the vegetation to undetectable levels by late 1983. Sampling of ecological conditions, initiated in 1980, included bi-weekly or monthly physical-chemical limnology, plankton, and fish populations at 8 stations. In addition, annual cove rotenone samples of fish were conducted at 6 sites.

Limnological conditions varied little among years until 1983. Reduction in macrophytes was accompanied by a decrease in water clarity, as measured by Secchi disk, of about 40%. Chlorophyll *a* concentrations approximately doubled in 1983, indicating that the decrease in clarity was at least in part due to phytoplankton response to nutrient levels. Phytoplankton density in 1983 peaked at about twice the density of 1980-82. Summer phytoplankton density in 1984 was intermediate between 1983 and previous years. Summer and fall 1984 chlorophyll levels were slightly reduced from 1983, and water clarity was slightly increased. In contrast, zooplankton, which pulsed earlier each year, peaked in early 1984 at a density about double that of previous years. Potassium concentrations, like chlorophyll, increased in 1983 and fell to intermediate levels in 1984.

Fish populations responded rapidly to the vegetation control. Planktivorous gizzard and threadfin shad increased during late 1982 and early 1983, and remained high through May 1984 as indicated by cove rotenone samples. Largemouth bass, the principal game species, had year classes about two-thirds smaller in 1983 and 1984, as indicated by summer seine samples and May 1984 cove rotenone data. Growth rate of young bass and survival from age I to II increased in 1983. Cove rotenone samples showed a marked reduction in diversity and biomass of sunfishes (*Lepomis* spp.). Most pronounced declines occurred for small, vegetation-dependent species. Further changes in the fish community are anticipated and research is scheduled to continue through 1986.

The Illinois Herbivorous Fish Stocking Simulation System (IHF3S)

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Over the past 4 years research on the efficacy and impacts of using herbivorous carp to control aquatic vegetation has been conducted at the Illinois Natural History Survey. This research effort has included studies on the bioenergetics, feeding characteristics, and ecological impacts of the carp, and seasonal aquatic plant dynamics. The ultimate integrator of all the information obtained is the Illinois Herbivorous Fish Stocking Simulation System (IHF3S), a computer-implemented stocking model. Recommendations for stocking herbivorous carp in Illinois have been made based on a series of analyses using the stocking model.

Triploid Grass Carp (*Ctenopharyngodon idella*) Feeding Rates and Species Preferences for Common Aquatic Macrophytes of Washington State Ponds

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Eurasian milfoil (*Myriophyllum spicatum*) and pondweed (*Potamogeton* sp.), along with other common macrophytes in various combinations, have been offered to diploid and triploid grass carp. The experiments include: the comparison of feeding rates and food preferences between diploid and triploid grass carp; the effect of fish density and plant density on feeding rate and preference; triploid grass carp body length relating to the feeding rate and preference; and the effect of water temperature on feeding rate and preference of diploid and triploid grass carp. The results give an indication of which nuisance macrophytes will be controlled by triploid grass carp populations upon introduction into Washington State's lakes with their relatively cold temperate water temperatures.

Use of the Triploid Grass Carp for Aquatic Plant Management in Florida

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Grass carp (*Ctenopharyngodon idella*) certified triploid (3N = 72) by Coulter Counter are permitted for aquatic plant management by the Florida Game and Fresh Water Fish Commission. Recommendations are made as to number and size of fish, additional control methods needed and retention measures needed after an onsite field inspection is completed. Many factors including water usage, plant density, trophic state, problem and non-problem species, past plant control measures, and others are used to formulate recommendations.

An Update on the Corps' Aquatic Plant Control in Florida

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Gas and Ion Permeability of Benthic Barriers

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All aquatic vegetation management strategies impose a certain degree of perturbation on the structure and/or function of aquatic ecosystems. These perturbations may include the structural collapse of the vegetational canopy, the depletion of oxygen from water columns, etc. Benthic barriers may have a very significant impact on sediment diagenesis. A study was designed to evaluate the permeability of various benthic barriers to several ions and gases on a controlled laboratory environment and under field conditions using dialysis techniques. Emphasis will be placed on Silicone Benthic Membranes.

Additional comments will be directed towards the current status of Silicone Benthic Membranes.

Operational Hydrothol 191 Application in a Potable Water System

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Potable water is distributed to Tempe, Arizona, population 150,000, via approximately 25 miles of canals. Fifteen miles are cleaned occasionally with machines, 10 by Hydrothol 191 regularly.

For 6 years, Hydrothol 191 has been approved at 0.2 ppm for potable and irrigation water. Average waterflow is 290 cfs and dominant weeds are sago pondweed, curly leaf pondweed, Spirogyra and Cladophora species.

Cost, benefits, application methods and water quality will be discussed in detail.

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

Over the years, aquatic plant control has evolved from the days of simple 2,4-D and water mixed in a 55 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 in past history for containing a tremendous amount of waterhyacinths (Eichhornia crassipes). This makes hyacinths the number one target plant. 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 the before mentioned technologies, the river is presently under maintenance control of waterhyacinths, with a free and unobstructed flow of normal activities.

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 also caused problems. Frogs-bit (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 Frogs-bit.

An Evaluation of Hydroacoustics as a Tool for Measuring Abundance of Aquatic Macrophytes

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The ability of fisheries hydroacoustic equipment to measure aquatic macrophyte density was investigated by comparing a variety of combinations of the available acoustic system parameters, such as frequency, beam pattern, pulse length, transmit power, and receiver sensitivity. Best results were observed with the narrowest beam angle, shortest pulse length, lowest transmit power, and lowest receiver gain possible. With the hydroacoustic equipment that is presently available, a solid layer of milfoil, 2 m thick, which has a large target strength, presents a problem with multiple scattering and shading of the lower plant portions and lake bottom by the upper portion of the plant layer.

Evaluation of Landsat for Aquatic Plant Surveys

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Some method of remote sensing is needed to improve the speed and accuracy of the state's aquatic plant survey. Landsat satellite imagery was evaluated because of its low cost and the recent availability of an image analysis system within the Department. Methods have been developed to take raw image photographs into the field for ground truthing, after which a reasonably accurate map can be constructed of the major emerged and at or near surface submersed plant populations. Currently under investigation is the discrimination of deeply submersed plants.

Use of A Multiple Diffusion Unit to Study the Effect of Allelopathic Agents on Hydrilla

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A commercially available apparatus (Ecologen) has been used to grow hydrilla and should be useful for studying the effect of phytopathic chemicals produced from sediment or by organisms. The unit consists of four growth chambers mounted to a central chamber. Cultures of hydrilla and a second organism can be maintained in separate chambers separated from the central chamber by a membrane (test series) to permit diffusion of phytopathic products; polyethylene film or glass plates can be used in place of the membrane to permit hydrilla and the second organism to grow in pure culture medium (control series). The success and limitations of the approach will be considered.

Recent Studies in the Management of Florida Red Tide

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Chloroform extracts of extracellular metabolites of the marine green alga *Nannochloris* sp. (collectively termed "Aponin") are known to be cytolytic toward the red tide organism *Ptychodiscus brevis*. Aponin was tested for activity against isolated canine tracheal smooth muscle, and no discernable effect was observed up to 10.0 µg/ml. The absence of an effect, in this instance, is particularly significant inasmuch as the cytolytic activity of aponin could be responsible for the release of airborne toxins of *P. brevis*, and these may cause asthma-like responses in many persons. The absence of an effect of aponin provides further evidence that this material is a potentially useful red tide management agent.

Luxury Consumption of Primary Nutrients and Their Relationship to Biomass Productivity in the Waterhyacinth

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Renewed interest in the biological treatment of wastewater and general water quality improvement has again focused attention on the waterhyacinth for the removal of primary nutrients and heavy metals. Monoclonal waterhyacinths were exposed to various concentrations of nitrogen and phosphorus for a single pulse-feeding with these elements. The plants were then grown in nutrient solutions deficient in nitrogen or phosphorus and quantitative measures of responses due to the luxury consumption of these elements were observed.

Control of Tuber Formation in *Hydrilla verticillata*

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Chemical control of *Hydrilla verticillata* has been marginally effective due to rapid reinfestation caused by tuber and turion sprouting. Prevention of tuber formation would significantly enhance chemical control techniques. Ethylene, applied as ethephon, reduced tuber production in greenhouse cultures by 80 percent when applied at a level of 0.1 mg l⁻¹ ethephon at 2-d intervals. Thidiazuron (N-Phenyl-N'-1,2,3-thidiazol-5-yl urea) stimulated endogenous ethylene production in hydrilla. A single dose (10⁻⁶ M) completely inhibited tuber production for seven months in greenhouse cultures.

Influence of Photoperiod on *Potamogeton nodosus*, *P. pectinatus*, and *Hydrilla verticillata*

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Hydrilla verticillata (monoecious strain), *Hydrilla verticillata* (dioecious strain), *Potamogeton nodosus*, and *Potamogeton pectinatus* were grown in a greenhouse under 10, 12, 14, and 16 h photoperiods. Relative growth rates did not differ with photoperiod, but the production of tubers or winterbuds did. Vegetative propagule production was stimulated by short days (10 to 12 h photoperiods) except for dioecious *Hydrilla verticillata* which did not produce tubers during an eight week exposure to the experimental photoperiods.

Operations on Monoecious Hydrilla Plants Grown in California

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Viable seed have not been found on monoecious hydrilla plants collected in the eastern United States and cultured at Davis, California. Two years of culturing these plants in large outdoor tanks has shown that both male and female flowers will form. However, pollen does not germinate on nutrient incubation media. Ovules produced synergid and mother egg cells, but viable embryos did not develop. Some ovules became enlarged and seed-like in appearance. They developed elongated outgrowths from endosperm tissue, some of which penetrated the ovary to form endosperm haustoria. Examination of seed grown in North Carolina showed them to have well-developed embryos. The coleoptile, young leaves, meristem, and branch buds were apparent.

Influence of Temperature, Light Intensity and Competition on Growth of Monoecious and Dioecious Hydrilla verticillata (L.f.) Royle Biotypes

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Controlled environment studies are being conducted to determine relative rates of growth, shoot elongation, production of lateral branches and roots, and chlorophyll levels over a range of temperatures (10-35 C) and light intensities (5-120 $\mu\text{E m}^{-2} \text{s}^{-1}$). In a set of greenhouse experiments, the ability of the two biotypes to compete is being assessed directly by establishing a replacement series in which the total number of plants remains constant but the proportion of the two biotypes is varied. This design is being conducted under various light intensities. At the end of the experiment, growth and reproductive responses will be determined and the competitive abilities of the two biotypes will be compared.

These data will be useful in delimiting environmental tolerances and predicting habitats in which these two biotypes may successfully establish themselves.

Sonar Report - Efficacy and Label Status

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Sonar (fluridone) has been tested since 1981 in numerous lakes and ponds having a wide variety of problematic aquatic weeds. Many submersed and emersed species have been documented to be controlled for 1-2 years. Factors such as formulation, timing, and tolerant species identify Sonar as a selective aquatic herbicide. No adverse environmental conditions have occurred as a result of Sonar use.

Review of the Effects of Endothall on Mammalian and Aquatic Ecosystems

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The history and present status of endothall are reviewed using the basic label as a means of representing available data. Each label statement reflects some facet of research completed on the compound. The meaning of the statements and information behind them are presented.

Aquatic Weed Control With Aquashade: A Case History

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** Town of Indian Lake, Indian Lake, New York

Adirondack Lake, a shallow, 215-acre impoundment situated in the Adirondack Mountains of upstate New York, has been infested with broad-leaved pondweed, Potamogeton amplifolius, for approximately 40 years. In 1983, an estimated 70 percent of the water surface was covered with the floating leaves and stems of this plant. For years the Town of Indian Lake, New York, had attempted to control the growth of this plant through cutting/harvesting, 2,4-D applications, and overwinter drawdown, but had met with very little success. In early May of 1984, Clean Lakes Incorporated was contracted to apply 350 gallons of Aquashade, a registered herbicide which is in fact a dye, to the lake for lakewide aquatic plant control. It was intended that Aquashade would suppress photosynthesis in the submerged plants by reducing the penetration of red light. It is estimated that the plant biomass was reduced by more than 75 percent in 1984, and the majority of the plants grew no more than 36 inches tall in the impoundment, which averages 7 feet in depth.

Response of Waterhyacinth to Exogenously Supplied
Gibberellic Acid (GA₃)

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The length-to-width ratios of newly produced petioles increased with increase in GA₃ concentration. However, maximum leaf area was recorded at a GA₃ concentration of 0.03 ppm in the float type plants (with bulbous petioles) and 0.10 ppm in the canopy type plants (without bulbous petioles). GA₃ up to 0.05 ppm stimulated the growth of the float type, while the canopy type required rates higher than 0.05 ppm for stimulated growth.

APPLICATION FOR MEMBERSHIP

There are three regular classes of membership available upon application made in accordance with the Charter adopted in 1961. These classes are:

- A. Active Membership\$ 25.00
- B. Student Membership 5.00
- C. Commercial Sustaining Membership 200.00

Name of Applicant _____ Spouse's Name _____

Home address * _____ Zip Code _____

Present title & Employer _____

Business Address * _____ Zip Code _____

Business Telephone _____ Home Telephone _____

Amount of Remittance \$ _____ Signature of Applicant _____

Membership Type: ACTIVE ____; COMMERCIAL SUSTAINING ____;

STUDENT ____; SUBSCRIPTION ____.

*Please indicate address to be used by our business office.

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