ABSTRACTS

THIRTY-FOURTH ANNUAL MEETING

OF

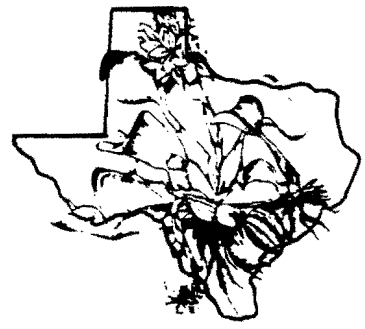
THE AQUATIC PLANT MANAGEMENT SOCIETY, INC.

AND

SIXTH ANNUAL MEETING

OF THE

TEXAS AQUATIC PLANT MANAGEMENT SOCIETY, INC.



HILTON PALACIO DEL RIO
SAN ANTONIO, TEXAS

JULY 10-13,1994

MONDAY, JULY 11, 1994
1:15 PM - 5:00 PM

SESSION II
AQUATIC PLANT MANAGEMENT IN TEXAS

Extention Methods for Aquatic Vegetation Management in Texas
Jim Davis, Texas A&M University, College Station, TX

Within the State of Texas the Texas Agricultural extension Service has assumed the major responsibility for aquatic vegetation control in privately owned water. As an educational organization TAEX works through local organizations as well as consultants to guide pond and lake owners in vegetation management in the over 850,000 acres of private waters in the State. Methods as well as successful and unsuccessful demonstrations are discussed.

AN OVERVIEW OF COMMERCIAL AQUATIC PLANT MANAGEMENT IN PRIVATE TEXAS IMPOUNDMENTS

by

Ernest A. McCune III
Lake Management Services, Inc.
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ABSTRACT

There are many aquatic plant species throughout Texas with a diversity of sizes, shapes and colors. These plants stabilize shorelines, oxygenate water, provide spawning habitat and cover for fish and serve as food sources and refuges for insects, birds, waterfowl and wildlife. With more than 600,000 private lakes and ponds throughout Texas, many used as multi-purpose impoundments, excessive aquatic plant growth can severely interfere with these purposes. Advances in education and technology, over the past 15 to 20 years, have increased the awareness of private lake and pond owners, paving the way for commercial aquatic plant management.

Aquatic Plant Control and Water
John Wedig, Lower Colorado River Authority, Austin, TX.

When the Lower Colorado River Authority was created by the Texas Legislature in 1934, it was given responsibility for the "control, storage, preservation and distribution of the waters of the Colorado River and its tributaries" in the ten contiguous counties along the Colorado River mainstem from San Saba to the Gulf of Mexico. The LCRA utilizes a Pest Management Committee to evaluate and recommend the 'least toxic' methods for pest control. The Pest Management Plan Manual has been developed by the LCRA as an action plan guide for managing high priority pest problems, including noxious aquatic weeds.

Ed Withers, FCWD
Lake Cypress Springs

"Aquatic Plant Control at Lake Cypress Springs"

An introduction on Lake Cypress Springs will be given. Then, the steps we have taken to control Hydrilla will be presented.

An explanation for both successful and unsuccessful results is to be discussed.

Response to new methods using public involvement where an inhabited reservoir is involved.

MANAGEMENT OF SHALLOW IMPOUNDMENTS IN NORTH TEXAS TO PROVIDE EMERGENT AND SUBMERGENT VEGETATION FOR WATERFOWL

LEN G. POLASEK, Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843

Abstract: Previous studies indicate that migrant and wintering waterfowl partition feeding locations among water depths and emergent and submergent plant communities. However, limited information exists on shallow-impoundment management for waterfowl in the southern United States. I determined the effects of drawdown on continuously-flooded versus moist-soil zones, tilled and non-tilled plots, and fall versus spring drawdowns on vegetation and seed production in shallow impoundments. Partial drawdowns are effective in maintaining submergents while enhancing emergents. Effects of tillage application and drawdown timing are species specific; therefore, these management techniques can enhance or control beneficial and detrimental plant species.

Low Temperature Limitations on the Growth of Waterhyacinth

Chetta S. Owens[1] and John D. Madsen[2]
[1]ASci Corporation, Lewisville, TX and [2]US Army Engineers Waterways Experiment Station, Lewisville, TX.

Waterhyacinth is considered the dominant aquatic nuisance plant in subtropical and tropical regions of the world due to its ability to form dense mats. Experiments were conducted over the winters of 1992-1993 and 1993-1994 in ponds and greenhouses located in Lewisville, Texas to determine chronic and acute low temperature tolerances. Waterhyacinth withstood low temperatures above freezing for an extended time period. When temperatures dropped

Carbon source for submerged leaves of the endangered

Zizania texana (Texas wildrice)

P. Power - Southwest Texas State University
and R. D. Doyle - Us Army Engineer
Waterways Experiment Station,
Lewisville Aquatic Ecosystem Research Facility

ABSTRACT

Zizania texana, an endangered heterophyllous macrophyte endemic to the San Marcos River, produces submerged ribbon-like leaves and emergent reproductive culms in flowing water and only emergent reproductive culms in standing water. To determine the carbon source for submerged leaves DIC was manipulated in a closed chamber using pH drift techniques. Photosynthesis slowed to detection limits as pH approached 8.7 (CO_2 <0.02 mM, HCO_3^->4.5 mM), suggesting that *Z. texana* cannot utilize HCO_3^-. Growth of submerged leaves and therefore survival of this species in the river depends upon a constantly replenished CO_2 supply from flowing water.

An Overview of Grass Carp Use in Texas

Earl W. Chilton II, Texas Parks and Wildlife Department, Austin, TX.

Grass carp were first legally introduced into Texas in 1981 when 270,000 were released into Lake Conroe as part of a Texas A&M University research study. In 1989, the Texas legislature allocated $750,000 for Texas Parks and Wildlife Department to determine the safety and effectiveness of triploid grass carp for vegetation control in Texas. After reviewing research results, as well as current literature, the Texas Parks and Wildlife Commission legalized triploid grass carp use, by permit, in January 1992. Since that time over 32,000 permits have been issued for a total of more that 85,000 fish. Currently, research is underway to determine behavior, growth, salinity tolerance, and reproductive success in the Trinity River and Galveston Bay area.

An Investigation of Grass Carp Spawning in the Lower Trinity River, Texas

Mark A. Webb
Texas Parks and Wildlife Department
1004 East 26th Street
Bryan, Texas 77803

Texas Parks and Wildlife Department personnel conducted ichthyoplankton sampling in the Lower Trinity River of Southeastern Texas during spring 1992 and 1993 in response to concerns over growing grass carp populations and possible predation on smooth cord grass downstream in the Galveston Bay system. Ichthyoplankton samples taken in 1992 were found to contain large numbers of grass carp eggs including many that were apparently viable and developing at the time of collection. Although successful grass carp spawning had been reported at many locations within the Mississippi River basin, the Trinity River collections appeared to be the first in another U.S. river system. However, no larval or juvenile grass carp were found during the 1992 sampling, leaving questions as to the success of hatching and survival to juvenile stage.

As in 1992, samples collected in the Trinity River during spring and summer 1993 contained grass carp eggs which appeared viable and were developing; however, 1993 samples also contained recently-hatched larvae in substantial numbers. These samples confirmed not only that a second successful spawn had occurred but also that large numbers of larvae were being produced.

Additionally, a grass carp (ca. 65 mm TL) was collected from the Houston Ship Channel (downstream from the TPWD collection sites) by the Texas Water Commission in July 1993. Texas Parks and Wildlife Department's Resource Protection Division also reported 65 grass carp juveniles between 102-178 mm TL during a fall 1993 fish kill investigation in a bayou off the Houston Ship Channel. Although stocking grass carp has recently been allowed under permit in Texas, legally stocked triploids and illegally stocked diploids are generally 150-200 mm TL or larger at the time of stocking. Collection of the aforementioned small juveniles suggests origin from a natural spawn, indicating that successful grass carp recruitment as well as spawning, egg development, and hatching occur in the Trinity River, Texas.

The Biology of Free-ranging Grass Carp in East Texas River and Bay Systems.

Howard S. Elder, Department of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843, 409/845-5777 (presenter).

Brian R. Murphy, Department of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843, 409/845-5777

Recent confirmation of grass carp spawning in the river systems entering Galveston Bay is a serious concern to many fisheries ecologists. The impacts that free-ranging grass carp might impose on native aquatic plants, associated fish species, and waterfowl in the Galveston Bay system cannot be predicted. Grass carp captured in the Trinity River by commercial fishermen were examined to determine population structure, diet, and ploidy. The fish were primarily diploids, and represented a broad range of age classes. This study provides strong evidence that naturally spawned grass carp are being recruited to adult sizes in the Trinity River.

Effectiveness of Low-Density Triploid Grass Carp Stockings

Brian G. Blackwell, Department of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843, 409/845-5777 (student-presenter).

Brian R. Murphy, Department of Wildlife and Fisheries Sciences, Texas A&M University, 210 Nagle Hall, College Station, TX 77843, 409/845-5777.

Texas law currently allows triploid grass carp to be stocked at a maximum rate of 7 per surface acre in private waters. Thus, stockings are considered low density when compared to other areas. We evaluated the effectiveness of low-density triploid grass carp stockings for submersed vegetation control in heavily vegetated small Texas impoundments. We attempted to reduce, but not completely remove, submersed vegetation from four small impoundments. Results were variable, but tended to indicate that low-density triploid grass carp stockings can provide control of nuisance submersed vegetation. Vegetation type and density need to be considered when making stocking recommendations.

The Corps' Lewisville Aquatic Ecosystem Research Facility: New Opportunities for Aquatic Plant Research, Education, and Cooperation in the State of Texas.

R. Michael Smart, US Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX 75056

The USAE Waterways Experiment Station is operating a new research facility in Lewisville, Texas. The facility is being developed under the Corps' Aquatic Plant Control Research Program for studies of the biology, ecology, and management of aquatic plants. The unique collection of research capabilities and personnel at the facility provide new opportunities for cooperative research and education related to aquatic plants and their management in Texas.

Angler Opinions on Fishery Management Tools: Who Wants What?

Robin K. Riechers, Texas Parks and Wildlife Department, 4200 Smith School Road, Austin, Texas 78744.

Management of resources for maximum recreational and economic benefits is often complicated by the differing opinions of a diverse set of user groups. Since 1986 Texas Parks and Wildlife Department has conducted mail surveys to determine anglers' support or opposition toward several management programs and regulations. Angler differences in support have been explored by species preference, avidity levels, and other angler groupings (salt and fresh water anglers, tournament and non-tournament, etc.), and generally support or opposition is predictable based on the way the regulation will affect the group. For instance, tournament anglers and fishing club members indicated significantly greater ($P < 0.0001$) opposition to removal of freshwater vegetation (41% were opposed) than did non-tournament anglers and non-club members (27% and 28%, opposed, respectively). Additionally, salwater anglers showed significantly greater ($P < 0.0001$) support for a mandatory stamp to retain a specific species as compared to freshwater anglers. By obtaining information about anglers, and sub-groups of anglers, management should be better able to anticipate and predict the reactions of specific groups to management actions and programs, and thus maximize user satisfaction of those resources.

Imazapyr For Controlling Shoreline, Marginal and Ditchbank Vegetation

Michael Standish* / Alan "Bo" Burns
Vegetation Specialist / Vegetation Specialist
American Cyanamid Co.
P.O. Box 1040
Granger, TX 76530

Imazapyr, under the trade name ARSENAL® herbicide, has been used for several years to control troublesome weed & brush species on utility rights-of-way, highway roadsides and industrial plant sites. Imazapyr is labeled for non-irrigation ditchbanks to the waters edge. Recently it received a supplemental label for use in low lying areas when water has drained but may be isolated in pockets due to uneven or unlevel conditions. Field trials over the past three years with imazapyr have shown excellent control, 12 MAT, on several exotic plants such as: Alternanthera philoxeroides, Arundo donax, Melaleuca quinquenervia, Panicum hemitomon, Panicum repens, Phragmites spp., Schinus terebinthifolius, Tamarix ramosissima, and Typha spp.

TUESDAY, JULY 12, 1994
8:30 AM - 12:00 PM

SESSION III
ECOLOGY AND PHYSIOLOGY

Potential Impact of Turtle Herbivory on Aquatic Macrophyte Communities

by Gary O. Dick[1] and R. Michael Smart[2]

[1] ASci Corporation, Lewisville TX
[2] U S Army Engineer Waterways Experiment Station Lewisville Aquatic Ecosytem Research Facility, Lewisville TX

Abstract

Red-eared turtle (*Trachemys scripta elegans*) herbivory has been observed to interfere with the artificial establishment of several native species of aquatic macrophytes. Effects of this herbivory were experimentally ascertained on communities comprised of *Vallisneria americana, Najas guadalupensis, Potamogeton nodosus, Hydrilla verticillata* and *Myriophyllum spicatum*. In communities protected from turtles, *Hydrilla* became the dominant species, comprising over 60% of the standing biomass. Where turtles grazed, communities were dominated by *Potamogeton*. *Hydrilla* was reduced to less than 5% of the biomass, and *Vallisneria* was essentially eliminated from the community. Significant differences were also seen in community biomass production, with protected communities reaching 50% greater total biomass.

AQUATIC PLANT FEEDING PREFERENCES BY THE RED-EARED TURTLE

Kimberly J. Mauermann, Gary O. Dick and R. Michael Smart
U.S. Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX.

Although red-eared turtles (*Trachemys scripta elegans* Wied) are generally considered omnivores, as adults they consume a considerable amount of aquatic plant material. We evaluated possible feeding preferences among five submersed aquatic plant species - *Hydrilla verticillata, Myriophyllum spicatum, Najas guadalupensis, Potamogeton nodosus* and *Vallisneria americana*. The five species were offered together to female turtles held in 2 m diameter pools. Consumption was checked daily over a 3 day period. Preference order was *V. americana* > *N. guadalupensis* > *H. verticillata* > *P. nodosus* = *M. spicatum*. A subsequent 24 hr pairwise comparison experiment verified preferences and was used to ascertain maximum consumption rates.

THE EFFECTS OF AQUATIC PLANT COMMUNITIES ON WATER QUALITY

David R. Honnell[1], John D. Madsen[2], and R. Michael Smart[2]

[1] AScI Corporation, Lewisville, TX. [2] U.S. Army Engineer Waterways Experiment Station, Lewisville, TX

The water quality of four ponds with differing plant communities were examined over a two year period. Water quality parameters examined included dissolved oxygen, pH, conductivity and temperature on a diel basis, and dissolved nutrients at biweekly intervals. The Changes in water quality are primarily associated with canopy formation. This physical barrier reduces wind driven water movement and impedes reaeration, thus allowing depletion of oxygen and degradation of water quality. Unlike the exotic species, native species rarely form extensive monospecific populations in larger bodies of water. Extensive areas of dense canopy will degrade water quality as well as impeding navigation and recreational activity.

Foraging Efficiency and Growth of Juvenile Largemouth Bass Associated with Exotic and Native Aquatic Macrophytes

by R. M. Crouch

U.S. Army Engineer Waterways Experiment Station, Lewisville, TX.

Abstract

The effects of different aquatic macrophytes on behavior and growth of juvenile largemouth bass (*Micropterus salmoides*) are poorly investigated. *Hydrilla verticillata, Potamogeton nodosus* and *Vallisneria americana* were established in 650-L tanks, and one juvenile bass was introduced to each tank. Larval odonates were added in equal numbers as the single food source, and bass were allowed to forage for a 10-day period. Short-term growth of bass, and odonate survival and emergence were used to assess the effects of each plant species. Bass growth was greater in *V. americana* and *P. nodosus*, while odonate survival was higher in *H. verticillata*.

DYNAMICS OF *EICCHORNIA CRASSIPES* AND RELATED AQUATIC PLANTS IN LAKE CHAPALA

Eric Gutiérrez [1]; Felipe I. Arreguín [1]; Manuel Guzmán A.[2]; and Gualberto Limón M.[3] *

ABSTRACT

This lake is the largest natural lake in México and belongs to the Lerma-Chapala-Santiago hydrological system, in which water resources are both a much demanded and a highly valuable asset.

In recent years, and for the second time in this century, water haycinth plants have covered a significant portion of its surface (~20%), impairing the benefitial uses of this large shallow lake, which include recreation, agriculture and water suply to the Guadalajara Metropolitan Area.

This paper discusses the dynamics of this plant as related to physical, chemical and hydrological factors. The types of mats of WH and its seasonal distribution patterns affected by wind are both used for a control strategy, which also comprises actions in the Lerma watershed.

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(3) Diseños Hidráulicos y Tecnología Ambiental, S.A.. Apdo. Postal 5-7, Col Chapalita. Guadalajara, Jal. 45000 México
* To whom correspondence shall be addressed.

Environmental Influences on the Early Phenology of Monoecious Hydrilla in Lake Gaston

Chad R. Coley* and Stratford H. Kay
Crop Science Department
North Carolina State University, Raleigh, NC 27695

ABSTRACT

Preliminary evaluations in the spring of 1994 at Lake Gaston, North Carolina and Virginia, have shown relationships between soil-water interface temperatures and monoecious hydrilla tuber and turion germination. Propagules collected from the 1-M depth were dormant up to 12° C. Turion dormancy was broken at 13° C, as evidenced by the presence of elongation. Tuber dormancy was broken at 16° C as evidenced by the presence of swollen apices. Shoot elongation increased with rising water temperatures until emergence from the hydrosoil. After emergence from the hydrosoil, light penetration appeared to be the over-riding factor regulating further shoot elongation.

Long-term Competition Between American Lotus and Eurasian Watermilfoil

by Joe R. Snow[1], R. Michael Smart[1] and Gary O. Dick[2]

[1] U S Army Engineer Waterways Experiment Station Lewisville Aquatic Ecosystem Research Facility, Lewisville TX
[2] ASci Corporation, Lewisville TX

Abstract

Competitive interactions between American lotus (*Nelumbo lutea*) and Eurasian watermilfoil (*Myriophyllum spicatum*) were investigated over two growing seasons in an earthen pond. Forty 1m-diameter (0.20m deep) sediment containers were planted with various combinations of both species. Lotus was unaffected by the presence or absence of watermilfoil and where it was successfully established, lotus was dominant. However, lotus could not be established in depths greater than 1m. These depths were dominated by watermilfoil.

Reproductive Biology of Southern Naiad in Southwest Florida

John R. Cassani, E. Lasso de la Vega and H.P. Allaire

Southern naiad (*Najas quadalupensis*) is the aquatic macrophyte most frequently encountered at undesirable levels in costal southwest Florida. Comparably little ecological information is available for this species. Our objective was to characterize the reproductive biology of southern naiad with the intent of defining a "weak point" in its life history. Utilizing this type of strategy may help aquatic plant managers develop more effective strategies for control. Preliminary results indicate light intensity as a key factor regulating seed germination in vitro. Southern naiad flowers were most abundant from January through May, coinciding with seasonal regrowth.

ABSCISIC ACID INDUCES CHANGES IN GENE EXPRESSION DURING LEAF DEVELOPMENT IN THE AQUATIC MACROPHYTE, POTAMOGETON NODOSUS

Doreen Gee, USDA-Agricultural Research Service, Aquatic Weed Control, Laboratory, Section of Plant Biology, University of California, Davis, CA 95616-8537

Application of abscisic acid (ABA), to the heterophyllous aquatic macrophyte P. nodosus, induced the formation of floating leaves while the plant was still submerged. However, not all leaves were responsive to ABA and there was a window of 2-4 days when the leaves were responsive to ABA treatment. Experiments with ^{14}C labeled-ABA showed that ABA translocated to the nodes. To attempt to elucidate the mechanism of the ABA response in leaf development, a cDNA library was prepared from 12 hr ABA-treated plants and several clones that were induced by the ABA treatment from the actively growing shoot tips were isolated and characterized.

Abstract
" Some Chemical and Biochemical Characteristics of Six Lakes in Northwest Hillsborough County (Florida)" Andrew L. Massell, Patricia M. Dooris, and Dean F. Martin, Institute for Environmental Studies, Department of Chemistry,University of South Florida, Tampa, FL 33620-5250.

We revisted and resampled six lakes that we had studied previously [D. F. Martin, D.M. Victor, and P.M. Dooris, Water Res. 10:65-69 (1976)] for the effects of artificial augmentation. Samples were analyzed for the usual chemical constituents, and hydrilla bioassays were run. Previously, three lakes showed good potential for hydrilla growth, and it had infested one lake (Lake Saddleback) where it is now under control by means of herbivorous fish. Lake Starvation should have been infested on the basis of water hardness and nutrient levels, but hydrilla was absent, and remains so,probably because of naturally hydrilla inhibitors. The use of Maucha diagrams to denote chemical differences will be discussed.

Monitoring Physiological Effects of Triclopyr and Fluridone on Non-target Aquatic Plant Species

Susan L. Sprecher[1] and Anne B. Stewart[2]

[1]US Army Engineer Waterways Experiment Station, Vicksburg MS

[2]AScI Corporation, Vicksburg, MS

Physiological assessments allow identification and comparison of herbicide effect among susceptible and tolerant non-target aquatic plants. Eight days following triclopyr treatment at 1 mg/L for 12 hr or 2.5 mg/L for 24 hr, peroxidase enzyme activity increased significantly in the target species *Myriophyllum spicatum*, but not in tolerant *Vallisneria americana*, *Elodea canadensis* and *Potamogeton pectinatus*. Exposure to 2, 10, or 25 µg/L fluridone for 90 days produced changes in chlorophyll, carotenoid, and phytoene pigments, and in rates of photosynthesis, respiration and carbohydrate production, that were related to levels of herbicide tolerance in *P. pectinatus*, *P. nodosus*, *Heteranthera dubia*, and *V. americana*.

Effects of Flurprimidol on the Growth and Carbohydrate Status of Eurasian Watermilfoil

Linda S. Nelson
US Army Engineer Waterways Experiment Station, Vicksburg, MS

Studies were conducted in 55-L aquaria under controlled-environment conditions, to evaluate growth regulator effects of flurprimidol on Eurasian watermilfoil (*Myriophyllum spicatum*). Treatments included flurprimidol concentrations ranging from 0 to 500 µg/L with exposure times varying from 0.25 to 28 days. Extending the flurprimidol contact time increased the growth inhibitory response. Shoots were 14-64% shorter than untreated plants at 14 DAT. Growth inhibition persisted 56 DAT for plants exposed to 25 and 100 µg/L flurprimidol for 28 days and 200 µg/L flurprimidol for 10 days. Growth inhibited plants accumulated starch in shoots and roots, whereas plants showing little or no growth suppression did not. Treatments that most effectively suppressed shoot length accumulated up to 68% more total nonstructural carbohydrate compared to untreated plants. Shoot and root dry weight biomass were unaffected by flurprimidol.

Random Amplified Polymorphic DNA (RAPD) reactions can identify the hydrilla biotypes found in the U. S.

Frederick J. Ryan
USDA ARS Aquatic Weed Lab
Plant Biology Section, Robbins Hall
University of California, Davis, CA 95616-8537

The Random Amplified Polymorphic DNA (RAPD) reaction is a method of generating genetic markers for organisms, and is, in a sense, a genetic fingerprint. The RAPD reaction has been carried out with 60 primers, with different accessions of monoecious and dioecious hydrilla from the U.S. Two primers have been found which distinguish the monoecious biotype from the dioecious. The RAPD reaction has been used in conjunction with patterns of isoenzymes and tuber proteins to identify the biotype of new infestations of hydrilla. This method can also be used to measure genetic variability within these biotypes, and identify alien biotypes of this plant.

TUESDAY, JULY 12, 1994
1:15 PM - 3:15 PM

SESSION IV
PREVENTING AQUATIC WEED INFESTATIONS

Nonindigenous Aquatic Weeds As Biological Pollutants in the United States. Randy G. Westbrooks. USDA APHIS PPQ. Whiteville, North Carolina.

Most plant species that have been moved beyond their historical ranges by man survive only under cultivation or are benign in their effects on natural ecosystems. Introduced species that do threaten the biodiversity of natural areas and/or production capacity of developed or agricultural ecosystems are called biological pollutants. Two introduced aquatic plants that have become biological pollutants in the United States include floating water hyacinth (*Eichhornia crassipes*) and hydrilla (*Hydrilla verticillata*). One objective of APHIS PPQ is to prevent the entry and establishment of such foreign weeds into the United States under authority of the Federal Noxious Weed Act (94 taxa are listed as Federal Noxious Weeds; including 16 aquatic species). Regulatory strategies that are used to achieve this goal include **encouraging production of weed free commodities for export to the United States, preclearance** (inspection of high risk commodities at foreign ports of export), **exclusion** (inspection at U.S. ports of entry), **early detection, containment and eradication** (of incipient infestations within the United States). Presently, 10 Federal Noxious Weeds are being eradicated from 14 locations in the United States through cooperative projects with affected states. The eradication of hydrilla in the Imperial Irrigation District in southern California (almost completed) stands as one of the program's success stories. Another success story has been the detection and elimination of a rhizomatous form of wild red rice (*Oryza rufipogon*) from a small infestation in the Everglades National Park in south Florida.

Aquatic Weeds Intercepted by the U.S. Department of Agriculture. Larry Fowler, Regional Botanist, U.S. Department of Agriculture, APHIS, PPQ, Brownsville, Texas.

The Federal Noxious Weed Act (FNWA) of 1974 lists 17 aquatic taxa. Of the seven FNWA taxa intercepted, Ipomoea aquatica, Water Spinach, is encountered most frequently. It has been intercepted from 23 countries in both hemispheres, mostly as seed in airport passenger baggage. It is known to occur in the states of California, Florida, Texas and Hawaii. The most common avenues of entry for aquatic weeds are passenger baggage and seed contamination. For every 20 FNWA weeds intercepted, about 17 are terrestrial, one will be parasitic, and three are aquatic. Officers of the USDA-APHIS-PPQ have seized 2,551 illegal importations between 1985 and 1993.

Water Spinach (*Ipomoea aquatica*): a crop in California, a weed in Florida; How it relates to the Federal Noxious Weed Act 1974. Mario Rodriguez, U.S. Dept. of Agriculture, APHIS, PPQ, DEO, Hyattsville, MD.

Water Spinach is listed as a state noxious weed in Florida. Due to its aggressive nature and ability to spread quickly over vast areas, water spinach has caused concerns that it may invade the Everglades; impending catastrophic damage to the environment. Water spinach's ability for rapid growth and adaptability provide the advantage to outcompete native vegetation, clog and impede waterways, and infest rice and sugarcane fields. However, water spinach is considered a food crop in California and Hawaii. Growers in California are causing problems by shipping water spinach seeds into Florida. The state of Florida may impose penalties on market owners receiving the seeds in Florida but have no authority to deal with the exporters in California. Florida has asked APHIS for assistance to address this problem under the authority of the Federal Noxious Weed Act of 1974.

Florida's Noxious Aquatic Plant Prevention Program.

William E. Caton, Bureau of Aquatic Plant Management, Department of Environmental Protection, Tallahassee, FL

Because of its semitropical climate, Florida has been particularly susceptible to the establishment of non-indigenous aquatic plant introductions. Many non-indigenous aquatic plants have been introduced into Florida through a variety of means, e.g., plant fanciers, aquarium plant businesses, discharge of ship ballast, agricultural interests, and government agencies. Between 1980 and 1993, $114 million in public funds have been spent in Florida to control waterhyacinth, waterlettuce and hydrilla in public water bodies.

This presentation will focus on the history of Florida's non-indigenous aquatic plant problems and the regulations designed to prevent the introduction and spread of noxious aquatic plants.

Screening Criteria for Potentially Invasive Nonindigenous Plants: A Florida Model.
BURKS, K. C., M. E. KANE, and G. JUBINSKY. Bureau of Aquatic Plant Management, Florida Department of Environmental Protection, Tallahassee, and University of Florida, Gainesville.

To evaluate quantitatively the invasive potential of diverse plant taxa, Florida is building a screening model that draws on the technology of tissue culture. Initial studies have shown a strong positive correlation between a plant's regenerative capacity *in vitro* and its weed potential in nature. High regenerative capacity was clearly exhibited, for example, by three known invasives, *Crassula helmsii*, *Hygrophila polysperma*, and *Limnophila sessiliflora*. Specific results for tested species will be presented, along with a discussion relating the data to other criteria used in scoring potential high-risk exotics.

TUESDAY, JULY 12, 1994
3:30 PM - 4:45 PM

SESSION V
MANAGEMENT STRATEGIES AND TECHNIQUES

Short-Term Summer Drawdown as a Potential Tool for Management of Monoecious Hydrilla

Angela G. Poovey* and Stratford H. Kay
Crop Science Department
North Carolina State University, Raleigh, NC 27695

ABSTRACT

Testing was initiated in 1993 in outdoor mesocosms to evaluate a short-term, summer drawdown for management of monoecious hydrilla. Plants exposed for only one week rehydrated quickly and had regrown substantially by six weeks after re-flooding. Either three or four weeks of exposure significantly suppressed both vegetative regrowth and production of tubers and turions. Plant recovery was poorer when plants were grown in lake sand than when grown in a silt loam hydrosoil. The results of this study suggest that a summer drawdown of three to four weeks duration may break the growth and reproductive cycle of monoecious hydrilla.

ANALYSIS OF COPPER IN AQUEOUS SYSTEMS

Emily Deaver and John H. Rodgers, Jr.
University of Mississippi

Copper is used in aquatic plant management for control of a variety of nuisance vascular and nonvascular plants. Analytical measures of copper in these situations are valuable for 1) understanding efficacy, 2) monitoring copper persistence and fate, and 3) evaluating potential risks to non-target species. Measurements of total copper give no indication of the bioavailable fraction. Approaches such as computer modeling coupled with analytical/biological methods such as AA, ISE, ICP, ASV and bioassays contribute to resolution of this dilemma.

Restoring Lake Jackson, Osceola County, Florida

Mikel W. Hulon, Florida Game and Freshwater Fish Commission,
Kissimmee, FL.

Abstract: Lake Jackson (1,020 acres), located in Osceola County, was overdrained by man-made canals in the mid-1950's to allow for agriculture activities. Water levels decreased dramatically and annual fluctuation was severely restricted.

During the past 30 years aquatic plant communities have continued to increase in density forming monocultures of pickerelweed (Pontederia cordata), duck-potato (Sagittaria lancifolia) and cattails (Typha spp). Organic substrate two to three feet deep, comprised of dead and decaying plant material has built-up on the lake bottom and eliminated productive fisheries habitat.

The goal of this restoration project is to restore desirable aquatic habitat and reestablish a quality sport fishery in Lake Jackson. Restoration activities include: building a water control structure ($650,000), degrading and backfilling 10,000 ft of levees and canals ($250,000), conducting a muck removal operation on 32,000 ft of shoreline ($1,000,000) and aquatic plant management ($100,000).

HABITAT RESTORATION USING SONAR* IN A WATERFOWL MANAGEMENT WETLAND. David P. Tarver. SePRO Corp.

Lake Seminole, Chattahoochee, Florida is a 37,000 acre reservoir regionally and locally important for navigation, waterfowl hunting, fishing, flood control and recreation. This resource has become dominated by hydrilla, giant cutgrass, water hyacinth and other exotic aquatic plant species.

Desser Slough, a 4 mile long, 120 acre inlet had become heavily dominated by hydrilla and giant cutgrass and of little waterfowl value due to limited aquatic flora diversity. The three year habitat restoration project, designed and funded by the Corps of Engineers, DowElanco, and SePRO Corp., included Sonar for hydrilla control and Rodeo* for giant cutgrass control followed by native flora plantings. Report included flora nutritional values for waterfowl and wood duck nesting success.

*Trademark of SePRO Corp.
*Trademark of Monsanto

WEDNESDAY, JULY 13, 1994
8:30 AM - 12:00 PM

SESSION VI
MANAGEMENT STRATEGIES AND TECHNIQUES

Evaluation of Copper Herbicides for the Control of Waterhyacinth (Eichhornia crassipes) Ken Langeland, Brian Smith, and Neal Hill, IFAS Center for Aquatic Plants, University of Florida, Gainesville, FL.

Herbicides currently used for waterhyacinth control cannot be used within certain distances of domestic water supply intakes or if they are, use of water is restricted for certain periods of time. Copper-containing herbicides can be used in domestic water supplies without such restrictions. Therefore, copper-containing herbicides, Komeen® and Cutrine® were evaluated for their ability to control waterhyacinth. Komeen® or Cutrine® were applied to the foliage of waterhyacinth held in 100-ft² PVC frames at rates of 2.4, 5.4, 7.2, and 10.8 lb elemental copper per acre. Silenergy®, an organosilicone adjuvant, and X-77®, a nonionic surfactant, were also evaluated. Copper rate was the only variable that influenced waterhyacinth control. Two applications of copper at 2.7, 5.4, 7.2, and 10.8 lb per acre provided 17, 61, 71, and 85% control of waterhyacinth. This study suggests that copper-containing herbicides have potential for management of waterhyacinth in drinking water reservoirs.

EVALUATION OF *EICCHORNIA CRASSIPES* CONTROL STRATEGIES IN LAKE CHAPALA

Gualberto Limón M. (1) *; Eric Gutiérrez (2); Pilar Saldaña (2); Jesús Rodríguez P.(1); and Rubén Huerto (1)

ABSTRACT

The magnitude and complexity of the water hyacinth infestation in Lake Chapala required the development and evaluation of different control strategies.

Using the available information, a mathematical model was adapted to simulate growth and control of this plant. The model provided information on the control intensity needed and the evolution of the water hyacinth infestation under different intensities.

Several control alternatives were designed, varying the composition of chemical and mechanical means, as well as the duration of the control period. The model allowed comparison of the different options and contributed to a better use of the available resources for this program.

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* To whom correspondence shall be addressed.

Integrated Control of Waterhyacinth with Weevils and Paclobutrazol

Thai K. Van and Ted D. Center
USDA/ARS Fort Lauderdale, Florida

Abstract: Weevil infestations increased leaf mortality rates. This effect was more severe and led to complete waterhyacinth control by weevils in high plant densities when intraspecific plant competition was high. However, at low plant densities simulating a regrowth or colonization situation, waterhyacinth partially compensated for weevil feeding and survived. Combinations of weevils with the growth retardant paclobutrazol gave complete control of waterhyacinth regardless of plant densities. The combined effects were synergistic, with accelerated leaf mortality rates exceeding production rates leading to plant death after 4 months. These results demonstrated the potential for enhancing biological control using integrated strategies.

REMOVAL OF TRIPLOID GRASS CARP USING FISH MANAGEMENT BAIT (FMB)

Craig T. Mallison, Rue S. Hestand, III and Boyd Z. Thompson

Florida Game & Fresh Water Fish Commission, Eustis, Florida

ABSTRACT

Fish Management Bait (FMB), a rotenone-laced food pellet, was tested in hatchery ponds and seven central Florida lakes to evaluate its potential for removal of triploid grass carp *(Ctenopharyngodon idella)*. Initial applications of FMB were successful when water temperatures exceeded 23°C. Up to 79% of the triploid grass carp were removed from hatchery ponds and 69% were removed from a 0.5 hectare lake. In lakes ranging from 38 to 152 hectares, 119 triploid grass carp were removed. Secondary applications of FMB were less effective and each test removed less than 15% of the fish present. Removal of non-target fish was minimal (primarily forage species) and no wildlife was visibly affected. FMB showed promise as a practical tool for triploid grass carp population control.

AMUR/STOCK Simulations for Examination of the Effects of Site Conditions on Plant Control by Grass Carp

by

R.M. Stewart and W.A. Boyd

USAE Waterways Experiment Station

The AMUR/STOCK simulation model, developed by the Waterways Experiment Station for the Aquatic Plant Control Research Program, was used to examine the effects of important site conditions on levels of plant control by grass carp. Site conditions examined were plant species, overwintering biomass levels, seasonal growth rates, maximum biomass levels, and grass carp stocking size, dispersal patterns, and mortality and escapement rates. Results of sensitivity analyses for each of these site conditions will be presented and examined in terms of their potential contribution to variability in control levels observed from otherwise similar grass carp stocking efforts.

An Overview on Current Biological Control Research for the Management of Aquatic Plants

By

Alfred F. Cofrancesco[1],
Michael J. Grodowitz[1], and
Ted Center[2]

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Research Center,
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Over the last 35 years, the U.S. Army Corps of Engineers and the U.S. Department of Agriculture have cooperated in research on the biological control of a number of problem plants. This cooperation has lead to the introduction of twelve biological control agents which have significantly impacted noxious aquatic plant populations. Currently, research efforts are focusing on the development of resource management techniques to increase the active use of biocontrol agents at the operational level, as well as the development of new agents. Active research projects are being conducted on the following target plants: Hydrilla verticillata, Myriophyllum spicatum, Melaleuca quinquenervia, and Trapa natans. To date, four insect biocontrol agents have been released on Hydrilla verticillata in eight states. The releases began in 1987, with over 3.5 million individuals being released. One of these agents, Hydrellia pakistanae (a fly from India), is established throughout peninsular Florida and portions of Alabama, Texas, and Louisiana. Another agent, Hydrellia balciunasi, has been released in both Texas and Florida, but its establishment has only be verified in Texas. An endemic pathogen is also being examined that has significantly impacted hydrilla in pond studies. Research is being conducted to examine both native and exotic weevil biocontrol agents of Myriophyllum spicatum. The native weevil, Eubrychiopsis lecontei, has been associated with significant declines of milfoil in Vermont, New York, and Minnesota. The exotic weevils from China are being tested for host specificity in U.S. quarantine facilities. Melaleuca quinquenervia, an introduced tree from Australia, is causing severe problems in Florida. Two insect biocontrol agents that cause defoliation of Melaleuca trees are being studied in U.S. quarantine facilities and it is expected that at least one of these agents will be released within the next year. In addition, other agents which attack various parts of the Melaleuca tree are being examined in Australia so a complex of agents can be identified. Research on biocontrol agents of Trapa natans is still in the overseas survey phase. A number of potential agents have been found and a priority screening list is being developed.

Use of Native Aquatic Plants for Control of Nuisance Species in Guntersville Reservoir, Alabama

[1]R.D. Doyle and [1]R.M. Smart
[1]US Army Engineer Waterways Experiment Station, Lewisville, TX

Establishment of beneficial native plants in areas subject to infestation by nuisance species may ameliorate the negative impact of the nuisance species. Nuisance species often form a dense canopy or mat at the surface and negatively impact the ecological and economic values of a lake. In Guntersville this growth form is exhibited by the non-native Eurasian watermilfoil and nuisance, albeit native, mat-forming cyanobacteria Lyngbya. Native emergent and submersed plants were able to compete with these nuisance species for light and sediment nutrients. Plots of established natives were shown to significantly suppress the re-growth of watermilfoil and to decrease the standing biomass of Lyngbya.

LABORATORY EVALUATIONS OF FLURIDONE FOR CONTROL OF HYDRILLA AND EURASIAN WATERMILFOIL.

M.D. Netherland and K.D. Getsinger
US Army Engineer Waterways Experiment Station
Vicksburg, MS.

Laboratory studies to determine fluridone efficacy versus hydrilla [*Hydrilla verticillata*(L.f.) Royle] and Eurasian watermilfoil (*Myriophyllum spicatum* L.) following various treatment rate and half-life ($t^{1/2}$) scenarios, and static exposures to very low initial treatment rates (0.25 to 5.0 µg/L) were conducted. Results suggest that high treatment rates (100 µg/L) followed by short half-lives (7 to 10 d) are much less effective than lower treatment rates (25-50 µg/L) followed by longer half-lives (21 to 28 d). Moreover, results indicate that fluridone concentrations as low as 1 µg/L can significantly inhibit chlorophyll, photosynthesis and biomass production compared to untreated control plants. Results will be discussed as they apply to observed fluridone dissipation in the field.

Preliminary Evaluation of Water Exchange Characteristics at Lake Gaston and Implications for Herbicide Efficacy

Stratford Kay*, Steve Hoyle, Chad Coley, and Angela Poovey
Crop Science Department
North Carolina State University, Raleigh, NC 27695

ABSTRACT

Herbicide efficacy on monoecious hydrilla and other aquatic vegetation in Lake Gaston has been at best marginal. Studies were initiated using Rhodamine WT dye to evaluate the water exchange characteristics in several different lake environments and estimate the potential for loss of herbicides from treated sites. Dye half-life ranged from about two hours in the river run section of the reservoir to approximately six hours in areas that were more isolated from the wind and wave action on the main body of the reservoir. These data suggest that water exchange may reduce efficacy in many areas of Lake Gaston.

Phenological Timing of Control Technologies for Eurasian Watermilfoil

John D. Madsen
U.S. Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX.

The timing of control can be optimized to coincide with low points in starch storage of target species. Carbohydrate dynamics of Eurasian watermilfoil (*Myriophyllum spicatum*) populations were studied over a three-year period in ponds at LAERF. From these studies, it was determined that two control points were found for this southern population, the first occurring from May through July, and the second occurring in October or November. These coincided with peaks in autofragment and inflorescence formation. In comparison, published information for northern populations exhibited only one control point, occurring from May through July.

Progress on Eradicating Catclaw Mimosa in Florida

David L. Sutton and Kenneth A. Langeland, University of Florida, IFAS, Fort Lauderdale Research and Education Center, and Center for Aquatic Plants, Gainesville.

Abstract

Catclaw mimosa (Mimosa pellita Humboldt & Bonpland ex Willdenow var. pellita) is being controlled with herbicides on five sites in Florida. Three of the five stes are within the parameters of an eradication program that calls for no new seed production for at least 10 years. These three sites have had competing vegetation removed and all catclaw mimosa is removed as it germinates. The two other sites are under intense control programs, but the volume of competing vegetation, which is being removed, has made it difficult to find every catclaw mimosa plant in the area. These last two sites should be within the parameters of the eradication program in the next 6 to 12 months. Detection and delineation surveys will continue as well as extension efforts to locate any new infestations.

Effects of Sub Lethal Doses of Garlon 3A and Komeen on Canopy Structure of *Myriophyllum spicatum*

Lars W.J. Anderson

USDA/ ARS Aquatic Weed Control Research Laboratory, Plant Biology Section, University of California, Davis, CA 95616

Established cuttings of *M. spicatum* were exposed to 0., .05, .1, .25, and .5 ppmw triclopyr or Cu as one-time applications for 14 d. Vertical distribution of biomass, branch production as well as light penetration through the total canopy were affected at >0.1 ppmw Garlon 3A 45 DAT. Lower concentrations of triclopyr produced more temporary effects on the canopy. Komeen produced transient effects from which plant recovered by 45 DAT. Results suggest that sub lethal rate could be used to alter canopy characteristics without complete removal of plant populations.

ALTERNATE PAPERS

Hydrilla Control Program in Mexico

M.C. Ovidio Camarena Medrano, Instituto Mexicano de Tecnologia del Agua, Jiutepec, Morellos, Mexico.

Since hydrilla was introduced in the irrigation district during the eighties decade, the pest has been increasing. In Baja California, the control was started in 1985 with triploid grass carp with excellent results. In 1993, an integral control program was started in Tamaulipas, with diploid grass carps as the basic method (at least 13 kg/km after mechanical control). This year, there are 40,000 carps to be stock in the Tamaulipas districts canals.

A diagnosis of pest source is being carried out in Brave River and Friendship and Falcon dams as well as of the grade of dispersion oh hydrilla to other districts in order to develop a national hydrilla management program.

Still sampling hydrilla tubers - don't we ever learn?

Alison Fox and Bill Haller
IFAS Center for Aquatic Plants
Gainesville, FL

Populations changes of hydrilla propagules are notoriously difficult to detect, because of their clumped distribution and the small size of most samplers. Learning to manage these propagules becomes more important as techniques for consistently removing, and potentially eliminating, mature plants improve. Preliminary tuber sampling in Grassy Lake, GA, compared a USACE sampler (625 cm^2) and 10 cm diameter core sampler (78.5 cm^2). Means were similar (75 tubers m^{-2}) but the larger sampler showed half the variance, and with 50 samples could detect a population change of 50% compared to only a 90% change with comparable cores. Further calibration and comparisons of samplers and sites is in progress.

The Effects of Triploid Grass Carp and Sonar Treatments on Aquatic Plants in Lake Yale

Rue S. Hestand, III, Boyd Z. Thompson, and Craig T. Mallison
Florida Game and Freshwater Fish Commission, Eustis, Florida

ABSTRACT

This study was conducted to determine if triploid grass carp *(Ctenopharyngodon idella)* could control hydrilla (*Hydrilla verticillata*) regrowth in a large lake without detrimentally impacting submerged native plants. In July 1987, 5,600 triploid grass carp were stocked on 81 hectares of hydrilla located in the south end of Lake Yale (1,636 hectares, Lake County, Florida). Hydrilla had expanded to 90 hectares in the south end of the lake by December 1987 and to 1310 hectares or about 81 percent of the lake by the end of 1991. A total of 21,145 triploid grass carp (13/hectare) were stocked from 1987 through 1990. The stocking rate adjusted for mortality was 11,280 or seven/hectare (nine/hectare of hydrilla) which had not stopped the spread of hydrilla in Lake Yale. The continued expansion of hydrilla resulted in the need for Sonar (fluridone) treatments in 1992 and 1993 that virtually eliminated the hydrilla. Following the 1993 treatment the grass carp have severely impacted the remaining submerged plants.

Egeria densa: Problems and Potential Solutions for the Sacramento Delta

Lars W.J. Anderson* and Suzanne Fellows

USDA/ ARS Aquatic Weed Control Research Laboratory, Plant Biology Section, University of California, Davis, CA 95616

Egeria densa **has proliferated dramatically in the Sacramento Delta over the past three years and now impedes recreational and commercial activities. Preliminary small-tank studies with three copper-based herbicides (CuSO4, Komeen and Earthtec) showed that Komeen provided superior copper uptake and reduction in biomass. Operational use of any herbicide will require proper timing and placement due to net-flow and tidal cycles in the Delta. Associated dissipation studies in small-volume containers did not reveal any significant differences in half-life of total copper between CuSO4 and Earthtec; Cu persisted longer in the absence of soil, particularly when derived from Komeen.**