ABSTRACTS

THIRTY-SEVENTH
ANNUAL MEETING

THE AQUATIC PLANT MANAGEMENT SOCIETY, INC.

SANIBEL HARBOUR RESORT & SPA
FT. MYERS, FLORIDA
JULY 13-16, 1997

1.

Control of Aquatic Weeds in New Zealand

John S. Clayton, National Institute of Water
and Atmospheric Research, Hamilton, New Zealand.

This paper reviews some of the major aquatic weeds in New Zealand lakes and discusses some of the problems they cause. Approaches to the management of nuisance weed beds are also discussed including 'leave alone' strategies, targeted control and attempted eradication of high risk species. Mechanical control of nuisance weeds has tended to focus on problems associated with strandings (e.g., removal of shoreline strandings and at hydroelectric station intakes), but refinement of removal methods at their source is continuing. Chemical control of aquatic weeds is an effective option for target weeds of national importance (e.g., water hyacinth and salvinia) and for specific waterbodies where an acceptable degree of selective control can be achieved. Research results using grass carp have confirmed eradication of egeria is possible in small waterbodies and this may be followed by native plant recovery.

2.

Aquatic Ecosystem Restoration Foundation

J. L. Decell, Vicksburg, MS.

The Aquatic Ecosystem Restoration Foundation (AERF) was formed by several chemical companies involved in aquatic plant management, to ensure that technical research capabilities needed by industry and the users, would be maintained. The AERF is a non-profit, tax exempt organization formed for the conduct and support of applied research for the management of aquatic pest species. Current founding members consist of aquatic pesticide manufacturers, formulators and distributors. In addition, allied groups such as applicators and lake associations will be invited to participate.

3.

Invasive Plants: What's Florida Doing?

K. A. Langeland, Center for Aquatic Plants and Department of Agronomy,
University of Florida-IFAS, Gainesville, FL.

Public, as well as private, lands have been set aside worldwide to protect and maintain native habitats. While native plant communities are of value in their own right in these National Parks, State Parks, County Parks, aquatic preserves, etc., protection of wildlife composition through the highest trophic level depends on stability of the vegetation. Stability of native plant communities is increasingly threatened by the introduction of nonindigenous invasive plants, those plants that have the potential to grow to large populations without the aid of man in a region they did not previously inhabit. The ultimate result of such invasions can be displacement of the native plant communities and subsequent changes in higher trophic levels of wildlife populations. Florida's Exotic Pest Plant Council (EPPC) has listed 117 species that are or have shown the potential to invade and disrupt

native plant communities in the state. EPPC's efforts have focused attention on the current and potential problems associated with invasive plants and cooperative efforts involving universities, agencies, and industry, are on the increase to systematically abate the spread of the most invasive species, refine management technology, develop public education and volunteer programs, and sometimes prohibit the sale of certain species.

4.

Managing Melaleuca in the Everglades

Francois Laroche, South Florida Water Management District, West Palm Beach, FL.

Introduced into Florida from Australia in the early 1900s, *Melaleuca quinquenervia* (melaleuca) constitutes one of the greatest ecological threats to the biological integrity of the Everglades. Purportedly introduced to dry South Florida's wetlands and creating a timber resource in the region, melaleuca has expanded rapidly in the last few decades. Hydroperiod manipulation and frequent fires have facilitated the spread of this exotic pest plant.

A prior study indicated that melaleuca, once introduced, can overtake a one square mile area within 25 years. Current estimates conservatively place the infestation level at 400,000 acres. It is estimated that the Everglades would be overwhelmed by uncontrolled expansion of melaleuca in less than 100 years.

The Melaleuca Task Force, composed of representatives from various local, state and federal agencies, was formed in 1990 to develop a management plan and to make recommendations for the integrated management of melaleuca. These recommendations for management and research efforts have included biological control using Australian insects, herbicide applications, fire and flooding.

A present, the melaleuca program is not truly integrated. Biological control agents are under study but not yet available. Consequently, the initial melaleuca control efforts have been concentrated on herbicidal control and limited use of physical and mechanical control methodologies. The "girdle" application method with a fifty percent solution of the herbicide ARSENAL is the primary tool used in the least infested areas, while aerial application with a combination of the herbicides ARSENAL and RODEO is the most effective method for large melaleuca monocultures.

5.

Brazilian Pepper or ... *Schinus "terribleitsbeenforus"*

Dan Clark, Conservation Officer, City of Sanibel, Sanibel, FL.

The Brazilian pepper *Schinus terebinthifolius* was introduced into Florida in the late 1800's for ornamental purposes. Native of Brazil's tropical coast, Brazilian pepper is now found in most tropical and subtropical regions of the world. Florida is the "not-so-proud" owner of almost one million acres of this aggressive exotic plant, and the numbers of infested acres is still on the rise. A brief discussion of Brazilian pepper's physiology, distribution in Florida, and consequences of its

presence will be presented. Current control efforts in the public and private sectors will also be discussed as well as the direction of the future management of Brazilian pepper. Control efforts including restoration and legislation on Sanibel Island, Florida will be presented.

6.

Why We Don't Want Wetland Nightshade in Our Wetlands.

Alison M. Fox, Center for Aquatic Plants and Department of Agronomy, University of Florida-IFAS, Gainesville, FL.

Wetland nightshade, (*Solanum tampicense*, also known as aquatic soda apple) is a prickly, briar-like, nonindigenous plant that is dominating the understory vegetation in some forested swamps of southwest Florida. Although currently confined to six counties (including Lee County), there are concerns that if allowed to spread, this plant could severely impact some of Florida's pristine wetlands, such as the cypress swamps of Big Cypress National Preserve and the Everglades National Park. Data will be presented on aspects of the reproductive biology of this species that relate to its survival and dispersal mechanisms, along with results from preliminary herbicide trials.

7.

Wetland Plants are Aquatic Plants; 25,000 References Can't be Wrong

Vic Ramey, Center for Aquatic Plants, University of Florida-IFAS, Gainesville, FL.

The Aquatic and Wetland Plant Information System (APIRS) of the University of Florida Center for Aquatic Plants maintains the world's largest collection of scientific literature on the biology, ecology, utilization and management of aquatic and wetland plants. More than 44,000 items are cataloged in the APIRS database, which can be accessed by personal phone call or through the APIRS Internet site. In addition, APIRS produces videotape programs, books and ID decks, drawings, photographs and other items related to aquatic and wetland plants. Contact Karen Brown or Victor Ramey at APIRS, Center for Aquatic Plants, 7922 NW 71 ST, Gainesville, FL 32653; Tel: (352) 392-1799. Web site: http://aquat1.ifas.ufl.edu/ E-mail: varamey@nervm.nerdc.ufl.edu

8.

Relative Concentrations of Allelopathic Materials in Cattail Plants (*Typha domingensis*)

Maria T. Gallardo and Dean F. Martin, Institute for Environmental Studies, Department of Chemistry, University of South Florida, Tampa, FL.

2-chlorophenol and salicylaldehyde are thought to be among the chemical species responsible for the allelopathic behavior of cattails. This research deals with the determination of the concentration and distribution of these compounds in the cattail plants and their release in the surrounding waters in an effort to characterize the observed toxic effect of the cattails over other plant species.

9.

Eradication Program for *Oryza rufipogon* Griff in Florida.

Vernon V. Vandiver, Jr., Matthew W. Brodie and Thai K. Van. Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

Oryza rufipogon Griff, Wild Red Rice, was collected during a survey in the Everglades National Park, Dade County Florida, in September 1988, the only know infestation in the United States. As *O. rufipogon* threatened both cultivated rice and also aquatic and wetlands sites in Florida and other states, efforts to determine the extent of the infestation and to eradicate the weed were initiated. This details the status of the eradication effort being conducted by the Division of Plant Industry, Florida Department of Agriculture and Consumer Services; the University of Florida, Institute of Food and Agricultural Sciences; and the National Park Service, U.S. Department of the Interior.

10.

Courting Consensus: Talk Ain't Cheap When Managing Aquatic Plants in Florida's Kissimmee Chain of Lakes

Mike Bodle, South Florida Water Management District, West Palm Beach, FL.

Florida's Kissimmee chain of lakes are the focus of multifaceted aquatic plant control and environmental restoration projects. Tens of millions of dollars have been spent in the past decade, with similar amounts projected for the future. These projects proceed only with open and spirited communication amongst many parties.

Cooperative interagency planning seeks to involve all users of a waterbody and respond to as many needs of users as possible. While multi-group coordination can be arduous, it is essential and enables a wide range of environmental projects to proceed and support a broad sweep of parties.

11.

Evaluation of *Hydrellia pakistanae* for Biological Control of Hydrilla: An Experimental Approach

James P. Cuda, Entomology and Nematology Department, University of Florida-IFAS, Gainesville, FL.

The leaf-mining fly *Hydrellia pakistanae* Deonier (Diptera: Ephydridae) was released in the United States in October 1987 by the USDA as a potential biological control agent of hydrilla, *Hydrilla verticillata* (L.f.) Royle. The insect can be considered a biological success because it is now widespread throughout the southern United States where hydrilla infestations are problematical. Although hydrilla declines have been observed at several sites, usually within a year following release of *H. pakistanae*, there has been no definitive study that demonstrates unequivocally that the introduction of *H. pakistanae* by itself is responsible for the observed hydrilla declines. From June 1995-December 1996, a field experiment with adequate controls was conducted at the Center for Aquatic Plants to determine if *H. pakistanae* is capable of causing declines in hydrilla populations in north central Florida.

12.

Replacement of Hydrilla Problems in South Florida by Hygrophila and Several Native Aquatic Plants

David L. Sutton, Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

In South Florida Hydrilla (*Hydrilla verticillata* (L.f.) Royle) is no longer considered a major aquatic weed problem. Herbicides and grass carp (*Ctenopharyngodon idella* Val.) are two factors responsible for reducing the threat of this exotic submersed plant. However, during the past few years new aquatic weed problems have arisen in the areas formerly occupied by Hydrilla. Exotic Hygrophila (*Hygrophila polysperma* (Roxb.) T. Anderson) poses the most serious threat, followed by native species such as eel-grass (*Vallisneria* spp.), fanwort (*Cabomba caroliniana* Gray), and lemon bacop (*Bacopa caroliniana* (Walt.) Robins. These plants are more resistant to available herbicides than Hydrilla and are low on the food preference of the grass carp. Causes for the increase in abundance of these plants and methods to manage their growth will be discussed.

13.

Biology and Management of *Lyngbya wollei.*

C.W. DuBose, Center for Aquatic Plants and Department of Agronomy, University of Florida-IFAS, Gainesville, FL.

Loss of water use, displacement of native flora and fauna, aesthetic forfeiture, and ultimately losses of revenue are problems caused by the filamentous blue-green algae *L. wollei.* Furthermore, *L. wollei* is extremely difficult to control using standard chemical, biological, and mechanical measures. Expansion of *L. wollei* in the head waters of Crystal River has prompted concern and research. Residents of Crystal River are not in favor of using herbicides due to manatee presence; therefore, the Southwest Florida Water Management District plans to have benthic mats suction-removed in July 1997. In addition, plantings of *Vallisneria americana* will be assessed to determine if competition improves *L.wollei* management.

14.

Floating and Emergent Vegetation Communities in Orange Lake: Historical Perspectives and Current Management Issues

Karen R. Warr, John R. Shuman, Judith C. Bryan, St. Johns River Water Management District, Palatka, FL

Orange Lake, located in north-central Florida is a shallow lake with extensive floating and emergent wetlands. Historical literature, maps and interviews with long time residents reveal that floating islands and mats have long been a part of Orange Lake. However, some current users and resource managers perceive the floating communities as undesirable due to access problems and their desire for increased open water habitat. Fishery managers have proposed demonstration projects for the removal of floating wetland communities in Orange Lake in order

to benefit gamefish populations and recreational fishing. We are conducting research studies designed to assess the value of the wetlands from an ecosystem management perspective. These studies include analysis of the historical vegetation coverage, fish and wildlife usage of the floating and emergent wetlands, formation analysis of the floating wetlands, as well as recreational and economic analyses.

15.

Physiology and Chemical Control of Torpedograss [*Panicum repens*]

B.E. Smith, K.A. Langeland, and D.G. Shilling, Center for Aquatic Plants and Department of Agronomy, University of Florida-IFAS, Gainesville, FL.

Torpedograss is a non-native and extremely invasive grass weed found in aquatic, wetland, and terrestrial habitats throughout Florida. Efforts to eradicate torpedograss have at best lead to temporary suppression in most aquatic situations. Torpedograss has proven itself resilient to common herbicide practices. Research was conducted to enhance glyphosate activity on torpedograss. Factors tested included rate, time of year, adjuvant impacts, time of re-treatments, plant growth regulators, coverage, and multiple treatments. Additional tests were conducted on the herbicides fluazifop, imazapyr, fluridone, quinchlorac, 2-4,D, Scythe, diquat, and tank-mixes with glyphosate. Some treatments have eradicated torpedograss.

16.

Aquatic Plant Diversity and its Influence on Fish Growth

Eric D. Dibble and Sherry L. Harrel, Department of Wildlife and Fisheries, Mississippi State University, MS.

We experimentally investigated the relationship between aquatic plant diversity and individual growth of young fishes in enclosures (10 m diam) constructed in a pond (1.2 ha). Juvenile bluegill (*Lepomis macrochirus*) and largemouth bass (*Micropterus salmoides*) were introduced into the enclosures (May, 1996). Each enclosure contained either a plant monoculture (*Hydrilla verticillata*), or a diverse culture of plants (*Vallisneria americana, Heteranthera dubia, Potamogeton nodosus,* and *Najas guadalupensis*). Plant treatments were replicated 6 times. Spatial-complexity between plant treatments was measured, and individual fishes were marked dorsally with different color combinations of fluorescent elastomer dye. Pop-nets and strata traps were used to obtain subsamples of fish in each treatment during the experiment. The pond was drained (October, 1996) and all fish were collected by hand, identified, and immediately measured for lengths (SL & TL; mm) and weights (g). Spatial-complexity of plants and individual growth of the fishes differed significantly across the plant treatments. These results suggest that differences between spatial-complexity provided by monospecific and diverse strands of plants may be directly, if not, indirectly responsible for the differences in fish growth.

17.

A Data Review to Obtain a Historical Perspective on Aerial Aquatic Plant Coverage and Fish Populations in Aliceville Lake Using Geographic Information Systems

Sherry L. Harrel and Eric D. Dibble, Department of Wildlife and Fisheries, Mississippi State University, MS.

Since impoundment in 1979, historical reports have dealt with encroachment and steady increases of non-native aquatic plants in Aliceville Lake, a 3,320 ha reservoir on the Tennessee-Tombigbee Waterway. Also, a large database on fish species in Alabama and Mississippi including Aliceville Lake has been provided. Although much anecdotal evidence suggests increased aerial plant coverage has affected annual declines in fish growth and recruitment, no empirical evidence exists (with the exception of a report in 1996). We attempted to search all known literature and create a historical database on aerial aquatic plant coverages in coves of Aliceville Lake and relate those coverages to fish populations. Vector-based geographic information systems (GIS) was used to map out plant coverages of coves and analyze relationships with attributes such as fish species abundance, size and age class distribution, and condition. Data were too sparse to accurately develop a comprehensive survey of plants, or determine impacts on fish populations. More attention needs to be directed toward delineation of plant types (native vs. non-native) and how changes in coverage affect relationship with fish populations. These baseline data are required before management regimes for both fishes and aquatic plants can be established.

18.

Grass Carp Stocking in the Santee Cooper Lakes: Big Lakes, Big Solutions

Steven de Kozlowski, South Carolina Department of Natural Resources, Columbia, SC.

The 170,000 acre Santee Cooper lake system, comprised of Lakes Marion and Moultrie, is the largest and one of the most important multipurpose freshwater resources in South Carolina. An expanding hydrilla population, which displaced desirable native plant species and impaired a variety of water use activities in up to 48,000 acres, threatened to infest over 50% of the lake system. As part of an integrated management strategy, sterile grass carp were incrementally stocked between 1989 and 1996 to provide long-term control of hydrilla. A discussion of the incremental stocking strategy, use of grass carp population studies, hydrilla coverage, and water use impacts will be presented.

19.

Stress Response of Juvenile Largemouth Bass Exposed to Sub-lethal Levels of Five Commonly Used Aquatic Herbicides.

Elizabeth D'Silva, Jimmy Winter, Department of Range, Wildlife and Fisheries Management, and Raynaldo Patiño, Texas Cooperative Fish and Wildlife Research Unit, Texas Tech. University, Lubbock, TX.

Aquatic herbicides are thought to be safe for fish and aquatic invertebrates because laboratory studies show that these herbicides are toxic only at levels much higher than their legally permitted application rates. However, lethal toxicity tests provide no indication of whether fish are experiencing the sublethal effects of herbicides at concentrations typically used in aquatic environments.

The primary objective of our study was to determine the stress response in juvenile largemouth bass, *Micropterus salmoides*, that were exposed to sublethal concentrations of five commonly used aquatic herbicides (diquat, endothall, glyphosate, 2,4-D, and fluridone). The second objective was to rank these aquatic herbicides according to the intensity of the stress response elicited in the bass. The concentrations of the herbicides used for each experiment were 0, 0.1x 1.0x and 10.0x mg/l, where x was the legal application rate of the herbicide. Blood was sampled from sacrificed fish at 2, 8, 24, and 48 hours of exposure. Blood parameters measured included cortisol, glucose, and osmolality. Exposure to the herbicides resulted in changes in the blood parameters being measured. The intensity and the rate of occurrence of the stress response varied with each herbicide. These differences were also associated with the concentration of the herbicide and the length of exposure. The results of this study will provide management information to agencies and land owners as to the most benign herbicide available for the control of aquatic vegetation with respect to maintaining a healthy largemouth bass population.

20.

Problems Caused by Aquatic Weeds in Irrigation Canals in Egypt

Yassin M. Al-Sodany, Biology Department, Faculty of Education of Kafr El-Sheikh, Tanta University, Kafr El-Sheikh, Egypt, Kamal H. Sholtout, Faculty of Science, Tanta University, Tanta, Egypt, and David L. Sutton, Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

Egypt lies in the arid northeast corner of Africa. "Egypt is the gift of the Nile" Herodotus said in the 5th century BC. The Nile "the father of rivers" emanates from the Sudan, flowing north through Egypt for 1,545 km, emptying into the Mediterranean sea. Along its course, the Nile provides Egypt and her people with life and sustenance. The network of canals allows for about 3.2 million ha of cultivated land in Egypt. The construction of the Aswan High Dam in 1971 provides several years of irrigation reserve and adds 0.5 million ha of arable land, but major problems with aquatic weeds arose as a result of its construction. Aquatic weeds cause problems for agriculture, navigation, public health, and fisheries. For example more than 2,800 km of canals and about 15,000 ha of lakes are infested with water hyacinth (*Eichhornia crassipes* (Mart.) Soms). These weeds cause serious problems by reducing the hydraulic efficiency of the irrigation system. The Ecology Research Unit of the Botany Department of Tanta University is attempting to identify the magnitude of aquatic weed problems in the Nile Delta region. Information will be presented on these aquatic weeds and methods to control their growth.

21.

CAL/FED: Coordinating Aquatic Plant Management Programs in California

Nate Dechoretz, Program Supervisor, California Department of Food and Agriculture, Sacramento, CA.

The Cal/Fed Bay-Delta Program is a three phase effort to develop a long-term solution to problems affecting the San Francisco Bay/Sacramento-San Joaquin Delta estuary in Northern California. The Program addresses four categories of Bay-Delta problems. The categories are 1) ecosystem quality, 2) water quality, 3) water supply reliability, and 4) system vulnerability. The Cal/Fed Bay-Delta Program was established in May 1995 and is comprised of a consortium of state and federal agencies with management and regulatory responsibilities in the Bay-Delta. Consortium members have recognized the current and future impact of exotic invasive aquatic species to California efforts to restore the Bay Delta system. In response, a *Statewide Management Plan for Aquatic Nuisance Species* will be developed to identify policies, procedures, strategic actions, and specific tasks. The development of this plan presents a unique opportunity to establish a coordinated multi-agency approach directed toward the control and eradication of exotic aquatic species, including aquatic weeds such as hydrilla, watermilfoil, water hyacinth, egeria, and alligatorweed.

22.

Use of a Weevil to Control Eurasian Watermilfoil in Washington State

Mariana Tamayo, Christian Grue, Gilbert Pauley, Washington Cooperative Fish and Wildlife Research Unit, School of Fisheries, University of Washington, Seattle, WA, and Kathy Hamel Water Quality Assistance Program, Washington Department of Ecology, Olympia, WA.

The weevil *Euhrychiopsis lecontei* has been associated with declines of Eurasian watermilfoil (*Myriophyllum spicatum*) in Vermont. Studies in Vermont and Minnesota suggested that the weevil may be an effective biological control for Eurasian watermilfoil. Last year, Washington State began to evaluate *E. lecontei* as a control agent of *M. Spicatum*. To determine the distribution of the weevil in Washington, 38 waterbodies with Eurasian or northern milfoil (*M. sibiricum*) were surveyed. Overall, adult weevils and/or larval damage were found in nine (24%) of the waterbodies surveyed. Weevil adults or larval damage occurred in seven (32%) of the waterbodies surveyed in eastern Washington, and was associated with the presence of northern milfoil. In western Washington, weevils were found in two (13%) waterbodies. Weevils were associated with Eurasian watermilfoil in both of these lakes. This summer, laboratory and field trials are being conducted to identify some of the factors governing the distribution of the weevil.

23.

Effects of Inorganic Turbidity on the Growth and Reproductive Potential of Native Macrophytes

Robert Doyle, US Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX.

The effects of increased inorganic turbidity on the growth and reproductive potential of the northern ecotype of *Vallisneria americana* at various stages of the plant's life history was investigated in a series of laboratory, greenhouse, and mesocosm experiments. Water column turbidity was maintained by periodic (up to 3X/day) additions of natural sediments (80% clay, 20% silt) to experimental tanks. Sediment slurries were sonicated to completely disperse clay particles prior to addition to the tanks. Mature plants survived even unusually high levels of turbidity for up to 10 weeks in these shallow water experiments. However, the plants experienced linear declines in plant mass, number of daughter plants produced, inflorescence mass, and number and mass of winterbuds formed with increasing turbidity. Winterbuds and seedlings both showed decreased survival and vegetative growth with increasing turbidity. Implications of reduced growth and reproductive capacity under turbid conditions for habitat restoration efforts are discussed.

24.

Nutrient Effects on Autofragmentation of *Myriophyllum spicatum* L. (Eurasian Watermilfoil)

Dian H. Smith, Biological Sciences Department, University of North Texas, Carollton, TX.

Autofragmentation provides Eurasian watermilfoil with a successful propagule for intermediate to long distance dispersal. Phenological studies suggest autofragmentation is linked to flowering, seed set and end of the growing season; however, alterations from optimum growing conditions, such as reduced bioavailability of nutrients, also induce autofragmentation. A 2 x 2 factorial design was utilized to investigate effects of sediment nitrogen levels and water potassium levels on autofragment production in Eurasian watermilfoil. The study was conducted in sixteen mesocosm tanks with four tanks per treatment and 24 replicates per tank. Results indicated that reduced levels of nitrogen significantly increased autofragmentation ($p<0.001$). Low nitrogen treatments averaged 158 autofragments per tank while high nitrogen treatments averaged 43. Reduced potassium levels did not significantly alter the production of autofragments which averaged 102 per tank for low and 99 per tank for high treatments ($p>0.50$). It appears that autofragmentation is enhanced when nitrogen is reduced, allowing plants to colonize new potential sites.

25.

An Overview of the Aquatic Plant Control Research Program

John W. Barko and Robert C. Gunkel, Jr., U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

The Aquatic Plant Control Research Program (APCRP) is the Nation's only Federally authorized research program for technology needed to manage nonindigenous aquatic plant species. The program addresses aquatic plant problems of major economic significance in navigable waters, tributaries, streams, connecting channels, and allied waters of the United States. The APCRP is designed to provide effective, economical, and environmentally compatible methods for assessment and management of problem aquatic plants nationwide. Research efforts are currently focused on the development of management methods for the submersed aquatic plants, hydrilla and Eurasian watermilfoil. The present research program is organized into four technology development areas: Biological Control, Chemical Control, Ecological Assessment, and Management Strategies and Applications.

26.

An Overview of the Ecological Assessment Technology Area

John D. Madsen, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

An overview of the Ecological Assessment Technology Area of the Aquatic Plant Control Research Program will indicate the past contributions of this research area, current research directions and interrelations between current work units, and future directions for this technology area. A brief overview of the research capabilities of appropriate WES researchers and facilities will also be provided.

27.

Predicting Invasion Success of Eurasian Watermilfoil

John D. Madsen, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

A better understanding of factors related to invasion and colonization success of exotic species might improve both the planning and implementation of managing early stages of invasions in new areas. Data from lakes containing Eurasian watermilfoil were evaluated to compare the extent of Eurasian watermilfoil dominance in those lakes to common limnological parameters. Invasion success appears optimal in mesotrophic lakes, with intermediate light transparency. A few correlations were then applied to a database for the State of Minnesota to predict potential invasion success in lakes of various categories.

28.

An Assessment of the Aquatic Macrophyte Seed Bank in Lake Onalaska, Wisconsin

Dwilette G. McFarland, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, and Sara J. Rogers, Environmental Management Technical Center, Onalaska, WI.

Submersed aquatic vegetation, dominated by *Vallisneria americana* Michx., declined dramatically in Lake Onalaska, WI, following drought conditions in the late 1980's. Coinciding with the decline were marked increases in the abundance of *Myriophyllum spicatum* L., particularly in areas vacated by *V. americana*. Recent evidence indicates that much of the lake has remained unvegetated, but that since 1994, beds of *V. americana* have made a partial recovery. While the production of vegetative propagules may largely account for increased populations of both species, the extent to which seed production may have contributed to their expansion in the lake is unknown. To assess the germination potential and distribution of the aquatic macrophyte seed bank in Lake Onalaska, sediment cores (5 cm deep) were collected from 74 sampling sites in July 1996. Seedling emergence from sediments was observed in an environmental growth chamber operated at 25C and a 14-hr photoperiod over a period of 8 weeks. Fifteen species of aquatic macrophytes germinated in sediments from 55 sites. *V. americana* seedlings emerged from sediments from 39 sites throughout the lake, but were most prevalent in sediments collected generally downstream (within 250 m) of established *V. americana* beds. Seedlings of *M. spicatum* emerged from only two collected sediments that had supported this species in protected areas. These findings suggest that seed production may play a greater role in the dispersal of *V. americana* than *M. spicatum*, and further emphasize basic differences in their survival strategies, particularly in flowing water systems.

29.

Phenological Studies to Improve the Management of Hydrilla

Chetta S. Owens, U.S. Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX, and John D. Madsen U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Hydrilla verticillata, a nonindigenous submersed aquatic plant, was first introduced into the United States in the 1960's. Hydrilla exhibits aggressive growth, forming dense canopies of biomass at the surface of the invaded aquatic systems, affecting fisheries, water quality, transportation and recreation usage. At the LAERF, the study of phenological weak points in the life strategies of invasive plants provides potential timing for optimum management techniques. Biomass and TNC allocation of hydrilla has been studied since January 1994; results through June 1995 will be discussed. Biomass was produced during the warm months, growing from overwintering shoots and root crowns, not tubers. Tuber and turion production occurred during the winter months with germination occurring in August. A carbohydrate storage minima was observed in late July, with

storage split between stolon (7%) and root crown (10%). Tubers and turions ranged from 58 to 68% TNC. These studies provide more insight into the timing of major allocation shifts in the hydrilla seasonal growth cycle.

30.

Techniques for Establishing Native Aquatic Plants in Unvegetated Reservoirs

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

A critical component of integrated pest management approaches is to never leave an empty niche. Empty niches invite colonization by weedy species and are the primary cause of our recurring aquatic plant management problems. Manmade aquatic systems such as reservoirs are particularly vulnerable to infestations of exotic weedy species because, at the time of construction, they generally lack aquatic vegetation of any kind. Many of these systems have extensive littoral areas that could support diverse native plant communities that would enhance the structure and function of our reservoir ecosystems. Unfortunately, nuisance exotic species generally arrive, establish, and spread to excess before native aquatic plants can become established.

We are developing methods for large-scale establishment of desirable native aquatic plants. Techniques to be discussed include propagation and production of plant propagules as well as implementation (establishment in multipurpose reservoirs).

31.

An Overview of Biological Control Activities for Noxious Aquatic Plants

Alfred F. Cofrancesco, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

In the two years since the last meeting of the Aquatic Plant Control Research Program significant changes in the program have occurred. Funding reductions required that the five biological control research projects be consolidated into two new work units. The focus of the Biological Control Technology Area has not changed, however, priorities and the magnitude of effort have been adjusted. The main focus of this technology area is still to identify and release host specific biological control agents. We continue to actively examine both insects and pathogens of noxious aquatic plants and have identified a number of candidates for hydrilla and Eurasian watermilfoil.

32.

Plant Pathogen Biocontrol Research on Hydrilla and Eurasian Watermilfoil

Judy F. Shearer, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Fungi collected from hydrilla (*Hydrilla verticillata*) and Eurasian watermilfoil (*Myriophyllum spicatum*) in the People's Republic of China in 1994 and 1995 were screened for pathogenicity in containment during 1996. More than 65% of

the isolates screened (66 of 97) caused some damage. Of 13 isolates assigned a rating of '3' or more, five caused the same damage when tested again. Of these five, one was a *Phoma* sp. from hydrilla collected in Qiao Zhuang. The remaining four isolates were collected from the Huai-roi Reservoir on milfoil, three being *Mycoleptodiscus terrestris* and the other was a *Cylindrocladium* sp. Small scale testing of an endemic pathotype of *M. terrestris* formulated into a biocarrier and extruded into a dry granule reduced above ground biomass of hydrilla 88, 95 and 99 % when applied at low, medium or high dose rates, respectively. Preliminary results indicate that the fungal agent maintains viability in the dry granule up to 3 months post extrusion.

33.

Insect Biocontrol Research for Noxious Aquatic Plants

Michael J. Grodowitz, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Research in the use of insect biological control for the management of noxious aquatic plants has mainly been involved in three areas including overseas exploration, quarantine, and release/establishment. The target plants have been the submersed species; hydrilla and Eurasian watermilfoil. The main thrust of the Corps research has been the release and establishment of insect biocontrol agents of hydrilla in areas west of Florida; i.e., Alabama, Mississippi, and Texas. Currently, permanently established populations occur for three of the four insects released for hydrilla management; i.e., *Hydrellia pakistanae*, *H. balciunasi*, *Bagous affinis*, and *B. hydrillae*.

34.

An Overview of Chemical Control Technology

Kurt D. Getsinger, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Research and development activities in the Chemical Control Technology Area concentrate on developing and evaluating chemical products and application techniques that will improve the management of nuisance aquatic plants. Current research efforts are focusing on developing species-selective control of target plants, precision herbicide application techniques, and integration of control strategies with ecological principles. Studies are conducted in controlled-environment chambers, greenhouses, hydraulic flumes, outdoor mesocosms, experimental ponds, and as operational-scale field applications. Cooperators and partners include Federal, state, and local agencies, Corps of Engineer Districts, academic institutions, and the private sector. Interactions also occur with Federal and state regulatory agencies. Proven benefits derived from these studies include lower herbicide use-rates, improved environmental compatibility, and reduced application costs.

35.

Selective Use of Herbicides

John G. Skogerboe, R. Michael Smart, U.S. Army Engineer Waterways Experiment Station, Lewisville Aquatic Ecosystem Research Facility, Lewisville, TX, Kurt D. Getsinger, Mike D. Netherland, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS, and Gary O. Dick, University of North Texas, Denton, TX.

Herbicides can often be used to selectively remove exotic weedy vegetation from an aquatic system, allowing unaffected native plants to proliferate and occupy the vacant niche. Studies are being conducted in outdoor mesocosm systems at the Lewisville Aquatic Ecosystem Research Facility, TX, to determine the species-selective potential of registered and EUP aquatic herbicides (fluridone, triclopyr, and others). Preliminary results indicate that application of low treatment rates (fluridone, 5-10 ug/L; triclopyr, 0.5-1.0 mg/L) to mixed plant communities consisting of Eurasian watermilfoil, vallisneria, sago pondweed, American pondweed, water star grass, and elodea, can selectively control Eurasian watermilfoil. In this fashion, herbicides can be used to restore and maintain diverse and valuable aquatic habitats.

36.

Herbicide Delivery Systems

David Sisneros, U.S. Bureau of Reclamation, Denver, CO, and Mike D. Netherland, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

This effort focuses on the evaluation of innovative application techniques, formulations, and delivery systems to improve the control of nuisance aquatic vegetation. In 1996, studies were conducted at two sites (Idaho and Colorado) to determine the efficacy of reduced-rate endothall applications on *Potamogeton pectinatus* in flowing-water canal systems. A prototype flow-compensating delivery system was developed to dose canals with endothall to achieve a target concentration of 0.4 mg/L for 96 hr. Water residue samples were collected at 12-hr intervals along with pH, temperature, and DO. Aqueous endothall water concentrations were maintained between 0.3 and 0.4 mg/L for 84 hr. Plant biomass was significantly reduced at both sites, compared to untreated controls, at 28 DAT in Idaho and 17 DAT in Colorado.

37.

Integrated Use of Herbicides and Pathogens for Submersed Plant Control

Linda S. Nelson, Judy F. Shearer, and Michael D. Netherland, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

A mesocosm study was conducted to evaluate the efficacy and selectivity of the herbicide fluridone and the fungal pathogen *Mycoleptodiscus terrestris* (*Mt*), applied alone and in combination with one another, against hydrilla, Eurasian watermilfoil, American pondweed, and vallisneria. Treatments included 5 g/L

fluridone, 100 and 200 colony forming units (CFU) per ml of *Mt*, integrated treatments of 5 g/L fluridone + 100 or 200 CFU/ml Mt and untreated controls. Treatment with either fluridone or 200 CFU/ml *Mt* alone was sufficient to reduce hydrilla growth by 40% 84 DAT, however the combined application of *Mt* plus fluridone reduced biomass by 93% compared with untreated plants. Eurasian watermilfoil biomass was not affected by *Mt* alone and was equally inhibited (75% reduction at 84 DAT) with treatment of fluridone or fluridone with *Mt*. Treatments had little effect on American pondweed or vallisneria. With the exception of American pondweed, all treatments that included fluridone significantly reduced total chlorophyll. Results show that integrating a low dose of fluridone (5 g/L) with *Mt* can effectively and selectively reduce hydrilla biomass with minimal effect to nontarget plant species such as vallisneria and American pondweed.

38.

Computer Tools Developed and Released Under the Aquatic Plant Control Research Program

John D. Madsen, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

The Aquatic Plant Control Research Program (APCRP) has developed several computer tools to assist in various aspects of aquatic plant management. Because of budget reductions, the previously introduced APROPOS system will not be developed. Instead, a Windows®-based program, entitled the Aquatic Plant Information System (APIS) will be released. APIS contains information on various aspects of aquatic plant management. In addition to the simulation models (e.g., AMUR STOCK, HERBICIDE, and HARVEST), APIS will include biocontrol and aquatic plant identification systems, and instructional information developed for APROPOS. Additional DOS-based models will be also be included.

39.

Adaptations of Phytophilic Fishes

K. Jack Killgore, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

At least 80 species of fishes inhabit structurally complex habitats. Phytophilic fishes may be considered as a guild, or complex of guilds, since resident species share several morphological, physiological, and reproductive traits. Most species are small, elongate, surface-dwelling forms, with auxiliary methods of respiration, and high reproductive investment. Two body forms predominate: accelerators and maneuverers. Hues of phytophilic fishes are subdued; bright colors are conspicuous in only a few species. Most species are moderately tolerant of degraded water quality and have coping mechanisms to prevent suffocation and increase energy available for locomotion, growth, and reproduction.

40.

Using Endothall as a Marker with Glyphosate Treatments of Waterhyacinth

William T. Haller, Center for Aquatic Plants and Department of Agronomy, University of Florida-IFAS, Gainesville, FL.

Following treatment with Rodeo, waterhyacinth and water lettuce usually requires 2 to 3 days to develop symptoms of the treatment, depending upon temperatures, etc. This makes it difficult for applicators to return to the same location daily, and know where plants have previously been treated. Consequently, we applied Hydrothol 191 at various rates as a marker for Rodeo. Rodeo applied at 7 pints/acre in 80 gallons of water was marked in both plants with Hydrothol 191 added at 8 to 20 oz/acre. Hydrothol below 8 oz/acre was not easily visualized, and rates above 20 oz/acre apparently antagonized Rodeo effectiveness.

41.

Aquatic Weed Problems in Brazil

R. A. Pitelli and E. D. Velini, Paulista State University, Jaboticabal and Botucatu, Sao Paulo State, Brazil

There are three main classes of problems involving aquatics weeds in Brazil. The first one occurs in small artificial ponds used for supplying water for irrigation systems. The major weed is *Typha* spp., which quickly decreases the water storage capacity, reducing, year by year, the agricultural area served by the pond during the dry season. Some of these artificial ponds, which are located near livestock facilities, are eutrophic, providing good conditions for a profusion of *Pistia stratiotes*, *Salvinia* spp., and *Eichhornia crassipes*. The second class of problem occurs in irrigation and drainage canals. In these canals the most troublesome weeds are *Brachiaria* spp., *Echinochloa* spp., and *Typha* spp. Other very common weeds are *Eichhornia* spp. and *Polygonum* spp. The third class of problem occurs in the large reservoirs built for hydroelectric schemes, the main source of electric power in Brazil. As a consequence of the low natural fertility of the tropical soils, the waters of these artificial lakes are naturally poor in nutrients. For this reason, for a long time the aquatic plants were not a problem, with the exception of the reservoirs near the big cities, where *E. crassipes*, *P. stratiotes*, and *Salvinia* spp. were the major weeds. Nowadays, with the natural evolution of the reservoirs and the erosion and pollution processes, the water fertility has increased. When compounded by some other specific ecological disturbances, the aquatic weeds become serious problems, causing excessive economic losses. For example, in a 35,000-ha reservoir, the introduction of the voracious carnivorous fishes (*Cichla ocellaris* and *Plagioscion squamosissimus*) reduced drastically the populations of herbivorous fishes, providing conditions for profuse growth of *Egeria densa* and *Elodea* sp.

After four years, 5,000 ha were completely infested by these weeds, interfering with fluvial transportation and fishing activities. During the rainy season, large masses of these weeds detach from the bottom of the reservoir and reach the turbines, causing serious disruptions in the energy generation systems. Other reservoirs have serious problems with *Echinochloa polystachya*, *Brachiaria arrecta*,

Enhydra sessilis, *Polygonum* spp., *Eichhornia crassipes*, and *E. azurea*. Chemical control is very difficult, and only one herbicide is permitted to be used in aquatic environments.

42.

Getting Invasive Aquatic Weeds Off the Market: A Case History from Washington

Jenifer Parsons, Washington Department of Ecology, Olympia, WA.

Lake managers have often been frustrated after spending their days combating invasive non-native plants, only to find them for sale in a local fish store or nursery that evening. In 1992 Washington State quarantined several aquatic and wetland plants, making their sale and distribution illegal. However, for several years this law was not enforced due to questions of enforcement authority in pet stores and lack of inspector training in aquatic plant identification. Through a several step process these difficulties have recently been surmounted, and these plants are no longer available from local stores. The present challenge is preventing their sale by out-of-state mail order companies.

43.

Culture and Growth of *Sagittaria stagnorum*

D. Lamar Robinette, Forest Resources Department, Clemson University, Clemson, SC and David L. Sutton, Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

The genus *Sagittaria*, commonly called arrowheads, contains species exhibiting a variety of growth forms ranging from emergent to strictly submersed plants. One member of this group, *Sagittaria stagnorum* Small, may display three different leaf forms on the same plant and has potential as an aquatic ornamental because of its unique growth habit. Because little information is available on nutrients influencing growth of this native Florida species, studies were conducted outdoors to evaluate various levels of fertility on growth of *Sagittaria stagnorum*. Information will be presented on growth, as measured by plant number and dry weight, for plants cultured in sand with various amounts of a controlled release fertilizer.

44.

Characteristics of the Root Zone During Growth of Maidencane and Torpedograss

William G. H. Latham and David L. Sutton, Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

Maidencane (*Panicum hemitomon* Schult.), an aquatic grass, and Torpedograss (*Panicum repens* L.), a grass that grows in terrestrial and aquatic habitats, were cultured outdoors in a flooded sand medium fertilized at three different rates. Culture periods of 16 weeks were studied during the summer of 1996 and winter of 1997. At 4-week intervals, interstitial water samples were collected and analyzed for Redox potential, pH, and dissolved oxygen. Further analysis of the interstitial

water for Conductivity, ammonia-nitrogen, nitrate-nitrogen, phosphate-phosphorus, calcium, copper, iron, potassium, magnesium, manganese and zinc were performed in the laboratory. Results of these analyses will be discussed.

45.

Effects of Sonar, Alone and in Combination with Reward, on Watermeal

Steve T. Hoyle and Stratford H. Kay, Crop Science Department, North Carolina State University, Raleigh, NC.

Sonar was applied alone, mixed with Reward, and followed three weeks later by Reward to determine if potential synergism may exist with combination treatments. Reward also was applied alone for comparison. Whenever Reward was applied, the watermeal turned grey-brown within a few hours of treatment, but greened up totally within three to four days. All ponds treated with Sonar were clear by the end of the growing season, whereas those treated only with diquat still were covered with watermeal. Combination of Reward with Sonar did not improve overall efficacy or speed up weed control.

46.

Use of Frog's Bit for Removal of Pollutants from Agricultural Wastes

Luz Teresa Valderrama, Pontificia Universidad Javeriana, Department de Biologia, Santafe de Bogota, D.C., Colombia, and David L. Sutton, Ft. Lauderdale Research and Education Center, University of Florida-IFAS, Ft. Lauderdale, FL.

Frog's bit (*Limnobium* spp.) have characteristics that make them useful for removal of pollutants from enriched waters. Frog's bit, a member of the family Hydrocharitaceae, grow as surface, free-floating aquatic plants, and thus obtain their nutrients directly from the water column. Two species are known to occur. *Limnobium spongia* (Bosc) Rich. ex Steud. is native to North America, and *Limnobium laevigatum* (Humb. & Bonpl. ex Willd.) Heine is present in South America. Information will be presented on use of these species to remove nutrients from agricultural wastes.

47.

Environmental Impact of Pollution on the Biological Diversity of Aquatic Plants

Dr. Kaiser Jamil, Biosciences Division, Indian Institute of Chemical Technology, Hyderabad, India.

To keep the lakes, ponds and rivers free of aquatic weeds, several chemical and mechanical methods have been tried with little success, with repeated operations. This has resulted in the selective growth of hardy weed species to the exclusion of others. The diverse aquatic plant life which is important for the health of the water bodies suffer due to these operations and created imbalances. A study has been conducted to evaluate and list out the aquatic plants which have been terminated due to man's interference and the weeds which have become aggressively domi-

nant in these water bodies. These interesting and alarming findings of such an important documentation will be presented. Water analysis from several lakes and rivers appear to have a direct impact on the biological diversity of the aquatic plants.

48.

The Latest News From EPA

Randy Dominy, Pesticides Section, Environmental Protection Agency, Atlanta, GA.

The Region 4 Pesticides Section of the Environmental Protection Agency (EPA) is responsible for ensuring compliance with the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) which regulates the registration, production, and use of pesticides. The Region 4 area encompasses the eight southeastern states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee. The Pesticides Section in Region 4 works cooperatively with each of these states through a cooperative agreement to ensure compliance with all state and federal laws pertaining to pesticides.

This presentation will address some of the key legislative issues which impact pesticides and their use as well as some of the more prevalent registration/labeling issues that are specific to aquatic weed control.

In addition, a brief synopsis of the Methyl Parathion Misuse cases will be presented. Over 1500 misuse inspections have been conducted in the states of Mississippi, Alabama, and Tennessee, resulting in a number of arrests and two federal trials to date. Applicators were illegally applying and selling methyl parathion, a cotton insecticide, for indoor pest control. Identification of these illegal applications resulted in the relocation of over 1200 persons from contaminated homes, as well as the closure of several daycares, restaurants, and motels.

49.

Hydrilla verticillata in New Zealand

John S. Clayton , Paul D. Champion, National Institute of Water and Atmosphere, Hamilton, New Zealand.

Dioecious male *Hydrilla verticillata* plants were first recorded in New Zealand in 1963, but it has remained restricted to four isolated lakes in the Hawkes Bay region, North Island, New Zealand. In view of the potential threat from this species, an eradication trial in one of these lakes was initiated in 1988 using sterile grass carp (*Ctenopharyngodon idella*). Total removal of hydrilla weed beds was achieved 29 months after grass carp introduction and the main body of the lake has remained in a devegetated state for a further seven years. Viable hydrilla tubers (asexual propagules) have been recovered from devegetated lake sediments throughout this period. Occasional small hydrilla plants have also been recorded during the study, but these have been restricted to shallow-water turf vegetation and beneath the occasional fallen tree which can obstruct fish browsing. The longevity of hydrilla tubers (7+ years) and the occasional production of new

propagules on isolated plants would appear to make the goal of national eradication of hydrilla unattainable. Future management will need to focus on long-term control with a view to minimizing the risk of escape to other water bodies.

50.

Effects of Split Applications of Sonar on Monoecious Hydrilla at Lake Gaston in 1996

Stratford H. Kay, Chad R. Coley and Steve T. Hoyle, Crop Science Department, North Carolina State University, Raleigh, NC.

Sonar was applied as single or three-way split treatments at a total application rate of 150 ppb to eight coves in Lake Gaston, NC and VA. Splits were applied with 50% of the total treatment initially and 25% weekly for the following two weeks. Water samples were collected and analyzed by immunoassay over a 42-day sampling period. No fluridone symptoms appeared on hydrilla in any of the treated coves except for one which received a full treatment. By the end of the season, there was no evidence of any effect on hydrilla at any site. Residue analyses indicated that rapid herbicide dissipation due to water movement was the cause.

51.

Aquatic Plant Management: "Texas Style"

Michael Smart, US Army Engineer Waterways Experiment Station, Lewisville, TX, Mark Webb, and Phil Durocher Texas Parks and Wildlife Department, Austin, TX.

Texas lacks natural lakes but has two kinds of reservoirs - unvegetated and hydrilla-infested. Neither of these situations provide optimum habitat for man or beast (fish and wildlife). The movement of hydrilla northward and westward across the state has demonstrated that unvegetated reservoirs invite colonization by hydrilla. In an effort to halt this spread, Texas Parks and Wildlife Department is proposing to embark on a statewide program for establishing desirable native aquatic plants in unvegetated reservoirs. Hydrilla control efforts will also be followed with establishment of appropriate native plants. We discuss the proposed program and solicit comments.

52.

Hydrilla Update from Washington State

Kathy Hamel, Washington State Department of Ecology, Olympia, WA; Sharon Walton, King County Water and Land Division, Department of Natural Resources, Seattle, WA; Terry McNabb and Ernie Marquez, Resource Management, Inc., Tumwater, WA; and Mark Sytsma, Biology Department, Portland State University, Portland, OR.

The monoecious variety of *Hydrilla verticillata* (hydrilla) was identified from a connected two-lake system located near Seattle, Washington in May 1995. This is the only known occurrence of hydrilla in the Pacific Northwest and action was

taken immediately to eradicate the plant. Prior to whole lake treatment with Sonar®, a diver survey showed that hydrilla was widespread throughout the two lakes. The lakes were treated in 1995 and 1996 using a scenario where fluridone concentrations were maintained at about 10-20 ppb throughout the summer and into fall. A spring 1996 diver survey, prior to the second Sonar® treatment, showed that plant coverage and the tuber bank was substantially reduced. The emergence of hydrilla was also monitored using sediment temperature probes and sediment surveys. Hydrilla began to germinate from the tubers at 14C and emerged from the sediment at temperatures between 15-16C. There were no viable hydrilla plants detected in the lakes during the fall 1996 survey. The results from the spring 1997 survey will be reported at the meeting. Management activities will continue until hydrilla is eradicated.

53.

Hydrilla Eradication : "California Style"

Nate Dechoretz, Program Supervisor, California Department of Food and Agriculture, Sacramento, CA.

The California Department of Food and Agriculture has maintained an active hydrilla eradication program since 1976. The eradication program is a major component of CDFA's Pest Prevention System, directed at protecting California's agricultural, natural, and urban resources from exotic pests. Two new infestations of hydrilla were detected in 1996. One infestation was found in Shasta County (120 miles north of Sacramento), adjacent to the Sacramento River, approximately five miles downstream from an infestation detected in 1985. The second infestation was detected in October 1996 in Tulare County, approximately 100 miles southwest of Fresno. This infestation is within the Tule River drainage and two miles upstream from Lake Success, a 2500-acre reservoir owned and operated by the U.S. Army Corps of Engineers. Lake Success provides water for districts which supply irrigation water for 125,000 acres of agricultural land. In response to this new infestation, CDFA issued an emergency eradication proclamation, which precipitated effective quarantine and treatment activities to contain and eradicate hydrilla from these locations.

54.

Invasion of Lake Tahoe by Eurasian Watermilfoil: a Tale of Two States

Lars W. J. Anderson, USDA-ARS, University of California, Davis, CA.

Aquatic macrophytes have plagued a well-defined (ca. 160 acre) marina area in South Lake Tahoe since the 1970's although proper identification of these plants had not been documented. In 1995, USDA/ARS conducted aerial and boat surveys over the lake and reported that *Myriophyllum spicatum* was the predominant species in the marina area and in several, apparently new, infestations in small marinas in the lake-proper. These smaller sites together total no more than ca. 15 acres. Analysis of plants via RAPDs and flavonoid content has subsequently verified the original identification as *M. spicatum*. Aerial and boat surveys in 1996 showed that

M. spicatum areal coverage had doubled or tripled in one year in the small marinas. Since Lake Tahoe is in California and Nevada, regional governing agencies must agree on (1) significance of the infestation to the lake ecosystem and economy (2) management strategies. The regulatory climate is further complicated since the Lahontan Regional Water Quality Control Board (Cal-EPA) currently prohibits introductions of any chemicals into the lake under its current Basin Plan, and has severe restrictions on dredging. Given the pristine nature of Lake Tahoe and the relatively recent spread of *M. spicatum*, an aggressive plan to remove this exotic species would seem to be the wisest approach to take.

55.

Hydrophytes: Their Definition and Classification Based on Their Ecology in Tropics

K.T. Joseph, Department of Botany, University of Calicut, Kerala, India.

We don't have, as yet, and unequivocal definition for hydrophytes, nor do we have a conclusive and universally acceptable classification for this fascinating group. The morphological variability and the diversity in habit, so far, frustrated all attempts to construct a precise biological classification of this highly heterogenous group. Consequently, most of the proposed classifications are based on life-forms and growth-forms. It has been overly evident that to set absolute standards to habit-classes, whatever the criteria used, is a hopeless endeavour in this case. So, instead of a single system, we have now, a number of systems of classification of hydrophytes. But none of them is universal and fully convincing.

In tropics, the climate is of many types with heavy monsoon rains. Hence, as matter of convenience, we can recognize tropical hydrophytes mainly into three groups according to their adaptations. 1. Plants growing in running water. 2. Plants growing in stagnant water. 3. Wetland or marsh plants. Based on this a detailed classification is proposed.

The abstracts have been listed and numbered in the order that they appear on the program. The following index is an alphabetical listing of first authors with their abstract number.