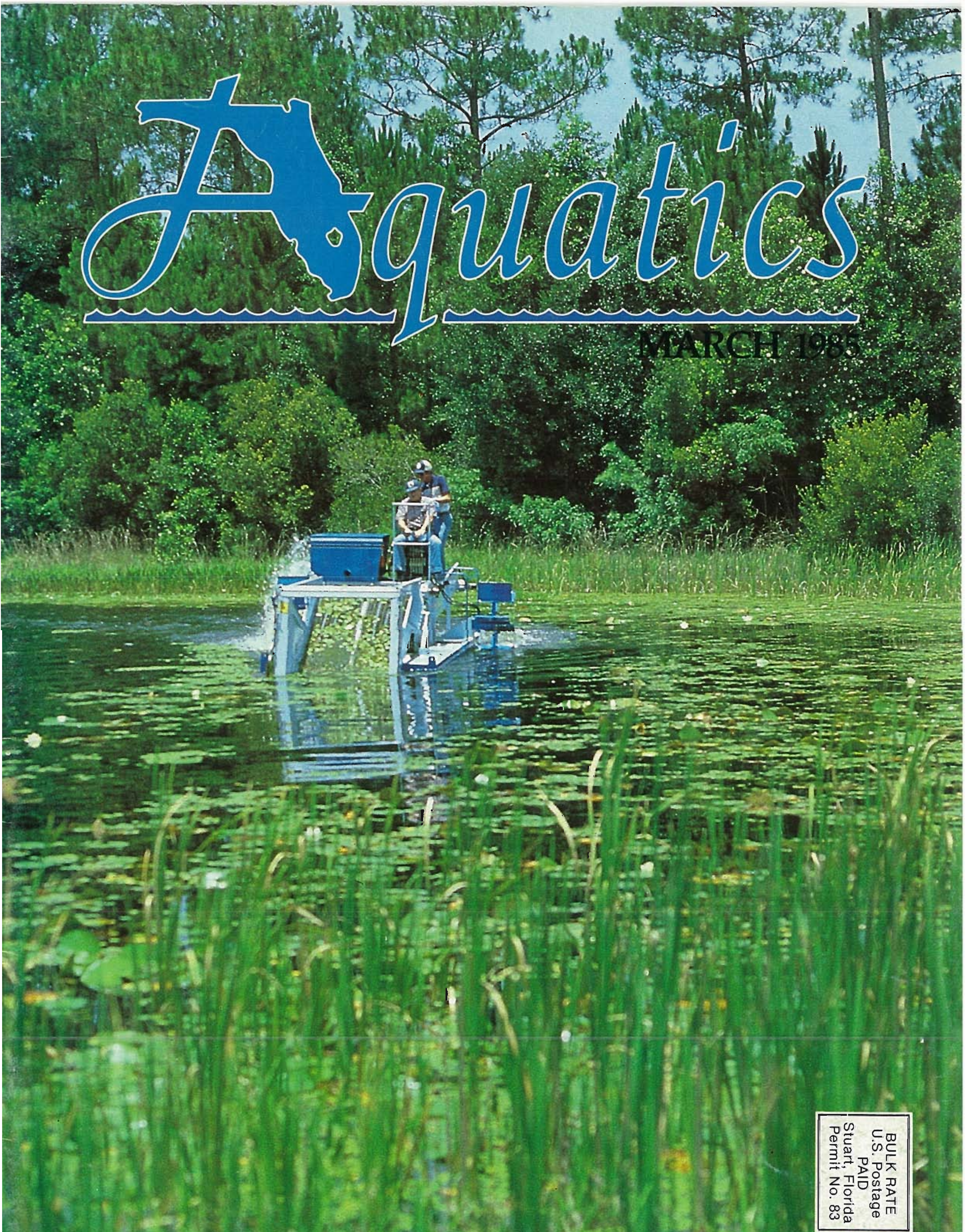
Aquatics

MARCH 1985



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CORRECTION

Please note a correction in the December 1984 issue of "Aquatics." Mr. David Clippinger and Dr. John Osborne's article entitled "Surgical Sterilization of Grass Carp, A Nice Idea," has a misplaced paragraph. Page 10 should have read as follows:

hybrid grass carp in field trials within canals (Beaty, et al., 1982). With modifications based upon Dr. Beaty's technique, the following procedure was used at UCF to 'sterilize' grass carp. The grass carp were anesthetized with methane tricainesulfonate and quinaldine. They were placed ventral side up and midventral scales were removed between the pelvic fins and vent. An incision was made between the pelvic fins and vent to expose the gonads; the gonads extend along the dorsal side of the entire body cavity. Approximately one-third of each of the two gonads were bisected and removed. Nitrofurizone (0.2%) was added to the body cavity and the incision was closed with two to three sutures. After revival under aeration, the fish were ready to be stocked. The timing of the surgery of mature grass carp had to be adjusted to allow for the absorption of eggs and milt after the breeding season. Surgery performed on immature fish was more difficult than on mature fish since the gonads were undifferentiated and appeared as thin, white threads; consequently, surgery on immature fish was aided by magnification. Surgery was performed on 18 male and 15 female sexually mature grass carp and 93 immature grass carp (1-2 years old) in November, 1983.

In May, 1984 the grass carp were examined for mortality, regeneration of the gonads, and a pathway for gametes to enter the environment. Remarkably, no mortality occurred for either mature or immature grass carp over the seven month post-operation period. The incision was healed on all of the fish and many fish had complete scale replacement. Some fish ap-

For the rest of this article, please refer to 1984 December issue, page 10.

EDITORIAL

Since "Aquatics" was first published 6 years ago this month there has been a lot of water flow down the creek so to speak. The magazine has editorialized on many issues of concern to aquatic applicators and it is interesting to read the editorials of the "old" issues. The editorials of the first several "Aquatics" discussed the American Assembly Conference and later addressed budget cuts, rule making and philosophical approaches to aquatic plant control. Time tempers emotional issues, somehow reason prevails, and a look back to 6 years ago clearly shows that progress in aquatic weed control has been dramatic. Some of those changes:

- *Compared to 6 years ago, the grass carp is no longer* persona-non-grata. *It appears that the production of sterile fish has clearly opened the doors for learning where, when, and how to best use this biocontrol in Florida.*
- *The "Lead Agency" which once had to seek, find, and train aquatic applicators has evolved into a regulatory agency.*
- *Aquatic personnel in the Water Management Districts, 298's, City, County programs and private applicators have become the best that exists. We no longer have to teach plant identification, calibration, and other basic concepts to the experienced people in these organizations.*
- *Scientists throughout the state have a greater awareness of aquatics, and research is conducted in many, many different disciplines which certainly benefits the State. (In 1970, DNR had to recruit scientists to conduct research on aquatic weed problems in order to utilize appropriated research monies!)*

So where does this all fit in the big scheme of things? Here it is, FAPMS and "Aquatics" magazine has filled the needs that they were designed to meet when first organized. We have come a long way since acrolein, sulfuric acid, water buffalo and draglines. Now comes the hard part, it is no longer a problem of developing and utilizing technologies for aquatic plant management, but in coping with personnel changes, philosophical differences, and emotionalism. Aquatic weed management is no longer a weed problem but a people problem.

The need for an active Society is even more important today because the only way to solve a people problem is through educational programs. FAPMS continues to lead the way!

Bill Haller

THE COVER

A mechanical harvester racing towards the finish line at the 1982 Aquatic Weed Short Course held in Gainesville.
Photo by:
Ken Langeland
N.C. State University.

Aquatics

MARCH 1985/Volume 7, No. 1

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AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society. This publication is intended to keep all interests informed on matters as they relate to aquatic plant management, particularly in Florida.

NOTE: Correspondence: Address all correspondence regarding editorial matter to Daniel Thayer, Editor, "Aquatics" Magazine, 7922 N.W. 71st Street, Gainsville, FL 32606.

Water Primrose

by
Debbie White[1]

Introduction

Ludwigia uruguayensis or commonly water primrose, is a plant of aquatic habitats and low wet areas such as drainage ditches and lake shores. Its distribution extends north to New York and west to Missouri and it also occurs south of the equator into northern Argentina and Uruguay[1]. The largest populations, however, occur in the southeast U.S. In South Carolina in particular, populations of water primrose are expecially robust and a nuisance in many water systems. Growth of this perennial plant may be so vigorous that a small lake may be covered in a single season. Increasing reports of problem populations of this plant have stimulated research into its history and biology.

Identification

Identification of a species like water primrose can further complicate the problems caused by an overabundance of weeds. Since there are approximately 27 species of *Ludwigia* occurring in southeastern U.S. aquatic or wetland communities, it is important to recognize some members of this group of plants[2]. It is especially useful when common names are used to refer to several different aquatic species.

Ludwigia uruguayensis can be distinguished from other floating aquatic plants by a complex of characteristics (see Figure 1). The creeping part of the stem forms adventious roots along its length and ascends to an erect leafy portion usually 1.5 to 3 feet in height. The oblanceolate leaves (approximately 5-6× longer than broad) are alternately arranged on the stem. All these vegetative parts of water primrose are covered with straight white hairs.

Water Primrose

The flowers of *L. uruguayensis* form in the leaf axils along the erect stem from July through September. They have usually five separate yellow petals (.5-1 inch long) and below these five hairy sepals. The number of stamens (10) is twice the number of petals. The long tube portion of the flower containing the ovary develops, when fertilized, into the pubescent capsular fruit. It is attached to the main stem by a slender long petiole and at maturity is ½ inch long and ⅛ inch in diameter. The seeds within this fruit adhere in one row to fleshy outer parts. As the fruit dries it opens by slits along the fruit length to release the seeds.[2, 3, 4]

Some plant taxonomists have described more than one species based on the variation of the morphological characters within *Ludwigia uruguayensis.* Changes in the classification has resulted in several synonyms for this species[5]. Those commonly found in floras are *Jussiaea uruguayensis, J. michauxiana,* and *Ludwigia grandiflora.* Recent studies of the systematics of this species have found genetic differences between taxa occurring in the United States. This work may eventually explain the biological variability of this species and give insight into the reason for its ecological success.

Growth

The versatile growth habit of water primrose enables this plant to establish either by rooting or by extending parts of the stem horizontally along the ground. These horizontal stems or rhizomes form adventitious roots along their length and can extend even into open water. Once this species establishes on lake margin, the rhizomes continue to grow and intertwine. Floating mats begin to form along the waters edge which creates a substrate for the growth of other plants. The resulting belts of vegetation can effect the ecological health of the water body by shading the lake's water column and inhibiting the growth of flora and fauna beneath the mat. If the amount of light is permanently reduced, the balance for resource competition will be shifted in favor of those species tolerant of these new conditions. Ultimately, a decrease in oxygen levels in the lake and other changes in water chemistry can occur and exclude the species that were once present.

Although *Ludwigia uruguayensis* occurs and may even be common in areas throughout the southeastern U.S., problems with it are limited mostly to the Coastal Plain of South Carolina. This may be due to lake morphometry and drainage patterns, nutrient levels or other characteristics of this area or even due to the genetic differences within the species mentioned previously. The Sante Cooper Lake system (approximately 110,000 acres) supports the largest population of water primrose. The most serious problems occur in Lake Marion where it was established in over 9000 acres in 1980[6,7]. More recently, floating mats continued to cover the lake margins and have grown throughout the 20,000 acres of cypress swamp at the northern end. The limited light and water conditions in swamps are not usually conductive to weed growth. The ability, then, of water primrose to prosper in these sensitive natural communities is of special concern to biologists.

In Florida, water primrose is reported from only a few northern localities yet records show populations have been here since at least 1966. Reported problems with this species are few although species identification is often inaccurate. However, habitats where it is a problem in other states are similar to the flora and ecology found in parts of Florida. Also, the increase and spread of this plant can be alarming not only locally but regionally as well. In the 1960's water primrose was known from only four counties in South Carolina. Although it may partly be a result of better collection records, today the state has reported localities from sixteen counties. It also has become a nuisance in Texas where it establishes quickly on small ponds and is reported as a minor pest in Alabama, Arkansas, Louisiana, Mississippi, and by the Tennessee Valley Authority[8]. This alarming increase in water primrose in these states indicates that this species

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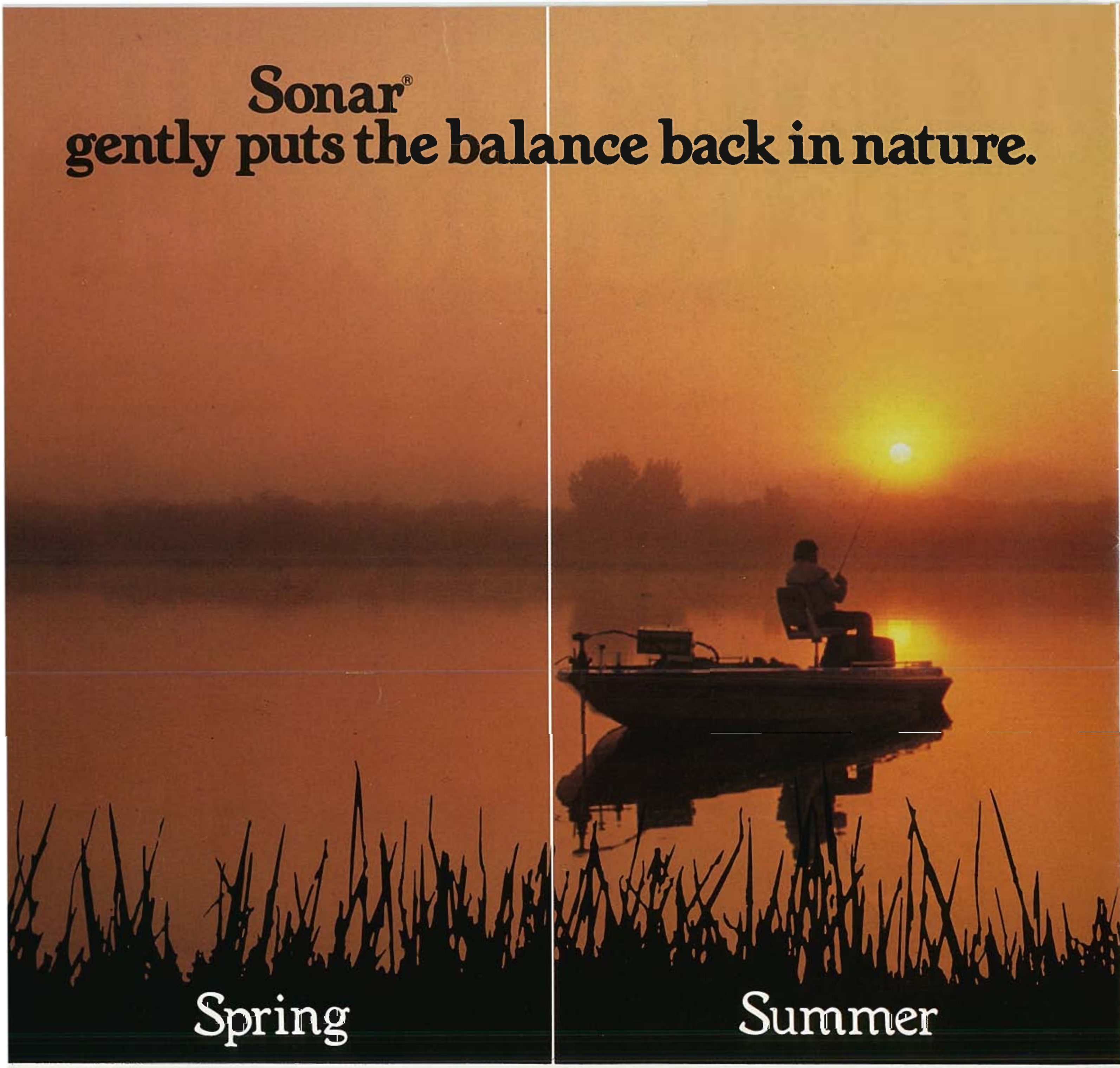

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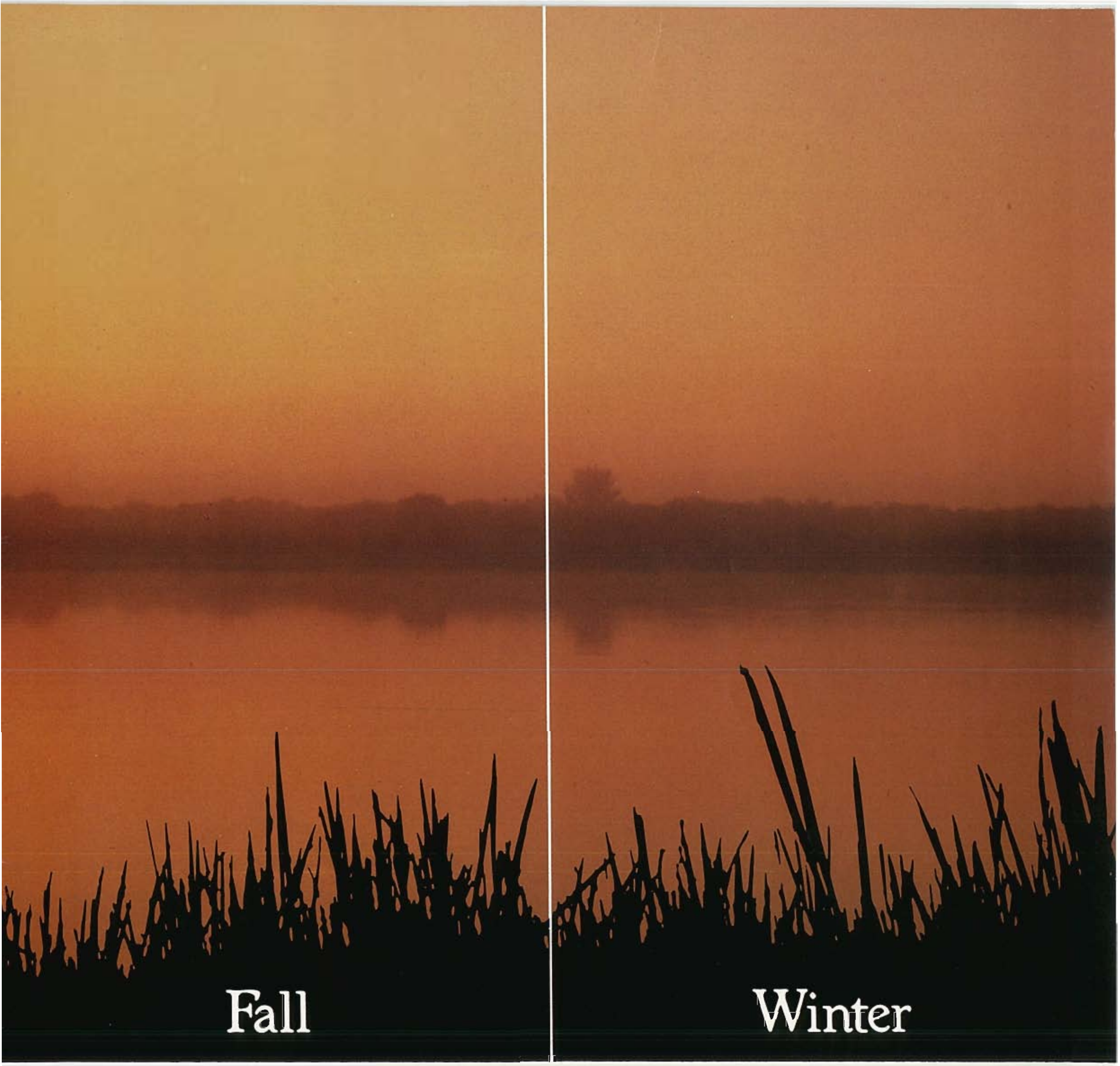

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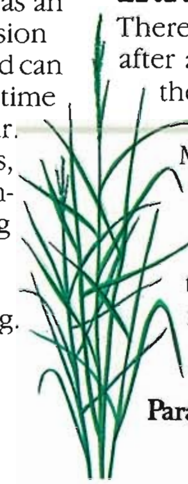
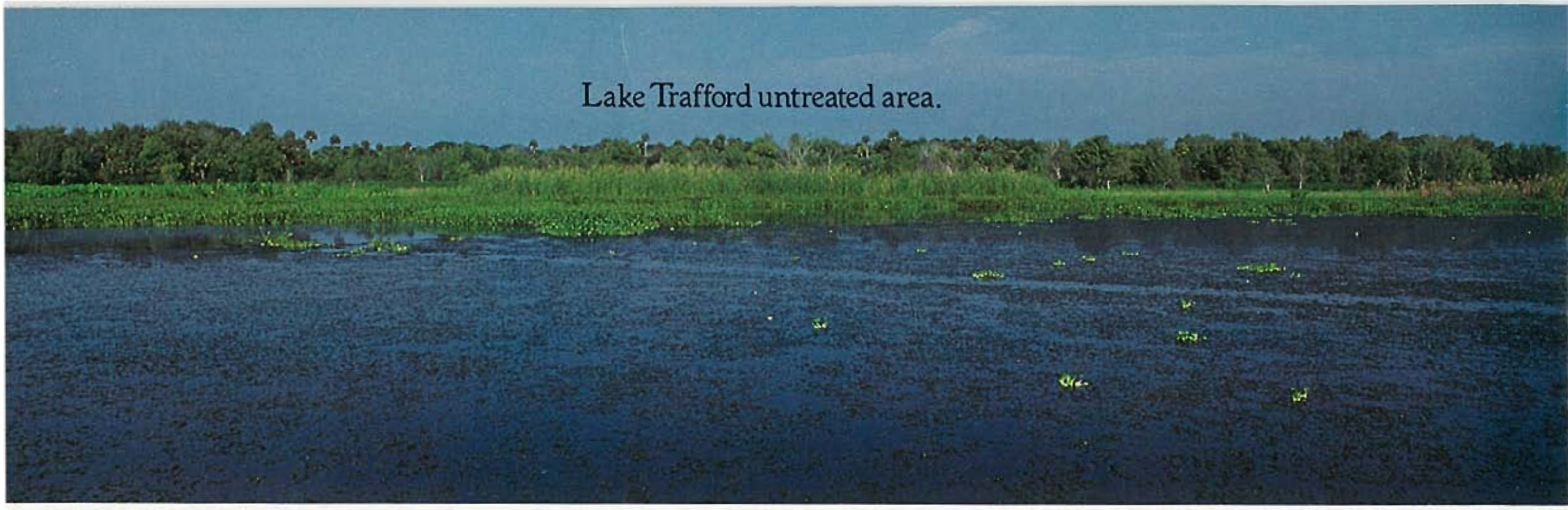
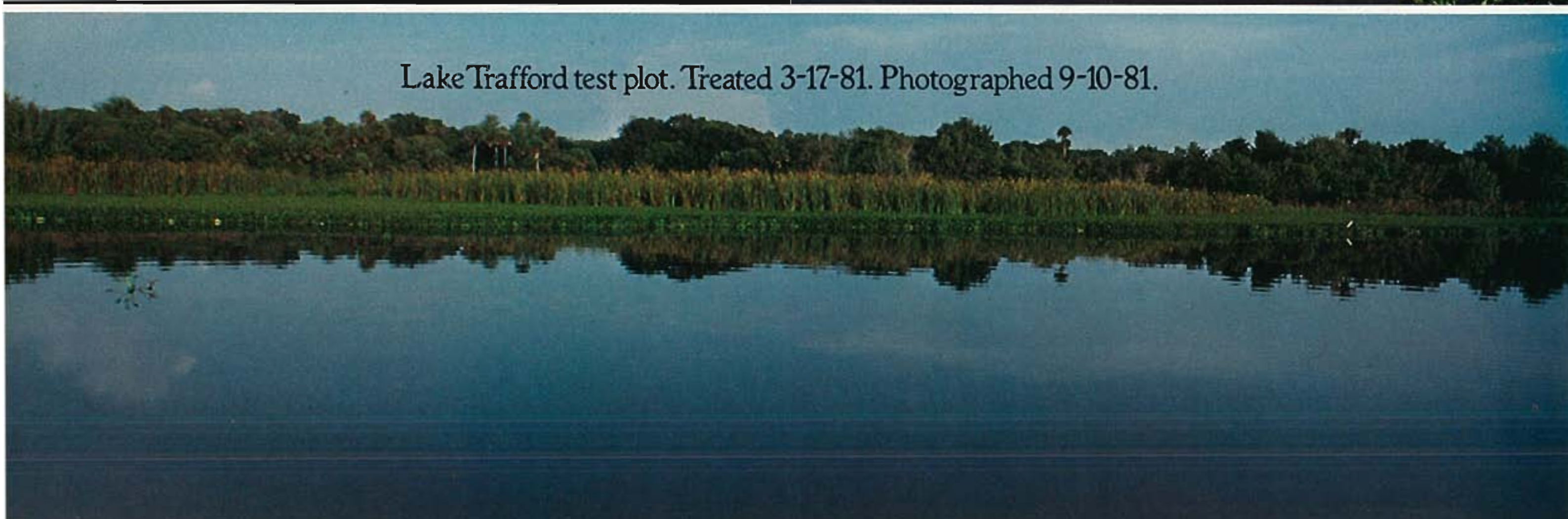


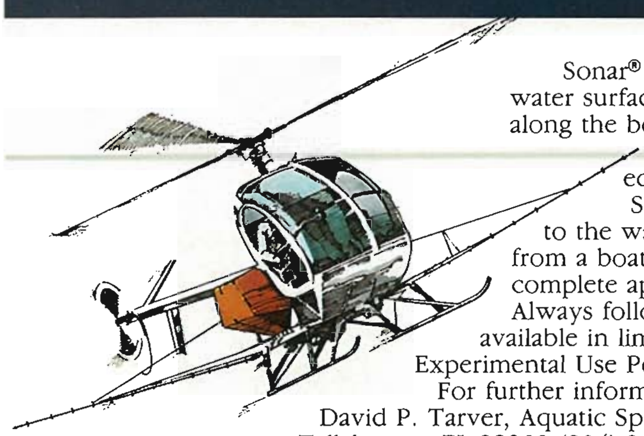
Paragrass



Lake Trafford untreated area.



Lake Trafford test plot. Treated 3-17-81. Photographed 9-10-81.



Sonar® aqueous suspension can be applied to the water surface or under the water surface or placed along the bottom of the water just above the hydrosoil. Any conventional application equipment can be used.

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For further information write or phone:
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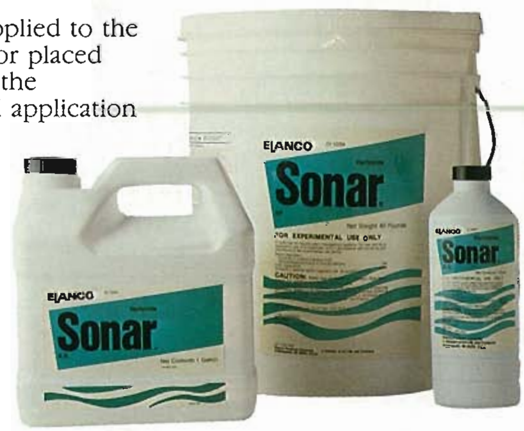

Elanco Products Company, A Division of Eli Lilly and Company, Indianapolis, IN 46285, U.S.A.

continued from page 4

should be considered a potential aquatic pest in this state. □

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The Status of Hydrilla and Water Hyacinths — 1984

by
Jeff Schardt
Department of Natural Resources
Tallahassee, Florida

The Department of Natural Resources (DNR) conducts an annual inventory of aquatic plants in most of Florida's, publically accessible water bodies. This survey is conducted to define aquatic plant populations within individual water bodies as well as on a statewide scale. Management and research efforts can then be directed toward plants which are creating problems or could potentially restrict waters from their primary use.

Since 1982, from the first of April to the end of October, more than 1.25 million acres of fresh water have been inspected by the Department's six regional biologists. Water bodies are categorized into three basic systems; lakes, rivers and canals. Plant species are identified and then ranked according to the number of systems in which they occurred and by the acreage they were reported to cover.

Acreage is condensed to 100% coverage for consistency in comparisons between species and between years. For example, a ten acre lake with hydrilla scattered throughout, but covering about 20% of each square meter of bottom, would yield two acres of condensed plants (10 acre lake × 20% coverage = 2 acres of plants).

Finally, a subjective problem rating of none, moderate or severe is scored for each species depending on how it influences the primary use of each water body in which it was found.

Although all species are important to aquatic plant managers, the primary focus of the survey is on the problem-causing exotic plants, in particular, hydrilla and water hyacinths. Table 1 lists the number of water bodies and acres of water inspected in the 1982-1984 surveys.

Table 1
Number of Water Bodies and Acres of Water Surveyed

	1982	1983	1984
Lakes			
Number	279	327	333
Acres	996,777	1,033,816	1,046,654
Rivers			
Number	55	66	69
Acres	159,441	171,128	172,251
Canals			
Number	62	67	61
Acres	91,346	105,134	97,563
Total			
Number	396	460	463
Acres	1,247,564	1,401,052	1,407,442

Table 2 lists hydrilla presence and coverage in each system for the same period.

Table 2
Hydrilla Presence and Abundance in Lakes, Rivers and Canals

	1982	1983	1984
Lakes			
Number (Rank)	83 (16)	120 (17)	123 (19)
Acres (Rank)	34,482 (1)	34,036 (2)	39,308 (1)
Rivers			
Number (Rank)	24 (8)	25 (14)	30 (13)
Acres (Rank)	3,603 (1)	5,956 (1)	2,390 (2)
Canals			
Number (Rank)	56 (2)	61 (2)	58 (1)
Acres (Rank)	3,621 (2)	5,502 (1)	4,539 (1)
Total			
Number (Rank)	163 (10)	206 (11)	211 (13)
Acres (Rank)	41,706 (1)	45,394 (2)	46,237 (1)

Hydrilla presence was relatively low in natural systems during the three survey years, occurring in 30-37% of the lakes and 38-43% of the inspected rivers. At least 15 species were more common than hydrilla in lakes and seven in rivers during the three year inventory. No particular trends (increases or reductions in the number of lakes and rivers affected) were noted. Hydrilla was the first or second most commonly observed aquatic plant in terms of the number of canal systems affected, increasing from a 90% presence in 1982 to 95% during 1984.

Despite the low presence in natural systems, hydrilla was the most abundant aquatic plant species found in Florida public waters in 1982, covering approximately 42,000 acres. Only torpedograss *(Panicum repens)* covered more canal acres than hydrilla. In 1983, hydrilla increased to 45,000 acres; however cattails (*Typha* spp.) were slightly more abundant largely due to a 40,000 acre population in Lake Okeechobee. During 1984, this population gave way to encroaching torpedograss, reestablishing hydrilla as the most abundant aquatic plant (46,000 acres) surveyed.

Hydrilla is rated as the state's number one aquatic plant problem in 1984 as more than half of the hydrilla populations detected caused some access or use problem. Fifty-five moderate and 58 severe use restrictions were attributed to hydrilla in 1984. In water bodies common to the 1982 and 1983 surveys, 94 hydrilla increases and 90 reductions occurred. Between the 1983 and 1984 surveys, only 88 reductions occurred compared to 130 increases; however, a net hydrilla increase of only 1,000 acres was recorded.

Even though statewide hydrilla acreage increased during each survey year, significant reductions were managed in several major water bodies. Records kept by the DNR show that more than 18,000 acres of hydrilla were controlled during 1983. Major control methods included the use of copper, diquat, endothall and fluridone compounds as well as mechanical control. These efforts were evident during the 1984 survey, and if not for the continued hydrilla growth in Lake Okeechobee (more than 14,000 acres in two years) a significant statewide hydrilla reduction would have been achieved.

Table 3 shows the ten largest hydrilla changes from 1983 to 1984. Table 4 lists the ten largest hydrilla populations in 1984. Only three increases are among these changes compared to five from 1982-1983; however, these increases amounted to more than 10,000 new acres of hydrilla in 1984. Only boat trails were maintained in Rodman Reservoir (Putnam County) and Lake Okeechobee. A treatment using fluridone was conducted in Rodman Reservoir during late 1984, but results were not evident at the time of the survey. Hydrilla grew in only one section of Lake Harris until 1984. Control efforts using diquat, endothall and fluridone proved fruitless in stopping the spread in this 14,000 area lake. During 1983, hydrilla reached the water surface, fragmented and rooted throughout the system resulting in an increase of more than 600 acres in 1984.

Table 3
Largest Hydrilla Population Changes

	Water Body	Water Acres	Amt. of Change
1.	Lake Okeechobee	448,000	7,517 I*
2.	Rodman Reservoir	5,280	2,275 I*
3.	St. Johns River	96,000	2,262 D*
4.	Lake Rousseau	4,000	1,900 D*
5.	Withlacoochee River	3,600	1,520 D*
6.	Lake Lochloosa	5,705	1,337 D*
7.	Lake Marion	2,990	895 D*
8.	Sampson Lake	2,042	800 D*
9.	Lake Panasoffkee	4,460	720 D*
10.	Lake Harris	13,788	635 I*

Table 4
Largest Hydrilla Populations

	Water Body	Water Acres	Plant Acres
1.	Lake Okeechobee	448,000	21,849
2.	Rodman Reservoir	5,280	4,000
3.	Lake Pierce	3,729	1,280
4.	Lake Worth DD	1,931	1,200
5.	Upper Myakka Lake	1,020	950
6.	Lake George	46,000	600
7.	Lake Harris	13,788	650
8.	Crystal River	1,650	640
9.	St. Johns River	96,000	618
10.	Lake Marion	2,990	600

Seven of the ten largest hydrilla changes were decreases, accounting for a total reduction of nearly 9,500 acres. A 2,262 acre reduction occurred on the St. Johns River channel due in part to improved survey methods, but also because of competition with eelgrass, Southern naiad *(Najas guadalupensis)* and baby tears *(Micranthemum glomeratum)*, especially in the area between Palatka and Jacksonville. The Southwest Florida Water Management District (SWFWMD), using endothall products, removed more than 3,400 acres of hydrilla from the Withlacoochee River and adjoining Lake Rousseau.

Hydrilla continued to decrease on Lake Lochloosa (Alachua County) from fluridone treatments applied by the St. Johns River Water Management District (SJRWMD). Lake Marion hydrilla was reduced by nearly 900 acres by the Polk County Environmental Services using fluridone. The same herbicide, used by the Suwannee River Water Management District, was responsible for an 800 acre hydrilla reduction in Sampson Lake (Bradford County). The SWFWMD also was responsible for the control of more than 700 acres of hydrilla in Lake Panasoffkee (Sumter County) using a combination of endothall and fluridone.

With the addition of the large scale use of fluridone in 1982 to the control techniques already in use, the spread of hydrilla has been slowed in Florida. In 1984, the triploid grass carp was approved for use in Florida waters and stocking has begun in several public waters with histories of hydrilla problems. Despite this encouraging news, there are several major systems which require immediate attention, for example the Crystal River, the Myakka Lakes, Rodman Reservoir and Lake Okeechobee, which contains approximately half of all hydrilla reported in Florida's public waters.

Control of water hyacinths has been much more successful than for hydrilla. Table 5 lists water hyacinth presence and coverage in lakes, rivers and canals from 1982-1984. Water hyacinths were more common than hydrilla in natural systems during the three survey years, found in 53-59% of the lakes and 56-67% of the rivers surveyed. Water hyacinths ranked among the ten most common species in lakes and rivers during each survey year (second in rivers in 1983). As with hydrilla, no trends were evident in respect to the number of naturally occurring systems affected by water hyacinths. This stability was also evident in canals where water hyacinths were present in 69-70% of the systems during the three survey years.

While the number of systems affected by water hyacinths remained fairly constant from 1982-1984, plant acreage fluctuated widely. Rain was infrequent during 1980-1981 in Florida and water levels dropped accordingly. During 1982, water levels rose, germinating dormant water hyacinth seeds and the 8,300 acre population blossomed to more than 20,000 acres in 1983.

Cold weather during the winter of 1983 helped to reduce water hyacinth coverage, but DNR records show that nearly 50,000

Table 5
Water Hyacinth Presence and Abundance in Lakes, Rivers and Canals

	1982	1983	1984
Lakes			
Number (Rank)	147 (7)	188 (8)	196 (8)
Acres (Rank)	5,285 (8)	15,399 (4)	7,724 (12)
Rivers			
Number (Rank)	31 (4)	44 (2)	43 (5)
Acres (Rank)	1,916 (2)	3,407 (2)	1,121 (5)
Canals			
Number (Rank)	43 (4)	47 (4)	43 (4)
Acres (Rank)	1,774 (5)	1,774 (4)	1,054 (5)
Total			
Number (Rank)	221 (6)	279 (7)	282 (7)
Acres (Rank)	8,327 (4)	20,580 (4)	9,399 (8)

acres of water hyacinths were chemically treated during 1983. The principle herbicides used were 2,4-D and diquat formulations. This effort was evident in 1984 as only 9,400 acres of water hyacinths were recorded. Forty moderate and nine severe water use problems were attributed to water hyacinths in 1984, compared to 58 and 15, respectively, in 1983.

Of the water bodies common to the 1983 and 1984 surveys which contained water hyacinths, 136 supported increases in 1984 while 138 reductions occurred; however, there was a net reduction of approximately 11,000 acres.

Tables 6 and 7 list the ten largest water hyacinth changes from 1983 to 1984 and the ten largest populations in 1984, respectively. The

Table 6
Largest Water Hyacinth Population Changes

	Water Body	Water Acres	Amt. of Change
1.	Lake Okeechobee	448,000	3,286 D*
2.	St. Johns River	96,000	2,125 D*
3.	Orange Lake	12,706	1,900 D*
4.	Rodman Reservoir	5,280	605 D*
5.	Lake Monroe	9,406	505 D*
6.	Crescent Lake	15,960	444 D*
7.	Lake Isokpoga	27,692	425 D*
8.	West Lake Tohopekaliga	18,810	404 D*
9.	Lake George	46,000	240 D*
10.	Melbourne-Tillman DD	94,000	234 I*
	Lower Myakka River	640	235 I*

Table 7
Largest Water Hyacinth Populations

	Water Body	Water Acres	Plant Acres
1.	Lake Okeechobee	448,000	2,004
2.	Lake George	46,000	520
3.	St. Johns River	96,000	475
4.	Lake Lochloosa	5,705	380
5.	Lake Istokpoga	27,692	360
6.	Lake Kissimmee	34,948	340
7.	Lake Rousseau	4,000	325
8.	Withlacoochee River	3,600	310
9.	Melbourne-Tillman DD	94,000	295
10.	Orange Lake	12,706	250
	Lower Myakka River	640	250

South Florida Water Management District removed more than 7,000 acres of water hyacinths from Lake Okeechobee, Lake Istokpoga (Highlands County) and West Lake Tohopekaliga (Osceola County) using a mixture of 2,4-D and diquat. Thirty-three hundred acres of water hyacinths were controlled by the U.S. Army Corps of Engineers (COE) in the St. Johns River, Lakes Monroe and Goerge (Volusia County) and Crescent Lake (Putnam County) using 2,4-D. Rodman Reservoir water hyacinths decreased by more than 600 acres in 1984. The decline was brought about by the COE using 2,4-D and a biological control agent, the fungus, *Cercospora rodmanii*. The sharp increase of hydrilla in Rodman Reservoir is attributed in part to this reduction as the shading effect caused by water hyacinths was lost. A reduction in Orange Lake (Alachua County) of nearly 2,000 acres of water hyacinths was brought about by the SJRWMD using 2,4-D.

Despite the great progress in water hyacinth control in 1983-1984, maintenance programs must be stringently continued. The hard freezes of early 1984 will help, but concentrated control efforts are still required in Lake Okeechobee, Lake George, the St. Johns River, Lake Lochloosa and several Osceola County waters. It is important to note, that while water hyacinths are fairly easily and cheaply controlled, their tremendous growth rate makes them one of the greatest challenges facing aquatic plant managers. While nearly 50,000 acres of hyacinths were controlled in 1983, the net standing population dropped by only 11,000 acres in 1984. That is, to reduce water hyacinths by one acre, more than four acres were controlled. □

Aquatic Plant Research and Extension Surveys

Joseph C. Joyce[1] and William R. Summerhill[2]

During the past year two separate surveys were conducted in order to determine aquatic plant management research and extension needs for the State of Florida. The first survey involved 98 selected Extension Agents representing each Florida County. The second survey involved 144 members of the Florida Aquatic Plant Management Society (FAPMS) and was conducted at the Society's October, 1984 annual meeting in Plant City, Florida. Specific information was requested to determine; (1) estimates of the incidence and severity of aquatic weeds, (2) the nature and extent of requests to County Extension offices for information pertaining to aquatic weeds, (3) aquatic plant management research priorities, and (4) informational resources and support currently utilized and needed. The following is a summary of results, complete survey results will be provided upon request.

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SURVEY RESULTS

Extent and Type of Aquatic Weed Problems

Ninety-five percent of the county agents responding indicated that aquatic weeds were a problem, with 52 percent describing the problem as either "substantial" or "severe." Table 1 indicates the types of water bodies which had aquatic weed problems requiring managements. Seventy-four percent of the FAPMS members and 71 percent of the Extension Agents indicated public lakes as the most common type of waterbody under their area of responsibility. Table 2 provides an indication of the plants causing the major problem in terms of number of acres. The Extension Agents preceived filamentous algae to be the number one problem whereas FAPMS members felt hydrilla was a more severe problem. In terms of difficulty to control (Table 3) FAPMS members felt hydrilla in flowing water was the most severe problem followed closely by torpedo grass.

Table 1
TYPES OF WATERBODIES EXPERIENCING AQUATIC WEED PROBLEMS
(Multiple Response Question)

	FAPMS	EXTENSION AGENTS
Public Lakes	74%	71%
Flood Control Canals	68%	41%
Rivers	50%	44%
Public Ponds	48%	44%
Irrigation Canals	46%	41%
Creeks	45%	40%
Private Lakes	41%	75%
Reservoirs	34%	13%
Golf Course Ponds	33%	49%
Potable Water Supply	32%	3%
Condominium Ponds	31%	29%
Storm Water Detention	31%	32%
Farm Ponds	26%	65%
Fish Ponds	15%	14%
Other	10%	5%

Table 2
MAJOR PROBLEM SPECIES
(Relative Ranking of Severity)

	FAPMS	EXTENSION AGENTS
Hydrilla	1	5
Water Hyacinths	2	3
Aquatic Grasses	3	2
Duckweed	4	7
Water Lettuce	5	Not Rated
Eleocharis sp.	6	Not Rated
Cattails	7	4
Pondweed	8	6
Algae	9	1

When asked what types of control methods they utilized, FAPMS members indicate the following average percentages; chemical 85%, biological 30%, mechanical 20% and other 12%. The differences in perceptions of the two surveyed groups reflected in Tables 1 and 2 are due to the fact that Extension Agents have primary contact with private individuals or agricultural interests, whereas FAPMS members work more in the public agency maintained waterbodies.

Table 3
FAPMS RELATIVE RANKING OF MAJOR PROBLEM SPECIES IN TERMS OF DIFFICULTY TO CONTROL

Hydrilla (Flowing Water)
Torpedo Grass
Hydrilla (Lakes, Ponds)
Water Hyacinths
Eleocharis spp
Hygrophila polysperma
Filamentous Algae
Duckweeds
Water Lettuce
Other Aquatic Grasses
Frogbit
Bacopa sp
Other

Research Needs

The FAPMS members were asked to rank (see Table 4) a list of research topics as being the most important to aquatic plant management in Florida. The topics listed are those established by the Florida Aquatic Plant Advisory Council, but were not identified as such in the survey. Sixty-eight percent of the FAPMS members responding also felt it would be appropriate for public monies to be spent for the collection of registration data in order for the State of Florida to obtain an aquatic use label for an out of patent herbicide.

Table 4
FAPMS RESEARCH PRIORITIES
(In Relative order of ranking)

Criteria for Defining an Aquatic Plant Problem
Documentation of Treatment Impacts
Aquatic Plant Control in Flowing Waters
Relative Value and Importance of Aquatic Plants
Control of *Eleocharis, Bacopa, Limnophila,* and *Hygrophila*
Baseline Physiology of Problem Aquatic Plants
Effect of Diuron on Aquatic Flora and Fauna
Re-Establishment of Aquatic Plants
Sonar Application Methodology
Grass Carp Sterilization Techniques

Table 5
RESOURCES RELIED UPON TO OBTAIN INFORMATION ON AQUATIC WEED CONTROL
(Multiple Response Question)

	FAPMS	EXTENSION AGENTS
Herbicide Manufacturer Representatives	72%	3%
University of Florida (Gainesville)	43%	41%
Water Management District Personnel	38%	—
DNR Regional Biologists	32%	30%
Personal Contacts	29%	—
University of Florida (Ft. Lauderdale)	16%	44%
County Extension Agents	13%	62%*
DNR Personnel (Tallahassee)	12%	—
Other	6%	11%

*Personal knowledge

Table 6
INFORMATIONAL RESOURCES/SUPPORT NEEDED
(Multiple Response Question)

	FAPMS	EXTENSION AGENTS
Bulletins on Control Techniques	51%	57%
Identification Manuals	51%	—
Training Manuals	50%	42%
Information on Regulations	41%	—
Bulletins on Plant Biology	39%	—
Calibration Training	33%	—
Access to Computer Listing of Control Methods	30%	52%
Demonstrations	30%	20%
Onsite Assistance	11%	—
Short Courses	—	17%
Formal Training	—	46%
None	2%	6%

Technology Transfer Needs

Both surveys asked what resources were utilized for aquatic weed control information (Table 5) and what informational resources or support was needed (Table 6). FAPMS members relied mainly upon herbicide manufacturer representatives and University of Florida faculty in Gainesville. The county extension agents relied upon their own personal knowledge and University of Florida faculty at Ft. Lauderdale and Gainesville. Both groups felt a strong need for more bulletins on control techniques, training manuals and computer based information retrieval systems. Fifty-seven percent of the FAPMS members indicated that they had attended the biannual IFAS aquatic weed short course in Gainsville with 95 percent indicating the course was benefical.

FAPMS Member Profile

Of the 144 FAPMS members responding 35 percent indicated they had 1-5 years of experience, 51 percent had 6-15 years, and 14 percent had over 15 years experience. When asked to classify their own area of expertise the overwhelming majority indicated they were in some manner directly involved in field operations (Table 7).This is a strong indication that FAPMS is still serving the main group of professionals for which it was established — the aquatic applicator.

Table 7
FAPMS MEMBERS AREA OF EXPERTISE
(Multiple Response Question)

Agency Applicator	38%
Commercial Applicator	22%
Field Crew Supervisor	22%
Program Administrator	19%
Research Scientist	10%
Regulatory Personnel	4%
Herbicide Industry Representative	2%
Private Citizen	1%
Other	6%

SUMMARY

The information obtained from these two surveys are currently being used to reevaluate current and future aquatic plant research and extension programs within IFAS and the State of Florida. This input is invaluable since it will insure that the programs are directed towards the needs and desires of the primary user groups. Appreciation is extended to those individuals who took the time and effort to respond to the survey. □

Does Herbicide Application Affect Water Hyacinth Weevils?

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Water hyacinth, *Eichhornia crassipes,* is recognized as a serious aquatic weed problem in the southeastern United States, as well as in Texas and California. Biological control, utilizing water hyacinth weevils, was first proposed as an alternative to mechanical and chemical control in the early 1970's.

The effects of weevil damage have been documented in several studies worldwide and results suggest that under certain circumstances *Neochetina eichhorniae* and *N. bruchi* can reduce and achieve control of water hyacinth populations. Data are primarily from unmanaged sites where no herbicides are routinely used. They include locations in Australia (Wright 1982), Argentina (DeLoach and Cordo 1983), Texas (Confrancesco 1983), Louisiana (Goyer and Stark 1984), and the Sudan (Irving and Bashir 1984). In Florida, there are several documented cases of water hyacinth control using weevils. These include studies at Lake Alice and in canals in south Florida (T. Center, Personal communication).

Chemical control, typically involving spray application of the herbicides 2,4-D or diquat, is widely used in Florida and causes a relatively rapid decline in the water hyacinth weed mat. Some of the chemicals used may have a harmful effect on the weevils themselves. An additional concern to biocontrol people is the resulting loss of habitat for the immature stages of the weevils. The eggs, larvae and pupae all live within the hyacinth plant itself and cannot migrate away from plants that die and sink to the bottom of a lake. Futhermore, adult weevils, which live on the surface of the plant, appear to migrate (fly away) only at certain times during their life span (G. Buckingham, personal communication). Therefore, at highly managed sites where frequent spraying is employed, weevil populations may be reduced drastically as a secondary effect of spray programs.

Weevils mate and produce a new generation only 3 times a year. Thus weevil populations increase at a much slower rate than water hyacinths, which can double in biomass in as little as 10 days. As a result, rebound of the weed mat will remain unchecked by weevil feeding until the insect population can once again reach an adequate level. A cycle of repetitive large scale spraying may in this way preclude effective biocontrol by the weevils.

The surface waters in Florida serve many functions including recreation, transportation and commerce, power generation, irrigation and drainage. Consequently economic, aesthetic, environmental and political concerns necessitate the inclusion of all available tactics in a successful program of integrated aquatic weed management.

The research described below was designed to define the direct and indirect effects of herbicide application on water hyacinth weevils. The goal of this particular study is to find ways to minimize any potentially harmful effects of chemical control in the field and improve the level of water hyacinth biocontrol here in Florida.

One series of experiments was designed to examine any direct effects of herbicide formulations on the weevils. Screen-covered aquarium tanks containing Hoagland's solution were stocked with water hyacinth plants. Weevils were collected in the field and placed on the plants at a density of

3 weevils per plant. Then replicate tanks were sprayed with herbicide formulations at one of the following concentrations:

2,4-D at 0.5 gal/acre
2,4-D at 1.0 gal/acre
diquat at 0.75 gal/acre & Kover II at 0.25 gal/acre
diquat at 1.50 gal/acre & Kover II at 0.25 gal/acre
2,4-D at 0.5 gal/acre & polymer "573" at 8 oz./100 gal H_2O/acre.

All treatments were sprayed at the equivalent of 100 gallons water per acre. Control tanks were not sprayed. The number of live weevils were counted in each tank at 2 day intervals. Any dead weevils found were counted and preserved in alcohol. When all the plants were dead, the total number of live weevils remaining were counted and preserved.

No significant mortality of weevils was found in any of the tanks sprayed with those herbicide formulations listed above. Weevils in the sprayed tanks at the end of the experiments appeared to be healthy and would actively feed if fresh plant material was placed in the tanks with them. In conclusion none of the herbicides or additives tested in these trials were directly toxic to the weevils at the concentrations used. A similar result was found when weevil adults were dipped in labeled concentrations of Banvel and 2,4-D (D. Habeck, personal communication). We intend to continue this series of experiments by testing several additives which are used to formulate invert emulsions with 2,4-D.

Another series of experiments was designed to examine the behavior of weevils on sprayed plants in the field. A water hyacinth weed mat of approximately 400 plants was enclosed with PVC pipe and placed in a pond near Biven's Arm. The overall shape of this enclosure was rectangular (1m wide × 4m long). A large number of weevils were collected in the field. Of these, 400 weevils were marked on their backs with white paint and 400 weevils were marked with red paint. The white marked weevils were put on plants in one end of the weed mat and the red marked weevils were put on plants in the opposite end of the weed mat. Weevils were allowed to move around freely in the weed mats for 4 to 5 days. Then the herbicide 2,4-D (0.5 gal/acre) was applied to those plants at one end of the weed mat only (approximately 25% of the total number of plants in the enclosure). Every 2 days plants in all parts of the weed mat were examined and the numbers of red and white marked weevils found on sprayed vs. unsprayed plants were recorded. Monitoring of weevil migration continued until all the sprayed plants were dead. Control weed mats were not sprayed and weevil migration was monitored as described above.

We found that initially weevils migrated freely across the entire 1m × 4m enclosures. White marked weevils and red marked weevils were found evenly distributed throughout all of the plants. When plants were sprayed, no weevil response was seen immediately, and weevil distribution remained about the same as before spraying. However, by 7-10 days after herbicide application, when plants were mostly dying or dead, no weevils of either color could be found on any of the sprayed plants. From this data it appears that weevils are not migrating away as a direct consequence of exposure to the herbicide. Instead, they are leaving dead plants which have a reduced food quality, and moving to adjacent areas of healthy plants. We plan to follow up on this aspect of the project with field studies on a larger scale which will again monitor weevil migration after weed mats are sprayed.

Florida surface waters serve a variety of functions and their multi-use nature may sometimes necessitate the immediate and rapid removal of localized water hyacinth infestations. However, for environmental and economic reasons, the long-term goal of aquatic plant management in the state is to implement and promote biological control whenever possible. In looking for ways to improve the level of water hyacinth biocontrol we have tried to determine the response of water hyacinth weevils to herbicide application. The results reported here indicate that the weevils are not directly harmed by the herbicides tested thus far. In addition, it appears that adult weevils will move from sprayed plants to adjacent

areas of healthy unsprayed plants if they are available. This suggests the possibility of leaving small areas of water hyacinths unsprayed at field sites which must be controlled immediately with herbicides. These small areas of plants would provide a food source and haven for the weevils, conserving their numbers and allowing them to reproduce. Future work will focus on determining spray patterns which would conserve a minimum of weed habitat, as well as minimum densities of weevils needed to provide adequate biocontrol. □

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Management of a Monoecious Strain of Hydrilla in North Carolina

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New hydrilla, *(Hydrilla verticillata)* populations are rapidly being reported throughout the United States. In the Southeast, these populations are represented by strains that differ in genetic identity (Verkleij et al, 1983) and the ability to reproduce sexually (Conant et al, 1984; Langeland and Smith, 1985). Therefore, it is necessary to evaluate methodology for managing different strains of hydrilla growing under various climatic conditions.

Hydrilla was identified in North Carolina in 1980; and it was later determined to be a monoecious strain, compared to the dioecious, pistillate strain in Florida (Langeland and Schiller, 1983). In response to concerns over hydrilla's notoriety as an agressive aquatic weed and proximity of infestations to water bodies of major importance, state officials and university scientists immediately initiated research to develop an effective hydrilla management program. Preliminary findings of this program should be helpful to other states for developing hydrilla management programs.

Detailed studies of the growth characteristics of hydrilla in North Carolina were undertaken so that herbicide applications could be timed to optimize the plant's susceptability. Studies showed that above-ground hydrilla biomass does not persist through winter in North Carolina and regrowth in spring occurs (probably exclusively) from hibernacula (i.e. tubers and turions) (Harlan, Davis, and Pesacreta, 1985). Therefore, it was thought that an early application following hibernacula sprouting and prior to surface matting; and/or a late application before tuber formation began in earnest (i.e. August in North Carolina) would be effective in reducing hydrilla populations.

Materials and Methods

Big Lake, Reedy Creek Lake, and Sycamore Lake in Umstead State Park near Raleigh, North Carolina, and Lake Anne in a nearby housing subdivision were used to study the efficacy of herbicides on a monoecious strain of hydrilla. Hydrilla has been established in these lakes for several years.

Various herbicides, application techniques, and application times were evaluated (Table 1). Liquid formulations were applied in 100 gal tank mixes per acre containing 1% Poly Control.®[1] Pelleted and granular formulations were applied with a hand-held, centrifugal applicator.

A recording fathometer (Aqua Meter 394) was used to measure changes in hydrilla density in response to herbicide applications. The fathometer was operated along transects that were run perpendicular to the shoreline through the center of each plot, to the 2.5m depth contour (this is the maximum depth to which we have found hydrilla to grow in the lakes). The cross-sectional area of the strip chart occupied by hydrilla was measured planimetrically; and percent control was measured as the percent reduction from pretreatment cross-sectional areas.

Results and Discussion

When hydrilla was identified in North Carolina it was suggested that the monoecious strain may be easier to control than more southerly populations because of its "less robust" growth habit. Our experience has shown this not to be true. Control of the monoecious hydrilla strain in North Carolina has proven to be as difficult, and as variable as control of the dioecious strain in other Southeastern states. In fact, features of many North Carolina lakes make control very difficult.

Diquat (Diquat H/A) + chelated copper (Cutrine-plus) at a rate of 2 gal + 2 gal per surface acre, injected just below the water surface, gave partial and temporary hydrilla control when applied in Reedy Creek Lake in June (Table 1). Regrowth was rapid. After initial control of approximately 60%, hydrilla approached pretreatment levels 6 weeks after treatment, and after 9 weeks hydrilla exceeded pretreatment levels. Retreatment of these plots in August resulted in poor control (Table 1). Injection just below the surface of diquat + chelated copper in Lake Anne in June resulted

[1]Use of brand names in this publication does not imply endorsement of the products named or criticism of similar ones not mentioned.

Table 1. *Efficacy of various herbicide applications to a monoecious strain of hydrilla in North Carolina lakes.*

Herbicide, Rate, (lbs or gal formulation /surface acre), and Method of Application	Date of Appl	Percent Control at Weeks After Treatment 2	3	5	6	7	8	9	12	13	16	40	Location and Plot Number	
Cutrine-plus + Diquat H/A (2+2) Injected just below surface	6/83		61		17			0					Reedy Creek Lake	1
	6/83		64		33			0					Reedy Creek Lake	2
	6/83			40		17				0			Lake Anne	2
	6/83			10		8				0			Lake Anne	5
	8/83			11			0						Reedy Creek Lake	1
	8/83			36			5						Reedy Creek Lake	2
Cutrine-plus (2) Injected just below surface	6/83		68		39			0					Reedy Creek Lake	5
	8/83			5				0					Reedy Creek Lake	5
Diquat H/A (2) Injected just below surface	6/83			0									Lake Anne	1
Diquat H/A (2) Surface Application	9/83					22							Lake Anne	2
	9/83					2							Lake Anne	3
Diquat H/A (2) Injected with three foot drop hoses	8/84		91										Lake Anne	1
	8/84		92										Lake Anne	2
	8/84		82										Lake Anne	3
	8/84		86										Lake Anne	4
Aquathol K (6) Injected just below surface	6/83		93		99			99	94		94		Reedy Creek Lake	3
	6/83		58		79			61					Reedy Creek Lake	4
	6/83			25		36				9			Lake Anne	3
	6/83			12		7				0			Lake Anne	4
	3/83			67		36							Reedy Creek Lake	4
Aquathol K (6) Surface Application	9/83					30							Lake Anne	5
Aquathol K (7.7) Injected with three foot drop hoses	6/84	5	5		0								Reedy Creek Lake	3
	6/84	44	44		12								Reedy Creek Lake	4
	6/84	56	61		53								Reedy Creek Lake	5
	8/84		67										Reedy Creek Lake	3
	8/84		70										Reedy Creek Lake	4
	8/84		77										Reedy Creek Lake	5
Aquathol Granular (300)	6/84	46	49		67				54				Reedy Creek Lake	1
	6/84	24	17						55				Reedy Creek Lake	2
Sonar SRP (30)	5/84											100	Big Lake	1
	5/84											100	Big Lake	7
Sonar 5P (30)	5/84											100	Big Lake	2
	5/84											100	Big Lake	3
Sonar 4AS Injected just below surface (0.5)	9/83											100	Big Lake	4
Sonar 4AS Surface Application (0.5)	9/83											100	Big Lake	9
Fenatrol (13) drawdown application with handgun	12/83											62[2]	Sycamore Lake	2
	12/83											83	Sycamore Lake	3
	12/83											86	Sycamore Lake	4
Sycamore Lake — untreated	—											86	Sycamore Lake	1

[1]All liquid formulations were applied in 100 gal of tank mix per acre containing 1% Poly Control.®
[2]Percent control in Sycamore Lake was calculated by comparing August 1983 hydrilla density to July density.

in generally poor control. Only 40% control was observed in plot 2 and essentially no control in plot 5.

Application of chelated copper alone (2 gal/surface acre) or diquat (2 gal/surface acre) alone injected just below the water surface or applied as a surface spray gave similar control as when tank mixed. Control ranged from no control to fairly good control when chelated copper was applied in Reedy Creek Lake in June. The level of control observed with the relatively low rate of copper was surprising; but based on the poor control observed after the August retreatment we cannot suggest consistent control of monoecious hydrilla with copper alone.

After evaluation of results from our 1983 tests, several possible explanations were made for the poor hydrilla control with diquat and diquat +chelated copper.

Diquat is rapidly absorbed to suspended clay and organic particulates in water. The soils underlying the region are acidic, and dominated by firm clays. Total solids for surface waters of these lakes ranged in April from 30 to 100 mg/1, composed chiefly of clay platelets discharged from the drainage basins. By August, surface waters ranged from 20 to 30 mg/1 total solids, due to low flushing of the lakes, settling and precipitation of these materials onto the hydrilla (G. J. Pesacreta, unpublished manuscript). Although diquat is rapidly absorbed by plant tissue, competition for diquat ions from the charged clay ions in suspension may have prevented absorption of diquat by the submersed plants. Poor control after August and September applications may have resulted from a low physiological susceptability of the hydrilla due to maturity. However, absorption of diquat by clay particles may also explain reduced control observed in August and September because hydrilla accumulates a layer of particulates on its leaf surfaces through the growing season.

Another contributing factor to the poor response of diquat and, or copper is the basin morphometry of these lakes. Unlike natural lakes, all the water bodies in this study were stream impoundment. All have steep slopes and due to downhill contouring are deeper near their outlets. Consequently, treatment areas are usually steeply contoured fringes. Poorer control and rapid regrowth in deep area of the plots suggests that in spite of the use of Poly Control® as a sinking agent, the herbicides were quickly diluted by surrounding water before they were sufficiently absorbed by hydrilla.

To reduce the effect of dissipation in the deeper and extreme areas of the plots, three-foot drop hoses were used in 1984 applications to inject the herbicide and polymer in closer proximity to the plants. Much better control, ranging from 82% to 91%, observed after August applications in 1984 (Table 1) suggests that dissipation of the herbicide before it could be absorbed was the primary reason for the poorer control in 1983 applications and that use of the drop hoses minimized the problem.

Generally, endothall (Aquathol K) gave variable, and similar levels of control in 1983 as diquat, but longer control was observed (Table 1). Maximum control with endothall ranged from 12% to 99%. In plot 3 in Reedy Creek Lake, complete control was observed throughout the growing season, and fair control was observed through most of the growing season in plot 4.

As for diquat, dilution of the herbicide due to treatment of steeply sloping fringe areas probably explains poor control with endothall in 1983. Therefore, endothall was applied in 1984 by injection with drop hoses or as a granular formulation (Aquathol Granular).

Application of endothall with drop hoses in June 1984 did not improve performance of the herbicide over June 1983 treatments. However poor control with endothall after June 1984 treatments can be explained by another characteristic of Piedmont Lakes that causes difficulties in aquatic weed control. These impounded streams have very high drainage basin to volume ratios that allow for high flushing rates. Under normal flow conditions, the water in Reedy Creek Lake has a residence time of 11.2 days.[2] Following treatment, a rainfall of approximately 3 inches occurred which undoubtedly caused severe dilution and flushing of the herbicide. Fairly good control was observed after application of endothall with drop hoses in August 1984 (Table 1).

Based on fathometer tracings, granular endothall gave fair levels of control and good longevity. Both transects showed greater than 50% control 12 weeks after application without retreatment. This is fairly good considering the fringe nature of the plots and rain that occurred after application. In addition to fathometer tracings, direct visual observation of areas treated with granular endothall were made. Large areas devoid of hydrilla could be observed indicating very good control.

All three formulations of floridone (Sonar SRP, Sonar 5P, Sonar 4AS) gave complete control of monoecious hydrilla throughout 1984 when applied in September 1983 or May 1984 (Figure 1, Table 1). Since fluridone is known to diffuse from the treatment area, separation of results between the different formulations may be questionable. However, the seven acre treatment with the granular formulations in May 1984 is downstream and at the opposite end of the elongate 50 acre lake from the September 1983 treatment with the liquid formulation. Therefore, the results of these two applications are probably independent. Although the response of the two granular formulations are not distinguishable, they were probably equally as effective. Selective control of hydrilla was observed as *Chara* showed no injury symptoms.

The basin morphometry previously discussed caused great difficulty in applying fenatrol. Drawdown of Sycamore Lake was begun on September 4, 1983 to give the clay hydrosoil, which tends to hold moisture, ample time to become dry enough to apply fenac (Fenatrol). However, because of the large drainage area to lake volume, the lake refilled several times after the initial drawdown when rainfall occurred. Fenac was applied, at a rate of 13 gallons per acre, in December when the hydrosoil had finally become dry enough and was not frozen. Fenatrol appears to have resulted in good hydrilla control. Complete control was observed in the deeper water of the plots, but regrowth occurred along the shallow edges. We initially attributed this to poor coverage along the edges or to the herbicide washing down the slope before it was incorporated. However, nature intervened in 1984 with heavy rains in the spring to make evaluation of fenatrol plots difficult. High turbidity caused by erosion of clay soils into the lake caused a very shallow euphotic zone and thermocline that caused a large reduction in hydrilla coverage throughout the lake (G. J. Pesacreta, unpublished manuscript).

A transect over an untreated portion of the lake bottom had a similar tracing pattern (indicated in Table 1 as 86% control) as treated plots. The entire bottom of Sycamore Lake was treated by helicopter with Fenac in November 1984; and we reserve evaluation of Fenac efficacy on monoecious hydrilla until 1985.

Hydrilla regrowth in 1984 in all plots treated with diquat, copper, or endothall in 1983 may have occurred from a residual hibernacula population; or it is evidence that the growth cycle was not sufficiently disrupted to prevent hibernacula formation and subsequent regrowth the following year. Based on the low levels of control, the latter is probably true. However, in Reedy Creek Lake plot 3, where season-long control was observed, regrowth in 1984 must have occurred from residual hibernacula, or from encroachment from the rest of the lake. Continued treatments and observation in successive years will be necessary to determine if elimination of hydrilla by continued disruption of the growth cycle is feasible.

[2]Moore, Gardner, and Associates. 1981. Clean Lakes Study — Phase 1 for William B. Umstead State Park.

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Conclusions

The monoecious strain of hydrilla in North Carolina responded similarly to herbicides as the dioecious strain has responded in other southeastern states. Two to three applications per year of diquat will be necessary to maintain adequate control; and these should be injected with drop hoses and a sinking agent. Season-long control may sometimes be obtained with endothall, but retreatment will probably be necessary. Endothall should be injected deep with drop hoses and sinking agent or applied as a granular formulation, especially for fringe treatment. Initial application of diquat or endothall should be made early in the spring when hydrilla growth begins and successive applications made as necessary. At least season-long control should result from applications of one of the fluridone formulations; and the granular formulations should give control on fringe applications. Sonar is a selective herbicide and did not control *Chara*.

Acknowlegments

Herbicide applications were funded by matching funds from the United States Army Corps of Engineers, Wilmington district and the North Carolina Department of Natural Resources and Community Development, Office of Water Resources. Monitoring was funded by a grant from the University of North Carolina Water Resources Research Institute. Carolina Power and Light Company provided equipment and assistance for applications in 1983. □

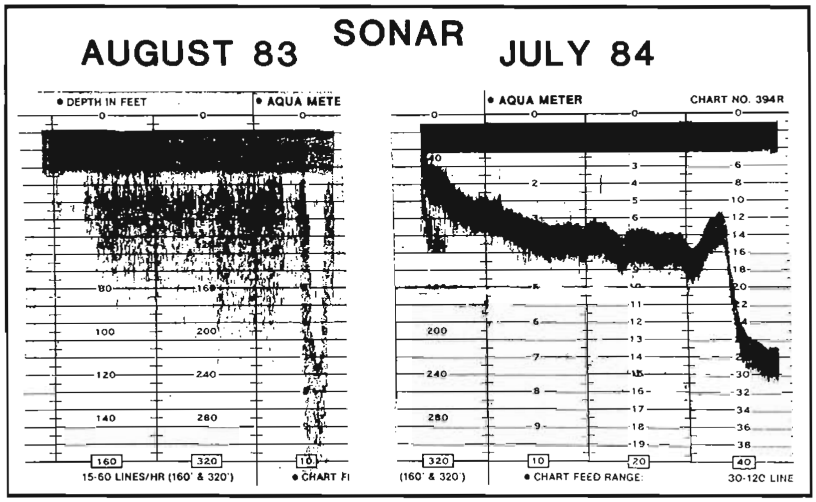

Figure 1. Fathometer tracings prior to, and following Sonar applications in Big Lake. (10 foot depth range). All vegetation along transect in August 1983 was hydrilla. The open area to the right of the tracing is the position of the former creek channel. For July 1984, all vegetation is gone along the tracing except for a small fringe of *Chara* at depths of 1 foot or less.

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Mimosa Update

by
Deborah White
Center for Aquatic Weeds

Field surveys for Florida populations of *Mimosa pigra* var. *pigra* (Aquatics, December, 1984) have continued with the help of the South Florida Water Management Districts. Areas covered include: Dade and Broward Counties canal systems, conservation areas east of the Everglades, Loxahatchee River basin, upper St. John's River, Taylor Creek, parts of the Kissimmee River system, Lake Okeechobee, and Fisheating Creek.

Another variety of this species occurs in Mexico and southern Texas. Although M. pigra var. *berlandieri* differs morphologically from the widespread type, its growth habit and ecological preferences are similar. Pure stands of this plant form in resacas or low drainage fields, on exposed lake margins, and in abandoned agricultural fields in this area. Floristically, Florida is similar to parts of Texas and Mexico. So, the ecological studies and management strategies being implemented in south Texas will give insight into the decisions that will be made concerning the presence of *M. pigra* in our state.

Investigations of the physiology, environmental requirements, biocontrol agents, and possible controls are being pursued. Development of control strategies for this weedy species will be of benefit not only here in subtropical Florida but also in many areas of the tropics that are presently impacted. □

Editor's note: Introduction of this plant to the New World Tropics possibly occurred in 1947 rather than in the 1960's as mentioned in the December, 1984 *Aquatics*.

AQUA-VINE

POSITION CHANGE

Glenn Horvath has become the new Aquatic Plant Manager at Suwannee River Water Management District as of November, 1984. He assumed the responsibilities held by Joe Flanagan whose position has changed to include the regulation and collection programs of the district. Glenn will be administering a $235,000 program which will primarily be responsible for the aquatic weeds within the Suwannee River Basin.

FAPMS ANNUAL MEETING

The annual meeting of the Florida Aquatic Plant Management Society will again be held at the Plant City Holiday Inn on Oct. 15-17, 1985.

If you want to present a paper, get your request in early to Bob Arnold, Program Chairman. Last year's meeting was a great success. Let's work with Bob to help make this year's meeting even better.

CHANGE OF OFFICERS

Len Bartos has been promoted to Acting Director, Field Operations, at the Southwest Florida Water Management District. Due to the increase in responsibilities, Len felt in all fairness to the District and to the Society that he should relinquish his duties as Editor. The new Editor of *Aquatics* is Dan Thayer, Center for Aquatic Weeds, Gainesville. Dan will be replaced by Don Doggett, Lee County Hyacinth Control District, as one of the directors.

NEW STUDENT

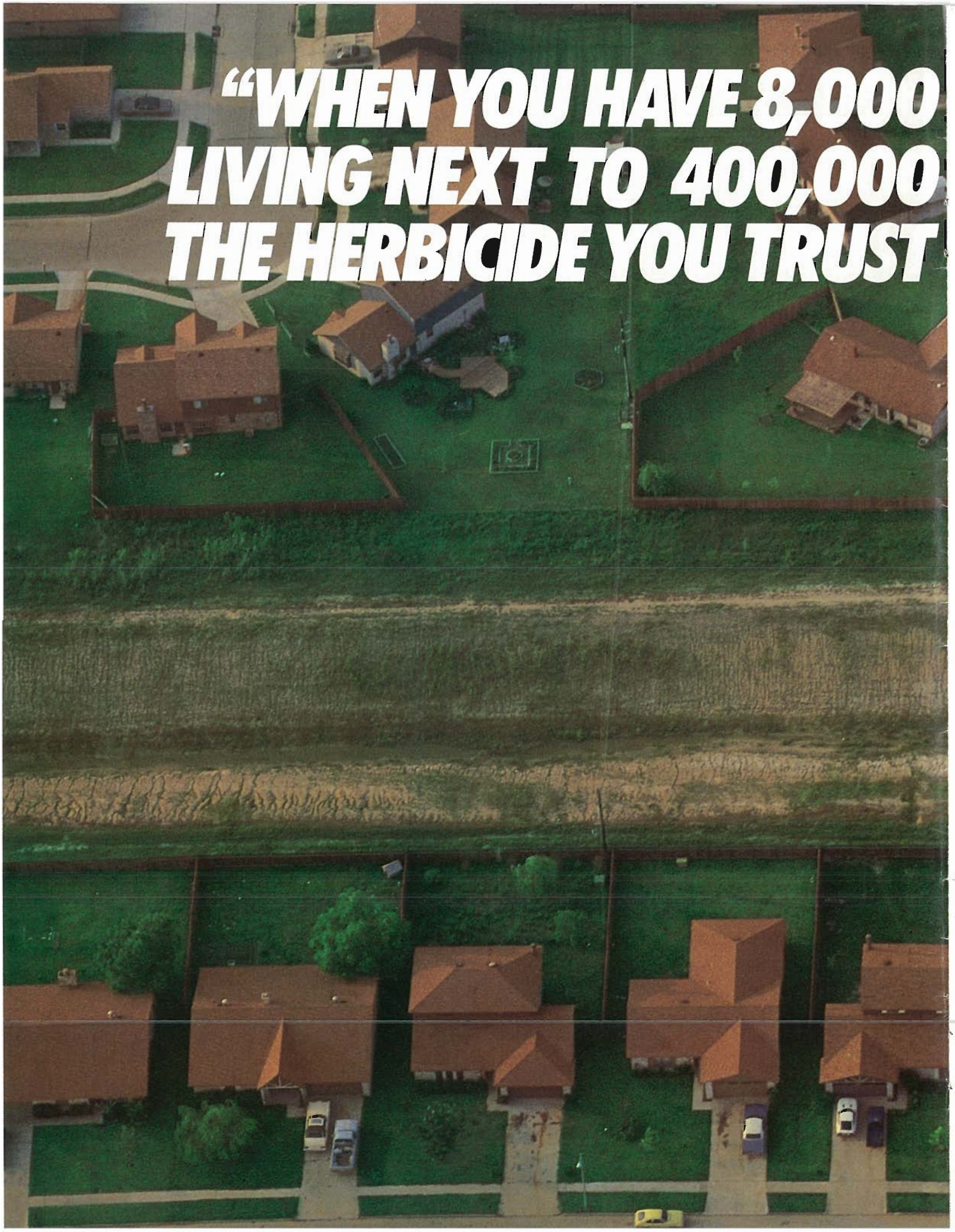
Dr. Haller has a new graduate student! Her name is Sue Newman, and she comes to us from Colchester, England. She will be working on a Masters Degree in Aquatic Plant Management. Prior to coming to the states, Sue worked for the Weed Research Organization in Oxford, England, with weed control in flowing waters. Sue received her B.S. degree at the Institute of Science and Technology, University of Manchester, in Management and Chemical Sciences. GOOD LUCK!

IN REMEMBRANCE

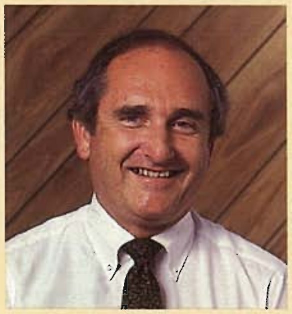
On June 30, 1984, Russell Yamcey passed away of pneumonia while camping with friends on the St. John's River. Russell was an Equipment Operator I with the Volusia County Aquatic Plant Control program. He had worked with the county for six months when he tragically died at the age of 27. Don Davies, his supervisor, says that Russ had a strong desire to learn all he possibly could about his job, almost to the point that it became an obsession. Over a period of several months, Russell had become very active in the aquatics program and was a well liked individual, he will be missed by all. Bill Christian has replaced Russell under the direct supervision of Stanley Blackwelder, who has been with the program since 1980.

DNR

The 1983 Florida Aquatic Plant Survey is now available from the Bureau of Aquatic Plant Research and Control, Tallahassee. The report represents more than 1.25 million acres of Florida's fresh water systems and addresses the forty most abundant aquatic plant species. For more information about the report, contact Jeffrey D. Schardt, Biological Administrator. (904-488-5631)


"WHEN YOU HAVE 8,000
LIVING NEXT TO 400,000
THE HERBICIDE YOU TRUST

MILES OF DITCHBANK WEEDS
FAMILIES,
IS RODEO.®"



JAMES B. GREEN
Director of Harris County, Texas
Flood Control District

"We switched from contact herbicides to Rodeo because we wanted a product we didn't have to worry about using. It had to get the job done safely—and Rodeo really delivered on that score. We're also covering a lot more ditch than before, and getting weed control that lasts much, much longer."

Harris County, Texas, which includes Houston, has 22 major watersheds and 8,000 miles of main-drainage ditch-banks for flood control. As James B. Green points out, "Trying to get around that in a spraying season really keeps you on your toes. We've found that one trip with Rodeo can give us as much weed control as 2 or 3 treatments with contact herbicides. And we're using that advantage to cover more area and do it faster."

Rodeo® herbicide is compatible with environmental standards. Properly applied, it will not adversely affect human, fish or animal health. What's more, there is no restriction on water use for irrigation or recreation after application.

When applied to the emerged foliage of labeled weeds, Rodeo translocates to the root system, destroying the entire plant. That means fewer repeat treatments. And Rodeo works only on vegetation it touches and has no residual soil activity.

BROAD-SPECTRUM CONTROL.

Rodeo controls more than 90 different annual and perennial grasses, broadleaf weeds and brush species. "That's made our spraying program simpler to operate," says Green. "We don't have to stock as many products in our inventory."

RODEO IS LABELED FOR YOUR TOUGHEST GRASSES AND BROADLEAF WEEDS, INCLUDING:

ALLIGATORWEED*	WATER HYACINTH	PHRAGMITES*
CATTAIL	JOHNSONGRASS	REED CANARYGRASS
GIANT CUTGRASS*	MAIDENCANE	SPATTERDOCK
GUINEAGRASS	PARAGRASS	TORPEDOGRASS*

*Partial Control

You can use Rodeo in flowing or standing water in most aquatic sites, including ditches, canals, lakes, rivers, streams and ponds.

For James B. Green, it all comes down to this: "We trust Rodeo for keeping weeds from clogging our flood control system—and we also trust it around people."

Rodeo cannot be applied within a half mile upstream of domestic water intake points, in estuaries, or rice levees when floodwater is present.

ALWAYS READ AND FOLLOW LABEL DIRECTIONS FOR RODEO.

Monsanto

RODEO. BROAD-SPECTRUM CONTROL FOR AQUATICS.

Applicator's Corner
ask the
"WEED DOCTOR"

The "Applicator's Corner" is a new feature of the magazine geared towards answering specific field question. Whether you apply chemicals, fungi or weed eating carp for a living, the "Weed Doctor" wants to hear from you. Any questions, comments, short notes, or papers dealing with field oriented problems are welcome. If you've found a certain application technique, chemical combination or a better spray tank additive, just tell the "Weed Doctor" what your problems were, what you used, how it worked, and what you recommend. If you've got a problem or question, send you letter to the Editor entitled Dear "Weed Doctor" and the "Doctor" will try to find one of our "professionals of the field" to answer your questions.

The applicator's corner can be a valuable instrument for getting that tremendous storehouse of knowledge from one of the societies most valuable natural resources — YOU. If you want the "Applicator's Corner" to work, the "Weed Doctor" needs to hear from you.

Question:
Dear "Weed Doctor":

Over the last several years we've noticed an increase in the amount of frog's-bit in our district. Do you know anyone who has successfully controlled the plant with herbicides?

Answer:
Eddie Knight with the Corps in Palatka has also experienced some increases in frog's-bit in his region and has tested several chemicals for efficacy. The "Weed Doctor" wishes to thank Eddy for his rapid and thorough reply.

Control of Frog's-Bit

by
Edward D. Knight[1]

Over the years, aquatic plant control has evolved from the days of simple 2,4-D plus water mixed in a fifty-five gallon drum (complete with a boat oar for occasional agitation), to what some people call "state of the art" application equipment. These modern tools might include a fiberglass tank with push-button control for agitation to a computerized system of calibration.

Herbicides have also made a giant step towards positive control of unwanted plants. In days of old, the words 2,4-D and water hyacinths were primarily needed to carry on a conversation about aquatic plant control. With the introduction of more and more exotic plants, new words now overtone the conversation; words like Hydrilla, Eurasian watermilfoil, Egeria and many more. As need has dictated, application technology and various herbicides have kept abreast of the control of most species.

Exotic plants are normally the target for these tools. Occasionally though, some native plant species grow to the point of becoming as much of a nuisance as the exotics. Frogs-bit (*Limnobium spongia*) has fallen into this category in most areas of the upper basin in the St. Johns River. Normally water hyacinths are the target plants, but over the past few years Frog's-bit has grown to the point of becoming a major hindrance to navigation. Control of this plant is somewhat difficult because none of the before-mentioned technologies have been aimed at this particular species of native vegetation.

The leathery emersed leaves, along with the thick, partially submerged spongy leaves, make for difficult absorption of systemic herbicides. Field rates of 2,4-D normally have no significant necrosis of the plant. Usually, a slight yellowing occurs several days after application and lasts for about two weeks with subsequent greening. An even application of a contact herbicide is difficult because of the partially submerged leaf portions and petioles. The exposed portion of the plant receives the contact well. Herbicide "burn" to these plant parts are fast. A mixture of 2,4-D and Diquat appears to be the best control at present. The Corps of Engineers last year controlled a substantial amount of Frog's-bit, using the two herbicides together. The best control was achieved with a formulation of two parts 2,4-D with one part Diquat at an acre rate of four quarts 2,4-D and two quarts of Diquat. X-77 was also used at a rate of ¾ pints per acre.

Due to the leathery nature of the exposed leaves, good coverage of the solution is important. The extra time spent soaking the plants normally insure a good kill, provided weather conditions are right. Frog's-bit is probably the most difficult emergent plant to control. The Corps of Engineers has worked with Monsanto to set up test plots and observe the effects of Rodeo. Dr. Clair Erickson has monitored the plots that were initially put in the Hatbill Park area of the upper St. John's River. Early observations looked very promising, but unfortunately, high water has moved the plant traps to parts unknown.

In conclusion, Frog's-bit can be controlled if proper guidelines of good application technique are followed every step to insure suitable results. As with all aquatic plant control, common sense is ingredient number one for a successful operation. □

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[1]Supervisor, Aquatic Plant Control, Natural Resources Project Office, U.S. Army Corps of Engineers, Palatka, FL.