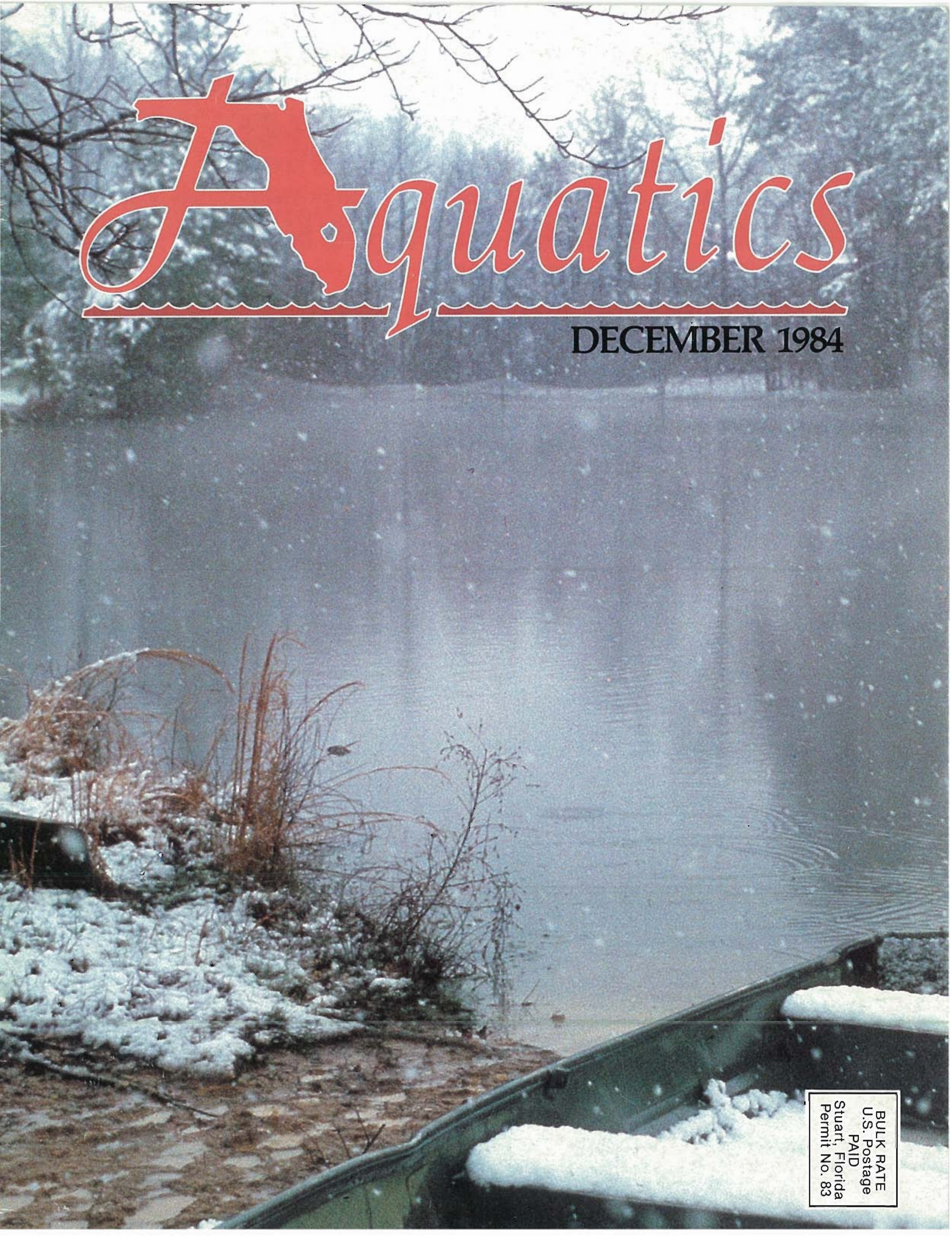
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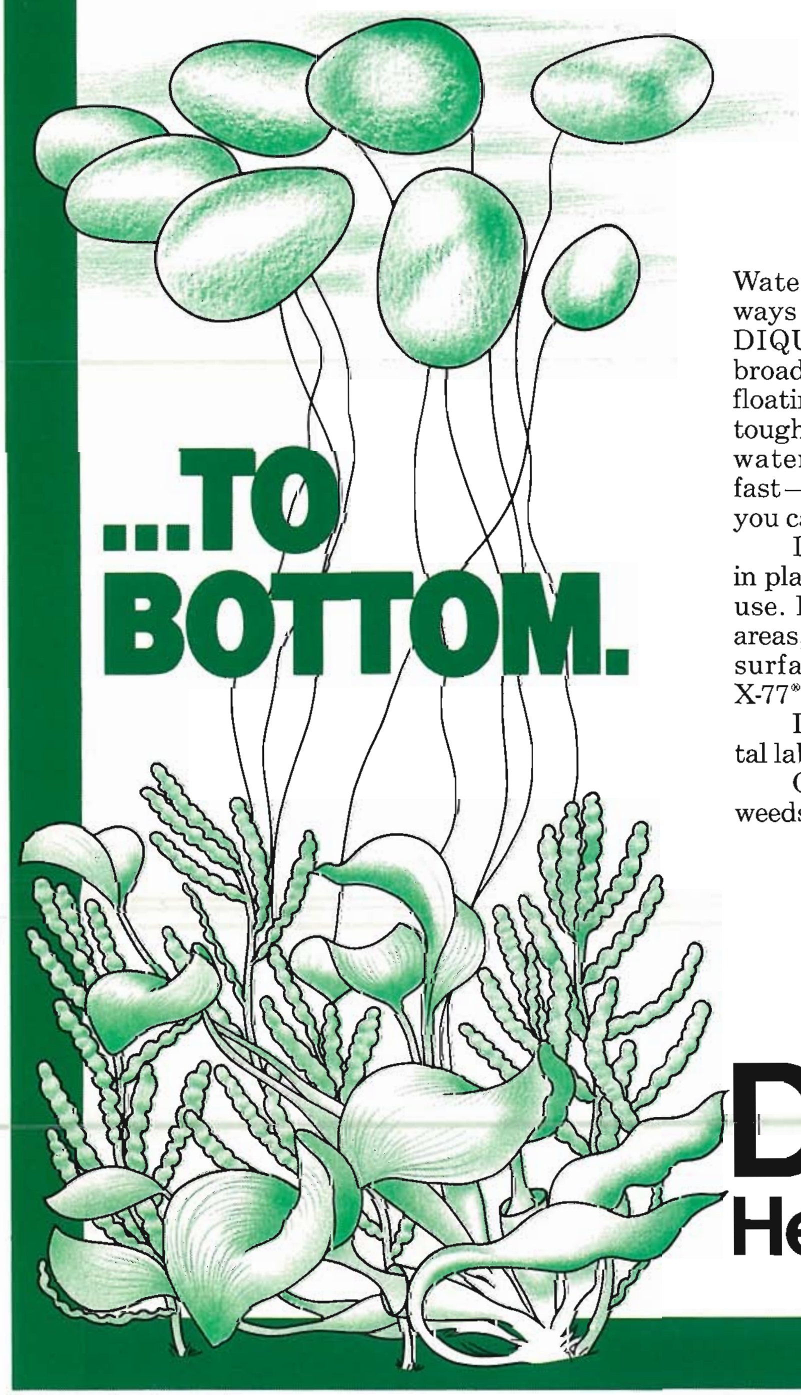

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EDITORIAL

The management of aquatic plants like all things change with time. People, attitudes, methods and regulations take on new wrinkles and if we're lucky improve in this aging process. The expression "grow or die" is a truism and if you'll excuse the pun — aquatic plant management is a "growing thing."

During the past few years some very important limbs have been added to our profession's family tree. Aquatic plant management societies have become established in the mid-south, west and the Carolina's. Hydrilla *has spread north to Washington, D.C., in T.V.A. lakes and Arizona, as well as the Santee Cooper area. Male plants were identified in North Carolina, viable seeds detected in the lab and recently in natural lakes. Here in Florida* Hydrilla *continues to present major problems in flowing water systems. Water hyacinths have aggressively reminded us that a continuous vigilance, maintenance control, is as critical today as in the past.*

During these past few years Aquatics *has also changed and hopefully matured. Conceived through Bill Maier's effort, the magazine is actually a national publication received by members of all chapters and the national organization.* Aquatics *is the Florida Plant Management Society's publication and should always address the issues here at home. In addition, I've attempted to include articles and cover shots from other parts of the country. As resource managers we all have much in common.*

In this final issue as editor I wish to sincerely thank all of the folks who have contributed to Aquatics. *You have maintained the quality, interest and standards of the magazine. Beginning in 1985, Len Bartos will become the fourth editor. Please generously give him your support and expertise as you have so faithfully given me.*

Thank you. It has been a pleasure. Have a memorable holiday season.

David P. Tarver
Editor

THE COVER

It's winter time and this small lake in North Carolina has definitely cooled down. Too bad this cold white stuff will not control the *Hydrilla*.
Photo by: Fred Tarver
N.C. State University.

Aquatics

DECEMBER 1984/Volume 6, NO. 4

CONTENTS

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.

CORRESPONDENCE: Address all correspondence regarding editorial matter to David P. Tarver, Editor, "AQUATICS" Magazine, 2416 McWest St., Tallahassee, Fla. 32303

The Yellow Water-Lily

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The water-lily family, *Nymphaeaceae*, is composed of eight genera with about 90 species. Of these genera, the *Nyphaea* is considered to be among the most primitive groups of the flowering plants.

Fossilized pollen grains of tropical *Nymphaea* species occur in geological outcroppings from the Jurassic period indicating these plants were present over 160 million years ago. Also, fossil remains of tropical water-lilies occur throughout Europe so conditions there must have been acceptable for their growth prior to the Ice Age. Botanists have linked these findings to the evolution of flowering plants.

Water-lilies attract attention of both botanists and aquatic gardeners because these plants are hardy, they adapt to cultivation, and they bear large, fragrant, showy flowers. This is particularly true for the yellow water-lily (*Nymphaea mexicana* Zucc.) with its large, fragrant, yellow flower (Figure 1).

Figure 1. Flowers of the yellow water-lily.

The yellow water-lily was first described in 1832 by Joseph Gerhard Zuccarini (1797-1848) from specimens collected in Mexico. Initially some confusion existed as to whether similar appearing plants collected from Florida were the same species. In 1838 Edward F. Leitner first discovered this plant in Florida and named it *Nymphaea flava.* Mr. Leitner continued to study plants in Florida for a number of years but unfortunately was one of the first casualties in the Seminole Indian War.

More than 30 years passed before the yellow water-lily was again 'discovered' in Florida. In 1877 Mary Treat gave the name *Nymphaea lutea* to specimens she had collected in the state. Then in 1888, Edward Lee Greene named this same plant *Castalia flava.* However, the correct Latin name is *Nymphaea mexicana* Zucc.

The yellow water-lily has also been given the common names yellow Florida water-lily, the Florida species, sun lotus, and banana water-lily.

The yellow water-lily is considered semi-hardy; that is, it cannot survive in areas subjected to prolonged low winter temperatures. Its native range, which formerly included most of Mexico, the Gulf Coast, and the southeastern United States, has been extended due to its introduction as an ornamental plant. It has acclimatized to some of these areas and has now naturalized in eastern North Carolina, and perhaps in several other states.

In South Africa, A. A. Mauve reported in 1968 that a hardy hybrid of the yellow water-lily, which apparently escaped from an aquatic nursery, established itself for several kilometers on both sides of the Vaal River. In this river the plant grew to a depth of about 3 meters. More recently, I. M. Johnstone in 1982 found this plant to be well established in Lake Ohakuri, a large hydroelectric lake on the Waikato River, in New Zealand.

The yellow water-lily grows in a variety of habitats but prefers still to slowly-flowing water sites. In Lake Okeechobee in Florida yellow water-lily plants are abundant along the Moore Haven canal and in other areas throughout the lake. It is also common in roadside ditches throughout Florida.

The first report of the yellow water-lily plant flowering outside its native habitat was in the Spring of 1878 at the Harvard Botanic Gardens, Cambridge, Massachusetts and then in July of 1882, it was recorded at the Royal Botanical Gardens, Kew, England.

All members of the genus *Nymphaea* have four sepals which distinguish them from species of the genus *Nuphar* which has six to nine sepals. Yellow water-lily plants are readily separated from other *Nymphaea* species by their numerous, bright yellow petals.

Long stalks arise from the leaf axils and bear single flowers which may float or be held above the surface of the water. The flowers open shortly before noon and close around 4:00 PM each day. The corolla measures from 6 to 10 cm in diameter when fully open and consists of obtuse to apically acute petals.

Seeds of the yellow water-lily are grayish brown, oblong to oval, 5 to 6 mm long, and 3 mm wide.

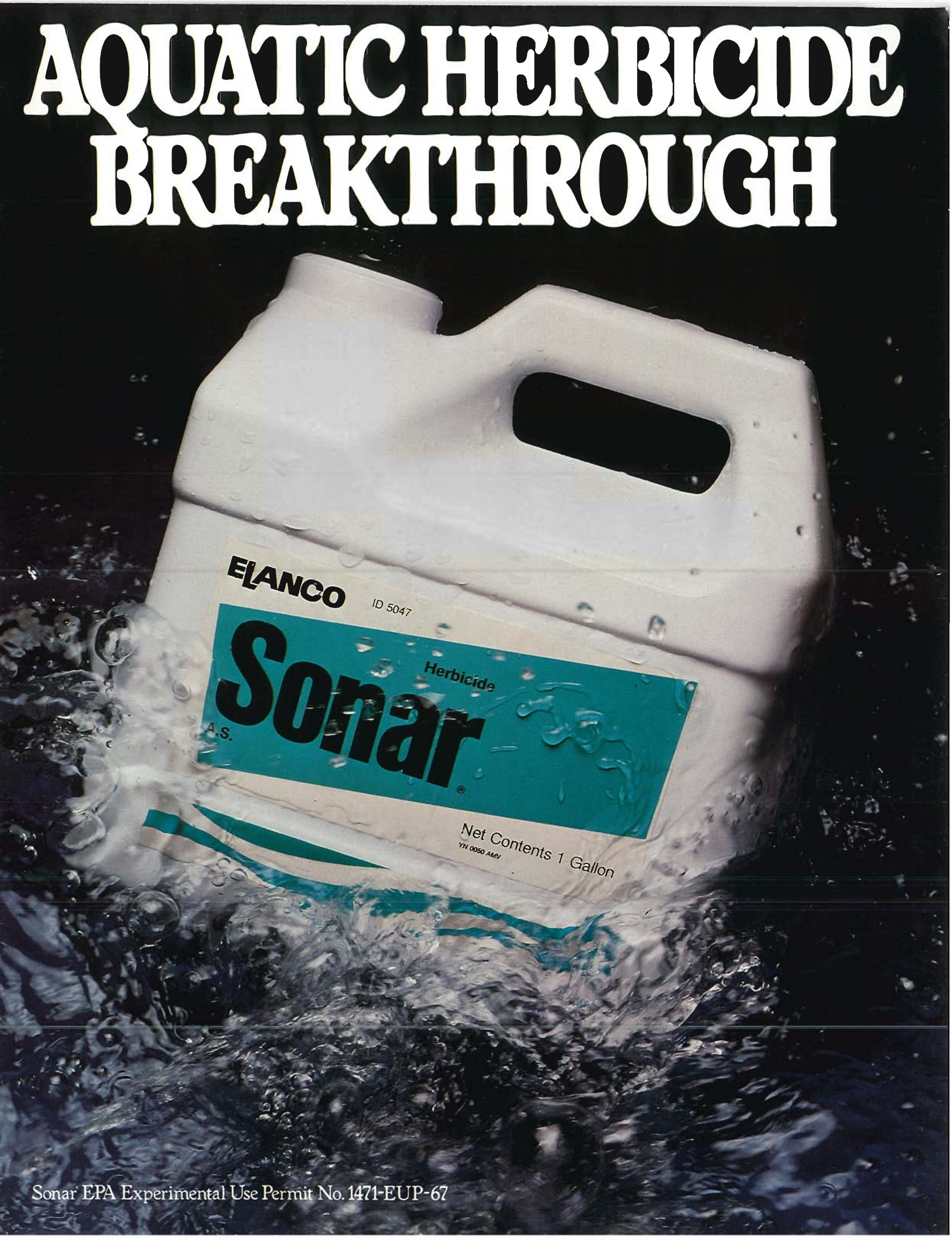
Soft, spongy stolons arise from the rhizomes which are usually short and erect with many fibrous roots. The stolons produce new leaf- and root-bearing rhizomes from nodes.

The stolons extend into the hydrosoil towards the end of the growing season and structures are produced on one side of the node consisting of several upward-pointing buds. A number of curved, fleshy, descending roots are formed on the other side of the node. These over-wintering roots resemble tiny bananas, hence the reason for one of its common names, banana water-lily.

At the beginning of the growing season, buds on the over-wintering structure produce a stolon from which new leaves and roots arise, thus forming a new plant and continuing the growth cycle.

New plants arise from seeds, or stolons during the growing season. The upper part of the rhizome produces stolons under the hydrosoil that elongate up to a meter from

Figure 2. Leaves of the yellow water-lily in winter on Lake Okeechobee showing the mottled colors of green and reddish-purple.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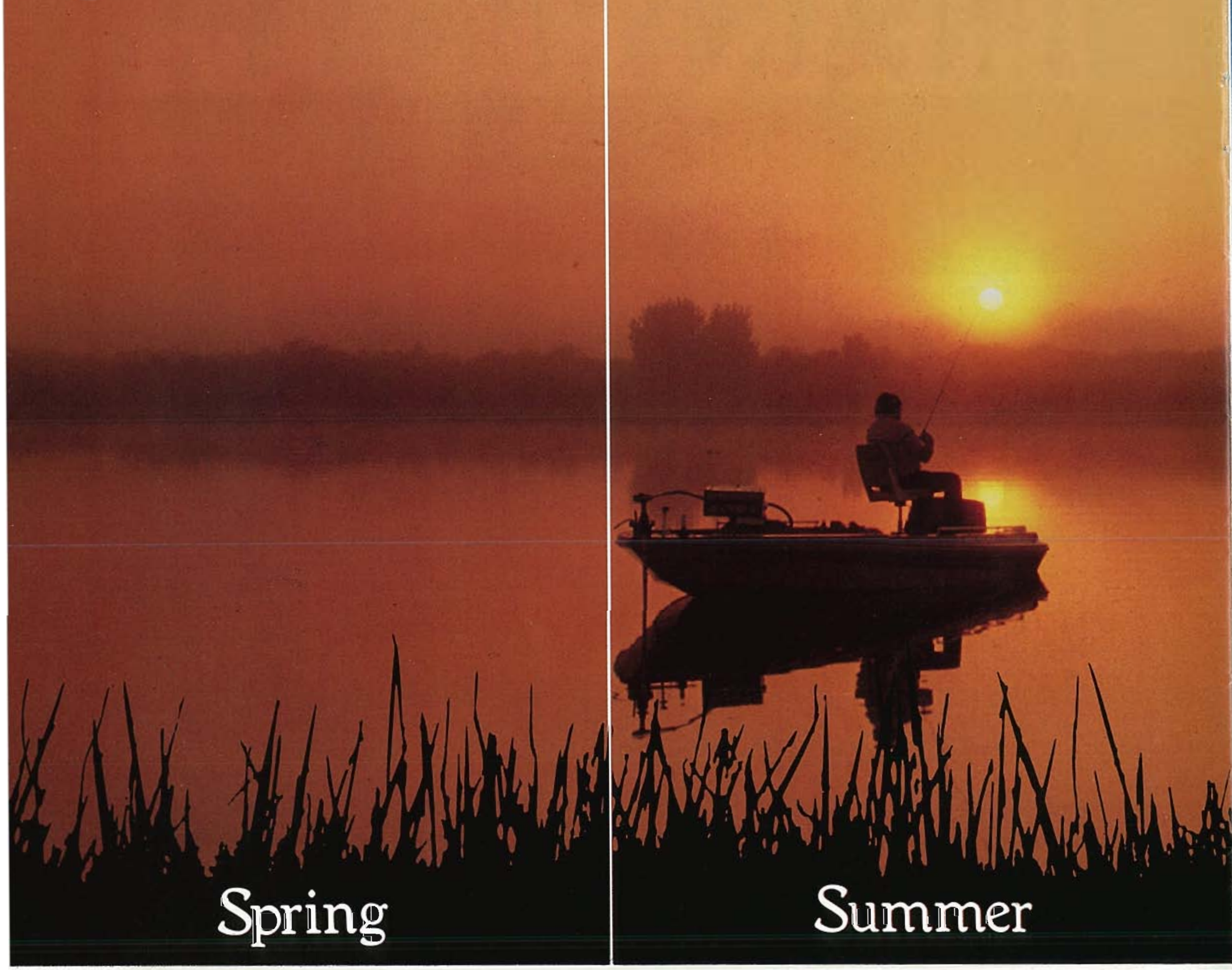

At last there's a new generation aquatic herbicide that manages a host of undesirable vascular plants without mismanaging the good life. Sonar® from Elanco.

Weed management.

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When you make Sonar part of your weed control program, you get effective management of your valuable water resources.

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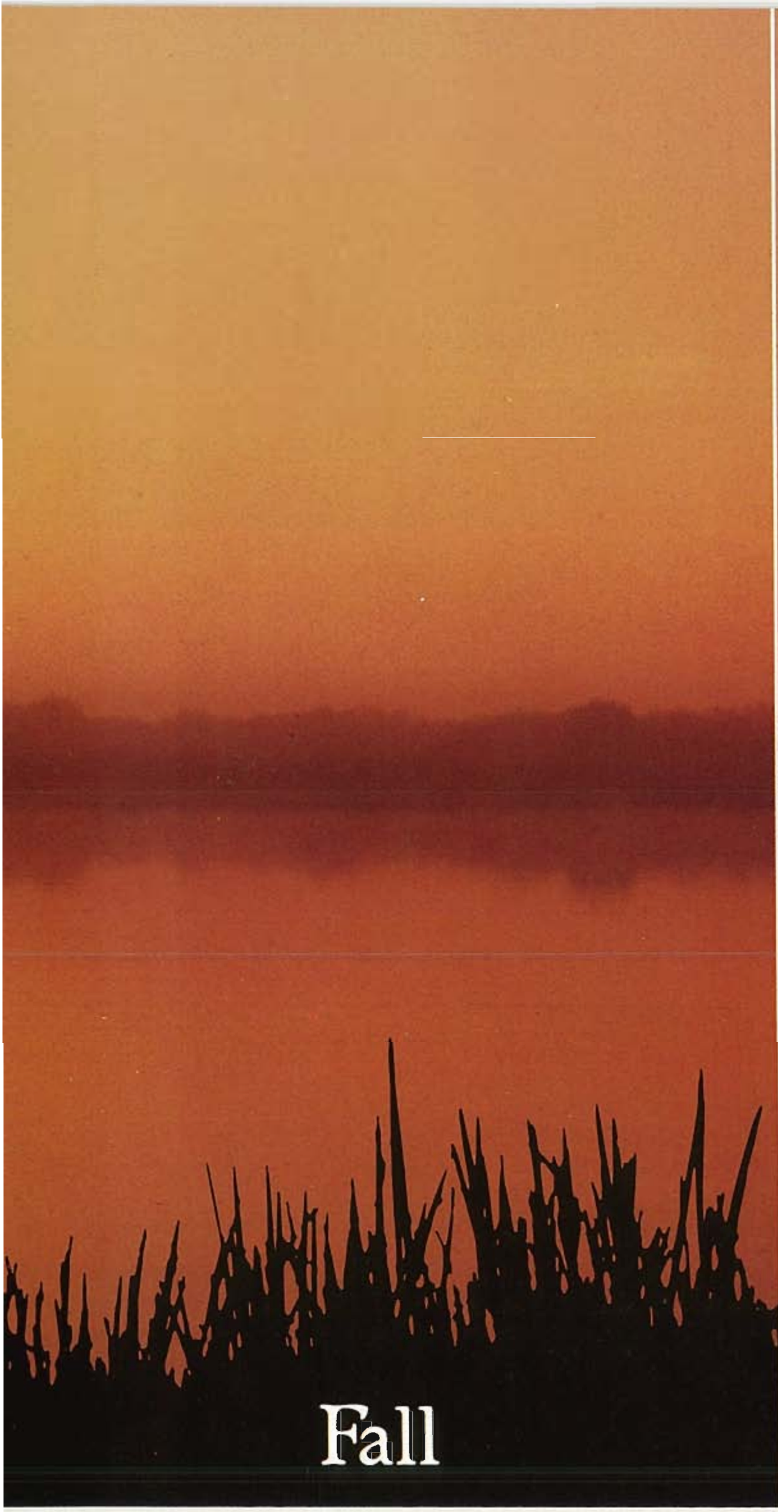
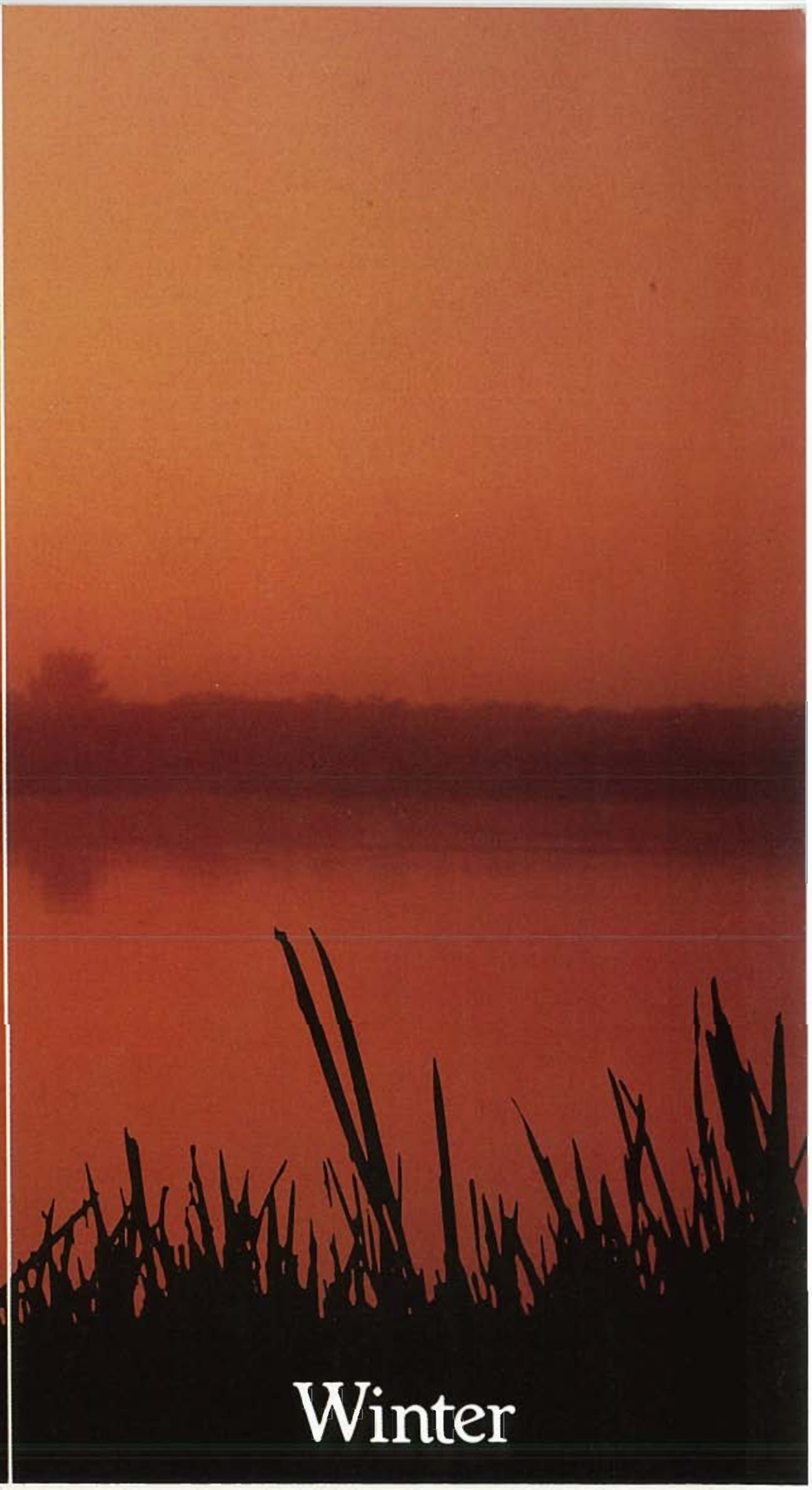
Four to six weeks after treatment, Sonar takes its toll on undesirable vegetation. And because of its slow action, there is no rapid oxygen depletion. This makes Sonar highly compatible with the aquatic environment and makes fish kills a thing of the past. Applied as directed, Sonar will not harm fish,

Elodea

Water milfoil





wildlife, or nearby trees and shrubs.

Flexible application.

Sonar can be applied to the entire surface of a pond or up to ten percent of larger bodies of water. Depending on existing equipment and user preference, Sonar is available as an aqueous suspension or 5% pellet and can be applied any time during the year. For best results, the label recommends applying Sonar when weeds are actively growing.

Pond weeds

Torpedograss

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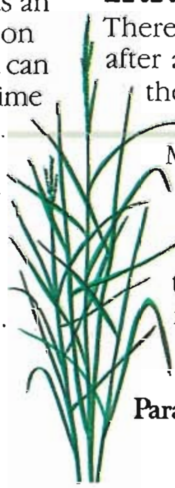
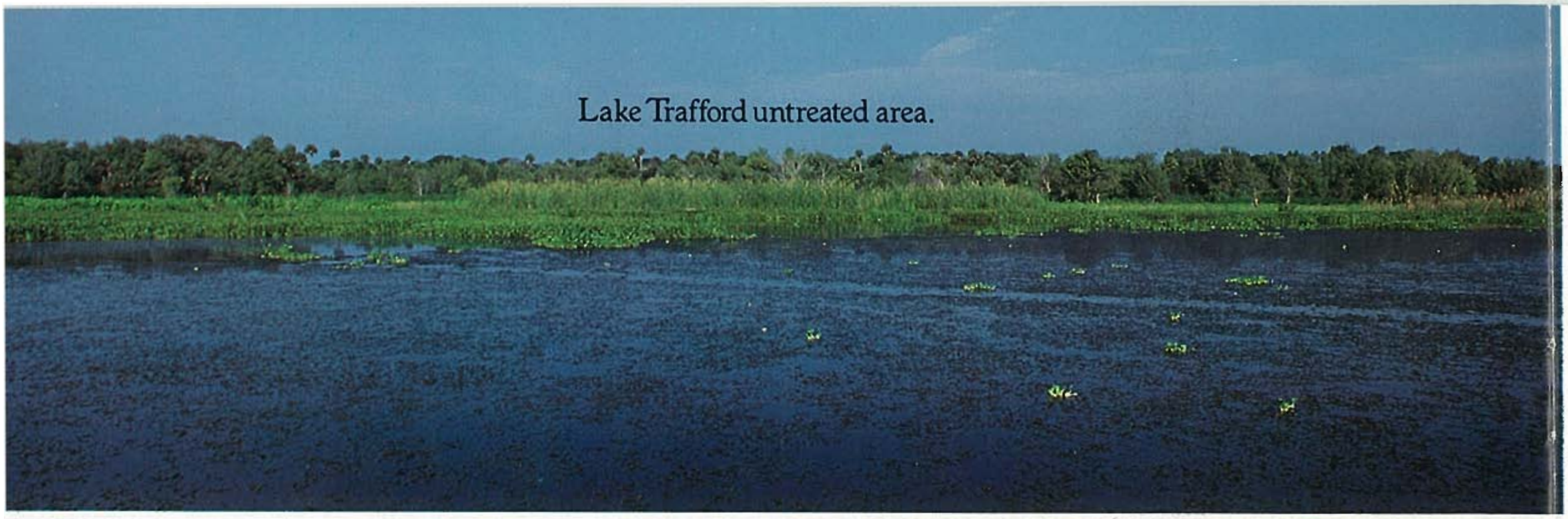
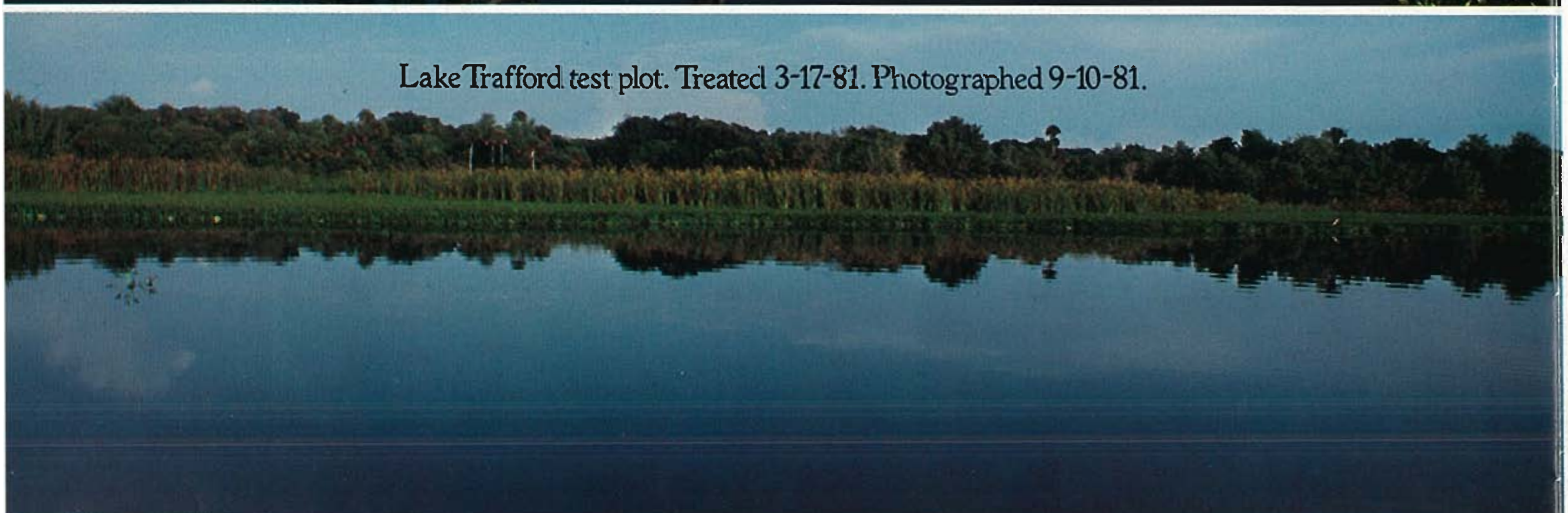
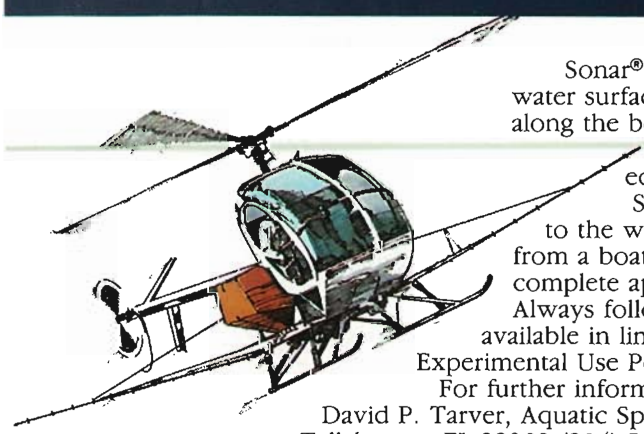


Paragrass


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.

Sonar 5% pellet can be applied to the water surface from the shore or from a boat. Refer to the Sonar label for complete application instructions.

Always follow label directions. Sonar is available in limited quantities under EPA Experimental Use Permit No. 1471-EUP-67.

For further information write or phone:
David P. Tarver, Aquatic Specialist, 2416 McWest Street, Tallahassee, FL 32303 (904) 562-1870

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the parent plant before sending up a terminal bud. The new plant after growing a few weeks produces new stolons, and the original stolon connecting the new plant with its parent dies.

Petioles of the yellow water-lily are slender and flexuous. Leaf blades are ovate-oval to orbicular in their overall outline and 8 to 15 cm when fully developed with margins that are entire to sinuate. The basal sinus, the space between the two lobes of the leaf extending from the point of attachment to the outside edge of the leaf, is generally about one-third the length of the leaf.

The leaf is dark green on top and reddish-purple below during the growing season. In some areas the leaves grow close together during the summer and form a dense canopy which shades other plants growing below them. For example, in Lake Ohakuri in New Zealand, the dense leaf canopy is considered advantageous because it has helped retard growth of less desirable submersed plants. The leaf canopy is not very dense in the winter and the leaves are mottled with colors of green and reddish-purple on the top surface (Figure 2).

The yellow water-lilies may have been fairly abundant in the mid to late 1890's as Mr. A. H. Curtis collected them during this time in North Florida and shipped several hundred a year to aquatic fanciers and nurseries. However, his supply was cut short when many of the areas where he collected this plant were inundated with water hyacinth (*Eichhornia crassipes* [Mart.] Solms.).

Today yellow water-lilies may be increasing in some areas in Florida because of effective management of water hyacinth and other weeds. However, it does not appear they will be a problem in any of the areas in which they are growing. Herbicides which are used to manage growth of other water-lilies would probably be useful for control of the yellow water-lily if it were to become a problem.

Insects and other herbivores may feed on yellow water-lily plants. However, it is not known whether this feeding is a major factor in preventing or reducing growth of the plants.

Studies are needed to determine nutritional requirements of the yellow water-lily and assess environmental factors which promote or discourage its growth. This information will be of value in evaluating its ability to compete with other plants in the aquatic environment.

Yellow water-lilies may be desirable vegetation along margins and shoreline areas of many ponds, lakes, and canals because of their showy flowers and dense leaf canopy. They could potentially become a weed in very shallow and small bodies of water because they may shade out other plants. Therefore, even though the yellow water-lily is indigenous to Florida and does not cause problems in areas in which it is growing, caution should be exercised in transplanting it to new aquatic sites.

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Acknowledgment

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Surgical Sterilization of Grass Carp A Nice Idea

Mr. David H. Clippinger and Dr. John A. Osborne[1]

It is now common knowledge that grass carp (White Amur) have a voracious appetite for submersed aquatic plants and consequently are either feared or admired because of it. Their ability to remove noxious aquatic plants from lentic waters is unquestioned. However, many biologists still question the fate of lotic waters containing grass carp since they are intermittent spawners in such systems. Grass carp have escaped into natural systems and are believed by some to have established natural reproducing populations (Stanley, et al., 1978). Many sexually mature grass carp are presently residing throughout the United States in lake systems. The development of the bighead-grass carp hybrid was one approach to the fertility problem. Due to the failure of this sterile hybrid as a weed control agent, the only recourse that appeared feasible was to return to the grass carp and render it sterile. Hormone and radiation treatments had previously failed to produce gonadal degeneration (Stanley, 1978) and the use of monosex fish had been disallowed as sexually mature individuals, even though of one sex, still presented a potential threat. The best approach seemed to be surgical sterilization.

The surgical procedure to remove fish gonads was first attempted on largemouth bass in June, 1983 at the University of Central Florida. In July, 1983, Dr. Paul Beaty, Coachella Valley Water District, presented a demonstration of the technique he and his coworkers had used to 'sterilize' grass carp for use in California. Their 'sterilized' grass carp were eventually compared to

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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- 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.

peared to have a bacterial infection around the incision (hemmorragic septicema — 28%). In all of the mature grass carp, some regeneration of the gonads was evident while 96.7% of the immature fish had definite regeneration from the cut end of the gonad. In mature male grass carp, many had extended regenerated lobes from the bisected end of the original organs. In many of these fish, the sperm duct was lengthened by the incorporation of swim bladder mesentery to provide the junction and pathway leading to the vent. Forty-four percent of the mature male grass carp flowed milt to the environment. Regeneration of the gonadal tissue appeared more extensive in mature female grass carp with 86.7% having a distinct route for eggs to pass to the environment during ovulation. All mature female grass carp regenerated ovarian membranes. Regrowth of the ovaries incorporated the body cavity peritonenum and support mesenteries of the intestine. The regenerated ovarian structures followed the path of the original ovaries which were positioned beneath the digestive system and attached along side the swim bladder. In most cases, the regenerated sections of the ovaries were distinctly abnormal in comparison to the normal condition. When mature females could not pass eggs to the environment, a membrane or adipose plug blocked the oviduct near the vent. At the time of the examination of the grass carp in May, immature female and male grass carp could be differentiated; 65.5% of the immature males and 57.4% of the immature females had open pathways for gametes.

To determine if oogenesis in regenerated ovaries would produce viable eggs, six mature female grass carp were chosen at random and spawned using hormone injections to induce ovulation (HCG, LHRH and carp pituitary hormone). Four of the six females ovulated successfully while all showed signs of egg hydration (reaction to the hormones). Eggs expelled during ovulation were dry fertilized and cultured in flowing water aquaria. For the most part, all of the eggs water hardened, hatched and developed into fry. Egg development and fry maturation appeared normal (Sion and Sukhanova, 1972). An estimated 20,000-30,000 fry were raised from the four 'sterilized' female grass carp.

Even though the procedure for sterilizing' grass carp was simple and imparted no mortality; the final product produced viable eggs and normal fry. Consequently, this method of sterilization has quickly become just another one of those nice ideas. □

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Evaluation of 2,4-D/Adjuvant Mixtures In Flowing Water

by

Kurt D. Getsinger

U.S. Army Engineers Waterways Experiment Station

INTRODUCTION

The invasion of nuisance submersed aquatic plants into rivers, streams, and canals has prompted interest in techniques for managing these plants in flowing water. One approach is to use chemical herbicides and herbicide/adjuvant mixtures. Adjuvants are designed to hold herbicides on the surface of leaves and stems, thus enhancing herbicide uptake into plant tissues. Examples of adjuvants are surfactants, wetting agents, oils, stickers, spreaders, thickening agents, and emulsifiers.

For a herbicide to be effective, some minimum concentration of that herbicide must be maintained near the target plant, either in the sediment or in the water column, for some minimum contact time. Contact time presents a problem in flowing water because the water column is continuously moving and herbicides released into the water at one point are transported downstream. Herbicide/adjuvant mixtures have been used effectively for controlling submersed plants in still-water; however, only limited data are available on their use in flowing water. A primary concern is the length of time adjuvants can hold herbicides in the vicinity of the target plant in flowing water.

This study was designed to determine which herbicide/adjuvant mixtures show potential in controlling submersed weeds in typical stream flow velocities and to compare the control achieved by these mixtures with results using conventional herbicide formulations. The submersed species Eurasian watermilfoil *(Myriophyllum spicatum L.)* and mixtures of the herbicide 2,4-D with various adjuvants were included in the initial studies. Eurasian watermilfoil was used as the target plant because it is rapidly spreading throughout flowing water systems in the West and in the Pacific Northwest. The herbicide 2,4-D was selected because of its proven efficacy on Eurasian watermilfoil. Adjuvants used in the initial phases of the study included the inverting oil/emulsion Asgrow 403 and the polymer Polycontrol.

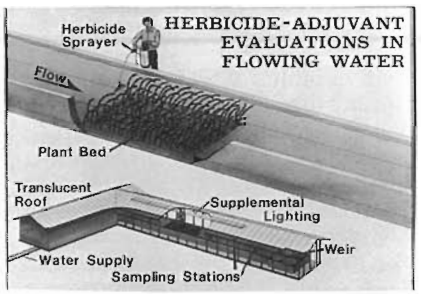

Figure 1. Flume system set up to evaluate herbicide/adjuvant mixtures in controlling aquatic plants in flowing water.

Approach

Herbicide/adjuvant experiments were conducted in a modified hydraulic flume. A schematic of the flume system is shown in Figure 1. A section of the flume channel was divided lengthwise into two equal areas (0.8-m wide × 0.9-m deep) to accommodate duplicate experiments (not depicted in schematic). Individual plant shoots, collected in the field, were cut into 15 cm lengths and planted in shallow polyethlene flats (23-cm wide × 32-cm long × 10-cm deep) and filled with a sand/mud mixture. These flats were arranged in outdoor holding tanks (21 flats per tank) to produce plant stands, ~ 3 m long, and 0.8 m wide consisting of over 1000 shoots each. The plant stands were allowed to grow in the holding tanks for 3-4 weeks to a height of ~ 70 cm. The flats of plants were transferred to the flume several days prior to testing. Greenhouse roof panels (90-percent transmittance) covered the plant stands in the flume and supplemental lighting was available, if needed.

Herbicide/adjuvant formulations were applied directly to the plant stands with techniques similar to those used in the field. Water samples were collected 2 m downstream from the plant stands by automatic samplers and were analyzed for herbicide residues. Experiments were run at velocities ranging from 1.5 to 30 cm/sec (0.05-1 ft/sec).

Initial Studies

The first herbicide/adjuvant formulation to be evaluated was an invert emulsion consisting of an inverting oil (Asgrow 403) and 2,4-D DMA (Weedar 64). This formulation was compared with: a) a liquid formulation of 2,4-D DMA (Weedar 64); b) a pelletized formulation of 2,4-D BEE (Aqua-Kleen) and; c) a noninvert mixture of Asgrow 403, 2,4-D DMA, and water.

All formulations were prepared to give a 2,4-D treatment rate of 45 kg acid equivalent (ae)/ha.

Both the invert emulsion and the noninvert mixture consisted of a ratio of 7 parts water to 1 part inverting oil and were prepared using a Minnesota Wanner (MW) Invert Pump Pak designed for aquatic spraying. The principal components of this system included a Briggs & Stratton 11-hp engine, a Wanner 10-gpm positive displacement piston pump, and a MW mechanical inverter.

The quality of an invert is related to a number of mechanical and environmental factors. Selecting appropriate metering orifices for water, herbicide, and inverting oil; maintaining adequate pressure; and eliminating fitting and line air leaks are critical for blending a good invert when using the MW Invert Pump Pak. Trace chemicals in the water used in blending an invert emulsion may also affect the quality of the invert. A deficiency in any one of these factors can result in a poor invert.

When prepared correctly, an invert emulsion consists of water surrounded by oil and has a mayonnaise-like consistency. The herbicide is dissolved within the water phase of the emulsion. Inverts have the appearance of snow flakes when sprayed under the surface of the water and flakes of invert stick to leaves and stems of submersed plants.

A poor invert mixture (non-invert) has a thin milky consistency, in contrast to the thick consistency of a desirable invert. Field applicators have implied that some confusion still exists concerning the consistency of a desirable invert emulsion. With that in mind, the invert emulsion and the noninvert mixture used in these initial studies were prepared with identical water sources, herbicides, and calibrated equipment.

The invert emulsion and the noninvert mixture were ejected from the MW Pump Pak into a 19-l plastic bucket. The formulations were transferred to a 7.6-ℓ pressurized pot and sprayed below the surface onto the plant beds at 20 psi using a hand-held wand with a flat-fan nozzle. The liquid 2,4-D DMA formulation was also applied on the plants using the pressurized-pot system. The pelletized 2,4-D BEE was broadcast over the surface of the plant beds by hand.

Stream velocity was set at 1.5 cm/sec (0.05 ft/sec) or 3 cm/sec (0.1 ft/sec) with a water depth of 70 cm. Each formulation was applied on duplicate plant beds. Water samples representing the top three-fourths of the water column were collected 2 m downstream from each plant bed at 2-min intervals for 60 min or 180 min after treatment. Samples were composited to represent 12-min periods and analyzed for 2,4-D residue.

Results

Water samples collected 5 m upstream from each plant bed during experimental runs showed no herbicide contamination.

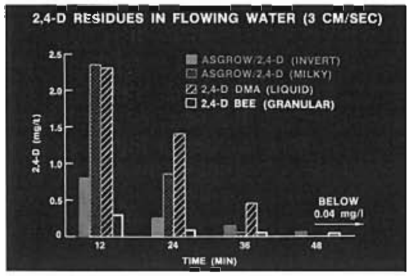

Figure 2. Effect of time on 2,4-D residues 2 m downstream of plant beds when using Asgrow 403/2,4-D, 2,4-D DMA and 2,4-D BEE.

Herbicide residue data (Figure 2) demonstrated that the noninvert mixture and the liquid 2,4-D DMA formulation released 2,4-D into the water in a similar fashion at a 3 cm/sec flow velocity. Both formulations released a large pulse of herbicide during the first 12 min, with herbicide residues below detection after 48 min. In contrast, the invert emulsion and the pelletized 2,4-D BEE formulation showed slower herbicide release rates, but herbicide resides dropped below detection 60 min after treatment.

The second herbicide/adjuvant formulation to be evaluated was a combination of the polymer Polycontrol (2.5%) and 2,4-D DMA (Weedar 64) prepared to deliver at a rate of 45 kg ae/ha. This polymer/2,4-D formulation was compared with a 2,4-D DMA treatment (45 kg ae/ha). The Polycontrol and 2,4-D DMA formulations were blended with a stirring motor and applied on duplicate plant beds with the pressurized-pot system. Herbicide residue data from the Polycontrol test showed a wash-out of 2,4-D from the polymer within 72 min posttreatment at 3 cm/sec, however, at a 1.5 cm/sec flow velocity detectable levels of 2,4-D were found at post-treatment 180 min (Figure 3).

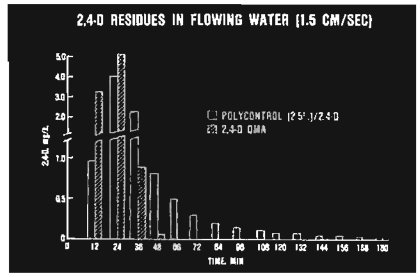

Figure 3. Effect of time on 2,4-D residues 2 m downstream of plant beds when using Polycontrol/2,4-D and 2,4-D DMA.

These initial data suggest that inverts and polymers may only hold 2,4-D for short periods of time when used in flowing water with a velocity ⩾ 3 cm/sec (0.1 ft/sec).

Future Studies

Evaluation of 2,4-D DMA mixed with other inverts and polymer adjuvants and applied in flowing water will continue at the Waterways Experiment Station for the next several years. Herbicides such as diquat and endothall will also be mixed with various adjuvants and tested in the flume system. □

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Fish Harvest Resulting From Mechanical Control of Hydrilla[1]

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Abstract

Mechanical harvesting of the submersed weed hydrilla, *Hydrilla verticillata* (L.F.) Royle, in Orange Lake, Florida entangled fish in the cut vegetation resulting in their disposal with the weeds on shore. Three block-net samples in dense hydrilla indicated fish standing crops (mean ± SD) of 205,000 ± 35,000 fish/hectare and 460 ± 30 kg/hectare. The estimated loss of fish to mechanical harvesting represented 32% of fish numbers and 18% of fish biomass. Fish most susceptible to mechanical removal with hydrilla were juvenile sportfish and smaller species. The monetary replacement value of the fish lost was estimated at over $6,000/hectare.

[1] Journal Series Number 2165 of the Florida Agricultural Experiment Station.

The exotic submersed aquatic plant hydrilla, *Hydrilla verticillata* (L.F.) Royle, has spread in the past 20 years into nearly every area of Florida and into several other states. Hydrilla forms a dense, entangled surface mat and rapidly dominates the native aquatic flora (Haller and Sutton 1975). In 1977, an estimated 9.1 million dollars were spent in Florida for hydrilla control programs (Haller 1979). Hydrilla is usually controlled with herbicides, but mechanical means are being used more frequently.

The majority of research on mechanical harvesting of aquatic weeds has involved engineering design and cost efficiency estimates (Bryant 1970; Koegel et al. 1977; Johnson and Bagwell 1979). Recent studies have evaluated the effects of mechanical harvesting on the nutrient budgets and water quality of Lakes (Wile 1978).

Orange Lake is a shallow (mean depth = 3 m) 5,000 hectare lake 30 km south of Gainesville, Florida. Before hydrilla was introduced in 1971, the predominant littoral plants were species of *Nuphar, Ceratophyllum*, and *Cabomba.* Low water levels from 1974 through 1978 favored the expansion of hydrilla, which covered 90% of the lake by the summer of 1977.

Methods

The mechanical harvesting operation utilized a harvester for cutting and picking up vegetation, a transporter for moving the vegetation to shore, and a shore conveyer which elevated the vegetation from the transporter to a dump truck.

In September 1977, three swaths 2.3 m wide, 1.5 m deep, 94, 162, and 230 m long, were harvested from an undisturbed hydrilla bed 500 m from shore in waters between 1.5 and 2 m deep. The harvester operated at 3-4 km/hour. After each swath was harvested, the vegetation was loaded onto the transporter and conveyed on shore into a dump truck. The vegetation from each load was weighed with a tared truck on truck scales, dumped, and hand-sorted for separation of fish. Fish were placed on ice and later separated into species and size classes, which were counted and weighed.

A population estimate of the fish in unharvested hydrilla was determined from three 0.08-hectare block-net samples. Nets were set in 1.5-2 m deep, undisturbed stands of hydrilla (similar to the harvested sites), and the lead lines were pushed into the sediment. Approximately 300 live fish, common to the lake, were captured by electrofishing, marked by fin clip, and released into each block net to determine recovery rates. Rotenone (2 mg/liter) was uniformly applied inside the nets through the vegetation with outboard motors. All fish coming to the surface were picked up over a 3-day period.

Results and Discussion

The block-net samples contained 20 species, of which sunfish made up 52% of the fish numbers and 57% of fish biomass (Table 1). The population estimate (210,000 fish weighing 460 kg/hectare) is similar to other fish population studies of dense submersed vegetation (Barnett and Schneider 1974). In general, this habitat contains a high population of both juvenile sportfish and small forage fishes (darters, gambusia, topminnow et cetera). The calculated average weight of the fish in the block-net samples was 2.2 g/fish.

The three loads of hydrilla, from which the fish were separated, weighed 540, 826, and 1,415 kg. The estimated hydrilla biomass (25,000 ± 240 kg/hectare) in Orange Lake is similar to previous estimates of dense hydrilla infestations (Haller and Sutton 1975).

Generally, the proportion of fish species removed with the harvested vegetation reflected their relative abundance in the block-net population estimate. Warmouth, for example, accounted for 18% of the estimated fish population, and 11% of the harvested species. The biomass of warmouth in the population estimate and in the harvested fishes constituted 21% of each sample.

Sunfish were dominant by weight and number in the block-net population estimate. They were also dominant in the harvested fish biomass (51 kg of a total 85 kg harvested/hectare), but were not dominant by number. Nearly half (49%) of the fish removed with the vegetation were bluefin killifish. The occurrence (130/hectare) of creel-size (>45 g) sunfish accounted for much of this group's weight dominance in the harvested hydrilla samples. Sunfish; were the only creel-size fish captured by the harvester during this study; however, large chain pickerel, largemouth bass, black crappie, and other large fishes were commonly collected with the vegetation in the harvesting operation.

The 66,000 harvested fish represented 32% of the standing crop by number and 18% by weight. The harvester selectively removed smaller fish. With one exception (redear sunfish), the percent fish loss to hydrilla harvesting was greater by number than by weight, evidence that larger numbers of

Table 1.—*Standing fish crops from block-net samples in hydrilla beds and quantities of fish lost during mechanical hydrilla harvesting in Orange Lake, Florida. Species are listed in the order of their numerical abundance in block-net samples.*

Species	Number/hectare ± SD (% of total)		Weight (kg)/ hectare ± SD (% of total)		Percent fish loss to hydrilla harvest	
	Block-net samples	Harvested samples	Block-net samples	Harvested samples	Number	Weight
Bluegill *Lepomis macrochirus*	43,000 ± 15,000 (21)	9,200 ± 400 (14)	110 ± 23 (24)	21 ± 4 (25)	21	19
Warmouth *Lepomis gulosus*	36,000 ± 9,800 (18)	7,100 ± 1,200 (11)	96 ± 7.5 (21)	18 ± 5 (21)	20	19
Bluefin killifish *Lucania goodei*	36,000 ± 14,000 (18)	32,000 ± 3,000 (49)	7.5 ± 2.9 (2)	4.6 ± 0.4 (5)	89	61
Redear sunfish *Lepomis microlophus*	27,000 ± 10,000 (13)	6,000 ± 600 (14)	53 ± 15 (12)	12 ± 8 (15)	22	23
Golden shiner *Notemigonus crysoleucas*	25,000 ± 8,000 (12)	1,800 ± 500 (3)	56 ± 16 (12)	3.4 ± 1.5 (4)	7	6
Black crappie *Pomoxis nigromaculatus*	15,000 ± 7,700 (7)	3,600 ± 1,000 (6)	24 ± 12 (5)	5.7 ± 1.5 (7)	24	23
Swamp darter *Etheastoma fusiforme*	9,700 ± 5,600 (5)	2,100 ± 400 (3)	3.2 ± 1.9 (1)	0.6 ± 0.1 (<1)	22	19
Bluespotted sunfish *Enneacanthus gloriosus*	4,000 ± 4,300 (2)	800 ± 500 (1)	5.3 ± 5.7 (1)	0.9 ± 0.4 (1)	20	17
Mosquitofish *Gambusia affinis*	3,500 ± 1,100 (2)	1,800 ± 700 (3)	0.9 ± 0.3 (<1)	0.2 ± 0.1 (<1)	51	22
Taillight shiner *Notropis maculatus*	1,400 ± 1,300 (1)	20 ± 30 (<1)	0.9 ± 0.9 (<1)	<0.01	1	10
Brook silverside *Labidesthes sicculus*	1,200 ± 800 (1)	80 ± 60 (<1)	0.9 ± 0.5 (<1)	<0.1	7	
Golden topminnow *Fundulus crysotus*	1,200 ± 900 (1)	500 ± 100 (1)	1.1 ± 0.6 (<1)	0.2 ± 0.1	42	18
Largemouth bass *Micropterus salmoides*	1,000 ± 200 (1)	300 ± 100 (1)	12 ± 0.4 (3)	2.5 ± 0.4 (3)	30	21
Lake chubsucker *Erimyzon sucetta*	300 ± 200 (<1)	100 ± 100 (<1)	30 ± 12 (7)	1.2 ± 1.0 (1)	33	4
Brown bullhead *Ictalurus nebulosus*	200 ± 300 (<1)	30 ± 20 (<1)	5.3 ± 9.1 (1)	0.4 (<1)	15	8
Chain pickerel *Esox niger*	200 ± 100 (<1)	50 ± 50 (<1)	30 ± 11 (6)	2.8 (3)	25	9
Gizzard shad *Dorosoma cepedianum*	100 ± 200 (<1)	0	0.4 ± 0.6 (<1)	0	0	0
Florida gar *Lepisosteus platyrhincus*	40 ± 20 (<1)	30 ± 20 (<1)	23 ± 17 (5)	11 ± 5 (12)	75	48
Dollar sunfish *Lepomis marginatus*	30 ± 60 (<1)	40 ± 75 (<1)	0.1 ± 0.1 (<1)	0.1 (<1)	133	100
American eel *Anguilla rostrata*	4 ± 7 (<1)	0	2.2 ± 3.7 (<1)	0	0	0
All species	205,000 ± 35,000	66,000 ± 2,000	460 ± 30	85 ± 19	32	18
Total sportfish	122,000 ± 19,000 (60)	26,000 ± 3,000 (39)	335 ± 14 (73)	61 ± 12 (72)	21	18
Creel-size sportfish[a]	360 ± 76	130 ± 90	6,318 (14)	13 ± 5 (15)	36	21

[a] Creel (harvestable) sportfish as determined by Swingle (1950). Only harvestable *Lepomis* species were captured by the harvester in this study.

small fish were being harvested. The average weight of harvested fish was 1.3 g, versus 2.2 g in block-net samples. The majority of fish harvested were young of the year, particularly with respect to sportfishes (D. DuRant, unpublished data).

An index of fish loss to hydrilla harvesting is the ratio (in percent) of fish in the cut hydrilla to that in the block-net samples. Four species were harvested in excess of half their estimated populations: bluefin killifish 89% by number and 61% by weight, mosquitofish 51% by number, Florida gar 75% by number, and dollar sunfish 133% by number and 100% by weight. These species are generally found in association with littoral vegetation rather than in open water. It is surmised that they sought cover in the vegetation when the harvester approached and consequently became entangled in the vegetation.

Three species — golden shiner, brook silverside, and taillight shiners — although abundant in the block-net samples, were not readily collected by the harvester. It is possible that these species, when disturbed by the harvester, swim out of the immediate area and thus avoid removal with the vegetation. Seven species, particularly the sunfishes, were almost equally removed with the cut vegetation. Bluegill, warmouth, redear sunfish, black crappie, swamp darter, bluespotted sunfish and largemouth bass all were harvested at rates between 20 and 30% of their population by number and 17 to 23% by weight.

Nearly all the data in this study are compared to the estimated standing crop of fish in dense hydrilla as determined by block nets. Maximum effort was given to accurately determine the fish population by using small nets (0.08 hectare), mark-recapture correction factors, 20 to 30 hours of pickup per net, and stirring of the vegetation by outboard motor.

All fish species commonly collected by electrofishing were placed in several nets of which this study is a portion. The recovery data from 18 block nets is currently being prepared for publication of a study similar to that of Grinstead et al. (1978). Recovery of finclipped fish (percent) in this study varied from 7.3% (brook silverside) to 81.3% for redear sunfish (D. Durant, unpublished data).

The block-net population estimate likely underestimates the population of small bluefin killifish, mosquito fish, and fishes of similar size. Marked fish of these species were larger than some individuals occurring in the nets (marking of small individuals of each species was not feasible) and their recovery rate would be slightly higher. To a lesser extent, estimates of fish removed by the mechanical harvester also are conservative because the 25-mm² mesh conveyer belts on the harvester, transporter, and conveyer allow some fish to fall onto the barge in inaccessible areas and on the ground under the conveyer.

Mechanical control of nuisance aquatic vegetation generally is considered more environmentally sound than chemical control. As well as reducing the use of herbicides, physical removal of plants removes nutrients and is generally thought to improve water quality. However, mechanical weed control has not been subjected to the same environmental scrutiny or regulation as chemical control. Regulations pertaining to mechanical control apply only to those activities defined as dredge-and-fill operations.

In contrast, agencies charged with the enforcement of pollution control and abatement laws frequently levy replacement charges for fish killed by applications of weed-control chemicals. If the mechanical weed control operation in Orange Lake, which involved 65 hectares overall, had been conducted by chemical means and the same number of fish had been killed as were harvested, the assessed value of these fish would have been over $410,000 based on current fish replacement values (Pollution Committee 1975).

This study shows that mechanical control of aquatic weeds can have direct and measurable impacts upon fisheries resources. The Orange Lake control program was small (65 of 5,000 hectares harvested), so its lakewide impact probably was minor. However, very significant changes in fish populations could occur in smaller lakes in which mechanical harvesting removes vegetation from the entire lake two or three times in a growing season.

There is potential for greater environmental damage by mechanical aquatic weed control programs than previously believed. As aquatic weed problems increase it is becoming more apparent that various control methods have both advantages and disadvantages. Their separate benefits and risks must be considered before a weed control program is begun.

Acknowledgments

We appreciate the assistance of T. Van, M. Glenn, and J. Carter in sorting the fish from the harvested vegetation. The cooperation of the Corps of Engineers and the contribution of truck scales by the Florida Highway Patrol made this study possible. D. Colle, J. Joyce, and L. Garrard critically reviewed and improved the manuscript. □

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Mimosa pigra — Armed and Dangerous?

by Deborah White

During the past ten years, *Mimosa pigra*, an armed leguminous shrub, has become one of the worst weeds of tropical and subtropical regions. It has been the subject of symposia and the bane of third world aquatic weed programs. A native of Central America, its distribution now extends from Mexico and the Americas across the equator to the old world tropics and northern Australia. Recently, populations of *M. pigra* were documented in central Florida where it is established along lake margins. The discovery of this noxious weed in Florida represents another serious threat to natural areas of this state.

Mimosa pigra, or commonly the giant sensitive plant, is a 1-4 m tall shrub. Recurved prickles and spines are scattered on its arching branches and bipinnate leaves. These armed stems, the open growth architecture as well as its thicket forming growth habit enable this plant to form impenetrable barricades in ruderal habitats. The leaves are pubescent, "sensitive" (meaning the leaflets fold upon touch) and have 6-16 pairs of leaflets or pinnae each with 20-30 pairs of sub-leaflets. The inflorescence of the sensitive plant is an axillary head appearing globose due to the exerted pink stamens of the individual flowers.

The dispersal mechanism of this species is another major reason for its rapid spread. Clusters of oblong flat legumes break transversely into one seeded sections, leaving the sutures as an empty frame. The seeds are covered with hooked hairs and are slightly unflated until the coat rots. This is an ideal seed morphology for dispersal success via water, wind or by hitching to moving objects. One of these natural mechanisms was likely responsible for the Florida introduction since both Mexico (the Yukatan peninsula) and the West Indies, which support populations of this Mimosa, are known distributional routes for plants. In tropical climates, it is reported *Mimosa pigra* can produce seeds twelve times per year. A mature plant can produce an average 42,000 seeds per year! Seeds collected from the Florida population began germinating after four days and these seedlings are now well established in Florida sandy muck.

Quick colonization of ruderal habitats complements the giant sensitive plant's superb dispersal mechanism. Secondary growth forests and recently disturbed areas are becoming increasingly common everywhere, whether they be a result of land use practices and/or temporary drought. Areas where *Mimosa pigra* is particularly aggressive include: 1) the "soak" zone and exposed margins of lakes and rivers 2) irrigation systems and unused wet agricultural or grazing lands 3) secondary growth forest 4) roadsides. Once established this plant can withstand almost total submergence, readily forming adventitious roots on aerial and submerged stems. Increased sedimentation around these colonies and subsequent water flow obstruction, the formation of armed barricades in wetlands, and competition with native and cultivated species are a few of the compelling problems created by this species.

The shrub was introduced into Thailand from Central America in the 1960's as a cover crop and for erosion control plantings. Its distributional explosion from these areas is a result of the intense use of the waters in this region by local people. Native people have also developed uses for the plant as firewood and in medicines so these local pressures must be considered in management schemes.

Various control measures have been investigated. Normal agricultural practices discourage Mimosa invasion in upland areas. Many tropical regions depend on manual, labor intensive controls and here cutting and burning strategies have been tried. These measures are mostly ineffective because of rapid regrowth. Herbicides currently used for control of *Mimosa pigra* are 2,4,5-T, picloram and 2,4,5-T, glyphosate, fosamine, and hexazinone for spot soil treatment. Also, biocontrols, education programs, and integrated management programs have been initiated.

There is no doubt that Florida does not want another weed problem. With recent legislation and studies on Florida wetland systems, we now better understand the significance of these areas. *Mimosa pigra* var. *pigra* was recently included on the federal Noxious Weed List (7 CFR Part 360) based on its presence in this state. Investigations of Florida's population will hopefully ensue to assess the potential of this species and to help solve this international dilemma. For more information on *Mimosa pigra* write:

Mimosa Bulletin
Center for Aquatic Weeds
7922 NW 71st Street
Gainesville, FL 32606 □

History of Aquatic Weeds In Lake Seminole

by A. K. Gholson, Jr.*

Continued from September issue of *Aquatics* Magazine

1973

Spray operations were continued in an effort to prevent the rapid expansion of water hyacinths.

Observations indicated that Hydrilla was moving to many new areas of the lake; that approximately 4,500 acres of Eurasian watermilfoil existed in the Spring Creek Arm of Lake Seminole; and that giant cutgrass continued to expand and to infest new areas.

1974

Spray operations continued to prevent spread of water hyacinths.

Observations this year revealed that Hydrilla infested approximately 50 acres, with some infestations being in 25-30 feet of water; that Eurasian watermilfoil infested 5,000 acres; and that giant cutgrass infested 1,600 acres.

*Retired Resource Manager, Recreation-Resource Management Branch, Operations Division, U.S. Army Corps of Engineers, Mobile, Alabama Lake Seminole).

1975

Application of 4,000 pounds of "Hydout" was applied to 16 acres in Seminole State Park, Lake Seminole's most heavily used area. Dust from the "Hydout" granules caused irritation of eyes and exposed skin areas of those making the application. Protective gear was employed, but it proved to be too bulky and extremely hot. Seasonal control of the *Hydrilla* was obtained, however.

An experimental plot of giant cutgrass was treated with "Roundup" with promising results.

Twenty-six acres of Eurasian watermilfoil were treated with "Aqua-Kleen" with fair results.

1976

This year observations indicated phenomenal expansion of giant cutgrass, Eurasian watermilfoil, and *Hydrilla*. Control efforts appeared to be futile on all fronts, with only seasonal or subseasonal relief at best.

1977-78

Early on in 1977, a realistic appraisal of Lake Seminole's aquatic problems, and control efforts, was made. Results of this appraisal indicated that problem aquatic vegetation was gaining ground at a phenomenal rate, and that control efforts were very expensive with only seasonal or subseasonal success at best, and that a more comprehensive approach to control was mandatory.

It was determined that during this period Lake Seminole's aquatic plant problem consisted of the following species and acreages:

a. Giant cutgrass (*Zizaniopsis miliaceae*) — 5,800 acres
b. Hydrilla (*Hydrilla verticillata*) — 1,500 acres
c. Eurasian watermilfoil (*Myriophyllum spicatum*) — 8,000 acres
d. Water hyacinth (*Eichornia crassipes*) — 800 acres.

1979-1983

Control efforts during this period were more comprehensive, better planned, and more effectively carried out. However, only seasonal control of the lake's major problems was obtained.

Overall evaluation of Lake Seminole's aquatic plant problems, and control efforts, revealed that the problems become increasingly larger each year.

In mid 1983, it was determined that Lake Seminole's aquatic problems had increased to the following:

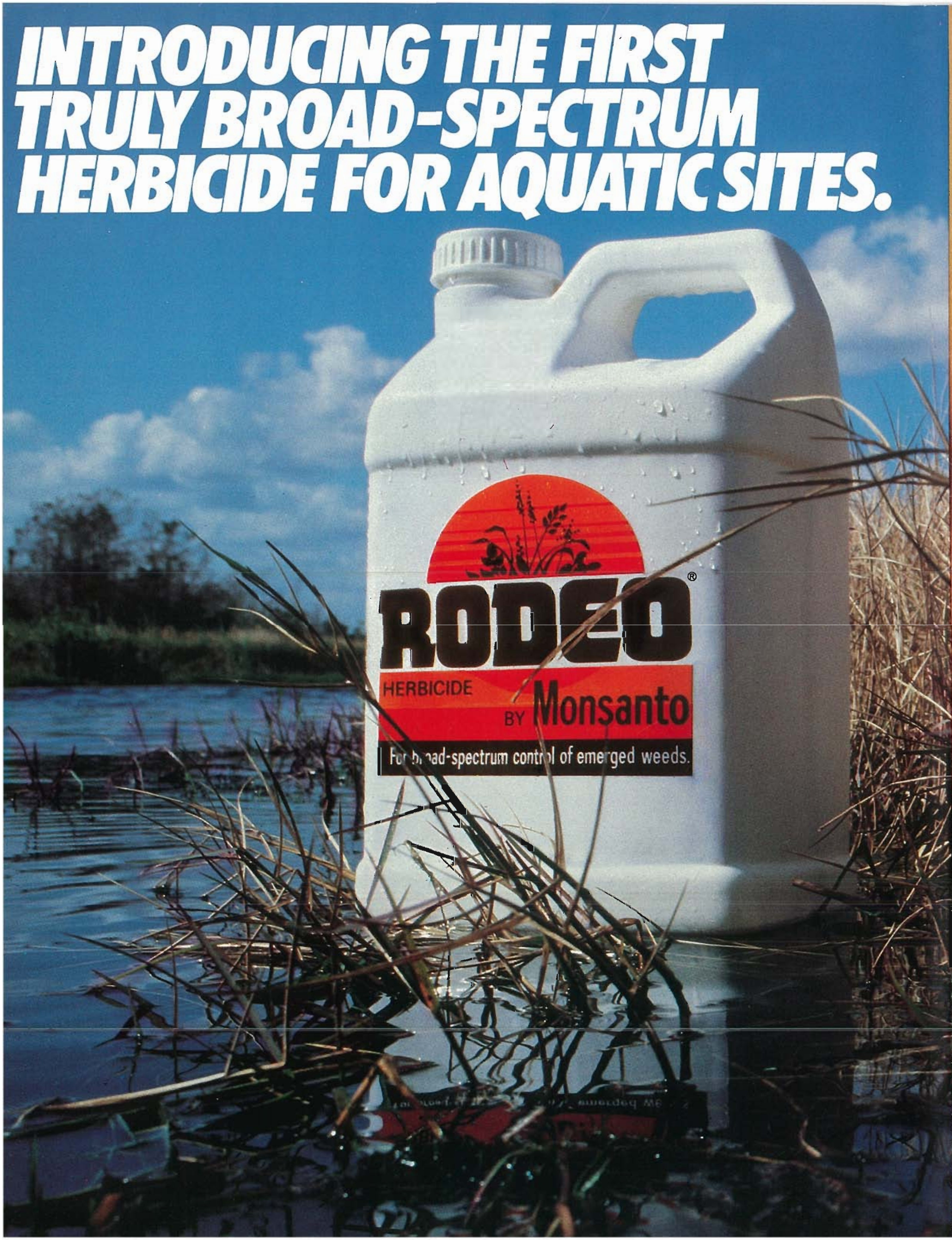
a. Giant cutgrass (*Zizaniopsis miliaceae*) — 8,000 acres
b. Hydrilla (*Hydrilla verticillata*) — 8,500 acres
c. Eurasian watermilfoil (*Myriophyllum spicatum*) — 11,000 acres
d. Water hyacinth (*Eichornia crassipes*) — 1,000 acres.

Conclusion

Lake Seminole's aquatic problem has progressed through the years to one of major proportions in 1983. Today, it is estimated that one-half of Lake Seminole's clear, shallow, and nutritious waters are infested with aquatic vegetation. This vegetation has impacted, and continues to impact, seriously on all project purposes and uses.

Satisfactory controls are not available, thus, the continued progress of Lake Seminole's aquatic problems seem likely.

An empirical approach, the approach mainly used to date, has proven to be unsatisfactory. Maybe, a more thorough understanding of the problem taxa through real and/or pure research will reveal the necessary biological data sufficient for an effective control strategy. □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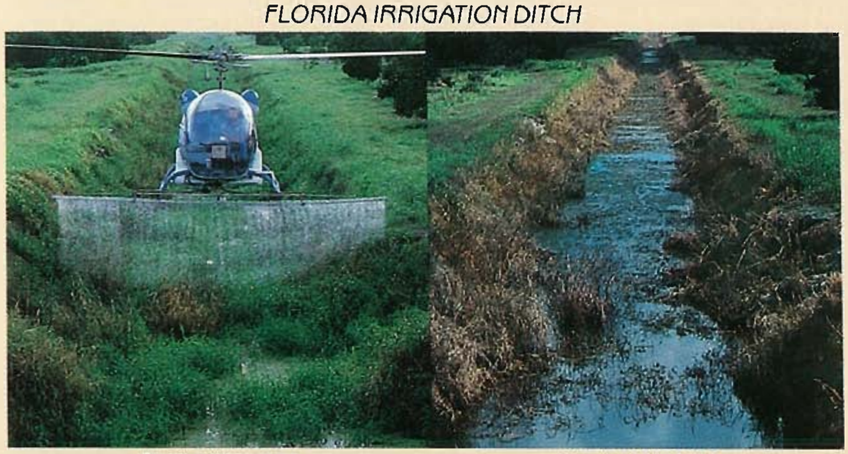

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Hydrilla Produces Viable Seed in North Carolina Lakes —

A Mechanism for Long Distance Dispersal

K. A. Langeland and C. B. Smith[1]

Seed production is often a mechanism by which long distance dispersal of plant populations occurs. Many aquatic plant species have seeds that are adapted to pass through the digestive tract of wading birds and migratory waterfowl. Therefore, plant populations can be dispersed over thousands of miles during seasonal migrations.

Hydrilla *(Hydrilla verticillata)* populations in Florida apparently do not have this ecological advantage. During the twenty-five years that hydrilla has been intensively studied by scientists in Florida, only pistillate flower production has been observed. Without pollination frm staminate flowers seed production cannot occur. Dispersal of these dioecious populations, therefore can occur only by vegetative mechanisms, i.e., fragmentation (Langeland and Sutton 1980) or transportation of tubers and turions. Joyce et al (1980) studied the potential for dispersal of hydrilla vegetative propagules by ring-necked ducks and coots in Florida. They concluded that this is not a mechanism for producing new hydrilla populations. Dispersal by vegetative means, therefore, is dependent upon transportation by water and cultural activities such as transportation on boats and trailers, and use as an aquarium plant.

When hydrilla was discovered in North Carolina in 1980, and in other Atlantic Coast states, steps were taken to prevent transportation of hydrilla fragments and vegetative propagules by cultural activities. This was accomplished by educating the public to identification and the potential problems that hydrilla can cause in lakes, and by placing warning signs at public boat ramps. This strategy was consistent with the knowledge that hydrilla did not produce seed in the United States. More recently, however, evidence has been accumulating to the contrary.

Van and Conant observed staminate flower production in September 1982 by hydrilla that was collected from Kenilworth Aquatic Gardens in Washington, D.C., and was being cultured under experimental conditions in Ft. Lauderdale, Florida (Vandiver et al, 1982). Subsequently, profuse staminate flower production by monoecious hydrilla populations growing naturally in North Carolina lakes was reported (Langeland and Schiller, 1983). It was reasonable to believe at this point that the necessary biology existed for hydrilla seed production in these populations.

The question arose whether the monoecious hydrilla populations were genetically capable of producing viable seed when Harlen et al (1984) reported that the North Carolina populations have a chromosone number of $2n=24$. Hydrilla chromosome numbers of $2n=16$ and $2n=24$ have been referred to as diploid and triploid (Verkleij et al, 1983). This implies that the North Carolina hydrilla populations ($2n=24$) could not produce viable seed because triploid organisms are usually sterile due to defective sex cell formation. Conant et al, however, observed seed production and germination under experimental conditions by hydrilla collected from Delaware and North Carolina.

We have now observed viable seed productions by hydrilla in North Carolina lakes. This confirms hydrilla's sexual reproductive capacity in the Northern Hemisphere.

Lake Wheeler, Lake Raleigh, Page Pond, Lake Benson, and Dunaway's Pond in Wake County, North Carolina, were sampled on a weekly basis in 1984 to determine if hydrilla was producing seed. In September we began to observe immature fruits in Lake Wheeler and Dunaway's Pond. Fruits were observed to progress through developmental stages during September and October (Figure 1). During October we began

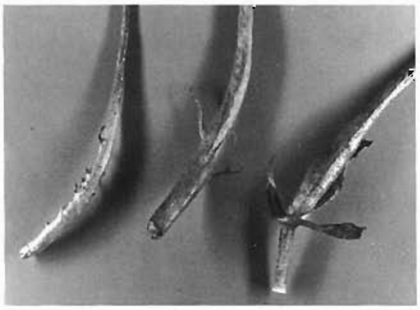

Figure 1

removing seed from apparently mature fruits. One to four seeds were found per fruit which ranged from soft and green (apparently immature, Figure 2) to hard and brown (apparently mature, Figure 2), however, only one apparently mature seed was found per fruit.

Figure 2

Seed production and fruits in various developmental stages were observed in Lake Wheeler and Dunaway's Pond throughout October. In late October immature fruits and seeds were observed in Lake Raleigh and Page Pond. In November fruit and seed production apparently ceased concurrent with senescence and increasing feeding pressure by water-fowl.

Seeds that were collected during October were placed in distilled water and maintained under natural sunlight in a western exposure window at 73F. Twenty-one days after collection, a seed from lake Wheeler germinated (Figure 3) and has continued to develop.

[1] Assistant Professor and Research Technician, respectively, Crop Science Dept., North Carolina State Univ., Raleigh, N.C. 27695-7627.

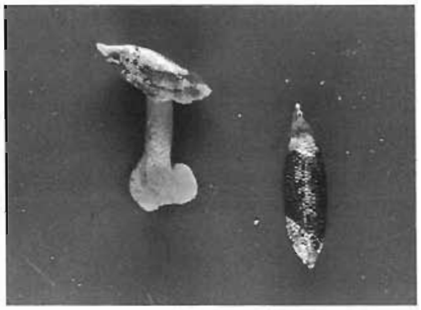

Figure 3

The numbers of seeds produced per tenth meter square quatrats were counted in four locations in Lake Wheeler. Up to 50 seeds per square meter were counted. This is relatively small compared to the large numbers of seeds that can be produced by other plant species but it is a substantial potential for dispersal. Also, this number represents the numbers of seeds contained in fruits and attached to the parent plant at one point in time; and probably grossly under estimates, seasonal production because fruits tend to dehisce as they mature. We will improve the methodology for quantifying hydrilla seed production during the 1985 growing season.

Observation of hydrilla seed production under natural conditions in North Carolina Lakes confirms the ability of at least one hydrilla strain in the Northern hemisphere to reproduce sexually. This suggests a natural mechanism for long distance dispersal and adaptation through genetic variability, previously believed non-existent. □

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EUROPEAN WEED RESEARCH SOCIETY

Dear David,

Please would you include a mention in the next edition of *Aquatics* of the European Weed Research Society's 7th international symposium on aquatic weeds to be held at Loughborough University of Technology, Loughborough, England from 15-19 September 1986. It has all the makings of being a really valuable and enjoyable meeting. I have enclosed of the first circular for the symposium for your information.

International weed problems and approaches to aquatic weed control will be covered. The symposium will be directly relevant to drainage engineers and others involved with the practical problems of managing aquatic plants in Europe and elsewhere, as well as to scientists interested in the applied biology of aquatic macrophytes, aquatic weed control and the environmental effects of aquatic plant management. The conference will include a one-day excursion to sites showing a range of aquatic weed problems, and approaches to aquatic weed control.

Obviously the February deadline cannot apply to *Aquatics* readers, but it would be useful for them to contact me as soon as possible and preferably before 31 May 1985.

I hope you may be able to help me by bringing the meeting to the attention of the Florida Aquatic Plant Management Society.

Yours sincerely,

Dr. P. M. Wade
Department of Human Sciences,
Loughborough University,
Loughborough
Leics. LE11 3TU.

NOTE: For a copy of the first circular, contact the editor.

AQUA-VINE

Letter to the Editor

Dear Editor:
The First International Symposium on Watermilfoil *(Myriophyllum spicatum)* and related Halagoraceae will be held on July 23, 1985 in conjunction with the annual meeting of the Aquatic Plant Management Society in Vancouver, British Columbia. The Symposium will include invited and contributed papers by noted individuals from around the world on the distribution, ecology, physiology, and management of watermilfoil and related species. For further information, please contact:

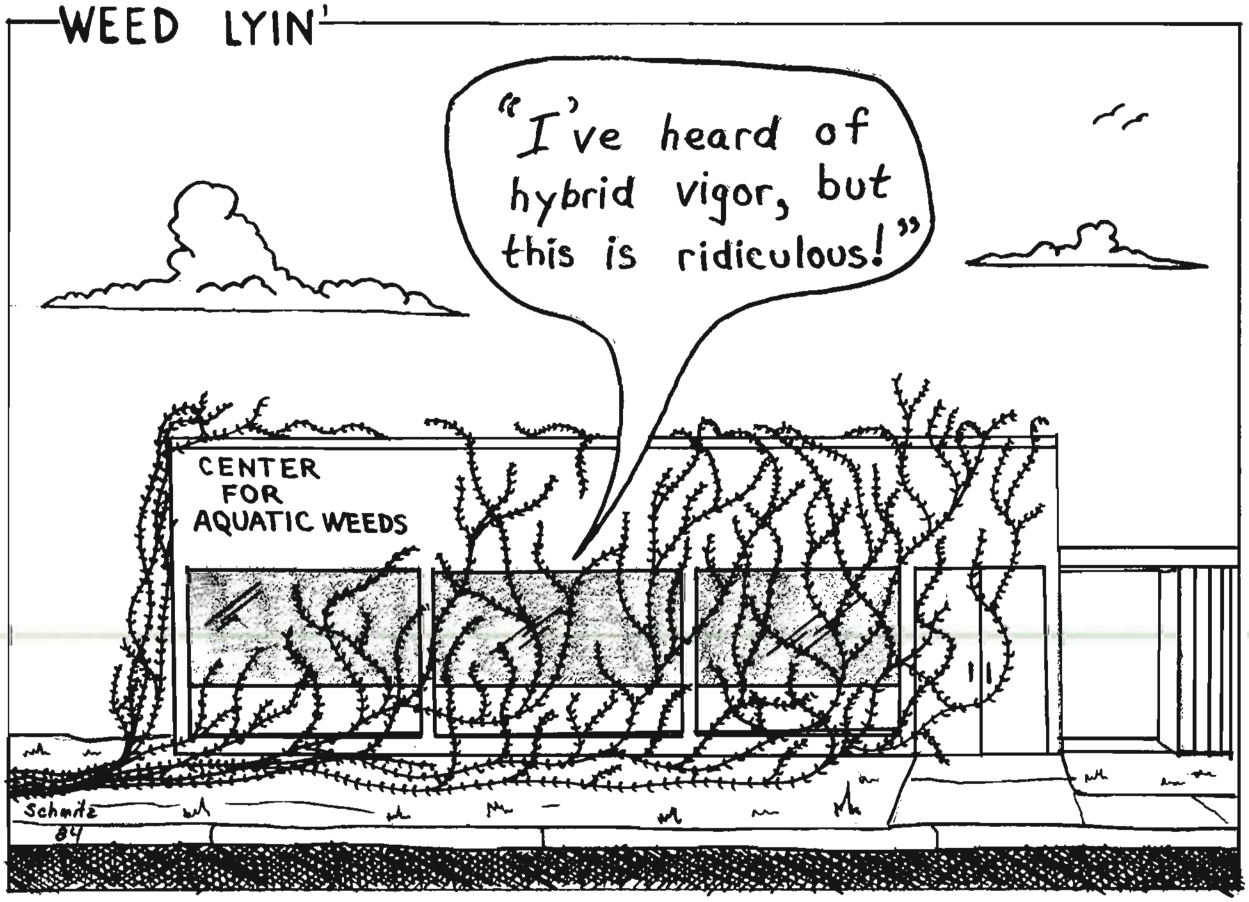
Mr. W. N. Rushing
P.O. Box 16
Vicksburg, MS 39182
Telephone: 601-636-3111 ext. 3542

A Letter to the Editor

Dear David:
In Aqua-Vine of the June 1984 issue, John Gallagher mentioned a colleague's observations that the hyacinth problem in the Sudan was "almost out of control." Since the Sudan was not mentioned in your March issue which was the subject of Dr. Gallagher's letter, I presume his statements were in response to Ted Center's talk at the University of Florida Short Course in June. Dr. Center mentioned reports that hyacinth was decreasing in the White Nile as a result of biocontrol.

I sent a copy of Aqua-Vine to Dr. Magzoub Bashir (UC-Berkeley alumnus), University of Khartoum, Sudan, and received a long letter in response. Both species of weevils and *Sameodes* are established in the Sudan and Magzoub reports that the project is "outstandingly successful." He further reports that "The annual activity of spraying the mats that accumulate behind Jebel Aulia dam to avoid the risk of the plant escaping from that area and infesting the northern part of the Nile beyond Khartoum is now completely stopped since 1982. As a matter of fact, the annual campaign to control the plant in the south by 2,4-D that used to cost over 1.5 million Sudanese pounds is now operating at less than one-quarter of its strength. Even this is now being questioned. The hyacinth control section in the Plant Protection Directorate who were strongly pro 2,4-D are now talking about 'integrated control'. . . . As a consequence of the success of this effort, the National Council for Research is now fully behind the Unit of Biological Control at the Faculty of Agriculture. . . . Please feel free to use the enclosed information to address the editor of Aquatics about the situation of BC of water hyacinth in the Sudan. Dr. Bashir will have an article about this project in an autumn issue of *Tropical Pest Management* (September?).

Dr. Gallagher's colleague and Dr. Bashir may have observed water hyacinth in different areas of the Sudan but it appears that biocontrol has been successful on much of the White Nile. Perhaps the mild climate of the Sudan has favored the insects over water hyacinth so that their control has been faster and more dramatic than in the U.S. It will be interesting to see if this success is repeated in India



where the weevils were released in 1983.

Sincerely,

Gary Buckingham
Research Entomologist

NOXIOUS WEEDS BUDGET REDUCED DRASTICALLY

It still seems that the Federal Administration cannot, or will not, recognize weeds as "real" pests. In a repeat of last year, the agency budget for Noxious Weeds has been submitted at $112,000. This compares to $789,000 for the current year, which was obtained by Congress with urging from SWSS, WSSA and individuals. The cut for 1985 is a staggering 85.8% of the present 1984 budget. Noxious Weed activities would be restricted to only commodity inspection at ports of entry, and the training of port inspectors. No project money would be available for control, regulatory, survey or research. The highly successful Common crupina (Idaho), Goatsrue (Utah), Orobanche ramosa (Texas) and Hydrilla (California and Florida) would be left with no funds. These are in various stages of the eradication process with the Goatsrue in year three of a seven year project. Goatsrue and the others would, of necessity, be abandoned to revert to preprogram status — that of potential explosive spread.

Reprinted from SWSS Newsletter Vol. 7, No. 1, 1984

CALENDAR NOTES

NORTHEASTERN WEED SCIENCE SOCIETY OF AMERICA ANNUAL MEETING / January 7-10, 1985, Atlantic City, N.J.
SOUTHERN WEED SCIENCE SOCIETY ANNUAL MEETING / January 14-16, 1985, Houston, Texas.
WEED SCIENCE SOCIETY OF AMERICA ANNUAL MEETING / February 5-8, 1985, Seattle, Wash.
GEORGIA FISHERIES WORKERS ASSOCIATION ANNUAL MEETING February 6-8, 1985, Savannah, Ga.
WESTERN AQUATIC PLANT MANAGEMENT SOCIETY ANNUAL MEETING / March 14-15, 1985, Phoenix, Ariz.
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE ANNUAL MEETING / May 23-28, 1985, Los Angeles, Calif.
FLA. ENTOMOLOGICAL SOCIETY MEETING / August 5-8, 1985 Ocho Rios, Jamaica.

EPA ISSUES GROUND WATER PLANS

A plan to protect ground water used for drinking, irrigation, and other uses has been issued by the Environmental Protection Agency. Alvin Alm, EPA's deputy administrator, said the plan relies on voluntary compliance by states, and that preventing groundwater contamination is now EPA's "No. 1 priority." As part of a long-term strategy to protect "vulnerable" drinking water sources, EPA is reevaluating 84 widely used pesticides to determine what action, if any, should be taken.

EPA ENFORCERS

The EPA's 23 criminal investigators have been sworn in by the U.S. Justice Department as official U.S. Deputy Marshals. This gives them the right to carry guns, make arrests, and execute search warrants. Courtney Price, assistant EPA administrator of Enforcement and Compliance, says investigators can now hold their own against "midnight dumpers and other flagrant violators." □

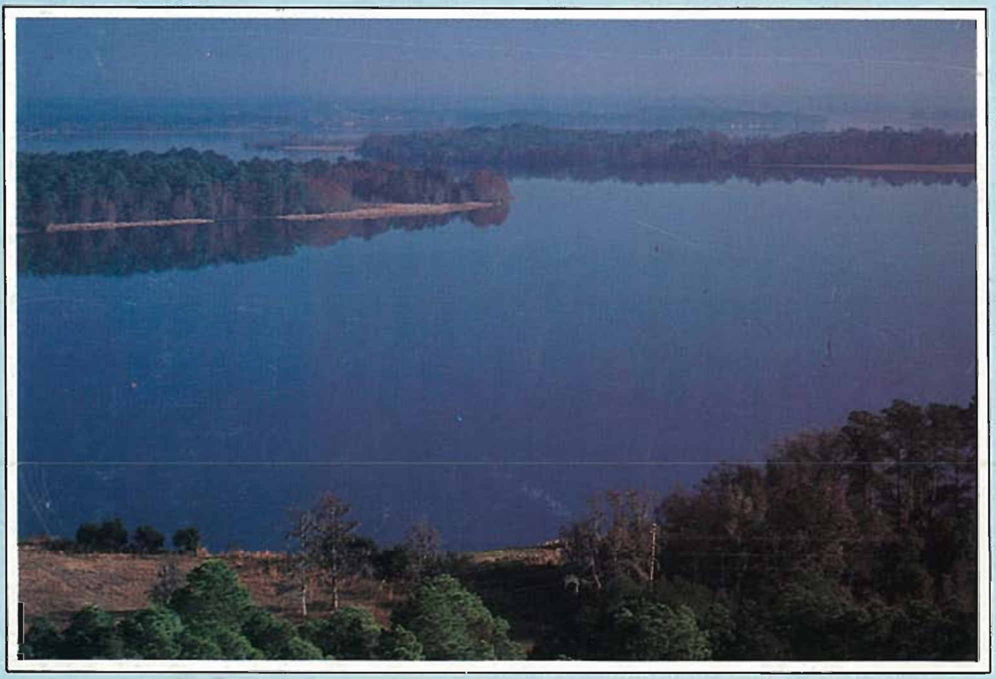
HERBICIDE HANDBOOK

Weed Society of America
309 West Clark St.
Champaign, IL 61820
1984, 515 pp. $10

Do you have trouble finding detailed information about a herbicide when you need it? If so, the solution to your problem is simple.

The Weed Science Society of America, a US-Canadian society, announces the publication of the Fifth Edition of the *Herbicide Handbook.* This 515-page handbook contains technical information on 138 herbicides and growth regulators. Chemical and physical properties, physiological and biochemical behavior, toxicological properties, synthesis, and associated information on all compounds has been reviewed and revised. Twelve new compounds were added since publication of the Fourth Edition in 1979. The handbook contains sections on terminology, conversion factors, references, Advanced Wiswesser Line Notation, manufacturers, trade names, and more. Remittance must accompany all orders.

Responsible aquatic weed management



Lake Rousseau, Florida: For over ten years, water resource managers at Lake Rousseau have relied on Pennwalt aquatic herbicides, confident that they will obtain effective control of submersed aquatic weeds without harm to the aquatic environment.

Since 1960, those responsible for aquatic weed management have relied on Pennwalt aquatic herbicides and algicides. All of Pennwalt's aquatic herbicides are based on endothall, and offer these important advantages:

- **Rapidly biodegrade into natural products**
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- **Will not bind or leave residues in the hydrosoil**
- **No significant movement from the treatment site**
- **Highly effective against algae and most problem submersed aquatic weeds, such as Hydrilla, Milfoil and Pondweeds**

Pennwalt's endothall formulations have a long history of being effective tools in weed management without causing adverse effects on man, other mammals, fish, shellfish or fish food organisms.

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AQUATHOL®
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HYDROTHOL® 191
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HYDROTHOL® 191
GRANULAR AQUATIC ALGICIDE AND HERBICIDE

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Use pesticides effectively. Read and follow label directions.