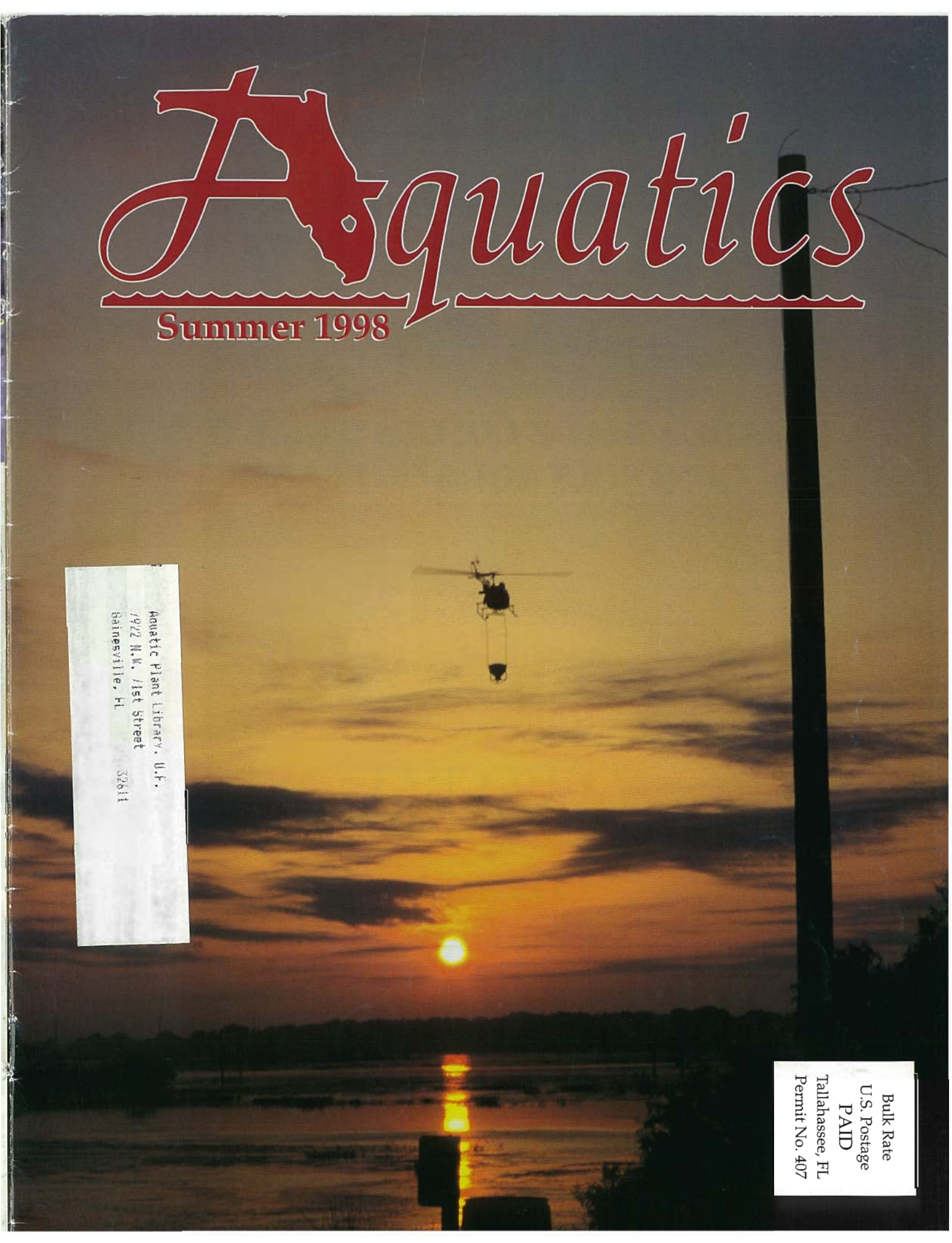
# Aquatics

Summer 1998





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## Letter to the Editor

Dear FAPMS Members and Other Aquatics Readers,

Well we did it! Your UF/IFAS Center for Aquatic Plants is now the Center for Aquatic and Invasive Plants, a change that truly could not have come at a more pivotal time in the expanding efforts to control unwanted vegetation. Everywhere you look these days there are more problems, and more opportunities. The problems we've been hitting pretty hard over the years, but let me take this time to describe just a few of the opportunities.

First, and possibly most important: invasive plant management as a developing field owes a great deal to our accomplishments in aquatic plant management. Just a few weeks ago I was at the Tennessee Exotic Pest Plant Council meeting in Chattanooga, hearing several speakers grappling with how to most effectively control the most important weedy species. Some were a little shocked to hear that Florida statues actually spell out what is meant by "maintenance control," and others were surprised to hear how our state prioritizes its aquatic weed problems and actions. If people listen carefully to what we've done, aquatic plant management will be the cornerstone on which invasive plant management is built.

And some of the bigger issues? Next year (16-19 February 1999), Adelaide, South Australia will host the 1st International Workshop on Weed Risk Assessment. Goals include gathering experts to develop methods for preventing import and export of plant species with weed potential and identifying and prioritizing weeds for coordinated control programs. A discussion paper related to the conference is on the Internet at "http://www.ozemail.com.au/~davcooke/virtue.htm". Finally, some concrete steps toward a coordinated approach to plant import and export, and perhaps consensus on control methods (does every country on the planet have to go through the same agonizing process to determine what the most reasonable integrated management plan for water hyacinth is?)

Closer to home? On April 28, 1998 Interior Secretary Babbitt released a summary of invasive plant problems, titled "Invasive Weeds Pose Major Threat to American Landscape." "Accidentally and on purpose, America is sowing seeds-literal seeds-of destruction...The invasion of noxious weeds has created a level of destruction to America's environment and economy that is matched only by the damage caused by floods, earthquakes, wildfire, hurricanes and mudslides." Babbitt was drawing on the conclusions from a multi-agency report titled, "Invasive Plants: Changing the Landscape of America," which will be available this summer. The book will note

*Continued on page 9*

Sunrise signals the start of aerial hydrilla treatments on the Kissimmee Chain of Lakes.

Photo by Dave Tarver

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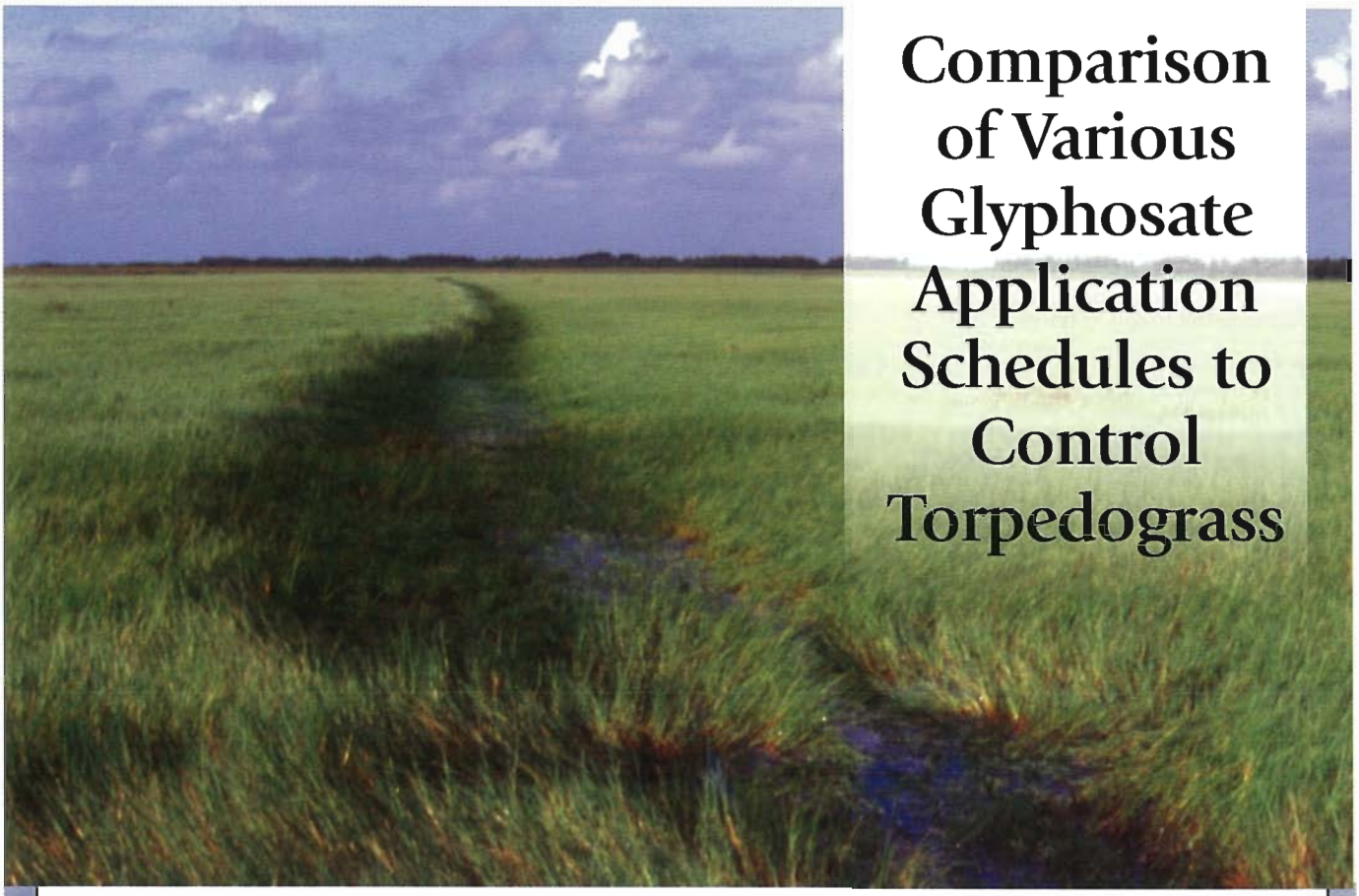
**EDITORIAL: Address all correspondence regarding editorial matter to Judy Ludlow *Aquatics* Magazine.**



# Comparison of Various Glyphosate Application Schedules to Control Torpedograss

Photo by Jeff Shardt

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Center for Aquatic and Invasive Plants
and
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South Florida Water Management District

Torpedograss (*Panicum repens* L.) is a perennial amphibious grass that has extensive underground stems (rhizomes) which support aggressive growth, and allows torpedograss to quickly overtake existing plant communities and form dense monocultures. Torpedograss is reported as a major terrestrial and aquatic weed throughout the subtropical and tropical world (Holm *et al.*, 1977). In Florida, Welker and Riemer (1973) described torpedograss as the most troublesome grass in south Florida and Tarver (1979) suggested that the invasion of torpedograss into Florida wetlands was becoming increasingly more critical because of multiple water uses. In the 1992 annual survey of public waters by the Florida Department of Environmental Protection (Schardt, 1992), torpedograss was ranked as the second most prevalent exotic weed reporting 14,000 acres of Lake Okeechobee infested with torpedograss. Infestations of torpedograss occur in diverse agricultural and nonagricultural areas.

Individual torpedograss rhizomes, which can exceed nine feet in length, and dormant axillary buds that occur along the entire length of the rhizome (personal observation) make torpedograss very difficult to control with herbicides. Systemic herbicides do not translocate appreciably to dormant buds. Therefore, sprouting and regrowth from these dormant rhizome buds occurs quickly following herbicide applications and results in the need for multiple herbicide treatments. Sutton (1996) reported that, for successful control, herbicide treatments must control all rhizomes since a few buds have the potential to produce a large amount of plant material in a short period of time.

Glyphosate is the most effective herbicide, which is labeled for use in aquatic habitats, for controlling torpedograss. Glyphosate

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readily translocates and follows the movement of photosynthates to areas of high metabolic activity (Sandberg *et. al.*, 1980). Generally, glyphosate provides excellent control of many perennial species (Majek, 1980), however, the complete control of torpedograss with a single application rarely occurs (Manipura and Somaratne, 1974; Chandrasena, 1990). Therefore, multiple glyphosate applications are necessary to eradicate torpedograss. Recognizing this, the answers to three questions can help to improve cost effectiveness. These are: 1) How many applications are necessary? 2) Does the interval between treatments (stage of regrowth) influence control? 3) Can glyphosate rate be reduced depending on how many times and the interval at which it is applied?

The objective of this study was to determine the most economically feasible means to control torpedograss with multiple glyphosate applications by using different combinations of numbers of applications, at different stages of regrowth, and different glyphosate rates.

## Methods and Materials

***Evaluation of multiple glyphosate treatments for torpedograss control.***

Two to seven glyphosate applications using the commercial formulation Rodeo® were applied in 0.25, 0.50, and 1.0 percent solutions using a handgun sprayer calibrated to deliver 100 GPA to a dense natural stand of torpedograss growing in the littoral zone on the north shore of Lake Okeechobee. Retreatments were applied at 3, 6, and 12 inches of regrowth. Treatments were replicated three times in 500 $ft^2$ plots.

Re-treatment times were based on visual evaluations taken frequently over the course of the experiment. Torpedograss retreatments continued as scheduled (2-7 times) or until no regrowth was observed. After the final treatments were applied, monthly visual evaluations continued until treatment effects were obviously becoming lost to regrowth or eradication. At the end of the study (twenty-two months), one biomass sample was collected from the center of each field plot using a 0.25 $m^2$ quadrat. Samples were placed in labeled paper bags, dried 72 hrs at 70 C, and weighed. Analysis of variance was used to determine treatment differences based on biomass data. Percent control was calculated as the percent biomass occurring in treatment plots compared to untreated control plots.

Treatment costs were estimated from South Florida Water Management District operational records and based on a two man air-boat crew treating emergent vegetation along canal banks, with herbicide cost factored in based on glyphosate rate and number of times applied.

## Results and Discussion

Environmental conditions varied over the 22 month study period. From June 14, 1995 (starting date) until summer 1996, field plots were inundated with 1-2 feet of standing water. Then lake levels began to recede and standing water did not occur in the plots from December 1996 until July 1997. A wild fire completely burned through all plots on February 9, 1997. Torpedograss regrowth occurred, both inside and outside plots, within two weeks after the fire. Lake levels began to rise in July 1997 flooding the plots to a depth of 18 inches at time of harvest (August 26, 1997).

Regardless of glyphosate rate or time of re-treatment, torpedograss foliage was completely necrotic within two weeks of every application. However, regrowth at different rates necessitated application of at least four treatments over the two year study period for acceptable control (Table 1).

Treatments that provided greater than 70% torpedograss control are not statistically different from one another, however, variability increased as control decreased. When treatments provided $\geq$ 98% torpedograss control, only one or two sprigs of torpedograss were

**Table 1. Cost comparisons for various glyphosate application schedules to control torpedograss.**

| Glyphosate Rate (% solution) | Number of Applications | Regrowth Stage (inches) | 8/26/97 Final Biomass (g/0.25m2) | Percent Control | Application Dates 6/14/95 and 9/13/95 plus: | Total Treatment Cost/ac * | Estimated Years of Control |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 12 | <1 | >99 | 6/3/96; 4/12/97 | 600 | 3+ |
| 1 | 7 | 3 | <1 | >99 | 10/11/95; 4/3/96; 6/3/96; 7/23/96; 8/23/96 | 1050 | 3+ |
| 1 | 5 | 6 | <1 | >99 | 11/1/95; 6/3/96; 4/12/97 | 750 | 3+ |
| 0.25 | 7 | 6 | <1 | >99 | 11/1/95; 12/6/95; 6/3/96; 8/23/96; 4/12/97 | 525 | 3+ |
| 0.5 | 4 | 12 | <1 | 99 | 6/3/96; 4/12/97 | 400 | 3+ |
| 1 | 6 | 3 | <1 | 98 | 10/11/95; 4/3/96; 6/3/96; 7/23/96 | 900 | 3+ |
| 0.5 | 7 | 6 | 1 | 98 | 11/1/95; 12/6/95; 6/3/96; 8/23/96; 4/12/97 | 700 | 3+ |
| 0.25 | 6 | 6 | 1 | 98 | 11/1/95; 12/6/95; 6/3/96; 8/23/96 | 450 | 3 |
| 1 | 5 | 3 | 2 | 96 | 10/11/95; 4/3/96; 6/3/96 | 750 | 3 |
| 0.5 | 7 | 3 | 2 | 96 | 10/11/95; 1/16/96; 4/3/96; 6/3/96; 7/23/96 | 700 | 3 |
| 0.5 | 5 | 6 | 3 | 94 | 11/1/95; 12/6/95; 6/3/96 | 500 | 3 |
| 1 | 4 | 3 | 3 | 94 | 10/11/95; 4/3/96 | 600 | 3 |
| 0.25 | 5 | 12 | 4 | 93 | 12/6/95; 6/3/96; 9/11/96 | 375 | 3 |
| 1 | 4 | 6 | 4 | 93 | 11/1/95; 6/3/96 | 600 | 3 |
| 0.25 | 7 | 3 | 4 | 93 | 10/11/95; 1/16/96; 4/3/96; 6/3/96; 7/23/96 | 525 | 3 |
| 0.25 | 6 | 12 | 4 | 93 | 12/6/95; 6/3/96; 9/11/96; 4/12/97 | 450 | 3 |
| 0.5 | 5 | 3 | 5 | 91 | 10/11/95; 1/16/96; 4/3/96 | 500 | 3 |
| 0.5 | 6 | 3 | 8 | 86 | 10/11/95; 1/16/96; 4/3/96; 6/3/96 | 600 | 2 |
| 0.5 | 4 | 6 | 8 | 86 | 11/1/95; 12/6/95 | 400 | 2 |
| 0.25 | 6 | 3 | 8 | 86 | 10/11/95; 1/16/96; 4/3/96; 6/3/96 | 450 | 2 |
| 0.5 | 6 | 6 | 8 | 86 | 11/1/95; 12/6/95; 6/3/96; 8/23/96 | 600 | 2 |
| 0.25 | 4 | 3 | 10 | 82 | 10/11/95; 1/16/96 | 300 | 2 |
| 0.25 | 5 | 3 | 15 | 74 | 10/11/95; 1/16/96; 4/3/96 | 375 | 1+ |
| 0.25 | 4 | 12 | 15 | 74 | 12/6/95; 6/3/96 | 300 | 1+ |
| 0.25 | 5 | 6 | 19 | 67 | 11/1/95; 12/6/95; 6/3/96 | 375 | 1 |
| 0.5 | 4 | 3 | 28 | 52 | 10/11/95; 1/16/96 | 400 | 1 |
| 0.25 | 4 | 6 | 30 | 48 | 11/1/95; 12/6/95 | 300 | 1 |
| 0 | 0 | 0 | 59 | 0 | | 0 | |

* Based on cost records assessed at $150/ac by the SFWMD for controlling floating and emergent vegetation with a two man air boat crew and glyphosate priced at $100/gal.

collected from a single replicate plot while no torpedograss was present in the two remaining replicated plots. Those plots were obviously best in terms of torpedograss control and also resulted in the most consistent results.

Estimated total costs among treatments were substantially different. Treatments providing 98% control or better produced the most consistent results but, treatment costs ranged from $400 to $1050/ac (Table 1). The most cost effective treatment was glyphosate applied four times at 0.50 percent to 12 inch regrowth at a cost of $400/ac for 98.6% control (in bold print Table 2). This treatment was $125 to $650/ac cheaper than any of the other top seven treatments. Treatments applied to 3 inch regrowth that gave 99% control were the most expensive due to the high glyphosate rate and number of applications necessary. Treatments applied to 6 inch regrowth that gave ≥98% control always required at least one additional treatment regardless of glyphosate rate and were $50 to $350/ac more expensive when compared to the most cost effective treatment. When glyphosate was applied to 12 inch regrowth at 1.0 percent 4 times, torpedograss control was 99.8% but cost increased $200/ac when compared to the same treatment at half the rate.

The majority of the treatments provided good (70-90%) to excellent (>90%) torpedograss control. However, the treatments differed not only in terms of cost but also appearance. It was observed when glyphosate was applied at 1.0 percent to 12 inch regrowth that a better kill was achieved for the first two applications. Regrowth in those plots occurred in isolated clumps compared to the more uniform regrowth from other treatments. Once the number of applications exceeded three or four, spot treatments would have been all that was necessary under operational conditions. Furthermore, the influence of glyphosate rate seemed to diminish as torpedograss control increased.

It should be possible to develop a management plan which would best control torpedograss at a minimum cost by starting at the higher rate followed by subsequent spot treatments at reduced rates (1.0 down to 0.25 percent depending on regrowth) applied at the 12 inch regrowth stage.

During the course of this study, anecdotal information was collected on occurrence of non-target vegetation in the treated plots. Buttonbush (*Cephalanthus occidentalis*) and primrose-willow (*Ludwigia peruviana*) were observed to not only survive (although briefly defoliated) but to expand in the absence of torpedograss in plots treated 4 to 7 times at various glyphosate rates. Smartweeds (*Polygonum* spp.), cordgrass (*Spartina bakeri*), redroot (*Lachnanthes caroliniana*), cattails (*Typha* spp.), and sedges (*Carex*

spp.), which were not present in the plots prior to treatment, colonized plots within a month after treatment, depending on season. In general, as torpedograss control improved plant diversity increased.

## Acknowledgments

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***References are available by contacting Ken Langeland, Center for Aquatic and Invasive Plants, 7922 NW 71st Street, Gainesville, FL 32653***

### Letter to the Editor

*Continued from page 3*

"the lack of adequate surveys and reliable monitoring data for many of these invaders"... Sounds like us a few decades ago?

Even closer to home? The UF/IFAS Invasive Plants Task Force continues to work on the issues of identification and control of invasive plant species, landscape recommendations, and a better understanding of the market forces that drive plant introductions, production and distribution.

Any comforting thoughts related to the overwhelming problems and related issues? At least one...we've got the role model of aquatic plant management for a solid foundation. Commercial sales of invasive non-native plant species? We've been there (melaleuca, Brazilian pepper, water hyacinth, hygrophila, and many more). Problems with accurate identification, taxonomy, and historical distribution? Water lettuce anyone? Concerns over how to generate appropriate funding to reduce environmental impacts of non-native weedy species? Been watching the aquatic plant control funding discussion in Tallahassee over the past few years? Need to develop consensus among the disparate interest groups? Pick any Okeechobee town hall meeting you wish.

Can we in aquatics tell the invasive plant people that we solved all the problems? No, but we certainly have experienced and talented people, and a hundred years of effort, to help us with the even bigger ones.

Randall K. Stocker
Director, UF/IFAS Center for Aquatic and Invasive Plants



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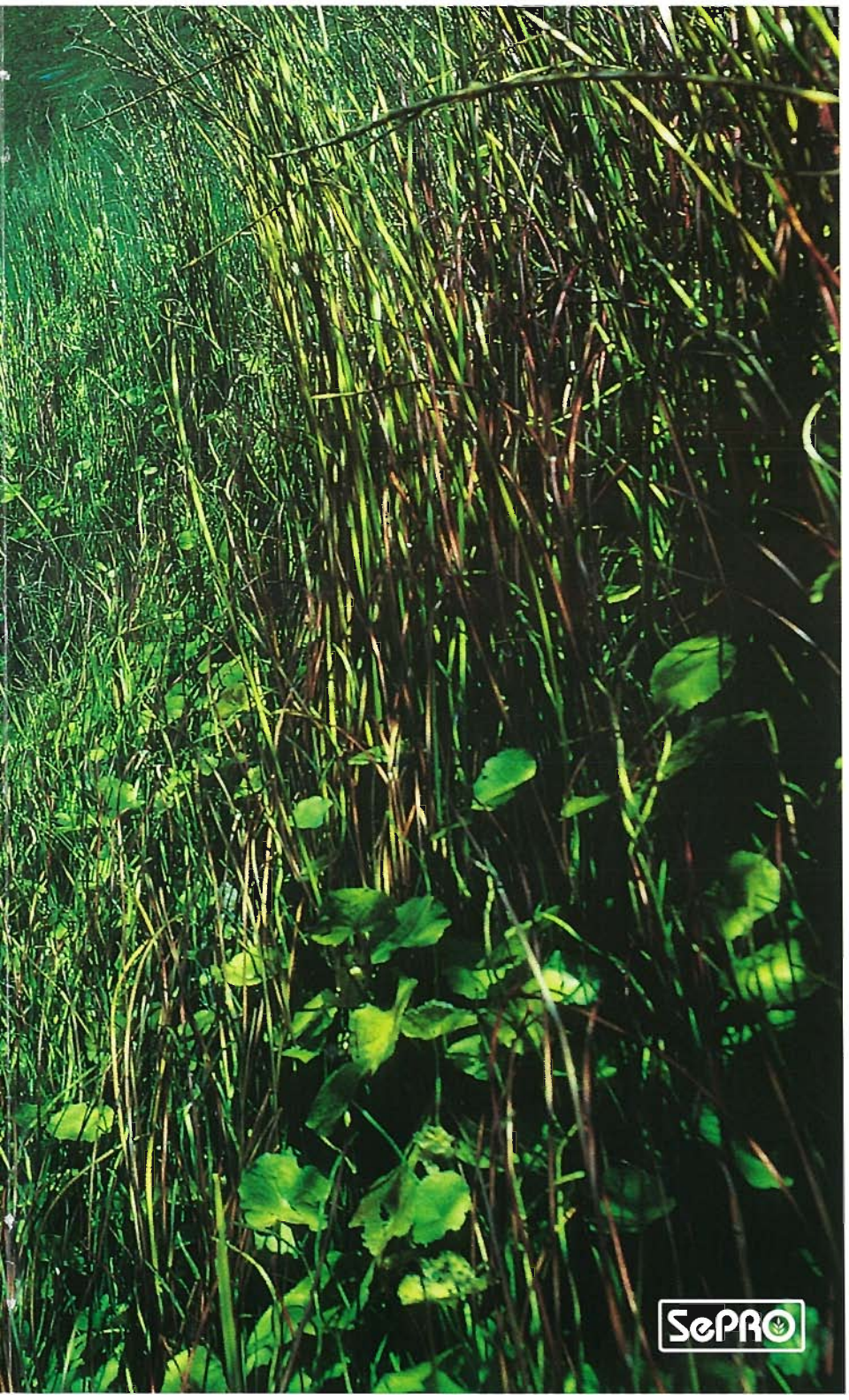


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# Water Hemlock Beautiful But Deadly

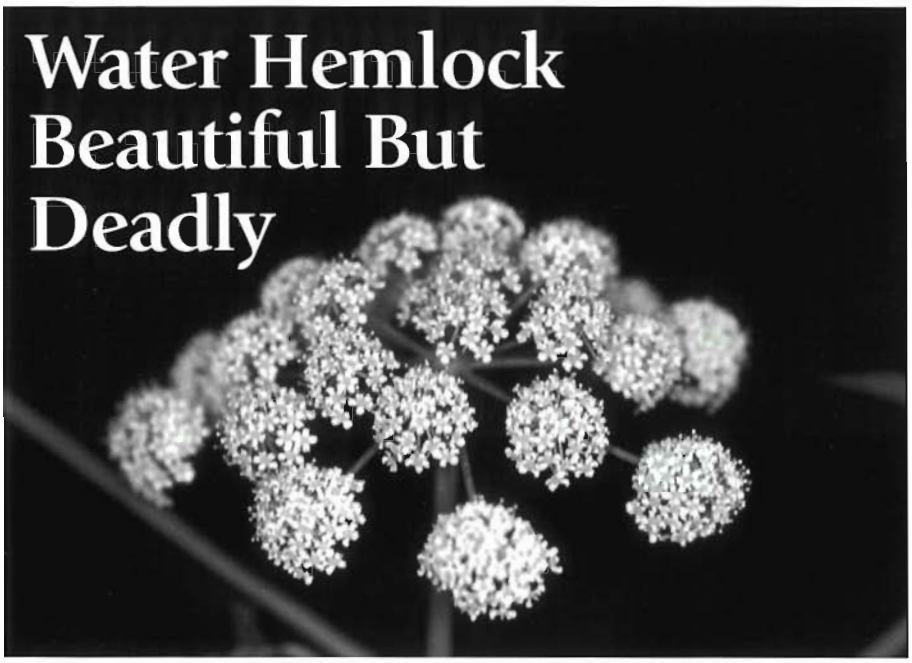

*Figure 3: Water hemlock inflorescence. Compound umbel 6" in diameter; umbelettes range from 1" to 1.5" in diameter; individual flowers between 1/8" and 1/4" across.*

**Lyn A. Gettys**
and
**David L. Sutton**
Fort Lauderdale Research and Education Center
University of Florida - IFAS

## Introduction

Plants have been cultivated for their usefulness to man throughout the ages. Early societies were created when nomadic hunter-gatherers discovered regions of fertile soil with edible plants. They settled and defended these areas so that they could enjoy and increase the bounty from the earth. The modern world is dependent on superior food crops developed from primitive native flora that now produce high yields of nutritious and flavorful fruits, grains and vegetables; however, we rely on plants for much more than food; virtually everything we use has its "roots" in botany.

Plants provide us with a vast array of modern cosmetics, cleansers, and perfumes; one only has to drive as far as the local "Giganto-Mart" for a dazzling selection of botanical shampoos, lotions and beauty products. In ancient Egypt, Cleopatra had slaves to bring her henna made from powdered mignonette (*Lawsonia inermis* L.) leaves to darken her hair, and products made from grinding parts from other plants were used to make her more beautiful.

The "home remedies" that our forefathers used for a wide variety of ailments often included plant parts or extracts, and when they were effective it was usually due to the presence of healing substances that occur naturally in these plants. In fact, many modern pharmaceutical products are derived from these substances. For example, aspirin was developed when scientists studied willows (*Salix* spp.). A popular home remedy for pain and inflammation involved the use of tea made from the bark of the willow tree. A chemical analysis was performed and salicylic acid (the active ingredient in aspirin) was isolated and found to be the active ingredient. Poppies (*Papaver somniferum* L.) are grown and harvested to produce opium, often used as a sedative, and yarrow (*Achillea millefolium* L.) was used as a poultice for wounds until at least the time of the Civil War.

While plants are wonderful organisms that we can not live without, there are a few that are dangerous to live *with*. Some plants possess substances that have awesome healing properties, but others can be dangerous or even deadly when ingested. All parts of the lovely oleander (*Nerium oleander* L.) and lantana (*Lantana camara* L.) are poisonous, and numerous other terrestrial plants that thrive in southern Florida have toxic properties as well.

This darker side of botany has been explored and exploited for thousands of years; for example, foxglove (*Digitalis purpurea* L.) was used for trials by ordeal in medieval Italy. A plethora of plants contain psychotropic, hallucinogenic or toxic ingredients and these can be lethal in even small doses. While some plants with these properties are used illegally as recreational drugs, others can be accidentally ingested with disastrous - and often deadly - results. One such "killer plant" is water hemlock (*Cicuta mexicana* Coult. & Rose).

The word "hemlock" brings to mind images of witches and demons, sorcerers and evil, Socrates and suicide - all with good reason! Water hemlock is one of Florida's native aquatic plants and holds the dubious honor of being a member of the most toxic indigenous plant genus in North America. A coarse, perennial dicotyledonous herb, water hemlock is a member of the Carrot family (Apiaceae), and occurs in wetlands throughout Florida. The following information on water hemlock is presented in an effort to increase the awareness and recognition of this beautiful but deadly aquatic plant.

## Family Characteristics

The Apiaceae or Carrot family includes 410 genera and 3,100 species; of these, approximately 94

*Figure 1: A monoculture of water hemlock in Water Conservation Area Number 3A.*

genera and 440 species may be found in the United States and Canada. Members of this family are perennial or annual herbs, and most have hollow stems at maturity. The family enjoys widespread distribution, with members being found most commonly in northern temperate regions.

The Carrot family includes many individuals of economic importance as food or spice crops, including dill (*Anethum* spp.), chervil (*Anthriscus* spp.), celery (*Apium* spp.), caraway (*Carum* spp.), carrot (*Daucus* spp.), parsnip (*Pastinaca* spp.), and parsley (*Petroselinum* spp.). The family also has several virulently toxic species, including poison hemlock (*Conium maculatum* L.), the plant thought to be responsible for the untimely demise of Socrates, and water hemlock (*Cicuta* spp.).

## Genus Characteristics

The eight members of the genus *Cicuta* can be found in wet and marshy areas throughout the eastern and southern United States, Canada, Europe, and Asia; however, only two species grow in the United States. Water hemlocks are sturdy, coarse perennial herbs that may grow to heights of 8 feet. These plants have hollow, glabrous stems and a cluster of thick, fleshy roots that resemble fingers. The leaves are composed of three leaflets, which are serrate to incised. The primary veins on the leaflets tend to ascend toward the sinuses of the serration, rather than toward the teeth.

Water hemlock inflorescences are produced as axillary and terminal compound umbels, bearing flowers with white or greenish petals. The petals are short-clawed at the base and have ovate blades with inflexed, abruptly narrowed tips. Flowers have easily accessible nectar secreted at the ovary apex, and attract small flies, moths, beetles or bees to serve as pollinators. The fruit of water hemlock may be ovate, oval, elliptic or suborbicular, and are flattened or compressed

laterally. Due to the striking morphological similarity between *Cicuta mexicana* and *Cicuta maculata* L., a thorough examination of the fruit is necessary to determine the identity of the plant in question; however, since the geographic range of *Cicuta maculata* is not thought to extend into southern Florida, any suspect plant found in this area is most likely *Cicuta mexicana*. Although both are deadly poisonous, *Cicuta maculata* is considered more virulent than *Cicuta mexicana*.

Members of *Cicuta* contain resins, alkaloids, and toxins known to be virulently poisonous to people and animals. While all parts of these plants are toxic, the roots and rootstocks are especially deadly.

## Water Hemlock Characteristics

Although members of the *Cicuta* genus are commonly called water hemlocks, several other common names can be associated with this group of plants, including fool's parsley, poison parsnip, wild parsnip, poison hemlock, wild carrot, and spotted parsley. *Cicuta maculata* is also known as American water hemlock, spotted cowbane, beaver poison, snakeweed, musquash root, death of man, and children's bane. Our southern Florida native species, *Cicuta mexicana*, is known simply as water hemlock.

Water hemlock can be found throughout Florida along marshy shores, in swamps and wetlands, in ditches, and in floating mats of vegetation (Figure 1). While it may commonly be found growing as a monoculture, water hemlock also intermingles with other plants.

The 1992 Florida Aquatic Plant Survey Report stated that water hemlock covered 76 acres of public lakes (compared to 47,834 acres of *Hydrilla verticillata* (L. f.) Royle) and 50 acres of public rivers (versus 4,090 acres of *Vallisneria americana* Michx.). Overall, water hemlock was ranked the 74th most common plant found in Florida's public bodies of water.

Stems of water hemlock may have purple striations or stripes; the roots are fleshy and finger-like. Leaves are alternate, with the lower leaves usually ternate-pinnate (with three leaflets) and up to 14 inches in length. The leaflets are oblong-lanceolate to lanceolate-ovate, serrated, and up to 4 inches long individually (Figure 2).

Water hemlock flowers between January and August. The small, white flowers are borne in compound umbels. The rays ("branches" of the umbel) range in length from 0.75 to 3.0 inches long, and the stalk of each individual flower in the inflorescence can be from 0.1 to 0.6 of an inch long (Figure 3).

Fruit of *Cicuta mexicana* is orbicular, constricted at the commissure, and usually 0.08 to 0.012 of an inch long. The fruit has broad, low, corky ribs that are broader than the spaces between the ribs, and has

*Figure 2: Water hemlock leaf. Overall length 5"; leaflets each about 1.5" in length.*

large oil tubes. Seeds are very oily, and have longitudinal grooves or furrows under the oil tubes.

## Deadly Reactions to Water Hemlock Ingestion

Most cases of accidental ingestion of water hemlock have occurred when individuals confuse water hemlock with wild parsnip (*Pastinaca sativa* L.), but others have been poisoned after eating hemlock leaves accidentally collected with watercress (*Rorippa nasturtium-aquaticum* (L.) Hayek). Since all parts of *Cicuta mexicana* are deadly poisonous, it is extremely important to not ingest plants harvested in the wild unless you are absolutely sure of their identity.

Plant ingestion is the fourth most common type of poisoning in the United States, accounting for 15 fatalities and 6.5% of all cases reported to the Poison Information Centers between 1983 and 1992. Most cases of accidental poisoning from plant ingestion were associated with philodendron (*Philodendron* spp.), dumbcane (*Dieffenbachia* spp.), and poinsettia (*Euphorbia pulcherrima* Willd. ex Klotzsch), but no deaths resulted from exposure to these plants. While water hemlock was not one of the ten most commonly reported plant exposures, most fatalities were associated with the ingestion of *Cicuta* spp.

Water hemlocks produce cicutoxin, a violent convulsant shown to be toxic to human beings and all classes of livestock. Ingestion of a root section the size of a peanut can kill an adult human, and a single root is enough to kill a cow.

Symptoms of water hemlock poisoning are not pretty. Within 15 minutes to an hour after ingestion of water hemlock, the victim will experience violent convulsions, seizures, dilated pupils, reddish tinted cyanosis, metabolic acidosis, and unconsciousness; death may occur within half an hour after onset of symptoms. Thanks to the wonders of modern medicine, it is now possible to survive poisoning by accidental ingestion of water hemlock; however, treatment must be swift and aggressive in order to be successful. Recovery is likely if the victim is treated with a combination of hemodialysis, hemoperfusion, forced diuresis, and artificial ventilation.

While the role water hemlock plays in southern Florida's ecosystem is uncertain, they have grown and thrived here for thousands of years and will probably continue to do so for thousands more. Since water hemlock may grow and intermingle with innocuous and edible aquatic plants sometimes collected in the field, correct identification of this beautiful but deadly plant is essential to eliminate the risk of accidental ingestion.

## Acknowledgements

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## References

Literature articles used in the preparation of this article may be obtained by contacting David Sutton. Mailing address: University of Florida - IFAS, Fort Lauderdale Research and Education Center, 3205 College Avenue, Fort Lauderdale, FL 33314; or email dlsutton@ufl.edu

# Fall Application of Sonar* for Selective Eurasian Watermilfoil Control

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## Introduction

One of the aquatic plants causing the biggest nuisance conditions in northern states is the exotic species Eurasian watermilfoil (*Myriophyllum spicatum*). Eurasian watermilfoil, hereafter referred to as milfoil, is a perennial, submersed aquatic plant introduced into the U.S. in the 1940's, which creates water use impacts and environmental concerns due to its ability to outcompete native plants and form a dense canopy on the water's surface. Aquatic managers are continuously searching for new and improved control techniques for this invasive species yet minimize impact on native vegetation. One control technique currently being tested is a fall application of Sonar for selective control of milfoil.

Fall Sonar treatments were first considered when hydrology data indicated that minimum stream flows usually occur in the Midwest and Northeast U.S. in September/October/November. Also, recreational use of northern lakes declines dramatically following Labor Day, so fewer people are impacted by any water use restrictions. In addition, fall Sonar treatments might assure selective control of milfoil because many native aquatic species are annual plants, producing seed or vegetative buds in late summer/early fall and then die or become dormant. Milfoil, in contrast, is a cold water perennial species that remains photoactive during late autumn and even under ice cover. Although it produces seeds, they do not seem to have a role in overwinter survival. Thus, fall Sonar treatments would theoretically provide less dilution/longer contact times due to reduced stream flow, minimize inconvenience to the public, and provide more selectivity due to the dormancy of most native species at this time of the year.

Center Lake (120 acres, 20-ft average depth) in Warsaw, Indiana is a popular recreational lake and is also used as a potable water supply. The north side of Center Lake has an expansive shallow area that supports an abundant amount of submersed plant growth. The Indiana Department of Natural Resources first docu-

**Table 1. Sonar concentrations in water in Center Lake, IN following a 12 ppb treatment on October 11, 1996.**

| Site | Date | | | | | |
|---|---|---|---|---|---|---|
| | Oct 18 | Oct 25 | Nov 8 | Dec 18 | Feb 11 | July 29 |
| DAT[1/] | 7 | 14 | 28 | 68 | 123 | 291 |
| South | 5.9 | 6.4 | 5.8 | 4.0 | 4.6 | 1.0 |
| West | 6.1 | 6.2 | 6.1 | 5.2 | 4.4 | - |
| North | 16.4 | 7.6 | 7.1 | 3.8 | 3.0 | - |
| Mean | 9.5 | 6.7 | 6.3 | 4.3 | 4.0 | 1.0 |

[1/] Days After Treatment

*Sonar is a trademark of SePRO Corporation, Carmel, IN.

mented milfoil in significant amounts in 1976 and it has dominated the flora in Center Lake for many years. Control efforts for the past 20 years have been primarily mechanical harvesting.

## Sonar Application

The fall application of Sonar was completed at Center Lake on October 11, 1996 with the cooperation of the Center Lake Lake Association, City of Warsaw, United Water, Indiana Department of Natural Resources, Indiana Department of Environmental Management, Aquest Corporation, and SePRO Corporation. Sonar A.S. was applied by sub-surface injection using trailing drop hoses from an airboat at a theoretical lake-wide concentration of 12 parts per billion (ppb). Water samples were collected periodically from the lake about 2 feet below the surface at 3 locations to determine Sonar concentrations in the lake. Sampling the littoral zone around the entire lake and collecting vegetation samples was completed on October 11, 1996, March 28, 1997, June 4, 1997, and July 29, 1997. Approximately 100 sampling sites were randomly selected for visual estimates of occurrence. A grapple was used to sample sites where the water was too turbid to see the plants and to sample plants that may have been obscured by the formation of milfoil canopies. The percent frequency of occurrence of a given species was calculated for all of the notation sites according to methods developed at Aquest Corporation. Total frequencies of occurrence, for all species, may be greater than 100% at a given notation site when plant species occupy different layers of the water column.

## Results and Discussion

Sonar concentrations were determined in the water within 48 hours of sample collection and quantified by immunoassay techniques (FasTEST) at SePRO Corporation. The data presented in Table 1 shows that 7 days after treatment (DAT) the south and west or deeper portions of the lake contained about 6 ppb, whereas the shallower north end contained 16 ppb. The mean lakewide concentration measured seven days after application was 9.5 ppb. The target lakewide concentration of 12 ppb was not achieved presumably due to Sonar uptake by plants and possible inaccuracies in determining lake volume. Concentrations of Sonar in the water decreased slowly over the winter and during the period of 7 through 123 DAT, half-lives calculated by regression analysis was estimated at approximately 100 days. A single water sample collected at the boat ramp on July 29, 1997, 291 DAT, contained 1 ppb of Sonar. The lengthy half-life is attributed to reduced photodegradation as a result of ice cover and cloudy days during the winter months.

**Table 2. Percent frequency of occurrence of submersed plants in Center Lake, IN following a fall 1996 treatment of 12 ppb Sonar.**

| Species | Date (MAT)[1/] | | | |
|---|---|---|---|---|
| | Oct 96 (0) | Mar 97 (5) | June 97 (8) | July 97(9) |
| M. spicatum | 100 | 68 | 61 | 5 |
| *P. pectinatus/pusillus* group | 58 | - | 49 | 39 |
| P. illinoensis/gramineus | 37 | - | 25 | 32 |
| P. amplifolius | 2 | 18 | 24 | 25 |
| P. nodosus | 3 | - | - | 36 |
| H. dubia | - | - | 3 | 11 |
| U. vulgaris | 18 | - | - | 9 |
| C. demersum | 25 | 86 | 40 | 32 |
| Najas spp. | 43 | 16 | - | - |
| *Chara sp.* | - | 2 | 25 | 9 |
| Total No. species [2/] | 11 | 5 | 10 | 9 |

[1/]MAT = Months After Treatment

[2/]Submersed species present in at least one sampling time at frequencies of <5% include:*P. crispus, P. richardsonii, E. canadensis, P. praelongus,* and *Vallisneria americana.*

The percent frequency of occurrence of submersed vegetation in Center Lake is presented in Table 2. Species found at less than 5% were omitted from the data set due to their low frequency of occurrence. The thinleaf pondweed species *Potamogeton pectinatus* and those belonging to the *P. pusillus* group were combined into one group. *Potamogeton illinoensis* and *P. gramineus* were also combined due to the difficulty in distinguishing between sterile specimens in Center Lake.

At the time of treatment, milfoil occurred in 100% of samples from throughout the lake. Other species that were commonly found were the two groups of pondweeds (58 and 37%), *Najas spp.* (43%), and *Ceratophyllum demersum* (25%). By June of 1997, milfoil occurrence had decreased to 61%, and a month later to 5%. Submersed plant dominance by mid-summer was shared by the *P. pectinatus/pusillus* group (39%), *P. Nodosus* (36%), *Ceratophyllum demersum* (32%), *P. illinoensis/gramineus* group (32%) and *P. amplifolius* (25%). *Najas spp.* were not found in the lake after spring of 1997. These species produce copious quantities of seed, and although susceptible to Sonar, naiad often recurs a year following treatment. Total number of submersed species present decreased by two from month of treatment (Oct 96) to July 1997. Total number of species present in the March 1997 sample were low due to early time of sampling, prior to active growth and emergence of most native submersed species.

The lake was informally surveyed again in March, 1998, primarily for presence/absence of milfoil, and very little milfoil was discov-

ered. Consequently, it appears that milfoil will remain at very low levels during the summer of 1998. Additional plant surveys will be undertaken in late summer so that any changes in plant populations can be documented.

In summary, preliminary data describing an application of a theoretical lake wide concentration of 12 ppb Sonar A.S. in the fall of 1996 to Center Lake provided at least one year of milfoil control, likely longer, and native species, other than *Najas spp.*, were not adversely affected by the treatments. Further sampling on Center Lake and other fall treatments are being monitored, but it appears that fall applications are effective and should provide another option for environmentally sound management of Eurasian watermilfoil.

## Acknowledgements

The authors would like to thank the Center Lake Lake Association for providing the vegetation data collected by Aquest Corporation, SePRO Corporation for providing the funding, and to all the cooperators for getting this project underway. Dr. Alison Fox reviewed the initial draft of the manuscript and provided half-life analysis of the Sonar residue data.



# AQUAVINE

## GFC News

**Dr. Jerome Shireman**, Director, Division of Fisheries, retired on March 27,1998 after three years of dedicated service to the Game and Fresh Water Fish Commission. **Ed Moyer**, will follow in Dr. Shireman's footsteps as the new Director, Division of Fisheries in Tallahassee. Ed will be moving from the Panama City office where he was the Director for the North West Region. Good Luck Ed!

## USACE News

**Calvin Long**, aquatic plant control applicator for the USACE, Palatka Field Unit recently had a successful kidney transplant. He is expected back at work late Spring. We wish him a speedy recovery!

## USFWS News

**Elizabeth Souheaver** is the new Refuge Manager of the Chassahowitzka National Wildlife Refuge Complex in Crystal River. Part of her responsibilities is overseeing the management of Crystal River Wildlife Refuge where an interagency aquatic plant management plan guides control efforts in manatee habitat.

## Other News

The **1998 Legislative Session** ended with record funding ($15.2 million) for DEP's Aquatic Plant Control Program; however, no recurring funds were established. Additionally, the Bureau of Aquatic Plant Management will remain at DEP

**SePRO** Corporation has purchased A&V (Sussex, WI) aquatics products business which includes algaecide, herbicide and colorant technologies.

### MEETINGS

**North American Lake Management Society, 18th International Symposium, "Cooperative Lake and Watershed Management: Linking Communities, Industry, and Government."**, November 11-13, 1998, Banff, Alberta, Canada, Contact Brian G. Kotak 403-525-8431 or Internet, www.biology.ualberta.ca/alms/1998.htm for further information.

**22nd ANNUAL MEETING OF THE FLORIDA AQUATIC PLANT MANAGEMENT SOCIETY**

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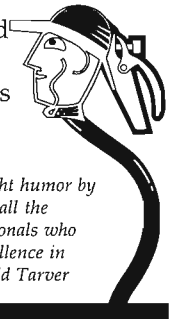

** Copyright © and Disclaimer! Hopefully to be considered as light humor by most, this column is written for all the hardworking and caring professionals who dedicate their work afield to excellence in aquatic plant management. David Tarver*

# Funny how some traditions just feel natural.

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Source: Van Thai, K., et al, *Weed Science.* 1987. Volume 35: 247-252.

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