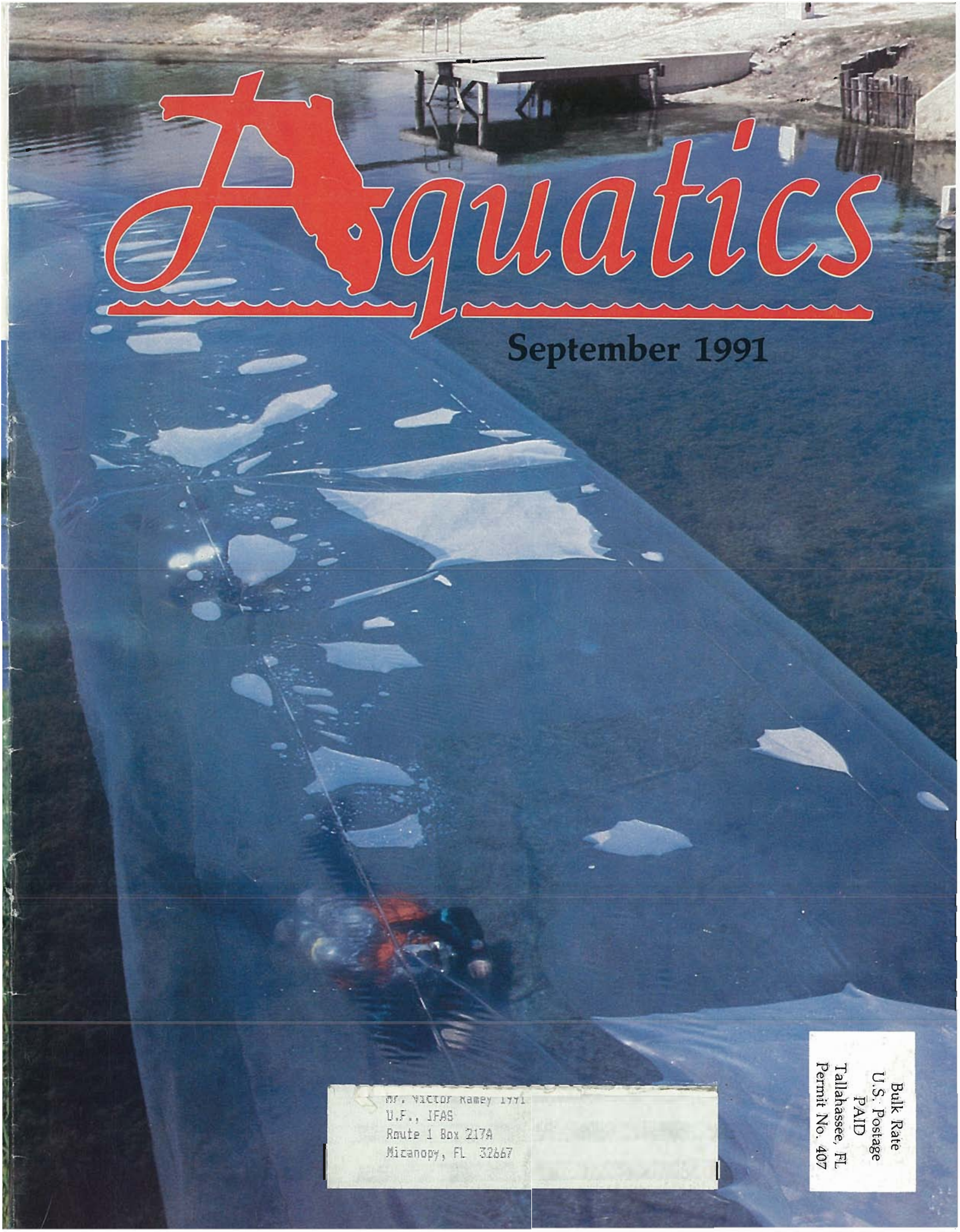
Aquatics

September 1991



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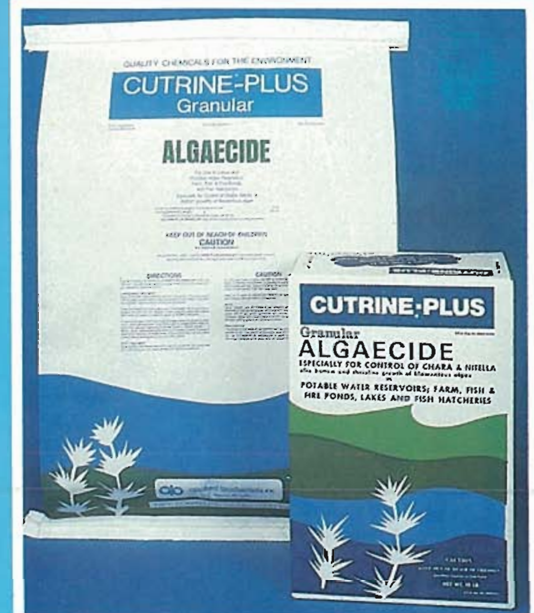

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Editorial

USE GOOD JUDGEMENT IN INTERPRETING AQUATIC HERBICIDE LABELS. A famous person, I think it was either Will Rogers or Carlton Layne, once said, "When the law becomes black and white, we no longer have democracy." This also applies to the interpretation of aquatic herbicide labels.

Herbicide labels contain much information such as use directions and restrictions intended to protect the user, the environment, and the general public. We also know, "The label is the law." But the law is not black and white, so therefore labels are open to interpretation.

I am often asked to interpret herbicide label statements. Questions usually arise concerning where and when a herbicide can be applied. These questions usually can be easily answered by considering the intent of the statement. For example, the Aquazine label states, "Apply Aquazine before water temperature exceeds 75 degrees Fahrenheit (22 degrees Centigrade)." This statement leaves room for the user to determine when, where, and how water temperature is measured. In the context of the label, the intent of this statement is clearly to prevent fish mortality from oxygen depletion. Therefore, if the user's water temperature measurements indicate that water temperature and other factors are unlikely to cause fish mortality, my interpretation is that the label statement has been fulfilled. Of course, if a fish kill occurs, the user's methods and judgement are subject to question.

Unfortunately, herbicide label statements are sometimes interpreted poorly. One example is herbicide use in areas not intended by the product maker. Another is regulatory agencies disallowing the use of certain herbicides where the maker did intend the product's use. For example, permit requests for use of Hydrothol 191 have been denied because of the label statement, "Do not use where fish are important resources." The intent of this statement is to prevent fish mortality because the herbicide can be toxic to some fish at high application rates when an entire water body is treated. Competent applicators can use this product for partial treatments, such as boat trails in large lakes, without causing fish mortality. Therefore, my interpretation is that when good judgement leads to Hydrothol 191 use which controls the target plant and does not kill fish, then this label statement has been satisfied.

I urge all aquatic herbicide users and regulatory personnel to use good judgement in herbicide label interpretation with special regard to the intent of the statement so that we can use all aquatic herbicides to their maximum safe potential.

—Ken Langeland

About The Cover

Daring divers were encased in a mysterious tube in Vortex Spring, Holmes County, while engaged in the work described in Leslie and Van Dyke's article in this issue.

Photo by Jess Van Dyke, Dept. of Natural Resources, Tallahassee

Aquatics

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CONTENTS

AQUATICS: Published quarterly as the official publication of the Florida Aquatic Plant Management Society. This publication is intended to keep all interested parties informed on matters as they relate to aquatic plant management particularly in Florida. To become a member of FAPMS and receive the Society newsletter and Aquatics magazine, send $10.00 plus your mailing address to the Treasurer.

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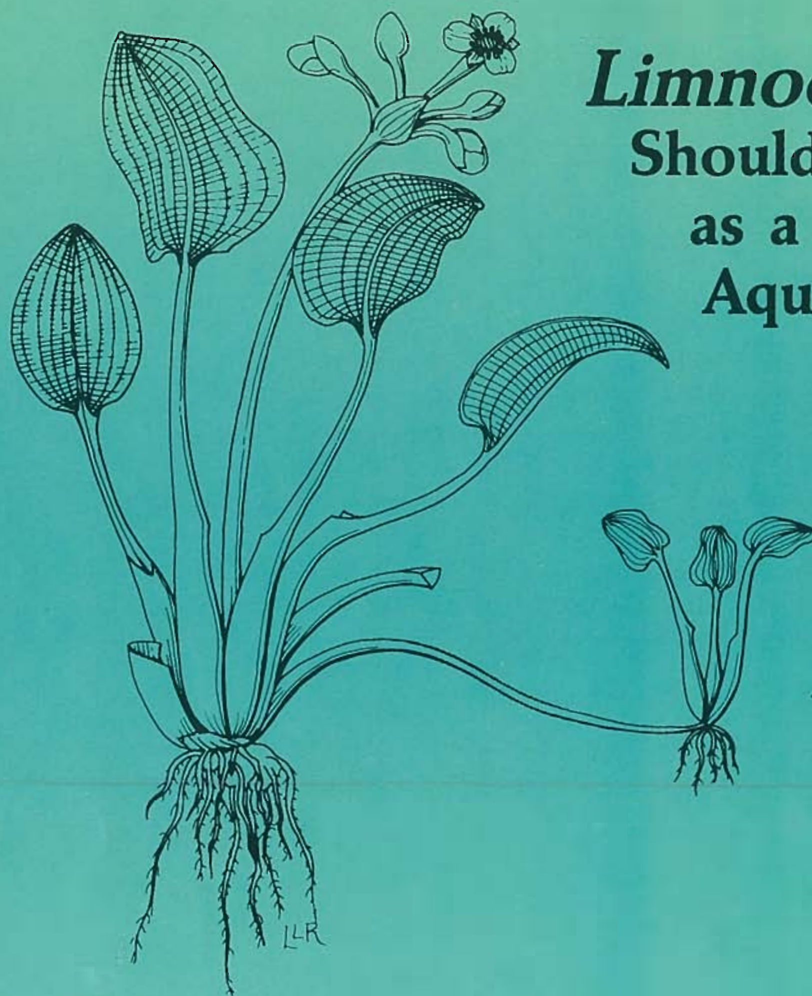

Limnocharis flava: Should It Be Listed as a Prohibited Aquatic Plant?

by
J. Douglas Oliver
Biological Scientist
Florida Department of
Natural Resources
Bureau of
Aquatic Plant Management
Tallahassee, Florida

Figure 1. Adult *Limnocharis flava,* drawn by Laura L. Reep. Reprinted with permission from Ramey (ed.), 1991.

Introduction

Limnocharis flava (L.) Buchenau is a little-known exotic aquatic plant now being considered for the prohibited plant list of the Florida Department of Natural Resources. A member of the Butomaceae (the flowering-rush aquatic family), it was thought to be present in South Florida (Godfrey and Wooten, 1979): However, recent reports do not list the presence of the plant in Florida public waters, at least not yet. For example, Schardt and Nall (1989) list more than 100 species from public waters, but not *L. flava*. There are no herbarium specimens from the United States in relevant collections such as those of Florida State University, the University of Florida, Louisiana State University, and Cornell University (pers. comm., Drs. L.C. Anderson, D. Hall, L. Urbach, and W.J. Dress respectively, 1990).

The common names of *Limnocharis flava* are water cabbage, velvet leaf, and sawah flowering rush (Achmad, 1971). As the name water cabbage suggests, the plant is used for human and animal food in some parts of the globe (Ramey, 1990). It has been introduced in various parts of the world as an ornamental plant, and is grown in aquaria and artificial ponds (Godfrey and Wooten, 1979). In Sri Lanka, many people think that the leaves cure rheumatism when the plant is eaten as a partly cooked salad (Kotalawala, 1976). Thus water cabbage has been deliberately introduced to many areas of the world.

L. flava is a native of the West Indies or South America, and was described by Carolus Linneaus, the father of modern biology. It has been introduced to southeast Asia, including India, Thailand, Burma, Malaysia (Kammathy and Subramanyam, 1967), Indonesia (Achmad, 1971), and Borneo (Kaul, 1967). Kotalawala (1976) wrote that in Sri Lanka (Ceylon), it was introduced into paddy fields and spread as a weed. Dassanayake (1976) lists *Limnocharis flava* as one of the three most troublesome weeds in Sri Lanka (behind *Salvinia auriculata* and *Eichhornia crassipes*). When a pasture was converted to a paddy field in Indonesia, 56 weedy plants grew, of which *Limnocharis flava* was one of three dominants (Simbolon, 1985).

L. flava is an emersed perennial aquatic herb with erect triangular stalks which flatten at the bases (Figure 1). The stalks frequently end in broad or lance-shaped leaves, each of which are about 2.5 - 8 inches (6 - 20 cm) long. These leaves have tapering leaf bases and four veins on each side of the midrib which converge at their tips (Ramey, 1990). When flowering, the plant has umbrellalike flower clusters.

L. flava can be distinguished from *Butomus umbellataus* (flowering-rush) by morphology (Stant, 1967, Kaul, 1976, Wilder, 1974) and by geographic distribution: *B. umbellatus* is found in cold regions such as the northern tier states and Canada (Boutwell, 1990), whereas *L. flava* survives only in warm regions.

Juvenile individuals of *Limnocharis flava* are submerged, but adults are emergent. They often occur in floating mats of vegetation (Cook, 1990).

At least 80% of the total plant volume is occupied by air-containing intercellular spaces (Stant, 1967). Thus the plant has abundant aerenchyma and some buoyancy, as well as partially aerial leafy shoots.

Ecology and Ecological Impact

Limnocharis flava is an emergent plant of quiet shallow waters (Kaul, 1978). It frequently grows along margins of canals (D.C. Schmitz of the Bureau of Aquatic Plant Management, pers. comm.) In Indonesia, it outcompetes and rapidly dominates native vegetation under flooded conditions in and around rice fields. It is difficult to control because it also can survive during dry conditions.

After flowering, the plant's inflorescence bends into the water and releases mature follicles containing seeds. Many follicles float but most sink immediately. Each follicle eventually opens and most seeds fall out and sink to the bottom. Some seeds germinate quickly whereas others germinate at various times over as long as several months (Kaul, 1978). Some follicles float for months and tend to move toward shore, where the seedlings and adults can thrive. Seeds that stay within a follicle disperse as it floats across water bodies.

Seeds have long periods of survival and can germinate when the seed coats break and the environment is favorable (Kaul, 1978). Thus in this shallow water species, wide dispersal and persistence is possible, in an intermittently wet environment.

On the other hand, *L.flava* is not winter hardy where frosts occur (Muenscher, 1944). Perhaps this lack of cold tolerance has resulted in local extinctions or die-backs of the plant.

L. flava can colonize wetland and littoral areas, where it can quickly come to dominate. Useful native aquatic plants may be replaced by this exotic invader, and the natural ecological balance may be altered. Accompanying water-dwelling animals also may be seriously impacted.

In rice fields, "A vigorous drainage... to clear the [*Limnocharis flava*] weeds from the paddy fields is likely to be very helpful in controlling these weeds" (Kotalawala, 1976). This quote suggests that deliberate control of the hydrology of some flooded areas can help to control *L. flava*.

Flowering rush, *Butomus umbellatus*, can be controlled by various herbicides. Boutwell (1990) states that good control of submerged flowering rush has been obtained using fluridone applied to ponded water. If wildlife is not a consideration (and in jurisdictions where it is legal), acrolein can control flowering rush in flowing water such as canals. Emergent and terrestrial flowering rush can be controlled well by herbicides such as glyphosate and bentazon, sometimes accompanied by a non-ionic surfactant (Boutwell, 1990, Kiessling et al., 1981). Thus it is plausible that *Limnocharis flava* also can be controlled by herbicides.

Reproduction

Water cabbage is propagated mainly by seeds, which often are carried by man. Sometimes agricultural implements or mud on the feet of birds also move the seeds to new areas (Kotalawala, 1976).

Limnocharis flava produces a tremendous number of seeds. In Sri Lanka, it produces them throughout the year: a single fruit produces about 1,000 seeds, and one plant may yield up to 1,000,000 seeds per year (Kotalawala, 1976).

The plant also expands vegetatively. An inflorescence can lose all of its flowers and fall on its side. It then sends up a young vegetative axis and sends down roots from the tip of the former inflorescence, finally becoming detached (Wilder, 1974).

We might expect vegetative reproduction to have another significant effect on dispersal and survival. Besides providing a means of increase, this method of reproduction usually decreases efficacy of herbicidal control, and might not be very vulnerable to mechanical means of control. For example, mechanical cutting of horizontal shoots by agricultural or other implements could result in the immediate production of small independent plants. Thus the reproductive methods of *L. flava* are doubtless very significant to its status as an exotic aquatic weed.

Economic Impact

Limnocharis flava is sold commercially as an ornamental aquatic plant. For example, Wilder (1974) mentioned that he bought living cultivated plants from a northern U.S. address. Residents of Florida and other states can currently buy plants shipped from a major nursery in the Midwest (pers. comm.) Thus the plant has potential access to Florida natural ecosystems.

Water cabbage is unusual in that it has a serious economic impact on buth agricultural and aquatic ecosystems. Agriculturally, the plant can be a pest, competing with rice in flooded fields, and thus having a negative impact as an agricultural weed. In rice fields, it uses up fertilizers applied to the fields, multiplies quickly, and renders large areas out of production.

Limnocharis flava is considered a weed in several warm nations of the world. For example, it is a "serious weed" in Indonesia and Malaysia (Holm et al., 1979). It is also a weed of the margins of canals. *Limnocharis* reduces the width of irrigation and drainage channels and traps silt (Kotalawala, 1976). Thus it has economic costs.

In terms of the economics of aquatic systems, *Limnocharis flava* competes with native aquatic plants that provide good cover and food for fish and wildlife. Thus the plant could have a negative economic impact on money-generating sport fisheries. This in turn could have a negative economic impact on tourism.

Conclusions

Limiting the spread of *Limnocharis flava* would have a positive effect on native aquatic plants, flood control and irrigation, and other matters mentioned above. Decreasing the availability of this weed to flooded agricultural systems (such as the rice fields of some regions), would be a valuable side-benefit.

"Limnocharis [*flava* plants of Sri Lanka]. . . occupied small areas in the beginning but . . . undesireable delay in recognizing . . . weed potential and failure to control them, has helped their spread to a very large area" (Kotalawala, 1976).

Acknowledgments

I thank Greg Jubinsky of the Bureau of Aquatic Plant Management for advice. Don C. Schmitz of the Bureau provided comments and citations. Karen Brown of the Aquatic Plant Information Retrieval Service of the University of Florida provided a valuable computer search of the literature.

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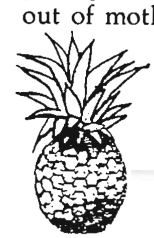

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Aerial ignition of Lake Okeechobee's northwestern marsh using the "ping-pong ball" system.

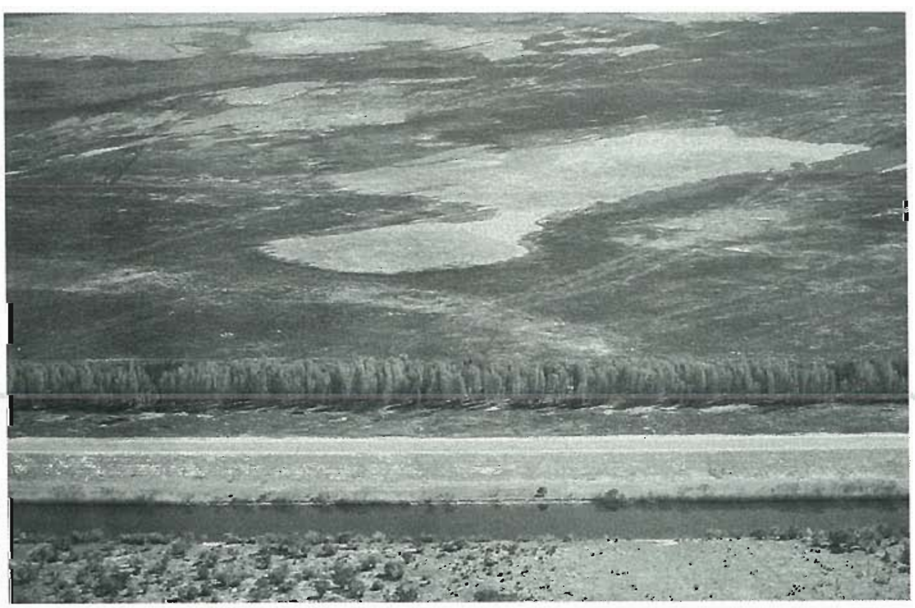
Prescribed Burning Program for Lake Okeechobee Marshes or Hot Times on the Big "O"

by
Donald D. Fox
Biological Administrator
Florida Game & Fresh Water Fish Commission
Okeechobee, Florida

A thick acrid smoke billows skyward, turning the sun into a cherry red sphere. A helicopter, at times only a precarious few feet above the flames, darts back and forth over the blazing landscape. Piercing eyes search the sky for telltale signs of changing weather. Two-way radios crackle with status reports and personnel assignments. Television crews busily setup cameras while correspondents scribble notes. This scenario is played out all too often as wildfires develop throughout Florida during the drier seasons and droughts. However, this particular event is not a wildfire. It is a "prescribed burn" of the marshes of Lake Okeechobee.

Many individuals view fire as a destructive force; however, in the natural setting, fire is an inherent factor directing the evolution of an ecosystem (Wade and Lunsford 1989). Throughout Florida, many ecologically diverse aquatic and terrestrial biotic communities evolved under a fire regime. Fire is a major factor structuring plant communities within pine uplands, saw-palmetto flatwoods, savannahs, and the Everglades (Robbins and Myers 1989). Fires assist in maintaining ecological diversity in wetland and marsh communities by altering or retarding successional states (Kirby et al. 1988). If a wetland ecosystem is to remain biologically healthy and viable, it must undergo intermittent change (Mitsch and Gosselink 1986). When an area experiences a fire event all plant communities are not affected equally, this results in a mosaic regrowth pattern that provides increased habitat diversity and enhances biological integrity.

The Lake Okeechobee Littoral Zone Technical Group (LOLZTG) first recommended development of a prescribed burning program for Lake Okeechobee marshes. This panel of aquatic scientists from state, federal, and private sectors was assembled by the South Florida Water Management District (SFWMD) to evaluate the condition of Lake Okeechobee littoral zone plant communities, and their attributes as fish and wildlife habitat. LOLZTG determined that available data indicated the current Lake Okeechobee water regulation schedule (15.5-17.5 ft. MSL) had altered the littoral zone (LOLZTG 1988). These changes included an overall loss of wading bird and waterfowl feeding habitat, and a decline in spikerush *Eleocharis* spp. and beakrush *Rhynchospora* spp. communities that serve as prime nursery areas for young gamefish and provide important habitat for forage fish and macroinvertebrates (Powell et al. 1983; Zaffke 1984; Milleson 1987, 1988). Other alterations were a decline in willow which provides rookery sites for wading birds and endangered snail kites *Rostrhamus sociabilis* (Zaffke 1984), and loss of moist soil annual plant production (Milleson 1987). Substantial loss of desirable fish and wildlife habitat has been ascribed largely to increases in density and coverage of torpedo grass *Panicum repens* and cattail *Typha* spp. (Milleson 1987; Shireman et al. 1990). These species form dense monotypic stands that preclude foraging by birds, and when inundated, usually support low dissolved oxygen concentrations. Optimum fish and wildlife habitat is attained when a marsh consists of a diversity of plant communities. Plant diversity and a mosaic distribution pattern assures a variety of available food plants, forage organisms, and cover sites (Mitsch and Gosselink 1986; Kirby et al. 1988). The present water level regulation schedule has created favorable conditions for cattail and torpedo grass expansion due to reduced competition with desirable plant species which are less resilient to prolonged inundation under current hydroperiod conditions. Cattail and torpedo grass coverage has increased 49 percent and 12 percent, respectively, from acreages estimated during 1977 vegetation surveys (Shireman et al. 1990). Within Lake Okeechobee marshes, dense cattail and torpedo grass collectively comprise 45% of emergent plant coverage, or approximately 33,860 acres and 10,680 acres, respectively (Shireman et al. 1990). Standing stock biomass has been measured at dry weights of 11 ton/acre for cattail and 16 ton/acre for torpedo grass (Shireman et al. 1990). The final LOLZTG report submitted in December 1988 recommended the implementation of a lower lake schedule (14.0-16.0 ft. MSL) to enhance and preserve fish and wildlife habitat values in the littoral zone of Lake Okeechobee (LOLZTG 1988). In addition, LOLZTG proposed a supplemental management plan to control nuisance cattail and torpedo grass, as a lower lake regulation schedule alone would not be effective in altering these plant communities. In the interim plan, prescribed fire was suggested as a potential tool to manage cattail and torpedo grass communities.



Mosaic burn pattern resulting from fire in Indian Prairie marsh area of Lake Okeechobee.

In addition to habitat enhancement, a prescribed burning program reduces the probability of "wildfire" situations through fuel consumption under controlled conditions (Wade and Lunsford 1989). Historically, the marshes and wetlands of Lake Okeechobee have been susceptible to periodic burning. Lightning has caused many of these fires; however, in recent years many fires have been the result of illegal activities of humans. Whether intentionally set, or of natural origin, these wildfires rarely occur when conditions are optimum for safe management. Uncontrolled fires within the Lake Okeechobee levee system create unwanted expenditures of manpower and support resources to prevent and minimize damage to private and government property. Also, wildfires create dangerous smoke conditions that can threaten population centers and transportation routes (PFF EWT 1985). Prescribed fire is the most practical manner to reduce dangerous accumulations of fuels, and under properly selected conditions, smoke direction and duration can be managed to achieve minimal impacts (Wade and Lunsford 1989).

Strict rules and regulations govern the use of prescribed fire, and all prescribed burns must be permitted by Florida Division of Forestry (FDACS 1989). Of foremost and utmost concern, are potential impacts upon populated areas. When fire is intentionally started, there are specified legal liabilities. Burners are responsible for inadvertent destruction which results from the fire and also are liable for damage which results from smoke generated by a prescribed burn (FDACS 1989). Heavy smoke can aggravate respiratory problems, cause accidents on highways, impact airports, and interfere with normal activities in schools, residential areas, hospitals, and industrial complexes (PFFEWT 1985). The burner is responsible for all products of a prescribed fire until the burn is extinguished completely. This includes residual smoke from smoldering trees, or ignited pockets of organic soils. A prescribed burn must be planned to utilize prevailing winds for proper smoke management, and the burner must know the fuel types and loads in the burn area (Wade and Lunsford 1989).

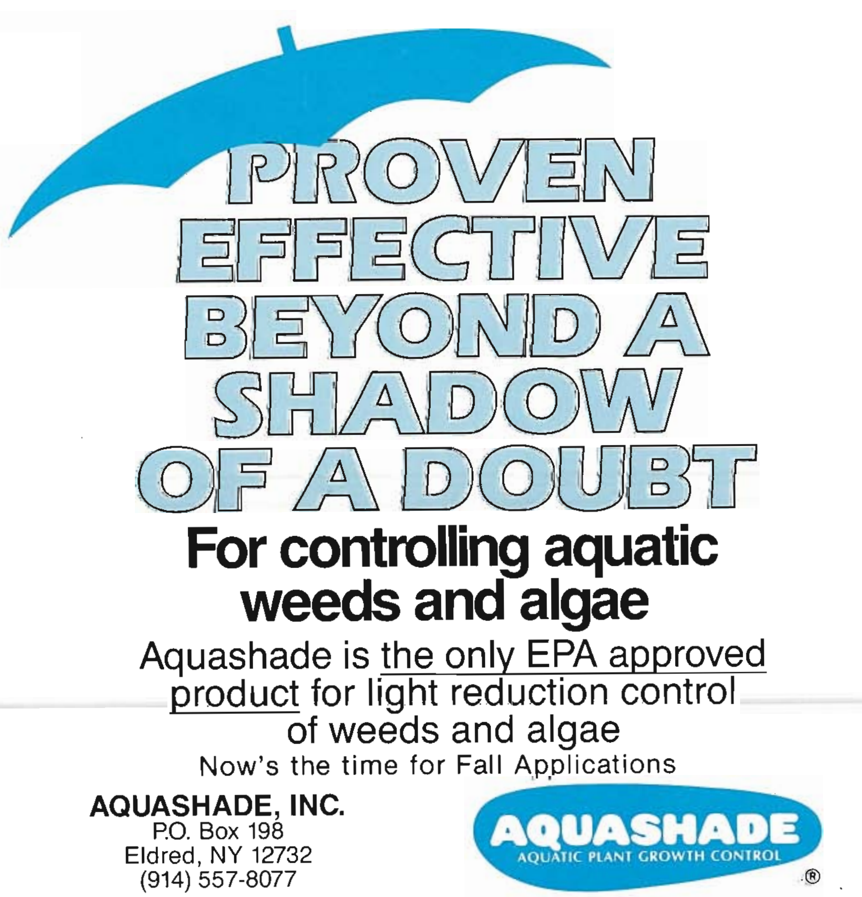
The drought during 1989 in south Florida and subsequent below normal water elevations in Lake Okeechobee provided the opportunity to use prescribed fire. To capitalize on the situation, a planning and coordination meeting was held in January 1989 to solicit input in development of a prescribed burning program for Lake Okeechobee marshes. To ensure all possible concerns were addressed an interagency multi-discipline approach was adopted. The planning meeting included representatives of SFWMD, Florida Game & Fresh Water Fish Commission (FGFWFC), U.S. Army Corps of Engineers (USCOE), U.S Fish & Wildlife Service (USFWS), Department of Environmental Regulation (DER), Department of Natural Resources (DNR), Division of Forestry (DOF), University of Florida (Cooperative Fish and Wildlife Research Unit), and the Audobon Society.

The primary concern in development of a prescribed burning program for Lake Okeechobee marshes was avoiding detrimental impacts to populated areas and transportation routes. However, a prescribed burn must also be planned to ensure minimal direct adverse impacts upon wildlife populations. In regard to wildlife, the greatest concern is for disruption of reproductive efforts. Many species of wading birds, as well as the endangered snail kite, nest in Lake Okeechobee marshes, as do alligators and waterfowl. Within Lake Okeechobee willow communities which provide bird rookery sites have been impacted adversely by excessive inundation under the present water level regulation schedule (Zaffke 1984). Therefore, during burning, extreme caution would be necessary to protect known and potential rookery sites from additional stresses.

After all issues were considered, a workable prescribed burning program was developed for Lake Okeechobee marshes. The north and northwestern marshes were selected for management with prescribed fire. These areas contain vast acreages of dense cattail and torpedo grass. Private land use adjacent to these marshes was prodominately improved pasture, therefore, risk for costly property damage would be slight should a spot fire develop. Also, the potential for residual smoke problems was low as large fuel items such as melaleuca trees are sparse in these areas and the soils are predominately sand, containing little peat or muck. Levee borrow canals (rim canals) and water control canals in the area provided excellent control lines for fire breaks.

December through early-March was selected as the optimum period to assure full advantage of prevailing northerly winds for fire control and smoke management. The prevailing winds would place dangerous smoke concentrations over open water areas of Lake Okeechobee. This would permit smoke to disperse to higher altitudes and dissipate prior to reaching smoke sensitive populated areas. Impacts on nesting wildlife would also be minimized during the December-March period.

The inaccessibility and swampy nature of the marsh areas of Lake Okeechobee selected for management with prescribed fire would not permit use of ground equipment for construction of control lines utilized in standard burning techniques. Other than a baseline constructed along the levee, fire barriers were existing physical features, such as canals and the lake itself. Each prescribed fire event on Lake Okeechobee would likely result in the burning of several thousand acres. An aerial fire ignition technique was selected due to equipment availability and its many attributes.



The specific firing system chosen was the delayed aerial ignition device (DAID), which is more commonly known as the "ping-pong ball" system (Wade and Lunsford 1989). The DAID system uses plastic spheres which resemble ping-pong balls. Each ball contains the compound potassium permanganate. The balls are loaded into a mechanical dispenser which is mounted in the rear seat of a helicopter. During firing operations the dispenser injects each ball with ethylene glycol prior to being jettisoned. The two chemical agents react to produce a flame that ignites the plastic ball, and subsequently the surrounding fuel loads. DAID has many operational advantages. Large acreages can be ignited in a single burning period, and the rapid firing technique greatly reduces the time needed for an area to burn out, therefore, allowing for a narrower burning time frame (Wade and Lunsford 1989). Smoke is emitted over a shorter period of time, and more smoke is entrained in convection colums where it is transported to higher altitudes (PFFEWT 1985). The DAID technique safeguards sensitive areas, such as bird rookery sites, from damaging head fires because back fires may be set to create burned out fire breaks. In addition, mosaic burn patterns can be created to enhance habitat diversity, and of utmost consideration, DAID is economical.

Delayed Aerial Ignition Device (DAID) aboard the GFC helicopter.

The first prescribed burn of Lake Okeechobee marshes was accomplished in early March 1989. In a

Control fire lines are set at the lakeward base of the Lake Okeechobee levee as fire breaks.

two day period approximately 7,500 acres were burned between Indian Prairie Canal (C-40) and Harney Pond Canal (C-41). A water level elevation of 13.5 feet MSL prevented the desired intensity and expansion of fire into the cattail community. Variable and unpredictable winds in conjuction with initiation of bird nesting activities prevented additional prescribed burning in 1989.

In early February 1990, a prescribed burn of approximately 12,000 acres was accomplished. The 1990 burn encompassed North Lake Shoal (King's Bar) and the marsh between Kissimmee River (C-38) and Indian Prarie Canal (C-40). A lake elevation of 12.4 feet MSL allowed for a much more complete burn of torpedo grass and cattail communities. Aerial reconnaissance revealed an estimated 75 percent of marsh habitat in the target area was burned. The 1990 burn was accomplished in a relatively short period of time. From the initiation of back fires to total burn out required only six hours.

During the Lake Okeechobee prescribed burns, Division of Forestry personnel provided supervisory authority, technical assistance, and fire suppression equipment and personnel. The U.S. Army Corps of Engineers established control lines at the lakeward base of the levee. These control lines provided a baseline from which to back fire before aerial ignition and served as a fire break for levee protection. Also, the Corps provided and manned the majority of fire suppression equipment utilized during prescribed burns. Florida Game & Fresh Water Fish Commission provided DAID dispensing equipment and ignition devices, dispenser operators, and helicopter support. Commission personnel also assisted in initiation of back fires and manned fire suppression equipment when needed. Also, Commission Wildlife Officers provided security and crowd control during burning operations.

Effects of fire on the marsh ecosystem of Lake Okeechobee are being analyzed by researchers from the Cooperative Fish and Wildlife Research Unit at the University of Florida. This investigation is a component of a much larger project entitled, "Ecological Studies of Littoral and Pelagic Systems of Lake Okeechobee", and is funded by the South Florida Water Management District.

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No One Wants A Fish Kill: Fish Can Live When Using Hydrothol 191 in Weed and Algae Control

by
Bill Moore
Atochem North America, Inc.

Introduction

Since the 1960's several million pounds of Hydrothol 191 have been applied on thousands of acres of submerged aquatic weeds and algae in Florida without killing fish and without any adverse effects to the environment. The use rates have generally ranged from 0.5 to 2.0 ppm in liquid, granule, or pellet formulations. For many years Hydrothol 191 was a primary tool for hydrilla control in many large natural lakes, as well as canals. Fish kills are avoided by trained applicators using methods described in this article.

Endothall acid is the active ingredient for both Aquathol K and Hydrothol 191. It is formulated as an inorganic potassium salt in Aquathol K and as an alkylamine salt in Hydrothol 191. The amine salt gives Hydrothol 191 its algicidal properties but also increased fish toxicity. Aquathol K has a wide margin of safety to fish.

Under laboratory conditions, Hydrothol 191 has been shown to be toxic to some fish species at rates in excess of 0.3 parts per million. Under actual field conditions, proper use results in rare or no fish kill. Any changes to the ecosystem which may occur during the weed treatment period are of short duration, and fish will quickly return to the treated area. Endothall acid degrades rapidly and completely into naturally occuring by-products based on the elements: Carbon, Hydrogen and Oxygen.

Algae Control

Hydrothol 191 is not toxic to fish at the recommended algicide rates of .05 to 2.0 ppm. In six feet of water this equates to: 16 to 65 pounds of granular, or 3.3 to 12.9 pints of liquid formulation per surface acre. Large areas can be treated at these rates without harming fish. For marginal or spot treatments 0.3 to 0.8 ppm may be required for effective control.

Submerged Weed Control

Labeled rates of Hydrothol 191, as a herbicide, are 0.5 to 5.0 ppm. Rates of 0.5 to 1.5 ppm are generally all that is required for controlling the following plants: hydrilla, milfoil, coontail, pond weeds and niad. Higher rates may be required for vallisneria, elodea, cabomba, hydrophila and limnophila.

Hydrothol 191 can be applied at herbicidal rates without harming fish by consideration of the following:

1. **Sectional Treatments:** Apply in strips or blocks. Fish detect the presence of Hydrothol 191 and are repelled at rates that may be toxic. Apply products from the shoreline out. Do not trap fish in treated area. Do not treat more than one-tenth of a lake or pond at one time with rates in excess of 1.0 ppm. In canals, do not treat more than one third of width with rates in excess of 0.5 ppm with the liquid, or 1.0 ppm with the granular formulation.
2. **Placement:** Use long weighted trailing hoses to place the herbicide as close as possible to the bottom. This will allow you to reduce the rate and give fish more space to swim away from the treated area (By swimming over, as well as around). Some organizations have recently had success inverting Hydrothol 191 for better placement and slower release.
3. **Formulation:** The granular formulation has been shown to be less toxic to fish than the liquid formulation. The herbicide is concentrated on the bottom, and active ingredient is released at a slower rate.
4. **Herbicide Rate:** Use the lowest application rate required to control the target weed species. In most cases this will be 0.5 to 1.5 ppm.
5. **Water Temperature:** Hydrothol 191 is less toxic to fish in cooler water (less than 65°F).

Oxygen depletion from decaying vegetation can kill fish. Always insure that fish have adequate dissolved oxygen in the water before any herbicide treatment. Hydrothol 191 kills weeds rapidly.

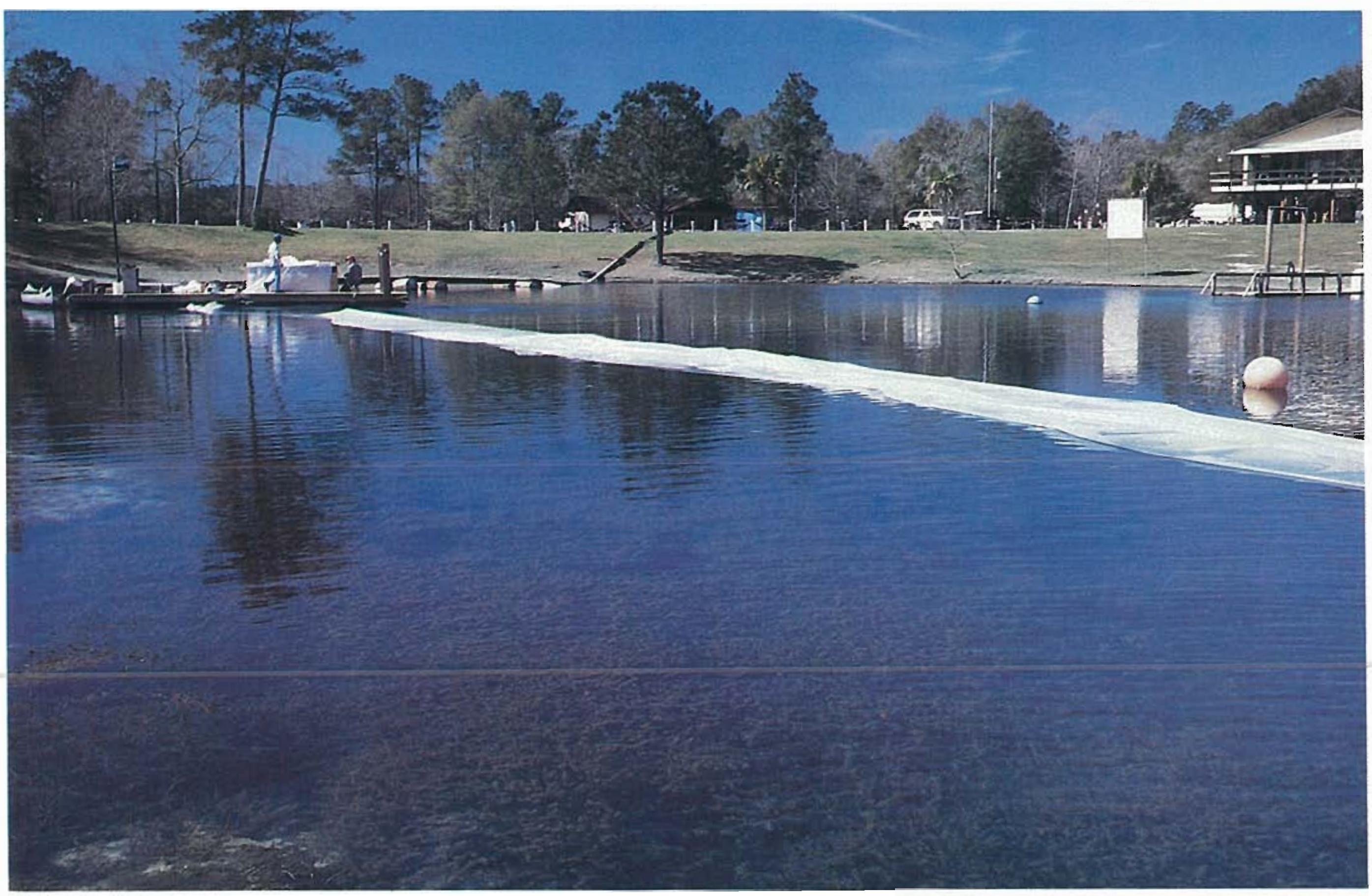
With the interest today in the use of non-persistent pesticides, consideration should be given to those products that satisfy this criterion. Endothall biodegrades rapidly into naturally occurring by products. It will not leave residues, accumulate in the hydrosoil or food chain, or move significantly from the treatment site in a lake or pond. Submerged weeds and algae can be controlled without harming emerged plants.

Efficacy, environmental considerations, historical use, and scientific evidence demonstrate that Hydrothol 191 is a valuable tool for aquatic plant and algae management. It has been, and is, used effectively without harming fish.

Success in Flowing Water with the "Aqua Control Sleeve"

by
Andrew J. Leslie and Jess M. Van Dyke
Florida Department of Natural Resources
Aquatic Plant Management
Tallahassee, Florida

Over the last ten years, great strides have been made in managing submersed aquatic plants in all areas except flowing waters. In flowing water, herbicide contact time may be insufficient to achieve effective weed control. Management options are reduced to reliance on contact herbicides to open up boat trails and swimming areas, where flows are low enough to ensure sufficient contact time, or on mechanical harvesters in high flow areas. Recent research has focused on slow-release herbicide pellets, adjuvant technology (finding a better "sticker"), benthic barriers, advanced harvesters, continuous drip herbicide systems, novel application timing, etc. Although these technologies have been partically successful, insufficient contact time continues to frustrate aquatic plant managers using herbicides in flowing systems. A recent innovation, however, has great potential to solve the herbicide efficacy problem in flowing water, at least for some applications. A device coined the "Aqua Control Sleeve" and patented by inventor/entrepreneur Darryl Dockery, is designed to channel the entire flow of a canal, spring or river through a vinyl tube. Theoretically, the water outside the tube becomes static, allowing the aquatic



"Aqua control sleeve" being installed in Vortex Spring to divert the spring's flow 2,000 feet downstream. This allowed effective weed control in the main spring and spring run.

plants to be effectively treated with conventional herbicide techniques. On March 11, 1991, we tested the prototype at Vortex Springs, in northwest Florida.

Test Site

Vortex Springs, a commercial diving/swimming resort, is located three miles north of US Highway 90 on Highway 81 near Ponce de Leon, Florida. The spring has high water flow (25 million gallons per day) through a narrow spring run (20-30 ft. across, 4-6 ft. depth). The spring head basin (0.75 a) averages about 30 ft. in depth (maximum depth 62 ft.). The 2,900 ft. spring run and spring head basin total about 2.7 a. Water temperatures are typically 68°F.

Hydrilla, first noticed in 1986, rapidly dominated the system. From October 1986 to June 1987, 145 triploid grass carp were stocked but control was not achieved in the constantly cool waters of Vortex Springs. By March 1991, the spring head basin had a 40% cover of hydrilla to 30 feet water depth. The spring run contained a 95% cover which surfaces in the summer.

Methods and Materials

The device consisted of an inflatable collar constructed on-site to fit into and seal the spring cave mouth, a manifold constructed on-site to adapt the collar diameter down to the 10 ft. diameter, 150 ft. long sections of tube. The device is made of 12-mil, 3-ply, virgin, extruded vinyl which is very resistant to tearing. All sections were put together on-site by divers, and joints are heat sealed.

The study site was divided into two sections: 1) spring head basin and 900 feet of spring run, and 2) the remaining 2,000 feet of spring run. In late February 1991, large vinyl manifolds were put in place across the run at the start and end of section 2. Two thousand feet of ten foot diameter tubing was attached in 150 foot sections. The installation effectively channeled all of the water flow through the tube, isolating section 2 from the rest of the spring run. Water outside of the tube became static and tannic colored (probably from groundwater seepage). On March 11, 1991, another device was placed in the spring mouth and its terminus manifold attached to the intake manifold of section 2. The tube very effectively shunted all of the spring flow through the tube; the water at the spring head became visibly static.

Section 1 (1.6 acres) was treated with 24 gallons of Aquathol K, 3-quarts of Nalquatic, and 3-quarts of Aquashade. Aquathol was used to test efficacy of contact herbicides and to minimize the down-time of the spring for commercial recreation. The Aquashade served to delineate treated areas to ensure evenness and to determine the amount of waterflow. The dye dispersed evenly, and did not move downstream. Treatments in Section 1 were conducted by Applied Aquatic Management, Inc. The Aqua Sleeve was removed from Section 1 after three days.

Section 2 (1.1 acres) was treated with 40-lbs. of Sonar SRP per acre. The Aqua Sleeve had been in place for 10 days prior to treatment, the water was colored, static, and well-oxygenated. Filamentous algae coated the plants and the Aqua Sleeve. The Sonar was supplied and applied by David Tarver of DowElanco, Inc. The device was removed 43 days after treatment.

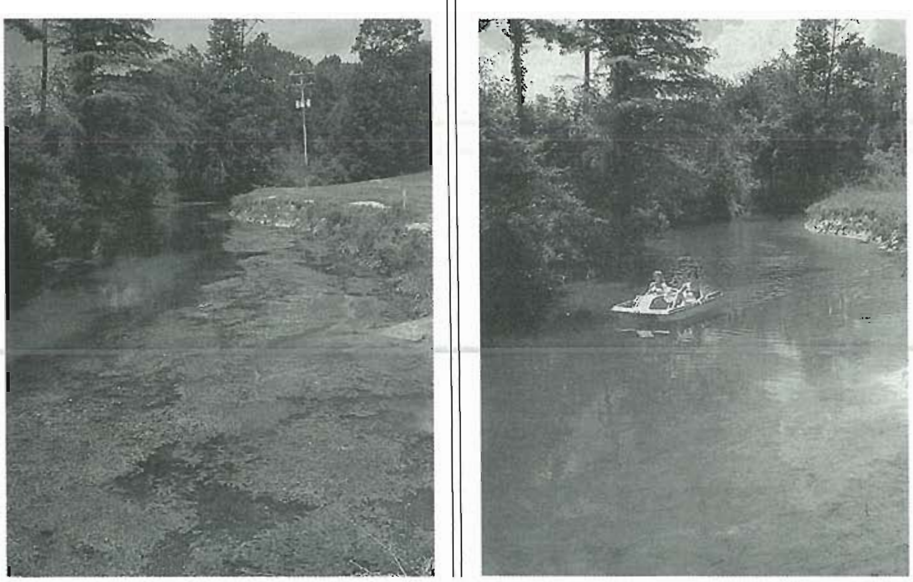
Results and Discussion

The Aqua Control Sleeve shunted the entire flow of this 25-million gallon per day spring and allowed the hydrilla, previously protected by heavy flow, to be controlled with herbicides applied with traditional methods. The work in Section 1 demonstrated that the entire flow of a spring could be channeled at its source. Hydrilla was eliminated from Section 1 by April 6, 1991 (36 days after treatment). After the sleeve was removed from Section 1, water flow flushed the organic matter from the system leaving a white sand bottom.

Ten days prior to treatment, the control sleeve was placed in Section 2. A six-foot flood delayed the initiation of the study but did not dislodge or damage the device. However, the time-lag did allow considerable production of filamentous algae on the hydrilla and on the sleeve in Section 2. Treatment with SONAR appeared to further exacerbate the filamentous algal production without significant reduction of the hydrilla in Section 2 by April 23, 1991 (43 days after treatment), but hydrilla was nearly eliminated by June 11, 1991 (72 days after treatment). Section 2 demonstrated that an open channel could be shunted through the Aqua Sleeve. Because of the virtual elimination of hydrilla in this system, it is plausible that the grass carp will be able to delay significant re-infestation, even at these cooler temperatures.

The pliable, tear-resistant Aqua Sleeve was designed to be reused. The sleeve remained in Section 1 for only 3 days which was sufficient for excellent control with Aquathol K. Afterwards, the sleeve was removed in good condition and could be reused. In Section 2, the sleeve which was in place for 63 days had to be discarded because it was covered with algae and filled with sediment.

To summarize, the Aqua Control Sleeve works: a flowing system can be changed to a static system long enough for Aquathol K or SONAR to effectively control hydrilla. The total cost of treating Vortex Springs was $10,000 or $3,700/acre. However, this cost would greatly decrease each time the sleeve was reused. The system works very well with the contact herbicide Aquathol K. The use of this device with SONAR also shows promise, but may be expensive if the sleeve cannot be reused. This increase in expense may be mitigated if multi-year control is achieved. The applicability of this system to other, larger, more complex springs, rivers and canals needs to be investigated.



Hydrilla growth in Vortex Spring run before (left) and after (right) treatments. The "aqua control sleeve" was in place for 63 days.

AQUAVINE

1991 FAPMS ANNUAL MEETING

The 15th annual meeting of the Florida Aquatic Plant Management Society will be held October 15-17 at the Daytona Beach Ramada Resort Surfside. All are welcome at the FAPMS Board of Directors meeting October 14 at 7:00 p.m. at the hotel. On October 16, the annual awards banquet at the hotel will include a Florida seafood feast. Contact: Vic Ramey, Rte. 1, Box 217A, Micanopy, FL 32667, (904) 392-1799.

FINAL REMINDER: 1991 FAPMS PHOTO CONTEST

Wendy Andrw has been difficult to live with these past couple of years. She's won far too many photo contest awards and her temperamental artist act is getting old. Let's throw some stiff competition her way! Get your finest shots printed and mounted and/or framed now! Eight-by-ten inch print size recommended. Awards are given in two categories: Aquatic Scenes and Operations. Bring 'em to the meeting in Daytona for a run at the ribbons.

USDA HONORS BIOCONTROL TEAM

On June 12, the United States Department of Agriculture recognized the Agricultural Research Service's Fort Lauderdale aquatic weed research group and their U.S. Army Corps of Engineers cooperators by presenting them its highest honor, the Distinguished Service Award. The award recognized the group's, ". . .exceptional research accomplishments through development of environmentally safe and less costly biocontrol technology for managing aquatic weeds."

USDA personnel recognized were research leader Kerry Steward, lead scientists Ted Center and Gary Buckingham, and research scientists Joe Balciunas and Thai Van. The Corps of Engineers recipients were the aquatic plant control research program manager Lewis Decell and biocontrol team leader Al Cofrancesco.

The award was presented by U.S. Secretary of Agriculture Edward R. Madigan, at the Department's Washington, D.C. headquarters. The award ceremony was followed by a luncheon and photo session at the U.S. Arboretum.

UPCOMING EVENTS

September 12-13
Florida Lake Management Society third annual meeting, Radisson Hotel, Winter Park, FL. Contact: FLMS, 203 Lake Pansy, Winter Haven, FL 33881. (813) 956-3771.

September 13-14
National horticulture short course, Orange Co. Civic Center, Orlando, FL. Contact: Uday K. Yadav, (407) 323-2500, ext. 5559.

October 2-4
Midsouth APMS 10th annual meeting, Best Western, Auburn, Alabama. Contact: Randall Goodman (205) 844-4786.

October 15-17
Florida APMS 15th annual meeting, Ramada Resort Surfside, Daytona Beach. Contact: Vic Ramey, Rte. 1, Box 217A, Micanopy, FL 32667, (904) 392-1799.

October 21-24
International symposium on wetlands, Pensacola, FL. Contact: G.A. Morshiri, Univ. of West Florida, 11000 University Parkway, Pensacola, FL 32514, (904) 474-2754.

October 25-26
Indiana Academy of Science international symposium on control and impacts of exotic plants and animals, University Place Conference Center, Indianapolis. Contact: Bill McKnight, Indiana State Museum, 202 North Alabama, Indianapolis, IN, (317) 232-8178.

November 11-16
North American Lakes Management Society 11th annual international symposium on lake and reservoir management, Sheraton Denver Tech Center, Denver, Colorado. Contact: Jim LaBounty (303) 236-6002.

November 14
Seminar on environmental issues affecting the horticulture industry, Agriculture Center Aquarium, Sanford, FL. Contact: Uday K. Yadav, (407) 323-2500, ext. 5559.

November 18
Texas APMS annual meeting, Windham South Park Hotel, Austin, Texas. Contact: Joyce Johnson (512) 389-4858.

November 18-22
US Army Corps of Engineers, Aquatic Plant Control Research Program annual research review, Dallas, Texas. Contact: Lewis Decell, Waterways Experiment Station, Vicksburg, MS, (601) 634-3449.

TREMENDOUS THANKS AND APPRECIATION DEPARTMENT

Dolly and Ronald Foran, Arlington Aquatics, Inc.

The Florida Aquatic Plant Management Society thanks Ronald and Dolly Foran for their generous

DO YOU KNOW THE FACTS?

Did you know that more than 5,000 lives are lost in accidents in Florida each year? How are these lives lost? Below are twelve ways that deaths occur in Florida accidents. Can you rank them from highest to lowest frequency of occurence? Place the letters next to the numbers and compare your ranking with the correct ranking found at the bottom of page 22.

1. ______	7. ______	A. Multiple car collissions	G. Falls
2. ______	8. ______	B. Firearm accidents	H. Pesticide accidents
3. ______	9. ______	C. Pedestrian accidents	I. Fires
4. ______	10. ______	D. Airplane accidents	J. Drugs
5. ______	11. ______	E. Boating	K. One car collisions
6. ______	12 ______	F. Non-boating drownings	L. Lightning

$500 donation to the FAPMS general fund. Their generosity will help the Society's activities keep going in a big way. Let's hope their shining example inspires other generous acts!

Mel and Tammi Fisher, Mel Fisher's Treasure Salvors, Inc.
On May 23, FAPMS member Jesse Griffen, center, presented Mel Fisher, left, and his daughter Tammi, right, with a FAPMS plaque of appreciation for their donation of a silver doubloon recovered from the 17th century wreck of the Santa Nuestra de Atocha. The doubloon was the grand prize of the 1990 annual meeting's raffle for the William Maier Education Foundation and everyone wanted a couple chances to win this piece of history. Roughly $1500 was raised to benefit aquatic scholars of tomorrow. Thanks to the Fishers for their generosity!

James Combee, Combee Airboats, Inc.
FAPMS member John Teevens, right, recently presented James Combee, left, with a FAPMS plaque of appreciation for his donations of a canoe for each of the past two FAPMS annual meetings. Each year the canoes have been highlights of the meetings and a whole lot of drooling has gone on as everyone awaited the awarding of these grand door prizes. Thanks to James, his sons, and all the Combee family!

FREE CALIBRATION CARDS AVAILABLE

Free credit card-sized laminated reference cards are available free to weed management folks. The cards include the most commonly used equations for field herbicide applications as well as some phone numbers you may need after you're unintentionally sprayed during a hurricane. The cards are available from:

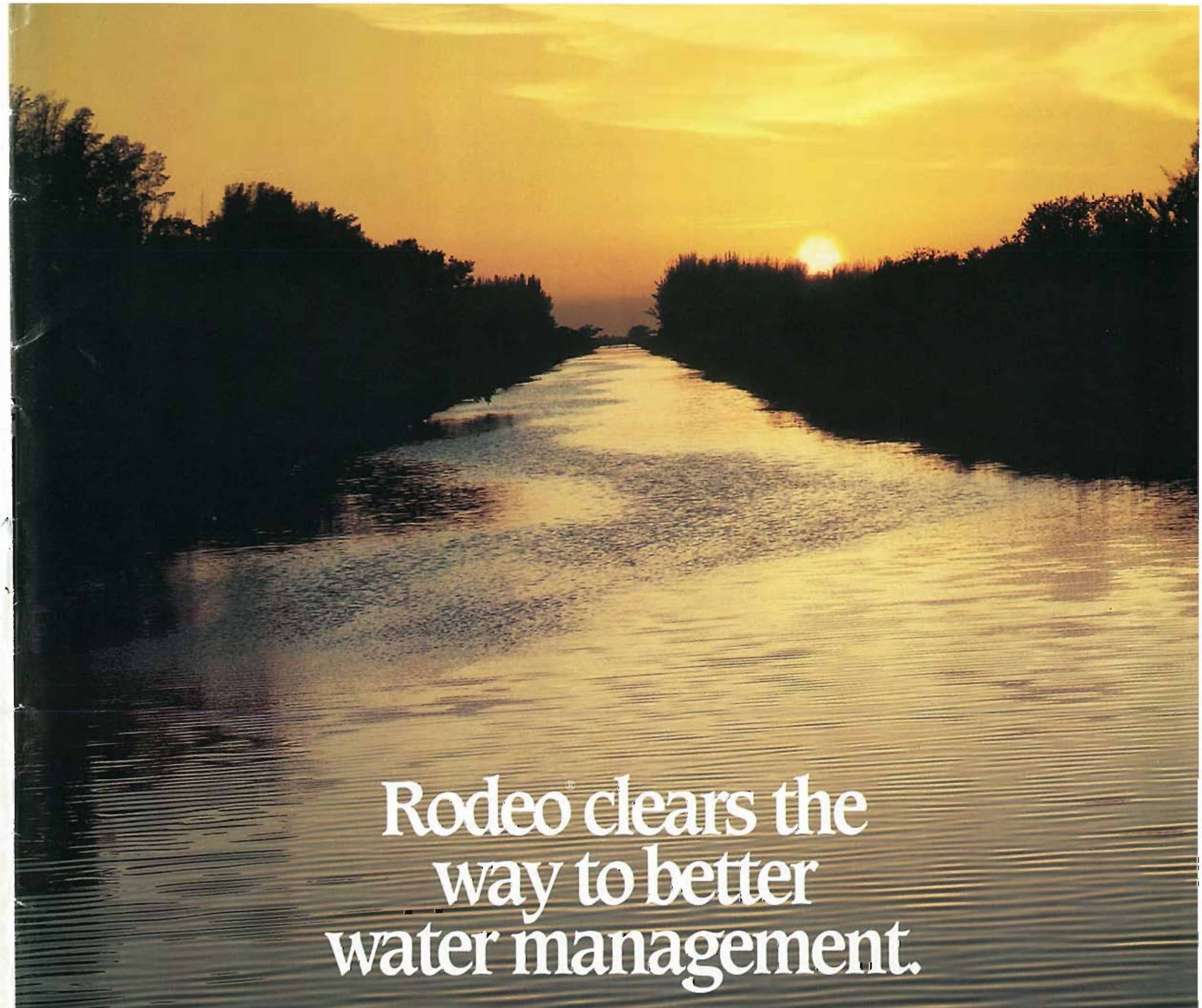
IFAS Center for Aquatic Plants
University of Florida
7922 N.W. 71st Street
Gainesville, FL 32606-3071
Phone: (904) 392-9613

CORRECTION

Photos of newly planted and grown pickerelweed, along with drawings of *Pontederia cordata* var. *cordata* and *Pontederia cordata* var. *lancifolia,* were reversed in the June 1991 "Aquatics" article, "Pickerelweed," by F. Melton and D.L. Sutton. Any confusion caused by these exchanges is regretted.

ANSWERS TO QUIZ

1, A. Multiple car collisions (1350)
2, K. One car collisions (800)
3, C. Pedestrian accidents (630)
4, G. Falls (550)
5, F. Non-boating drownings (430)
6, J. Drugs (200)
7, I. Fires (180)
8, E. Boating (80)
9, D. Airplane accidents (70)
10, B. Firearm accidents (50)
11, L. Lightning (10)
12, H, Pesticide accidents (2)

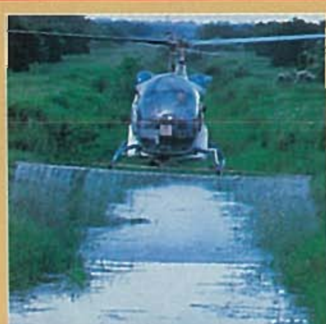


No other herbicide offers such effective performance.

You can clear away more than 170 emerged grasses, broadleaf weeds and brush species with Rodeo® herbicide. And once they're gone, they won't grow back. That's because Rodeo moves through the entire plant and kills it – roots and all.

Some herbicides provide only a temporary burndown. And mechanical efforts are also ineffective at providing lasting control. With Rodeo, however, maintenance becomes an economical spot treatment that takes minimal time.

There's no longer any reason for wetland sites or ditchbanks to become eyesores, health hazards or unsuitable as wildlife habitat. Rodeo is an effective, economical way to care for these areas. Just apply Rodeo a half mile or farther from a potable water intake. When this is done, treated water has no use restrictions.



Plus, with no residual soil activity, Rodeo won't leach into non-target areas. Use it with confidence to treat vegetation in and around lakes, rivers, streams, ponds, seeps, irrigation and drainage ditches, canals and reservoirs.

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DIQUAT is a highly active, water soluble contact herbicide that controls a broad spectrum of floating, submerged and marginal aquatic weeds, like hydrilla, salvinia, water hyacinth and cattails.

Not only is DIQUAT fast-acting and

biologically inactivated when absorbed through soil, it has no fishing restrictions.

So don't get tangled up with a bad crowd. Put them out of the picture with DIQUAT.

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