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June 1989

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**RODEO. EMERGED AQUATIC WEED AND BRUSH CONTROL.**

**EDITORIAL**

**Of Maintenance Control, Communication and Cooperation**

In 1970, the Florida Legislature organized aquatic plant control under the direction of the Department of Natural Resources in order to enhance the preservation, protection and management of state lands. The American Assembly Conference reiterated this approach in 1980 in order that one, multiple use oriented agency would oversee aquatic plant control functions within the state. Benefits of this centralized approach include: 1) coordination to ensure control where necessary and to avoid dual control operations, 2) statewide consistency in policy, goals, administration and control methods, and 3) equitable funding for aquatic plant control in all regions of the state.

As recently as the mid 1970s, various reports calculated between 40,000 and 60,000 acres of water hyacinth in Florida public lakes and rivers. Management philosophies and control programs were independently developed and executed by as many as 80 public agencies. During the late 1980s, under centralized control and funding distribution; by conducting a continuous monitoring effort; and through quick control response when problems are found, water hyacinth and water lettuce have been brought to their lowest levels this century. Only 3,600 acres of water hyacinth and 2,700 acres of water lettuce were identified in 485 public waters totalling 1.23 million acres during the 1988 survey. Water hyacinth has been reduced from the third to 24th most abundant aquatic plant in

*Continued on page 9*

**About The Cover**



Ocean access and multiple springs make Crystal River one of the most popular attractions in Florida.  
*Photo by Alison Fox*

# Aquatics

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# The Arrowhead Plants

by  
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## I. FAMILY CHARACTERISTICS

The genus *Sagittaria* is included in the Alismataceae or water-plantain family which is composed of 13 genera and about 90 species. Plants in the water-plantain family occur worldwide with most of them present mainly in the temperate and tropical regions of the northern hemisphere. The Alismataceae family has been of phylogenetic interest to botanists for many years since it is considered to be one of the most primitive of the existing monocot families.

Plants in the water-plantain family characteristically have fibrous roots; a cluster of basal leaves developing from a somewhat thickened rootstock; juvenile leaves that are bladeless but develop into either a linear or sagittate blade when mature; an erect or arching stem bearing the flowers; flowers that are perfect or unisexual; three, generally white deciduous petals; and a seedhead composed of flat or turgid achenes with resin ducts or wings or both of these structures.

The water-plantain family is of limited economic importance. Some members of this family may be especially suitable for aquascaping or re-vegetation projects. Corms of some of the species of *Sagittaria* have potential value as an edible food. Several species in the *Echinodorus* genus are cultured for use in the aquarium industry.

## II. CHARACTERISTICS OF SAGITTARIA GENUS

The genus *Sagittaria* is separated from other members of the family by the occurrence of staminate flowers borne on the upper portion of the inflorescence with the pistillate ones below. Since the staminate and pistillate flowers mature at different times, self-pollination is rare.

There are about 40 species of *Sagittaria* with 8 commonly found throughout Florida (Table 1). Members of this genus normally do not cause problems in the bodies of water in which they occur. They may be found growing either in small monoculture clumps or mixed with other

aquatic plants.

Plants of the *Sagittaria* genus are commonly called 'arrowhead' in reference to their leaf shape and 'wapato' because the early use of the corms (Figure 1) of some of these plants constituted the wapato eaten by the North American Indians. Sometimes these plants are referred to simply as 'sagittaria', 'sagittarias', or 'the sag's'.

The arrowhead plants are frequently heterophyllous and some of them may contain a combination of emersed, floating, or submersed leaves, or all three leaf forms, on the same plant at the same time. Leaf shapes range from completely bladeless to the typically sagittate and hastate forms (Figure 2).

Table 1. Arrowhead plants commonly found in Florida

Common Name	Scientific Name
Common arrowhead, wapato, duck-potato	<i>Sagittaria latifolia</i> Willd.
Spring-tape	<i>Sagittaria kurziana</i> Gluck.
Dwarf arrowhead	<i>Sagittaria subulata</i> (L.) Buch.
Slender arrowhead	<i>Sagittaria graminea</i> Michx.
-	<i>S. graminea</i> var. <i>graminea</i>
-	<i>S. graminea</i> var. <i>chapmanii</i> J.G. Sm.
-	<i>S. graminea</i> var. <i>weatherbiana</i> (Fern.) Bogin
No common name	<i>Sagittaria engelmanniana</i> J.G. Sm.
No common name	<i>Sagittaria stagnorum</i> Small
No common name	<i>Sagittaria lancifolia</i> L.
No common name	<i>Sagittaria isoetiformis</i> J.G. Sm.

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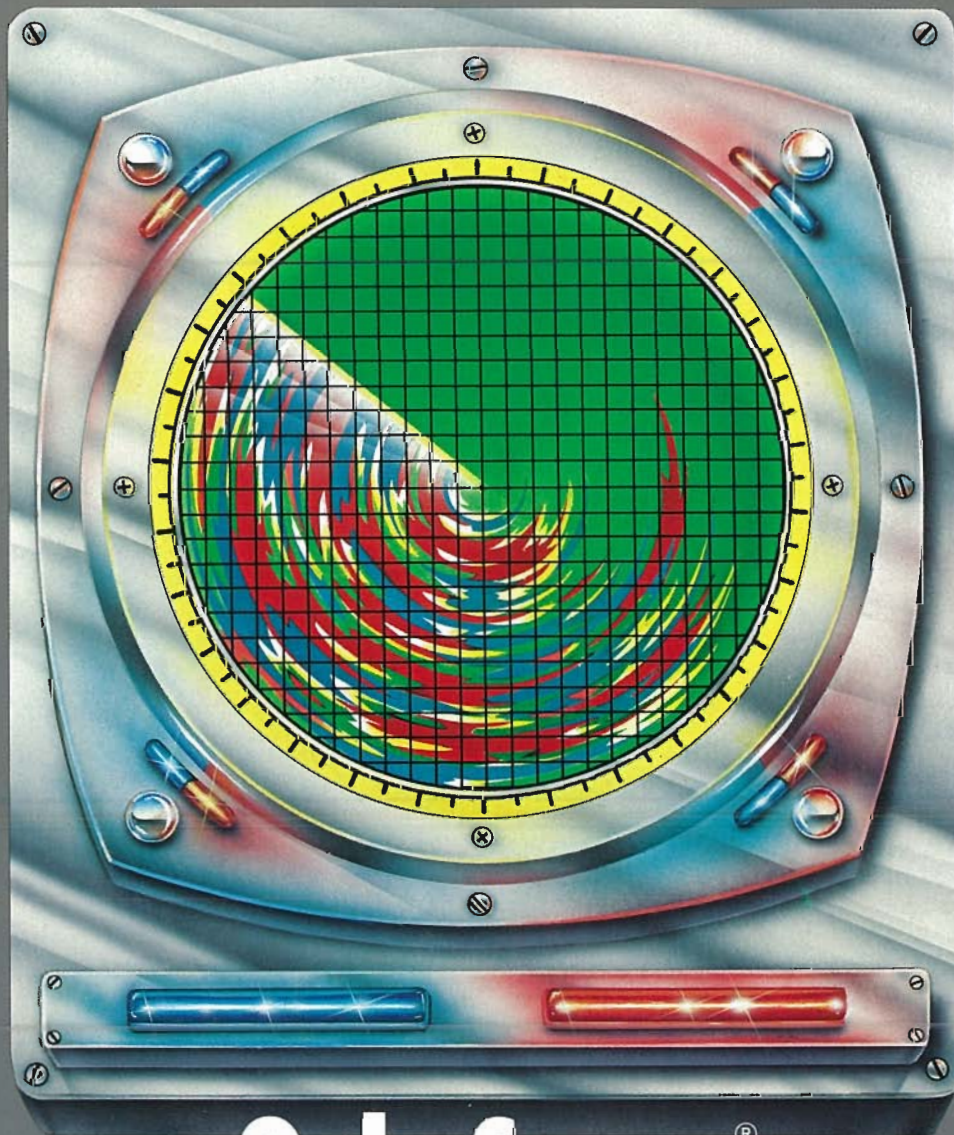
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Figure 1. Corms of *Sagittaria stagnorum*.

### III. COMMON ARROWHEAD

Common arrowhead (*S. latifolia*) is probably the most well-known of all the *Sagittaria* species. This species occurs throughout the U.S. and Canada. The plants normally grow emersed, and overwinter by corms borne terminally on slender rhizomes.

Mature common arrowhead leaves display the typical broadly ovate-triangular shape. Strap-like leaves, characteristic of juvenile and submersed plants, rarely are found on mature plants. The leaves of common arrowhead consist of a spongy petiole with a smooth blade, but those plants exhibiting a hairy surface have been classified as a variety of common arrowhead, *Sagittaria pubescens* Muhl.

The flowers of common arrowhead are borne on a stem which extends above the water at about the same height as the emersed leaves. The petals are white, as broad as long or broader, and about 2.5 cm in width.

### IV. SPRING-TAPE

Spring-tape (*S. kurziana*) grows submersed and prefers flowing water as it is often found in large springs and the streams issuing from them. This species is commonly found in the central and northern parts of Florida. The leaves are strap- or ribbon-like, flat and linear, and up to 2.5 m in length. Small floating leaves may

form at the tips of long submersed ones.

The flowers of spring-tape are borne on stems that are about the same length as the leaves. The flowers extend just above the surface of the water. Flowering occurs throughout the year.

Spring-tape can tolerate periods of drought or low water. Under these conditions, the leaves are relatively short. It is not known however how long the plants can live in saturated soil without water covering their leaves.

### V. DWARF ARROWHEAD

Dwarf arrowhead (*S. subulata*) is commonly found in tidal areas in fresh to strongly brackish water in the central to northern parts of Florida. Their tolerance to salt water is not known but they seem to thrive in areas where most other freshwater aquatic plants do not exist. Periodic tidal fluctuations in water levels do not seem to

restrict their growth.

When compared to the other members of this genus, dwarf arrowhead has very short leaves. These plants often grow in a thick monoculture that resembles a freshly cut lawn. The leaves do not grow more than 30 cm in length. The flowers with white petals are held above the surface of the water by a stout stem. Once the seed head has formed, it curves back down toward the water and may become submersed during seed ripening.

### VI. SLENDER ARROWHEAD

Three separate varieties of slender arrowhead (*S. graminea*) have been described (Table 1). These plants grow submersed or emersed but do not persist when water levels decline, although *S. graminea* var. *graminea* will resist drying somewhat if their roots remain in saturated sediments.

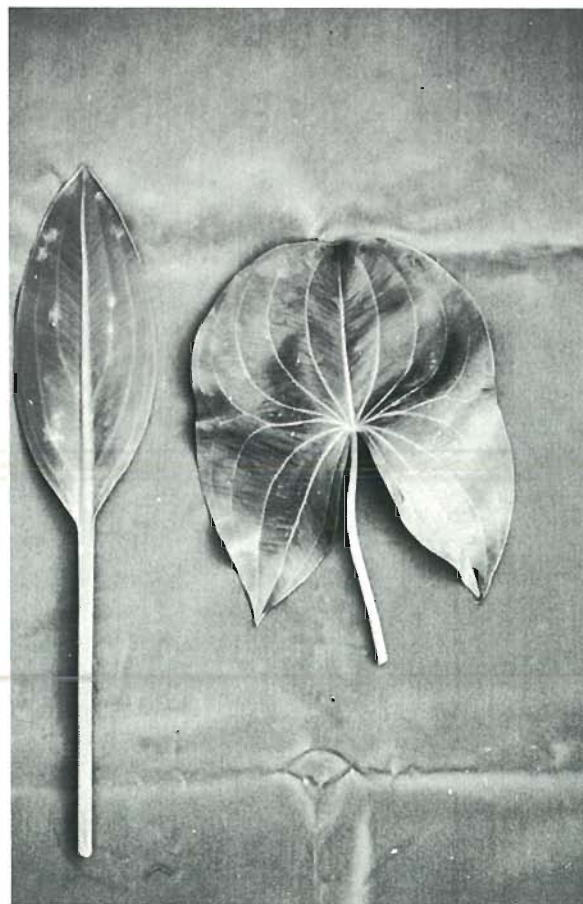


Figure 2. Emerged leaves range in shape from the almost bladeless *Sagittaria lancifolia* (left) to the typically sagittate and hastate forms of common arrowhead (right).

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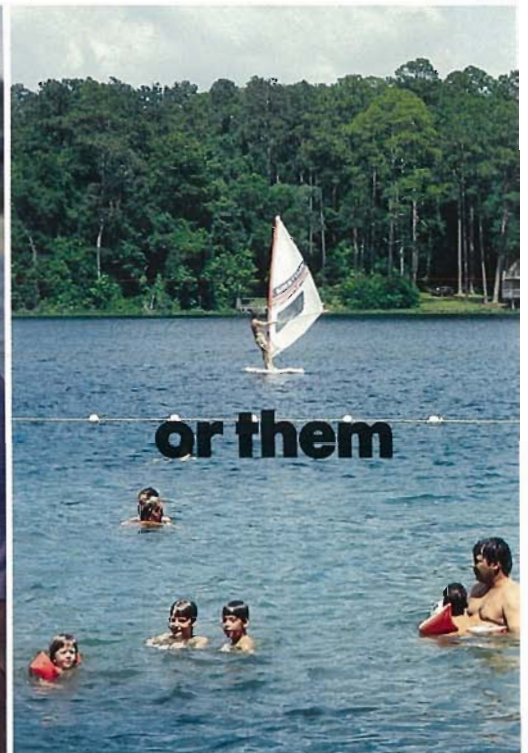
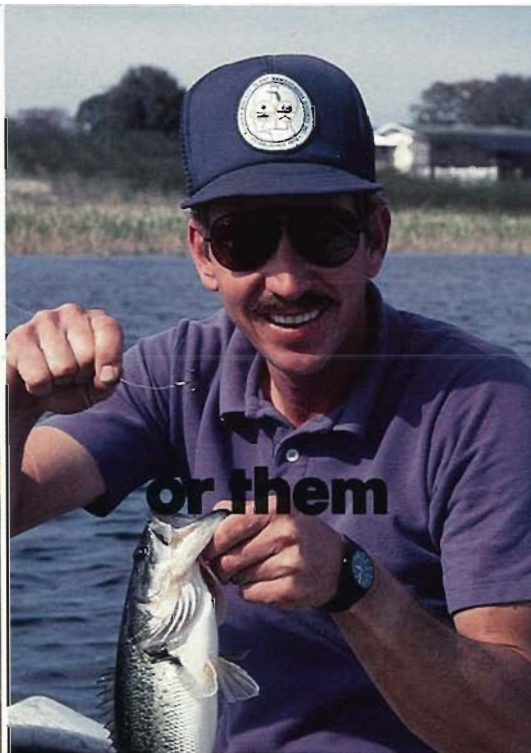




Figure 3. Emerged growth form of *Sagittaria stagnorum*.

The variety *weatherbiana* is found mainly in the northern parts of Florida while the other two are present throughout the state. Slender arrowhead is generally found in shallow water, along shorelines, and marsh areas. The submersed leaves are linear while the emerged ones have a linear-lanceolate to elliptic blade attached to the petiole. The leaves grow up to 50 cm in length. Flowers are borne on stalks above the surface of the water. The varieties are separated from each other mainly on the form of their leaves and other growth habit characteristics.

#### VII. OTHER ARROWHEAD PLANTS

Plants of *S. engelmanniana* grow in shallow water, marshes, and along shoreline areas in the northern portion of Florida. These plants are erect but tolerate being submersed. The leaves are somewhat variable in size and shape. The strap-like juvenile leaves are generally not found on adult plants. The early leaves tend to have a long petiole with a linear-elliptic to oval leaf blades with older ones taking on the more sagittate form. The leaves can grow up to 80 cm or more in length. Flowers with white petals are borne on a stalk that is generally a little shorter than the leaves.

Plants of *S. stagnorum* grow in a variety of aquatic habitats throughout Florida, but are not as common

as some of the other species. This species commonly produces submersed, floating, and emerged leaves on the same plant. Blades of the emerged and floating leaves are elliptic, oval, or ovate (Figure 3). Petioles of the emerged leaves are stiff while those attached to the floating leaves are spongy and weak. Submersed leaves are rather short and linear.

It is not uncommon to find a large number of flowers present on *S. stagnorum* plants as compared to other members in this genus. The flowers are not borne on stout stems as exhibited by many of the other *Sagittaria* species, but develop on slender, lax stems. Actually, the flowers float on the water, supported by buoyant whorls of flower buds just beneath the surface. As the inflorescence develops, whorls of the buoyant buds below the surface push distal ones out of the water.

Plants of *S. lancifolia* grow emerged along shorelines, in swamps, and in brackish tidal marshes in central to northern Florida. The leaf blade is ovate to elliptic or narrowly lanceolate and attached to a rather stout petiole. The flower stem extends above the water with as many as 10 whorls of flowers. The lower 1 to 4 whorls contain pistillate flowers with the staminate ones above.

Individuals of the *S. isoetiformis* species generally grow submersed in relatively shallow and marshy

environments in the central and northern parts of Florida. Emerged forms usually are the result of a drop in water level rather than the plant growing out of the water. The submersed leaves are flat and strap-like with an occasional widening at the tips, though not of sufficient width to form a definite leaf blade. The flower stem is sufficiently strong to support the flowers just above the surface of the water.

#### VIII. MANAGEMENT OF ARROWHEAD PLANTS

Arrowhead plants seldom grow to such an abundance that they cause problems. However, when plant growth needs to be managed several herbicides are available. These include Banvel-720, Sonar AS, Sonar 5P, Sonar SRP, Visko-Rhap Low Volatile Ester 2D, Weed-Rhap A-4D, Weed-Rhap A-6D, Weed-Rhap LV-4D, and Weedar Emulsamine E-3. Anyone applying herbicides to manage growth of aquatic plants need to follow the instructions on the label for the proper amount of herbicide to use and to adhere to any restrictions that may apply.

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#### X. ACKNOWLEDGMENTS

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*Continued from page 3*

public waters during this same period. Likewise, since the development of economical large-scale hydrilla control methods, most Florida waters have been kept open and usable with a 15-20% reduction in hydrilla coverage expected for 1989.

While the centralized approach has proven effective, aquatic plant control in Florida is again becoming fragmented. Special appropriations have transferred funds from the Department to specific areas which were not control priorities. Various agencies, including the Corps of Engineers, Game and Fresh Water Fish Commission and U.S. Department of Agriculture have assumed increasingly active statewide roles in authorizing or conducting aquatic plant control. Reduced availability of state funds has eliminated many canal districts from direct coordination with the Department via the review of proposed programs.

Centralized control requires constant communication and cooperation among all agencies involved in aquatic plant management. As control has become more decentralized, coordination among control groups has lessened.

Attention is shifting away from exotic plant management within the state as a whole and focusing on the special interests of each agency involved in aquatic plant control. While it is more difficult to sustain maintenance control under decentralization, it can be done – but only through strong communications and above all, cooperation.

One of the most pressing issues facing aquatic plant management during the next two years is the Department's anticipated reduction in funds available for local governments. Without strong support from all groups who directly or indirectly benefit from these funds, it is unlikely the funding level will be increased, and further unlikely that all

necessary aquatic plant control will be financed. Aquatic plant managers have worked too hard to give up maintenance control now.

A good first step in cooperation has been the recent formation of interagency discussion groups at the field level on waters such as Lakes Okeechobee, Yale, Rousseau, Istokpoga and the Kissimmee River Basin. However, the influence from these groups is very localized. One of the few forums available for resolving aquatic plant problems with statewide significance, such as the projected funding shortage, is the Florida Aquatic Plant Management Society. It is therefore imperative for all Society members, regardless of affiliation, to take an active, cooperative role by communicating through the Society and its various committees in order to do our part in "Preserving Florida's Water Heritage."

Jeff Schardt

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# CRYSTAL RIVER: A "NO WIN" SITUATION

by

Thomas H. Dick

Citrus County Aquatic Services

Lecanto, Florida

All of us in the aquatic plant management profession realize that it is often difficult at best to combat the growth of aquatic vegetation to insure that the general public can utilize Florida's waterways for their intended purposes. And, I'm certain that each of us have our own "pet peeve," or particularly problematic area with which to contend. I am equally certain, however, that no aquatic plant manager can claim any worse than those found in the Crystal River watershed.

Florida's Crystal River is located in the Big Bend area of the state's west coast. The river has its source in several large springs located in an area called Kings Bay, from which the river flows in a north-westerly direction about 7 miles to the Gulf of Mexico. The water, as its name implies, is extremely clear, and the water temperature, due to the springs influence, remains warm year round. Crystal River/Kings Bay has become a popular retirement area because of these waters. The area has also grown to be a popular attraction to fishermen, divers, and other water related recreational enthusiasts. In addition, the West Indian manatee has chosen Crystal River as its most popular winter home. So what's the problem, you ask?

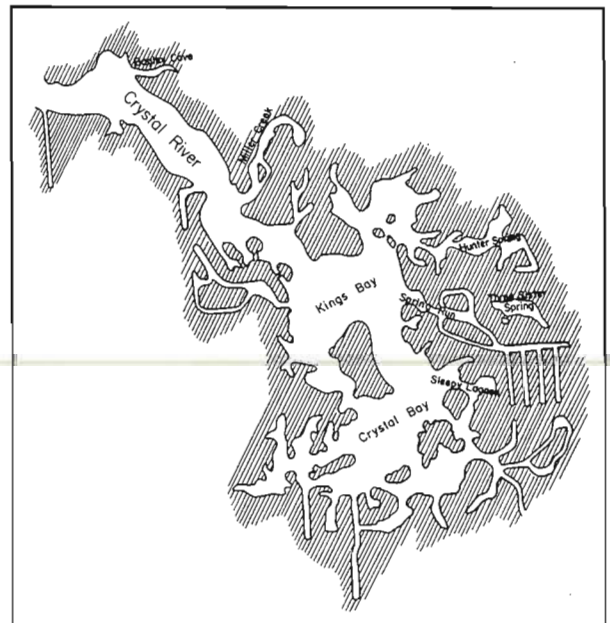
Along with the residents, tourists, and manatees, HYDRILLA arrived!! In fact, many believe that Crystal River is the very first Florida waterway that hydrilla was introduced into. Big deal, you say...we all have that dreaded plant to contend with. Yes! But, you

don't have the unique combination of factors affecting control efforts aimed toward this plant. Let me explain...

Text books tell us that hydrilla, under ideal conditions, can grow at a rate of 1 to 2 inches per day. Conditions then must be SUPER ideal in the waters of Crystal River because we have experienced growth rates of up to twice this value! That's right. Up to 4 inches per day in some areas!! We speculate that the clarity of the water, coupled with the very warm water temperatures coming from the springs plays an important role. We also feel that this waterbody receives an abundance of nutrients from the City of Crystal River's sewage treatment plant, from large amounts of storm water runoff entering the system via drainage ditches and large culverts from major highways, roads, business parking lots, shopping centers and lawns. Other sources of nutrients may be leakage from an estimated 500 septic tanks around the River, and fertilizers leaching into the water from lawns along the many finger canals that provide access to Crystal River.

So just get some herbicides, quit your belly-aching, and go to work, you say. Well, that we have...only our results

have been less than satisfactory. Controlling submersed vegetation in flowing water systems is probably the most difficult aspect of aquatic plant management. Here in Crystal River the flowing water problems are further complicated by the numerous springs previously mentioned, and by tidal fluctuations. The water certainly does MOVE but how much, in which direction and for how long is many times anybody's guess. We've studied tide charts and have treated on incoming tides; we've treated on dead low incoming tides; we've treated on tides being held out of the system by a favorable wind; we've treated in the spring, summer, fall and winter; we've even treated when astrologers indicate that the planet's alignments are favorable for the applicator to have a suc-



Crystal River watershed

cessful day; but, our results are still never reliable or even predictable. Some of our treatments have been successful, but more often than not, they have been less than desirable. We have not been able to find the solution to providing the necessary contact time between the herbicide and the target plants.

We have utilized ALL of the herbicides registered for the control of hydrilla in the state of Florida. We have used these products at their maximum allowable rates but still to no avail. We have even utilized both the polymer and the invert type systems in an attempt to get the material to remain in place long enough to affect hydrilla. Still, no reliable results. We even went to one product manufacturer and were the driving force behind the endohall label change of two years ago, which changed the rates of this product allowed in flowing waters from 4 to 10 gallons per acre to a 3 ppm concentration. Because of the water depths found in parts of this river, this allowed us to almost double the gallonage of this prod-

uct being placed in the water in these sections. Surely this is the solution, right? WRONG! Results were still relatively poor and never the same.

Meanwhile, the residents are growing restless.irate citizens, you say. We all have those. Yes, but, these are not your ordinary, run of the mill, Florida residents. Most of these fine people are affluent retirees from other regions of the United States. They are unfamiliar with hydrilla, and equally unfamiliar with waters rich in nutrients and a year-round growing period for aquatic plants. They have moved to this area primarily for the water resources afforded by the Crystal River and have invested a sizable portion of their retirement nest egg to build a waterfront home. Needless to say, they are not very tolerant to an aquatic plant management program that meets with only partial success. Remember now, these folks are retired; they stay home all day, and WATCH the plants grow!!! (They all also have my

home telephone number and are not at all shy about calling to inform me about how much they pay in "waterfront" taxes.)

Have I mentioned yet that the Crystal River holds an OUTSTANDING FLORIDA WATERWAY (OFW) designation?? Well, it does and while I'm not quite sure what this designation really means, I do know that it means that the Florida Department of Environmental Regulation gets an opportunity to comment on anything and everything that has to do with the water quality of this system, including the control methods utilized for aquatic plant control.

Enter the U.S. Fish and Wildlife Service... Because a large number of manatees have shown a preference for the Crystal River as a winter refuge, and because this animal is an endangered specie, some "special" agreements have been entered into between the USF&WS, the CORPS, DNR, and Citrus County. Crystal River's warm winter waters attract

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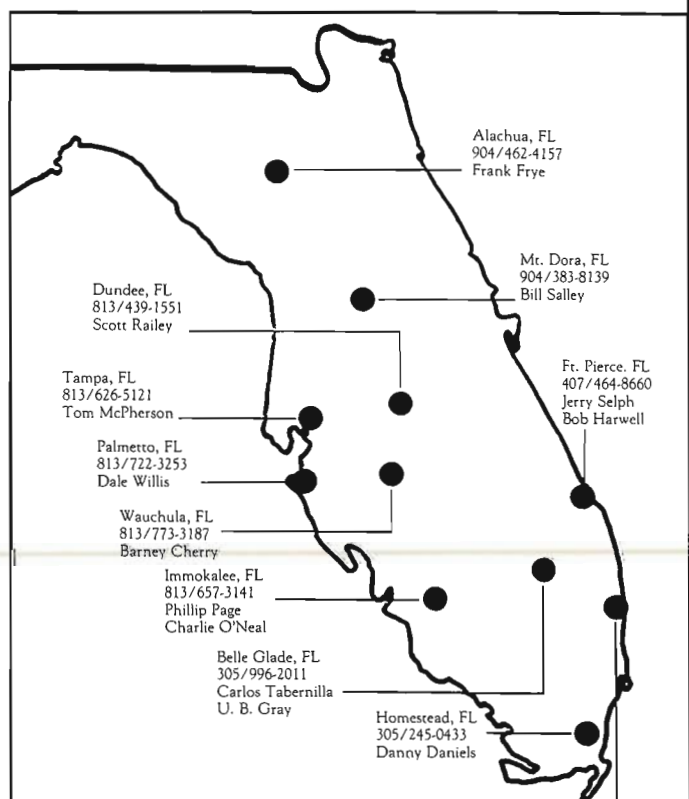
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manatee populations to this area during the colder months in Florida. These special part-time residents require certain conditions during their stay. Namely, a sufficient supply of food (aquatic plants) and harborage areas. Since Crystal River is for the most part a monoculture (hydrilla being the dominant plant), arrangements have to be made to reserve adequate amounts of hydrilla for the manatees to eat and to find shelter in. Towards this goal, Citrus County and these other agencies have devised *two* work plans for aquatic plant control in this river. The plans relate to the presence or absence of manatees. During their presence, and even in preparation for their arrival, our aquatic plant control activities are significantly reduced. Our choice of control methodologies is also limited to only one choice of herbicides, endothal (this to be used only in select areas remote to manatee habitats), and mechanical harvesting. Basically hydrilla growth is allowed to grow to levels much higher than normally tolerable.

We realize the importance of this area to the manatees, and perform these required functions for the sake of these endangered creatures. But, some of the residents who have spent hundreds of thousands of dollars on their retirement homes (they still have my telephone number) only to have what they feel are excessive weeds in *their* waterfront backyards are not at all sympathetic or tolerant to the situation.

Partially because of our inability to predictably control hydrilla in this waterway with aquatic herbicides, and partially because of some concerns voiced by the USF&WS over the potential danger of manatees uptaking undesirable amounts of herbicides via the food chain, Citrus County has the largest mechanical harvesting operation in the State of Florida and perhaps the Nation. The decision to utilize mechanical harvesting devices was initially a popular one with *all* the residents. Finally, they would have

guaranteed removal of the vegetation that prohibited their use of the waterway. But the whole hearted cheer for mechanical harvesting was short-lived when the residents learned that the harvesters could at best only hope to keep up with the rate of growth of the hydrilla in a series of "trails" designed to provide navigation access for all. The trails were placed down the center of canal systems and some of the residents became upset because, in most instances, they still had weeds against their seawalls and docks and these were now their responsibility to navigate through or otherwise contend with. You see, the scheme of the mechanical plan was to provide a network of navigation "arteries" for all to use. It can be likened to that of snow removal in the northern states; a plow will clear a path along highways and roads for the use of the general public, but, you're on your own to get out of your driveway onto the created path! (Don't bother to try to explain this concept to anyone...I had to have my telephone number changed to an unlisted one!).

Quite frankly, residents are pretty evenly divided over this issue. Some want us to return to our efforts with herbicides because when they were successful the weeds were gone from around their boats, docks, and waterfront seawalls. Others are getting used to the trails and are more than likely those people who were somewhat skeptical over the use of "chemicals" in this system to begin with.

We fought long and hard to try to achieve the proper balance of vegetation for the co-existence of man, manatees, and the entire aquatic environment. Our obstacles are many. We have to deal with hydrilla in a flowing, warm water system highly enriched with nutrients. The plant has a tremendous propensity for growth. Tides and springs play havoc with our herbicide control activities. An OFW designation and the presence of manatees means that our

program is highly scrutinized by agencies not all that familiar with aquatic plant control methods. We develop two workplans for this river system and must always be conscious not to over control vegetation.

We really haven't had to be too concerned over this last statement due to our past track record, except when Hurricanes Juan and Elena nearly visited Citrus County. Mother Nature did an awesome job in reducing populations of hydrilla; even to the point of placing concern that the manatee population that winter would not have sufficient vegetation. Of course at the same time, we had a large constituency that praised the actions of these hurricanes because they finally no longer needed the "snow plow." Their properties were clear of vegetation. But wait...what's this new stuff in the water that sometimes clings to the bottom but then also floats to the surface emitting an awful odor? And what happened to the crystal clarity of the water? It's now cloudy and murky.

Enter *lyngbya*...The hurricanes forced hyper-saline water up the Crystal River and into Kings Bay which, because of its springs is normally an area of low salinity. As a result of its salinity intolerance, 92% of the hydrilla present was wiped out. Without competition from hydrilla for both nutrients and sunlight, and with the additional nutrients being released from the decaying hydrilla, a filamentous blue-green algae, *lyngbya*, already present in small quantities, opportunistically began spreading throughout the bay. The surface mats of this algae impair navigational and recreational uses of the waterbody. Upon decaying, the algae releases a foul, musty odor. Additionally, when washed up on the banks of canals and the bay, these mats produce an aesthetically unpleasant material resembling used toilet paper!

So what's the big deal, you ask? Just get the appropriate algaecide and go to work, right? I only wish

it was that easy. There is no effective control method to combat this algae. Researchers indicate that the best means to reduce lyngbya is to not OVER CONTROL the macrophytes in the same system; so these larger plants will again consume their fair share of the available nutrients.

So, here's where we are. We CAN'T effectively control hydrilla in this system; but even if we could, we SHOULDN'T because of its importance to the manatees and the reduction of the lyngbya populations. Quite a predicament, huh? So much for the goal of keeping nuisance exotic aquatic plants at their lowest feasible level.

Meanwhile, the residents have given up on trying to con my phone number out of Ma Bell; they have now organized a search party to locate my whereabouts. I guess maybe I should've entitled this article... "you can please all of the people, some of the time; and you can please some of the people all of the time; but, you just can't seem to win in Crystal River.

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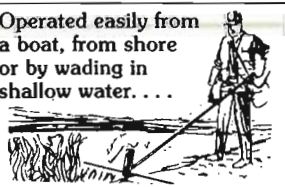
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# Crystal River's Gentle Giants

by

Alison Fox

Center for Aquatic Plants  
University of Florida  
Gainesville, Florida 32606

No discussion of Crystal River would be complete without a profile of one of the area's most famous winter inhabitants, the endangered West Indian Manatee (*Trichechus manatus*). Growing to 13 ft. in length and over 3,000 lb., these gentle gray giants, which may live for as long as 50 years, are distant aquatic cousins of the elephants<sup>1,2</sup>. Surfacing about every four minutes to breathe (although dives of over 20 minutes are possible) these graceful, seal-like mammals, never leave the water<sup>2</sup>.

Being vegetarians that can live in both fresh and salt water, and having no natural enemies, manatees have had no need to develop complex social patterns. However, the West Indian manatee is not very tolerant to cold conditions (the southeastern United States are the northern boundary of their range, which extends throughout the Caribbean, south to Brazil), and between November and March, large numbers may converge on sources of warm water around Florida. Their attraction to the warm-water discharges of power plants and to freshwater springs, coastal waterways and bays, where temperature variations are minimal, unfortunately tends to expose manatees to heavy boat traffic, often with fatal consequences.

Although the U.S. population may be less than 1200 animals, over 200 visited the Chassahowitzka National Wildlife Refuge (which includes Crystal and Homosassa Rivers) in the winter of 1987/88, and again in 1988/89 (P. Hagan, *pers. comm.*), making it one of the

most important manatee sanctuaries in the country. Their endangered status grants manatees legal protection at the federal (administered by the U.S. Fish and Wildlife Service-USFWS), and state (D.N.R. and Florida Game and Fresh Water Fish Commission), levels, with severe penalties applied for the deliberate capture or negligent harm of any individuals. Increasing the U.S. population,

tainty of survival in the wild for such calves, will severely limit the rate at which population numbers might be increased.

Instead, major efforts are being made to reduce mortality rates in their native range. A few natural causes of high mortality, such as toxic 'red tides' and severe winters, have been reported, but over 30 percent of manatee deaths for which a cause has been determined have been attributed to human activities. Out of 133 reported deaths, 43 manatees were killed by boats in 1988 (J. Delaney, Save the Manatee Club *pers. comm.*), either by propeller strikes or animals crushed in shallow water or docks. This was the worst year for manatee kills by boats since records started in 1976. Efforts to reduce the number of manatee mortalities due to human activity have included: strictly enforced boat speed regulations; exclusion of all boats and people from certain important areas of refuges; the operation of a "Manatee Hotline" 1-800-342-1821 for reporting any manatee injuries, death or harassment; various methods of public education about the dangers of disturbing both the animals and their food supply. Manatees may be severely injured by entanglement in discarded fishing

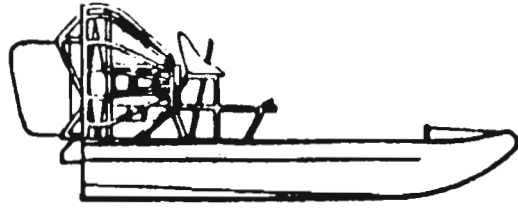


line and are threatened by less direct human activities such as losses of habitat, especially along the rapidly developing south-east and west coasts of Florida.

There is no evidence that pollution by pesticides or industrial chemicals has been directly responsible for any manatee deaths. However, it has been

or at least maintaining it, is currently unlikely to be achieved by captive breeding programs. Although several manatee calves have been born in captivity<sup>3</sup>, long gestation periods (about 13 months) and single births (2-5 years apart to females probably at least 8 years old<sup>2</sup>), and the uncer-





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suggested that high copper concentrations found in the tissues of some manatees may have resulted from feeding on vegetation treated with copper-based herbicides<sup>2</sup>. A study of the dissipation of copper residues after two applications of copper and diquat in King's Bay, Crystal River in 1980, showed that there were large natural variations in the copper contents of plants and sediments, which were not significantly affected by the herbicide treatment<sup>4</sup>. As a precaution, however, copper-based herbicides are not used in Crystal River during the winter when manatees concentrate in this area.

The potential of manatees for the biological control of aquatic weeds has not been ignored. In Guyana, manatees have kept some irrigation and drainage canals weed-free for over 20 years, but similar efforts in south Florida have been less successful in the long term<sup>1</sup>. Manatees need waterways to be at least 6 ft. deep; without obstructions (such as culverts in which they may become

trapped and drown); with little boat traffic; and with access to warm waters (over 65 F) in winter. The latter requirement restricts manatee use to tropical climates or requires movement of the animals to warm water refuges every winter. Although manatees remain passive and immobile out of water, making their transport easy and safe, it is widely considered inappropriate that an endangered species should be thus manipulated.

With regard to weed control in fresh waters that manatees naturally inhabit, it has been calculated, from detailed studies of their feeding patterns and from estimates of winter plant biomass, that over 1000 manatees (most of the U.S. population) would have to feed for 120 days in King's Bay, Crystal River just to remove the standing biomass of submersed plants<sup>5</sup>. Since the major weed problems in this area occur during the highly productive summer season, after most of the manatees

have left for the gulf, their impact on the hydrilla problem in this popular resort area is insignificant.

Encountering manatees in the wild is a rewarding but rare experience which cannot be encouraged if it threatens to disturb them. Rescued manatees undergoing veterinary treatment and rehabilitation are kept in captivity in several locations around Florida and can always be seen at 'Nature World', Homosassa Springs and the 'Living Seas' in the Epcot Center, Orlando. In addition to the federal and state manatee protection projects, numerous private organizations contribute to research and public education. An excellent way to help this work and to receive comprehensive and up to date information on these endearing creatures is to 'Adopt-a-manatee' through the Save the Manatee Club, 500 N. Maitland Ave., Suite #210, Maitland, FL 32751.

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# Dyeing in a Dead-end Canal

by

Alison Fox<sup>1</sup>, Bill Haller<sup>1</sup> and Curt Getsinger<sup>2</sup>

<sup>1</sup>Center for Aquatic Plants, Gainesville, FL.

<sup>2</sup>US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Crystal River, a spring-fed river system on the Gulf coast of Florida, was one of the sites where hydrilla was first found in the United States. An unusual characteristic of the Crystal River that makes hydrilla control there particularly challenging, is the combined influence of freshwater springs and tides on water movement. Water levels in the many canals, built for water-front housing development in the 1950's and 60's, may rise or fall 4-5 ft. within 6 hours on spring (full and new moon) tides. Much to the annoyance of boat-owning residents, hydrilla thrives in the clear, shallow canals and in the past herbicide treatments have resulted in erratic levels of plant control.

Little information has been available concerning herbicide use in fresh water tidal systems, so over the last 18 months a study of water movement has been conducted in four dead-end canals using fluorescent dye and herbicides. The aim of the project (sponsored by the US Army Corps of Engineers Waterways Experiment Station and Jacksonville District) was to evaluate factors which influence the rate of tidal flushing in the Three Sisters canals and to recommend appropriate management strategies to the Citrus County Aquatic Plant Management Program.

Several applications of an inert, red dye (Rhodamine WT) have been made to whole canals simulating herbicide treatment under a variety of conditions (Figure 1). Dye concentrations were measured, using a portable fluorometer, on each high tide for several days and the rate of dilution calculated. Since high tides occur every 12.5 hours

this involved some pretty odd sampling times. Fortunately, most residents, glad that their weed problems were being investigated, kept their dogs in at night and didn't worry about part of their backyard turning red!

Although the project has not yet been completed, provisional

and canal water, the faster temperature related circulation patterns remove the dye from the canals.

In consequence it has been recommended that hydrilla be mechanically harvested from the canals in the summer, when dilution rates are fastest and

herbicide contact time is reduced. Optimum time for herbicide use, when dilution is a least 5 times slower, is in the fall, and to a lesser extent in the springtime. Chemical applications at these times should provide good hydrilla control due to adequate herbicide contact time. In fact, successful applications of endothall were made in October 1987 and 1988, and in March 1988, based on the dye data. Fluridone treatments to two canals in October 1988 resulted in clear symptoms of herbicide uptake, but no significant reduction in plant biomass was observed within 14 weeks after treatment. Further applications of endothall and prolonged or split-treatments of fluridone have been planned for fall 1989.

Although the combined effects of tides and springs on water movement may be unique to canals in the Crystal River, these results and investigative techniques will be applied to other tidal areas to test the hypotheses. Broader implications arising from this study (eg. use of drugs to assess effects of water temperature on herbicide dispersal; herbicide application methods; and simulations of herbicides avoiding expensive residue analyses) are being examined in other habitats, so we expect to be dyeing in a variety of other places long after we leave the dead-end canals.

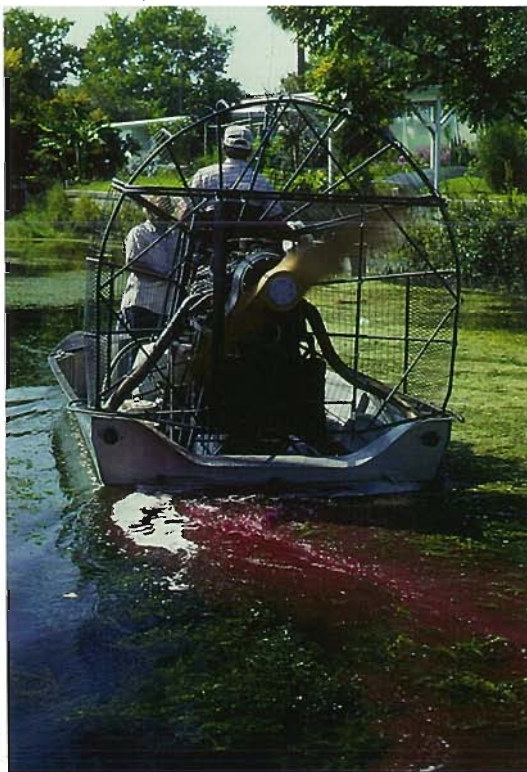


Figure 1. Applying dye to measure water movement can be an effective tool for estimating herbicide contact time.

results have been very informative and are currently being used to recommend hydrilla management in the canals. The type of tide (spring or neap) did not appear to affect dilution of the dye. Large amounts of vegetation had some influence on slowing dilution rates but by far the most important factor was the temperature of the canal water in relation to the water temperature of nearby springs. In brief, the greater the difference in temperature between the spring

# AQUATIC PLANT CONTROL AND ITS EFFECT ON DISSOLVED OXYGEN

By  
Gregory C. McClain  
Citrus County Aquatic Services  
Lecanto, Florida

**I**t would seem obvious through presentations, and discussions following these presentations, that there are some questions regarding the control of aquatic vegetation and what effect it has on dissolved oxygen.

The following article has been written from knowledge gained through field experience. The contents of this article are basic and are not intended to cover all the aspects of dissolved oxygen. It is primarily based on situations and findings that I encountered here in central Florida. I hope that this article will create some insight for the applicator and encourage others to realize the need for a guide to be developed that the applicator could use in the field.

First of all, I feel that we all know that this gas (dissolved oxygen) is necessary for the existence of fish and other aquatic life. A level of 5 to 7 mg/liter (this is the same as 5 to 7 ppm) usually indicates healthy water. In addition the dissolved oxygen is essential for the purification processes normally carried on in water by microorganisms. These organisms use organic matter in the water as food, breaking down, or biodegrading the complex organic matter into simple end products that can be utilized by other organisms. Such a breakdown of

organic matter by microorganisms in the presence of oxygen is called aerobic decay.

If the available dissolved oxygen has been used up and decomposition continues, it must proceed without oxygen. This process is called anaerobic. It is highly undesirable to have anaerobic decay only, since it tends to produce large amounts of sludge and noxious gases such as hydrogen sulfide. Another product of anaerobic decay is methane gas (also known as "swamp gas"), for it is often formed in such areas. It is highly flammable and, if it accumulates in a trapped area, can explode!

If large amounts of aquatic plants are suddenly treated and start to decay, a demand is placed on the dissolved oxygen, the aerobic microorganisms present will utilize the oxygen at a much faster rate than normal. This demand is called a BOD, biochemical oxygen demand or biological oxygen demand.

There are numerous conditions to be considered prior to controlling aquatic plants mainly with herbicides. This is where being a "professional applicator", or an "applicator" who looks at his line of work as "just a job", reflects the professionalism of the entire

industry. The fact that the industry is still relatively new and technology continues to grow leaves us with the fact that there are no "cut and dry" procedures to follow.

Field experience is the key to a professional aquatic plant manager. Knowing the system where control operations are needed is essential. Just a few questions a plant manager should ask are: Is the water body a canal, river, lake, pond, etc.? Is the water moving? What is the intended use of the water body? How much of the vegetation will need to be controlled for this intended use and where? Will the vegetation die and start to decay rapidly or will it take several weeks or more? What time of year is it? What is the water temperature?

If the vegetation is going to start to decay rapidly, then the amount of dissolved oxygen at the time of treatment could be a critical factor to be considered. You'll need to know from experience just how much plant matter can be allowed to decay without using up all the available oxygen. If you are in doubt in a given situation, ask around, call your local regional biologist or IFAS extension agent. If they cannot answer your questions they'll refer you to someone who can. Asking questions is a sign of a



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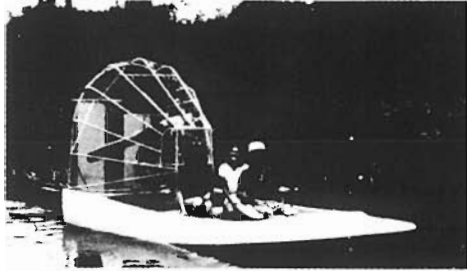
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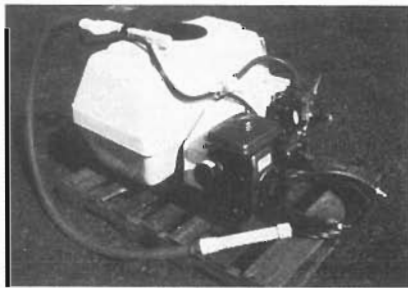
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If for some reason there is no time to find the answer and the D/O is 4 ppm then the best measure to take is to treat only a small portion of the area. Continue monitoring the dissolved oxygen content to determine just how much is used. If you controlled too much and the oxygen content drops below 2 ppm the fact that you did not treat the other areas will allow the fish to move to an area where there is still sufficient oxygen to survive. If the dissolved oxygen content prior to control is at or below 3 ppm and several random tests are conclusive of this then the control operation with herbicides or any method that would allow the plants to decay in the water should be stopped. At this point you would either need to continue monitoring the oxygen level for improvement or mechanically remove vegetation to a point where the system can bring itself back into balance.

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It is also very important to understand how and when oxygen is produced and some of the many factors that contribute one way or the other to the process.

A basic fact is plants need light in order to grow. This process is called PHOTOSYNTHESIS. Photosynthesis is the conversion of light energy, in the presence of chlorophyll and other substances, carbon dioxide, water and certain minerals to carbohydrates or starches that are utilized by the plant as food. Oxygen is a by-product given off by the plant during this process. When light energy is reduced, such as a cloudy day, oxygen production is reduced. At night when there is no light energy, the plants reverse the process by using oxygen. This process is called RESPIRATION. As a result of these two different processes, you will find through monitoring oxygen levels that the level will usually be higher during daylight hours than at night.

To be able to accurately deter-

mine the current low oxygen level, it is recommended that readings be taken at or just before daybreak when the levels will be at their lowest. The readings should be taken at different depths to insure the overall condition. In a situation where hydrilla is topped out, you may find the oxygen level at the surface to be high and just a few inches below that it may be zero. Water temperature plays a key role in oxygen content. Warm water will hold less dissolved oxygen than cold. In deep water areas, not too common in Florida, there may be a thermocline or layering of water temperatures and the oxygen content can vary drastically from layer to layer. In a situation with large amounts of vegetation and high water temperatures, such as we experience during July and August the oxygen level could be critical. This case is especially true when floating plants are covering a water body such as a dead end

canal. Floating plants release little or no oxygen into the water and at the same time shade the light energy from the submersed plants preventing them from producing oxygen. In certain cases this can cause what is known as a "D/O kill" or "natural fish kill". If oxygen levels are critical at the peak oxygen producing time of day then you can imagine what the levels will be like in the morning.

Nearly every situation an applicator will confront will in some way be different and each situation will have different factors which the applicator will have to be aware of in order to make the right decision.

In conclusion it's up to the applicator to make what is known as a FIELD DECISION as to whether or not he or she can conduct control operations and feel certain that there will be little if any adverse effects on the environment.

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# FISH KILL

By

Terry Warson, Aquatic Plant Technician  
Citrus County, Aquatic Services  
Lecanto, Florida

The words "Fish Kill" are the two most dreaded words in the nozzle head's vocabulary! A nightmare that can drag an applicator through the maze of organizations that control the life and death in the depths. From the Environmental Protection Agency, Department of Agriculture and Consumer Services, Department of Natural Resources to the Game and Fish Commission to Mrs. Smith's Friends of Fish – there's more eyes on an applicator in this predicament than Bill Dance on national T.V. *FISH KILL*, these words have more electricity than the Florida Power's Crystal River Nuke Plant! Let the public find 3 dead fish in an area you have just treated, and you will draw every roving reporter that is writing for the local press, the *National Enquirer* and even to the Associated Press wire service. Scales will be removed, gut length measured, eyes checked and livers confiscated. After 6 to 10 weeks of research, in which time the applicator has become addicted to alcohol, divorced and his friends have shunned him forever, it is determined that *no herbicide* traces were found; that the fish came from the craw of a great blue heron that had been hit solidly with a high served tennis ball at the Plantation Inn Courts!! Only then can the applicator's life begin to phase back

to normal.

Because I am a professional applicator for Citrus County's Division of Aquatic Services and a person who firmly believes that God doesn't deduct time spent while fishing, I am aware of the possibilities of a fish kill. Let's look at a fish kill that happens almost daily:

The D.O. is 6; PH 6.5; water temperature 71°; no wind; the aquatic plant control was started at the end of a canal (navigation trails only) plenty of room for fish to flush into; BUT, dead are: 297 Brim; 109 Bass; 6 crayfish; 2 blue crabs; 6 apple snails; 11 fresh water shrimp and 37 unidentified minnows. WHAT CHEMICAL WAS USED? Diesel fuel! No wonder you say. No, it wasn't in the water system – it propels the Kabota Engine that turns the pumps that make the harvester operate. The above fish, crustaceans and larva were removed from 500 pounds of hydrilla (a half load). Fish from 0.635 centimeters to 17.178 centimeters were taken from a random sample of topped out hydrilla harvested in the Indian Waters area of Crystal River. Harvesting in this area was found to be the most effective way of controlling the plant as contact herbicides are more often than not ineffective because of the many

springs and tides and their dilution effects. With herbicide results being unpredictable, and the U.S. Fish and Wildlife Services being concerned over the use of herbicides during the time when manatees are present in this area (October to March) the harvesting method was ordered. You see hundreds of the endangered West Indian Manatee congregate in these waters and while no hands-on evidence has ever been shown that herbicides directly affect the manatee – the U.S. Fish and Wildlife people would rather be safe than sorry. Harvesting is therefore a very important tool in our field of work.

It is not my intent to berate the necessity of the role of the harvester in aquatic plant management. Instant relief for nuisance weeds and the removal of nutrients from our water systems are the main PLUS in mechanical harvesting. I have watched water weeds roll up the conveyor for over 2,000 hours and know how beneficial mechanical harvesters are. I have spent equal time with a bow gun and boom in operation. With just three methods, Mechanical; Chemical and Biological, to use in the important battle in which we are engaged with the war against water weeds, I feel as both a nozzle head and a harvester jockey



that we ALL need to introduce more input on better methods of aquatic plant control and lake management.

It has become evident to me that hydrilla has yet another undesirable trait in that it is one of the most effective nature "nets" in trapping young fry during the harvesting operation. Coontail and nitella seem to be a close second. It's a tragedy but one that we must for now live with. So until we come up with better methods, I have this advice to "nozzle heads": when John Q. Public yells at the herbicide applicator from his dock, "How many fish have you poisoned today?", but has just handed the harvester a cold drink - put on your ear protection and dark polaroids and idle away. Only you know deep down he does not really know what the hell a FISH KILL is.

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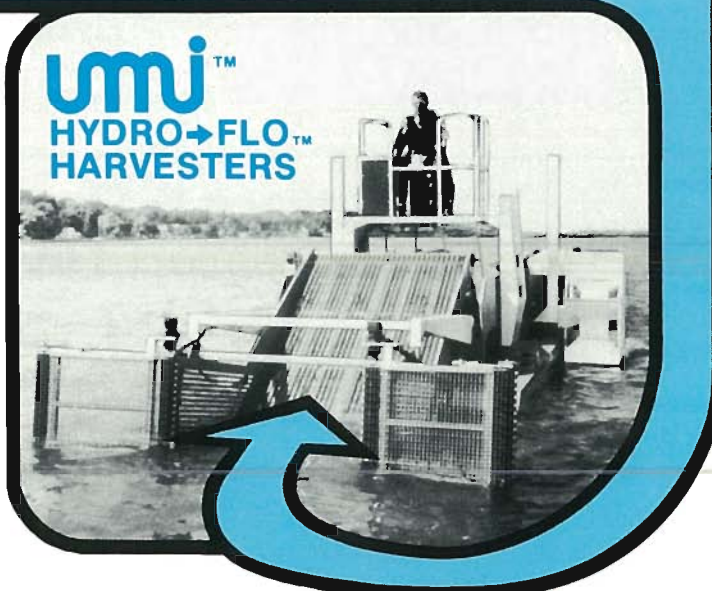
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# AQUAVINE



## DNR NEWS

The Department of Natural Resources has recently hired two new biologists. Robbie Lovestrand replaced Judy Ludlow at the West Palm Beach area office following the transfer of Judy to the Orlando area office following the transfer of Bill Caton to the Tallahassee office. Robbie has a M.S. degree in Wildlife Management from Texas A&M and has spent the last couple years working at the Center for Aquatic Plants in Gainesville. Jackie Jordon also came from the University of Florida where she worked with biological control of aquatic plants. Jackie will work in the Research Section under the direction of Greg Jubinsky in the area of her expertise.

## NEW AQUATIC INFESTATION

Recently, John Everson with the City of Orlando, discovered water poppy (*Hydrocleis nymphodies*) growing in Fern Creek within Orlando's city limits. Water poppy is a small lily with showy flowers

and is a popular aquarium industry plant. The infestation is about .25 of an acre and will hopefully be eradicated with applications of both Banvel and diquat.

## LOLOP

On April 26 the South Florida Water Management District and the Corps of Engineers entered into a cooperative agreement for the control of aquatic vegetation on Lake Okeechobee. The agreement follows the SFWMD, Corps, DNR, DER, and GFC signatures to a document outlining the environmental management philosophy for aquatic plant management on Lake Okeechobee.

## APMS

The annual meeting of the Aquatic Plant Management Society (APMS) is slated for July 16-19, 1989 in Scottsdale, Arizona. Scottsdale, for you "Cracker" folk, is located just outside Phoenix.

Program Chairman and Photo Contest Chairman David Sutton, needs your papers and your pictures. Bring photos to the meeting. For more information you can call Dave at (305) 475-0541.

## AWARDS

Award your best applicator and favorite picture by submitting

them to Awards Committee Chairman Terry Peters, well in advance of the next annual meeting.

Look for the "Applicator of the Year" nomination form in your next FAPMS newsletter. When you see the form, fill it out and get it in to Terry ASAP. Don't put it off, it's an important part of the annual meeting.

Photo submission deadline is October 1, so don't delay.

Terry's mailing address is located under "FAPMS Officers" on page 3 of this magazine.

## EQUIPMENT DEMO

This is the year for the equipment demonstration at our annual meeting. If you have equipment you would like to display in Daytona, contact Lee Ivy at (305) 434-1100.

## FOREMAN WANTED

We are looking for a Foreman/Certified Aquatic Applicator who has been in the Aquatic field a minimum of three years and preferably has some supervisory experience. The position pays between \$8.20 to \$11.84 per hour depending on experience.

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