This is a Draft Document that Will be Sent to all Participants of the Hydrilla Issues Workshop and Adjusted Later Based on Returned Comments

Hydrilla Management in Florida: A Summary and Discussion of Issues Identified by Professionals with Future Management Recommendations

<u>Draft Final Document</u>

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The Situation

Following the introduction of hydrilla (*Hydrilla verticillata* L.f. Royle) into Florida's waterways in the late 1950's, it has spread throughout the state. The ability of this plant to occupy nearly the entire water-column of small lakes and thousands of contiguous acres of large lakes has resulted in the expenditure of millions of state dollars on an annual basis for control efforts. Through the 1990's the herbicide fluridone was used to selectively and economically control hydrilla, particularly in large Florida lakes. By maintaining low concentrations (5-10 ppb), fluridone offered selective treatment for large acreages of hydrilla at a relatively low cost compared to other methods such as contact herbicides and mechanical harvesting. Hydrilla control with triploid grass carp would also be cost effective but offered limited plant selectivity and grass carp add the risk of complete removal of all submersed habitat that is so important to the largemouth bass fisheries of large lakes. Nevertheless, triploid grass carp are stocked for hydrilla control in more than 70 public lakes. Research during the last several years revealed that several populations of hydrilla, particularly in large Central Florida lakes, have become resistant to low concentrations of fluridone. Fluridone will still control hydrilla at higher, sustained doses (15-40 ppb) but these high doses impact non-target native aquatic macrophytes and maintaining greater concentrations significantly increase the cost of control. There are no other registered herbicides available with comparable environmental, cost, and application characteristics to replace fluridone, placing management agencies in the difficult situation of trying to balance cost and selectivity as they attempt to manage hydrilla in Florida lakes.

There were several lines of discussion from the workshop that are pursued in this document, and these include the following: 1) Hydrilla is an exotic plant that can cause numerous problems with the intended use of Florida's aquatic systems. In recognition of the historical problems caused by hydrilla, Florida State law mandates management of hydrilla to the lowest feasible level. 2) The selective management of hydrilla is difficult and expensive and has become further complicated by the development of increased resistance to fluridone, our most cost-effective treatment 3) Using current control methods, hydrilla cannot be selectively eradicated from the waters of Florida. 4) There are some recognized benefits of hydrilla to fish and wildlife; however, maintaining optimal coverage levels that do not impact other uses of the water body over an extended period of time has proven to be very difficult in most aquatic systems. 5) Given the funding constraints and the lack of cost-effective or selective controls, we are faced with the reality that in some water bodies we may have to live with the presence of expanding hydrilla populations for one or more seasons. Current technology and funding will dictate the lowest feasible level of hydrilla until new and more effective management techniques become available. 6) When possible, efforts should be focused on reducing hydrilla coverage to the lowest feasible level and encouraging the re-establishment and proliferation of native submersed vegetation.

The purpose of this document is to summarize the current issues associated with hydrilla control, outline the pros and cons of current control technologies, and discuss issues that impact or are impacted by current management options. Recommendations will also be made for developing lake-specific management strategies and for future research needs.

In discussing hydrilla and hydrilla management, one of the issues that is often overlooked is the temporal nature of how we view hydrilla and management results. A small-scale infestation today may cause no problems, but may lead to a system-wide infestation within one or two growing seasons. Likewise, a system that is completely infested with hydrilla today may be subjected to a severe disturbance (e.g. the impact of the 2004 hurricanes on large Central Florida Lakes) that greatly reduces the biomass for one or more seasons. When assessing the impacts of grass carp, one must view the management over a fairly long period, because at some point in time, the fish have likely reduced the hydrilla and left native plants at a level that would lead one to consider the stocking a success. From the standpoint of hydrilla providing valuable fish and wildlife habitat, certain levels of hydrilla likely provide good habitat quality without impacting other uses of the lake. Nonetheless, this situation is rarely static, and history would suggest that hydrilla can often expand and interfere with other uses of the water body. In these cases, by allowing hydrilla to aggressively expand, subsequent large-scale management efforts are often required. Efforts to bring hydrilla back under control can require multiple treatments that will extend over more than one season. In the end, it is difficult to say when and where hydrilla will manifest itself as a problem, and once it does become a problem, it is difficult to say how long the extensive infestations will remain. One must keep in mind that this is a plant with a six-decade history of expansion that has withstood our most vigorous efforts of control. Management efforts should be viewed on a lake-by-lake basis, and what works for one lake or chain of lakes, may not be appropriate for another group of lakes.

Introduction

Due to the above-mentioned new challenges, researchers from the University of Florida sponsored a workshop on December 6 and 7, 2004 to identify issues related to the management of hydrilla in Florida. The workshop included over 40 experts from county, state and federal agencies that have professional experience with water resource management (see Appendix I).

The workshop began with a series of introductory presentations, followed by a session to identify and prioritize the current issues related to hydrilla management. In this document, we summarized the proceedings of this workshop, and the critical issues identified and prioritized by the assembled experts (see Appendix II). Following the workshop, the authors met in late December 2004 and discussed how to proceed with this document. It was decided that a comprehensive literature review of all the issues identified at the workshop would serve primarily to reiterate the knowledge and background already held by the panel of experts attending the workshop. Therefore, in this document, we briefly summarized the literature for each issue and made management recommendations that reflected the workshop proceedings and conventional wisdom from the literature. The management recommendations are being provided to all workshop participants for comment, followed by revision. After revisions, this white paper will be sent to a larger audience and can be used by each appropriate county, state and federal resource management agency (if they choose) to help with their management decisions regarding hydrilla. We recognize that public involvement and public education will be important components of moving forward with future hydrilla management programs.

Synopsis of Introductory Presentations

"Hydrilla Management Before Fluridone", by Dr. Bill Haller, UF/IFAS Center for Aquatic and Invasive Plants

-Hydrilla introduced into Florida in 1958-1960
-Control measures included mechanical, biological, chemical measures
-Problems with all of these strategies
-Grass carp symposia in 1976 and 1994
-Fluridone approved for use in 1980
-Cost of hydrilla control with Fluridone much lower than other herbicides
-Mike Netherland noted hydrilla resistance to Fluridone in 1999
Where to go from here
-Current herbicides that gain USEPA approval have a single, simple, mode of action
-Such herbicides are almost certain to cause resistant response by plants, so occurrence of plant resistance to new herbicides will continue
-Similar to agricultural herbicide uses, we need several different compounds to prevent resistance
-However, the aquatic herbicide market is very small compared to agricultural markets, lowering the incentive to develop new compounds
-Use of grass carp, as a management tool is likely to increase
-State and federal agencies may need to incur the cost of developing and testing New aquatic herbicides (third party registrations)
-We need research and development of compounds with more than one mode of action

"Recent Challenges and Current Viable Options for Hydrilla Management in Florida", by Dr. Mike Netherland, US Army Engineer Research and Development Center /Center for Aquatic and Invasive Plants

-Management of hydrilla should include an evaluation of the relative benefits and harm in doing so
-Hydrilla has some benefits as habitat to fish and wildlife when it is present at low densities, but high densities can have detrimental properties
-1990s is when hydrilla spread throughout the Kissimmee Chain of Lakes and Lake Istokpoga, where most control budget is currently spent
-We may need to realize that current management strategies such as whole-lake reductions may not be compatible with current realities of viable options
-Control of the spread of hydrilla across lakes has been unsuccessful
-Compared to other regions, shallow lakes and warm temperatures in Florida cause hydrilla to potentially occupy a large portion of lake surface area,

which is the problem.
-Prior to resistance, Fluridone was a low-cost option to reduce large acres of hydrilla in large lakes, with little impact on native plants
-Resistance to Fluridone was inevitable, and it developed simultaneously in several locations in Florida
-With resistant hydrilla, it has been difficult to maintain contact times at high concentrations of Fluridone due to water management schedules, flushing rates, and bacterial breakdown of Fluridone
-The primary issue with resistance is selectivity, because non-target impacts of herbicide use are certain to increase with Fluridone resistant hydrilla
-The Kissimmee Chain and Lake Istokpoga present the major challenges due to resistant hydrilla and importance of native plants to those ecosystems, causing high risk of non-target impacts
-We need to know if high coverage of hydrilla is a flood control threat in these lakes

"Current Florida DEP Management Strategies for Hydrilla in Florida", by Jeff Schardt, FL Department of Environmental Protection

-Management of hydrilla has reduced the total acres from 140,000 to 110,000, and the total number of water bodies from 280 to 186
-Large-scale hydrilla control has been ineffective with mechanical removal or use of insects
-Fluridone and Endothall are the two chemicals currently available for use on large systems
-Grass carp remove hydrilla but are nonselective for other native plants
-Fluridone most effective in January-May due to low rainfall increasing contact time, and lower light availability for growth
-Fluridone tolerant hydrilla and microbial breakdown of the compound have made long contact times necessary for control difficult to obtain
-65% of hydrilla control total budget is spent on Lake Istokpoga and the Kissimmee Chain of Lakes
-Lake stage and flow greatly influence the cost of Fluridone treatments, with high lake Kissimmee stage (e.g., 55 ft MSL) costing over four times the amount that a low stage (e.g., 49 ft MSL) would cost
-Hydrilla control will require cooperation among all state and federal agencies involved in large lakes in Florida

"Water Management Schedules and Hydrilla Management", by Susan Sylvester, U. S. Army Corps of Engineers, Jacksonville District

-USACOE managed lakes in Florida are operated using regulation schedules for flood control, navigation, and water supply for agriculture and downstream flow
-The regulation schedules have reduced variation in water levels compared to historic hydrologic regimes
-Temporary deviations from the schedules have been used to aid hydrilla treatments, but they require planning and multi-agency input
-Impacts of hydrilla on flood control in large lakes has not been evaluated

Summary of Presentations

The introductory presentations confirmed that viable management options for hydrilla in Florida are changing. Use of Fluridone as a long-term control measure for hydrilla on large lakes is currently a much less viable and cost-effective option than it was in the 1990s, and non-target plant impacts are likely to be significant for lakes with Fluridone-tolerant hydrilla. New compounds are needed, and third-party registrations may be required to invoke the resources necessary to develop these compounds. Water regulation will continue to play an important role in management options for hydrilla.

Critical Issues Identified in the Workshop

Although many issues were discussed, we provide a brief literature summary of the following top five issues identified by the participants in the workshop and make recommendations regarding the issues:

Integrated Plant Management
Triploid Grass Carp
Current and Future Chemical Management Practices for Hydrilla
Water Regulation Schedules and the Use of Fluridone
Wildlife and Fisheries Management

Neither the issues identified nor the recommendations provided should be considered as having any particular ranking within this document.

An additional section describing the Florida Statutes and Florida Administrative Codes pertaining to management of aquatic plants in Florida is added to clarify the laws relating to aquatic plant management in Florida and what agencies are responsible with what legislative authority.

Integrated Plant Management

In the final phase of the Hydrilla Issues Workshop held December 7, 2004 the participants listed Integrated Aquatic Plant Management as one of the top five issues. Integrated Aquatic Plant Management is the process of evaluating all available tools and then using those tools in a combination that will achieve the management objectives for a given aquatic system and a given budget. There are several written descriptions in reports and manuscripts that describe this management strategy. The following summary outlining Integrated Aquatic Plant Management is from the North American Lake Management (NALMS)/Aquatic Plant Management Societies' (APMS) aquatic plant management manual (Hoyer and Canfield 1997):

A successful integrated aquatic plant management plan is built on six main principles: (1) identify the uses of the water body and determine if any of these uses are impaired or benefited by aquatic vegetation; (2) understand plant ecology and the ecology of the water body; (3) set management goals; (4) consider all management techniques and select for use those that are most appropriate for the defined problems; (5) develop an action plan and a program to monitor the success or failure of management activities; (6) establish a long-term aquatic plant management education program.

The Department of Environmental Protection and other agencies charged with the management of aquatic plants generally follow the above procedures with some exceptions that came out in the Hydrilla Issues Workshop.

Throughout the workshop it became obvious that for the above Principle (4) the number of tools that are available for aquatic plant management is declining, especially for large lakes with abundant hydrilla that is resistant to low concentrations of fluridone. This hinders the ability to use fluridone for the selective control of hydrilla and enhancement of native plants. Fluridone provides short-term control of resistant hydrilla at higher use rates, but at an increased risk of killing non-target plants and at a significantly higher cost. Thus, to maintain some level of control, other management methods like contact herbicides and/or mechanical harvesting will have to be used, understanding that the total area of hydrilla control will be much less for equivalent expenditures. More information and some recommendations to alleviate this problem will be made in the section on herbicides.

The workshop participants strongly felt that the above noted procedures need to be followed working toward the development of lake management plans making sure to involve all stakeholders. Developing individual lake management plans by incorporating stakeholder input can be accomplished (e.g., Tsala Apopka Chain of Lakes, Hoyer et al. 1999). However, this is time consuming and requires dedicated financial resources.

Integrating Mechanical or Biological Control Methods

While this document provides detailed discussions and recommendations for grass carp, chemical use, and water level deviations, there is limited mention of mechanical and classical biological control approaches. Workshop participants suggested that moving towards an integrated management approach was the number one issue and priority, yet there was little input regarding how to incorporate mechanical or biological control methods with the current management techniques. Both mechanical and biological control were noted as tools that may be used for hydrilla control, yet both options have been available for many years and technological advances that demonstrate methods for improved use of these tools are very limited.

The lack of discussion on mechanical harvesting likely reflects the fact that there have been limited advances in technology over the past several decades (Haller 1996). While mechanical harvesting can provide immediate relief from hydrilla, the typical cost of control ($500 to $1,200 per acre), limited capacity to address large-scale infestations, and rapid re-growth of hydrilla have greatly limited the use of harvesting as a primary tool for hydrilla control. It should be noted that as the potential for integration of mechanical harvesting is discussed, in-lake disposal methods could significantly increase efficiency and reduce costs by up to 50% compared to standard trucking and disposal methods (Sabol 1981). While recent evaluation of a machine called the Kelpin harvester provided hydrilla control at approximately $200 per acre (Haller 1996), these large machines can be difficult to move from site to site, and the upfront costs for building the number of machines necessary to integrate this technology into a statewide program would be substantial. Lastly, a significant increase in the use of harvesting suggests the issue of non-target organism mortality as described by Haller et al. (1980) would need to be revisited. While mechanical harvesting represents a tool that could be immediately integrated into the larger state hydrilla control program, issues such as cost-effectiveness, use patterns and efficiency, non-target impacts, and disposal methods would require further discussion prior to embarking on a large-scale mechanical control effort.

Classical biological control has a much better chance of providing a long-term and highly selective tool for hydrilla control; however, overseas exploration for new organisms has been very limited over the last decade. The Hydrellia flies *Hydrellia pakistanae* and *Hydrellia balciunasi* have been released in Florida for the control of Hydrilla. *H. pakistanae* became established, while *H. balciunasi* has not. While research with *H. pakistanae* continues, there is limited evidence that demonstrates presence of the hydrellia fly provides a consistent and quantifiable level of control that is compatible with an operational management program. Hydrellia flies are already present in many lakes throughout Florida, and their effectiveness is related to the ability to build up a threshold population density (Wheeler and Center 2001). Fly populations are impacted by both winter weather patterns as well as the nutritional value (nitrogen) of the hydrilla, with damage typically noted in the top 20 cm of the hydrilla canopy (Wheeler and Center 2001). Lake Seminole on the border of Florida and Georgia does represent a site where *H. pakistanae* populations are thought to have increased to a level that provided a large-scale, but short-term reduction in hydrilla biomass (Grodowitz et al. 2003b) Nonetheless, at the current time, the presence or absence of the hydrellia fly within a waterbody has little bearing on the hydrilla management approach taken by resource managers in Florida. From an integrated plant management standpoint, the presence of hydrellia flies is likely having some level of impact on hydrilla growth potential (Doyle et al. 2002), and therefore, where present, the hydrellia fly would already be considered part of an integrated management program.

The operational use of this tool as a primary means of managing a hydrilla infestation remains a significant question. There has been a recent research emphasis on mass rearing and release of hydrellia flies to provide a more pro-active approach to hydrilla management, and these results are being analyzed. Results from laboratory and the field indicate that herbivory by *Hydrellia* spp. can impact hydrilla by reducing photosynthesis, thereby impacting biomass production and tuber formation. This research suggests that sustained herbivory, even at relatively low levels (i.e., 15% to 30% leaf damage) may reduce hydrilla's competitive advantage over native species allowing native species to compete more favorably (Doyle, et al. 2002, Grodowitz et al. 2003 and Grodowitz and Smart et al. 2003).

Researchers from the U. S. Army Engineers Engineer Research and Development Center (ERDC), Vicksburg, MS have continued work with *H. pakistanae* in the laboratory and field and they have developed mass rearing capabilities. Mass rearing allows introduction or augmentation of *Hydrellia* sp.. Researchers with the ERDC are currently working with the Florida DEP regarding permits for releasing *Hydrellia* flies into selected Florida Lakes. In addition to releasing the flies, there are plans for follow-up monitoring of hydrellia fly populations and their impact on hydrilla. It should be noted that it may take a number of years and a number of fly introductions for impacts to be seen and documented.
As research with the hydrellia fly continues, aquatic resource managers in Florida should pay close attention to results that provide a quantifiable demonstration of the effects of site augmentation with the flies.

Due to the limited number of classical biological control options available, aquatic resource managers within the state of Florida should encourage interested agencies (FLDEP, USACOE, University of Florida) to meet and discuss the feasibility, advisability, and target countries for renewing overseas searches for biological control organisms on hydrilla. While the performance of the upcoming hydrellia fly augmentation releases will be monitored, to date, *H. pakistanae* has not been indicative of an organism that will provide a predictable level of hydrilla control necessary to relieve pressure on aquatic managers.

Recommendations

Recommendation 1: Florida Department of Environmental Protection (FDEP) should begin establishing for each lake/aquatic system receiving significant State of Florida aquatic plant management funds an initial working group composed of senior FDEP and Florida Fish and Wildlife Conservation Commission (FWC) staff that is charged with developing a preliminary, written, aquatic plant management plan. Other appropriate state and federal agencies will be notified of the formation of this working group and those agencies will be allowed to determine whom among their staff are best qualified to provide input on the development of the plan. The plan must consider the principal or planned use of the water body, the optimum sustained use by the public of the water body's living aquatic resources, and/or sound biological management principals. The working group must utilize stakeholder input throughout the development of lake management plans. Finally, the working group shall also determine the historical level of hydrilla infestation, current status of the hydrilla, and technologies and funding available for control when determining the minimum feasible level of hydrilla. This must be done with the recognition that protection of human health, safety, and recreation are mandated by the Florida legislature when determining minimum feasible levels of hydrilla.

Justification: The Florida Department of Environmental Protection and the Florida Fish and Wildlife Conservation Commission are the two entities charged by the Legislature to manage aquatic plants throughout the state of Florida. Senior staffs from these two groups know the lakes, have extensive experience, and know other pertinent players at each lake. Senior staff of these agencies in conjunction with appropriate representatives from other local, state, and federal agencies has the best chance of coming up with a temporary yet workable lake management plan. These individuals also know the consequences of failure (i.e., legislative involvement) to their programs. Both the FLDEP and FWC have statewide responsibilities regarding hydrilla management, therefore, these two groups will be the most knowledgeable regarding the need for including Water Management Districts, the US Army Corps of Engineers, US Fish and Wildlife Service, County cooperators, and other groups with a stake in management policies regarding hydrilla.

Triploid Grass Carp

Throughout the Hydrilla Issues Workshop the use of grass carp as a tool for controlling hydrilla was mentioned many times. All participants were aware that grass carp are used extensively in Florida, but some felt it was necessary to reevaluate their use, especially in some of Florida's larger public lakes (e.g., KCOL) containing abundant populations of Fluridone resistant hydrilla. This concern was largely driven by the reality that Fluridone resistant hydrilla is consuming a large portion of the management budget. As these fluridone resistant plants spread they will consume larger portions of the budget and therefore the need to consider the cost-effectiveness of grass carp balanced with the potential environmental impact.

Diploid grass carp arrived in Florida and other parts of the country in the early 1970s. Their arrival caused an explosion of research on their use as an aquatic plant management tool. Today only sterile triploid grass carp can be used for aquatic plant control. An excellent summary of the majority of grass carp research for aquatic plant management can be found in the Proceedings of the Grass Carp Symposium held in Gainesville, Florida (U. S. Army Corps of Engineers 1994). There were two major consensuses that came from the grass carp symposium that were also parallel from participants in the Hydrilla Issues Workshop: 1) when stocked in sufficient densities at a large enough size to avoid predation (approximately > 12 in) grass carp are very efficient at controlling all submersed aquatic vegetation, and 2) when grass carp are stocked into a lake at densities high enough to control all submersed aquatic vegetation they are extremely hard to remove from a system. Thus, if the elimination of submersed aquatic plants is an acceptable management objective for a lake system, then grass carp are an efficient cost effective means of aquatic plant control.

Less clear from the Proceedings of the Grass Carp Symposium (U. S. Army Corps of Engineers 1994) and the Hydrilla Issues Workshop is the potential for grass carp to be used after herbicides have decreased aquatic plant biomass to selectively control regrowth of hydrilla and maintain moderate levels of native aquatic vegetation. Florida lakes Deer Point, Miccosukee, and Conway have all been used as success stories at maintaining some submersed vegetation with low levels of carp controlling hydrilla. However, with the exception of Lake Conway (Leslie et al 1994) there has not been consistent evaluations and publication of data confirming the successes of these examples. With a quick literature review we found some more current evidence suggesting that stocking low levels of grass carps can achieve control of palatable problem species while maintaining moderate levels of native aquatic vegetation in ponds (Pipalova 2002) and small impoundments (Blackwell and Murphy 1996).

Contrary to the above findings, Hanlon et al. (2000) examined long-term macrophyte control in 38 Florida lakes using triploid grass carp and found an apparent break point suggesting an all or nothing control response. These efforts suggest that stocking grass carp between 25 to 30 grass carp per hectare of vegetation can result in a lake having some plants left (Hanlon et al. 2000). However, the remaining vegetation will be unpalatable submersed, floating leaf, and emergent vegetation. Hanlon et al. (2000) also noted that while stocking rates based on the amount of submersed vegetation provides a "narrow window of opportunity" to control nuisance vegetation like hydrilla while maintaining some submersed plants it is extremely difficult to achieve a stocking rate of 25 to 30 grass carp per hectare of vegetation. These rates are difficult to maintain in individual lakes because of varying grass carp mortality rates, fish mobility, and changing limnological conditions. When grass carp were stocked at densities greater than 25 to 30 fish per vegetated hectare the complete control of aquatic vegetation was achieved and lakes stocked with less than 25 to 30 fish per vegetated hectare tended to have the same or higher amounts of aquatic vegetation as when the lake was originally stocked. Similar results were found in Washington State when Bonar et al. (2002) evaluated grass carp stocking in 98 lakes and ponds. Nineteen months after stocking in the Washington lakes and ponds, submersed macrophytes were either completely eradicated or not controlled at all with a small percentage (18%) maintaining an intermediate level of submersed aquatic vegetation. Bonar et al. (2002) recommended against stocking grass carp in lakes where eradication of submersed vegetation cannot be tolerated.

Grass carp have been used to control hydrilla in several large systems including Lake Conroe in Texas (Klussmann et al. 1988), Santee Cooper Reservoir in South Carolina (Kirk et al. 2000), and Lake Guntersville in Alabama (Webb et al. 1994). In lakes Conroe and Santee Cooper almost complete control of all submersed aquatic plants was achieved while in Lake Guntersville hydrilla was reduced for a one to two year period while maintaining moderate levels of other submersed plants. In Florida, Lake Istokpoga (surface area approximately 12,100 ha) was stocked with 125,000 grass carp with little or no impact on the abundance of aquatic macrophytes. The hypothesis is that the grass carp left Lake Istokpoga through outlet canals before they could impact the hydrilla in the system, however insufficient data were collected to support this hypothesis. Lake Yale is another large Florida lake (surface area approximately 1,635 ha) where grass carp were used in an attempt to control hydrilla. Initially, the carp were stocked at low levels (approximately 7/ha or 3/acre) but additional stocking brought that density to approximately 17/ha (7/acre) where the consumption rate of the carp exceeded the growth rate of the submersed vegetation. The final result was the complete elimination of submersed and emergent vegetation (primarily grasses) for several years. It took 4 to 5 years of intense electro-fishing and other carp removal strategies to bring carp densities to a level where revegetation efforts once again established littoral vegetation. The cost of these efforts was high and would suggest that current technologies for grass carp removal are not cost-effective or practical. Thus, the large lake case histories show a similar trend to the pond and lake studies listed above. Some large lakes experienced total elimination of submersed aquatic vegetation, some had no reduction in aquatic plants and there was limited evidence that some level of temporary hydrilla control can be achieved while maintaining other species of submersed aquatic vegetation.

With little hard evidence that submersed aquatic plant control can be achieved with low density stocking of grass carp while maintaining some submersed aquatic vegetation, a common warning in the grass carp literature is the statement that “unless complete elimination of submersed aquatic vegetation can be tolerated, grass carp stocking is not recommended.” Thus, the key to universal use of grass carp for plant management is to have the ability to develop a cost-effective strategy to remove the fish from a system if the amount of plant control exceeds target amounts. Historically, managers have experimented with several methods for removing grass carp from lake systems including: herding, angling, attracting, use of lift nets, and toxic fish baits (Schramm and Jirka 1982; Bonar et al. 1993; Mallison et al. 1994). Unfortunately, all techniques used in the removal studies were time consuming, labor intensive, sometimes quite expensive and in each case failed to remove a major portion of the carp population. This is especially important in light of evidence suggesting that it may take only 0.5 carp per acre to maintain complete control of submersed vegetation regrowth after complete control of submersed vegetation is achieved (Moxley et al. 1993).

Recently, grass carp have been trained experimentally to come to sound (Willis et al. 2002) and then after training placed in ponds to evaluate recapture after attracting with sound (Duncan 2002). Another new method for the removal of grass carp from lake systems is the use of bioerodible capsules containing fish toxicant that could be implanted in the carp and used to euthanize the fish after a given period of time (Thomas 2004). These and other new methods for manipulating carp densities could make the grass carp a more useful and acceptable aquatic plant management tool.

Much more could be written on the volumes of grass carp literature that exists but the brief summary above covers the major issues brought up at the Hydrilla Issues Workshop.

Recommendations

Recommendation 2: Throughout the literature review, Grass Carp Symposium and the Hydrilla Issues Workshop it is clear that if there was some cost-effective and selective method of removing grass carp from a lake system before complete eradication of submersed aquatic vegetation was accomplished then triploid grass carp would be an excellent method of hydrilla control for large and small lakes. Therefore, we recommend making funds available for more research on new techniques for removing grass carp from lakes. Research on this and other methods may be expensive but a successful method would pay great dividends to aquatic plant management in Florida lakes.

Comments on the first draft of this report echoed warnings from previous studies suggesting that if total elimination of aquatic vegetation is unacceptable then the use of grass carp to control vegetation in large or small lakes should not be considered. However, if research provides an efficient method to remove grass carp from a lake then it is recommended that this method be evaluated in a Florida lake requiring aquatic plant control.

Justification: With the onset of resistant hydrilla there are limited tools with which to manage large infestations of hydrilla that are cost effective and selective. Thus, increased use of grass carp will likely be a major alternative. Because of the fear of complete removal of submersed aquatic plants from lake systems, it is imperative that some means of predictably removing grass carp from systems be obtained.

Current and Future Chemical Management Practices for Hydrilla

The impetus for organizing the Hydrilla Issues Workshop revolved around the phenomenon of fluridone resistance. As a result much of the dialogue focused on the challenges associated with managing fluridone-resistant hydrilla (FRH). Discussion related to this issue included current and past chemical alternatives, as well as the potential for developing new products. In this section we address current and future chemical management practices, and identify the strengths, weaknesses, and issues associated with these management strategies. We conclude by making specific recommendations related to future chemical control efforts.

A Basic Understanding Fluridone Resistance

Within the aquatic plant and resource management communities the challenges associated with managing FRH have not been well understood. In order to provide background information to a broad range of resource managers a Symposium on Herbicide Resistance in Aquatics was held at the Aquatic Plant Management Society Meetings in Tampa, FL in July 2004. The recent Hydrilla Issues Workshop in December was organized to specifically focus on hydrilla management and fluridone resistance issues. While there remains much to learn regarding hydrilla and fluridone resistance, the following statements provide an overview of our current understanding of this issue:

1. Formerly sensitive populations of hydrilla have developed increased resistance to low levels of fluridone in numerous Florida lakes. Despite a similar genetic origin for hydrilla throughout Florida (Madiera et al. 1997), the majority of lakes with "resistance issues" have a history of fluridone management. While literature is sparse regarding hydrilla and fluridone resistance, recent publications describing this phenomenon have become available (MacDonald et. al 2002, Michel et al. 2004, Arias et al. 2005).

2. Fluridone resistance is caused by various point mutations at site 304 in the phytoene desaturase (PDS) gene, and each point mutation has a different impact on the response of hydrilla to fluridone (Michel et al. 2004). The fact that adjoining lakes support hydrilla with different mutations indicates that fluridone resistance has evolved independently at different sites.

3. The development of fluridone resistance was not predicted by the scientific community based on the asexual nature of dioecious female hydrilla, and the lack of previous evidence of resistance to PDS inhibitors such as fluridone. In fact, hydrilla is the first example of a somatic mutation leading to development of widespread resistance in the field.

4. FRH is currently widespread with populations dominating the Kissimmee Chain of Lakes, Lake Istokpoga, several Polk County Lakes, and numerous other public and private water

bodies throughout the state. Resistant biotypes of hydrilla are present in lakes that contain well over 100,000 surface acres of water, and as the critical mass of FRH infestation increases the threat for continued inter-lake spread of these plants is greatly increased.

5. It has been suggested that it took approximately 14 years for hydrilla to develop resistance to fluridone. This scenario is based on the registration of fluridone occurring in 1986 and the documentation of resistance in the year 2000. Evidence from research ponds and various lakes suggest that selection of resistant biotypes can occur in a much shorter period of time. For example, large-scale fluridone treatments on Lake Cypress, FL were not initiated until 1996 and the entire 4000-acre lake contained a tolerant biotype by 2000. The complete dominance of resistant plants on Lake Cypress within 4 years of an initial treatment would suggest that fluridone resistant strains were established in the lake within a couple of years of the initial large-scale treatment. While rapid selection for resistant biotypes was inevitable, the subsequent dominance of these resistant biotypes was likely accelerated by successive treatments with sub-threshold fluridone concentrations.

6. There is currently no evidence of a "fitness penalty" for the development of fluridone resistance. This means that FRH is likely to be just as competitive and aggressive as the sensitive biotypes. Therefore, once resistant plants become established and produce tubers, it is unlikely that active management, lack of management, or intra-specific competition between the biotypes will remove the resistant plants from the system.

Use of Fluridone for Control of Resistant Biotypes of Hydrilla

For those individuals with a peripheral involvement in hydrilla management, one of the more difficult questions to address is why aquatic plant managers continue to use fluridone after resistance has developed. First and foremost, the number of tools available for hydrilla control is quite limited, and fluridone and triploid grass carp remain the only tools currently proven to provide cost-effective control of large-scale hydrilla infestations. In addition, the slow plant death following a fluridone application is a desirable trait that is often overlooked, and yet from a wildlife and fisheries, and water quality standpoint, the incremental loss of dense hydrilla over several months may be one of the most important characteristics of any fluridone treatment, whether for susceptible or resistant biotypes.

The level of fluridone resistance can vary considerably and therefore, while the term resistance connotes a qualitative character (i.e. a population is or is not resistant), it is the quantitative determination of the level of resistance that is more critical to issues such as treatment cost, non-target plant impacts, and long-term efficacy. Quantifying the sensitivity of a hydrilla population to fluridone can be determined through intensive sampling and laboratory assay to assist aquatic managers in determining treatment strategies.

The most resistant strain of hydrilla characterized to date, remains sensitive to fluridone well within the label's maximum allowable use rate of 150 ppb. One of the key attributes of fluridone has been its specificity for plants and hence its wide margin of safety for non-target organisms (invertebrates, fish, and wildlife) up to the maximum use rate. There are also no fishing, swimming, or potable water use restrictions associated with the use of fluridone up to the maximum rate of 150 ppb. Therefore, increasing traditional use rates of fluridone from 5 to 10 ppb by 3 to 5 times, while certainly changing the economics of hydrilla control, is not expected to have a direct adverse impact on invertebrates, fish, wildlife, or recreational uses of the water body. There will, however, still be indirect impacts because of loss of fish and wildlife habitat.

While resistance has greatly impacted the economics of fluridone treatments, fluridone costs remain competitive and are generally lower than costs of other chemical techniques when one considers control on a per vegetated acre basis. Nonetheless, this comparison may not be appropriate as contact herbicides tend to be applied directly to a densely vegetated priority area, and therefore control is generally limited to the immediate vicinity of the treatment zone. In contrast, fluridone tends to be quite long-lived in the water column and will disperse well beyond the treatment site. This has allowed the use of fluridone to control hydrilla in large areas throughout a water body. The need to maintain a long-term concentration in the water column regardless of the plant distribution or density is both a strength and weakness of fluridone. Fluridone is the only chemical tool that can be used in a cost-effective manner to prevent hydrilla expansion when plants are widely distributed on a large water body. In contrast, when resistant hydrilla is concentrated within an area of a large water body, dispersion of residues to areas without hydrilla or into sites dominated by native vegetation reduces either the cost-effectiveness or selectivity of the treatment.

The reality of managing resistant hydrilla has greatly reduced the expected longevity of control following a fluridone treatment. As a result, yearly applications of fluridone have been conducted since the late 1990s to suppress hydrilla growth during the spring and summer months in the Kissimmee Chain of Lakes. The greatest challenge in developing treatment strategies is related to the need to maintain a fluridone concentration above a target threshold for an extended period of time (Netherland and Getsinger 1995). Initial water levels and water level schedules can have a dramatic impact on the cost and effectiveness of treatments in large flowing lakes such as the Kissimmee Chain or Lake Istokpoga. Under the best of conditions (sites with limited or no flow) the ability to maintain fluridone residue thresholds for over 100 days when targeting a resistant biotype has proven challenging (see the following section).

<u>Selectivity Concerns:</u>
In addition to the significant cost increase and reduced longevity of control created by hydrilla resistance, adverse impacts to non-target vegetation have also been noted as the use rates have increased. While the lower use rates of fluridone for control of susceptible hydrilla had minimal impacts to important native submersed (e.g. vallisneria, Illinois pondweed) and emergent (e.g. bulrush, knotgrass, maidencane, water lily, spatterdock) vegetation, the higher use rates necessary to control FRH have shown potential to result in significant injury to several native species. Unfortunately, the vast majority of published literature regarding the selectivity of fluridone has been conducted in the northern tier states with an emphasis on submersed aquatic species (Getsinger et al. 2002). Due to the whole-lake use patterns of fluridone, non-target plant

injury is a significant issue, and the desire to protect native vegetation will likely result in a practical upper limit on fluridone residues depending on the native communities present in a given water body. The availability of an accurate immunoassay test for fluridone analysis (Netherland et al. 2002) has greatly facilitated hydrilla management, and similar sampling protocols could be used to determine the relation between field residues and non-target impacts.

One of the major concerns regarding fluridone selectivity is based on repeated applications and increasing use rates of fluridone. Fluridone impacts plants in a unique way, and the bleaching symptoms tend to be highly visual for the more sensitive emergent species. Intense bleaching at the new growing points is a symptom of exposure, yet these symptoms do not indicate that plant death is imminent. While fluridone is often referred to as a systemic herbicide, it is not translocated in the phloem like glyphosate or 2,4-D (e.g. Rodeo, Weedar), and therefore a long-term aqueous exposure to fluridone is required to kill even the most sensitive emergent plants. A short-term exposure to high fluridone residues can result in a severe but temporary bleaching of new growth that is followed by rapid recovery. In contrast, long-term exposure to near threshold concentrations can greatly reduce the growth of non-target plants and may eventually result in death of established emergent plants. While investigations are ongoing, the area of fluridone selectivity definitely requires further research attention. It should be noted that regardless of the fluridone use rate, it is unlikely that treatments would result in a complete loss of vegetation. Higher use rates would likely alter plant competition and result in a significant shift in the vegetation community from a dominance of native grasses, lilies, or submersed macrophytes to more tolerant plants such as pickerelweed, smartweed, or the macrophytic algae Chara or Nitella.

Endothall as a Chemical Alternative

With the onset of fluridone resistance, use of the aquatic herbicide endothall has significantly increased over the past several years. Endothall has been used for hydrilla control for over 30 years, and unlike fluridone it requires only hours to a few days of exposure to provide control of hydrilla. Typical use rates for endothall are in the range of 3000 ppb and, therefore, while the exposure time is greatly reduced, use volumes are in the range of 100 times greater than fluridone on a per acre basis. The increased volume requirement presents practical limitations to the amount of Endothall that can be applied. Product volumes, product costs, rapid control of vegetation, and a 3-day fishing restriction have typically limited the use patterns of endothall to smaller treatment areas. While endothall provides a strong benefit in small treatment blocks, there is ongoing discussion of increasing the size of treatment blocks to manage larger contiguous areas of hydrilla. Regardless of the size of the treatment block, the concentration and exposure time of endothall in the treatment area remains a critical element in achieving the desired level and longevity of hydrilla control (Netherland et al. 1991). Endothall currently represents the key chemical alternative to fluridone in preventing the establishment of new infestations of hydrilla. In addition, the practice of integrating endothall into fluridone treatments for control of FRH has enhanced the efficacy of both compounds.

At the present time endothall is typically viewed as a product that provides several weeks to a few months of relief from hydrilla. Research is ongoing to improve the longevity of endothall treatments for use on shoreline strips, boat trails, and large contiguous blocks of hydrilla. With the spread of FRH, endothall is an indispensable tool for creating access or open water in the midst of large hydrilla infestations. Despite a significant increase in endothall use for hydrilla control during the past several years, the literature is sparse regarding improving methods, treatment timing, or use rates for hydrilla control. The recent development of an immunoassay for endothall detection in the water column has greatly facilitated both laboratory and field research efforts. Monitoring treatment timing, formulation differences, and various use rates in the field is currently ongoing.

Two of the major concerns associated with endothall use are the requirement for posting a 3-day fishing restriction (fluridone has no use restrictions), and the potential for a rapid decay of plant biomass that could reduce dissolved oxygen to levels that could result in a fish kill. In December 2004, the registrant submitted data to the USEPA requesting that the 3-day fishing restriction for Aquathol be removed from the label. While fish kills in association with herbicide applications on large public water bodies have been rare, a cautious approach is still warranted. The timing of application (e.g. water temperature) and the density of the target vegetation at the time of treatment are likely the most significant variables that will determine if there is a potential for significant oxygen depletion. Reduced efficacy of endothall over time has also been noted as a significant concern. While these observations remain anecdotal research into potential tolerant strains of hydrilla and enhanced environmental degradation are ongoing.

In regards to plant selectivity, the nature of endothall degradation and the use patterns favor the selective use of this product. While endothall use rates are typically in the range of 3000 ppb, the molecule is rapidly degraded by microbial action. In addition, use patterns typically result in the treatment of smaller areas within large lake systems. Rapid dispersion and degradation result in minimal exposure of plants outside of the treatment zone. Submersed applications of endothall do not tend to have impacts on emergent vegetation (Skogerboe and Getsinger 2001). Vallisneria and macrophytic algae tend to thrive following endothall applications, while Illinois pondweed and naiads tend to be fairly sensitive.

Contact Treatment Strategies

Within the Harris Chain of Lakes (Griffin, Eustis, Harris), the Saint Johns Water Management District, Lake County Mosquito and Aquatic Plant Management, and the FDEP have implemented an intensive surveillance and spot treatment strategy with endothall to prevent hydrilla from expanding within these systems. The recent expansion of hydrilla in these large lakes has been attributed to improved water clarity. The management response has been to greatly increase surveillance using a variety of people (agency personnel, contractors, and the public) to locate and map new hydrilla infestations. Spot treatment strategies are rapidly implemented to prevent further spread, and follow up visits are made to insure treatment efficacy. This approach has been effective for these systems; however, there may be unique features of these lakes that favor this strategy.

Hydrilla within the Harris Chain of Lakes represents small pioneer infestations that may be deterred from rapid expansion by the shading activities of intense phytoplankton blooms. Recovery of hydrilla following the small contact herbicide operations is likely hindered by the reduced water clarity provided by these blooms. Furthermore, the plants in the Harris Chain of Lakes are susceptible to fluridone, so any large-scale recovery of hydrilla could be set back using a low rate and cost-effective fluridone treatment. In contrast, hydrilla growing in the Kissimmee Chain of Lakes or Lake Istokpoga is widespread and past growth has not generally been constrained by phytoplankton blooms. In these systems water quality conditions following a contact treatment are often favorable for rapid recovery of any plant tissue that survives the initial herbicide application. In addition, this hydrilla has an increased resistance to fluridone, and the inability to manage growth with contacts through the spring could lead to a situation of widespread hydrilla coverage and inability to implement whole-lake management strategies during under conditions of high biomass and high precipitation and flow during the summer months.

It is interesting to note that through the spring of 2005 hydrilla infestations on the Kissimmee Chain of Lakes, Lake Istokpoga, and Lake Weohyakapka are greatly reduced following the intense disturbance from hurricanes in the summer of 2004. This has led to the suggestion that a greater emphasis should be placed on surveillance and spot control for hydrilla management on these sites. In addition, the current situation of highly colored water on these lakes is a strong deterrent to hydrilla recovery due to markedly reduced light penetration into the water column. The combination of highly stained water and low hydrilla biomass in the spring of 2005 may allow for the successful implementation of the surveillance/spot treatment strategy through the summer and fall of 2005. While a surveillance and spot treatment strategy may represent a sound management program as long as current low biomass and water clarity conditions exist, most aquatic managers recognize that these conditions can change rapidly. As water clarity improves and sprouting hydrilla tubers survive over thousands of contiguous acres, maintaining hydrilla control with a surveillance/spot treatment strategy will be greatly complicated. The current example illustrates that need for aquatic plant managers to use prevailing conditions to their advantage when implementing hydrilla control strategies.

Current State Policy on the Use of Copper-based Products

In the late 1980s and early 1990s the State of Florida began moving away from the use of copper-based products for hydrilla control in natural water bodies throughout the state. A policy was implemented regarding copper use in manatee aggregation areas, but this soon became the standard for the majority of natural water bodies. While copper use has not been banned as part of the state program, its use is generally limited to urban and artificial water bodies that are considered degraded. Within the state program, copper is sometimes used in combination with diquat in areas around boat ramps where retention time is often very limited due to the small size of the treatment. Despite considerable debate regarding the fate and toxicology of copper that is bound to the bottom sediments, it is not disputed that each application results in further accumulation of copper in the sediment. A 1992 workshop held at the University of Florida was organized to present information on the bioavailability and toxicity of copper (Joyce 1992).

Several opposing viewpoints were expressed regarding copper toxicity to non-target organisms and the bioavailability of copper bound to sediments. Despite the passage of over 12 years, the major issues associated with copper use remain largely unchanged.

FDEP has taken the stance that copper should not be used if reasonable alternatives exist. The major concern expressed over the use of copper was the need for multiple treatments and hence an impact on the accumulation of copper in the sediments. Given the recognition that FRH has become widespread, there is some question as to whether the state should consider the use of copper on a limited basis as a rotation tool for endothall. The combination of diquat and copper has been a standard treatment for hydrilla in other parts of the country, and the efficacy of this combination is not in question. The amount of copper necessary to enhance diquat activity is currently not well defined, and studies along these lines could prove valuable in allowing recommendations of reduced copper rates for improved hydrilla control. This approach would seek to use the minimal amount of copper necessary to control hydrilla. It should be noted that low rates of copper may also enhance the activity of endothall or fluridone.

Potential Development of Alternative modes of action

During the course of the Hydrilla Issues Workshop, the need for development of alternative modes of action was discussed. While many in attendance viewed this as an industry responsibility, two alternatives were presented that would allow state and federal agencies and university personnel to become more integrally involved in the process of registering products for aquatic use. The two alternatives proposed included cooperation with the USDA IR-4 program and the potential for a state agency within Florida to explore a third party registration.

The USDA IR-4 program was initiated in response to the loss and lack of products available for minor use markets (e.g. vegetables, horticulture). While industry was generally averse to investing extra money to develop products in these niche markets, they were willing to move into these markets. With the consent of an industry partner, the IR-4 program helped to develop data requirements that would support a new product use in minor markets. These data were then submitted to the Environmental Protection Agency for registration of the product in the minor use market. The end-user benefited as a new tool became available for their industry. It is worth noting that in several cases, IR-4 has helped to develop new tools in response to resistance issues in minor use markets. Current discussions are ongoing within the IR-4 program to include the field of aquatic plant control.

One area where IR-4 could be particularly helpful would be in the development of food crop tolerances (i.e. the maximum amount allowed in commodities) that would reduce the restrictions on new and existing aquatic products. For example the irrigation restrictions on the recently registered products triclopyr and imazapyr are largely driven by a lack of tolerances in food crops. Development of these tolerances would be aligned with the IR-4 mission, and would provide greater flexibility for use of chemical tools in aquatics.

Third party registration would involve the FDEP or another governmental agency becoming involved in registering a product for their exclusive use for hydrilla control. While close cooperation with Industry would be required, precedent for this arrangement has been set by the Florida Fruit and Vegetable Growers Association (they have several third party registrations), and by the Florida Tropical Fish Farmers Association. This approach could provide an incentive for evaluating off-patent compounds. At the present time there is little incentive for researchers to screen off-patent herbicides, as it is very unlikely that industry would be willing to consider investing several million dollars in such a project. While this would be a non-traditional approach, there are numerous scenarios where private industry and government could work together to develop new tools for the aquatic market.

One of the greatest challenges to the research community and Industry is identifying desirable attributes for a new product in the aquatic market. Despite the large number of products available in terrestrial agriculture, there are actually very few herbicides that would have a good fit within the aquatic market. Some of the key attributes that have been identified include the following:

1. A compound must have a very strong toxicology package for mammalian, bird, fish, and invertebrate organisms. This requirement eliminates many families of herbicides from consideration. Water use restrictions (e.g. fishing, drinking water, etc.) are generally undesirable and are largely based on the toxicological properties of the compound.

2. A compound must provide a high level of selective control for hydrilla.

3. A compound with a long residual in the water column and an alternate site of action compared to fluridone represents a strong candidate.

4. A compound with a short residual in the water column and systemic activity on hydrilla would be highly desirable.

5. Products that result in a slow pattern of plant death (e.g. like fluridone) would be beneficial from a water quality standpoint.

6. The product should be easy to apply, cost-effective, safe for applicator handling, and preferably used at low volumes.

The Development of Acetolactate Synthesis inhibitors as an alternative to Fluridone

There was considerable interest expressed at the workshop regarding the development of new herbicides for aquatic use. Acetolactase synthesis (ALS) inhibitors currently show strong potential to control hydrilla at low use rates. These compounds block the formation of essential branched-chain amino acids in plants. The ALS enzyme system is unique to plants, therefore non-target toxicity of these compounds is very low. Preliminary evaluations indicate that several ALS inhibitors are active on hydrilla at rates in the low part per billion range. Due to the low use rates, activity on a specific plant enzyme, and impact on the new growth of hydrilla it is likely that ALS chemistry would have a very similar use pattern to fluridone. The maintenance of low concentrations over a long period of time will be critical to the efficacy of an ALS inhibitor. While the issues of potential resistance development and use of water for irrigation have been discussed, the need to evaluate new modes of action is deemed the more critical issue at this point in time. In regards to the selectivity of ALS chemistry, research is ongoing at the greenhouse and field scale. The herbicides penoxsulam and imazamox recently received Experimental Use Permits from the EPA for up to 500 acres of water in Florida. Both compounds are expected to provide good control of hydrilla at low use rates. Several use sites have been identified for evaluation in the spring and summer of 2005.

Recommendations

Recommendation 3: Based on the extent of Fluridone resistant hydrilla (FRH), the identification and development of new herbicides for hydrilla control is critical. FDEP should immediately re-invigorate Florida's chemical research programs for aquatic plant management programs. FDEP should lead by obtaining needed state and federal funding (goal 10% of State of Florida's existing activities budget), and entering into agreements with universities, federal agencies or private entities for research and the development of new or improved aquatic plant control methods. In addition to the USEPA data requirements for the registration of a new product, a thorough evaluation of the efficacy and selectivity of a new herbicide will be critical prior to recommending its use on large public water bodies.

Justification: The inability to develop new tools for hydrilla control will result in further spread of FRH and this will greatly compromise the ability of the FDEP and its cooperators to manage hydrilla throughout the state. The best strategy for resistance management is the development of multiple tools that can be rotated. To conduct the appropriate research, funding is needed. FDEP provided research funding in the 1980s (FS 369.20(4)(b)) and the State of Florida got a good return on investment. Therefore, a good argument can be made to the Florida Legislature for increased research funding. As the largest purchaser of aquatic herbicides in the world, the FDEP and other end-users should make it clear to Industry that new tools would be welcomed and integrated in to their existing program. The increased reliance on endothall as the sole chemical alternative to fluridone may result in future problems with endothall efficacy. Finally, the addition of new aquatic products could provide enhanced benefits to the state for control of aquatic invasive species other than hydrilla.

Recommendation 4: There is a strong need to improve our ability to quantify the impact that fluridone or other lake management techniques are having on key non-target plant species. Methodologies for collecting reliable and useful field data need to be worked out between responsible agencies so results can be compared across both managed and unmanaged water bodies and sites treated at different fluridone use rates.

Justification: While increasing fluridone use rates does not pose a direct threat to non-plant organisms, the potential loss or severe reduction of a key individual plant species is a legitimate concern that requires improved data collection to support future decision-making. The bleaching symptoms following a fluridone application are quite visual, and conclusions on the ultimate impact to these native plants are often anecdotal and based on a bias regarding fluridone use for whole-lake management. There has been little or no quantitative assessment of the impact to native submersed and emergent vegetation following increased use rates of fluridone. While laboratory and mesocosm data for non-target native plants are currently being generated, these data need to be put in the context of actual field results. The FWC has conducted some initial field monitoring, but these efforts have generally been limited and have remained internal.

Recommendation 5: For sites where the hydrilla remains susceptible to fluridone, consecutive year applications are discouraged. It is also crucial that resistance management strategies be developed to prevent FRH from developing a dual resistance to another mode of action.

Justification: Fluridone has proven its utility in providing large-scale hydrilla control, and a successful treatment should greatly reduce the need to conduct an application the following the year. In situations where adequate control is not achieved, aquatic managers need to determine the basis for this reduced efficacy (e.g. increased resistance, loss of residues to flow, enhanced degradation). Based on the widespread coverage of FRH on the Kissimmee Chain of Lakes and several other large lake systems, it is apparent that sequential applications of fluridone can ultimately facilitate the lake-wide expansion of resistant biotypes.

ALS chemistry represents a potential new tool that could be rotated with fluridone for control of susceptible hydrilla. In the case of FRH, management with an ALS herbicide will be complicated the fact that managers will be treating plants that have already developed a resistance to one mode of action. For sites already dominated by FRH, management strategies need to be considered to prevent development of a dual resistance to both fluridone and ALS inhibitors. This issue suggests that more than one new mode of action is needed for the long-term control of hydrilla.

Recommendation 6: In addition to considering rotation schemes with fluridone, aquatic managers also need a contact product that can be rotated with Aquathol. There are currently no new products that are seeking registrations. In order to provide a new tool that would be available for immediate use of combinations of products should be further evaluated. . We recommend that copper only be considered for hydrilla control when used in combination with the herbicide diquat or other registered herbicides. Research should be conducted to determine if low rates of products such as the dimethyalklyamine formulation of endothall or hydrogen peroxide can enhance the activity of diquat or endothall for spot control of hydrilla.. As the treatment of new infestations is the top FDEP priority for hydrilla control, addition of an additional contact product would provide a highly useful tool to address this priority.

Justification: Endothall is the only contact product in wide-scale use in Florida public waters, and this complete reliance on a single contact herbicide does not represent a good resistance management strategy. There are many cases where multiple applications of endothall are being applied in the same areas. In lieu of waiting for a new contact herbicide registration (this could be years away), aquatic managers are encouraged to support research that evaluates the use of combination products to provide enhanced control and the ability to rotate products.

Recommendation 7: When possible, intense but small-scale management of hydrilla is preferable to large-scale whole-lake management efforts. In the case of larger lakes, this requires a considerable commitment to surveillance, sound reporting of the exact locations and size of hydrilla infestations, rapid action, and aquatic managers who can make decisions on the optimal treatment recommendations for insuring that small infestations are not allowed to spread. This recommendation fits with the current priority list of the FDEP regarding intense management of new finds, and this strategy should be employed to delay the spread of hydrilla, especially resistant strains.

Justification: When practiced properly, this form of management most resembles the highly successful water hyacinth maintenance control program and it represents the best use of limited state resources and manpower. Preventing the establishment and dominance of hydrilla in water bodies with abundant native vegetation is the best management practice both in terms of cost-effectiveness and selectivity. If hydrilla can no longer be controlled in this manner, then whole-lake options should be considered. Experience suggests that once hydrilla has been allowed to cover a water body, it is likely that whole-lake management will be required for multiple years to keep the plants under control. This increases both the long-term cost and the likelihood of resistance development.

Water Regulation Schedules and the Use of Fluridone

Water regulation schedules for the Kissimmee Chain of Lakes (Lake Tohopekaliga, Lake Cypress, Lake Hatchineha, and Lake Kissimmee) and Lake Istokpoga received considerable attention at the Hydrilla Issues Workshop. This discussion was based on the direct linkage between water levels and release schedules, and the cost-effectiveness and overall efficacy of fluridone when managing FRH. It is important to note that the issue of regulation schedules and deviation requests is currently unique to fluridone applications, as other management practices are not typically impacted by regulation schedules. The participation of state and federal water managers with engineering backgrounds greatly facilitated the discussion addressing water regulation schedules and issues related to hydrilla and hydrilla control at the Workshop. The interaction of the engineers with field biologists, researchers, and resource managers focused mainly on the large flood control lakes noted above. In this section we provide an overview of the situation, describe issues associated with fluridone use and water schedules, discuss hydrilla in relation to flood control, and provide recommendations for future work in this area.

The Kissimmee Chain of Lakes (KCOL) often refers to the lakes regulated by the seven existing regulation schedules for lakes upstream of the S-65 structure on Lake Kissimmee. The following lakes are regulated under these seven regulation schedules in the Kissimmee River – Lake Istokpoga Basin Water Control Plan:

a. Lakes Kissimmee, Hatchineha, and Cypress
b. Lake Tohopekaliga
c. East Lake Tohopekaliga, Fell's Cove, and Lake Ajay
d. Lakes Hart and Mary Jane
e. Lakes Joel, Myrtle, and Preston
f. Alligator Chain of Lakes (Alligator, Brick, Lizze, Coon, Center, and Trout)
g. Lake Gentry.

The vast majority of hydrilla problems, large-scale fluridone treatments, and issues with FRH have occurred on Lakes Tohopekiliga, Hatchineha, Cypress, and Kissimmee. Yet the proximity of lakes that contain FRH to upstream sites that are regulated by control structures is a cause for concern. In addition to the potential spread of FRH into these upstream lakes, water flows through these lakes can have a strong impact on downstream whole-lake herbicide applications. For brevity, subsequent reference in this section to the Kissimmee Chain of Lakes will be limited to the four large lakes noted above.

Large Lake Situations

Lakes Tohopekiliga, Cypress, Hatchineha, and IstokpogaIstokpoga have shown the capacity to support thousands of contiguous acres of hydrilla, with historic infestation levels from the late 1980s to the 2000s noted as high as 60 to 90 percent of the surface acreage on individual water bodies. In response to the potential for hydrilla to overwhelm these systems, management on these multi-purpose use lakes represents a large percentage (up to 65%) of the FDEP aquatic plant management budget. The increased reliance on fluridone for use on the KCOL and Istokpoga in the 1990s was a function of the magnitude of the hydrilla problem, increased funding availability to the FDEP, public pressure to greatly reduce the hydrilla, and early success with several large-scale applications. It is now documented that each of these lakes is dominated by FRH, and this has greatly increased the costs and technical challenges of managing hydrilla in these systems. If left unmanaged, there is a high likelihood that some or all of these lakes could support sustained and dense infestations of hydrilla that would have detrimental impacts on recreational use, access for navigation, tourism, real estate values, native plant communities, water quality, fisheries, and flood control. Given the history of dense hydrilla coverage on these lakes, some level of hydrilla management is necessary if these systems are to serve their multi-purpose functions.

The relationship between water regulation schedules and the management of FRH has become a complex topic that could, and probably will, justify its own workshop. As the authors of this document all have biology/limnology backgrounds, we will not make any recommendations regarding water schedules, as our suggested changes would likely have unforeseen impacts on other important uses of the water. We have therefore chosen to focus on the two major areas of debate that came out of the recent workshop. It is important that the readers of this document distinguish between 1) the issue of hydrilla control as it relates to regulation water schedules, and 2) the presence of dense hydrilla as a potential threat to flooding and flood control structures.

It is instructive to use the circumstances of 2004, to highlight how management philosophies impact different views of hydrilla control on the KCOL. After lowering the lake levels due to implementation of the Lake Tohopekiliga extreme drawdown,, a significant fluridone treatment (low water levels and low flow), and three successive hurricanes that impacted the KCOL in 2004, it is apparent that the current level of hydrilla biomass is much lower than recent historical levels. While hydrilla can be found throughout the lakes, it is sparse, and could hardly be considered problematic at the end of 2004. The length of time it will take to become problematic again cannot be predicted. There is one management viewpoint that says now is the time to take advantage of the low biomass and prevent the hydrilla from recovering. Another management viewpoint suggests that given the current level of infestation, large-scale management is not justified. These are honest differences of opinion; however, it is important that each group seeks to understand the other's point of view. With or without management, it is apparent that hydrilla will continue to persist and cause problems in the KCOL for the foreseeable future. Therefore we are forced to debate the optimal amount of hydrilla and management effort that allows these lakes to serve their multi-function purpose.

Hydrilla Control in Relation to Regulation Schedules for Water

Based on comments of various agency personnel participating in this meeting, water regulation schedules are based on the multi-purpose function of these lakes and they encompass a wide range of uses including flood control, irrigation, downstream water delivery to the Kissimmee flood plain, habitat for fish and wildlife, and endangered species issues. One of the major concerns voiced by many participants was the increased frequency of deviation requests to support fluridone applications in the KCOL and Lake Istokpoga. Requests for deviations have become a yearly event, and they have coincided with the spread of FRH in these systems.

The current practice of FDEP requesting temporary water schedule deviations to reduce water levels and flow on the Kissimmee Chain or Istokpoga has strong merit when viewed solely in the context of improving the cost-effectiveness and efficacy of a fluridone treatment for hydrilla control (Table 1a and 1b). Due to the need to "maintain" much higher residues than in the past, this table reflects only the initial cost of treatment, and not the additional applications needed to sustain a target concentration.

It has been suggested that timing of the fluridone treatments be changed to increase compatibility of the treatments with regulation schedules. Regardless of the susceptibility of the hydrilla, it is well established that late winter or early spring is the optimal time to initiate fluridone applications. This treatment timing coincides with a period of low initial biomass and rapid growth as the plants start to emerge from the cool water temperatures and short days of the winter. Initiation of deviations will therefore typically be desired during the months of January through April, and limiting discharges from lakes may be desired as late as July. Requests to the US Army Corps of Engineers for a deviation should be made from several months to a year prior to the desired deviation start date in order to allow time for the proposed deviation to be developed, coordinated, and evaluated. Based on experience with attempting to control dense stands of hydrilla on other systems, initiating large-scale fluridone treatments outside of the timeframes noted above are not recommended regardless of the water level and flow conditions. In situations where hydrilla biomass is low and active growth is occurring, treatment timing is not as critical.

Table 1a. The impact of initial water levels on the amount of fluridone required to achieve an initial target concentration on West Lake Tohopekaliga.

West Lake Tohopekaliga	~ Number of Acre- Feet	~ Lbs of Fluridone to Achieve an initial 30 ppb	~ Initial Product Cost to Achieve 30 ppb
Full Volume	151,000	12,292	$3.0 Million
-1.0 Ft. Volume	131,000	10,664	$2.6 Million
-2.5 Ft. Volume	102,000	8,303	$2.0 Million

Table 1b. The impact of water discharge rates on the amount of fluridone lost from Lake Tohopekaliga on a daily basis. The cost and lbs of fluridone loss values provided are approximate.

West Lake Tohopekaliga	Discharge of 100 CFS	Discharge of 250 CFS	Discharge of 500 CFS	Discharge of 1000 CFS
Lbs of Fluridone Loss/ Day	16 lbs / Day	40 lbs / Day	80 lbs / Day	160 lbs / Day
Cost / Day	$4000	$10,000	$20,000	$40,000
Lbs of Fluridone Loss/ Month	480 lbs/ Mo.	1200 lbs/ Mo.	2400 lbs/ Mo.	$4800 lbs/Mo.
Cost/ Month	$120,000	300,000	$600,000	$1,200,000

Prior to the onset of FRH, management of susceptible strains of hydrilla, although complicated by high water levels and flow, was technically feasible due to the ability to maintain threshold concentrations over a long period of time. The following graph illustrates why FRH presents a significant technical and economic challenge in comparison to previously susceptible strains of hydrilla (Figure 1). The maintenance of threshold concentrations of fluridone for controlling FRH is greatly complicated by high initial water levels, and inflow and outflow through the lake. While improved control of FRH would result if water levels and flow were optimal, there is no indication that such treatments would provide long-term control (greater than 1 season) of hydrilla. The continued use of fluridone on these systems also increases the risk of selecting for hydrilla biotypes with an even greater level of resistance.

As noted above, the onset of FRH has resulted in a significant decrease in the longevity of hydrilla control following fluridone applications. For example, while control efforts on Lake Istokpoga used to be conducted every other year, fluridone treatments have been initiated for the past 3 consecutive years due to the quicker recovery by the FRH. The resistance issue has created a cycle that has resulted in reduced long-term efficacy, and yet the need for more frequent treatments at higher rates is necessary to achieve FDEP program goals of managing hydrilla to the lowest feasible level. While this presents a conundrum, it is obvious from the Workshop that current alternative tools are either limited in their ability to provide cost-effective control on a large scale, or they are not proven to provide selective control on a large-scale basis.

The issue of what new regulation schedules may be implemented in the future to facilitate hydrilla control is beyond the scope of this document. Currently it is expected that revised regulation schedules for some or all of the lakes of the Kissimmee Chain will be developed through the KCOL Long-Term Management Plan, and that these revised schedules may be implemented in late 2007 or later. The need for control of hydrilla should be considered in developing some or all of the revised schedules. Before new regulation schedules for Kissimmee Basin lakes are implemented which adequately facilitate hydrilla treatments, the choice facing plant managers would seem to be one of changing management tools and learning to live with more hydrilla, requesting temporary deviations to facilitate hydrilla treatments, increasing funds available to compensate for high water and flow, or living with the control that is achievable with a fixed budget and existing regulation schedules. Stakeholder comments will be an important part of this process.

It is important to note, that as future new chemistries are developed, there is a good possibility that some of these products will require a prolonged exposure period to provide optimal control of hydrilla. Therefore, while the current issue of water regulation schedules is unique to fluridone, water regulation management in relation to new products may be a topic for future discussion. It is therefore important that upcoming discussions and long-term management plans regarding regulation schedules be broadened beyond the issue of fluridone.

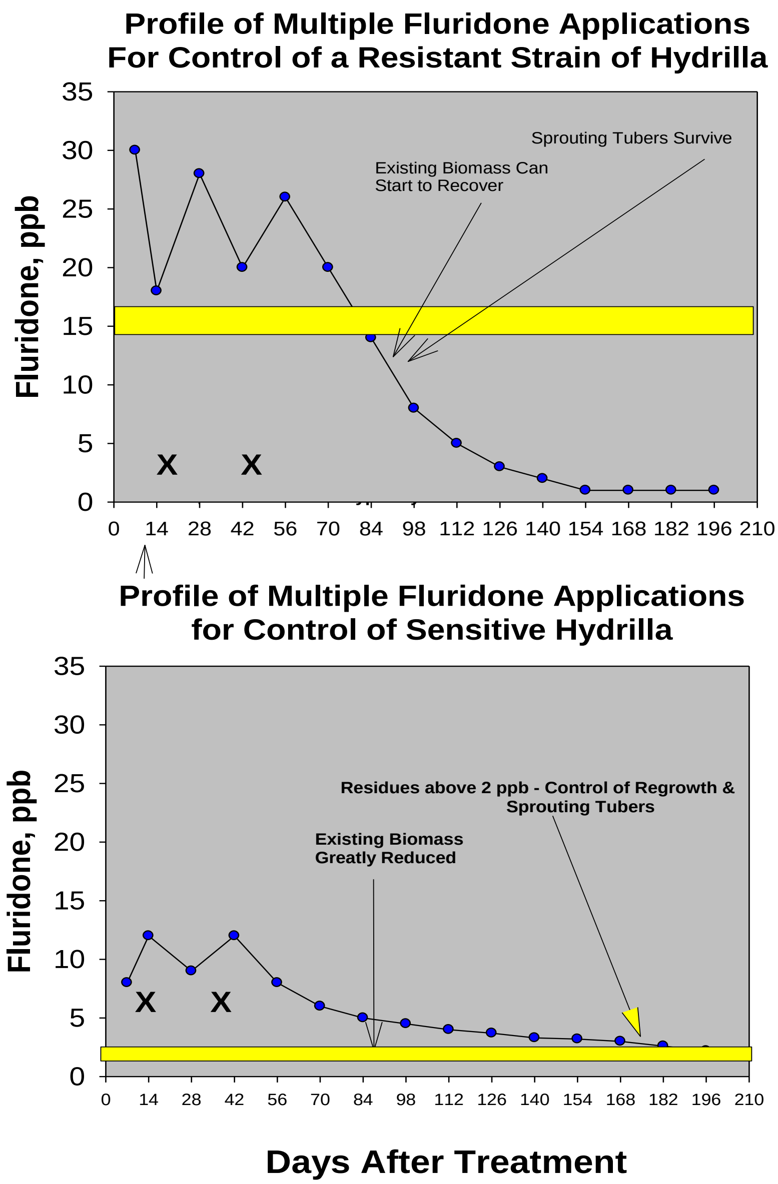

Figure 1. Hypothetical Fluridone treatment scenarios for control of a resistant and susceptible population of hydrilla. Yellow shaded areas represent concentration thresholds below which fluridone is no longer phytotoxic to hydrilla. The large X's represent additional bump treatments required to maintain residues above thresholds.

Lake Specific Issues

Topics that deserve special note include the impacts of hydrilla management on endangered species (specifically snail kites), the use of water for irrigation from Lake Istokpoga, and the potential for enhanced degradation of fluridone. The snail kite and irrigation issues are tied to water regulation schedules and deviation requests to support fluridone treatments. Enhanced degradation has not been a common observation, but it is a new phenomenon that has been observed to negatively impact some fluridone applications.

Large-scale hydrilla control efforts can include the potential for indirect adverse effects to the endangered snail kite (*Rosthamus sociabilis plumbeus*). These impacts are largely related to water deviation requests that can impact nesting success of the snail kite. Lowering water levels at a different rate at certain times of the year can cause nests to collapse. In the Kissimmee Chain of Lakes nests are more frequently constructed in herbaceous vegetation that is more susceptible to collapse. Snail kites must nest over water to help support the vegetative structure below the nest and to reduce predation of the nests by terrestrial predators. Another potential indirect impact results from the actual herbicide application activities. Snail kite biologists and aquatic plant managers have recently begun coordinating to exchange information on the location of active nests in order to create buffer zones that prevent disturbance of the nest. From a longer term perspective, the use of higher rates of fluridone could impact the composition of emergent vegetation in the littoral zone of lakes. However, it is not known if these impacts would have a negative or positive effect in terms of snail kite habitat.

Although non-target plant injury has become a greater long-term concern, there is no evidence of emergent plants rapidly succumbing to fluridone treatments early in the course of an application when snail kites are beginning to establish nests. While improved data regarding non-target species susceptibility, rapid collapse of emergent plants is inconsistent with the use of fluridone. The issue of the impact of sustained dense infestations of hydrilla on organisms such as the snail kite, apple snail, and native vegetation, while important, did not generate much discussion in the Workshop.

Concerns with snail kite nesting on Lake Istokpoga are minimal, yet there is fairly extensive use of Istokpoga water for irrigation of crops. With presence of FRH in some sections of Istokpoga requiring higher fluridone use rates for control, it has become increasingly important for management plans with fluridone in Istokpoga to address potential exposure of certain sensitive crops to herbicide residues in irrigation water above the 1 ppb limit described on labels for fluridone herbicides.There have been no irrigation problems reported with the past use of fluridone in Lake Istokpoga, yet the increasing use rates due to the presence of FRH can cause a potential conflict between fluridone residues necessary to control hydrilla, and residue levels that could result in phytotoxicity to sensitive crops. Treatments conducted in the spring of 2005 resulted in fluridone residues in the outlet canal water that feeds an extensive irrigation network. In response, the FLDEP used large quantities of powder activated carbon applied from a boat and drip system to reduce these residues in the irrigation canal water. The rapid degradation of fluridone following the spring 2005 treatments in Lake Istokpoga and decisions to halt further treatments, prevented any further potential issues with fluridone residues in irrigation source water. This situation did point out that Lake Istokpoga is an important source of agricultural water, and any future treatment recommendations need to consider this critical use of the water.

In the last three years, there have been sporadic events of rapid loss of fluridone in an isolated number of Florida lakes treated for control of FRH. While fluridone loss is often influenced by typical environmental variables such as flow and water quality, studies have determined a factor in this phenomenon is enhanced degradation of fluridone by a microbial agent(s). Since this discovery, investigations have been ongoing to determine the causative agent(s) responsible for enhanced degradation and the environmental factors that trigger such events. While research efforts by industry and government scientists have provided some understanding of this phenomenon and informed managers on potential improved strategies for fluridone use, results to date have demonstrated that the processes involved are complex and difficult to study under laboratory and field conditions. Ongoing research continues to examine processes affecting fluridone dissipation and potential mitigation techniques to address confirmed events of enhanced microbial degradation.

Fluridone treatments conducted in the spring of 2005 resulted in a rapid loss of residue in both the Kissimmee Chain of Lakes and Lake Istokpoga. Operational plans called for several split applications to maintain a target threshold of fluridone on the lakes; however, residues dropped rapidly and the ability to maintain these thresholds was compromised by the rapid half-lives observed early in the treatment cycle. Due to the rapid loss of fluridone in these systems, additional treatments were halted. There are numerous variables that contribute to fluridone dissipation/degradation, yet the enhanced loss of fluridone residues in the Spring of 2005 is still under investigation.

Hydrilla as a Threat to Flood Control

There was considerable debate at the Hydrilla Workshop regarding the potential for hydrilla to threaten the flood control function on the KCOL and Lake Istokpoga. While there was a strong divergence of opinion regarding the nature of this threat, it was apparent that there are more unknowns than knowns. When the structures were placed on the KCOL and Lake Istokpoga, these lakes did not support hydrilla, and it was likely unforeseen byresource managers that hydrilla could occupy thousands of contiguous acres on these lakes. The potential threat, if any, that hydrilla poses to flood control problems is a key question, as one of the main justifications for the intense management of hydrilla on the KCOL and Lake Istokpoga is largely predicated on the potential of dense hydrilla to pose an increased threat of flooding. The need to manage hydrilla on a large scale obviously ties back in to the requests for water schedule deviations on an annual basis.

In regards to hydrilla and flood control, there were two major questions posed to the engineers that attended the workshop. First, at what level of infestation would hydrilla potentially pose a threat to the ability to move water downstream, and hence the flood control function on the KCOL or Lake Istokpoga? The second question involved the dense growth of hydrilla near the structures, and the threat of a large mass of plants jamming against structure. There were no definitive answers to either of these questions, although there were several lines of interesting discussion both within and outside of the formal session. The following issues were discussed:

1. Within the KCOL, Lake Tohopekaliga and Kissimmee contain water control structures while Lakes Cypress and Hatchineha do not have water control structures associated with them. Should we view these lakes differently in terms management practices and the threat of hydrilla to impact flood control?

2. The potential for placing a structure between Lake Hatchineha and Lake Kissimmee was discussed. This structure would allow increased latitude to manipulate water levels on individual lakes and could facilitate and isolate the impacts of future fluridone treatments as well as drawdowns.

3. There are contingency plans in place to remove debris that may become lodged against structures on Lake Tohopekaliga and Kissimmee. There was discussion as to whether these plans are adequate in terms of a severe hydrilla infestation.

4. While it is well documented that submersed plant growth in canals create resistance to water flow and thereby increase the chance of flooding, it was unclear if this principle applies to larger lakes. Given the large size of Lake Tohopekaliga, Kissimmee, and Istokpoga in relation to the small structures, it was asked if plants could create enough resistance to flow to prevent downstream water movement?

5. It was noted during the Workshop that there is not an extensive history of submersed plants impacting structures (flood control, bridges) in the State of Florida. While floating plants have impacted structures, there is not sufficient experience with submersed plants to make a definitive statement regarding the threat they pose.

The only engineering opinion that presently exists regarding the potential impact that rooted aquatic plants could have on flood control was conducted for Lake Istokpoga and was authored by Howard L. Searcy consulting engineers in July 1993 (Contract # C-3019 for the South Florida Water Management District). The authors ran simulation models (FEMA/SURGE model) that included the presence of two different levels of hydrilla infestation. The model represented rooted macrophytes for potential friction losses, modified bathymetry, partial blockages, or total blockage. The worst-case plant scenario was a 50% lake infestation of 13,000 acres, and the other scenario included hydrilla occupying up to 2000 acres of Lake Istokpoga. The model results indicated that the higher levels of hydrilla could nearly double the flooding threat in comparison to the lower density hydrilla from 3.4 to 7.1 feet above regulation following a 100-year flood event. This differential was reduced from 3.2 to 5.3 feet for a 50-year event, and further reduced from 1.9 to 2.3 feet for a 10-year event. The model would suggest that the increased flooding threat posed by a 100-year storm is significant in comparison to the relatively minor threat for a 5 or 10-year flood. The validity of this model is not well known, and it will be the topic of future discussions. Future modeling will need to take into account a much greater range of hydrilla acreage (2000 to 25,000 acres), as well as location of the infestations within the lake. The conclusions from this model would tend to support both intense management based on the 100-year flood risk, as well as reduced management based on the 10-year flood risk.

Recommendations

Recommendation 8: A formal request will be made to appropriate Water Management Districts for a detailed response as to the threat hydrilla causes to flood control. This inquiry should include all water bodies where FLDEP Aquatic Plant funds are likely to be spent to reduce hydrilla. The response should include an engineering assessment of the amount and locations of hydrilla that could create an increased risk of flooding. Once such a response is formulated, aquatic plant managers can develop plans to insure that hydrilla is managed in critical areas that represent an increased risk of flooding.

Justification: It was apparent from the workshop that the threat hydrilla poses to the flood control function of these lakes is not well understood. For FDEP to consider changing management practices on these lakes, there needs to be a clear understanding of the implications of leaving high levels of hydrilla in the system. While it was noted that mechanical measures are in place to deal with plants becoming lodged in the structure (track hoes or draglines), it was unclear if these plans take into account a large infestation.

Recommendation 9: As it is likely that new herbicides may require an extended exposure period, it is recommended that an assessment of regulation schedules take into account the improved economics and efficacy that reduced water levels and flow can afford. In lieu of deviation requests on a yearly basis, the impact of deviation requests every two or three years should be studied, including the impacts to fish and wildlife. The seasonality of treatments may be adjusted based on the ability to manipulate water levels or flow during various times of the year.

Justification: Resistance management plans will likely prevent sequential or back-to-back use of new products within these lakes. Therefore, when treatments are initiated, it is likely that we will be dealing with a significant hydrilla infestation, and it is important to provide optimal conditions to allow extended control of the hydrilla.

Recommendation 10: With the long-range viability of fluridone in large lakes with FRH in doubt, the FDEP, FWC and South Florida Water management District (SFWMD) need to develop long-term aquatic plant management plans for how, when, and where to manage hydrilla on the large flood control lake systems.

Justification: If the hydrilla infestations become more severe on these systems, increasing fluridone rates may not be a feasible option. It is important that priority zones for access, navigation, and habitat improvement are included in a lake management plan that does not include the use of fluridone.

Wildlife and Fisheries Management

Like all submersed aquatic macrophytes, hydrilla can provide habitat, food resources, and refugia for fish and wildlife. For fishes, a number of studies have evaluated the value of hydrilla as habitat. Intermediate coverage of hydrilla has been associated with quality largemouth bass (*Micropterus salmoides*) populations, causing high production of young fish (Colle and Shireman 1980; Maceina et al. 1995; Hoyer and Canfield 1996; Miranda and Pugh 1997; Tate et al. 2003), and quality fisheries (Moxely and Langford 1985; Maceina and Reeves 1996). However, high hydrilla coverage (> 85%) can reduce fishing effort due to difficulties in angler access (Colle et al. 1987), may cause fish growth rates to decline (Colle and Shireman 1980), and represents a risk to fish populations due to low oxygen and potential fish kills.

In the 1980s, FDEP funded a multi-year research project to address relations between aquatic plants and the limnology (i.e., water quality and fisheries) of Florida lakes (Canfield and Hoyer 1992). This research demonstrated that fish populations only had a chance of being negatively impacted when aquatic plant coverage was less than 15% or more than 85%. These findings suggested aquatic plant control programs have a broad window of plant coverage that they could work within, without causing major negative changes in water quality and/or fisheries (Canfield and Hoyer 1992). An important issue when controlling submersed aquatic plants, however, is that that the significance of hydrilla for quality largemouth bass fisheries may be related to lake size (Hoyer and Canfield 1996). Small lakes have relatively high littoral area to surface area ratios, possibly allowing adequate habitat for sport fish even in absence of submersed macrophytes. In large lakes, submersed plants such as hydrilla may substantially increase the available habitat over that which is provided by littoral areas (Hoyer and Canfield 1996). Thus, hydrilla management strategies for fishery benefits should consider lake size and the other available habitat present at each lake.

Considering wildlife, hydrilla provides a food resource for some aquatic birds including waterfowl. Johnson and Montalbano (1984) found 12 species of waterfowl consuming, and preferring, hydrilla while over-wintering in Florida. Similarly, Montalbano et al. (1979) found hydrilla to be the most common plant food found in the esophagi of ducks and coots in two Florida lakes. Esler (1990) reported that total bird use in experimental plots in a Texas reservoir was substantially greater with the presence of hydrilla than without the plant. Examining aquatic bird data on 46 Florida lakes, Hoyer and Canfield (1994) showed that bird abundance and species richness remain relatively stable as macrophyte abundance increases, but birds that prefer open water habitats (e.g., double-crested cormorant, *Phalacrocorax auritus*) are replaced by species that use macrophyte communities (e.g., ring-necked duck, *Athya collaris*). Additionally, some species require certain types of emergent vegetation to be present regardless of the total lake-wide coverage of aquatic plants (e.g., least bittern, *Ixobrychus exilis*). Thus, for aquatic plant management some judgments have to be made regarding the positive and negative impacts on habitat preferences for aquatic bird species.

Some strategies for managing hydrilla with Fluridone have included temporary deviations of lake level regulation schedules and these associated changes in water level could influence habitat availability for several bird and fish species. Participants in the Hydrilla Issues Workshop noted that manipulated low water used for hydrilla control should be considered in the context of available basin-wide habitat for birds rather than lake-specific habitat considerations (Appendix II). Wading bird densities in Florida generally decline with increases in water levels (Breininger and Smith 1990; David 1994), and thus, temporary declines in water levels for hydrilla control could increase wading bird habitat.

There is no evidence that hydrilla directly influences habitat quality for the endangered snail kite *Rostrhamus sociabilis*. However, low water levels have been associated with poor nest success (Beissinger and Snyder 2002) and lower juvenile survival (Dreitz et al. 2004) for snail kites. Changes to lake regulation schedules therefore may influence habitat quality for snail kites and should be considered in the plans. Dreitz et al. (2001) contended that relatively few adult snail kites might exhibit low nest success during low water due to their ability to select alternative locations when water levels decline. Nevertheless, hydrilla management strategies that include changing water levels should obviously consider habitat for wading birds and the snail kite in the context of regional habitat availability.

Recommendations

Recommendation 11: Hydrilla management actions should aim to keep non-target impacts to a minimum because non-target impacts of hydrilla control measures on native plant abundance could greatly reduce available fish and wildlife habitat. Where control of resistant hydrilla is limited because of budgetary considerations and/or insufficient selective management tools and where hydrilla coverage is not impacting the designated uses of a lake, FDEP should consider allowing some hydrilla to persist. Where water level manipulations are needed to improve the efficiency of hydrilla control with Fluridone, aquatic plant management plans should consider the impacts of water level changes on fish and bird populations.

Justification: Research has found no evidence that a wide range of hydrilla coverage (15% to 85% coverage) represents a threat to wildlife and fisheries, and in most cases, hydrilla even provides beneficial habitat. However, high hydrilla coverage (> 85%) can cause problems for fisheries and hydrilla coverage greater than 40% to 50% generally cause problems with recreational activities. Water-level manipulations in lakes have been shown to significantly influence bird and fish populations.

Florida Statute and Florida Administrative Code

Aquatic plant managers in the state of Florida must manage aquatic plants so as to protect human health, safety and recreation and to the greatest degree practicable prevent injury to non-target plants, animal life, and property. Any modifications of plant control activities by the Florida Department of Environmental Protection (FDEP), however, are guided by Florida Statute (FS 369.20-369.255) and the Florida Administrative Code (FAC 62C-20). Both documents are attached in Appendix III so all participants in the workshop have access and can read them.

Prior to the recognition of hydrilla resistance, Fluridone was the only available herbicide that might offer the ability to eradicate hydrilla from an aquatic system. Initially, aquatic plant managers under the jurisdiction of FDEP may have performed many of their activities under the Florida Statute's and the Florida Administrative Code's definition for an Eradication Program (FS 369.22(2)(e) and FAC 62C-20.0015(11)). "Eradication program" was defined as a method for the control of non-indigenous aquatic plants in which control techniques are utilized in a coordinated manner in an attempt to kill all the target aquatic plants on a permanent basis in a given geographical area. With the continued re-growth of hydrilla it became obvious that aquatic plant managers were actually working in more of a maintenance control direction. A "maintenance control program" is defined as a method for the control of non-indigenous aquatic plants in which control techniques are utilized in a coordinated manner on a continuous basis in order to maintain the plant population at the lowest feasible level as determined by the department (FS 369.22(2)(d)). The Florida Administrative Code also clearly directs the department that "lowest feasible level" is the level of plant control permitted by funding and technology (FAC 62C-20.0015(13)). Now with the development of fluridone resistance (see Herbicide Section), the probability of eradication by fluridone will be zero, and maintenance control will continually push the target of lowest feasible level higher. Thus, the loss of a cost-effective herbicide like fluridone does not affect FDEP's ability to manage plants, but severely limits the acreage of control due to cost and selectivity considerations of other management tools. The spread of fluridone resistant hydrilla also means that managers may have to allocate funds in such a manner that minimal or no hydrilla control activities can be implemented on a given system for one or more growing seasons. Given the current funding and technologies, we may have to accept an increased level of hydrilla in a given aquatic ecosystem. So as identified by the experts in attendance at the Hydrilla Issues Workshop, FDEP will have to establish how much hydrilla will be left in a given system given public use, environmental and budgetary considerations.

The Legislature has also established that the FDEP shall supervise and direct all maintenance programs, excluding the authority to use fish as a biological control (FS 369.22(4). Because aquatic plants can be important in lakes, it would greatly assist FDEP's maintenance management efforts if comprehensive lake management plans were developed for the lakes requiring major expenditures for aquatic weed control. The importance of having a comprehensive management plan was clearly identified by the experts attending this issues workshop. However, the development of such plans will cost money and time. Until plans are developed, FDEP will have to expand existing plant management techniques (i.e. contact herbicides and mechanical harvesting) within their budget to achieve maintenance plant levels.

Deciding how many plants should be left in a lake can be difficult, but the Florida Legislature provides guidance in statute ((FS 369.20(2)). The Florida Aquatic Weed Control Act states it shall be the duty of FDEP to manage plants so as to protect human health, safety, and recreation. In Florida, the lack of flood control represents the greatest human health and safety concern. Consequently, FDEP staff in attendance had questions regarding the impact of dislodged hydrilla on water control structures. The current response to the potential threat of vegetation clogging a structure is for water management agencies to station or have nearby mechanical devices (e.g., trackhoes or draglines) at each structure to remove plants accumulating in front of structures in emergency situations. As this workshop made clear, there is a strong potential for increased hydrilla coverage on those flood control lakes that contain structures *(*Lake Tohopekaliga, Kissimmee, and Istokpoga*)*. Therefore, it is up to the SFWMD to insure that current response measures are adequate given different densities of hydrilla*.* With the exception of lakes containing flood control structures, the major issue regarding hydrilla management for FDEP will, therefore, be recreation. Recreation for most lake users will translate to access and fishing.

Some participants at the issues workshop believe it is possible to use grass carp in a maintenance program and help reduce aquatic plant control costs. Florida statutes, however, are clear that use of fish such as the grass carp is not under the control of FDEP (FS 369.20(2)). Use of Grass carp is under the control of the Fish and Wildlife Conservation Commission (FWC) and their regulation is detailed in the Florida Administrative Code (FAC 68A-23.088; see Appendix III). Pertinent to any discussion about using grass carp in a maintenance program is the FWC's authority to deny any permit to stock triploid carp in any water body, other than private ponds, if such proposed stocking is inconsistent with the principal or planned use of the water body, the optimum sustained use by the public of the water body's living aquatic resources, or sound biological management principals (FAC 68A-23.088 (3) (d)). FDEP, however, is charged with the guidance and coordination of all plant management activities of all public bodies, authorities, agencies, and special districts (FS 369.20(3)). Thus, FDEP and FWC must work together to determine how best to use grass carp as a tool for aquatic plant management in the state.

Because issues requiring research have been raised concerning the use of grass carp, FDEP must recognize that it has the statutory authority to promote, develop, and support research activities directed toward the more effective and efficient control of aquatic plants (FS 369.20(4)). If a research project involving barriers to carp movement is advanced (see grass carp section), FDEP also is charged with the authority to construct, acquire, operate, and maintain facilities and equipment (FS 369.20(4)(c)).

Recommendations

Recommendation 12: FDEP and cooperators shall consider implementing a maintenance program using registered contact herbicides and/or mechanical harvesting on water bodies with fluridone resistant hydrilla. The initial focus shall be on public and private access points and trails to maintain recreational use. If there are funds available after access allocations, FDEP will set as the working objective of maintaining submersed plant coverage above 15% of the water body's surface area. FDEP unless advised differently by the working group establishing the lake management plan shall not attempt to manage submersed vegetation coverage below 15% of the water body's surface area, especially on large lakes where the submersed vegetation is the vast majority of fish habitat. In many aquatic systems hydrilla constitutes the vast majority of remaining submersed vegetation. Therefore, while goals are to maintain native submersed plants above a certain percentage, aquatic managers will often be faced with recognizing hydrilla as a constituent of the submersed vegetation community.

Justification: The Florida Aquatic Weed Control Act states it shall be the duty of FDEP to manage plants so as to protect human health, safety, and recreation. Access and fishing are two important issues in each category mentioned by the Legislature. Access and fishing are also two areas that can draw public ire if not managed properly. Research has shown the probability of encountering an impacted fish population increases when aquatic plant coverage is below 15% or greater than 85%, thus providing a wide "window of opportunity" for managing plants and fishing. This is critical because with the development and spread of hydrilla resistance to fluridone, the existing funding and technology means fewer acres of hydrilla can be managed. Implementing a maintenance program as recommended can buy time until improvement in technology and funding can be achieved.

Recommendation 13: FDEP work with their cooperators (i.e., become the lead agency) to seek funding for the establishment of a comprehensive aquatic plant management plan at each lake requiring major amounts of state dollars for weed control. These planning efforts should directly incorporate stakeholder concerns and directions for management.

Justification: Participants in the Hydrilla Issues Workshop acknowledged throughout the meeting that what is "done" depends upon having a lake management plan. FDEP is mandated by the Florida Legislature to guide and coordinate weed control activities on all public waters (FS 369.20(3)). Because aquatic plants affect water quality and FDEP works with FWC on plant/fish management problems, FDEP is a logical state agency to lead the long-term effort to get a workable lake management plan for each lake requiring aquatic plant management. FDEP is also the state agency best positioned with the Legislature to ask for funds for the development of a comprehensive aquatic plant management plan because FDEP and the water management districts have developed similar surface water improvement plans (SWIM) for Florida.

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Appendix I - Workshop Participants

NAME	Agency/Affiliation
Chris Horton	Bass Anglers Sportsman's Society/ESPN
Dean G. Barber	Florida Department of Environmental Protection
Matt Phillips	Florida Department of Environmental Protection
David Demmi	Florida Department of Environmental Protection
Joe Hinkle	Florida Department of Environmental Protection
Ed Harris	Florida Department of Environmental Protection
Jess Van Dyke	Florida Department of Environmental Protection
Judy Ludlow	Florida Department of Environmental Protection
Jeff Schardt	Florida Department of Environmental Protection
Terry Sullivan	Florida Department of Environmental Protection
Bill Torres	Florida Department of Environmental Protection-BIPM
Jim Estes	Florida Fish and Wildlife Conservation Commission
Bill Johnson	Florida Fish and Wildlife Conservation Commission
Steve Rockwood	Florida Fish and Wildlife Conservation Commission
David Eggeman	Florida Fish and Wildlife Conservation Commission
Joe Benedict	Florida Fish and Wildlife Conservation Commission
Vicki Pontius	Highlands County
Keshav Setaram	Orange County
Dean Jones	Polk County
Mike Bodle	South Florida Water Management District
Bob Howard	South Florida Water Management District
Dan Thayer	South Florida Water Management District
Brian Nelson	Southwest Florida Water Management District
Wayne Corbint	St. John's River Water Management District
Steve Miller	St. John's River Water Management District
Mike Netherland	U.S. Army Engineer Research and Development Center
Cathy Byrd	U.S. Army Corps of Engineers Jacksonville District
Kamili Hitchmon	U.S. Army Corps of Engineers Jacksonville District
Adam Stuart	U.S. Army Corps of Engineers Jacksonville District
Susan Sylvester	U.S. Army Corps of Engineers Jacksonville District
Charles E. Ashton	U.S. Army Corps of Engineers Jacksonville District
Bob Pace	U.S. Fish and Wildlife Service
Art Roybal	U.S. Fish and Wildlife Service
Mike Allen	University of Florida
Mark Hoyer	University of Florida
Patrick Cooney	University of Florida
Christy Horsburgh	University of Florida
Julie Terrell	University of Florida
Bill Haller	University of Florida
Karl Havens	University of Florida
Dan Canfield	University of Florida
Will Strong	University of Florida

Appendix II - Minutes and Notes from the Workshop

These notes are organized according to each issue identified.

Integrated Plant Management

Art Roybal: Have we taken an integrated approach? It is a management approach on the ecosystem and changing the condition with multiple methods of attack. We have used grass carp, chemicals, and physical control, but sometimes this doesn't work. Maybe we should use different methods of control at the same time.

Jess Van Dyke: We need applied research on grass carp combined with low rates with of herbicides. Compare costs, efficacy, and containment.

Brian Nelson: The major question we are facing is: How do you manage hydrilla with contact herbicide if you loose sonar?

Dean Barber: We can manage with Grass Carp and herbicide. We need to look at water shed management with this fish. We have been too conservative with research and stocking in large scale systems.

Terry Sullivan: We need to look at an integrated approach. Look at whole lake approach with sonar, contact herbicide, and grass carp.

Jeff Schardt: DEP needs to look at its policy for copper use. Look at its inside policy to integrated approach. Research on better ways to get native plants in the system if we are getting hydrilla out of systems. What are the best native plants to plant in the system? Talk at the beginning of Kiss restructuring…Hatchinhaw and Kissimmee structure that is missing…..is it cost keeping that out…..could we get coordinated funding to get that structure in place. Also develop a habitat drawdown schedule in that plan….maybe we can rotate storage of water to help with hydrilla control.

Dave Eggman: We need to have management plans based on specific lake needs. Need to get to not only the uses but have a plan on each of the lakes.

Bob Pace: There needs to be flexibility with climactic changes (in case of wet winter or hurricane), and flexibility with funding (able to move money from one project or carry over from one year to next).

Steve Rockwood: For water fowl species, hydrilla is a beneficial plant. Presence of hydrilla can mitigate the loss of habitat for water fowl. Should we set lake by lake priorities based on the need of plants for water fowl? Maybe treat after the migration water fowl.

Bill Haller: We don't need to allow high levels of hydrilla in lakes because it will happen without us trying. We need more tools to control hydrilla. The pressure of stocking carp is going to rapidly increase, and we need to have more tools to utilize with grass carp to control hydrilla.

Bill Johnson: If you aren't able to maintain high enough concentration of herbicide at every sprig of hydrilla, then the use of herbicide is not effective.

Dave Eggman: We stocked carp in lakes in the 80's at very high density, so we backed off with sonar. Then we lost sonar's effectiveness, so we have picked back up on carp in public lakes. We will probably try and increase. We have an issue group next week to address how to handle carp in lakes, which will include such issues as: where do we put barriers, who will maintain them.

Brian Nelson: There is a lot of integration of control methods on the smaller lakes, it is just not on the big lakes.

Dean Jones (Polk): As we move forward from here, please don't forget about the people doing the spraying. Think about the men putting it out….resources of people putting it out. Resourses/time allocation to application feasibility.

Patrick Cooney: Would you be stretching yourselves too thin both financially and in personnel by creating lake by lake management goals that would need to be altered frequently, depending on user wants and needs? Won't it just end up with people fighting for the same limited resources of money and personnel to carry out the management plan on one lake just to fail in another? It seems like a state wide goal is more attainable than specific lake by lake goals with the current resources available.

Jeff Schardt: What is integrated plant management? What are you going to tell me that I don't know? We have used every tool we have to control, and I can't do it. So you spend a lot of time telling me to do it. You won't help me. Don't tell me to integrate. Tell me how to integrate. We need the focus on refining the methods of what we already have. Tell me how it works and when it works and when it doesn't and why. This doesn't help me with the big five. I won't be able to use grass carp on the those lakes. The fish will just escape. I need management techniques for these big 5 lakes. Kissimmee chain of lakes and Istokpoga. We walked away from walk in water….but still spend over million dollars on contact.

Grass Carp

Jess Van Dyke: We need applied research on grass carp: low rates of carp with low rates of herbicides. Compare costs, efficacy, containment.

Dean Barber: We can manage with Grass Carp and herbicide—need to look at water shed management with this fish. We have been too conservative with research and stocking in large scale system.

Jeff Schardt: There has been discussion about carp in lakes. If we think about putting carp in big lakes, we need barriers. Whose responsibility is it to build, establish, and maintain electric barrier?

Dave Eggman: Look at barrier stuff when you look at research for carp. I know how to stock fish….but we need barrier design.

Water Level Regulations

Jeff Schardt: Big 5 lakes (Kissimmee Chain and Lake Istokpoga): We need research to determine hydrilla levels on the impact of flood control. This is the most important thing. Review policies on water level lowering…we need to do something now for this. COE and WMD looking at the schedules for hydrilla control. Temporary deviations. We also need to revise the way the temporary deviations are put into place. We need all agencies at the table at the start. We need money—especially from the federal level. If we can't get the water level down….can the feds make up the $ from the different water levels.

Wayne Corbin: The geographical location of lakes undergoing drawdowns for hydrilla control concern the wildlife…the locations next to that are then limited because wildlife is disturbed. We need to figure out ways to rotate drawdowns.

Steve Miller: Snail Kites…the real issue is snail kites. Gave a history of snail kites. Kiss and Toho chain is key to snail kites…it is a non viable population. Wants to drawdown his area but put it off last year because of Toho. Now needs to drawdown kiss …..but there is talk about Toho getting drawn down again….we need kiss down. Need to take a region wide perspective when doing water level drawdowns and not just a lake system.

Steve Miller: Structure integrity—what distance to keep…Mike N: need control research of resistance/friction of the mass with water flow is this a problem or is the problem only if the mass breaks free. How far in front of structure do we need to control?

Adam Stuart: Temporary water level deviations can be used on a yearly basis until 2008 on the Kissimmee chain. We need to be talking earlier. Once the sonar is in the water, is it better to manage for a certain level and try to keep this. Or do we not do any discharges and just realize we will have more water if it rains. Balancing contact time with water levels….is it better for contact time (water levels) or flow?

Herbicides

Ed Harris: More research for herb development. Adding aquatic labels. Either with state university level. Label extensions.

Matt Phillips: We are increasing concentration of sonar to combat resistant hydrilla—but, we don't have a good handle on the susceptibility of native plants. Knot grass is affected at 20 ppb…..but what about lilies? We are seeing damage and loss of native plants. More research to find susceptibility of native plants to increased sonar levels. Grass carp may be a good alternative if we have to use high levels of sonar which will kill everything—we are losing many stands of native plants. Needs the research quickly.

Dave Eggman: We need research (collect data) in field to determine selectivity

Dean Barber: We need another herbicide product. We need to stimulate aquatic interest via a 3rd party. It is necessary to have multiple site inhibitors or multiple modes of actions (MOA). If this is a significant problem. They are doing this on terrestial side.

Bill Haller: We won't find a herbicide with multiple MOA. We will need to register many herbicidess with different MOAs.

Vicki Pontius: Research issue—agriculture and non target impact of sonar.

Mike Netherland. Should we distinguish hyd and hyd tolerant sonar when developing a plan?

Mike Allen: Well if you have hyd and use sonar you have hyd tolerant sonar type.

Mike Netherland: It hasn't happened everywhere….if it is a new infestation, we might be able to control.

Brian Nelson: Hydrilla tolerant to sonar is a big issue because you can't meet goals of minimum feasible levels.

Bill Haller: The problem is that everyone is talking about plans of controlling hydrilla, but we don't have the tools to manage hydrilla in some lakes. There are some lakes we can't buy enough sonar to control hydrilla. What about contact herbicide….we don't have enough $.

Wayne Corbin: pleading/afraid to get the encourage the scientist/nasty chemical groups to get a new compound—need a letter of concern addressed.

Mike Netherland: we already did a search—get rid of 90% of them. We have found about 4 or 5 compounds. But each will create resistance….how do we use these compounds to delay the resistance….it will happen but you can get a few more years. In terms of managing susceptible hydrilla, we can allow these plants to expand, as it is much easier to control a susceptible lake with topped out hyd. We should use these treatments sparingly and should never treat back to back with susceptible hyd. But tolerant hyd…..spend $ on this while it is low.

Dean Jones: Reviewing and considering more increase of copper uses.

Brian Nelson: Haller painted a pessimistic picture about getting a new herbicide regulated…getting short term solutions. And if we get one it will be short lived also.

Wildlife Fisheries Management

Jeff Schardt: Research has issues of drawdown due to Apple Snails on the timing and the extent and the speed of the water. Also AVM is an issue—killing off eagles and coots in the Carolina. Also, with snail kites we've had suggestion of setting crews back from active snail kite nests….how far of a set back needed). Need an enforceable set back area for tour boats also.

Wayne Corbin: The geographical location of lakes undergoing drawdowns for hydrilla control concern the wildlife…the locations next to that are then limited because wildlife is disturbed. We need to figure out ways to rotate drawdowns.

Steve Miller: Snail Kites…the real issue is snail kites. Gave a history of snail kites. Kiss and Toho chain is key to snail kites…it is a non viable population. Wants to drawdown his area but put it off last year because of Toho. Now needs to drawdown kiss …..but there is talk about Toho getting drawn down again….we need kiss down. Need to take a region wide perspective when doing water level drawdowns and not just a lake system.

Bob Pace: Need to know how far from birds nest herbicide applicators must maintain.

Structure

Steve Miller: Structure integrity—what distance to keep…Mike N: need control research of resistance/friction of the mass with water flow is this a problem or is the problem only if the mass breaks free. How far in front of structure do we need to control?

Adam Stuart: Structural stability via mat of hydrilla or tussock? Need investigations. Even if the structural stability isn't an issue what about clogging the gates. System performance also needs to look at. What is the effect of lake volume of stage if the lake is covered with hydrilla? May just be ball park numbers….

Jeff Schardt. Need to have emergency procedures to get hydrilla off the structures.

Brian Nelson: How does hydrilla effect sedimentation rates?
Minimum Feasible Levels

Jeff Schardt: Needs agency commitment for invasive species management. Needs an agency policy because of the people changing within the agencies—once we get some understanding with a personnel then they move on and we have a new person. Coordinated response from agencies for hydrilla control (within and between).

Matt Phillips: What is more important controlling hyd or maintaining native plants? It depends on the lake. We need a more lake by lake decision process rather than blanket statement for state due to differences in user groups.

Dave Eggman: Need to have management plans based on specific lake needs. Need to get to not only the uses but have a plan on each of the lakes. Right now, if you have money and you find hydrilla, you control.

Jeff Schardt. We need to redefine the lowest feasible level of hydrilla ($, tech, and uses).

Mark Hoyer: Legistature set up for DEP to set the lowest feasible levels.

Jim Estes: Funding comes from DEP, so DEP sets priorities. They need to set purposes of hydrilla control when decisions are made to control. Set priorities based on objectives.

Jeff Schardt. Agrees with Jim, but feels that there needs to be concurrance from the FWC. It is necessary to get things worked out between FWC and DEP.

Chris Horton: If you keep the public involved in the decision of a lake by lake basis it will be easier to go to the legislature to get funding

Jeff Schardt: We don't have time nor personnel to create a plan for every lake….so what we did is put a website out there…We got more help from the web page….we don't have time to get together every year for 350 lakes with a staff of 2. some can take months. We are excited that BASS is coming to FL. Maybe BASS can help us in an effort to set individual plans for several lakes with angler interests.

Brian Nelson: Hydrilla tolerant to sonar is a big issue because you can't meet goals of minimum feasible levels.

Biocontrol

Jeff Schardt: Renew bio control on hydrilla research.

Personnel

Joe Hinkle: More involved in sonar treatment—more help in our section. More staff—man power.

Jeff Schardt: We don't have time nor personnel to create a plan for every lake….so what we did is put a website out there…We got more help from the web page….we don't have time to get together every year for 350 lakes with a staff of 2. some can take months.

Public Involvement

Mike Bodle: This issue is beyond the general public…local agencies need to address public awareness to include the public and get their support because this topic is getting complicated. Public education needed at the agencies. Wants the public involved prior to crisis.

Chris: Anglers aren't screaming in FL—we are fortunate. Bass anglers perspective want habitat/structure. Can help educate the public. Need public buy in…it is key to make sure the public is involved or well informed. In the name of progress….make sure the public is involved.

Water Quality

Steve Miller: Water quality issues—stick marsh. Pollution load reduction goals. It is a good water quality if you get rid of hyd you will loose our capabilities.

Appendix III – Florida Statutes and Florida Administrative Codes

The 2004 Florida Statutes

Title XXVIII
NATURAL RESOURCES; CONSERVATION, RECLAMATION, AND USE
Chapter 369
CONSERVATION
View Entire Chapter

PART I

AQUATIC PLANT CONTROL

369.20 Florida Aquatic Weed Control Act.--

(1) This act shall be known as the "Florida Aquatic Weed Control Act."

(2) The Department of Environmental Protection shall direct the control, eradication, and regulation of noxious aquatic weeds and direct the research and planning related to these activities, as provided in this section, excluding the authority to use fish as a biological control agent, so as to protect human health, safety, and recreation and, to the greatest degree practicable, prevent injury to plant and animal life and property.

(3) It shall be the duty of the department to guide and coordinate the activities of all public bodies, authorities, agencies, and special districts charged with the control or eradication of aquatic weeds and plants. It may delegate all or part of such functions to the Fish and Wildlife Conservation Commission.

(4) The department shall also promote, develop, and support research activities directed toward the more effective and efficient control of aquatic plants. In the furtherance of this purpose, the department is authorized to:

(a) Accept donations and grants of funds and services from both public and private sources;

(b) Contract or enter into agreements with public or private agencies or corporations for research and development of aquatic plant control methods or for the performance of aquatic plant control activities;

(c) Construct, acquire, operate, and maintain facilities and equipment; and

(d) Enter upon, or authorize the entry upon, private property for purposes of making surveys and examinations and to engage in aquatic plant control activities; and such entry shall not be deemed a trespass.

(5) The Department of Environmental Protection may disburse funds to any special district or other local authority charged with the responsibility of controlling or eradicating aquatic plants, upon:

(a) Receipt of satisfactory proof that such district or authority has sufficient funds on hand to match the state funds herein referred to on an equal basis;

(b) Approval by the department of the control techniques to be used by the district or authority; and

(c) Review and approval of the program of the district or authority by the department to be in conformance with the state control plan.

(6) The department shall adopt rules pursuant to ss. 120.536(1) and 120.54 to implement provisions of this section conferring powers or duties upon it and perform any other acts necessary for the proper administration, enforcement, or interpretation of this section, including creating general permits and exemptions and adopting rules and forms governing reports.

(7) No person or public agency shall control, eradicate, remove, or otherwise alter any aquatic weeds or plants in waters of the state unless a permit for such activity has been issued by the department, or unless the activity is in waters expressly exempted by department rule. The department shall develop standards by rule which shall address, at a minimum, chemical, biological, and mechanical control activities; an evaluation of the benefits of such activities to the public; specific criteria recognizing the differences between natural and artificially created waters; and the different amount and quality of littoral vegetation on various waters. Applications for a permit to engage in aquatic plant control activities shall be made to the department. In reviewing such applications, the department shall consider the criteria set forth in subsection (2).

(8) As an exemption to all permitting requirements in this section and ss. 369.22 and 369.25, in all freshwater bodies, except aquatic preserves designated under chapter 258 and Outstanding Florida Waters designated under chapter 403, a riparian owner may physically or mechanically remove herbaceous aquatic plants and semiwoody herbaceous plants, such as shrub species and willow, within an area delimited by up to 50 percent of the property owner's frontage or 50 feet, whichever is less, and by a sufficient length waterward from, and perpendicular to, the riparian owner's shoreline to create a corridor to allow access for a boat or swimmer to reach open water. All unvegetated areas shall be cumulatively considered when determining the width of the exempt corridor. Physical or mechanical removal does not include the use of any chemicals or any activity that requires a permit pursuant to part IV of chapter 373.

(9) A permit issued pursuant to this section for the application of herbicides to waters in the state for the control of aquatic plants, algae, or invasive exotic plants is exempt from the requirement to obtain a water pollution operation permit pursuant to s. 403.088.
(10)

History.--ss. 1, 2, ch. 70-203; s. 3, ch. 80-129; s. 32, ch. 85-81; s. 1, ch. 89-151; s. 187, ch. 94-356; s. 2, ch. 96-238; s. 2, ch. 97-22; s. 75, ch. 98-200; s. 91, ch. 99-245.

Note.--Former s. 372.925.

369.22 Nonindigenous aquatic plant control.--

(1) This section shall be known as the "Florida Nonindigenous Aquatic Plant Control Act."

(2) For the purpose of this section, the following words and phrases shall have the following meanings:

(a) "Department" means the Department of Environmental Protection.

(b) "Aquatic plant" is any plant growing in, or closely associated with, the aquatic environment and includes "floating," "emersed," "submersed," and "ditch bank" species.

(c) "Nonindigenous aquatic plant" is any aquatic plant that is nonnative to the State of Florida and has certain characteristics, such as massive productivity, choking density, or an obstructive nature, which render it detrimental, obnoxious, or unwanted in a particular location.

(d) A "maintenance program" is a method for the control of nonindigenous aquatic plants in which control techniques are utilized in a coordinated manner on a continuous basis in order to maintain the plant population at the lowest feasible level as determined by the department.

(e) An "eradication program" is a method for the control of nonindigenous aquatic plants in which control techniques are utilized in a coordinated manner in an attempt to kill all the aquatic plants on a permanent basis in a given geographical area.

(f) A "complaint spray program" is a method for the control of nonindigenous aquatic plants in which weeds are allowed to grow unhindered to a given level of undesirability, at which point eradication techniques are applied in an effort to restore the area in question to a relatively low level of infestation.

(g) "Waters" means rivers, streams, lakes, navigable waters and associated tributaries, canals, meandered lakes, enclosed water systems, and any other bodies of water.

(h) "Intercounty waters" means any waters which lie in more than one county or form any part of the boundary between two or more counties, as determined by the department.

(i) "Intracounty waters" means any waters which lie wholly within the boundaries of one county as determined by the department.

(j) "Districts" means the six water management districts created by law and named, respectively, the Northwest Florida Water Management District, the Suwannee River Water Management District, the St. Johns River Water Management District, the Southwest Florida Water Management District, the Central and Southern Florida Flood Control District, and the Ridge and Lower Gulf Coast Water Management District; and on July 1, 1975, shall mean the five water management districts created by chapter 73-190, Laws of Florida, and named, respectively, the Northwest Florida Water Management District, the Suwannee River Water Management District, the St. Johns River Water Management District, the Southwest Florida Water Management District, and the South Florida Water Management District.

(3) The Legislature recognizes that the uncontrolled growth of nonindigenous aquatic plants in the waters of Florida poses a variety of environmental, health, safety, and economic problems. The Legislature acknowledges the responsibility of the state to cope with the uncontrolled and seemingly never-ending growth of nonindigenous aquatic plants in the waters throughout Florida. It is, therefore, the intent of the Legislature that the state policy for the control of nonindigenous aquatic plants in waters of state responsibility be carried out under the general supervision and control of the department, and that the state itself be responsible for the control of such plants in all intercounty waters; but that control of such plants in intracounty waters be the designated responsibility of the appropriate unit of local or county government, special district, authority, or other public body. It is the intent of the Legislature that the control of nonindigenous aquatic plants be carried out primarily by means of maintenance programs, rather than eradication or complaint spray programs, for the purpose of achieving more effective control at a lower long-range cost. It is also the intent of the Legislature that the department guide, review, approve, and coordinate all nonindigenous aquatic plant control programs within each of the water management districts as defined in paragraph (2)(j). It is the intent of the Legislature to account for the costs of nonindigenous aquatic plant maintenance programs by watershed for comparison management purposes.

(4) The department shall supervise and direct all maintenance programs for control of nonindigenous aquatic plants, as provided in this section, excluding the authority to use fish as a biological control agent, so as to protect human health, safety, and recreation and, to the greatest degree practicable, prevent injury to plant, fish, and animal life and to property.

(5) When state funds are involved, or when waters of state responsibility are involved, it is the duty of the department to guide, review, approve, and coordinate the activities of all public bodies, authorities, state agencies, units of local or county government, commissions, districts, and special districts engaged in operations to maintain, control, or eradicate nonindigenous aquatic plants, except for activities involving biological control programs using fish as the control agent. The department may delegate all or part of such functions to any appropriate state agency, special district, unit of local or county government, commission, authority, or other

public body. However, special attention shall be given to the keeping of accounting and cost data in order to prepare the annual fiscal report required in subsection (7).

(6) The department may disburse funds to any district, special district, or other local authority for the purpose of operating a maintenance program for controlling nonindigenous aquatic plants and other noxious aquatic plants in the waters of state responsibility upon:

(a) Receipt of satisfactory proof that such district or authority has sufficient funds on hand to match the state funds herein referred to on an equal basis;

(b) Approval by the department of the maintenance control techniques to be used by the district or authority; and

(c) Review and approval of the program of the district or authority by the department to be in conformance with the state maintenance control plan.

(7) The department shall submit an annual report on the status of the nonindigenous aquatic plant maintenance program to the President of the Senate, the Speaker of the House of Representatives, and the Governor and Cabinet by January 1 of the following year. This report shall include a statement of the degree of maintenance control achieved by individual nonindigenous aquatic plant species in the intercounty waters of each of the water management districts for the preceding county fiscal year, together with an analysis of the costs of achieving this degree of control. This cost accounting shall include the expenditures by all governmental agencies in the waters of state responsibility. If the level of maintenance control achieved falls short of that which is deemed adequate by the department, then the report shall include an estimate of the additional funding that would have been required to achieve this level of maintenance control. All measures of maintenance program achievement and the related cost shall be presented by water management districts so that comparisons may be made among the water management districts, as well as with the state as a whole.

(8) The department shall have the authority to cooperate with the United States and to enter into such cooperative agreements or commitments as the department may determine necessary to carry out the maintenance, control, or eradication of water hyacinths, alligator weed, and other noxious aquatic plant growths from the waters of the state and to enter into contracts with the United States obligating the state to indemnify and save harmless the United States from any and all claims and liability arising out of the initiation and prosecution of any project undertaken under this section. However, any claim or claims required to be paid under this section shall be paid from money appropriated to the nonindigenous aquatic plant control program.

(9) The department may delegate various nonindigenous aquatic plant control and maintenance functions to the Fish and Wildlife Conservation Commission. The commission shall, in accepting commitments to engage in nonindigenous aquatic plant control and maintenance activities, be subject to the rules of the department, except that the commission shall regulate, control, and coordinate the use of any fish for aquatic weed control in fresh waters of the state. In addition,

the commission shall render technical and other assistance to the department in order to carry out most effectively the purposes of s. 369.20. However, nothing herein shall diminish or impair the regulatory authority of the commission with respect to the powers granted to it by s. 9, Art. IV of the State Constitution.

(10) The department is directed to use biological agents, excluding fish, for the control of nonindigenous aquatic plants.

(11) The department shall adopt rules pursuant to ss. 120.536(1) and 120.54 to implement the provisions of this section conferring powers or duties upon it and perform any other acts necessary for the proper administration, enforcement, or interpretation of this section, including adopting rules and forms governing reports.

(12) No person or public agency shall control, eradicate, remove, or otherwise alter any nonindigenous aquatic plants in waters of the state unless a permit for such activity has been issued by the department, or unless the activity is in waters expressly exempted by department rule. The department shall develop standards by rule which shall address, at a minimum, chemical, biological, and mechanical control activities; an evaluation of the benefits of such activities to the public; specific criteria recognizing the differences between natural and artificially created waters; and the different amount and quality of littoral vegetation on various waters. Applications for a permit to engage in aquatic plant control activities shall be made to the department. In reviewing such applications, the department shall consider the criteria set forth in subsection (4).

History.--ss. 1, 2, ch. 74-65; s. 4, ch. 80-129; s. 33, ch. 83-218; s. 16, ch. 84-254; s. 2, ch. 89-151; s. 188, ch. 94-356; s. 76, ch. 98-200; s. 92, ch. 99-245.

Note.--Former s. 372.932.
369.25 Aquatic plants; definitions; permits; powers of department; penalties.--

(1) As used in this section, the term:

(a) "Aquatic plant" means any plant, including a floating, emersed, submersed, or ditch bank species, growing in, or closely associated with, an aquatic environment and includes any part or seed of such plant.

(b) "Department" means the Department of Environmental Protection.

(c) "Nonnursery cultivation" means the tending of aquatic plant species for harvest in the natural environment.

(d) "Noxious aquatic plant" means any part, including, but not limited to, seeds or reproductive parts, of an aquatic plant which has the potential to hinder the growth of beneficial plants, interfere with irrigation or navigation, or adversely affect the public welfare or the natural resources of this state.

(e) "Person" includes a natural person, a public or private corporation, a governmental entity, or any other kind of entity.

(2) No person shall engage in any business involving the importation, transportation, nonnursery cultivation, collection, sale, or possession of any aquatic plant species without a permit issued by the department or the Department of Agriculture and Consumer Services. No person shall import, transport, nonnursery cultivate, collect, sell, or possess any noxious aquatic plant listed on the prohibited aquatic plant list established by the department without a permit issued by the department or the Department of Agriculture and Consumer Services. No permit shall be issued until the department determines that the proposed activity poses no threat or danger to the waters, wildlife, natural resources, or environment of the state.

(3) The department has the following powers:

(a) To make such rules governing the importation, transportation, nonnursery cultivation, collection, and possession of aquatic plants as may be necessary for the eradication, control, or prevention of the dissemination of noxious aquatic plants that are not inconsistent with rules of the Department of Agriculture and Consumer Services.

(b) To establish by rule lists of aquatic plant species regulated under this section, including those exempted from such regulation, provided the Department of Agriculture and Consumer Services and the Fish and Wildlife Conservation Commission approve such lists prior to the lists becoming effective.

(c) To evaluate an aquatic plant species through research or other means to determine whether such species poses a threat or danger to the waters, wildlife, natural resources, or environment of the state.

(d) To declare a quarantine against aquatic plants, including the vats, pools, or other containers or bodies of water in which such plants are growing, except in aquatic plant nurseries, to prevent the dissemination of any noxious aquatic plant.

(e) To make rules governing the application for, issuance of, suspension of, and revocation of permits under this section.

(f) To enter into cooperative agreements with any person as necessary or desirable to carry out and enforce the provisions of this section.

(g) To purchase all necessary supplies, material, and equipment and accept all grants and donations useful in the implementation and enforcement of the provisions of this section.

(h) To enter upon and inspect any facility or place, except aquatic plant nurseries regulated by the Department of Agriculture and Consumer Services, where aquatic plants are cultivated, held, packaged, shipped, stored, or sold, or any vehicle of conveyance of aquatic plants, to ascertain whether the provisions of this section and department regulations are being complied with, and to seize and destroy, without compensation, any aquatic plants imported, transported, cultivated, collected, or otherwise possessed in violation of this section or department regulations.

(i) To conduct a public information program, including, but not limited to, erection of road signs, in order to inform the public and interested parties of this section and its associated rules and of the dangers of noxious aquatic plant introductions.

(j) To adopt rules requiring the revegetation of a site on sovereignty lands where excessive collection has occurred.

(k) To enforce this chapter in the same manner and to the same extent as provided in ss. 403.121, 403.131, 403.141, and 403.161.

(4) The department shall adopt rules which limit the sanctions available for violations under this act to quarantine and confiscation:

(a) If the prohibited activity apparently results from natural dispersion; or

(b) If a small amount of noxious aquatic plant material incidentally adheres to a boat or boat trailer operated by a person who is not involved in any phase of the aquatic plant business and if that person is not knowingly violating this act.

(5)(a) Any person who violates the provisions of this section is guilty of a misdemeanor of the second degree, punishable as provided in s. 775.082 or s. 775.083.

(b) All law enforcement officers of the state and its agencies with power to make arrests for violations of state law shall enforce the provisions of this section.

History.--s. 1, ch. 69-158; ss. 14, 26, 35, ch. 69-106; s. 4, ch. 70-203; s. 1, ch. 70-439; s. 350, ch. 71-136; s. 2, ch. 71-137; s. 140, ch. 77-104; s. 1, ch. 77-174; s. 23, ch. 78-95; s. 1, ch. 84-120; s. 1, ch. 92-147; s. 189, ch. 94-356; s. 93, ch. 99-245; s. 1, ch. 2000-146; s. 1, ch. 2001-258.

Note.--Former s. 403.271.
369.251 Invasive nonnative plants; prohibitions; study; removal; rules.--

(1) A person may not sell, transport, collect, cultivate, or possess any plant, including any part or seed, of the species Melaleuca quinquenervia, Schinus terebinthifolius, Casuarina equisetifolia, Casuarina glauca, or Mimosa pigra without a permit from the department. Any person who violates this section commits a misdemeanor of the second degree, punishable by fine only, as provided in s. 775.083.

(2) The department shall study methods of control of plants of the species Melaleuca quinquenervia, Schinus terebinthifolius, Casuarina equisetifolia, Casuarina glauca, and Mimosa pigra. The South Florida Water Management District shall undertake programs to remove such plants from conservation area I, conservation area II, and conservation area III of the district.

(3) The department has authority to adopt rules pursuant to ss. 120.536(1) and 120.54 to implement the provisions of this section. Possession or transportation resulting from natural dispersion, mulching operations, control and disposal, or use in herbaria or other educational or research institutions, or for other reasons determined by the department to be consistent with this section and where there is neither the danger of, nor intent to, further disperse any plant species prohibited by this section, is not subject to the permit or penalty provisions of this section.

History.--s. 1, ch. 90-313; s. 190, ch. 94-356; s. 77, ch. 98-200.
369.252 Invasive exotic plant control on public lands.--The department shall establish a program to:

(1) Achieve eradication or maintenance control of invasive exotic plants on public lands when the scientific data indicate that they are detrimental to the state's natural environment or when the Commissioner of Agriculture finds that such plants or specific populations thereof are a threat to the agricultural productivity of the state;

(2) Assist state and local government agencies in the development and implementation of coordinated management plans for the eradication or maintenance control of invasive exotic plant species on public lands;

(3) Contract, or enter into agreements, with entities in the State University System or other governmental or private sector entities for research concerning control agents; production and growth of biological control agents; and development of workable methods for the eradication or maintenance control of invasive exotic plants on public lands; and

(4) Use funds in the Invasive Plant Control Trust Fund as authorized by the Legislature for carrying out activities under this section on public lands. Twenty percent of the amount credited to the Invasive Plant Control Trust Fund pursuant to s. 201.15(6) shall be used for the purpose of controlling nonnative, upland, invasive plant species on public lands.

History.--s. 3, ch. 96-238; s. 1, ch. 97-38; s. 21, ch. 99-205; s. 30, ch. 99-247; s. 4, ch. 99-312; s. 62, ch. 2000-152.
369.255 Green utility ordinances for funding greenspace management and exotic plant control.--

(1) LEGISLATIVE FINDING.--The Legislature finds that the proper management of greenspace areas, including, without limitation, the urban forest, greenways, private and public forest preserves, wetlands, and aquatic zones, is essential to the state's environment and economy and to the health and safety of its residents and visitors. The Legislature also finds that the

limitation and control of nonindigenous plants and tree replacement and maintenance are vital to achieving the natural systems and recreational lands goals and policies of the state pursuant to s. 187.201(9), the State Comprehensive Plan. It is the intent of this section to enable local governments to establish a mechanism to provide dedicated funding for the aforementioned activities, when deemed necessary by a county or municipality.

(2) In addition to any other funding mechanisms legally available to counties and municipalities to control invasive, nonindigenous aquatic or upland plants and manage urban forest resources, a county or municipality may create one or more green utilities or adopt fees sufficient to plan, restore, and manage urban forest resources, greenways, forest preserves, wetlands, and other aquatic zones and create a stewardship grant program for private natural areas. Counties or municipalities may create, alone or in cooperation with other counties or municipalities pursuant to the Florida Interlocal Cooperation Act, s. 163.01, one or more greenspace management districts to fund the planning, management, operation, and administration of a greenspace management program. The fees shall be collected on a voluntary basis as set forth by the county or municipality and calculated to generate sufficient funds to plan, manage, operate, and administer a greenspace management program. Private natural areas assessed according to s. 193.501 would qualify for stewardship grants.

(3) This section shall only apply to counties with a population of 500,000 or more and municipalities with a population of 200,000 or more.

(4) Nothing in this section shall authorize counties or municipalities to require any nongovernmental entity to collect the fee described in subsection (2) on their behalf.

History.--s. 12, ch. 97

CHAPTER 62C-20 AQUATIC PLANT CONTROL PERMITS

62C-20.0015 Definitions.

(1) "Aquatic plant" means any plant, including a floating, emersed, submersed, or ditchbank species, growing in, or closely associated with, an aquatic environment, and includes any part or seed of such plant.
(2) "Aquatic plant management" means an activity designed to control the growth of aquatic plants so as to protect human health, safety and recreation and, to the greatest degree practicable, to prevent injury to non-target plants, animal life, and property.
(3) "Beneficial aquatic plants" mean indigenous aquatic plant species that provide fish and wildlife habitat, water quality protection, and shoreline stabilization.
(4) "Bureau" means the Bureau of Aquatic Plant Management, an administrative subdivision of the Department of Environmental Protection, located at 2051 E. Dirac Dr., Tallahassee, Florida 32310-3760, telephone (850) 488-5631.
(5) "Classes of Surface Water" means the classification of surface waters as defined by the Department of Environmental Protection, pursuant to Rule 62-302.400, F.A.C.
(a) "Class I – Public Water Supplies" means surface waters designated for human consumption.
(b) "Class II – Shellfish Propagation or Harvesting" means surface waters where shellfish are grown or harvested for human consumption.
(c) "Class III – Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife" means all surface waters of the state of Florida, which are not included in Class I, II, IV or V.
(d) "Class IV – Agricultural Water Supplies" means secondary and tertiary canals within agricultural areas.
(e) "Class V Waters – Navigation, Utility and Industrial Use" means waters designated for such use.
(6) "Collection" means the removal or gathering of any aquatic plant, including any part or seed thereof, from the place in which it is growing in the natural environment.
(7) "Connection" means any depression, ditch, canal, culvert, pipe, or any other natural or man-made conveyance, whether permanent or intermittent, which joins the surface water of one waterbody to the surface water of another waterbody in such a manner as to allow the interchange of water between the waterbodies. Waterbodies with conveyances which are subject to man-made controls, including but not limited to dams, weirs, water control gates, and valves which are preventing the interchange of water between waterbodies at the time of the use of an herbicide for aquatic plant management activities, and throughout any water use restriction periods required by the herbicide product label, shall not be considered to be connected.
(8) "Control area" means an area of water containing the aquatic plant management site within which opportunity exists for the mixture of water temporarily degraded by management activities with receiving or adjacent waters. This includes the area of water in which the use of a herbicide or mechanical aquatic plant management activity is undertaken.
(9) "Department" means the State of Florida Department of Environmental Protection.
(10) "Ditchbank species" means those plants usually growing not directly in water but near water's edge at normal water level.
(11) "Eradication program" means a method for the control of non-indigenous aquatic plants in which control techniques are utilized in a coordinated manner in an attempt to kill all the target aquatic plants on a permanent basis in a given geographical area.

(12) “Herbicide” means any chemical product used to chemically control or regulate aquatic plant growth.
(13) “Maintenance program” means a method for the management of aquatic plants in which techniques are used in a coordinated manner, on a continuous or periodic basis, in order to maintain the target plant population at the lowest feasible level funding and technology will permit, as determined by the department.
(14) “Manatee aggregation site” means a specific area within a waterbody or canal system where manatees periodically congregate, as identified by the bureau in consultation with the U.S. Fish and Wildlife Service and the department’s Office of Protected Species Management.
(15) “Natural waters” means those surface waters created through geological and biological processes whether or not subsequently modified by man.
(16) “Noxious aquatic plant” means any part, including but not limited to seeds or reproductive parts, of an aquatic plant which has the potential to hinder the growth of beneficial plants, to interfere with irrigation or navigation, or to adversely affect the public welfare or the natural resources of this state.
(17) “Outstanding Florida Waters” means waters designated by the Environmental Regulation Commission as worthy of special protection because of their natural attributes as listed in Rule 62-302.700, F.A.C.
(18) “Permit” means a license issued by the department, pursuant to this chapter.
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(19) “Person” means individuals, children, firms, associations, joint ventures, partnerships, estates, trusts, business trusts, syndicates, fiduciaries, corporations, and all other groups or combinations.
(20) “Regional biologist” means a biologist employed by the bureau who is located in a region of the state designated by the bureau, and whose duties are to carry out the responsibilities of the bureau within the region as assigned.
(21) “Riparian owner” means a person who possesses fee title to property that extends to the ordinary high water mark of navigable waters, or to the bottom.
(22) “Sovereignty lands” means, pursuant to Article X, Section 11, Constitution of the State of Florida, the title to lands under navigable waters, within the boundaries of the state, which have not been alienated, including beaches below mean high water lines, is held by the state, by virtue of its sovereignty, in trust for all the people.
(23) “Waters” or “Waters of the State” means rivers, streams, lakes, navigable waters and associated tributaries, canals, meandered lakes, enclosed water systems, and all other bodies of water.
(24) “Waters of Special Concern” means Class I and II waters, Outstanding Florida Waters, and waters designated by rule as a fish management area by the Florida Game and Fresh Water Fish Commission.

Specific Authority 370.021, 369.20, 369.22, 369.251 FS. Law Implemented 369.20, 369.22, 369.251, 403.088 FS. History–New 2-9-82, Amended 7-9-85, Formerly 16C-20.015, 16C-20.0015, Amended 5-3-95.

62C-20.002 Permits - Applications.

(1) No person shall attempt to control, eradicate, remove, or otherwise alter any aquatic plants in waters of the state, including those listed in Section 369.251, F.S., except as provided in a permit issued by the department unless the waters in which aquatic plant management activities are to take place are expressly exempted in Rule 62C-20.0035, F.A.C.
(2) Permits issued pursuant to this chapter are not intended to allow for the collection and subsequent use of the removed plants, unless specifically provided for in the permit conditions.
(3) Application format and requirements:
(a) All applications for new permits or modifications to existing permits shall be submitted in accordance with the requirements of this rule.
(b) All application documents shall be submitted in an 8 1/2 by 11 inch format and be of good quality and clearly legible.
(c) Each application shall be submitted on DEP form 50-032(16) (Aquatic Plant Management Application, effective date 5-3-95, which is hereby incorporated by reference), and is available at no cost from the bureau.
(d) All applications, except for those from government agencies, research institutions, and wastewater treatment facilities approved by the Department of Environmental Protection, shall be in the name of and signed by the riparian owner who shall, upon request, provide proof of riparian ownership. An application may be submitted by an agent of the riparian owner provided that the name, address, telephone number, signature of the riparian owner, and agent is provided on the application. Persons representing multiple riparian owners such as, but not limited to, governmental agencies and officers of homeowners associations may submit an application without the name, address, telephone number, and signature of all riparian owners. However, the name, signature, address, and telephone number of the contact person must be shown.
(e) As part of the application, the applicant shall provide the name of the waterbody, if it is named, and a map with directions to the proposed management site using county, state, and U.S. highway names and route numbers.
(f) As part of the application the applicant shall provide a detailed diagram of the proposed management site which shall contain at a minimum the following information:
1. 1. Riparian owner's property boundaries, including dimensions.
2. 2. Approximate water's edge at the time of the proposed application.
3. 3. All prominent features such as docks, fences, trees, etc., located near the water's edge.

4. All aquatic plant communitieslocated at the site identified by name or symbol, with a clear depiction of the aquatic plants proposed for control including the dimensions of the control area and the vegetation not to be controlled.
5. The proposed control method to be used.
2. 6. Type of public notification to be used when applying herbicides with water use restrictions required by the herbicide product label.

7. Legends thatexplain all symbols and patterns used.
.(g) Each applicant shall submit one complete application bearing original signatures and two copies of the complete application to the appropriate regional biologist.
.(4) The regional biologist shall review and determine the completeness of each application and may conduct an on-site inspection.

.(5) Final agency action on permit applications.
.(a) Allconditions of the permit shall be stated on the permit.
.(b) Permits shall be effective for a period of three years from the date issued.
.(6) Permit amendments:
.(a) The permittee may request an amendment subject to the procedures and review criteria of this chapter.
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.(b) Following notice to the permittee, the department is authorized to amend a permit issued pursuant to this chapter during the term of the permit to restrict or limit the scope of the permitted activity. This shall be done if necessary to ensure the protection of human health, safety, recreation, plant and animal life, and property.
.(c) A permit issued pursuant to this chapter may be transferred at the written request of a new owner or assignee of the permitted property when accompanied by written consent from the permit holder. If any changes, additions, or modifications to the permit are requested, an application for a new permit must be filed for processing.
.(7) It shall be the responsibility of the permittee to submit a renewal application 45 days prior to the expiration date of the permit.
.(8) When a person enters into a contract with the department to conduct aquatic plant management for research purposes or pursuant to an eradication or maintenance program initiated under Chapter 62C-52, F.A.C., or Chapter 62C-54, F.A.C., the execution of the contract shall constitute the department's permit for aquatic plant management.

Specific Authority 370.021, 369.20, 369.22, 369.25, 369.251 FS. Law Implemented 369.20, 369.22, 369.25, 369.251, 403.088 FS. History–New 5-8-77, Amended 2-9-82, 7-9-85, Formerly 16C-20.02, 16C-20.002, Amended 5-3-95.

62C-20.0035 Waters Exempt from Permitting.
.(1) No aquatic plant management permit is required by the department for the following waters:
.(a) Waters wholly owned by one person, other than the state, provided there is no connection to Waters of Special Concern.

.(b) Class IV waters or artificially created waters used exclusively for agricultural purposes, provided there is no connection to Waters of Special Concern.
.(c) Electrical power plant cooling ponds, reservoirs, or canals unless used as or connected to waters designated by the department as manatee aggregation sites.
.(d) In waters of 10 surface acres or less provided there is no connection to Waters of Special Concern. The acreage of waters in systems with any connections shall be calculated for each individual water rather than collectively as a system. Natural connections between non-exempt waters shall be considered part of those waters.
.(e) In that specific area of a waterbody where a dredge and fill activity is permitted by the Department of Environmental Protection and aquatic plants are removed as a part of the permitted activity.
.(2) Although certain waters are exempt from the department’s permit requirements, all aquatic plant management activities shall be conducted in a manner so as to protect human health, safety,

recreational use, and to prevent injury to non-target plant and animal life, and property, to the greatest degree practicable. When applying a herbicide in exempt waters, all persons shall comply with label rates, instructions, cautions, and directions, and shall follow the public notice requirements of paragraph 62C-20.0055(2)(c), F.A.C. No aquatic plant management activity using herbicides or mechanical harvesting equipment shall be conducted when manatees are in the control area in exempt waters. Copper-based herbicides shall not be used in any exempt waterbody connected to any natural waterbody designated as a manatee aggregation site without a permit from the department.

Specific Authority 370.021, 369.20, 369.22, 369.251 FS. Law Implemented 369.20, 369.22, 369.251, 403.088 FS. History–New 2-9-82, Amended 7-9-85, Formerly 16C-20.035, 16C-20.0035, Amended 5-3-95.

62C-20.0045 Criteria for Issuing, Modifying or Denying Permit Applications.
.(1) The department recognizes the varied human and environmental concerns for Florida's waters. Aquatic plant management permits shall be issued to allow persons reasonable access to, and use of, these waters while maintaining sufficient native vegetation to provide for environmental concerns such as the impact upon fish, wildlife, water quality, and shoreline stabilization. Native aquatic plant species in natural waters will not be considered for control unless the native species alone, or when intermingled with nonindigenous species, have become noxious.
(2) In determining whether a permit shall be issued for aquatic plant management purposes, the department shall consider the following criteria:
(a) The noxious aquatic plant species present and the potential of the target plants to create adverse effects.
.(b) The amount and quality of the aquatic plants within the waterbody and the proposed management site, and their importance to biological communities that are utilizing them.

(c) The positive or adverse impacts of the aquatic plant management activities on public interest considerations such as:
1. 1. Health and safety of the public.
2. 2. Navigation.
3. 3. General public's access to, or use of, the waterbody.
4. 4. Riparian property owners' access to, or use of, the waterbody.
5. 5. Swimming, fishing or other recreational activities.
6. 6. Water flow or the potential for flooding.

(d) The positive or adverse impacts of the aquatic plant management activities on fish and wildlife considerations such as:
1. Endangered or threatened species, species of special concern, or their prey species and habitat.
2. The potential of the management activities to improve habitat for the production of fish and wildlife, including non-game species.
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3. The potential of the plant management activities to increase or improve native aquatic plant species diversity.
(e) The positive or adverse impacts of the proposed aquatic plant management activities on water quality considerations such as:
1. 1. Native plant coverage which may protect or improve water quality.
2. 2. Native plant coverage which may prevent or reduce shoreline erosion and runoff.

3. Nutrient levels, dissolved oxygen levels, deposition of organic matter, herbicide residues or other impacts on water quality outside of the control area designated by the department.
.(f) The protection of the receiving waterbodies consistent with the classes of surface waters established pursuant to Chapter 62-302, F.A.C.
.(g) The potential of the proposed activity tospread noxious aquatic plants, or to promote the survival and growth of native aquatic plants.
.(3) The department will not issue more than one permit for the same activity at the same site, at the same time, in the behalf of a riparian owner.
.(4) The removal, cutting, collecting, or altering in any way of mangroves, mangrove seeds (fruits) or propagules, or plants restricted by Rule 46-42.001, F.A.C., are not regulated by this chapter and, therefore, shall not be permitted pursuant to Chapter 62C-20, F.A.C.
.(5) If after review of a complete application the department determines that the proposed activity does not conform to the criteria as established in Rule 62C-20.0045, F.A.C., the department shall deny the permit.

Specific Authority 370.021, 369.20, 369.22, 369.251 FS. Law Implemented 369.20, 369.22, 369.251, 403.088 FS. History–New 2-9-82, Formerly 16C-20.045, 16C-20.0045, Amended 5-3-95.

62C-20.0055 Management Method Criteria and Standards, Operations and Reporting Requirements.
.(1) Management Method Criteria and Standards
.(a) Herbicide control activities:

1. Allherbicide control activities shall be in conformity with label requirements of the product to be used.
1. 2. Herbicides that require water use restrictions when used according to label requirements, and do not indicate a potable water intake setback distance on the label, must not be used to manage floating plants within 0.5 miles of a functioning potable water intake in a lake or within two miles upstream or 0.5 miles downstream of a functioning potable water intake in a river system.
2. 3. When used to manage aquatic vegetation other than floating plants, herbicides that require water use restrictions when used according to label requirements, and do not indicate a potable water intake setback distance on the label, must not be used within two miles of a functioning potable water intake in a lake or within two miles upstream or 0.5 miles downstream of a functioning potable water intake in a river system.

3. 4. When management activities, using a herbicide without a potable water setback distance, are to take place within two miles of a functioning potable water intake in a lake, or within two miles upstream or 0.5 miles downstream of a functioning potable water intake in a river system, written notice by certified mail must be given to the operator of the water treatment plant and to the bureau at least one week prior to the treatment activity, unless an alternative notification system has previously been approved by the department.
.5. When more than one herbicide is registered for use in an aquatic site, the department shall require the use of the herbicide which it determines has the least adverse effect upon human health, safety, recreational uses, non-target plants, fish, and wildlife. In determining which herbicide shall be used, the following criteria shall be considered:
.a. Which herbicide will provide the greatest protection to human health, safety, and recreational uses.
.b. Which herbicide will provide the greatest protection to non-target plant and animal life.
.c. Which herbicide will be most effective at controlling the targeted species.

1. 6. Noherbicide shall be permitted for use in violation of label requirements as registered by the Department of Agriculture and Consumer Services or the United States Environmental Protection Agency.
2. 7. Application of herbicides shall be conducted at all times in a manner to cause the least possible adverse effect on human health, safety, recreational uses, non-target plants, fish, or wildlife.
3. 8. Management activities using herbicides shall not be permitted in manatee aggregation sites when manatees are present except when automatic herbicide spreaders operating on timing devices have been authorized by a permit.
4. 9. In order to protect the welfare, safety, and health of manatees, when manatees are sighted in a control area, all herbicide control operations must cease immediately (except when automatic herbicide spreaders operating on timing devices have been authorized by a permit), and shall not be resumed until all manatees have left the control area of their own volition. No manatee may be herded or harassed into leaving the control area.
5. 10. Proposed herbicide treatments that may cause the rapid decay of aquatic vegetation and possible oxygen depletion, shall be required to be staggered or conducted in stages to allow time for recovery and stabilization of oxygen levels between treatments.

(b) Mechanical and Physical Control Activities:
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1. 1. Mechanical aquatic plant management operations shall be conducted in a manner which will not cause further significant spread of noxious aquatic plant species. All cut or harvested aquatic vegetation shall be deposited as prescribed in the permit. No substrate is authorized to be recontoured or removed under an aquatic plant management permit.
2. 2. When manatees are sighted within 50 feet of mechanical operations, all operations must cease immediately and shall not be resumed until all manatees have left the mechanical operations area of their own volition. No manatees may be herded or harassed into leaving the control area.

3. An aquatic plant management permit is required to fluctuate water levels when the primary purpose is for aquatic plant management. A permit to fluctuate water levels may also be required from the appropriate water management district.
(c) Biological Control Activities:
3. 1. The use of fish as a biological control for aquatic plants requires a permit from the Fish and Wildlife Conservation Commission which has statutory authority for the regulation of the use of fish.
4. 2. All other biological control agents shall be used only if approved for general release by the U.S. Department of Agriculture and the Florida Department of Agriculture and Consumer Services.

(2) Operations Requirements:
.(a) All persons conducting aquatic plant management activities shall remove from the site and properly dispose of, in accordance with label instructions, all herbicide containers which result from aquatic plant management activities.
.(b) All persons conducting aquatic plant management activities shall allow employees of the department to conduct inspections, sample waters in management sites, observe control activities at management sites, and review records required by; subsection 62C-20.0055(3), F.A.C., of this chapter in order to determine compliance with the terms of this chapter and permit conditions. In addition, all persons shall allow employees of the department, acting as agents of the Department of Agriculture and Consumer Services, pursuant to an interagency memorandum of understanding (effective date 22 May 1985, which is hereby incorporated by reference and is available from the bureau) to remove samples from spray tanks to ascertain compliance with the terms of this chapter, and permit conditions.
.(c) Prior to undertaking herbicide control activities, each permittee shall notify potential users of waters, subject to or affected by the aquatic plant management activities, if there are use restrictions on the herbicide label for treated waters. The permittee must use one or more of the following methods of notice, which shall be stated on the permit, for posting water-use restrictions to properly notify the affected public:
1. 1. The posting of signs at access points.
2. 2. The publication of notice in a newspaper of general circulation in the affected area.
3. 3. The placement of notices at the management site.
4. 4. The establishment of a signal or marker system.
5. 5. Giving notice at established point of contact.
6. 6. Other methods, approved in advance by the department, designed to reach the affected public.
.(d) The notice shall include, at least, the types of activities which will be temporarily prohibited, or restricted, and the dates for which these prohibitions, or restrictions, are applicable. The notice must remain posted during the period for which any use restrictions are in effect.
.(e) Any person engaged in aquatic plant management must have a copy of the aquatic plant management permit when conducting control activities, unless activities are being undertaken pursuant to Chapter 62C-54, F.A.C.
.(f) If the department finds that immediate, serious danger to the public health, safety, or welfare requires emergency action, it is authorized, to suspend, restrict, or limit the scope of the

permitted activity by emergency order. Any emergency action taken pursuant to this rule shall be promptly reported to the Governor as agency head.
.(3) Reporting Requirements:
.(a) Eachpermittee shall maintain records of herbicide use conducted pursuant to this chapter on DEP Form 50-031(16) (Aquatic Plant Management Annual Operations Report, effective date 5-3-95, which is hereby incorporated by reference and is available from the bureau). An equivalent report may be used provided it is approved in advance by the bureau.
.(b) The Operations Report Form, or other approved equivalent form, shall be sent to the bureau each year within 30 days following the anniversary of the issue date or the expiration date of the permit.
.(c) Subsequent permits will not be issued or renewed until the Operations Report is received. A permit is subject to revocation if the Operations Report is not received within the required time frame.

Specific Authority 370.021, 369.20, 369.22, 369.251 FS. Law Implemented 369.20, 369.22, 369.251, 403.088 FS. History–New 2-9-82, Amended 7-9-85, Formerly 16C-20.055, 16C-20.0055, Amended 5-3-95.

62C-20.0075 Penalties.
.(1) Following proper notice, the department is authorized to modify, revoke, suspend, annul, or withdraw any permit granted by it, or deny or modify any permit request, if the department determines that the following actions were committed by the permittee or applicant:
.(a) Submission of false or inaccurate information in the permit application, requests for amendments or renewals, or records maintained pursuant to subsection 62C-20.0055(3), F.A.C.
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.(b) An unresolved violation of a permit, permit conditions, this chapter, or Florida Statutes relating to aquatic plant management activities.
.(c) Failure to file an operations report within the specified period of paragraph 62C-20.0055(3)(b), F.A.C.
.(2) Violators of this chapter involving the use of herbicides are subject to penalties as provided in Sections 403.141 and 403.161, F.S.

Specific Authority 370.021, 369.20, 369.22, 369.251 FS. Law Implemented 369.20, 369.22, 369.251, 403.088, 403.141, 403.161 FS. History–New 2-9-82, Formerly 16C-20.075, 16C-20.0075, Amended 5-3-95.