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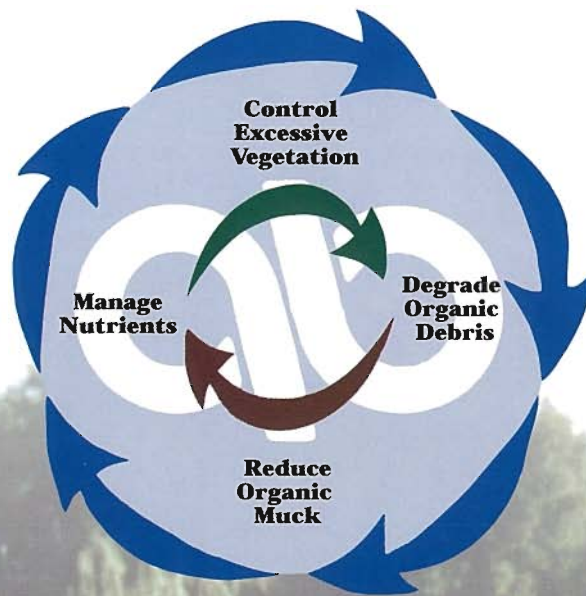
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Survey of hydrilla in Lake Seminole.
Photo by Steve Ausmus, USDA-ARS.

Aquatics

Winter 2005/Vol. 27, No. 4



Contents

A Summary of Future Management Recommendations from the Hydrilla Summit in Florida
By Michael D. Netherland, Mark V. Hoyer, Micheal S. Allen and Dan Canfield . . . 4

New Potential Aquatic Plant Herbicides 9

Comparison of Repeat Herbicide Applications for Wild Taro Control
By Tyler J. Koschnick, W.T. Haller and R. Krantz 11

Vic Ramey
By Jeff Schardt. 17

University of Florida Scientists Explore Africa for Natural Enemies of Hydrilla
By W.A. Overholt and J.P. Cuda 18

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AQUATICS (ISSN 1054-1799): Published quarterly as the official publication of the Florida Aquatic Plant Management Society Registration No. 1,579,647. This publication is intended to keep all interested parties informed on matters as they relate to aquatic plant management particularly in Florida. To become a member of FAPMS and receive the Society newsletter and Aquatics magazine, send \$35.00 plus your mailing address to the Treasurer.
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A Summary of Future Management Recommendations from the December 2004 Hydrilla Summit in Florida¹

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Allen³, and Dan Canfield³

Background

In December 2004, personnel from the UF-IFAS Department of Fisheries and Aquatic Sciences, UF-IFAS Center for Aquatic and Invasive Plants, and the US Army Engineer Research and Development Center hosted a two day workshop in Gainesville, Florida to identify and discuss, in light of conventional wisdom, the key issues associated with hydrilla (*Hydrilla verticillata* L.f. Royle) management. Professionals were invited from numerous federal, state, and county organizations. The meeting discussions were wide ranging and included numerous topics and points of view. At the end of the meeting, the group identified five key issues.

1. Integrated Plant Management
2. Triploid Grass Carp
3. Current and Future Chemical Management Practices for Hydrilla
4. Water Regulation Schedules and the Use of Fluridone
5. Wildlife and Fisheries Management

Following identification of the key issues, we reviewed pertinent literature for each topic. Our original intent was to produce a white paper that summarized key literature for each issue, but we quickly realized that such a document, while serving as a much needed literature review, did not challenge the group to think of future management options.

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We therefore decided that following each topic; we would include recommendations that were subject to the comments of the meeting participants. Our draft was submitted in the early spring of 2005 for comment. We received excellent suggestions and critique from reviewers that improved both the quality of the overall paper and the specific recommendations. The majority of comments were incorporated into the document. The final document was completed in June 2005 and was entitled "Hydrilla Management in Florida: A Summary and Discussion of Issues Identified by Professionals with Future Management Recommendations". The entire document can be found on the Florida LAKEWATCH website at <http://lakewatch.ifas.ufl.edu>. During the workshop and in compiling this final document, it was evident that there are many different ideas regarding hydrilla management in Florida. It was therefore important that the strengths and limitations of our current management options were clearly stated and we hope this initial document accomplished this task.

On December 6th and 7th, 2005, the Florida Department of Environmental Protection as a part of their internal review process invited over 60 stakeholders from county, state, and federal agencies, academia, and private industry (both profit and non-profit) to discuss the future of hydrilla management in Florida. During this meeting our management recommendations were discussed in detail and then further edited based on the ability of the group to form a consensus opinion. While this meeting was professionally facilitated and the process often proved to be tedious, the revised

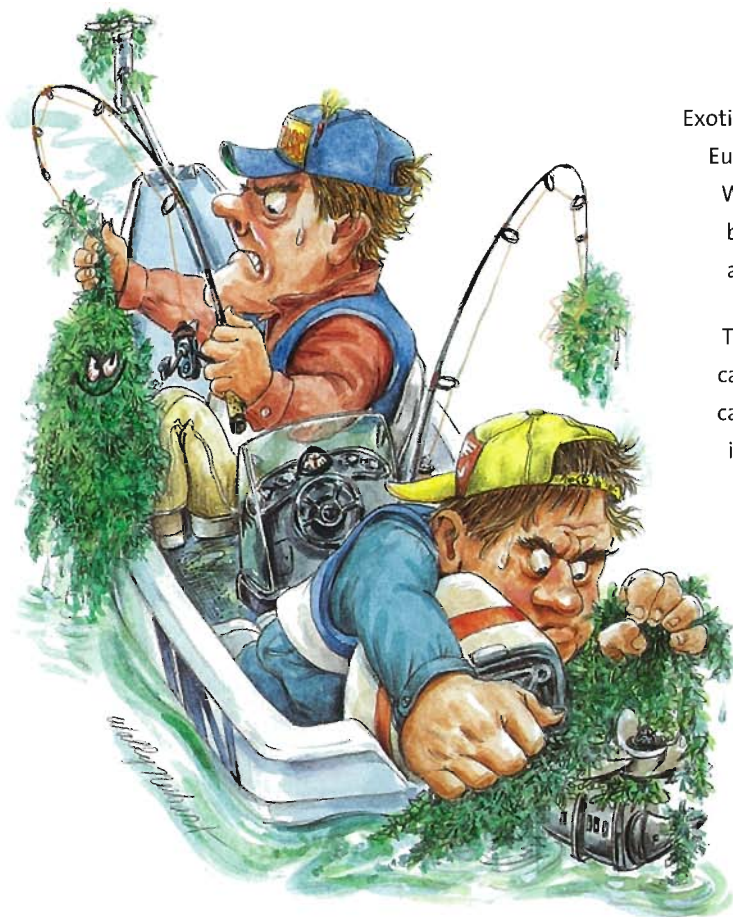
recommendations will help to guide the FLDEP as they move forward in developing strategies to manage hydrilla. The following represents our original management recommendations from the 2004 hydrilla summit. We hope to see the revised recommendations in a future issue of Aquatics to give the readers a feel for the evolution of this process.

Future Management Recommendations

The recommendations and justifications that we provide below should be viewed in the context of the overall document, and we therefore encourage people with an interest in this topic to read through the entire document.

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.

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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.

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.

Recommendation 3: Based on the extent of Fluridone resistant hydrilla (FRH), the identification and development of new her-

bicides 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 year. In situations where adequate control is not achieved, aquatic managers need to determine the basis for this reduced efficacy (e.g. increased herbicide 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 contact products being considered for registration. 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 dimethylalkylamine 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

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of a new 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.

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/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.

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.

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.

Current and Future Status

It is interesting to note that following the December 2004 meeting held in Gainesville, FL, there have been many developments related to the recommendations that were made. First and foremost, the successive hurricanes of 2004 proved to have a fairly severe and longer lasting impact on the hydrilla infestations in Central Florida than was expected. While hydrilla remains present, it did not reach significant levels of infestation that have been observed over the past several years. Many of these lakes were treated with contact herbicides to prevent the expansion of littoral areas that were starting to become established. In addition, in 2005 the US Environmental Protection Agency approved 2 new compounds for Experimental Use Permits (EUP) with an emphasis on hydrilla control. There are also 2 other compounds that have been submitted for a EUP with an emphasis on control of hydrilla. Concurrent EUP's for four new active ingredients would represent a first in aquatics. Lastly, there are indications that a renewed interest in biological control will lead to more overseas efforts in Africa and China.

Ultimately, we hope our efforts will help with future statewide efforts to manage hydrilla.

New Potential Aquatic Plant Herbicides

Aquatic plant resistance issues over the last few years have stimulated new discussion about the need for additional management tools. Industry researchers listened to this discussion and have responded by bringing to the market four new aquatic herbicides. The following are summaries of Experimental Use Permits (EUP) for each potential new product:

Editor.

BASF

In 2005, BASF was granted an experimental use permit to treat 2,100 acres of floating, emergent and submersed aquatic vegetation in eleven U.S. states. Weeds targeted by the BASF EUP included Fluridone-resistant hydrilla, hydrilla, Eurasian water milfoil, sago pondweed, frogbit and water hyacinth, among others. Results to-date of the EUP treatments have shown effective control and minimal non-target impact. This EUP carried no restrictions on fishing, swimming and livestock water. BASF plans to continue and expand the EUP program in 2006. For more information, please contact Bo Burns at 919-844-5375 or burnsaj@basf.com.

SePRO Corporation

SePRO Corporation is developing *Galleon SC* as a new herbicide for large-scale management of problem aquatic weeds. The active ingredient in Galleon has recently been registered for use in rice agriculture. The herbicide is currently under review by US EPA for potential aquatic registration. Under an EPA Experimental Use Permit in 2004 and 2005, the herbicide was applied in aquatic sites totaling over 400 acres. Results of the test program have shown excellent activity on hydrilla, water hyacinth, water lettuce, milfoils, duckweeds and several other problem aquatic plants. In 2006, further EUP testing is planned in multiple US locations totaling up to 1,500 additional acres. Please contact David Tarver, SePRO Director of Technical Aquatic Development (Ph: 850-668-2352), for information regarding the EUP program for Galleon SC.

Valent

Flumioxazin 51WDG (brand name pending) is a new herbicide being evaluated for control of undesirable aquatic vegetation. Flumioxazin belongs to a new class of chemistry that is different than currently registered herbicides. Flumioxazin is a 51 percent water dispersible granule that is mixed with water and applied to aquatic areas. Flumioxazin controls weeds by inhibiting protoporphyrinogen oxidase (PPO), an essential enzyme required by plants for chlorophyll biosynthesis. Flumioxazin is a contact, fast acting herbicide and has shown activity on hydrilla (*Hydrilla verticillata*), water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*) and other aquatic weeds. An Experimental Use Permit (EUP) has been submitted to EPA requesting treatment of up to 900 acres in Florida, Georgia, South Carolina, Alabama, Texas and Indiana with flumioxazin (500 acres

in Florida and 100 acres in each of the other six states). Flumioxazin will be evaluated as a subsurface application targeting submersed aquatic weeds or as a surface application targeting floating undesirable aquatic weeds in lakes, ponds, non-irrigation canals and other water bodies with limited or no outflow. It is expected that this EUP, when approved, will be conducted in spring and summer 2006. In addition to conducting the EUP, flumioxazin will also be evaluated in greenhouse, growth chamber, and field and mesocosm studies during the 2006 season.

Bispyribac 80WP (brand name pending) is a new herbicide being evaluated for control of undesirable aquatic vegetation. Bispyribac belongs to the pyrimidinyloxybenzoic acid class of herbicides, a new class of chemistry that is different than currently registered herbicides. Bispyribac is formulated as an 80 percent water-soluble powder that is mixed with water and applied to aquatic areas. Bispyribac controls weeds by inhibiting acetolactate synthase (ALS), a key enzyme in the biosynthesis of the branched-chain amino acids isoleucine, leucine, and valine, which are essential for plant growth. Bispyribac is a systemic slow acting herbicide and has shown activity on hydrilla (*Hydrilla verticillata*), water lettuce (*Pistia stratiotes*), water hyacinth (*Eichhornia crassipes*) and other aquatic weeds. An Experimental Use Permit (EUP) has been submitted to EPA requesting treatment of up to 900 acres in Florida, Georgia, South Carolina, Alabama, Texas and Indiana with Bispyribac (500 acres in Florida and 100 acres in each of the other six states). Bispyribac will be evaluated as a subsurface application targeting submersed aquatic weeds or as a surface application targeting floating undesirable aquatic weeds in lakes, ponds, non-irrigation canals and other water bodies with limited or no outflow. It is expected that this EUP, when approved, will be conducted in spring and summer 2006. In addition to conducting the EUP, flumioxazin will also be evaluated in greenhouse, growth chamber, and field and mesocosm studies during the 2006 season.

Please contact Dr. Michael Riffle (mriff@valent.com) for more information on either product.

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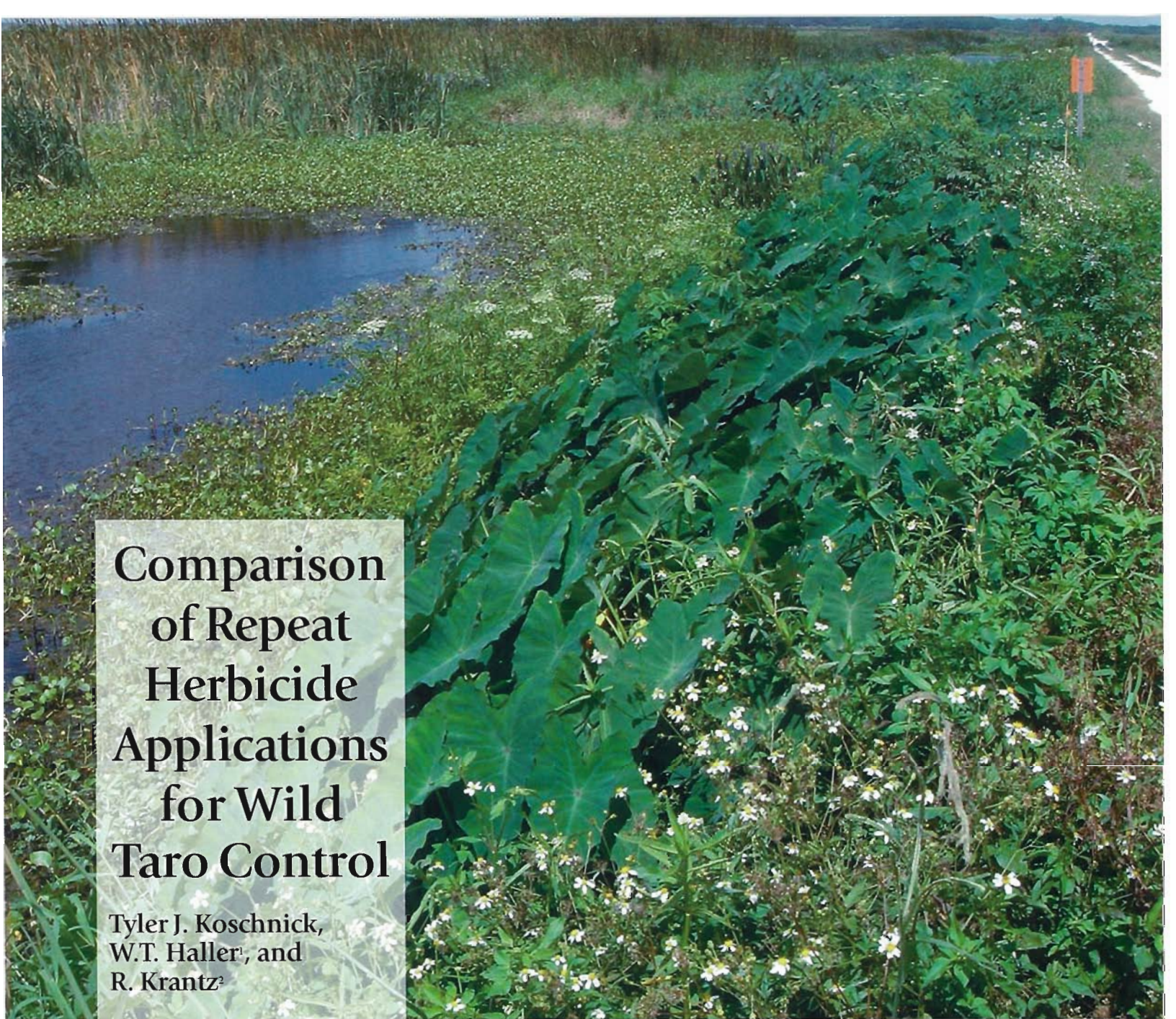
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Comparison of Repeat Herbicide Applications for Wild Taro Control

Tyler J. Koschnick,
W.T. Haller¹, and
R. Krantz²

Introduction

Wild taro (*Colocasia esculenta* (L.) Schott) is native to India and SE Asia, and it is cultivated in many areas of the world for food production, being referred to as the potato of the Pacific (Begley 1981). Different varieties of taro produce different sizes of edible plant portions, and although taro is the most common name, it is also called dasheen

¹ Visiting Assistant Professor and Professor, Center for Aquatic and Invasive Plants, Agronomy Department, University of Florida, Gainesville, FL.

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(French), eddoe (West Indies), and cocoyam (Africa) (Maga 1992). In 1975, there were approximately 1.8 million acres of taro production in Africa, 136,000 acres in Asia, and 82,000 acres in Oceania (Wang et al. 1980). Although all plant parts appear to be edible, most people are probably familiar with production of *poi* from corms, which are high in starch (Allen and Allen 1933). The corm must be cooked, because eaten raw it causes irritation of the mouth due to presence of either an acrid substance or calcium oxalate crystal (Miller 1927).

Taro was intentionally introduced into Florida from Africa in the early 1900's as a potential root-food crop (Maga 1992). However, it has escaped cultivation and is invading many natural areas, and taro is widespread throughout the state found along shorelines of lakes, ponds, ditches and canals. Taro has the ability to produce large amounts of biomass, and in Florida cultivation, it was able to produce 1 to almost 5 tons of dry biomass per acre, depending on row spacing and time of year (Shih and Snyder 1984). Taro mainly spreads through

A scenic photograph of a lake with a boat and autumn trees. The sky is a deep blue with light clouds. The trees in the background are in various shades of green, yellow, and orange. The water is calm and reflects the sky and trees. In the foreground, there are tall green reeds. A small boat with two people is moving across the water, leaving a white wake.

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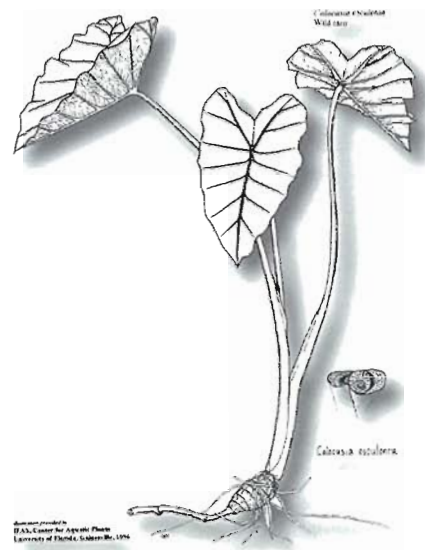
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vegetative means, but also has the ability to produce seed under optimum growth conditions (e.g. New Guinea) (Cooper 1986). There are few acceptable methods of chemical control due to the relatively rapid regrowth that occurs after herbicide application due to the extensive amount of underground plant tissue. Preliminary data from greenhouse trials suggests that wild taro needs to be sprayed multiple times for adequate control with 2,4-D or glyphosate. Field trials were conducted to compare efficacy of repeat applications of triclopyr, 2,4-D, imazapyr, or glyphosate over time.

Materials and Methods

Field plots (10' x 50') were established along a levee shoreline of Emerald Marsh (St. Johns River Water Management District) containing monotypic stands of wild taro. Approximately 2/3 of the taro in the plots was on dry ground, with 1/3 in water less than 1 foot deep. Plots were sprayed

with glyphosate (4 lb/A), 2,4-D (2 lb/A), triclopyr (2 lb/A), and imazapyr (0.4 lb/A), and 2,4-D or triclopyr were also sprayed in combination with carfentrazone (0.05 lb/A). Each plot was sprayed with a backpack sprayer with a total spray volume equivalent to 100 gallons/acre (1.15 gallons/plot) containing 0.4% silicone surfactant. A silicone surfactant was used as previous greenhouse trials indicated it was superior to other surfactants for taro control (data not shown). Plots were sprayed from the top of the bank down towards the water. Enough diluent was applied to cover the plot two times (down and back) during each treatment. Treatments were replicated 3 times and plots were randomly selected for each herbicide/time combination. Plots were sprayed on June 18, 2003, September 12, 2003, and again on May 14, 2004. The interval between applications allowed sufficient time for plant tissue to recover



Wild taro (*Colocasia esculenta*)

from herbicide treatment without reforming monotypic stands. Efficacy was evaluated by counting the total number of surviving stems in each plot on December 15, 2003 (after two repeat applications with all combinations except triclopyr+carfentrazone, which only received one application),

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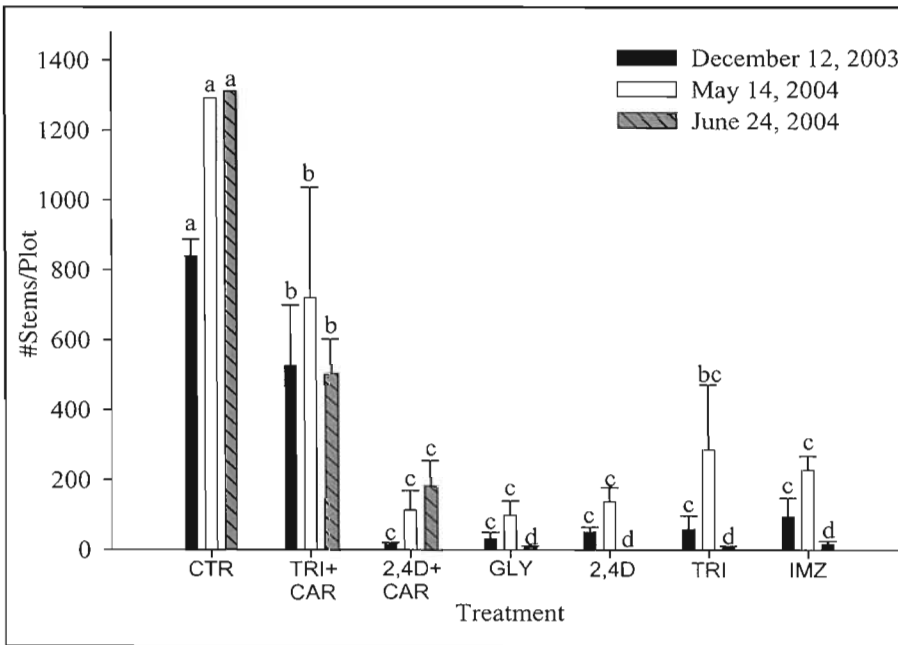


Figure 1. Total number of wild taro stems surviving repeat applications of herbicide (CTR = untreated, TRI = triclopyr, CAR = carfentrazone, GLY = glyphosate, IMZ = imazapyr, and 2,4D = 2,4-D amine) in 10x50' field plots during three evaluation periods. Applications of herbicide were completed on 18 June 2003, repeated on 12 September 2003, and again on 14 May 2004 (TRI+CAR was only treated once on 18 June, and 2,4D+CAR treated twice on 18 June and 12 September). Means with different letters are significantly different across treatments for each evaluation period according to Fishers protected LSD ($p \leq 0.005$).

May 14, 2004 (just prior to the third repeat application), and finally on June 24, 2004.

Results and Discussion

Carfentrazone did not visually appear to enhance the efficacy of 2,4-D or triclopyr after the first application. Therefore, triclopyr+carfentrazone plots were only sprayed one time, and 2,4-D+carfentrazone plots were sprayed 2 times on the respective treatment dates. These plots were used to compare one application of triclopyr or two applications of 2,4-D with 3 applications of each herbicide.

During the first evaluation (6 months after treatment), there was no difference between herbicides on any of the plots sprayed twice, but there was a significant reduction in stem counts compared to control plots (Figure 1). Total stem counts ranged from 15 to 95 stems/plot, whereas the controls averaged 840 stems/plot. The triclopyr+carfentrazone plot was

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only sprayed one time, and had more stems/plot (526) compared to all the plots sprayed twice. This indicates that single applications maybe futile when trying to control taro at the rates evaluated. Similar results were observed during the second efficacy evaluation (11 months) prior to the third application of the herbicides (May 14th, 2004). Wild taro stem counts slightly increased from the 2nd to 3rd herbicide application.

There were no differences in wild taro stem counts in plots sprayed three times with glyphosate, imazapyr, 2,4-D or triclopyr on June 24th, 2004 (~ 1 year after the first application and 41 days after the third application) (Figure 1). Although 3 applications of 2,4-D reduced the total number of stems/plot to 0, it was not statistically different from imazapyr (17), triclopyr (7) or glyphosate (8) applied 3 times. Triclopyr+carfentrazone (sprayed once) had 502 stems/plot and 2,4-D+carfentrazone (sprayed twice) had 182 stems/plot compared to the 1312 stems in the control plot.

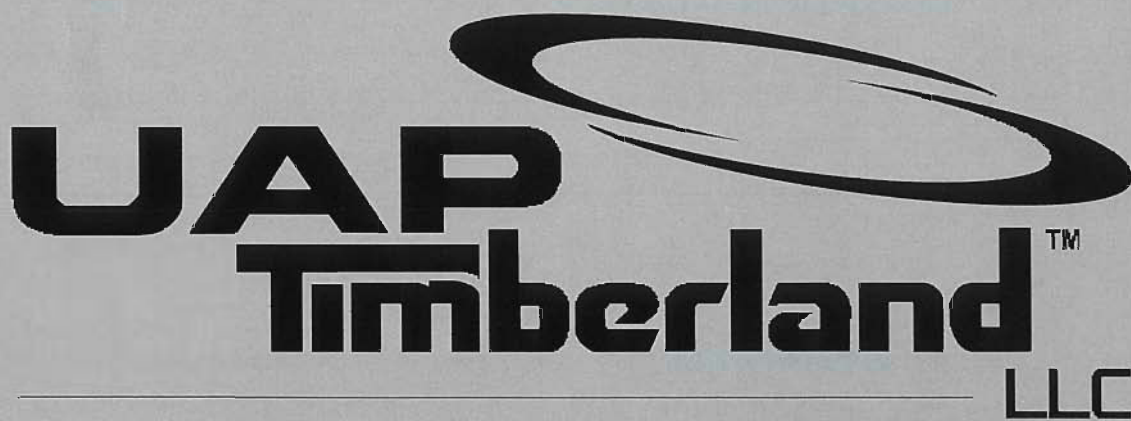
Surviving stems were mainly isolated on the side of the plot closest to the water's edge, except for when plants began to recolonize the shoreline (e.g. triclopyr+carfentrazone plots). The reduced efficacy along the water edge was either due to lack of adequate coverage on the lower portion of the plot, or due to the presence of water over a portion of the stems. Therefore, comparisons should also be completed in inundated sites.

This study confirms preliminary greenhouse trials, and suggest a minimum of 3 applications of glyphosate, 2,4-D, triclopyr or imazapyr are necessary to control wild taro at the rates evaluated in this study. A single application reduced total number of stems/plot 1 year after application by approximately 50% (e.g. triclopyr+carfentrazone), 2 applications reduced stem counts further to about 200 stems/plot (e.g. 2,4-D+carfentrazone), but 3 applications in a year reduced stem counts to < 20/plot. There were no differences in efficacy between the herbi-

cides tested, but some may be more inherently selective than others.

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Vic Ramey

Managers and educators around the world recently lost a strong ally in their efforts to understand and control aquatic and invasive plants.

Vic Ramey died from a stroke on Thanksgiving Day, November 24, 2005 – less than halfway through his 58th year.

No one reached more people in the field of aquatic plant management than Vic Ramey. He not only had vision, but more

importantly, the passion and persistence to bring information to the public at all levels. He did this with little permanent staff, few recurring funds, and borrowed or donated equipment. While we struggled to find better ways to control new plant problems, Vic assembled a team and produced the largest worldwide online library with more than 60,000 articles on aquatic plants and their management. While we searched for ways to communicate with the public, Vic cobbled together other teams and funding from government, private, and public sources to develop lesson plans, guides, photo-murals, and a 600-page web site covering all aspects of aquatic plants in Florida.

Some educators stand confidently before their audiences to tell them what they think they ought to know. Vic circulated among

stakeholders and asked what they want to learn. Some leaders resolutely exhort their subjects to press forward, doing their best with what

they have. Vic worked behind the scenes, with the grass roots, to provide managers with the technologies they need. This quiet leadership led to a web site accessed by more than 55,000 visitors scoring more than 1.6 million hits per month. His latest

and perhaps most passionate and ambitious project was, with the assistance of teachers at all grade levels, to develop lesson plans and learning activities using the materials he had created over the past 25 years. While meeting Florida classroom standards and benchmarks, his goal was to introduce aquatic and invasive plant issues into the environmental conscience of all Floridians, starting with our young people.

In developing instructional mes-

sages, Vic was adamant that we should not only point out the problems and dangers of invasive plants, but we should provide alternatives as well. Show people how beautiful native plants are in their natural surroundings in southeastern wetlands, lakes, and rivers. So while we naturally mourn the tragic loss of

“No one reached more people in the field of aquatic plant management than Vic Ramey.”

“Perhaps the best way to honor Vic is to preserve what he has already accomplished and continue moving forward - up the path that he has laid out for us.”



this wonderful man with the quirky smile, let us also be thankful for and reflect upon our time shared with Vic Ramey and the gifts that he has left for us.

When great leaders and innovators are lost, we often are inspired to create monuments or memorials to honor their achievements. Vic has already done this for us with the website (<http://plants.ifas.ufl.edu>) and his many instructional tools. Perhaps the best way to honor Vic is to preserve what he has already accomplished and continue moving forward - up the path that he has laid out for us.

Vic Ramey— a leader— an innovator—our friend.

by Jeff Schardt

In lieu of flowers Vic's family has suggested contributing to:

The Florida Aquatic Plant Management Society Scholarship Fund, c/o Don Doggett, Lee County Hyacinth Control District, P.O. Box 60005, Ft. Myers, FL 33906

or

The Conservation Trust for Florida, 352/466-1178, www.conserveflorida.org

University of Florida Scientists Explore Africa for Natural Enemies of Hydrilla



W. A. Overholt and J. P. Cuda
University of Florida, Institute for Food and Agricultural Sciences



Left: Jim and Benoit examining our first find of hydrilla in Lake Tanganyika.
Above: Hydrilla collected from Lake Tanganyika.

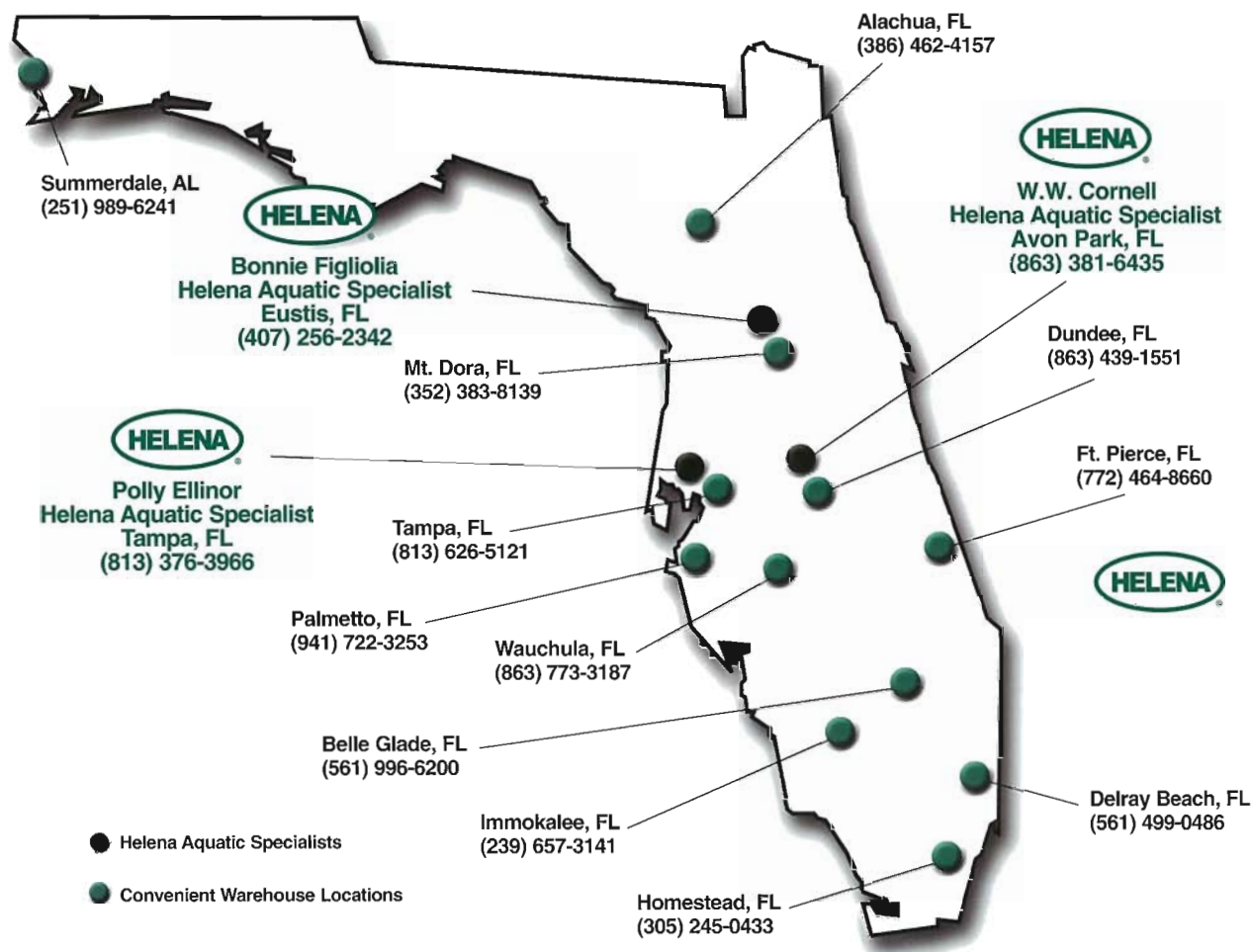
The recent discovery in Florida of herbicide resistant populations of the pernicious invader of Florida's fresh waters, *Hydrilla verticillata*, has stimulated a renewed interest in classical biological control of this exotic plant. With funding support from the Florida Department of Environmental Protection, UF/IFAS faculty members Bill Overholt and Jim Cuda traveled to eastern Africa in September, 2005 to explore for natural enemies of hydrilla, and make contacts with African scientists for possible future collaboration. After an exhausting 20-hour plane trip, Overholt and Cuda landed in Nairobi, Kenya, where they visited the headquarters of the International Center of Insect Physiology and Ecology (ICIPE), an African-based research center focused on biologically intensive pest management, biodiversity conservation and the exploitation of beneficial insects for poverty alleviation. A jet-lagged Overholt and Cuda were welcomed to the institute by Director General, Professor Christian

Borgemeister, who expressed a keen interest in collaborating with UF/IFAS on hydrilla biological control, and possible future collaboration on African exotic plant problems. While in Nairobi, the UF researchers also took the opportunity to visit the National Museums of Kenya to examine hydrilla specimens in the facility's herbarium.

Next on the researchers' itinerary was an 8-hour road trip traversing the scenic Rift Valley, and ending at ICIPE's sub-station at Mbita Point, on the eastern shore of Lake Victoria. There, the UF team met Dr. Bob Copeland, an ICIPE scientist with vast experience in African insect biodiversity. A quick search of Lake Victoria did not reveal hydrilla, and the team, now including Copeland, returned to Nairobi to catch a flight to Bujumbura, the capital of the war-torn nation of Burundi, where literature and herbarium records indicated the presence of hydrilla.

In Burundi, the team was wel-

comed by Mr. Benoit Nzigidahera, the Director of Research for the National Institute for the Environment and Conservation of Nature, and Mr. Evariste Nkubaye, of the Burundian Institute for Agricultural Sciences. Together, the group visited several sites along the shores of Lake Tanganyika, thought to be the second oldest and second deepest lake in the world. Broken pieces of hydrilla were found on the shore at nearly all locations visited, and growing plants were found at one location in shallow water. Collected hydrilla samples were placed in plastic buckets and covered with mosquito netting to capture emerging insect herbivores. One to two days later, two weevil species and several immature and adult midges were collected from the makeshift cages. These insects were brought back to Florida and are now being examined by taxonomic experts.



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*Above: Bob digging with a rake for hydrilla in Lake Tanganyika.
 Top right: Bob (left) and Bill examining contents of collecting pan for hydrilla insects.
 Right: Jim heading offshore with Benoit and Evariste in a boat of questionable sea-worthiness.
 Right: Jim, Benoit and Evariste collecting insects from emergence buckets.
 Bottom right: Fred explaining the finer points of hydrilla ecology in Lake Kyoga.*



The team next flew to Entebbe, Uganda, and then continued by road to the nation's capital city, Kampala. Dr. James Ogwang, the Director of the Coffee Research Institute, and former Head of Biological Control in Uganda, who played an instrumental role in the highly successful project on biological control of water hyacinth in Lake Victoria, hosted the visit. Also joining the team in Uganda were UF graduate, Dr. Fred Wanda from the Fisheries Resources Research Institute and Mr. Omar Wadda, the Head of Uganda's Water Hyacinth Control Unit. The group traveled to Lake Kyoga, 3 hours north of Kampala, where historical records indicated the presence of hydrilla. Within 5 minutes of arriving at the lake shore,

sprigs of broken hydrilla were found on the beach. Unfortunately, time did not permit rearing in Uganda, but based on the diversity of insects found on hydrilla in Lake Tanganyika, it seems almost certain that natural enemies will also be found in Lake Kyoga, as well as many other locations in eastern Africa.

Based on the positive results of the two week trip, Overholt and Cuda will develop a larger grant to support continued exploration for natural enemies of hydrilla in eastern Africa. Future collaboration with the highly motivated and experienced African scientists encountered during the trip will greatly enhance the chance of finding host specific and effective natural enemies for one of Florida's most serious invasive aquatic plants.



AQUAVINE

Unwanted Pets Have the Ability to Become Threats. Habitattitude News Release. "Many unwanted animals (snakes, birds, fish, iguanas and small mammals) are simply set free to fend for themselves. Many wind up dead, unable to find food or otherwise adapt to their new surroundings. According to Florida law, releasing non-native animals is a first-degree misdemeanor, punishable by fines up to \$1,000 and a year in jail. But the law is rarely enforced. "Who's going to see if

they just throw them out the back door?" said Dan Martinelli, executive director of the Treasure Coast Wildlife Hospital. "These are living creatures, not throw-away items." Read the full news story at www.habitattitude.net.

"The reasons behind endangerment of one species cannot easily be applied to another." An article in the December issue of Conservation Biology examines the use of surrogate animals to predict or target what is endangering another species. Researchers often use similar, often called umbrella or flagship, species to identify the cause of endangerment to others. These substitutes may be chosen because they are biologically similar representatives of the troubled species, or they may be used to develop a predictive model to which the original species can be related. The authors Tim Caro, John Eadie, and Andrew Sih suggest three criteria that must be met in order to use substitute species with confidence. The first is to establish the relationship between the level of

the disturbance and vitality rate of the substitute. Second, the trait(s) that affect both species' viabilities must be identified. Third, the trait value and the disturbance threshold must be established for the substitute. The authors see these hurdles as almost insurmountable, especially in a field as cautious as conservation. "Where at all possible, we advocate making every possible effort to examine the target species directly before resorting to substitute species," the authors conclude. To receive a PDF of this article please contact journalnews@bos.blackwell-publishing.net

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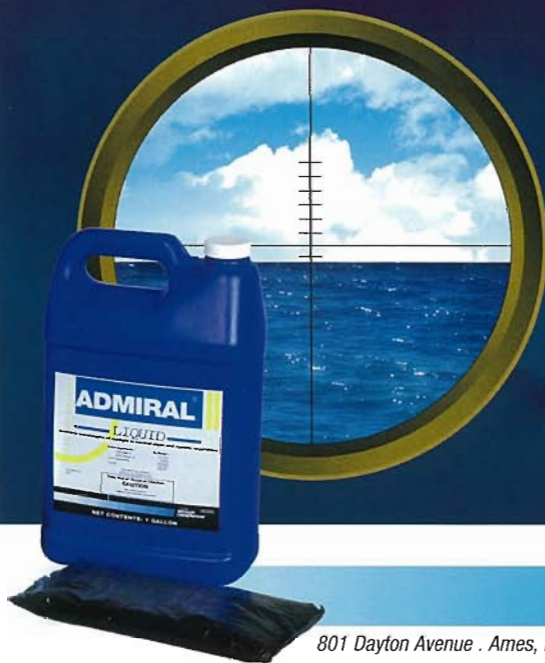
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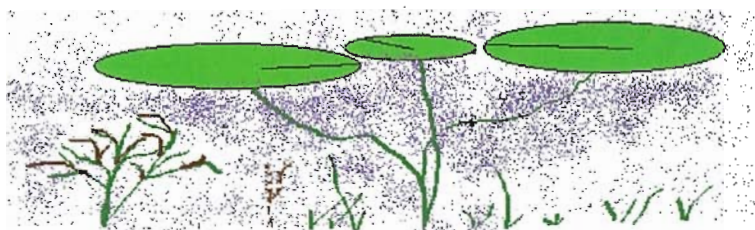
suspoemulsion adjuvant. This new technology uses residual cereal grain materials to make microsponges, called Biocar®, that absorb the herbicide treatment, coat the vegetation and provide a protective film on the foliage that reduces wash-off and dilution. This technology is being used in the ornamental, landscape, and golf course markets. To learn more about TopFilm™ call Lucia Marshall at 636-936-1400 or visit www.biosorb-inc.com

SePRO Corporation announces new information on the fate of aquatic plants that have been subjected to treatments of fluridone. A paper presented by Dr. Kenneth

Wagner, a consultant with ENSR International, quantifies "what survives, what doesn't and for how long; all broken down into multiple dose categories." The study covers high, moderate and low doses of Sonar and their effects on both target and non-target vegetation and was released at the North American Lake Management Society (NALMS) in November 2005. To learn more about SePRO products contact Steve Miller [stevem@sepro.com] or visit www.sepro.com

FAPMS Information Portal
The information portal was added to the Florida Aquatic Plant Management Society's webpage to

inform people about the society but also to give everyone interested in Aquatic Weed Control and Wetland Management a starting point to look for information. If you were not able to find what you are looking for on the web just select the hyperlink "Ask FAPMS" and we'll point you in the right direction. Visit FAPMS at www.fapms.org



Calendar

February 13-17, 2006.

Weed Science Society of America (WSSA). Annual Meeting. New York, NY. www.wssa.net

February 21-23, 2006.

Florida Chapter of American Fisheries Society, Ocala, FL. Student travel grants are available. See awards section at: www.sdafs.org

February 26, 2006.

National Invasive Weeds Awareness Week (NIWAW) www.mawma.org

March 8-10, 2006.

Southeastern Lakes Management Conference. 15th Annual. Columbus, GA <http://science.kennesaw.edu/~jdirnber/lake.html>


March 27-29, 2006:

Western Aquatic Plant Management Society Conference (WAPMS). 25th Annual. San Diego, CA. The WAPMS announces a \$1000 conference scholarship to support students in their pursuit of a degree in aquatic sciences. www.wapms.org/scholarship.html All application materials should be submitted electronically (pdf format preferred) to dfspencer@ucdavis.edu.

Oct 30-Nov 2, 2006.

Annual FAPMS meeting, St. Petersburg, FL.

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