

A Q U A P H Y T E

A NEWSLETTER ABOUT AQUATIC, WETLAND AND INVASIVE PLANTS

Center for Aquatic and Invasive Plants

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News from APIRS

By Karen Brown

Times have changed greatly since the mid-1980s when the Aquatic Plant Information Retrieval System (APIRS) was created. Then our mission was to assist people in developing countries who were often in crisis with life-threatening aquatic weed infestations. Today many of those problems persist with aquatic and other invasive plants because, once established, they are often impossible to eradicate and their growth characteristics make them difficult to manage even at low levels. Aquatic weeds can be an expensive and sometimes desperate problem and there is often conflict over the best means to try to control them. Research and progress continue as we maintain our mission to collect the literature on aquatic weeds and other invasive plants to be of service to those who manage them. Yet 30 years after we began APIRS, the world still struggles to contain aquatic weed infestations.

In the beginning, APIRS staff collected literature from all scientists working in the field of aquatic weeds and made it available as annotated citations via our literature searches, which were printed and mailed. Scientists sent us their reprints, societies sent us their proceedings, we exchanged reports with research institutions, and we scoured the University of Florida libraries. Our scope was world-wide with an emphasis on developing countries and our own state of Florida. Our funding came from international, national, state and regional sources as well as from the University of Florida. Since the water line is not a hard, fast boundary, we began to collect the literature on riparian and wetland plants, vegetation in lagoons and estuaries, and seagrasses. Our categories include control methods, ecology, morphology, physiology, reproduction, taxonomy, surveys, remote sensing, economics, and utilization, plus the many sub-categories that accompany these broader topics. As funding diminished, we felt as though we were being drowned by the same aquatic weeds that smothered the world's waterways, but in a different form.

Funding for APIRS now comes solely from the state of Florida via the University of Florida and the Florida Fish and Wildlife Conservation Commission (FWC) Invasive Plant Management Section (IPMS). FWC is the lead agency in Florida responsible for coordinating and funding invasive aquatic plant control on public waterways throughout the state. Their Aquatic Plant Management Program designs, funds, coordinates, and contracts invasive aquatic plant control efforts.

Their mission is to reduce the negative impacts from invasive nonindigenous plants like water hyacinth, water lettuce and hydrilla to conserve the multiple uses and functions of public lakes and rivers.

Floating water hyacinth and water lettuce, two of the world's fastest growing plants, covered as much as 125,000 acres of Florida public waters as recently as the 1960s and therefore are the FWC's highest management priorities.

*Invasive plants infest 94% of Florida's
438 public waters inventoried in 2012.
These waters comprise 1.26 million
acres of fresh water.*

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See APIRS, continued on page 16.

At the Center 2012–2013

By Dr. William T. Haller, Acting Director

I was truly surprised when Aquaphyte editor Karen Brown asked me to update readers on Center activities and I learned it has been two years since we published the last issue. Time flies when you work hard and are having fun at the same time! The past two years can certainly be characterized by two phrases: continued success and rapid change (and a lot of the latter).

The UF/IFAS Aquatic Weed Short Course was held in May of both 2012 and 2013 in South Florida with over 400 aquatic plant managers in attendance each year.

In both years, the Center's Information Office, in cooperation with the Florida Fish & Wildlife Conservation Commission (FWC), has offered the week-long intensive "PLANT CAMP" attended by approximately 24 leading secondary school science teachers who participate in a week of field trips, laboratory exercises and curricula review for incorporating invasive species lessons into their school science programs (see related article on page 4).

In 2012, Center staff was invited by the UF/IFAS administration to contribute to and participate in a display to celebrate the 150th Anniversary of the Land Grant College Act. The theme was the importance of water to Florida and included topics on water conservation, efficient irrigation of crops and urban environments, recreation, aquaculture and invasive species. The display was set up and staffed at the Smithsonian Folk Life Festival on the National Mall in Washington, D.C. for a week in early July where it was very well attended. It was then returned to Gainesville where it was displayed for several months at the Florida Museum of Natural History and visited by several thousand people. Thanks to Amy Richard, Dr. and Mrs. Jim Cuda, Dr. Lyn Gettys and several others who took time to staff the display to hand out information and answer questions.

This year the FWC Invasive Plant Management Section, which funds invasive plant research, control, and outreach on public water bodies and lands in Florida, and the Center held a Research and Outreach Review Meeting. The purpose was to exchange information on current scientific research and outreach activities in Florida. The meeting was attended by approximately 100 participants including university and government scientists; federal, state and local government natural resource managers; and outreach professionals.

Rapid turnover of students is normal, expected and common at universities. Changes in permanent staff are less frequent. The "new" graduate students I mentioned in the 2011 Aquaphyte have moved on to hopefully very green pastures all over North America. Dr. Brett Bultemeier is now employed by Clarke working in both mosquito and aquatic weed control. Dr. Jeff Hutchinson has taken a position with the U.S. Fish and Wildlife Service in Texas. Research Associate Dr. Lyn Gettys has filled the Aquatic/Natural Area Plants faculty position at the UF-IFAS Ft. Lauderdale Research & Education Center; Kate Wilson (MS) is now the Invasive Species Coordinator for Alberta Environment in

Edmonton, AL, Canada; and Leif Willey (MS) just began work as a Research Biologist for Aquatic Systems, Inc. in South Florida.

Several new graduate students are working at the Center or with affiliated IFAS faculty. Those at the Center include three new MS students: Jon Gosselin (New Hampshire), Heather VanHeuveln (Florida) and Carl Della Flore (Georgia).

The Center staff turnover bug hit hard this year. Amy Richard, Coordinator of Education/Training Programs in our Information Office resigned in July 2013 after 23 years of service to the LAKEWATCH Program and the Center Invasive Plant Education



Initiative. She is pursuing a Master of Fine Arts degree in, of all places, Iowa and has been superseded by Katie Walters. Aimee Cooper of the UF-IFAS Assessment of Non-Native Plants in Florida moved to south Florida and now works part-time on that project. Dr. Deah Lieurance arrived in January 2013 to work full-time on the Assessment with Dr. Luke Flory, Assistant Professor of Plant Ecology in the UF-IFAS Agronomy Department. Long time Administrative Assistant Roberta (Bobbi) Goodwin retired in November 2012 after 30 plus years of service to the university. She worked for UF President Marston in the early 1980's, and then very ably assisted former Center Directors Joseph Joyce and Randall Stocker before assisting me as current Director. Fortunately, Kim Lottinville agreed to assume this role and with her 23 years of experience at UF/IFAS has really contributed to a smooth transition. Best wishes and good luck to those departing the Center; and welcome to those new to our organization.

Personally, due to having such a dedicated and capable group at the Center, I have continued to work on several aquatic weed research topics. Screening and studies on selectivity of potential new aquatic herbicides is continuing with the cooperation of several agencies and agrichemical companies. Hopefully, the BASF product, topramezone (an HPPD inhibitor) will soon be registered for aquatic weed control by the US Environmental Protection Agency. In addition, we have been working on deep water harvesting of hydrilla and fish by-catch issues with FWC and Texas Aquatic Harvesting, Inc.

So the last two years have brought lots of exciting research, new students and changes which are refreshing and fun!

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News from the Information Office

By Karen Brown, Information Office Coordinator

Until approximately 1990, the Aquatic Plant Information Retrieval System (APIRS) was our primary focus as we created and built our database and collection. Shortly thereafter, however, we began to expand our offerings under the creative vision of Mr. Victor Ramey. We began to refer to ourselves as the Information Office to incorporate APIRS with our other educational endeavors such as video programs (now DVDs), and plant identification guides (ID decks, laminated fold-outs, botanical line drawings, photomurals, and more). We built our first website around 1995 and began uploading an extensive photograph collection, videos, original text, university extension publications, a world-wide guide to aquatic plant field guides and textbooks, invasive plant management plans, and other common website materials. In addition, APIRS went online and researchers and others were able to perform their own literature searches, or request them via e-mail and receive them electronically.

A short time later, we began a comprehensive addition to the main website called *Plant Management in Florida Waters*. It included just about everything one could want to know about aquatic plant management in addition to information about freshwater systems in our state. This website was heavily used and very popular but, with time, needed a complete technical overhaul and the content needed review, revisions, and updates.

Rebuilding Plant Management in Florida Waters – the Website

Florida has more than 100 years of experience managing aquatic plants, beginning in 1899 when Congress authorized the U.S. Army Corps of Engineers to remove water hyacinths obstructing navigation in Florida rivers. Currently the Florida Legislature has designated the Florida Fish and Wildlife Conservation Commission (FWC) as the lead agency in the state to “direct the control, eradication, and regulation of noxious aquatic weeds and direct the research and planning related to these activities. . . so as to protect human health, safety, and recreation and, to the greatest degree practicable, prevent injury to plant and animal life and property.” Accordingly, the FWC administers programs under the Florida Aquatic Weed Control Act in which pesticides approved by the U.S. Environmental Protection Agency (US EPA) and the Florida Department of Agriculture and Consumer Services (DACS) are used.

In October 2011, new legislation was adopted by the EPA's Clean Water Act regarding pesticides "applied in, over, or near waters of the U.S." This legislation is known as the National Pollution Discharge Elimination System (NPDES) and is administered in Florida by the Department of Environmental Protection (DEP). Because the FWC contracts with government and private entities to control problem aquatic plants in Florida's 1.25 million acres of public lakes and rivers, and much of this work is accomplished using registered herbicides, it fell to FWC to fulfill the requirements of this new legislation for the DEP. It was decided to review, revise and restructure the *Plant Management in Florida Waters* website to coincide with the implementation of the NPDES regulations to demonstrate that FWC programs conform to the new legislation and to make this information readily available to pesticide applicators and the public.

Updating the website, which consisted of hundreds of pages within pages within pages and hundreds of embedded images and tables, proved to be a Herculean effort. The project took five people more

than a year and will always be a work in progress as new material is added or updated. The site's design and organization was completely changed. The site's architecture (what you don't see when you view and navigate through a website) was also completely changed and updated to meet current World Wide Web standards.

The revision of the *Plant Management in Florida Waters* website was funded by the FWC. Jeffrey Schardt, with 37 years of experience in aquatic plant management, played a key role in the reorganization, revision, and the provision of additional material for the website. Integrated plant management is presented in terms of interactions among water uses, plant types, available technologies, current environmental conditions, and funding. Details are provided regarding the parameters considered by biologists when developing FWC aquatic plant control permits and contract programs.

The site was organized into five primary sections and targets both newcomers to the subject and experienced aquatic plant managers. The five sections include 1) Why Manage Plants? 2) an Overview of Florida Waters; 3) Control Methods; 4) Developing Management Plans; and 5) Research and Outreach. The website is already rich with content and we add new and revised material on a regular basis. *Plant Management in Florida Waters* is expected to remain a work in progress and one we are very proud of. Please visit the site at: plants.ifas.ufl.edu/manage

Florida Invasive Plant Education Initiative & Curriculum

When the “Education Initiative” was begun back in 2005, it, too, required a website to contain its curriculum, PLANT CAMP information, teaching resources, social media, and other information. This website was also revised in 2012/2013 to bring it up to current World Wide Web standards and to reorganize it and refresh its look. Read more about the Education Initiative on page 4 and visit the content-rich website for educators at: plants.ifas.ufl.edu/education

Educational Products

The Information Office also continues to add to and reprint our popular educational products. These include our educational DVD series, plant identification guides in several formats, photo-murals and line drawings, and more. With the advent of invasive plant issues in public lands, plant identification aids covering upland species in natural areas were needed. The *Invasive and Non-Native Plants You Should Know (Recognition Card Deck)* and *Invasive and Other Non-Native Plants Found in Public Waters and Conservation Lands of Florida and the Southeastern United States (A Recognition Guide for 94 Plants)*, a laminated fold-out guide, were created and added to our collection. View these and other products at: plants.ifas.ufl.edu/products

The name, “Information Office,” allows us plenty of room to expand and grow in any direction. Our office encompasses a variety of high-quality materials that make us proud. Visit us at plants.ifas.ufl.edu and check out the portals to our other sites on the right side of our home page. Feedback is always welcome. Let us know if we can help you with anything — we are the Information Office!

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Florida Invasive Plant Education Initiative & Curriculum

By Katie Walters, Coordinator, Education Initiative

PLANT CAMP 2013

Trekking through the woods, identifying and removing invasive plants, hopping in an airboat to survey Hydrilla maintenance control, dip-netting macro-invertebrates – it was all in a day’s work for teachers who attended PLANT CAMP 2013, an annual five-day workshop for school teachers, hosted by the Center for Aquatic & Invasive Plants at the University of Florida.

The immediate goal of PLANT CAMP is to introduce teachers to the topics of invasive plant management and give them the curriculum, information from experts, and hands-on experience they need to teach this material with confidence. The long-term goal is for today’s youth to draw on this knowledge as they mature into responsible environmental stewards.

Former PLANT CAMP attendee Debra Porter recently wrote an article in *Middle Ground*¹ that addressed “nature deficit disorder.” This idea, put forth by Richard Louv in his book, *Last Child in the Woods*, describes a disconnect with nature that occurs when children spend less time outdoors and more time inside using electronic media.



Forensic botanist David Hall shows PLANT CAMP teacher Aaron Barnes ways to identify plants

The Florida Invasive Plant Education Initiative develops curriculum that bridges this gap – including hands-on, reading, and electronic media activities – to engage students about their role in the environment and their community. PLANT CAMP introduces teachers to this curriculum and provides necessary background knowledge first-hand by presenters at the top of their fields to ignite a real interest and excitement about invasive plant management. Launched eight years ago, the Initiative is a collaborative outreach effort by the University of Florida-IFAS Center for Aquatic and Invasive Plants (CAIP) and the Florida Fish and Wildlife Conservation Commission/Invasive Plant Management Section.

University of Florida faculty, FWC regional and state park biologists, administrators from FWC’s Invasive Plant Management Section, and plant managers from



PLANT CAMP participants get their hands dirty inspecting critters during a pond ecology lab

the private sector contribute as presenters and instructors, providing a rare behind-the-scenes look at natural resource management activities in the state of Florida.

At the end of the workshop, teachers participate in a round-robin style discussion about what they learned and how they will use the materials to engage their students. Teachers saw opportunities for community service projects, getting students’ families involved, field trips, and pond ecology explorations. They realized there was much that could be done on or near their school property – getting students active and outside.

Being more knowledgeable about the whole process of controlling/managing invasive plants makes teachers much more likely to teach the material, get students engaged, and introduce their students to careers in natural resource management. Here are a few comments from teachers’ evaluations of this year’s PLANT CAMP:

- “Opened up a new world of understanding. I can see taking this experience back to students with many suggestions for career opportunities.”
- “The walk provided useful background info and the lab is easily transferable to the classroom (especially the [mobile phone] app).”
- “Everything was excellent, well-planned. Activity was versatile for middle school all the way to AP [Advanced Placement] courses.”
- “This was awesome...these people are so professional. Witnessing the [weed harvesting] machine on the lake in action with the men giving such detail was amazing. Thank you!”

Lakeville: A Natural Resource Management Game

Lakeville is a multi-disciplinary teaching unit about ecosystems, natural resource management (i.e., invasive species), and civic responsibility. It was developed by Dan Kahn, Jason Evans, and Amy Richard. There are three “sessions” that make up the Lakeville Unit. Each session is designed to encourage critical thinking while enhancing students’ environmental knowledge. Sessions 1 and 2 provide students with background information (if needed) and Session 3 brings it all together in a fun game-show style activity that gives students a chance to use their persuasive debate skills and make management decisions about a local freshwater habitat. The goal is to prepare students for their future role as citizens and environmental stewards.



Students from PK Yonge Developmental Research School participate on the Citizen Advisory Panel during Lakeville

Thanks to generous funding from the Florida Fish and Wildlife Conservation Commission (FWC), the Aquatic Plant Management Society (APMS), the Aquatic Ecosystem Restoration Foundation (AERF), and the Florida Aquatic Plant Management Society (FAPMS), the Lakeville Unit was demonstrated in 10 Florida classrooms this past year, and will be brought to 14 more this coming school year.



Three students from PK Yonge work together to fill out score sheets for Lakeville

Referred to as “Lakeville – On the Road,” this was a pilot project to test the effectiveness of onsite demonstrations as a way of encouraging repeated use in the class-

room. Enthusiasm for the project was evident when several teachers were approached last fall (2012) and many committed to a demonstration within a matter of days.

Lakeville is accompanied by a 250 page Unit Guide, which includes Teacher Guides and activities for all three sessions. Teacher Kits were produced that include the Unit Guide as well as classroom sets of activity booklets



Teachers from PLANT CAMP play students' role in Lakeville: A Natural Resource Management Game

and materials to play Session 3, Lakeville — The Game. Every teacher who has Lakeville demonstrated in their classroom receives a free Teacher Kit so they will be able to continue teaching their classes about invasive species management. As one participating teacher said, “It is really nice to have someone come in and demonstrate the curriculum and show the flow of how the activity goes, as it would take a lot of time to figure out all of the components.” These kits are also available for purchase or loan by emailing caip-education@ufl.edu

To see what kind of an impact on-site demonstrations had on the students’ knowledge, pre- and post-tests were implemented. Results from the tests show that students are gaining a greater understanding of the terms native, non-native, invasive and weeds—including the distinctions between the terms non-native and invasive (i.e., non-native plants are not necessarily “bad”). Across the board, students consistently improved on their post-test scores, with the number of students who answered specific questions correctly increasing (on average) by as much as 66% (e.g., the invasive species definition question).

When questioned about the need to manage invasive species, the number of students who answered the question correctly increased an average of 58% between the pre- and post-tests.

Lakeville was also demonstrated at PLANT CAMP 2013, with the teachers playing the role of students. The goal of these demonstrations is to get the teachers comfortable and excited about the unit. One teacher said “... actually participating in the game makes me much more likely to actually use it.” PLANT CAMP attendees will be approached this coming school year about on-site demonstrations in a continuing effort to connect teachers to the resources they need.

Production of eelgrass sod for use in lake restoration projects

By Lyn A. Gettys

The Aquatic Habitat Restoration and Enhancement Subsection of the Florida Fish and Wildlife Conservation Commission (FWC) is charged with planning and executing lake restoration projects in Florida. Fish and wildlife populations are healthiest when submersed aquatic vegetation (SAV) is present, so SAV is often planted to improve habitat. Lake restoration projects rely on the use of native SAV to maintain ecological integrity. Eelgrass (*Vallisneria americana*) is a highly desired species for restoration projects. Also called tapegrass or American watercelery, eelgrass is a perennial submersed aquatic herb with ribbon-like leaves arising from a central rosette. The species is widely adapted and is tolerant of adverse environmental conditions such as high turbidity, low light levels and various water chemistry regimes. Although eelgrass produces seeds, most colonization is the result of vegetative reproduction of ramets (plantlets).

Florida lakes are typically quite shallow, ranging from approximately 4 to 15 feet and averaging about 10 feet. Restoration efforts at some sites have been effective but in other cases, establishment of self-sustaining populations of SAV has been unsuccessful. This could be due in part to planting techniques in the field. The roots of field-collected plants used for revegetation are sometimes damaged during collection, which can cause transplant shock and failure to establish. In addition, the typical procedure of hand-planting individual ramets is very labor-intensive. This is especially true when ramets are planted at a fairly high density as recommended for best establishment. In response to these issues, researchers at the UF-IFAS Center for Aquatic and Invasive Plants partnered with FWC lake restoration biologists to investigate techniques and develop methods to optimize field plantings and hopefully improve restoration success.

We assessed the feasibility of producing eelgrass “sod” that can be cultured in the greenhouse and transplanted to the field. This novel approach addressed several of the challenges associated with revegetation programs. First, a relatively small number of plants are needed to start sod in the greenhouse; this can be desirable if eelgrass supplies are limited. Second, culturing sod under greenhouse conditions completely eliminates predation and grazing while plants become established. Third, high-density populations are transplanted using the sod technique, which improves the likelihood of field establishment. Finally, large swaths of the restoration site can be planted quickly, reducing labor costs.

Our first goal was to identify the best matrix in which to culture eelgrass sod. This matrix had to be biodegradable for breakdown after planting, but also stable enough to support the sod during greenhouse culture and transport to the field. We tested two potential matrix materials – 100% cotton burlap and 1" thick coir (coconut fiber). We cut sheets of each matrix to 1.5' x 2' and inserted eight rooted plantlets on 6" centers through the matrix. Planted sheets were placed on a layer of sand amended with a

controlled-release fertilizer in 1.5'-deep tanks filled with well water. As newly planted sheets had a tendency to float, each sheet was weighted down with 2 bricks that were placed between the newly planted ramets. After 16 weeks of culture, we found that most sheets hosted well-established populations of eelgrass, with an average of 80 plants per sheet (a 10-fold increase from the original planting density of 8 ramets per sheet). Matrix type did not have a significant effect on total number of plants produced during the culture period, but mats with a burlap matrix were extremely unstable and fell apart upon removal from culture tanks. In contrast, coir mats maintained their structural integrity upon removal from tanks and were selected as the best matrix to use for production of eelgrass sod.

Our next goal was to “ground-truth” this new eelgrass sod technology to determine if it could be transferred to the field to increase the success rate in areas where previous revegetation efforts had failed. We established additional coir matrix sod in the greenhouse using the procedures described above, and then transported the sod to planting sites at three lakes. Well-rooted eelgrass sod in the coir matrix was transplanted at single locations in Lakes George, Jesup and Josephine. Water depth at the planting sites was 1.5' at Lakes George and Jesup and 2' at Lake Josephine. Planting sites were protected by exclosures at all three locations to reduce herbivory by turtles and other aquatic fauna. Eelgrass sod was transplanted at all sites with and without fertilizer, with 4 replicates each of fertilized and unfertilized treatments. Sod was placed on the bottom of the lake and secured with 8" long metal spikes; fertilizer tablets were pushed into the lake sediment under the sod in plots calling for fertilizer. Within 48 hours of planting, sod planted at Lakes George and Jesup had been torn or pulled up by wave action; this problem was addressed by returning to these locations and top-dressing the sod with pea gravel to provide more stability. This problem did not occur at Lake Josephine, where deeper water at the planting site resulted in reduced wave action; it therefore seems likely that planting site instability is a function of water depth.

Field visits 4 months after planting revealed that eelgrass sod had become established with varying degrees of success at the three sites, and that there was no difference between fertilized and unfertilized plots. Small plants were visible at the Lake George site, but plants did not extend beyond the original pieces of sod and failed to colonize the unplanted area within the exclosure. It is worth noting that the Lake George planting site had virtually no SAV present and previous plantings failed to establish. The observation that eelgrass was persistent 4 months after planting suggests that sod use may improve the success rate of revegetation at this site. In contrast, plantings of eelgrass sod at Lakes Jesup and Josephine were much more successful. Plants at both sites were well-established and growing vigorously 2 months after the sod was transplanted. Healthy, self-sustaining populations of eelgrass are still present at both sites more than a year after planting and have expanded to fill the unplanted areas within the exclosures.

These experiments revealed that the use of eelgrass sod for restoration and revegetation projects may be an effective strategy to increase transplant success and improve population establishment, and may provide a new, more cost-effective tool for lake restoration programs. If water at the planting site is shallow

(< 1.5'), care should be taken to ensure that sod is securely anchored to the planting site by top-dressing with gravel. Another alternative for shallow-water plantings is to locate the planting site behind existing populations of emergent plants, which will protect the newly planted sod by reducing wave and current action.

These small-scale studies led us to explore whether the production of eelgrass sod could be scaled up to produce larger pieces of eelgrass sod. We also wanted to address the stability issue when planting eelgrass sod in shallow water. With these goals in mind, we identified a product composed of a large (3' x 15') "pillow" of coir enclosed in a coir rope net. We built large tanks (9' x 45' x 2' deep) out of plywood and pond liners, each accommodating 9 mats. As with our smaller sod experiments, we found that the coir pillows floated, so they were weighted down with bricks prior to planting. This was one of the few parallels between small-scale and large-scale eelgrass sod production.

Four of these tanks were set up to produce 36 pieces of eelgrass sod, for a total of over 1600 square feet of coverage. The first tank to be planted had 20 g of controlled-release fertilizer per square foot broadcast over the bottom of the tank before the mats were placed on top. This is half the low label rate recommended by the fertilizer manufacturer for culture of terrestrial nursery plants and approximately equal to the rate used in our production of small eelgrass sod. The water level in the tank was brought up to approximately 1 foot and well-rooted ramets of eelgrass were inserted on 6" centers into the openings in the coir rope net wrapped around the coir pillow (Fig. 1). Once planting was complete, the water level in the tank was increased to 1.5' and maintained at that level throughout the culture period. It quickly became clear that our protocol for production of small eelgrass sod could not

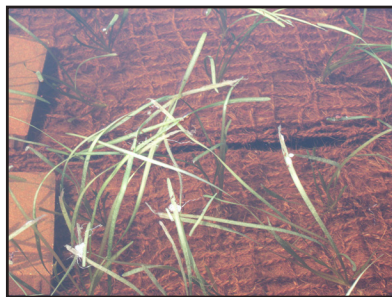


Fig. 1. Well-rooted ramets of eelgrass inserted into openings of the coir rope net wrapped around the coir pillow.

be scaled up for production of large eelgrass sod without modifications. The tank became murky within a week and an algae bloom reduced water clarity to virtually zero. Pumps and biofilters were installed in an attempt to control the algae without success. The algae impeded the growth of the eelgrass by blocking sunlight and smothering the plants so we ultimately abandoned this tank.

We reduced the fertilizer to 10 g per square foot in the next three tanks we planted. This helped reduce – but did not eliminate – the algae problems. A new tank was set up and planted as before, but we did not add any fertilizer before planting. Instead, we waited until the eelgrass started to grow well (approximately 4 weeks after planting), then inserted a 7.5 g controlled release fertilizer tablet under the planted mats at 1 foot intervals (equivalent to 5 g per square foot). Plant density and establishment quickly increased and the algae blooms noted in earlier plantings failed to materialize.

After 16 weeks of greenhouse culture, all mats hosted robust populations of eelgrass (Fig. 2 and inset photo). Transport to the field was accomplished by rolling each 3'-wide piece of sod onto a 4' length of aluminum fence post, which acted as a spool and provided handles on either end of the roll. This process was fairly quick (a 15' long piece of sod could be rolled in 5 minutes) and resulted in an easy-to-transport unit. Although a rolled 3' x 15' section of eelgrass sod is fairly heavy when saturated, the coir



Fig. 2. Well-rooted eelgrass sod in a large coir matrix after 16 weeks of greenhouse culture. Inset: Eelgrass sod removed from the tank for transport to the field.

drains rapidly and weighs approximately 50 pounds within a few minutes of being removed from the tank. The sod is rolled with the shoots of the eelgrass inside and the drained coir retains enough water to ensure that plants do not desiccate during short transport periods. Rolled eelgrass sod is then loaded onto a boat, transported to the revegetation site, unrolled on the bottom of the site, and secured with custom-fabricated landscape "staples" with 1' legs and a 3' span (Fig. 3).



Fig. 3. Field installation of eelgrass sod by UF and FWC personnel.

The large sections of eelgrass sod were transplanted to field plots in August 2011. Site visits to Lake Jesup during summer 2012 and early spring 2013 revealed that they had

established self-sustaining populations and had grown beyond the original transplant site. The coir pillow wrapped with a coir rope net is more stable but still degrades in the field as desired. Topdressing the sod with pea gravel at shallow planting sites may not be necessary; we have used 1' rebar "staples" to anchor the sod in more recent plantings with great success. These experiments show that eelgrass sod may provide a new tool for restoration managers and could result in more successful, cost-effective lake restoration programs.

(Adapted from an article in *Aquatics* magazine, Spring 2012, Vol. 34(1); Updated September 2013.) Sources for materials, supplies and literature used to prepare this paper are available from the author.

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MARY'S PICKS

Items of special interest from APIRS reader/cataloger, Mary Langeland ~

MCFARLANE, E. WATERCRAFT INSPECTOR HANDBOOK. 2012. WISCONSIN DEPARTMENT OF NATURAL RESOURCES, UW-EXTENSION, WISCONSIN ASSOCIATION OF LAKES, 160 PP. (Available online)

The Wisconsin Volunteer Aquatic Invasive Species Program, created in the fall of 2003, developed the Water Craft Inspector Handbook with the following explanation of the program's intent: The Volunteer Aquatic Invasive Species Program promotes water resource stewardship by actively involving individuals in preventing the spread of aquatic invasive species that can harm Wisconsin's ecosystem, economy, and recreational opportunities. Your involvement as a Clean Boats Clean Waters Volunteer Watercraft Inspector will help to keep Wisconsin's waters free of additional aquatic invasive species by increasing awareness about the potential impacts of aquatic invasive species and inspecting boats and trailers before entering and when leaving lakes. Clean Boats Clean Waters Volunteer Watercraft Inspectors are trained to conduct boater education at the boat landing. It's a very simple and fun process that:

1. Educates boaters on how and where invasives are most likely to hitch a ride into water bodies and what they can do to help prevent the spread of invasives;
2. Communicates about the laws and issues surrounding the existence, spread, and effects of invasives to Wisconsin's waters;
3. Performs boat and trailer checks – looking for any plants, animals and mud that must be removed before entering and when leaving every water body;
4. Distributes informational brochures;
5. Collects data that will assist the WDNR to evaluate the potential spread of invasive species, public awareness of invasive species issues, and the effectiveness of the invasive species program.

(Excerpts from the Wisconsin Watercraft Inspection Program Handbook.)

MARSH, H., O'SHEA, T. J. & REYNOLDS, J. E. ECOLOGY AND CONSERVATION OF THE SIRENIA: DUGONGS AND MANATEES. 2012. CAMBRIDGE UNIVERSITY PRESS, NEW YORK, NY; CONSERVATION BIOLOGY 18; 538 PP.

Dugongs and manatees, the only fully aquatic herbivorous mammals, live in the coastal waters, rivers and lakes of more than 80 subtropical and tropical countries and territories. Symbols of fierce conservation battles, sirenian populations are threatened by multiple global problems. Providing comparative information on all four surviving species, this book synthesises the ecological and related knowledge pertinent to understanding the biology and conservation of the Sirenia. It presents detailed scientific summaries, covering sirenian feed biology; reproduction and population dynamics; behavioural ecology; habitat requirements and threats

to their continued existence. Outlining the current conservation status of the sirenian taxa, this unique study will equip researchers and professionals with the scientific knowledge required to develop proactive, precautionary and achievable strategies to conserve dugongs and manatees.

(Excerpt from the Marsh et al book cover)

PITELLI, R. L. C. M., PITELLI, R. A., SANTOS, S. C. D., SILVA, A. F. D. & VELINI, E. D. MACROFITAS AQUATICAS DO RESERVATORIO DE NOVA AVANHANDAVA. 2013. MARIA DE LOURDES BRANDEL - ME, JABOTICABAL, BRAZIL, 98 PP.

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PITELLI, R. L. C. M., PITELLI, R. A., RODRIGUES, C. J. & DIAS, J. H. P. MANUAL DE IDENTIFICACAO DAS PLANTAS AQUATICAS DE PORTO PRIMAVERA. 2012. FUNDACAO DE APOIO A PESQUISA, ENSINO E EXTENSAO (FUNEP), JABOTICABAL, BRAZIL, 71 PP.

Robinson Luiz de Campos Machado Pitelli is the primary author of these field guides which provide information on the aquatic plants of two reservoirs in Brazil – Nova Avandava and Porto Primavera. Both are in Portuguese. The spiral-bound guides are similar in that they offer at least 2 photographs of each plant on one page facing a page with a written description plus its importance to the waterbody (invasiveness, habitat, plant effects, unique facts, etc.) The guides for the Nova Avandava Reservoir (7" x 10 1/8") featuring ~40 species and for the Porto Primavera Reservoir (6" x 8 1/4") featuring ~27 species could be used in the field as the pages are glossy paper and could withstand dampness. Amongst the invasive species of concern in both reservoirs is *Hydrilla verticillata*. Hydrilla or hidrila, the common name in Portuguese, is relatively new in Nova Avandava Reservoir having been detected by Pitelli in June 2012. On the other hand, hydrilla was first found in 2005 by Lars Anderson (University of California) during a visit to the Porto Primavera Reservoir.

According to the authors, this publication aims to develop a guide for identification of aquatic macrophytes present in New Avandava Reservoir, including a historic community of these macrophytes in the last three years, in order to serve as support material for staff and researchers who perform services in Nova Avandava. The book does not make generalizations about the biology of the different species of aquatic plants, but rather the plants in Nova Avandava Reservoir.

For the Porto Primavera Reservoir book the authors' state: Unlike a textbook of applied limnology, this is a manual for field identification, with clear photos and simple and direct information. We hope that this manual will be useful scientifically and practically for everyone involved in the science of aquatic macrophytes.

RICHARDSON, S. G. & MURAWSKI, E. MANAGEMENT OF NUISANCE AND EXOTIC VEGETATION ON PHOSPHATE MINED LANDS IN FLORIDA, FINAL REPORT, SEPTEMBER (2012). FLORIDA INDUSTRIAL AND PHOSPHATE RESEARCH INSTITUTE (FIPR), BARTOW, FLORIDA; PUBLICATION NO. 03-160-248; 179 PP. (Available online)

Invasive exotic plants are major problems in natural areas and on reclaimed mined lands in Florida. Even some native plants can be highly competitive when re-establishing plant communities on disturbed lands and are included in the term “nuisance plants.” There are regulatory requirements to control invasive plants which are a major contributor to reclamation costs on mined lands in Florida. The main purpose of this manual is to provide information that will aid in more cost-effective weed control and more successful reclamation of mined lands. The information is also applicable to restoration efforts in non-mined lands. Information in the manual is based on more than 20 years of research and demonstration projects conducted by FIPR Institute staff and cooperators, plus published reports and the experience of other researchers and reclamation and restoration practitioners. The recommendations in the manual are the authors’ attempts to summarize and synthesize the available published and unpublished information. A bibliography is also included for those who wish to delve into various topics in greater detail. The manual provides management methods for the various exotic and native nuisance plants and also for Florida vegetation communities and the related Florida Land Use, Cover and Forms Classification System (FLUCFCS) types. (*Excerpt from the Abstract*)

HALL, D., WEBER, W. J. & BYRD, J. H. (ED.) WILDFLOWERS OF FLORIDA AND THE SOUTHEAST. 2011. DW Hall Consulting, First Edition (July 12, 2011); 819 PP.

Wildflowers of Florida and the Southeast provides photographs and concise descriptions for many of the plants that occur in Florida and throughout the Gulf and Eastern Coastal Plains, particularly from North Carolina west into eastern Texas. This treatment contains descriptions and photographs of 768 plants. As an identification aid, the plants are arranged by flower color. The written description provides geographic ranges and habitats, season of flowering, type and shape of leaves, and many more details about each featured plant. Scientific names are listed along with the most frequently used common names known to the authors.

RANDALL, R. P. A GLOBAL COMPENDIUM OF WEEDS, SECOND EDITION. 2012. WESTERN AUSTRALIA DEPARTMENT OF AGRICULTURE AND FOOD, PERTH, WESTERN AUSTRALIA; 1124 PP. [ISBN 978-0-646-52878-1] Available online.

Predicting which plants will become weeds is difficult, with the single most important indicator of a species’ weed potential being a documented weedy history. Until now, the most comprehensive coverage of the world’s weed flora was produced in 1979 and listed 6400 species. This large

er compendium offers almost 21,000 entries, as well as a comprehensive index containing more than 15,000 alternate scientific names and 27,000 common names in numerous languages. This compendium is specifically designed to give anyone interested in the weed potential of a plant a report on its status with, most importantly, further avenues for finding more information through extensive reference listings.

BURRELL, C. C., MARINELLI, J. & HARPER-LORE, B. (EDS.) NATIVE ALTERNATIVES TO INVASIVE PLANTS. 2011. BROOKLYN BOTANIC GARDEN, BROOKLYN, NEW YORK; HANDBOOK 185; 242 PP. [NOTE EARLIER EDITIONS IN 2006, 2007]

The biggest enemy of any garden is not a pest, disease, or poison—it’s any plant with tougher survival skills than the plants it competes with, according to Burrell et al in their book **Native Alternatives to Invasive Plants**. The best way to weed out the invaders is with this fiendishly clever guide to native plants that can seek and destroy the top 100 most unwelcome perennials, grasses, vines, shrubs, and trees. While replacing the invaders, the beautiful, hardy native plants described here also attract native birds and butterflies, while turning away their own enemy invaders. Word-and-picture guides provide tips on care and maintenance, while helpful “at a glance” boxes depict shapes, sizes, best locations, and most attractive features of each native alternative.

BULTEMEIER, B. W. HERBICIDE RELEASE AND PLANT UPTAKE DYNAMICS OF SELECTED GRANULAR AQUATIC HERBICIDES. 2012. PH.D. DISSERTATION; UNIVERSITY OF FLORIDA, INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES (IFAS), GAINESVILLE; 90 PP. (Available online)

Granular formulations of aquatic herbicides have been utilized in weed management programs for many years. However, the most basic questions such as how long it takes for an herbicide to be released from granules have been largely unexplored. The release of herbicide from the granule is critical for ensuring that concentrations in the water reach the critical CET (concentration exposure time) required for weed control. The current studies were conducted to determine the rate of herbicide release from selected aquatic granules maintained under static and aerated water conditions, under known water flow conditions and under static conditions when placed over an organic sediment. Finally, the uptake of herbicides by roots and shoots was compared when herbicides were applied only to the root zone or foliage of hydrilla. These studies show very different herbicide release profiles between flowing and static water, as well as when granules are applied to high organic matter sediments. Of the herbicides evaluated, foliar uptake was much greater than root uptake, but translocation throughout the plant was found regardless of treatment location.

(*Excerpts from the abstract.*) **NOTE: Herbicides used in this study included: triclopyr, fluridone, endothall, quinclorac, topramezone, and bispyribac.**

FROM THE DATABASE

The APIRS database now contains more than 86,000 annotated citations to the aquatic and wetland plant literature and to the literature on invasive species in Florida. The database is created from the contributions of researchers, and is used by researchers, worldwide. A small sample of recent additions to the APIRS collection is provided below. References cited include peer-reviewed research articles, government reports, books and book chapters, dissertations and theses, and gray literature such as abstracts from proceedings. To obtain full-text of citations, contact your nearest academic library or search online.

To use APIRS, go to <http://plants.ifas.ufl.edu/APIRS/>

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Multiple introductions of invasive Eurasian watermilfoil and recurrent hybridization with Northern watermilfoil in North America.

J. AQUATIC PLANT MANAGEMENT 50:1-19 [JANUARY]. 2012.

MARY'S PICKS, *continued from page 9.*

GREIS, A. L. CHARACTERIZATION AND EVALUATION OF AMINOCYCLOPYRACHLOR ON NATIVE AND INVASIVE SPECIES OF FLORIDA (2012). M.S. THESIS; UNIVERSITY OF FLORIDA, AGRONOMY DEPT., GAINESVILLE; 103 PP.

Aminocyclopyrachlor is a synthetic auxin herbicide proposed for invasive species management and the release or restoration of native perennial grasses. As a component to natural areas restoration, it is also beneficial to understand the impact that herbicide residues have on native plant species. Studies were therefore initiated to determine the efficacy of aminocyclopyrachlor on several invasive grass species as well as the impact on establishment and growth of native species. Postemergence applications of aminocyclopyrachlor were evaluated under greenhouse conditions to determine the control of several invasive grasses including natal grass (*Melinis repens*), torpedograss (*Panicum repens*), paragrass (*Urochloa mutica*), West Indian marshgrass (*Hymenachne amplexicaulis*) and cogongrass (*Imperata cylindrica*), as well as several native grass and broadleaf species. *Eragrostis elliottii* was the most tolerant native grass evaluated. *Aristida stricta* and *Eragrostis spectabilis* were the most sensitive grasses. To assess the impact of aminocyclopyrachlor soil residues on native species, seedlings of several common forbs, grasses, and tree species were transplanted into field plots treated with varying rates of aminocyclopyrachlor. To further investigate the potential of aminocyclopyrachlor for cogongrass control, a field study was conducted in Hillsborough County, Florida. Aminocyclopyrachlor was evaluated alone or in combination with imazapyr or glyphosate and compared to standard rates of imazapyr and glyphosate. Two additional experiments were established and found that imazapic and imazamox were ineffective for cogongrass control.

(Excerpts from the abstract.)

WILSON, K. L. FLORIDA FRESHWATER BOATER AND ANGLERS' AWARENESS AND PERCEPTIONS OF AQUATIC INVASIVE SPECIES AND ADOPTION OF PREVENTIVE BEHAVIORS (2012). M.S. THESIS; UNIVERSITY OF FLORIDA, AGRICULTURAL EDUCATION AND COMMUNICATION DEPARTMENT, INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES (IFAS), GAINESVILLE; 218 PP.

Aquatic Invasive Species (AIS) pose considerable threats to aquatic ecosystems as well as community and state economies. Florida is home to the most registered boaters in North America and is also a destination for many non-resident boaters and anglers. As such, it is imperative that managers understand the current level of awareness, perceptions, and behavior of boaters in order to best prevent AIS spread. Registered Florida boaters and non-resident freshwater anglers were surveyed by mail (34% of 4119 responded) to determine their awareness and attitudes to-

wards AIS and the actions they took or would be willing to take in order to prevent the spread of AIS. Variables from the Model of Responsible Environmental Behavior were evaluated based on their ability to predict whether or not boaters and anglers adopted AIS preventive Best Management Practices. Intention to act, subjective norms, knowledge of action strategies, and attitudes were found to be the strongest predictors of whether or not boaters and anglers adopted BMPs. These factors should be emphasized in the development of an AIS prevention campaign. The campaign should include targeted venues and mandatory boat cleaning and/or inspection stations should also be considered.

(Excerpts from the abstract.)

NOTE: The following University of Connecticut dissertation is available to individuals with a ProQuest Research Account.

BENOIT, L. K. CRYPTIC SPECIATION, GENETIC DIVERSITY AND HERBICIDE RESISTANCE IN THE INVASIVE AQUATIC PLANT *HYDRILLA VERTICILLATA* (L.F.) ROYLE (HYDROCHARITACEAE) (2012). PH.D. DISSERTATION; UNIVERSITY OF CONNECTICUT, STORRS, CONNECTICUT; 128 PP.

Hydrilla verticillata (L. f) Royle (Hydrocharitaceae; commonly "hydrilla") is a submersed aquatic plant with a cosmopolitan distribution. It is a nonindigenous, highly invasive weed that causes serious ecological and economic harm in the United States, and consequently is of great management concern. Repeated use of the herbicide fluridone has led to the evolution of resistant strains in Florida hydrilla populations. I developed a standard method to screen the nuclear phytoene desaturase (pds) gene for three previously identified mutations that confer resistance. I screened accessions from the U.S. and other countries and detected hydrilla with pds mutations from five localities in Florida and one in Georgia. All pds mutations were found only in U.S. dioecious hydrilla, and all were located on the same homologous allele. Using this new method, lake managers may have hydrilla tested for resistance-conferring mutations prior to choosing a control treatment. The population genetic structure of hydrilla reflects the asexual reproductive history of the genus, the invasion history in different regions, and genetic divergence among hydrilla lineages that are in fact distinct species. Polyploidy and hybrid vigor are hypothesized to contribute to the success of introduced U.S. and Chinese populations.

(Excerpts from the abstract.)

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EDUCATION INITIATIVE,

continued from page 5.

FYI: Curriculum Alignment and Development

In response to a national initiative to provide a consistent, clear understanding of what American students are expected to learn, Florida schools are slowly transitioning from Next Generation Sunshine State Standards (NGSSS) to Common Core State Standards (CCSS) over the next few years. Our curriculum is currently aligned to NGSSS, and we are in the process of re-aligning to CCSS and making these documents available on our Florida Invasive Plant Education Initiative website. Until the transition is complete within the state, we plan to provide both NGSSS and CCSS with our activities. Meeting state standards is required for teachers to include our material in their classrooms so keeping up with these changes is critical.

A list of our curriculum

Module 1 ~ Silent Invaders	39 lessons/activities
Module 2 ~ A Fish Tale	19 lessons/activities
Module 3 ~ Why Manage?	21 lessons/activities
Module 4 ~ Viva la Difference!	17 lessons/activities
Lakeville	25 lessons/activities

Florida Invasive Plant Education Initiative Website

<http://plants.ifas.ufl.edu/education>

The four core modules and one unit (Lakeville) available on the Education Initiative website provide an introduction to the issues of invasive species in Florida. The site allows teachers to download and print all of our activities and standards, view our audiovisual presentations, and link to our social media on Facebook and YouTube (where further resources such as photos and videos can be found). Our website is one of the primary ways we make our resources available to teachers.

Teachers can access the website easily on a smartphone or tablet – the site automatically scales to any screen size without sacrificing usability or readability. The site has an online form to join the mailing list, now at 1,800 contacts, and soon there will be an online form for ordering materials, free to Florida teachers. We will be offering special free items each month to encourage teachers to request materials that can be used with our curriculum such as large format posters, magnifiers, and activity booklets. To see what free item we are highlighting, teachers can follow us on Facebook or visit our website.

The site has already seen a lot of traffic this year: between December 2012 and December 2013 the Educa-

tion Initiative website received over 16,525 visits with 47,366 page views. The site will continue to be promoted directly to Florida teachers via our list-serv and PLANT CAMP participants who we hope will share their experience with others.



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¹ The magazine of the Association for Middle Level Education

Hot off the Press!

Just in – the latest book by esteemed author Sylvia Haslam of the Department of Plant Sciences, University of Cambridge. **The Waving Plants of the River** includes many illustrations by P.A. Wolseley. It is dedicated “To botanists of the future who devote their lives to reversing the decline and destruction of river plants.” Dr. Haslam has devoted her career to doing just that in England and beyond. This newest book discusses and adds to her earlier publications on river plants but also stands alone. Her intention is for readers to gain a better understanding of how water plants behave and how they work. In her introduction, Haslam writes, “As Izaak Walton (1653) cites, ‘Rivers... were made for wise men to contemplate and fools to pass by without consideration’. This book contemplates!”

The Waving Plants of the River
(ISBN: 978-0-9564692-4-3), 2013.
Forest Text, UK, 277 pp.

APIRS, *continued from page 1.*

Floating plants were present in 245 public lakes and rivers in 2012, covering over 7,500 acres. They are under maintenance control in 96% of Florida's public waters.

Approximately \$3.5 million was spent to control almost 28,000 acres of floating invasive plants in Florida public lakes and rivers during fiscal year 2011-2012, just to conserve maintenance control.

The submersed plant, hydrilla, infested almost 38,000 acres in 2012. Hydrilla is under maintenance control in 95% of the 181 public waters it infested in 2012; however, hydrilla tubers infest about 90,000 acres and represent the potential for immediate regrowth. 81% of the hydrilla reported in 2012 occurred in the Kissimmee Chain of Lakes and Lake Istokpoga, among Florida's largest and most important multiple-purpose waterways. Managers spent \$12.36 million treating nearly 30,300 acres of hydrilla in Florida public lakes and rivers during fiscal year 2011-2012 to conserve the multiple uses of these resources.

Seven plant species in addition to hydrilla, water hyacinth, and water lettuce were detected covering almost 15,000 acres in 87% of Florida's public waters in 2012. \$2.5 million was spent managing approximately 10,000 acres during fiscal year 2011-2012, mostly for the

control of torpedograss (*Panicum repens*), cattail (*Typha* spp.), and phragmites in Lakes Okeechobee, Istokpoga, and the Kissimmee Chain of Lakes, and floating islands and tussocks in Lake Tsala Apopka, to conserve fish and wildlife habitat and navigation in the extensive marsh systems of these waters.

(Excerpted from the Annual Report of Activities Conducted under the Cooperative Aquatic Plant Control Program in Florida Public Waters for Fiscal Year 2011-2012.)

Because the FWC-IPMS is our sole source of funding outside of UF, we have narrowed our boundaries to reflect their statewide scope. We have brought our focus back almost to its origins—to the aquatic weeds that cause the most environmental and economic harm here in Florida, and in other tropical and subtropical countries, because they are often the same species.

Invasive terrestrial plants in Florida's public lands and natural areas (referred to as upland plant species) also fall under the jurisdiction and funding of FWC-IPMS. Thus we began collecting the literature on the most problematic of these species as well; hence the changed name of our institution some time ago to the Center for Aquatic and Invasive Plants. And again, there was a shift in the focus of the literature we collect. While we maintain our interest in

all aquatic weeds and welcome contributions from researchers on all aquatic plant species, our priority must lie with those most problematic in our home state and these now include upland species in public lands.

While keeping up with the current literature on invasive plant species in Florida, we are striving to fill any gaps in our collection, especially grey literature such as agency reports (much harder to find via the Internet) and seminal work done by early researchers. We especially focus on control methods and the biology and ecology of the worst offenders. As the weeds persist and even change before our eyes (e.g. hydrilla populations developing resistance to the most widely used and effective herbicide, fluridone, around the year 2000), so do the research and the conferences and the literature...and APIRS!

We ask that researchers and agency personnel continue to contribute reports, proceedings and journal articles directly to us for the inclusion of annotated citations in APIRS. We sincerely thank all of the researchers who have contributed their findings to APIRS over the years.

To learn more about APIRS or perform your own literature search, visit plants.ifas.ufl.edu/APIRS or send an e-mail to kpbrown@ufl.edu to request a personalized literature search.

Florida Research and Outreach Newsletter



The Florida Fish and Wildlife Conservation Commission (FWC) Invasive Plant Management Section's Research and Outreach Program

publishes a newsletter to help resource managers in Florida stay informed about current FWC contracted research and outreach in invasive plant management. The FWC Invasive Plant Management Research and Outreach Program Newsletter is compiled by Don C. Schmitz, Research Program Manager, Invasive Plant Management Section, Florida Fish and Wildlife Conservation Commission in Tallahassee, Florida.

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For a list of issues, visit:
<http://plants.ifas.ufl.edu/node/668>

AQUAPHYTE

AQUAPHYTE is the newsletter of the Center for Aquatic and Invasive Plants (CAIP) and the Aquatic, Wetland and Invasive Plant Information Retrieval System (APIRS) of the University of Florida / Institute of Food and Agricultural Sciences (UF/IFAS). Support for CAIP is provided by the Florida Fish and Wildlife Conservation Commission, Invasive Plant Management Section, and UF/IFAS.

EDITOR: Karen Brown

AQUAPHYTE is sent to managers, researchers and agencies in 71 countries around the world. Comments, announcements, news items and other information relevant to aquatic and invasive plant research are solicited.

Inclusion in AQUAPHYTE does not constitute endorsement, nor does exclusion represent criticism, of any item, organization, individual, or institution by the University of Florida.

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