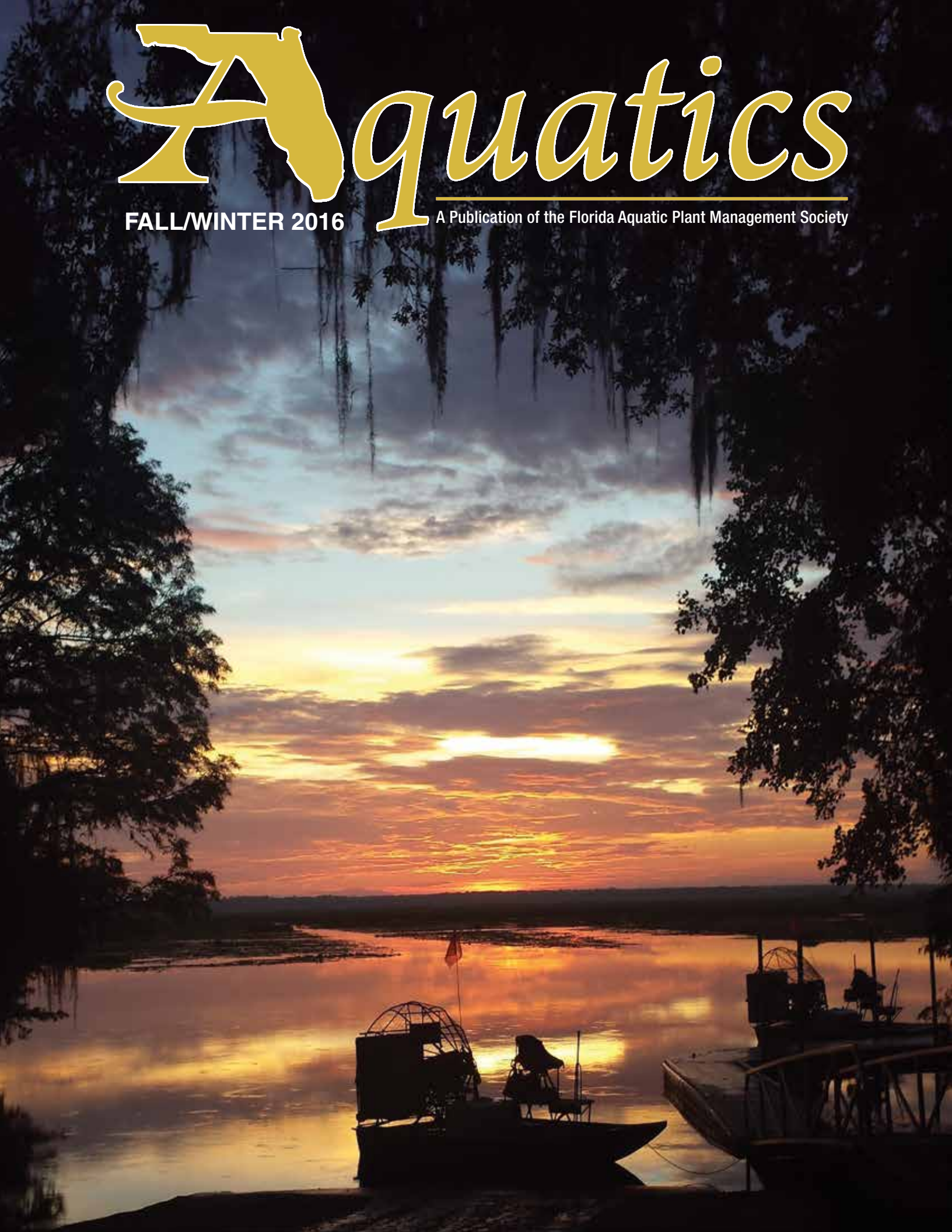


Aquatics

FALL/WINTER 2016

A Publication of the Florida Aquatic Plant Management Society



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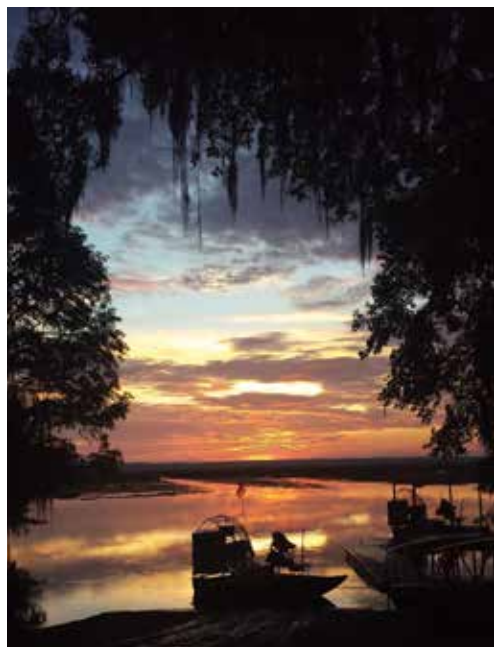
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COVER:

Sunrise at Lake Miccosukee (near Tallahassee) was taken by Jerry Merritt, a 15 year veteran with Applied Aquatic Management, Inc. Jerry has worked as an applicator throughout Florida in uplands, wetlands and aquatics. Jerry is "always enjoying my work and nature within many of the most beautiful places our state has to offer." This photo took 1st place in the Aquatic Scenes category of the Vic Ramey Memorial photo contest. Congratulations, Jerry! See other winning photos on pages 18.

Contents

- 4** Water Quality and Adjuncts
BY TINA BOND
- 6** Old World Climbing Fern: The State of the State
DR. STEPHEN F. ENLOE
- 14** 40th Annual Meeting of the Florida Aquatic Plant Management Society
 - 14 Honorary Lifetime Member Award
 - 15 Applicator of the Year Award
 - 16 Presidential Awards
 - 18 Vic Ramey Memorial Photo Contest Winners
 - 20 40th Annual Meeting Photos
- 22** The Magic Behind Herbicide Resistance in Hydrilla
BY LYN A GETTYS
- 26** Forty Years of "Preserving Florida's Water Heritage"
BY DR. JOE JOYCE, PRESIDENT FAPMS, 1981
- 28** APMS Regional Chapter Updates

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Water Quality and Adjuvants

by Tina Bond

Once upon a time there was a girl who was trying to kill some weeds. There were many types of weeds so she chose glyphosate as the herbicide of choice. She read the label and put the recommended rate of glyphosate and water in her backpack sprayer and went out to spot spray. Just a day later, the weeds were still green and growing. It didn't even look like there was anything sprayed. In fact, 5 days later the weeds were still green!! The girl wondered, "Why didn't this glyphosate work!?" She had made this application many times previously and it worked like a charm, but not this time. We will find out what happened to the girl and her herbicide failure, but first let's talk about water quality and its impact on pesticides!

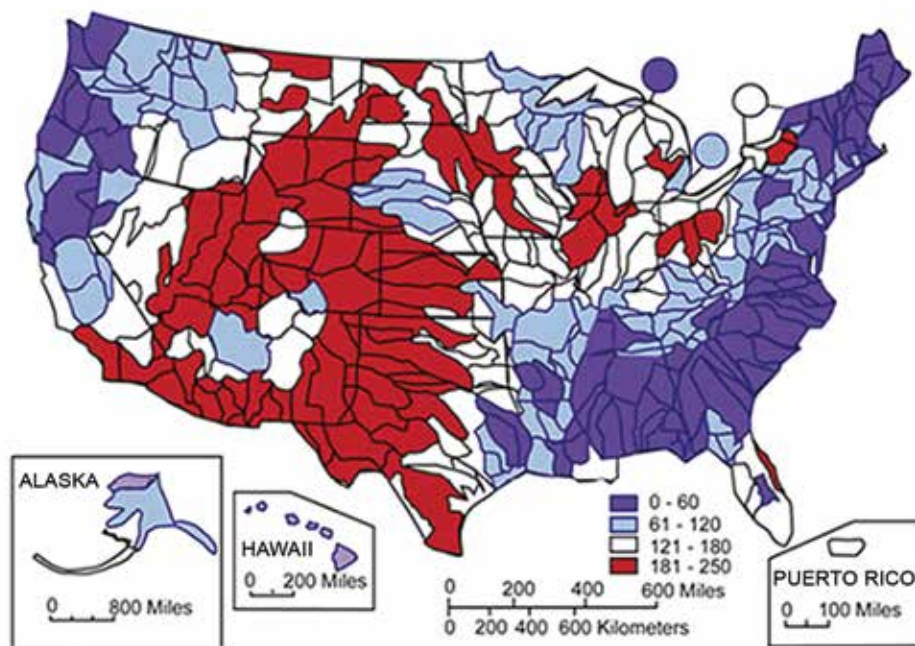
The quality of the water you use to mix pesticides can have a big impact on the efficacy of your application. In some cases, water can make up 95% of the total spray mix! The product is often blamed when an application does not result in the desired effects. The reality is, the quality of the water may be the culprit in a failed application.

Hard water, pH, and carbonates are some of the factors that impact water quality. Let's review the impacts of pH and hard water on pesticides.

pH

Many pesticides perform the best between a pH of 5-6.5. When water pH is above 7, pesticides can degrade in the water and lose their effectiveness. For example, flumioxazin is stable at a pH of 5, but at a pH of 7 it is very unstable and its half life is reduced to 24 hours. At a pH of 9, the half life of flumioxazin drops to 15 minutes! The degree and rate that glyphosate and other weak acid herbicides are absorbed by plant tissue may also be impacted by alkaline pH. Reducing the pH of a spray application mixes may increase its efficacy. Some insecticides and fungicides are also subject to degradation in spray water with pH greater than 7.0. Adjusting the pH of the water in your spray mix can help prevent the degradation of your pesticides. You can improve the pH of your water by adding water conditioners.

CONCENTRATION OF HARDNESS AS CALCIUM CARBONATE, IN MILLIGRAMS PER LITER



USGS. Used with permission. <http://water.usgs.gov/edu/hardness.html>

Hard Water

Hard water refers to the amount of positively charged minerals in the water, particularly calcium, sodium, magnesium and iron. Products like 2,4-D carry a negative charge. When you add 2,4-D to hard water, the negative charge of the 2,4-D reacts with the positive charge of the hard water, reducing the effectiveness of that pesticide. Some products are not affected by hard water. While the active ingredient in Hardball is 2,4-D, it does not carry the negative charge that amine forms do. While esters do not carry a charge, they are no longer used in aquatics. If your water exceeds 150 ppm calcium carbonate, you should consider using products that can help remove carbonates from the water, along with acid technology products that resist hard water charges.

Now that we know a little more about water quality, why do you think the girl's herbicide application failed? At a minimum, she did not test the pH of her water. If she had done this, she would have realized that her pH was way too high for a glyphosate application. Glyphosate works best in low pH. If you know you're going to be applying glyphosate, you should check the pH of your water to determine if the glyphosate will be impacted. If she really wanted to make her pesticide application work more efficiently, she could have sent a sample of her water to be tested. This way she'd know the pH and water hardness more accurately.

Water quality test strips will work in situations where the water source changes from site to site. Water testing done in a lab can be more helpful if water is being pumped from the same source. Because pH and water hardness can fluctuate on a daily basis, it is best to have a water analysis done regularly if the same water source is being used. Fortunately the girl did have a water test strip available to her, and here are the results:

As you can see here, the pH (the top of the strip) was somewhere around 9. The total hardness looked to be in the safe range, though the alkalinity looks to be on the high side for a glyphosate application.

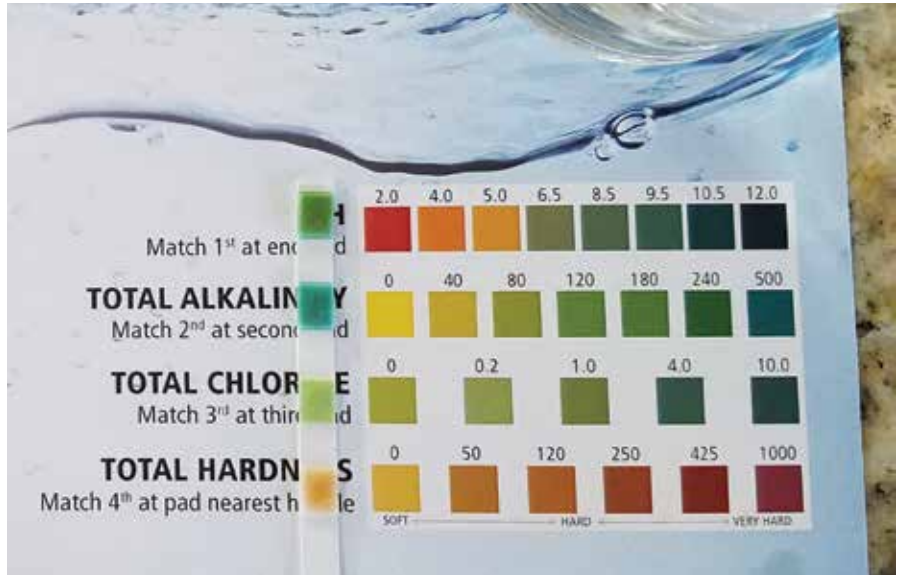
The most important thing you can do to ensure your pesticides are working to their fullest potential is invest in a water

test. Understanding what is in your water can help you make the right decision when choosing pesticides or water conditioners. If your water source changes from site to site, you can always purchase a pH litmus kit or pH meter. These can range in price depending on what you need.

So what did the girl do? She mixed an adjuvant/water conditioner (Hel-Fire) in

the tank first, followed by the glyphosate, and everyone lived happily ever after... except for the weeds! (And if you're not sure, yes, I was THAT girl!!)

Dr. Tina Bond (bondt@helenachemical.com) is a Product Specialist for Helena Products Group. She focuses on all specialty markets throughout the United States.



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Old World Climbing Fern: The State of the State



By Stephen F. Enloe

Old World climbing fern (*Lygodium microphyllum*) is an invasive fern that is native to the wet tropical and subtropical areas of Australia, Asia, and Africa. It was first detected in Martin County, Florida in 1965. However, expansion in Florida was slow until the 1990s, when it literally exploded across the southern part of the State. Many natural area and aquatic managers quickly realized that this invasive species was a true ecosystem transformer, smothering out native plant species under dense rachis mats and altering fire frequency and severity, even in fire tolerant communities. Its aggressive spread by wind dispersed spores and creeping rhizomes in both disturbed and undisturbed habitats has made it one of the greatest invasive plant threats to south Florida. Infesting a broad range of habitats, Old World climbing fern (OWCF), or lygodium, can be found in cypress, bayhead, and maple swamps, sawgrass marsh, wet prairies, tree



All photos by Jeff Hutchinson.

islands, mangrove communities, and many disturbed, wet areas.

In 1999, several state agencies, universities, and private conservation groups came together through the Florida Exotic Pest Plant Council (FLEPPC) to address the lygodium problem and formed the Lygodium Task Force. The first Lygodium Management Plan for Florida was subsequently produced in 2001. In 2006, the Lygodium Task Force released the second version of the Lygodium Management Plan for Florida, which documented the known biology, ecology, spread, available management tools, and land manager experiences

in dealing with this invasive plant. Since 2006, lygodium management efforts have continued throughout south, central, and more recently, north Florida, as lygodium has continued to spread. However, there have been no updates since the 2006 document was released.

In 2015, a small contingent of lygodium managers convened at the FLEPPC Annual Conference to discuss the future of the task force and lygodium management issues. This project was subsequently conceived as an effort to determine exactly where Florida stands in relation to the problem and how we should proceed in the near

future. Additionally, it was hoped the project would reinvigorate interest in stronger statewide collaborative lygodium management through rejuvenation of the Florida Lygodium Task Force. The overall goal of this project was to determine “the state of the State” of Old World climbing fern in Florida. We sought to understand what has transpired over the last decade and how land managers are dealing with this difficult problem. To accomplish this, we surveyed several land managers, state agencies, and University personnel to find out what was currently being done, what tools were being used, where land managers were struggling, and what the research directions should be for the immediate future. Determining quantitative estimates of acres infested, rates of spread, or acres treated were beyond the scope of this project and are not included here.

Thirty-six individuals, consisting of federal, state, and county agency, university, and private contractors were contacted and interviewed. Interviews were conducted by phone or in person, and ranged in length from 30 to 75 minutes (mean interview time = ~45 minutes). Fifteen primary questions were discussed with each individual, with some additional follow-up questions for clarification, or when individual responses opened up a side bar of interest. During the interview process, questions were carefully worded to prevent influencing respondents’ answers. Not all respondents were able to answer all questions, as their role in lygodium management varied. Respondent answers were recorded as accurately as possible and approximately 90 pages of text were transcribed. Interview data were then qualitatively coded and summarized by question across respondents’ answers to highlight common themes, disagreements and outlier responses. Common themes were built on the discussion that followed each question with each participant. So, what was learned from this exercise?

Florida has a solid core of land managers who have been working aggressively on lygodium for more than a decade. Respondents had over 402 years of cumulative experience working with OWCF, with a mean of 11 years per respondent, and a range of 3 to 30 years.

Almost 50% of the total respondents had 11 to 15 years of experience, which correlates well to when many state efforts against lygodium began ramping up.

Adaptive management of OWCF is the rule but limitations abound.

The overall strategies employed by most respondents followed a typical adaptive management formula for invasive plant management including survey/detection, prioritization, treatment, monitoring, reassessment, and follow-up. Numerous efforts have been ongoing over the last decade with a strong emphasis on both protecting uninfested areas by treating new infestations and bringing dense infestations down to more manageable levels.

Opportunism is the rule for detection, mapping, and post-treatment monitoring.

There is not currently a statewide survey plan in place and numerous independent entities are involved in piecemeal survey and detection efforts. These are largely done under tremendous personnel and budgetary constraints. Digital aerial sketch mapping has resulted in the most comprehensive geographically-broad survey across a large swath of south Florida. Additional aerial surveys are highly desirable to many land managers but have

not been systematically implemented. Several respondents reported opportunistic aerial mapping when they could hitch a ride on other planned flights (manatee surveys, etc.) Remote sensing tools have been studied but no comprehensive efforts have been undertaken. Most land managers collect a wide range of OWCF ground-based survey data on an opportunistic basis (i.e., when they can and where they can). However, on many state contracts, contractors do not have clear beforehand knowledge of infestations at the time of the bid process. Spray crews systematically work thru these properties, treating as they go, but not necessarily collecting survey data.

Treatment techniques have not changed over the last decade.

Hand-pulling is used on a very limited basis, where new infestations are detected. In these cases, an attempt is made to remove the entire rhizome, which is still small for new plants. Mowing, clipping, or other types of cutting are only used to create access trails into densely infested areas. These are not effective as stand-alone tools.

Fire is of great interest to many land managers and is still somewhat debated regarding its utility for OWCF management. Fire is routinely used as a landscape management tool and will continue to be



Aerial herbicide application to OWCF

utilized for many purposes beyond OWCF management. Many reports have provided mixed observations on the response of OWCF to fire. However, these have not provided any real clarification on impacts between individual plant responses and population level responses. It is very clear that OWCF is a fire-adapted plant and its use in OWCF management needs to be clarified for both spore management as a stand-alone tool and when used in an integrated manner with herbicide treatment and biological control.

Regarding herbicides, three herbicide treatment techniques are used. The first is aerial foliar treatment, used primarily for large, dense patches and where access is limited. The second is ground-based foliar treatment with backpack or handgun sprayers. This includes treating all matted lygodium on the ground and all lygodium climbing over other understory plants. The third is the integrated mechanical/chemical treatment of cutting vines at 4-5 feet above ground (i.e., a "poodle cut"), pulling them off the trees if needed, and treating all foliage below the cut. There has really been no major breakthrough beyond these treatment techniques over the last ten years.

The concept of optimal treatment timing to maximize control of OWCF would be ideal, but it is generally unrealistic. Treatments are often done in every month of the year. Treatment prior to peak spore production is desirable and implemented as often as possible. Outlier infestations are frequently treated when found, to prevent any further growth and spread. There are also limitations to treatment timing. Some contractors try to avoid spraying in winter (January), especially during cold weather, when OWCF treatments seem to be less effective. Hydroperiod also strongly influences treatment timings in many situations. Access to remote sites is severely limited when water is too low, and treatment is often impossible when water is too high. For example, seasonally high water in the summer prevents spray coverage of rachis mats that are temporarily inundated. These quickly begin growing as water recedes.

Re-treat when you can and where you can. Follow-up monitoring and retreatment

schedules vary widely and are affected by many issues. Time is the biggest issue for follow-up monitoring. Most respondents reported that they did not have enough time or personnel to do thorough post-treatment monitoring. Many reported doing spot checks, to get a feel for overall treatment effectiveness. Short-term monitoring occurs on contracted projects, to ensure contract requirements are met. These generally occur within a few months of treatment. However, contractors are often disconnected from monitoring efforts and do not go back to sites unless they receive a contract for subsequent year follow-up treatments. Some respondents reported that they attempted to do follow-up monitoring at six and twelve months after treatment. Others attempted annual follow-up monitoring of treated sites. Again, time and access often limited comprehensive monitoring.

Glyphosate is still the key treatment for lygodium. Overall, glyphosate is the most widely used herbicide. One hundred percent of respondents indicated that glyphosate was the primary herbicide used for OWCF control. Glyphosate concentration ranged from 1-5% (Figure 1). Forty-seven percent of respondents used a 3% concentration, while 37% provided a range of 2-3%. Higher concentrations above 3% (up to 5%) were primarily used for very small or sparse infestations, under the premise that it was best to increase the rate to get

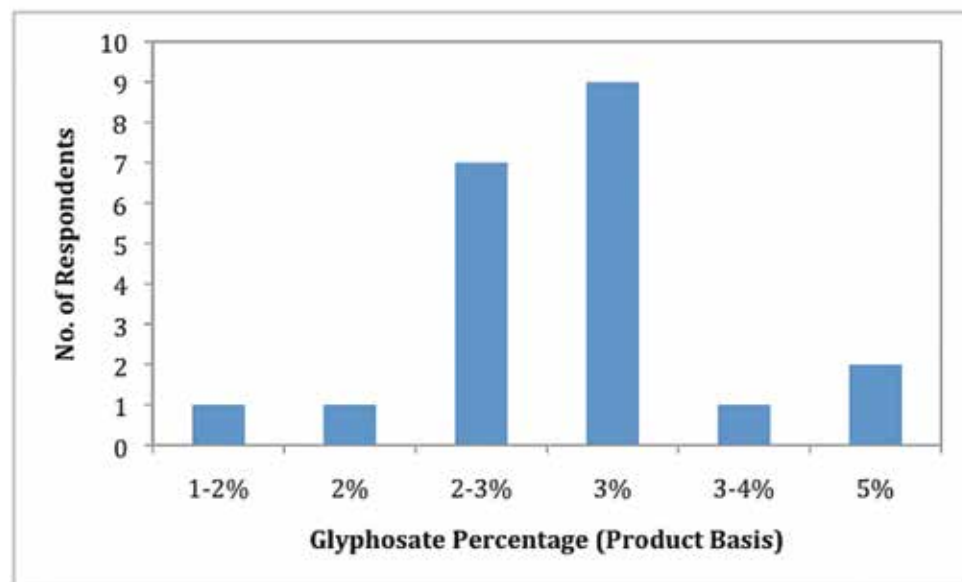
complete kill in these situations. Lower rates (less than 2-3%) were rarely used.

Metsulfuron was primarily used for aerial treatment, in accordance with the 24C label directions. This includes 0.5 to 2 oz/A for broadcast applications. However, some metsulfuron use was also reported for backpack treatments in accordance with the 24C label at a use of 0.5 to 2 oz/100 gallons for spot applications made on a spray-to-wet basis. In these cases, metsulfuron is primarily used when requested by site managers, either in a rotational fashion with glyphosate or in a tank mix with glyphosate. The key issue here is resistance management, which will be discussed later in this article. For backpack use, metsulfuron is primarily limited by the 24C label language that specifies 0.5 to 2 oz/100 gallons of diluent. Applicators have observed reduced control at this concentration and believe this is too low for effective control, when the total application volume by backpack is only 25-40 gallons per acre.

Triclopyr has not been widely used for OWCF control. Only eight percent of respondents indicated using triclopyr and concentrations ranged from 1-3%. Triclopyr was discussed as an effective option. However, non-target damage to trees and shrubs is the primary issue.

Adjuvants are critical for OWCF treatment success and many different products are useful. Respondents

Figure 1. Glyphosate concentration used for OWCF foliar treatment.



indicated that several adjuvants are used including wetters, spreaders, stickers, and water conditioners. These include non-ionic surfactants, non-ionic silicone blends, methylated seed oils, and ammonium sulfate. Hard water conditions have resulted in apparent reduced glyphosate efficacy. However, discussion of the hard water issue and ammonium sulfate (AMS) use was limited to only a few applicators. In general, applicators frequently develop a relationship with specific adjuvant suppliers, or use the cheapest adjuvants they can find that suit their needs.

Herbicide resistance has not become an issue for OWCF anywhere in the state. No respondents have ever observed complete herbicide treatment failure with either glyphosate or metsulfuron. Many respondents indicated that incomplete control was commonly observed during follow-up monitoring. However, it was attributed to incomplete coverage due to



Aerial view of Everglades tree island covered with Old World climbing fern.



Lygodium microphyllum Old World climbing fern

thick rachis mats, difficulty in accessing areas to treat, or applicator error in missed swaths or missed patches. Follow-up treatment of these types of missed areas has always resulted in control. This would suggest that herbicide resistance is not a problem anywhere in the state for OWCF. A lack of evolving herbicide resistance to glyphosate and metsulfuron does beg the question, “Why not?” Both herbicides have resulted in resistance development in agriculture and non-crop settings. Possible explanations for this include: 1) a lack of selection pressure (we are simply not treating at a high enough frequency); 2) high propagule (spore) numbers both from the spore bank and from new spores moving into treated areas from untreated stands. These could essentially wash out any buildup of resistance in a treated area; 3) a severe fitness cost due to resistance.

Non-target impact following herbicide treatment is a complex, yet surprisingly simple, issue. The complexity lies in the sheer number of ecological communities and species within those communities that could be of concern for non-target damage from herbicide treatment. This is something that managers are well aware of, but it becomes less critical with site specific realities. The foundational issue is the stark reality of a “do-nothing” approach for lygodium management. Where lygodium is allowed to grow unchecked, it tends to smother out most or all other herbaceous ground cover species. Where it canopies over trees and shrubs, the smothering effect, combined with the fire ladder effect, also results in the loss of mid- and overstory species. These characteristics strongly indicate its potential role as an “ecosystem transformer” by altering species richness and diversity, and altering habitat structure. Following these basic alterations are likely a host of cascading effects on other ecosystems services and trophic relationships. However, these have not been well studied, especially across different community types. Regardless, respondents were clear on the basic premise that there was nothing left underneath dense OWCF mats to worry about killing because it was already gone. The direct impact of dense lygodium infestations far exceeded any concerns of non-target impact from herbicides. With this

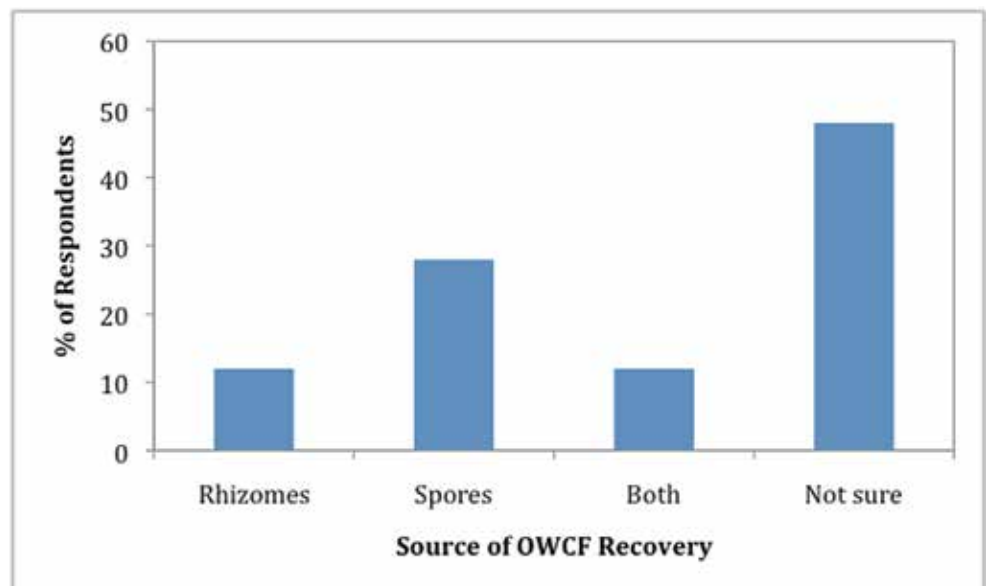
in mind, specific herbicides and application techniques require the following discussion.

Non-target damage was reported to not be a significant issue by many respondents. Clarification on this generally pointed to the techniques being used. Non-target damage was rarely seen with poodle cutting followed by glyphosate treatment. For sparse infestations, non-target damage was minimized where possible by pulling vines off of other vegetation before treatment or by covering native species before treatment. However, this was not always possible and some collateral damage was expected in those situations, especially with glyphosate. For aerial treatment, metsulfuron was observed to be much less injurious to many trees compared to glyphosate or triclopyr. However, metsulfuron was observed to injure or kill many native ferns, palms, and maples, including royal fern, sable palm, cabbage palm and swamp maple. Overall, the general consensus among applicators was that for broadcast applications, metsulfuron resulted in the least amount of non-target damage. Furthermore, it could be safely applied to sawgrass and bromeliads where glyphosate could not be applied without severe damage. Glyphosate could be utilized over deciduous woody species (cypress) in the dormant season with minimal negative impacts. It is also noteworthy that respondents provided very few species negatively impacted by herbicide treatment. Reasons for this were

not explored, but may be an indication of a general lack of time spent examining non-target injury.

Everyone knows OWCF can recover following treatment, but few are paying attention to how. When asked about OWCF recovery, the clear result was that 48% of respondents were not sure exactly where new plants were originating (spores versus rhizomes) on sites they managed (Figure 2). The key explanations provided for this uncertainty included two main issues. The first is a lack of time and personnel to do any thorough post-treatment monitoring. Most respondents reported that they are dealing with extremely large areas and cannot spend time examining this issue. There is also a strong disconnect between contractors and monitoring efforts. Monitoring is usually done by site managers or other state personnel after the contractors work through a site. Only a few contractors interviewed reported that they used their own QC personnel to assess treatment efficacy. However, they were generally only looking for spray skips and missed treatment areas and were not looking at the source of recovery. There is some institutional knowledge among contractor spray crews where a given crew ends up treating a site over several years. However, this knowledge is difficult to access and may only be remembered when spray crews revisit sites.

Figure 2. Respondent views on Post-treatment OWCF Recovery (n=25).

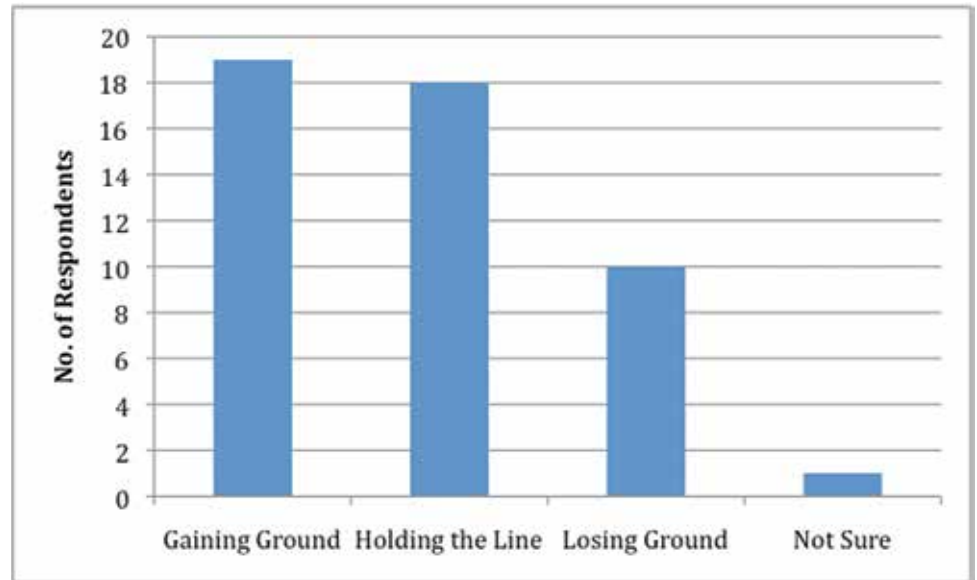


Many land managers believe they are gaining ground or holding the line against lygodium.

Sixty percent of respondents felt they were holding the line, but also noted that this concept is difficult to judge due to long distance spore dispersal. Respondents who were able to do follow-up treatments (63%) generally felt they were gaining ground (Figure 3). No respondent stated or implied eradication, but instead stated they were able to bring severe infestations under maintenance control. One contractor noted that for most recent lygodium contracts, infestations were much less severe than those of ten years ago. Respondents involved with the Central Florida Lygodium Strategy (CFLS) felt they were holding the line by a thread, but also felt strongly that the monitoring was worth the continued investment. Anthropogenic long distance dispersal beyond the CFLS sentinel sites (northward spread) was a great concern. Money was frequently mentioned as the key factor in their assessment. Where money was limited for retreatment, respondents almost always felt they were losing ground (33%). Private lands were widely viewed as losing ground, as were public lands with very limited exotic plant management resources. Areas characterized by limited access due to geographic remoteness or seasonal hydroperiod were also perceived to be losing ground.

Land managers are desperate for more and better management tools. When questioned on what additional tools were needed to manage OWCF, herbicide related tools were the top priority, followed by detection and monitoring tools, effective biocontrols, and IPM strategies involving biocontrol, fire, and herbicides. The diversity of responses to this question is indicative of several important things. First, it is clear that respondents are indeed thinking about the lygodium issue extensively. Land managers want to win this battle and they clearly need more tools to do so. The second is the diversity in tools suggested. Land managers want more tools in the toolbox. The third is the clear need for an accelerated program of herbicide research, as the toolbox is strikingly limited. The fourth is a greater emphasis on biological control and its integration with herbicides and fire.

Figure 3. Respondents' perceptions on progress against OWCF (n=30).



The current biocontrols are promising, but not quite there yet. The brown lygodium moth (*Neomusotima conspurcatalis*) and the lygodium gall mite (*Floracarus perrepae*) have been released extensively in the state. When questioned about perceptions of biocontrol efficacy, most respondents reported limited effectiveness. When asked to describe the extent of visual damage observed, moth damage was commonly reported as minor, spotty, and sporadic brown patches but no large landscape scale damage was reported. The strongest impact was reported from Johnathan Dickinson State Park where considerable brownout of localized patches was observed. Respondents generally had less experience with the gall mite. Several respondents reported observing some mite spread and damage, even when no mites had been released on site. Optimal impacts of mites were reported to be observed on new growth following fire. In one situation, lygodium height was reportedly reduced by sixty to seventy percent. However, in general, mite damage was generally reported as extremely limited. Biological control is a complex prospect with many factors making success very difficult. However, respondents were very supportive of continuing aggressive efforts to increase biological control of OWCF.

Private lands are the elephant in the room. The private land issue is of immense concern to many respondents and no one

has a clear solution for this issue. Among public land managers, interactions with private landowners are often very limited or non-existent. Many public lands in south Florida border other public lands on most sides. Public lands adjacent to large private lands provide opportunity for some interaction with landowners, while public lands bordering large scale urban development result in very limited interaction. Absentee land ownership is also a significant issue as is private land planned for future development. In this case there is no incentive to treat lygodium until mitigation opportunities arise. Respondents who do interact with private landowners indicated that many of them are well aware of lygodium problems on their properties. However, they generally cannot afford to treat natural areas. Many of these are ranchers who do not manage invasive plants in natural areas where they do not impact forage production. The most responsive private lands situations are generally where high value hunting leases generate an economic return that allows for lygodium treatment.

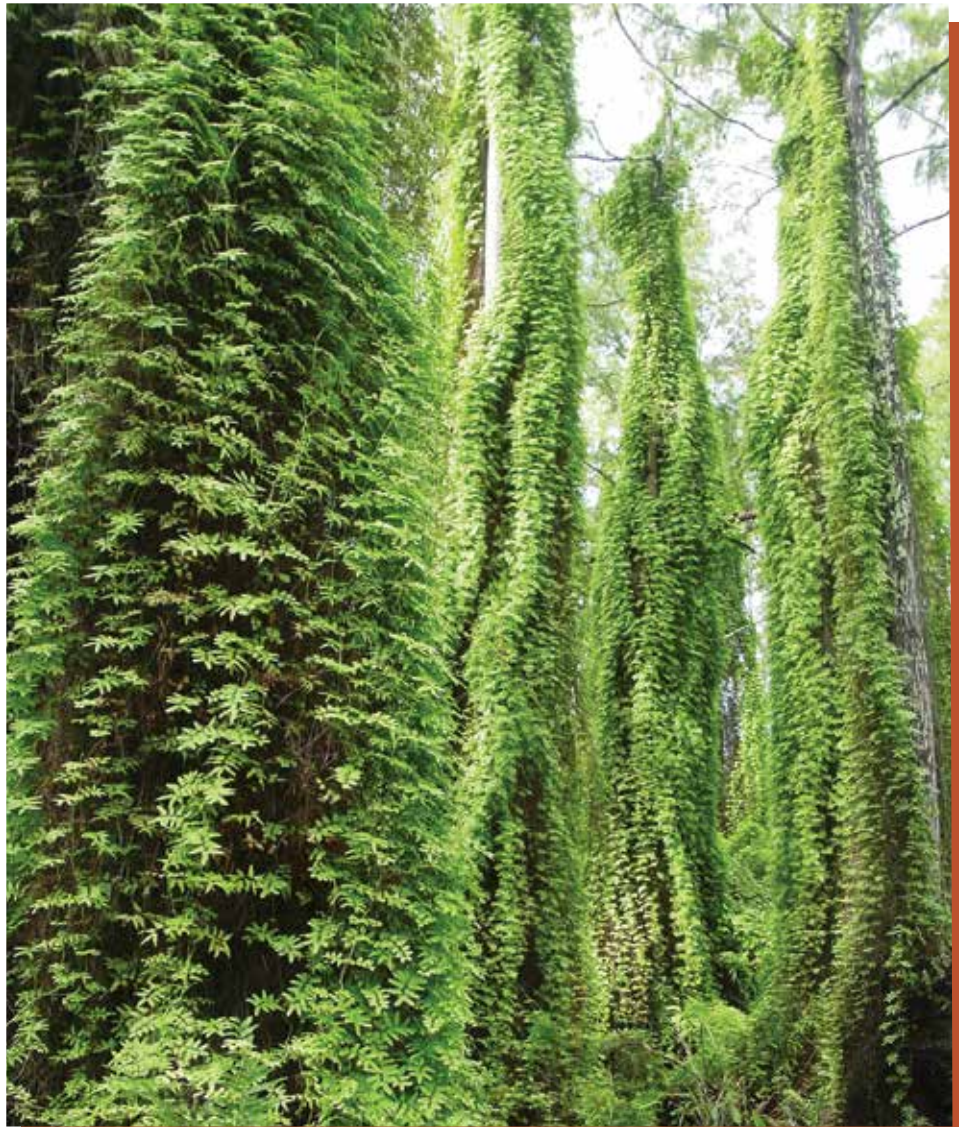
NRCS programs offer private landowners significant cost sharing opportunities for invasive plant treatment, including lygodium. This has resulted in treatment on many properties for landowners who are willing to enroll in the program. The long term outcomes on these programs are uncertain. The Central Florida Lygodium

Strategy has likely had the most success in interacting with private landowners on the lygodium issue. Since 2005, they have surveyed almost twenty thousand acres and treated over 1,300 acres of private land. They report that very few private landowners have declined to participate in the effort. As a “hold the line” strategy for containment of lygodium and protection of conservation lands, the CFLS annually reassesses the effort to decide if it is worth continuing. To date, there has been tremendous positive response to continue the effort. However, times are changing and the CFLS may soon be changing as well.

Conclusions. Make no mistake about it. Old World climbing fern is a serious problem and it is getting worse in many areas. However, there has been considerable progress on many public lands in Florida. Land managers are being as aggressive as possible at many sites and the current tools are still working. Adaptive management is applied within the context of “when, where, and how” you can get the job done. However, over the last decade, lygodium management has essentially reached a plateau and it is time to elevate it to the next level. Breakthrough research is needed on integrating the biology and ecology of OWCF with current and novel management tools. The Lygodium Task Force is ready to be reinvigorated. Continued partnerships and collaborations among public and private entities must continue. Florida has directed considerable resources to the lygodium program. Let’s keep this effort moving forward!

Acknowledgements. We would like to thank LeRoy Rodgers and the South Florida Water Management District for funding this project. We would also like to thank all survey participants for making the time to share such a wealth of knowledge and experience.

Dr. Stephen F. Enloe (sfenloe@ufl.edu) is an Associate Professor of Agronomy at the University of Florida’s IFAS Center for Aquatic and Invasive Plants in Gainesville.



“Poodle-cutting” OWCF

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40th Annual Meeting of the Florida Aquatic Plant Management Society

In spite of Hurricane Matthew forcing a change of venue in the ninth hour, the 40th Annual FAPMS Training Conference went on without a hitch. Bill Torres, our superhero event planner (motto: *neither rain, nor sleet, nor Hurricane Matthew...*) turned in a flawless performance, setting up shuttles to other hotels, providing quick on-site lunches, solving registration headaches. We even had perfect weather (although I don't think that can be attributed to Bill). It was sobering to drive through Daytona Beach and see debris piles the size of houses, blue roof tarps, broken store signs and bent street signposts. However, the sun was out, 308 people attended; 28 sponsors with 18 personnel were on hand, and everyone went home with their new knowledge, memories, prizes and CEUs.

Dr. Joseph Joyce gave the keynote pre-

sentation, "*FAPMS and 40 years of aquatic weed control in Florida*." As requested, Joe turned his presentation into an article for this issue (see page 26). He gave a heartfelt special thanks to Dr. Bill Haller during his presentation. Joe was presented with an **Honorary Lifetime Member** award from



Bill Haller

President Angie Huebner. **President's Awards** were presented to Dan Thayer, Kat Ethridge, Bill Torres, and Lyn Gettys (see next page).

Angie Huebner received an award in recognition of her outstanding leadership, service, and contribution to the FAPMS during her term as President. Andy Fuhrman has now stepped up as President for 2017. Other officer changes include Dr. Lyn Gettys stepping down as *Aquatics* editor, with Karen Brown resuming the role for the next year. Outgoing board members Bryan Finder (Polk County Parks and Natural Resources), Keith Mangus (Applied Aquatic Management), and Mike Hulon (Texas Aquatic Harvesting) were recognized for their service. New board members are Jeff Holland (Reedy Creek Improvement District), Randal Snyder (St.

Honorary Lifetime Member Award presented to Dr. Joseph C. Joyce

Dr. Joseph C. Joyce, a native of Jacksonville, Florida, obtained his B.S. and M.S. degrees from the University of Alabama, and later obtained his Ph.D. from the University of Florida. He is a Charter Member of FAPMS and served as President in 1981. He is also a member of the Aquatic Plant Management Society and served as President in 1991. He was a founding member of the FAPMS Research and Education Foundation and served as the Secretary/Treasurer from 1985 to 2014.

Joe's first professional experience began in 1972 with the U.S. Army Corps of Engineers. The highlight of his career with the Corps was serving as Chief of the Natural Resources Section. In this role, he led a successful effort to more effectively manage the invasive water hyacinth in waters of the State of Florida.

In 1983, Dr. Joyce joined the University of Florida/IFAS faculty as the Director of the Center for Aquatic and Invasive Plants. He has also served UF/IFAS as the Director of the Center for Natural Resources, as Interim Dean for Research, and Interim Vice President of Agriculture and Natural Resources. He served as the Senior Associate Vice President for 20 plus years and served as Director of the UF/IFAS Center for Leadership until his retirement in 2015.

Dr. Joyce also served in the Army Reserves for over 28 years and retired at the rank of Brigadier General.

He currently serves as the Executive Director of the University of Florida Leadership and Education Foundation, was appointed by both Governors Crist and Scott to the Environmental Regulation Commission, and is the Vice Chair of the Board of Farm Credit of Florida.

Dr. Joyce has over 40 refereed and non-refereed publications and helped produce many of the aquatic plant management videos created at the UF/IFAS Center for Aquatic and Invasive Plants.

In 2016, Dr. Joyce was inducted into the Florida Agricultural Hall of Fame for his contributions to Florida agriculture.

Dr. Joyce and his wife, Pam, reside in Gainesville. They have two sons and five grandsons.



Dr. Joseph C. Joyce

Applicator of the Year Award Presented to Alex Holmes, Applied Aquatic Management

Alex has worked for Applied Aquatic Management for 12 years. Following are highlights from his nomination for the **FAPMS Applicator of the Year** award:

- Alex has undertaken and improved the application of granular herbicides, as well as foliar and submersed herbicides.
- He understands herbicide activity and application methods and has created a high level of success in all programs.
- He has complete authority over the use of triploid grass carp as a private sector manager.
- He is responsible for the removal of navigational obstructions on the Wekiva River and has designed and constructed specialized equipment for the task.
- He is responsible for making herbicide applications for FWC and UF research projects because he is known for his consistency and attentiveness.
- Supervisors and peers view Alex as the “go to” person if there are issues with pumps, engines or equipment.
- He makes sure “everything is right.”
- He has a sharp eye for new challenges



Alex Holmes with President Angie Huebner

and has been consistently promoted due to his capabilities.

Congratulations, Alex!!

Johns River Water Management District), and Robbie Lovestrand (Florida Fish and Wildlife Conservation Commission). Welcome aboard!

Best Applicator Paper was won by Matthew Cole (St. Johns River Water Management District) for his presentation, “*Maximum Penetration or Not?*” which compared the efficacy of three current surfactants on herbicide uptake.

The very special **Applicator of the Year** award went to Alex Holmes of Applied Aquatic Management, Inc.

A good turnout for the **Vic Ramey Memorial Photo Contest** saw Jerry Merrit (Applied Aquatic Management) win 1st place in Aquatic Scenes (see cover photo); John Chapman (Southwest Florida Water Management District) 2nd place, and Steve Nutter (South Florida Water Management District) 3rd place. In the Aquatic Operations category, Steve Nutter took 1st place, Joyce Hertel (Fellsmere Water Control District) took 2nd, and Leonard Malecki (Orange County Stormwater) took 3rd. Congratulations, all!



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Presidential Awards

Outgoing President Angie Huebner presented the President's Award to the following outstanding individuals.



Daniel Thayer – FAPMS Board Member (1989-1990), Aquatics Editor (1985-1990), President (1991)

In recognition of your outstanding leadership and service to the Florida Aquatic Plant Management Society while serving as Editor for the Society. Your efforts have significantly contributed to the success of the Society. In addition, you are recognized for your technical expertise and dedication for further advancing the profession of aquatic plant management.



Kat Ethridge – FAPMS Registration Assistant volunteer for over 10 years

In recognition of exemplary service to the Florida Aquatic Plant Management Society in executing the annual training conferences. Your efforts significantly contribute to ensuring the success of annual training conferences year after year. You are

commended for your dedicated and selfless service to the Society.



Bill Torres – Local Arrangements Chair for more than 10 years (neither rain, nor sleet, nor Hurricane Matthew...)

In recognition of superior service to the Florida Aquatic Plant Management Society in executing the annual training conferences. Your efforts, willingness to exceed expectations and "can do" attitude ensure the success of annual training conferences year after year. You are commended for your impeccable service to the Society.



Dr. Lyn Gettys – Aquatics Editor (Spring 2014 – Summer 2016), Annual Conference Program assistance for many years (Thanks, Lyn, for providing printed programs and Books of Abstracts!)

In recognition of exemplary service, outstanding leadership and support to the Florida Aquatic Plant Management Society while serving as Editor for the Society. Your efforts have significantly contributed to the success of the Society. In addition, you are recognized for your technical expertise and dedication for further advancing the profession of aquatic plant management.

Annual Duck Race prizes in the Tech Duck category went to Dan Dorosheff (FWC) (1st place), Paul Sands (2nd place), and Joseph Liberatore (Allstate Resource Management) (3rd place). In an amazing feat of defying the odds, Dan Dorosheff *also won* 1st prize in the Outdoor Duck category. Joyce Hertel took 2nd place, and Mike Vaughn (Florida Department of Transportation) took 3rd.



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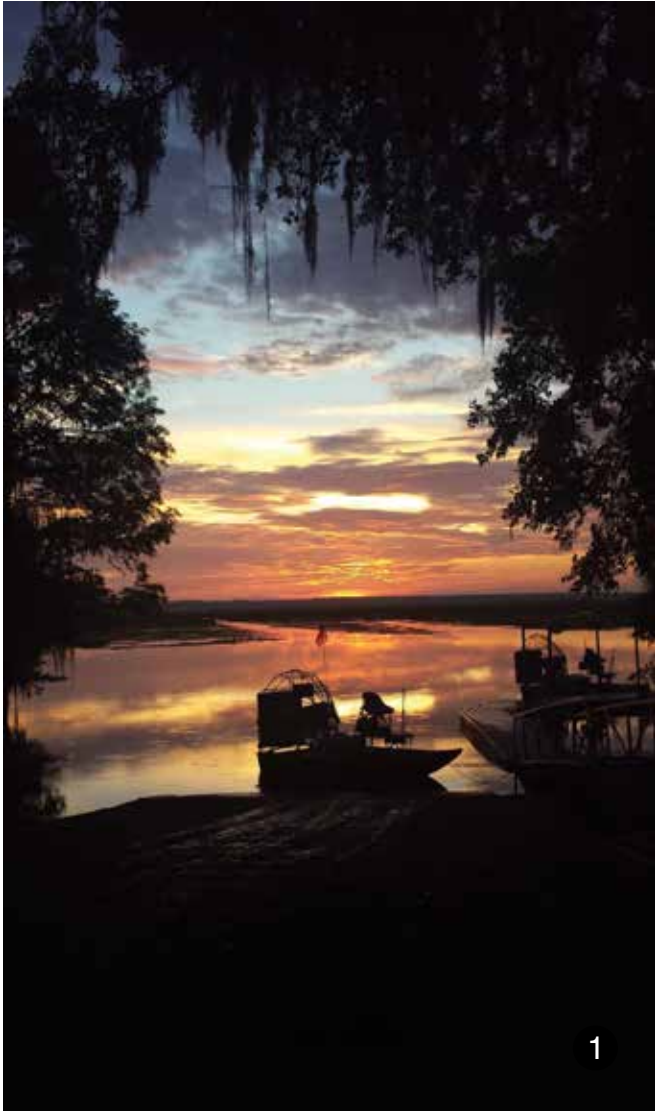
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Vic Ramey Memorial Photo Contest Winners



AQUATIC SCENES

1st place. "Sunrise at Lake Miccosukee" – Jerry Merritt (Applied Aquatic Management).

2nd place. "Manatee" – John Chapman (Southwest Florida Water Management District) taken on the Weeki Wachee River in Hernando County.

3rd place. "Alligator tarpon fishing" – Steve Nutter (South Florida Water Management District).





AQUATIC OPERATIONS

1st place. “Mario in the Thick” – Steve Nutter (South Florida Water Management District).

2nd place. “Aquatic spraying” – Joyce Hertel (Fellsmere Water Control District).

3rd place. “Blue Bomber” – Leonard Malecki (Orange County Stormwater) taken on Shadow Bay Springs Retention Pond, Orange County.



40th Annual Meeting of the FAPMS in Photos



FAPMS past presidents



Prize Wnner Craig Johnson –
Polk County



Teresia Cluts, always helping



Let the duck races begin



Lyn Gettys having fun



Equipment demonstration



Equipment demonstration



Full house



Keith Mangus – have camera, will shoot



FAPMS Scholarship Committee



Jerry Renney



Meeting set to begin

The magic behind herbicide resistance in hydrilla

by Lyn A Gettys

The weed

Hydrilla (*Hydrilla verticillata*) was first introduced to Florida in the 1950s as a potential aquarium plant. Aquarium dealers had little interest in this new species because they already had a perfectly good oxygenator – *Egeria densa*, known in the trade as anacharis – and weren't interested in diversifying their offerings. For more details about the sordid tale of hydrilla's release and subsequent escape into our waters, check out "The Historical Introductions of Waterhyacinth and Hydrilla into the United States" by Don Schmitz in the Spring 2016 issue of *Aquatics* magazine.

The tool

Hydrilla quickly invaded Florida's waters and became our most intensively managed submersed weed, but the labeling of the aquatic herbicide, fluridone, in 1985 brought a new tool to the aquatic plant management toolbox. Fluridone targets phytoene desaturase (*pds*), an enzyme that is needed to make the pigments used by plants during photosynthesis. Fluridone had many positive attributes: in a nutshell, very low concentrations of fluridone (typically less than 10 ppb) could be expected to provide excellent, multi-season control of hydrilla with little damage to off-target plants. This soon made fluridone the "go-to" treatment for hydrilla management; it was cost-effective, lasted a long time and didn't wipe out the natives – what's not to like?

The problem

All was well until the late 1990s, when reports of poor fluridone performance began to trickle in. At first, these failures were chalked up to "operator error" (c'mon, be honest, haven't you ever sprayed water because you forgot to put the herbicide in the tank?). However, it soon became

apparent that something else was going on. Extensive research revealed that some populations of hydrilla were resistant to fluridone. Before going on, let's break out some terminology related to how plants respond to herbicides.

Resistance terminology

There are a number of strategies that a plant can use to prevent a herbicide from working.

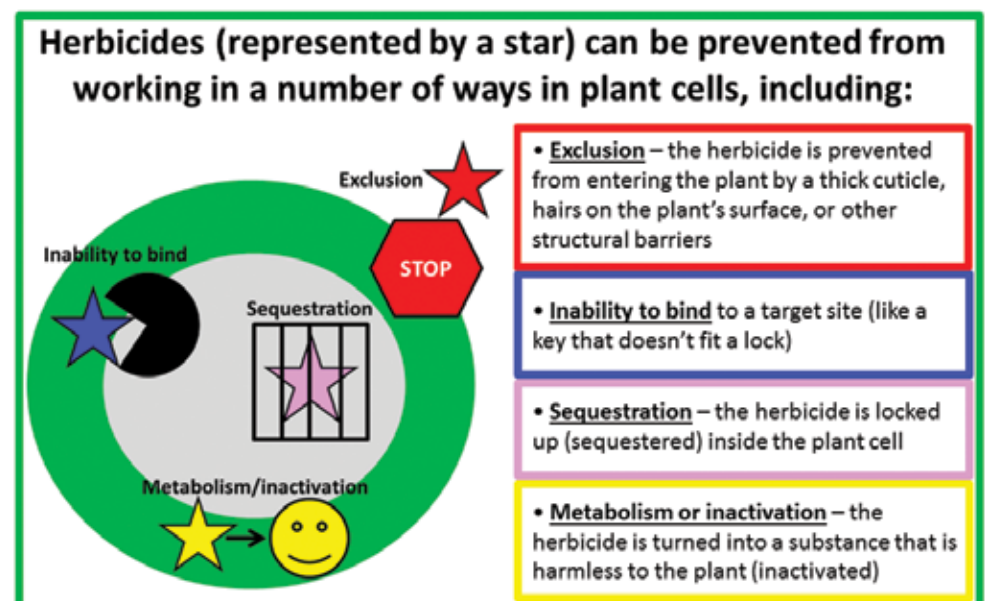
When a plant naturally has one or more of these strategies to prevent a particular herbicide (let's call the herbicide "Blammo") from working, it is considered **tolerant** of Blammo. This means Blammo has never caused the plant significant damage or provided any appreciable level of control. For example, 2,4-D doesn't damage grasses – it only works on broad-leaved species with a few exceptions such as waterhyacinth. A plant that lacks these defenses – and is well-controlled by Blammo – is considered **susceptible**. So what happens when a plant that has historically been susceptible to Blammo suddenly isn't affected by it? That, my friends, is **Blammo resistance**! If you replace "a plant" with

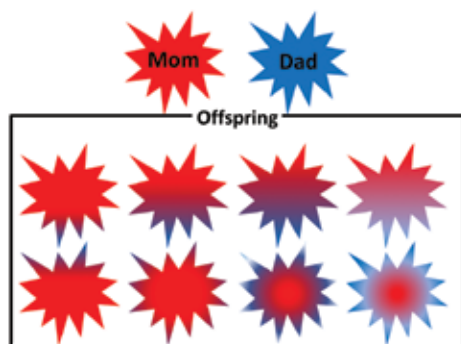


"hydrilla" and "Blammo" with "fluridone", you've described what happened in Florida in the late 1990s. Just how the heck does that happen? Through the magic of genetics, of course!

Genetic variation

All living things – plants and animals alike – use **genetic variation** to add "spice to life". Variation is important for a number of reasons, but for the purposes of our discussion, we'll focus on the fact that it gives a population the ability to adapt to changes in the environment. Genetic variation can occur from recombination or from mutation. **Recombination** happens when two organisms mate and produce offspring by sexual reproduction; these offspring get half of their genetic material from mom, and half from dad. I know what you're thinking – plants don't have sex! *Au contraire*, faithful reader, they do indeed... at least





most plant species do. Pollen (produced by dad) is used to fertilize eggs (produced by mom); these fertilized eggs become seeds, which germinate into seedlings. The genetic composition of each seedling is a mix of the genetic material from both parents, and the exact mix tends to differ among the offspring. As a result, most groups of seedlings are “hybrid swarms” – they’re different from either parent and from each other. The differences may be obvious or invisible, but they all add to the genetic variation in the population. The other source of variation is **mutation**, which can be induced or spontaneous. Induced mutation happens after exposure to a mutagen – a chemical, UV light or that sort of thing – that changes the genetic material in the exposed critter or plant. Spontaneous mutation is naturally occurring and results from random errors that occur when cells are preparing to divide.

Let’s pause for a brief pop quiz...which of these do you think is responsible for fluridone resistance in hydrilla?

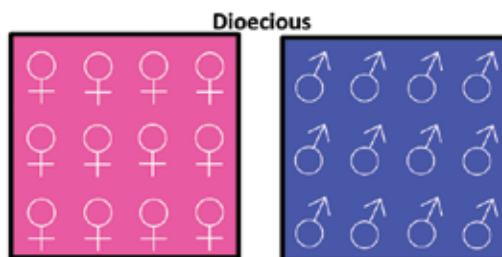
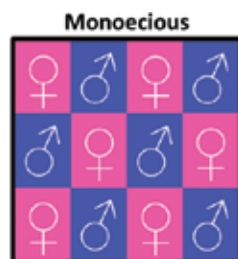
- A) recombination
- B) induced mutation
- C) spontaneous mutation

Could it be answer A? In short, no. There are two biotypes of hydrilla – monoecious and dioecious. Monoecious (from the Latin and Greek for “one house”) plants have separate “male” and “female” flowers on the same plant; they’re sort of like a co-ed dorm with boys and girls living under the same roof. In contrast, dioecious (“two houses”) plants have only “male” or “female” flowers – think of these as single-sex frat or sorority houses with the boys and girls living apart from one another. All of the hydrilla in Florida is dioecious “female”,

so our hydrilla populations are composed only of sorority sisters (!!!) with no boys present. No boy hydrilla means no pollen source, which means no seed production and, therefore, no recombination.

How about answer B? Nah, fluridone is not a mutagen.

Answer C, perhaps? Why, yes... yes it is! If we look back at the explanation for ruling out answer A, we know that hydrilla doesn’t make seeds – all growth and spread results from vegetative reproduction as opposed



to sexual reproduction. Vegetative reproduction relies on cell division – known as mitosis – to make new plant material, and one of the processes that occurs before mitosis is the source of fluridone resistance in hydrilla.

Mitosis and DNA replication

Mitosis starts with a single cell and ends with the production of two new cells that are identical to each other and to the original cell. In order for a cell to divide, all of the genetic material contained within it must be doubled; this occurs in the process of **DNA replication**. I know you’ve seen drawings of chromosomes in a cell, but you may not realize that each chromosome is made of densely packed and wound DNA (deoxyribonucleic acid), a double-stranded structure that contains all of the information needed for an organism to live its life. Before the cell can divide, the DNA loosens up and unwinds so it can be copied or replicated.

Unwound DNA is shaped sort of like a spiral staircase or a twisted ladder; the “side rails” are the backbone of the DNA and are made of sugars and phosphate,

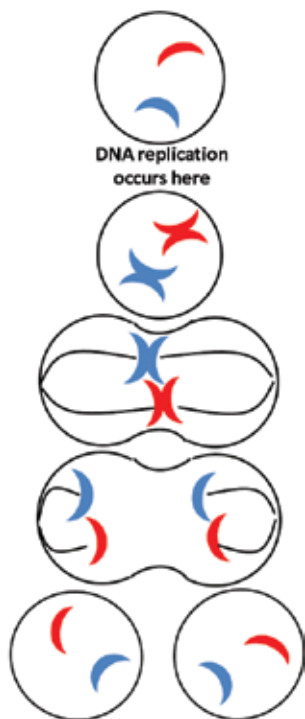
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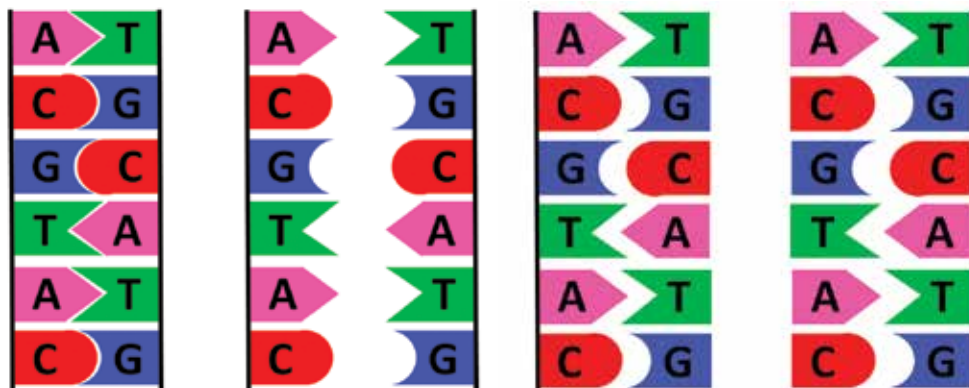
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while the “steps” are made of pairs of bases that are held together by hydrogen bonds. Even though each DNA strand is billions of bases long, the entire length is made from only four different bases. These bases (abbreviated A, T, G and C for adenine, thymine, guanine and cytosine) bind in a very particular way – A always binds with T and C always binds with G. This is called **complementary base pairing** and is critical to DNA replication. Why, you ask? Because during DNA replication, the double-stranded structure splits – think of the steps of a ladder breaking down the center – and each strand is used as a template to build a new strand identical to the original. Look at this picture and you’ll see what I mean.

So it’s a perfect system, right? Well, not really. Replication happens really, really fast; it has to, because, remember, there are billions of bases in each strand of DNA and if it took a long time, life as we know it would end before replication finished. Think I’m exaggerating? Just for fun, I decided to do a little math; how long do you think it would take for a two-billion-base-long strand of DNA to replicate if it ran at a rate of one base per second? Somewhere in the range of 63 years and 5 months. Check for yourself; that’s 2,000,000,000 bases at 1 second per base, divided by 60 seconds per minute, 60 minutes per hour, 24 hours



per day, and 365 days per year. I did take one shortcut – I didn’t factor in leap years. That’s for replicating one strand of DNA before one cell division. Yikes.

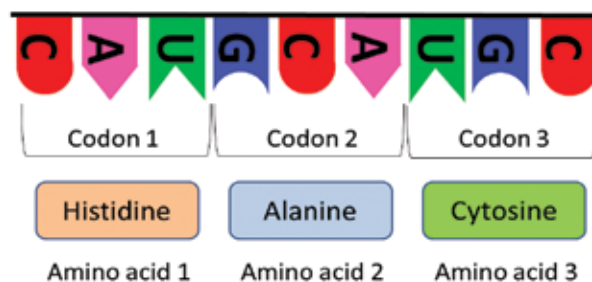
OK, so let’s agree that replication happens really, really fast. Mistakes do happen, and there’s a little enzyme called a polymerase that “proofreads” the strands to make sure there’s no monkey business going on – in other words, complementary base pairing works correctly so that A bases only bind with T and C bases only bind with G. The polymerase does a good job, but sometimes errors slip through. When that happens (say, an A base binds with G), the result is a cell that has a **point mutation** – a single incorrect base somewhere in the DNA sequence. This point mutation will be perpetuated in all of the cells arising from future divisions of that cell, since new DNA strands will be created using the mutated strand as a template. But what does this mean to the organism with the defective cell??? That depends on how the mutation affects gene expression.

Gene expression

There’s a nifty little flowchart of sorts in genetics known as the **Central Dogma** (hereafter CD), which states “DNA makes RNA, RNA makes proteins”. RNA (ribonucleic acid) is very similar to DNA but uses the base uracil (abbreviated U) instead of thymine. The “DNA makes RNA” step is called **transcription** and the “RNA makes protein” step is **translation**. The CD is totally separate from DNA replication, which occurs before the CD kicks in. Think of DNA as a stone tablet that has your favorite recipe carved on it. You can’t very well lug a stone tablet into

the kitchen to make double-fudge brownies now, can you? No! The stone tablet has to stay perfect so your kids and grandkids and great-grandkids and so on can make the double-fudge brownies too, so you can’t risk dropping the tablet, spilling stuff on it, or doing anything to damage it. You copy the recipe onto a sheet of paper – the sheet of paper is now the equivalent of RNA, which has been *transcribed* from DNA. You take the sheet of paper into the kitchen, which is already stocked with everything you need to make the brownies – the brownies are the protein, or the end product of gene expression after the RNA is *translated*.

RNA isn’t translated as one long strand; instead it’s read in three-letter snippets called **codons**. Each codon is associated with one particular amino acid; think of amino acids as the ingredients needed to make your brownies. Translation uses a special coding dictionary that outlines which amino acid is called for by each codon. All of the amino acids called for by the codons in an RNA sequence are strung together and processed to create the final product – this is gene expression, also known as the brownies! Recall that your recipe was engraved on a stone tablet – the DNA. If the stone tablet is intact and correct, then your double-fudge brownies will be just that – double-fudge. What happens if the tablet was chipped or damaged or just plain wrong... say, like from a point mutation?!?



That depends, because point mutations can affect gene expression – I mean, your brownies – in different ways.

Some point mutations are silent, meaning they have no effect on gene expression. For example, let's say the original text on your stone tablet said "Four ounces (½ cup) of chocolate chips", but the "Four ounces" line is damaged and unreadable. No worries, you still know that you need ½ cup of chocolate chips. Other point mutations are not silent, meaning they do affect gene expression. Some point mutations are detrimental and can result in a broken or

Goal: make an animal	
CAT → CAT	No mutation (wild type)
CAT → RAT	Silent point mutation – there's a change in the sequence but we still end up with an animal (no change in gene expression)
CAT → BAT	Silent point mutation – there's a change in the sequence but we still end up with an animal (no change in gene expression)
CAT → HAT	Point mutation – there's a change in the sequence and we end up with something different (change in gene expression); this may be good or bad
CAT → MAT	Point mutation – there's a change in the sequence and we end up with something different (change in gene expression); this may be good or bad
CAT → JAT	Nonsense point mutation – there's a change in the sequence and we end up with nothing – the system's broken (change in gene expression)

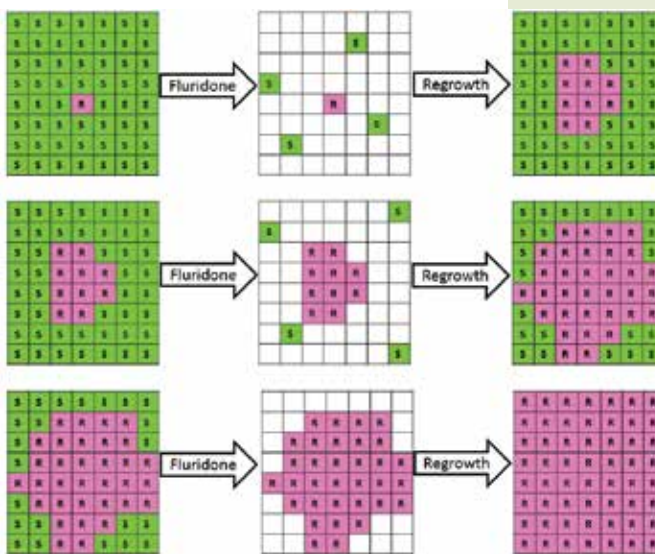
useless end product; for example, if the line "Bake for 45 minutes at 425 degrees" was changed to "Bake for 45 HOURS at 425 degrees", your brownies would be, um, crunchy. Still other point mutations have effects that may be good or bad, depending on the situation. Maybe the original tablet instructions called for half a cup of coconut, but that line was changed to half a cup of peanuts. Some people might not know the difference; in that case, the point mutation is neutral. However, your friend Maybelle loves your famous double-fudge brownies and she's enjoyed them many times in the past... back before the point mutation (peanuts instead of coconut) occurred. Maybelle has a peanut allergy; see where I'm going with that? Another way to look at the potential effects of point mutations is the "Make an animal" goal outlined by yours truly at the recent FAPMS meeting – check out the graphic for a refresher.

Herbicide resistance – it's just a typo

By now, I bet you've figured out that fluridone resistance in hydrilla is the result of a point mutation. In fact,

Hydrilla and fluridone resistance	
• AAC CGT TTC (arg) →	Susceptible
• AAC CGC TTC (arg) →	Susceptible
• AAC CGA TTC (arg) →	Susceptible
• AAC CGG TTC (arg) →	Susceptible
• AAC AGT TTC (ser*) →	Low resistance
• AAC TGT TTC (cys**) →	Moderate resistance
• AAC CAT TTC (his***) →	High resistance

it's most similar to the "coconuts to peanuts" scenario described above. That's because the point mutation has no discernible effect most of the time; if you don't have a peanut allergy, the peanut brownies are fine, but if fluridone-resistant hydrilla is treated with something other than fluridone, it dies. There are actually four different mutations that confer different levels of fluridone resistance to hydrilla, and all are simple point mutations within a single codon in the *pds* gene mentioned way back at the beginning of this article. These mutations don't affect hydrilla under normal conditions, but plants with one of these point mutations (resistant types) have

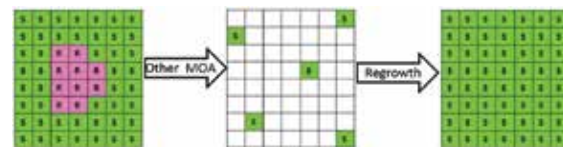


a distinct advantage when treated with fluridone – they survive the treatment. Susceptible plants (those without a mutation, also called "wild type") die. Although resistant types are initially very rare, over time they become the

dominant type in a population that is being treated with fluridone.

What's the solution?

This one's easy – rotate modes of action!!! It's important to remember that fluridone-resistant hydrilla is resistant ONLY to fluridone – it has no defense against other herbicides. A single application of a product with a different active ingredient is often enough to knock back a population of fluridone-resistant hydrilla. It may seem wasteful to use a different



– and often more pricey – product for hydrilla control if your population is still well-managed with fluridone, but the most expensive treatment is the one that doesn't work. Relying solely on a single active ingredient is a gamble because sooner or later your population will shift to resistant types and you'll lose tools from your toolbox. Don't be that applicator – rotate!!!

Resistance happens... At first, plants with the *pds* point mutation (shown here in pink) are a rarity in a population. However, they are able to survive exposure to fluridone, so they contribute most of the regrowth after treatment. Eventually most or all of the fluridone-susceptible hydrilla is killed off and all that remains are plants with the resistant bio-type. This population shift from mostly susceptible to mostly resistant means fluridone won't work anymore and you've lost an important tool from your toolbox.

Dr. Lyn Gettys (lgettys@ufl.edu) is an Assistant Professor of Agronomy at the University of Florida/IFAS Fort Lauderdale Research and Education Center. All images courtesy Dr. Gettys.

Forty Years of “Preserving Florida’s Water Heritage”¹

by Dr. Joe Joyce,
President FAPMS, 1981

First of all I want to thank the FAPMS Board and the entire membership for bestowing the Honorary Lifetime Member award to me at the 2016 annual meeting. This is a tremendous personal honor and means more to me than you will ever know. After the meeting I was asked to capture some of my presentation at the annual meeting for *Aquatics*, so here goes.

As everyone knows, the first major aquatic weed in Florida was the water hyacinth that, beginning in the late 1800s, created severe economic and environmental impacts to state water resources. For the first half-century, water resource agencies and private individuals attempted (mostly unsuccessfully) to cope with the problem. In 1961, in order to share and compare control information on water hyacinths, the Hyacinth Control Society was established. However, the situation in Florida changed dramatically in the late 1960s, prompting the establishment of FAPMS in 1976. The following outlines the political and professional situations and issues in the history of aquatic plant control in Florida that resulted in the formation of FAPMS:

- High cost of APMS meetings – 1976 APMS meeting at Bahia Mar in Ft. Lauderdale had a room rate of \$65 and meeting registration of \$60. Adjusted for inflation, this equals \$275 and \$255 today. At this meeting, the name of the Hyacinth Control Society was changed to the Aquatic Plant Management Society with plans to undertake a more national focus.
- APMS meetings were held in the summer during applicators’ busiest season
- New environmental issues and regulations (EPA 1970; FIFRA 1974) – water quality exemptions were needed for aquatic weed control, and herbicides

were being lost due to the lack of water and fish tolerances.

- ◊ A new Florida DER permitting rule for aquatic weed control (Chapter 16c-20) and water quality rules (Chapter 403.088) were being promulgated
- ◊ EPA began stricter regulation of herbicide labeling and registration requirements
- ◊ EPA required training and state certification of applicators (1974) thus requiring CEUs
- Politics – there was severe agency overlap and power struggle between the Florida Game and Freshwater Fish Commission (FGFWFC), the Department of Natural Resources (DNR) and the Department of Environmental Protection (DEP)
- New weed species such as hydrilla were creating exponential impacts and costs
- Not enough control funds to manage aquatic weed problems
- More commercial applicators were emerging
- The UF/IFAS Center for Aquatic Weeds was formed
- The use of grass carp created a controversy over how much vegetation to control and who would regulate the use of the fish
- New herbicides and application techniques were coming to the market

These issues created a desire for a political voice in the state. Additionally, there was a need for a single Florida organization for aquatic plant control, mosquito control,

and Chapter 298 drainage districts with an applicator-dominated Board of Directors. It was hoped that such an organization could create political pressure to resolve many of the agency conflicts and encourage additional funding, water quality exemptions and agency organizational legislation. It was also hoped that the voice of FAPMS could help the profession deal with the loss of numerous herbicides due to reregistration requirements.

Below is a timeline of the establishment of the society. As you can see, once the decision was made, the early organizers wasted no time in addressing the need for an applicator-based society.

To accomplish such a feat, it took the concerted effort of some key individuals. The one who is recognized as the “father of FAPMS” was Mr. Les Bitting with the Old Plantation Water Control District. Others were the signers of the FAPMS charter: Bob Blakely, Harold Brown, Joe Schweigart, Gordon Baker, Frank Wilson, Porter Lambert, Clarke Hudson, Charles Hargrove, Robert Morris, Vernon Myers, Bob Gates and Bill Maier. FAPMS owes a tremendous debt to these individuals for their vision and dedication to ensuring the initial success of our Society.

So what have we done over the past 40 years to fulfill the purpose envisioned for FAPMS? It seems to me that the original vision and hopes for FAPMS have accomplished because FAPMS is:

- Applicator based and governed
- Composed of public and commercial applicators

FAPMS Establishment Timeline

- July 1976 Key applicators meet to discuss (gripe) about relationship with and direction of the Aquatic Plant Management Society (APMS)
- Nov 1976 FAPMS charter signed; FAPMS incorporated
- Jan 1977 Petitioned to become a chapter of APMS (APMS provided \$500 start-up funds)
- Mar 1977 First annual meeting with 245 in attendance
- Sep 1977 Field day and fish fry at Okee-Tantie
- Nov 1977 *Aquatics* magazine was conceived
- Dec 1977 356 paid members

¹Partial content of this article was taken from two articles by Catherine Johnson *Aquatics* Fall 2000 22(3) and Fall 2003 25(3).

- Meeting in the fall and focusing on Florida issues
- Financially strong and stable
- Composed of 386 members (as of October 2016)
- Politically active when needed
- Awarding scholarships through the FAPMS Foundation (\$107,550 through 2016)
- Publishing a highly successful and widely distributed educational magazine, *Aquatics*
- Providing an organizational model which 7 regional chapters have copied

Other accomplishments included:

- EPA cancelled 24c labels for silvex, fenac, dalapon, dichlobenil, dicamba and amitrole due to no fish or water tolerance, so no herbicides available for grasses and cattails. Thus, a FAPMS Advisory Council recommended Section 18 (emergency exemption for roundup.) FAPMS sponsored this effort with FDACS.
- 1980 first "Applicator of the Year" awarded (Philip Jones and Lou German with the Southwest Florida Water Management District)
- Bill Maier Scholarship Foundation was established in 1985 and later expanded to include the Paul Myers Applicator Dependent scholarship.
- In cooperation with DEP, DNR, and FGFWFC sponsored the American Assembly Conference Sep 25-27, 1979.

This last accomplishment was critical to the resolution of many of the primary political and environmental issues that existed in the late 1970s. But what was the American Assembly Conference? It was a group of all interested parties that met in the Florida House of Representatives Chamber for 2-1/2 days to address all pertinent issues affecting aquatic plant management. The Conference produced 26 recommendations; four of the key recommendations were:

- DNR should be the lead state agency managing the Aquatic Plant Trust Fund
- FGFWFC should not conduct operations but be limited to grass carp permitting
- An Advisory Council should be established to provide input to DNR

- Exemptions (Chapter 403.088, FSS) should be enacted to ensure that aquatic plant management techniques conducted according to label restrictions or best management practices would be exempted from water quality (mainly dissolved oxygen) standards.

What does the future hold for FAPMS as an organization and aquatic plant management as an industry? Several key trends will determine the answer to this question, specifically:

- Older members with original sense of purpose and commitment are retiring and new leaders will need to step up to the challenge of carrying on the vision and philosophy of FAPMS.
- New invasive species will be introduced creating new operational and training challenges that will require cooperation between applicators, agency personnel, researchers and the

agrichemical industry.

- New herbicide development will be hampered by new regulations and high costs of registration
- FAPMS members must be involved. If not:

- ◇ NPDS permitting will become more difficult
- ◇ State water quality standards/exemptions could be changed (Chapter 403.088)
- ◇ Endangered species will be a major issue affecting control efforts

I, for one, am convinced that the FAPMS has emerging leaders that are up to these challenges.

Best wishes for another 40 years of professionally "Preserving Florida's Water Heritage".

Joe Joyce, Ph.D., joejoyce@ufl.edu
(Retired)

Too Many Weeds Spoil the Fishing



Exotic invasive aquatic plants such as Hydrilla, Eurasian Watermilfoil and Curlyleaf Pondweed, can be detrimental to a healthy fishery in lakes across the country.

These invasive plants when left unmanaged can alter the ecosystem of lakes and reservoirs, cause a decline in the fishery, and interfere with other valued uses of waterbodies.

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Aquathol® K and Aquathol® Super K Aquatic Herbicide
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A broad-spectrum non-selective aquatic herbicide.
No restrictions on fishing, swimming, irrigation, livestock watering, or potable water use

Hydrothol® 191 Aquatic Herbicide & Algaecide
A broad-spectrum herbicide and algaecide. Hydrothol® 191 provides a companion product or an alternative to copper algaecides when controlling difficult algae species.
*No restrictions on swimming, fishing or irrigation**

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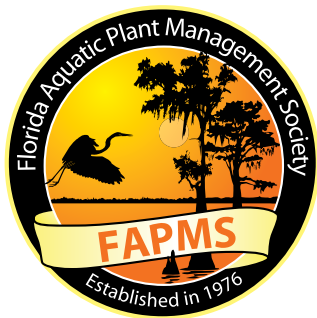


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APMS Selected Regional Chapter Updates



Florida Aquatic Plant Management Society Update

FAPMS President Andy Fuhrman (afuhrman@allstatemanagement.com)

FAPMS recently completed a very successful annual conference in Daytona Beach October 17-20. Hurricane Matthew did his best to stop this from occurring and closed our original venue. However, thanks to the tireless work of President Angie Huebner and Local Arrangements Chairman Bill Torres, we were able to relocate to another venue and the conference went off without a hitch.

This year we celebrated 40 years of this amazing organization. In addition to the regular program, FAPMS honored its charter members, past presidents and reminisced about the past four decades. Keynote speaker Joe Joyce took us for a stroll down memory lane and reminded us where this organization came from. We were also able to hand out over \$8,000 in scholarships to help the next generation achieve their educational goals. It was great looking back at the last 40 years and we are excited at what lies ahead for the next 40.

MidSouth Aquatic Plant Management Society and Regional Update

MSAPMS President: Ryan Wersal (ryan.wersal@lonza.com)

The Society held its 35th annual meeting in Baton Rouge, Louisiana which signified the first time the meeting has been held in Louisiana and only the 4th time in Society

history that it has been held outside of Alabama or Mississippi. The meeting opened Tuesday morning with a field tour of Henderson Lake, followed by classroom topics such as herbicide safety, aquatic plant



ID, equipment calibration, and biological control. Participants of the workshop also earned CEUs for their respective states. The general session opened with a session devoted to aquatic plant management in Louisiana where Patrick Banks, Assistant Secretary of Louisiana Department of Wildlife & Fisheries, gave the welcoming address. The program consisted of 24 talks with four given by students. The 36th annual meeting will be held in Birmingham, Alabama.

Alabama Update

Alabama Power Company operates 14 hydroelectric generating facilities and is responsible for aquatic vegetation management on 12 reservoirs which encompasses 160,000 acres of water and 3500 miles of shoreline within Alabama. Alabama Power manages vegetation if it meets any of the following criteria:

1. Creates a potential public health hazard by providing mosquito breeding habitat, or
2. Poses a threat to power generation facilities or water withdrawal structures, or
3. Restricts recreational utilization of the reservoir, or

4. Poses a threat to the ecological balance of the reservoir such as an exotic aquatic plant which is known to create problems in the above categories.

Most of the aquatic management program is geared around control of exotic plants; however, native plants can also meet the criteria described above. One of the struggles as managers is meeting the needs of the many stakeholders that use the reservoirs, and providing beneficial aquatic habitat for fish and wildlife. Public outreach and education is a major part of the management program and is the primary tool to keep the stakeholders informed of the many activities that occur on the reservoirs.

In terms of problematic species, Alabama Power Company has been actively managing lyngbya for over 25 years. With new herbicide formulations and input from experts in the field of nuisance algae control, lyngbya can be considered under control in many areas of the reservoirs. Lyngbya is constantly being monitored and treated as sites fit the aforementioned criteria. Hydrilla is a relatively new arrival to some of the reservoirs and small areas have been under active management for 8 years. Recently monoecious hydrilla has been identified on two additional reservoirs. Treating these areas with the goal of elimination as well as surveying for new sites is a constant activity. Eurasian watermilfoil has slowly been spreading on one of the lower reservoirs on the Coosa River over the past 4 years. Identifying new sites, treating, and eliminating this exotic plant will be a goal for years to come. Two acres of Cuban bulrush were identified and treated in 2016. This species is often overlooked though it can spread and disperse quickly throughout a reservoir without proper attention. Cuban bulrush will be on the list to watch out for in order to stem the spread of this invader.

Reservoir aging and sedimentation are also important factors that we deal with. The sedimentation reduces reservoir holding capacity and, depending upon where it is occurring, can create new areas for aquatic plant growth.

Georgia Update

Hydrilla invaded several Georgia Power Company reservoirs beginning in 2012. The incredible growth rate and biomass production that enables hydrilla to quickly take over a lake system and render many parts of a lake unnavigable has been well documented in the southeast US. The many challenges that hydrilla brings to aquatic plant managers include quick post treatment recovery, rapid expansion by fragmentation, and profuse tuber production, and make this plant one of the top offenders in Georgia and the rest of the United States. If the basic biology of hydrilla was not enough to contend with, managing it in Georgia Power Company reservoirs makes it even more difficult due to bulk water movement, as many of the waterbodies are run-of-the-river reservoirs.

Georgia Power is refining its management strategies to suppress hydrilla growth in three Fall Line reservoirs near Columbus, GA. Rhodamine dye studies are being conducted to better understand bulk water movement in areas where hydrilla has been difficult to control. Additionally, gaining a better understanding of the vegetative reproduction cycle of hydrilla has yielded more information on tuber ecology which has had a positive impact on management results. By understanding when hydrilla produces tubers, biologists are able to plan management strategies to impact the tuber bank in order to gain longer-term control. For example, it appears that the main onset of tuber production in Georgia Power reservoirs occurs in mid-September and lasts through October as cooler water temperatures and shorter day lengths occur. Understanding this has been useful in developing a management strategy whereby controlling much of the standing crop in the early part of the summer has led to a reduction in tuber production in

the early fall. Other refinements in the management of hydrilla include using alternate herbicide products in similar reservoir conditions to effectively gauge which has greater efficacy. Georgia Power still has many challenges to overcome in managing hydrilla, but through collaborating with academia, other experienced aquatic plant managers in the southeast, and consulting with industry experts, it should allow the management plants to continually improve.

Louisiana Update

The invasive floating fern, giant salvinia, continues to spread and cause ecological and economic losses throughout Louisiana and the Gulf Coast Region. The Louisiana Department of Wildlife and Fisheries (LDWF) treats in excess of 65,000 acres of nuisance aquatic plants each year. In fall 2015, giant salvinia covered an estimated 58,477 acres of Louisiana public waters. Controlling giant salvinia infestations are a challenge due to salvinia's extremely fast growth rate and the fact that it is a floating fern that moves around based on wind and water movement. It has proven to be particularly difficult to control in the many impounded swamps that are found throughout Louisiana. These areas typically contain dense stands of cypress and tupelo that provide shallow nursery areas for the plants where herbicide application is not possible.

No single plant control strategy has proven to be successful. A combination of chemical, biological, and mechanical control measures must be used in order to control the plant. Water level fluctuations, or drawdowns, have proven to be extremely effective at reducing salvinia coverage, and they typically have positive impacts on the lake's fish populations. Giant salvinia weevil introductions have been made continuously throughout the state. The limiting factor of their success is that they are not cold tolerant, and cannot survive the winter temperatures of north Louisiana. Herbicide applications can be successful when used in combination with either drawdowns or successful weevil establishment. The majority of giant salvinia

treated during the growing season is with a combination of glyphosate, diquat, and a surfactant. Herbicide applications during the winter months can be successful when using diquat and a surfactant. Eradication of giant salvinia in Louisiana is not a viable goal at this time, but it can be controlled to levels that allow use of public waters when multiple strategies are employed.

Another important issue for aquatic plant management in Louisiana continues to be preventing the introduction and spread of new species such as crested and yellow floating heart (*Nymphoides cristata* and *Nymphoides peltata*).

Mississippi Update

Common aquatic and wetland nuisance plant species found in public waters that are currently being targeted by control efforts in Mississippi are hydrilla, alligatorweed, torpedo grass, water primrose, giant salvinia, common reed, water hyacinth, and Chinese tallow tree. The MS Dept of Marine Resources, the Tennessee Tombigbee Waterway and the Ross Barnett Reservoir have active management programs that are targeting many of the aforementioned plant species. Algae management is also a concern in small ponds. Cuban bulrush, water lettuce, wild taro, Eurasian watermilfoil, and purple loosestrife are also present in the state but are not being actively managed at this time because they are not widespread problems or they occur in waterbodies that do not have the resources to address the infestations.

In private small ponds, the most problematic aquatic plant species continue to be southern naiad, spikerush, and water primrose. Since a large proportion of ponds in Mississippi are utilized for recreational fishing, a common practice is to fertilize low-productivity ponds to stimulate algae growth with the goal of increasing fish production and shading out submersed plants. Often, however, the algae bloom becomes excessive and leads to oxygen depletion, fish kills, odor problems, and a pond that is not pleasing to look at. Therefore, algae management is also a concern in small ponds. The increased nutrient load also

results in floating aquatic plant problems such as duckweed and watermeal which are not suppressed by the algae bloom.

In 2016, the Mississippi Aquatic Invasive Species Council (MSAISC) was formed within the state to address the growing concern of invasive aquatic plants. One of the first tasks of the MSAISC was to develop an invasive species management plan for the state. The plan can be found online at: www.anstaskforce.gov/State%20Plans/FINA_MS_AIS_Management_Plan_Mar_2013.pdf

The document also contains the objectives of the MSAISC.

Contributors

Josh Yerby, Alabama Power Company
Warren Wagner, Georgia Power Company (Director MSAPMS)

Alex Perret, Louisiana Department of Wildlife and Fisheries (Past President MSAPMS)

Gray Turnage, Mississippi State University

Ryan Wersal, Lonza Water Treatment (President MSAPMS)

Midwest Aquatic Plant Management Society Update

MAPMS President: Dick Pinagel (dick@aquaweed.com)

I hope that you had a great summer season! It was one of the better summers here in the Great Lakes region with lots of warmth and sunshine to grow aquatic plants for us to manage and study.



2016 Recap: The spring 2016 MAPMS meeting, held in Grand Rapids, MI, had an all-time high attendance of 240! Attendees represented 20 states from California to New York and everywhere in between. The program featured 33 total presentations with 6 student speakers along with many

poster presentations. Numerous universities were represented with students from: North Carolina State University, Clemson University, University of Wisconsin, University of Florida, Central Michigan University, Montana State University, Michigan Tech University, SUNY University in New York State, University of Minnesota at Twin Cities, and the University of Trent London Ontario Canada.

Current membership stands at 230 active members. Our annual student scholarship award, The Robert L. Johnson Memorial Research Grant, currently stands at \$10,000; one of the largest among the APMS chapter family. Our focus continues to be student participation, education, and outreach along with garnering governmental agency participation with our conference and other activities. An example of MAPMS commitment to students, besides the large RLJ Grant amount, is that they can attend our conference at no charge for registration and, in most cases, hotel room assistance is provided.

Additionally, MAPMS has entered the social media world with our Facebook Page – “MAPMS”! Also new is our “Whova” smart phone app. Whova is made available free of charge to each conference participant. This app allows for instant conference information and program updates, instant special event notification, a list of participants and sponsors along with their contact information, and instant networking opportunities with other conference attendees... all from your smart phone!

Most recently, the annual MAPMS Fall Board of Directors meeting was held in Milwaukee, Wisconsin. This board meeting takes place where the MAPMS conference will be held next spring; the Hyatt Regency Milwaukee. This allows for a Board review of the facility and to finalize details with hotel staff. At the meeting all committee reports were reviewed and discussed. Details related to preparation for the spring 2017 Conference such as meal planning, general session layout, and program details, were reviewed. Our program chair, Mr. Paul Hausler, is developing an outstanding program filled with speakers from the Midwest region and around the country; particularly featuring speakers from the host state of Wisconsin. Please make plans now to attend the 2017 Spring MAPMS Conference at the Milwaukee Hyatt Regency in Downtown Milwaukee Monday, February 27th thru Wednesday, March 1st. I look forward to seeing you in Milwaukee!

Northeast Aquatic Plant Management Society Update

NEAPMS President: Chris Doyle (cdoyle@solitudelake.com)



As winter approaches, although it's hard to tell when it's in the upper 60's in mid-November, lake managers are wrapping up another busy field season in the Northeast. Higher than average temperatures and reduced rainfall in the region certainly impacted nuisance aquatic plant growth and provided a myriad of project challenges. The Northeast Aquatic Plant Management Society has been busy planning for its 18th Annual Conference. Last year's conference had our highest attendance to date, exceeding 200 attendees for the first time.

This year, our annual conference will be held January 10th through 12th at Wentworth by the Sea on the Isle of New Castle in Portsmouth, New Hampshire. Our conference kicks off on Tuesday afternoon with hands-on workshops. This year's theme will be on remote sensing tools used for aquatic plant management. Weather permitting, participants will be able to go outside and observe a drone demonstration. Late afternoon on Tuesday features a mainstay of our conference: the aquatic plant workshop. Last year, this workshop featured over 50 previously frozen aquatic plant samples for inspection and, of course, the wildly popular quiz. Wednesday and Thursday are reserved for our technical presentations, and this year we have an impressive array of speakers from the far flung reaches of our country. Topics include hydrilla research and management (which continues to be a hot topic in the Northeast, which now hosts several large scale control projects and new infestation discoveries almost annually), new herbicide formulation research, large scale management case studies, non-chemical aquatic plant control projects and aquatic plant biology. Wednesday wraps up with our popular Technical Poster Slam and Annual Awards Banquet.

The year 2016 was a landmark year for our society to fund student scholarships. Only a few years ago, our society struggled

to connect with students conducting aquatic plant research in our region. But in 2016, we are proud to announce the society is currently funding four students from four different academic institutions, with three of them located in the Northeast. The research topics include starry stonewort, hydrilla, and aquatic plant mapping techniques. In addition to providing tangible research results for our society members and the aquatic plant industry, these funding opportunities are fostering relationships with the next generation of aquatic plant managers and their academic institutions. In addition, our Board approved multi-year funding for a joint scholarship with APMS, MAPMS, and several corporate sponsors for a starry stonewort (*Nitellopsis obtusa*) grant in 2017.

It's been a busy, yet rewarding year for the Northeast Aquatic Plant Management Society, and the groundwork for a successful 2017 has been established by a dedicated Board of Directors.

South Carolina Aquatic Plant Management Society

SCAPMS President: Cory Heaton (heaton2@clemson.edu)



I would like to take a moment to thank all of our board members, sponsors, and presenters for their efforts on planning the annual meeting. I would like to take another moment to thank all of them for having to do it twice thanks to Hurricane Matthew. A hurricane can't keep us down, and we have rescheduled our annual meeting for January 18-20, 2017. Bo Burns has worked diligently to assemble a wonderful agenda that is sure to provide everyone with a great educational experience. The SCAPMS website has been updated with links to everything you need for meeting registration. Check out the link and come spend a few days with us in Myrtle Beach. www.scapms.org/index.html



Calendar of Events 2017

January 10 - 12

Northeast Aquatic Plant Management Society (www.neapms.org); Portsmouth, NH

January 18 - 20

South Carolina Aquatic Plant Management Society (www.scapms.org); Myrtle Beach, SC

January 23 - 25

Southern Weed Science Society (www.swss.ws); Birmingham, AL

January 29 - February 3

Florida Mosquito Control Association Dodd Short Course (www.dodd.floridamosquito.org/Dodd/); Altamonte Springs, FL

February 6 - 9

Weed Science Society of America (wssa.net); Tucson, AZ

February 27 - March 2

Midwest Aquatic Plant Management Society (www.mapms.org); Milwaukee, WI

March 13 - 16

Western Aquatic Plant Management Society (wapms.org); Coeur d'Alene, ID

April 12 - 14

Florida Exotic Pest Plant Council (www.fleppc.org); Melbourne Beach, FL

April 19 - 21

Florida Vegetation Management Association, (www.myfvma.org/); Daytona Beach, FL

May 8 - 11

UF/IFAS Aquatic Weed Control Short Course (www.conference.ifas.ufl.edu/aw/); Coral Springs, FL

May 14 - 18

Global Herbicide Resistance Challenge Conference (www.ghrc2017.org); Denver, CO

June 6 - 9

Florida Lake Management Society (www.flms.net); Captiva, FL

July 16 - 19

Aquatic Plant Management Society (www.apms.org); Daytona Beach, FL

October 16 - 19

Florida Aquatic Plant Management Society (www.fapms.org); Lake Buena Vista, FL

October 22 - 26

20th International Conference on Aquatic Invasive Species (www.icais.org); Fort Lauderdale, FL

FAPMS Scholarship and Research Foundation, Inc.

Paul C. Myers Applicator Dependent Scholarship Awards 2016

Abigail Farr
Eckerd College

Jeremiah Lovestrand
Tallahassee Community College

Steven Olson
University of South Florida

Austin Edwards
University of North Florida

Roberto Navarro
Florida Polytechnic University

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