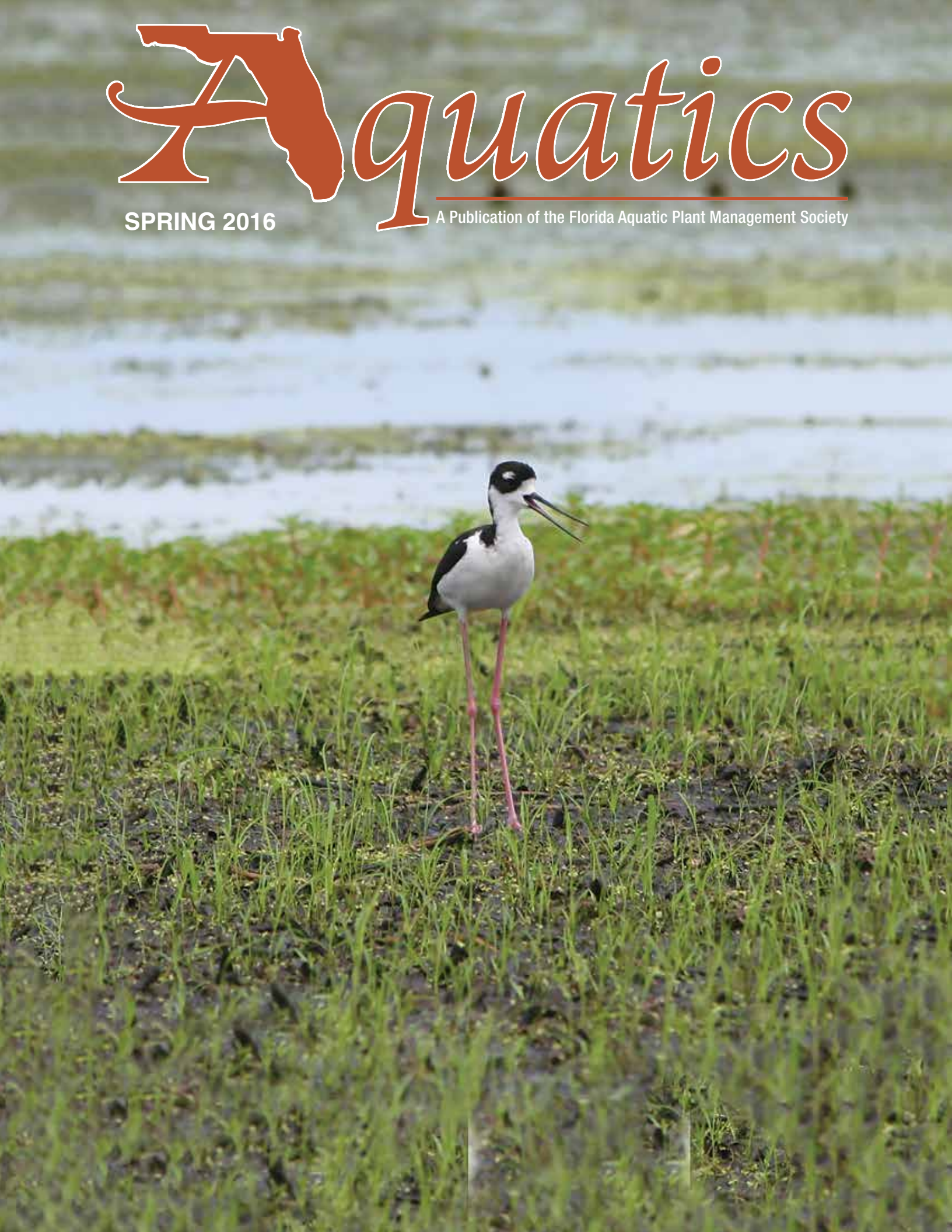
Aquatics

SPRING 2016

A Publication of the Florida Aquatic Plant Management Society



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Aquatics

SPRING 2016 Volume 38, Number 1

The black-necked stilt, *Himantopus mexicanus*, nests and forages on a near-shore mudflat in Fisheating Bay, Lake Okeechobee during June 2011 amidst a monoculture of seedlings of tropical American watergrass (*Luziola subintegra*). Research funded by the South Florida Water Management District and conducted at the UF/IFAS Center for Aquatic and Invasive Plants in 2009 and 2010 demonstrated that seedbanks of tropical American watergrass retain viability best under inundated substrates while seeds germinate and establish best under moist to saturated environments. Seeds of tropical American watergrass have not been found, however, to germinate under standing surface water. Photo courtesy Colette Jacono.

Contents

Committees

Aquatics Magazine Advertising
Angie Huebner
Invasive Plant Management
701 San Marco Blvd,Jacksonville, FL 32207-8175
904-894-3648
Angie.L.Huebner@usace.army.mil

Auditing
Keshav Setaram
SFWMD St. Cloud Field Station
3800 Old Canoe Creek Road., St. Cloud, FL 34769
ksetaram@sfwmd.gov

Awards
Scott Glasscock
Disney Pest Management
220 S Service Lane, Lake Buena Vista, FL 32830
Scott.glasscock@disney.com

By-Laws
Stephanie McCarty
407-461-4635, stephemccarty@aol.com

Editorial
Lyn Gettys
University of Florida Fort Lauderdale Research and Education Center
3205 College Ave, Davie FL 33314
954-577-6331, 954-475-4125 fax
lgettys@ufl.edu

Editorial (Associate)
Karen Brown
University of Florida - IFAS, Center for Aquatic & Invasive Plants
7922 NW 71st Street, Gainesville FL 32653
352-273-3667
kpbrown@ufl.edu

Governmental Affairs
Jeff Schardt
810 Remington Ave, Thomasville, GA 31792
850-591-1242
jeff.schardt@gmail.com

Historical
John Gardner
Aquatic Systems Inc.
2100 NW 33rd Street, Pompano Beach, FL 33069-1035
954-977-7736
john@aquaticsystems.com

Local Arrangements
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Florida Event Planning & Meeting Service
329 Dreadnaught Ct.,Tallahassee, Fl. 32312
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Helena Chemical
P.O Box 1758, Dade City, FL 33526
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boggsj@helenachemical.com

Merchandise
Steve Montgomery
Allstate Resource Management
6900 SW 21st Court, Bldg. #9, Davie, FL 33317
954-382-9766, 954-382-9770 fax
smontgomery@allstatemanagement.com

Nominating
Tim Harris
602 North Palm Ave, Palatka, FL 32177-0000
386-328-2737
Tim.T.Harris@usace.army.mil

Program
Jackie Smith
jackie.smith@MyFWC.com

Resource Demonstration
Brett Bultemeier
352-240-5560
6416 NW 168th St, Alachua, FL, 32615
bbultemeier@clarke.com

Scholarship
Keshav Setaram
SFWMD - Kissimmee Field Station
3800 Old Canoe Creek Rd, St. Cloud, FL 34769
407-846-5226
ksetaram@sfwmd.gov

Vendor
Scott Jackson
Sygenta
133 Sarona Circle, Royal Palm Beach, FL 33411
561-402-0682
scott.jackson@syngenta.com

Web Site
Angie Huebner
Invasive Plant Management
701 San Marco Blvd, Jacksonville, FL 32207-8175
904-894-3648
Angie.L.Huebner@usace.army.mil

In Memorium

John Lawrence Layer

Born December 9, 1940 Died January 21, 2016

John was born in Iowa City, Iowa and adopted by Lawrence and Mildred Layer. He grew up in Cedar Rapids, Iowa and later Colorado Springs, Colorado. John served his country in the US Navy during the Vietnam War. He served on 7 aircraft carriers, including the first nuclear carrier the USS Enterprise. Thanks to the GI Bill, John's educational career included studies at Seminole Community College and Stetson University and culminated in 1995 with a BS degree in Environmental Studies.

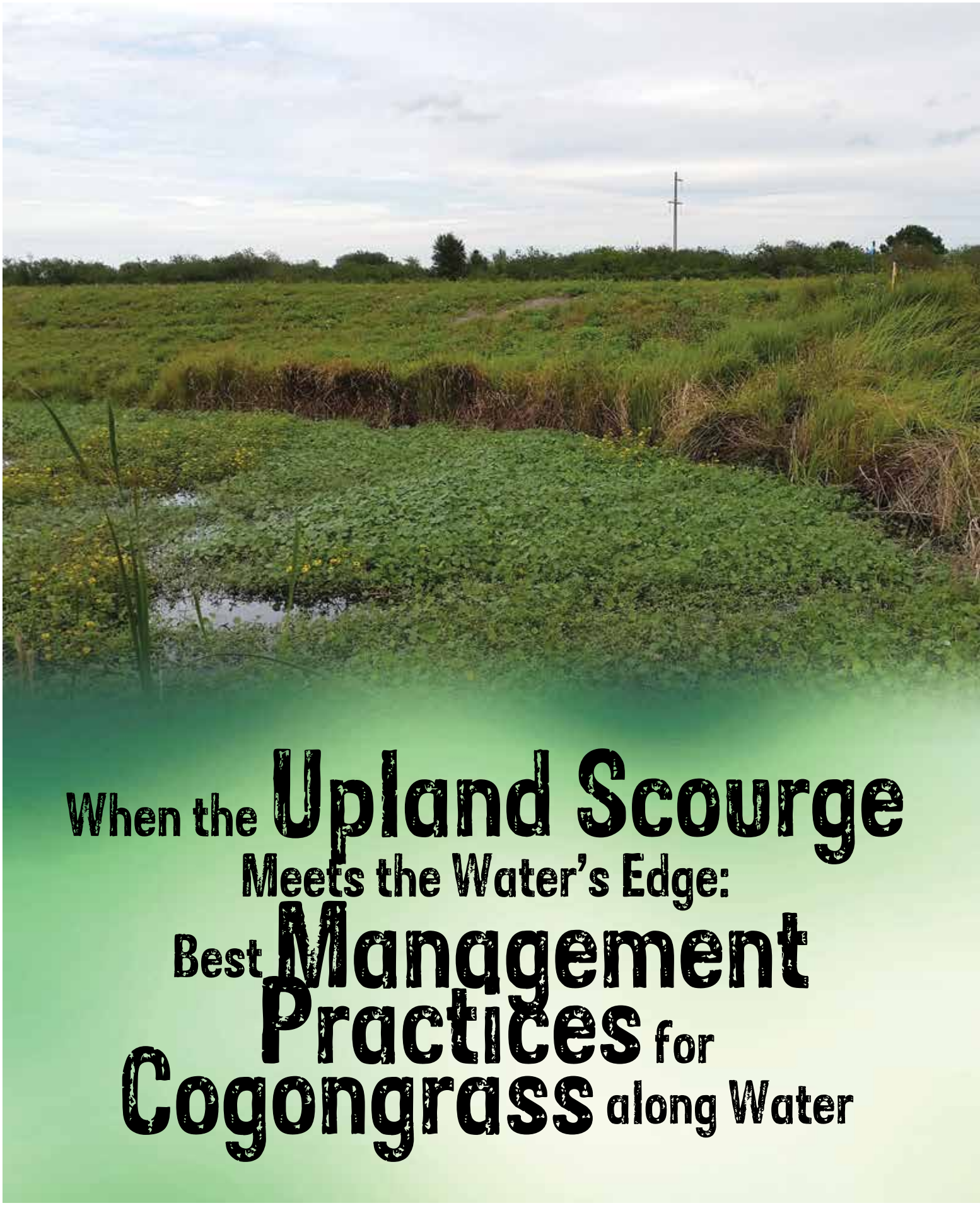
John started his work with invasive aquatic plants at the City of Maitland in 1974. When the City decided to contract out their work, John went to work for the contractor Paul Kawagouchi, Inc. and later Joyce Environmental Consultants, Inc. In 1978, he started Florida Environmental Services with a silent partner. When that partnership dissolved, John became the Supervisor of Aquatic Weed Control at the

St. Johns River Water Management District from 1981 to 1983 to ride out his non-compete agreement. While at the District, John worked closely with SePRO and Monsanto in their development of Sonar and Rodeo. The day his non-compete agreement was up, John left Government work to start Florida Environmental Consultants, Inc. with partner and wife, Beth. John worked every day at FEC from 1983 until this January, when his illness prevented him from continuing his field work.

John's passion was his work. His outspoken concerns for Florida's fresh water lakes and rivers made him a controversial figure. His other passion was collecting Indian artifacts and learning about Paleo man. He spent much of his leisure time scuba diving the rivers of north Florida looking for "the big one". He was very proud of his collection and his donation to the Silver River Museum. John was a man's man. He was fearless. He spent much of his life outdoors but he was happiest when he was in the seat of an airboat with a spray gun in his hand. He took so much pride in his work and felt that he really made a difference in the battle against invasive plants. John was a charter member of the Florida Aquatic Plant Management Society, a certified Pest Control Operator, a licensed Realtor and a licensed Charter Boat Captain.

John is survived by his wife of 36 years, Beth; son John; daughters Angela and Mary; eight grandchildren (Heather, Shauna, Haley, Jessica, Odie, Brandon, Dylan, and Jesse); and eight great-grandchildren.

Florida Environmental Consultants, Inc. will continue under the direction of Beth and son John, who worked with his dad for the last 10 years. We are saddened with the passing of this incredible man, but look forward to the future as we carry on his legacy.



When the Upland Scourge Meets the Water's Edge: Best Management Practices for Cogongrass along Water

by Stephen Enloe

Cogongrass is a plant that is near and dear to my heart. I have crawled through countless patches and given my blood to the needle-pointed rhizomes and razor-sharp leaf margins. I have been swarmed by paper wasps that take up residence under its dense leaf litter. I even lost my first wedding ring (not my wife, just the ring) to cogongrass, as I slung it off my finger during a fire ant frenzy. Quite frankly, cogongrass has ruined many a good day for me. So why go through all this ridiculous pain and suffering for such an undesirable grass? It is quite simple… I want to know how to best kill it. I want to be able to give aquatic and upland natural area managers the best recommendations possible to put cogongrass patches out of our misery. Cogongrass frustrates us all. We initially watch with satisfaction as patches brown out after treatment. This satisfaction turns to dismay when the same brown patches rapidly green back up within a year or two of treatment. Managers have often reported treating the same patches over and over for years, with little long-term success. Clearly, we are in great need of more, better, selective tools for cogongrass management. This is a need that also encompasses several invasive grasses here in Florida, including torpedograss, paragrass, West Indian marsh grass, elephantgrass, natalgrass, and more. So let's take a look at what we do know about cogongrass and how it relates to control along ponds, retention areas and other waterways.

It has gotten here both unintentionally and intentionally. Cogongrass (*Imperata cylindrica*) is native to much of southeast Asia and Africa. It was first discovered in Grand Bay, Alabama a little over 100 years ago as a contaminant of Satsuma orange packing materials from Japan. Cogongrass spread was slow for many years and any issues with weediness were completely unrecognized. Its dense green growth attracted ranchers to test it as a potential forage crop in a time where overgrazing and soil erosion had become rampant issues across the country. Cogongrass collected in the Philippines was planted in McNeill, Mississippi in 1921 and later in Texas, Alabama and Florida. Ranchers in Florida subsequently acquired and planted cogongrass across northwest Florida in the 1930s and 1940s. However, it quickly proved to be a terrible forage plant with low protein, low digestibility, and high silica. Cogongrass has also historically been planted as a soil stabilizer and allowed to "naturally" proliferate along many levees, dikes and other water impoundments. Many cogongrass problems around water have persisted for decades.

The seed debate continues. Beyond initial plantings by humans, researchers have debated how cogongrass has spread so far and wide across Florida and the southeastern USA. Seed dissemination by wind, water, animals, and current human activities has clearly played a major role in the colonization of new areas. But here is the first issue: Cogongrass is self-incompatible and requires outcrossing with another genetically distinct individual for successful pollination to occur. This means that clonal patches, whether large or small, cannot produce viable seed. Many researchers have found little to no viable seed production in many infested areas, even where cogongrass has been present for decades. So can managers use this to their benefit? Not really. Identifying individual clones is essentially impossible. Cogongrass inflorescences often disperse as a unit and may contain viable seed from multiple pollen donors. These seed can establish new patches that quickly intermingle and form patches similar in size and shape to single clonal introductions. The entire seed production question is also confounded by differential flowering times of patches across a landscape. It is often easy to see cogongrass patches in close proximity that flower completely asynchronously (at different times). The second issue is seed longevity, or the lack thereof. Cogongrass seeds are extremely small, contain very limited energy reserves, and have no dormancy mechanisms to form a long-lived seedbank. Studies have indicated that seed persist in the environment for less than one year and most survive for less than six months. These characteristics result in the need for a clear sequence of events for successful establish-

ment from seed. These include successful outcrossing with a nearby patch, ample moisture for seed fill, successful dispersal to a recently disturbed site, and rapid germination and establishment. Along waterbodies, these conditions can be hit or miss.

Rhizomes: the underground assault. Cogongrass growth and spread from rhizomes is an entirely different matter. Rhizomes are creeping underground stems that are segmented and contain a dormant bud at each node. Each segment or internode is loaded with energy reserves to fuel new shoot and root growth. A rhizome piece with as little as one to three nodes can easily establish a new plant. Rhizomes are also highly drought tolerant and may survive in a dormant state for months or years when shoot growth ceases and leaves dry down. Cogongrass is certainly known more for its tolerance of drought conditions than flooded conditions. Rhizome pieces have been widely spread with the movement of soil from road construction, fill material, fireplows, and tillage implements. Many retention ponds and stormwater treatment areas got off to a bad start with cogongrass rhizome-infested soil used in the construction process. Construction may also influence rhizome depth, which could have implications for control. Although rhizomes typically occur naturally in the top 15 to 30 cm of soil, major soil work (including fill work, roadside, dike, and levee construction and mineland reclamation) may bury rhizomes much deeper. Reports of rhizome depths up to one meter can be found in the literature.

So what does all this reproductive jargon mean for cogongrass growing along water? Cogongrass has generally not been classified as a wetland species in Florida. However, it is commonly observed thriving along wet ditches, in seasonally flooded pastures, and along many water body margins. Although no studies have been conducted in Florida, previous cogongrass seed and rhizome research in flooded and saturated soils in Louisiana indicated that increasingly wet conditions reduced seed germination and slowed seedling growth. This would be expected for an upland species. However, some cogongrass seedlings were still able to survive even flooded conditions for at least 4 weeks. Well-established rhizomes were much more tolerant of flooding and inundated conditions and performed much better than seedlings. Cogongrass culms extending above water may sometimes produce adventitious roots which could be advantageous in seasonally flooded conditions.

For seedling recruitment along waterways, drawdowns in the spring that expose substrate may aid cogongrass seedling recruitment along retention pond edges, while high water may reduce but not eliminate seedling recruitment. For rhizome spread from established patches along water, cogongrass is likely to advance downward in the dry period and persist for some time until higher water levels

return. Clearly, some period of complete inundation does eventually result in the elimination of cogongrass. However, no studies have determined exactly how long this takes. But it is clear that it may be a longer period than many situations in Florida can provide.

And how does this relate to control? The final issue is how water levels influence herbicide efficacy on cogongrass and is likely two-fold depending on where you are on the moisture gradient. Some invasive plants are more difficult to control in riparian areas as compared to upland situations. This may be the result of greater recruitment, growth, and recovery potential with higher and more consistent water availability. This is often evident in periods of drought, where cogongrass does appear healthier and more vigorous along water. More vigorous cogongrass generally means more rhizomes to kill. This may translate into more herbicide treatments to finish the job and the common perception that cogongrass is impossible to get rid of.

The second aspect is the likely stress induced in cogongrass by higher water conditions. It is not completely clear how cogongrass reacts to glyphosate and imazapyr when treated before and during periods of partial inundation. We know from countless years of torpedograss treatment with glyphosate that control is often poorer when water is high. Translocation studies have shown poor glyphosate movement below the water line in torpedograss and the same may be true for cogongrass in extremely wet to saturated soils. This is a question that has yet to be answered.

To summarize the key points. Cogongrass is not an aquatic grass, but it exhibits considerable tolerance to seasonal inundation. High water will likely reduce, but not necessarily eliminate, new seedling recruitment along shorelines. Well-established patches along water often have very abundant rhizome growth, which helps the species persist through wet periods, rapidly expand in drier periods, and generally increase the difficulty of effective control. Glyphosate and imazapyr are still the "go-to" herbicide treatments and will remain the standards until we can identify new treatment options. And for that, I will continue the fight, even if I have to donate a bit more blood to the cause.

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

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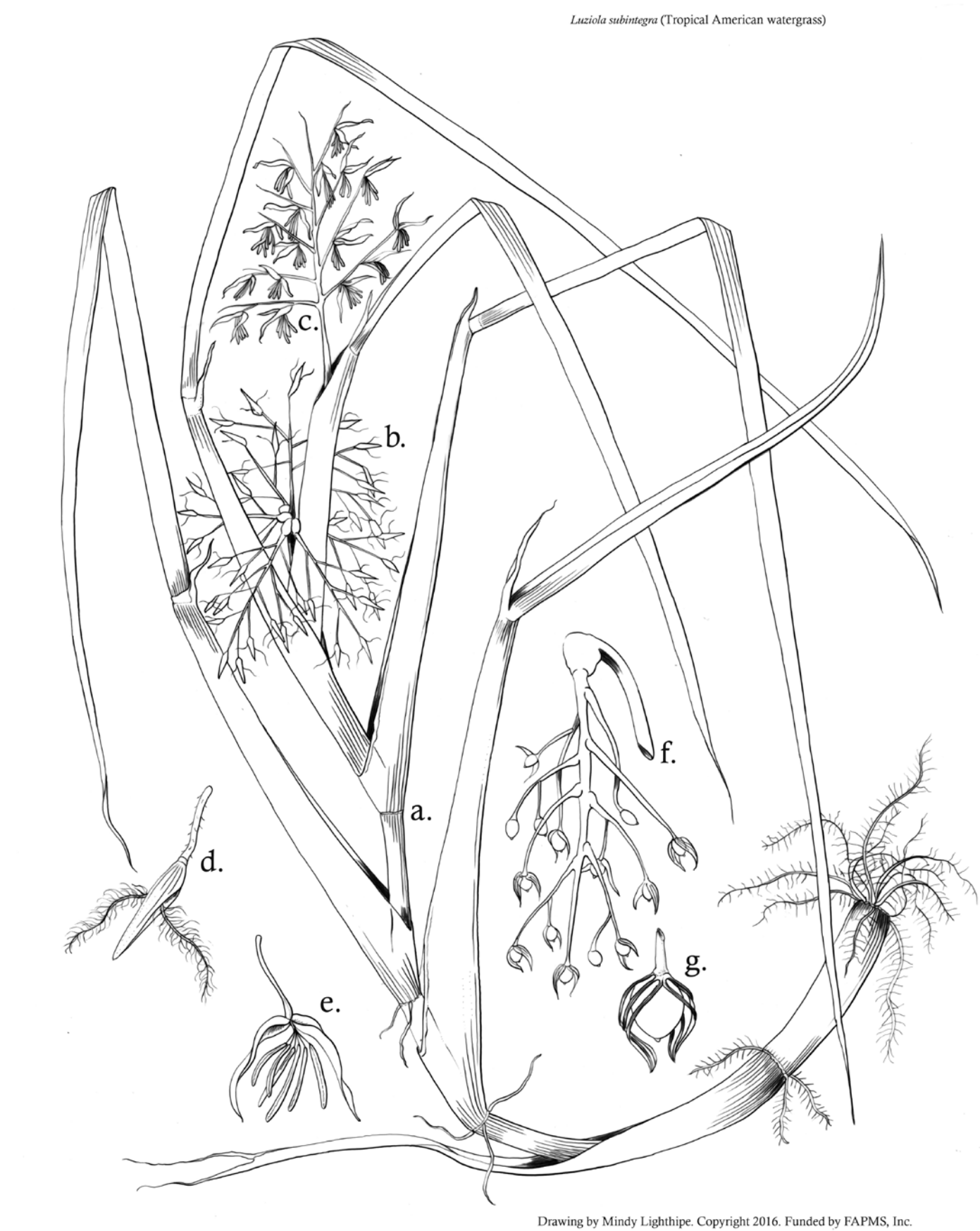

Figure 1. Tropical American watergrass, *Luziola subintegra*: a. Wide open sheaths connect the leaf to the main stem; note the long membranous ligule where the leaf joins the sheath; b. Female flower stalk; c. Male flower stalk; d. Female flower with stigmas protruding; e. Male flower with anthers free; f. Branching seed stalk; g. Fruit (seed) enclosed in lemma and palea, having lost interveinal tissue.

A GIANT WATERGRASS FROM THE AMERICAN TROPICS

Figure 2. Spring leaves grow upright from the base of tropical watergrass while culms from the previous season, encased in dry brown sheaths, extend horizontally.

by Colette Jacono

Tropical American watergrass, *Luziola subintegra*, sports characters that appear nearly grotesque, or gorgeous, depending on your point of view. In reality, the special effects are merely a function of the enormous size of this plant. Its giant size is all the better for learning the special characters that distinguish it from other grasses that grow in the many dimensions of the aquatic field.

Tropical American watergrass originates from the tropics of our western hemisphere and was only first recorded for North America in 2007 at Fisheating Bay. It soon expanded in that western embayment of Lake Okeechobee. Two years later a small, ditch bank population appeared at a restoration area near the eastern boundary of the Everglades. It was extirpated (eliminated) within a few years. Recently, however, the species has expanded its range beyond Fisheating Bay into Lake Hicpochee on the canalized Caloosahatchee, and into a ditch along Glades Co. Hwy 78. Both occurrences were likely discharged from a structure on the lake. As Mike Bodle of the South Florida Water Management District finds it "On the move again, nine years on", the timing seems right to present a new illustration of Tropical American watergrass (Figure 1), funded in full by FAPMS.

The water grasses, *Luziola*, are most closely related to wild rice, *Zizania*, and giant cutgrass, *Zizaniopsis*. Along with cutgrass, *Leersia*, these four genera make up the rice tribe of grasses in Florida. Typical tribal characters – the open sheaths, membranous ligules that become papery when dry, and the absence of glumes (bracts) at the base of individual flowers are shared features that help pull the group together. These characters are easily seen on Tropical American watergrass as artist Mindy Lighthipe has portrayed in Figure 1.

Tropical American watergrass regrows annually from the base as long, thick, horizontal stems (called culms) with hollow

centers, and as upright leaves directly from the base (Figure 2). The internodes are especially long, often up to 30cm. In Figure 1 the internodes have been shortened by the artist to fit a culm to the page. The culms grow to 2m long and depending on the environment, float in shallowly submersed mats or creep along the muck. Lower nodes along the culm may root and branch while the upper nodes produce leaves at the end of long sheaths. The sheaths open widely at the base and become spongy under aquatic conditions. When the environment dries, the old expanded sheaths become brittle, loosen and fall. Except for a sparse line of small hairs along the outer margin of the sheath, Tropical American watergrass remains free of hairs. The harshness felt when touching the plants comes from the rough edges on the leaf margins.

Figure 3. A membranous ligule appears on seedlings where the young sheath meets the fresh leaf.

Figure 4. The female flower stalk of tropical watergrass barely extends beyond the sheath. A dewlap can be seen as the yellowish hinge at the bottom of the leaf in the upper left of this image.

Where the sheath finally meets its junction with the leaf, the ligule suddenly appears as a long transparent membrane. The ligule will continue to grow with the leaf, extending to 1 to 1.5 cm long. As the ligule wraps around the culm, the center often splits and as it darkens with age it changes from a transparent membrane (Figure 3) to a pair of pointed, dry claws (Figure 1a). The leaves of tropical American watergrass are widely linear and narrow to a slender point at the tip. Thanks to the dewlap (the light-colored hinge of the blade joint), the leaves are not fixed in one plane. The dewlap is located just between the top of the sheath and the leaf blade (Figure 3, upper left in image). It allows the blade to position itself towards the sun, in spite of the lay of the culm.

In Florida, tropical American watergrass flowers once a year, from late November to mid-December. Male flowers are separate from female flowers and both are produced on their own stalks (Figures 1d and 1e). The female stalks carry only female flowers, are short and barely extend from the sheaths in which they develop (Figures 1b, 1f and Figure 4). Many closely arranged branches come off the female stalk, each

Figure 5. The male flower stalk bears white, male flowers. Here the upper flowers have dried, the stamens turning orange, while the lower flowers continue to shed fresh yellow pollen from their stamens.

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Figure 6. Southern watergrass (left) grows to 1/10 the size of tropical American watergrass (right). Here the leaves of southern watergrass are fully grown while those of tropical American watergrass are just beginning to develop off last year's culm.

branch notably swollen at the base. Each swelling, called a pulvinus, is composed of special motor cells which induce changes in turgor (rigidity) and result in branch movement. The most important detail for the determination of this species is that each branch of the female stalk ends in a flower at its tip.

The male flower stalks appear simultaneously to the female (Figure 1c and Figure 5). Sometimes they are produced off the same node as the female stalk, as in Figure 1, but other times they occur on separate branches or even separate culms. An interesting feature of the male stalk is that its flower type is not conserved. In other words, often male stalks bear only male flowers, yet other times they also hold some female flowers, and occasionally male stalks are all female in flower type. A very changeable species indeed!

Finally, many of the female flowers will mature into fruits. While it may not seem right to say there is an "absence of glumes" on the fruits, such is the case when the lower pair of bracts is missing. Remember, the absence of glumes is of prime importance when recognizing the rice tribe of grasses. A working translation is that each fruit is encased in only a single set of bracts, the lemma (lower bract) and palea (upper bract). The lower set of bracts (glumes) just never develops. When mature, the tissue between the veins of the lemma and palea fall away, leaving only the veins as cover. This offers a clear view of the fruit, an external wall protecting a single embryo, which may as well be called a seed (Figure 1g).

With this understanding of the tropical American watergrass behind you, try to move beyond the size barrier and look for comparable features on southern watergrass, *Luziola fluitans*, our common, delicate shoreline species of the southeast. Like tropical American watergrass, southern watergrass consists of long (to 1m) prostrate culms that branch at the nodes. The nodes also produce erect leaves on significant culms, the leaves are long and elliptic in shape and end quickly in a blunt tip. Yet like most all of its characters, including the membranous ligule, those of southern watergrass measure only 1/10 the size of its tropical cousin (Figure 6). In fact, all of the tropical American watergrass species are larger than those that are more temperate, increasing in plant and fruit size as their origin nears the equator. Southern watergrass differs from tropical in that its tiny female flowers are always produced on the same stalks as the male flowers. These stalks are tiny, few-flowered, and apparent in summer.

I hope that in learning the watergrass characters, you have just taken a long stride towards recognizing tropical American watergrass in the field. Use your knowledge to help stop this grotesquely gorgeous species from moving on again.

Many thanks to Mike Bodle, Jeremy Crossland, and Jon Morton for logistical support and management efforts.

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Dr. Colette Jacono (colettej@ufl.edu) is a botanist at the University of Florida's Center for Aquatic and Invasive Plants in Gainesville.

Profile: Mindy Lighthipe Botanical Illustrator

The Florida Aquatic Plant Management Society recently agreed to fund 3 line drawings by Mindy Lighthipe after a proposal was submitted by Karen Brown of the University of Florida/IFAS Center for Aquatic and Invasive Plants. One of these drawings (*Luziola subintegra*) has been completed, as you will see in the article about Tropical American watergrass by Colette Jacono.

Mindy graduated from Kean University with a BFA in Studio Arts and a MA in Art Education magna cum laude. She received certification from the New York Botanical Gardens in Botanical Illustration and went on to teach more than 20 different classes in their Botanical Art Program and develop a 250 hour certificate in Natural Science Illustration.

Mindy has been exhibiting her art since 1998 in juried and solo exhibitions. In 2009 she received a Silver Medal from the Royal Horticultural Society in London. In 2010 she had a solo exhibition at the Florida Museum of Natural History. She currently is teaching Scientific Illustration at the University of Florida.

Mindy says, "*I draw and paint the beauty of nature. I believe in protecting the earth and do so by educating people through my art.*" To learn more about Mindy's art, visit her website at www.MindyLighthipe.com

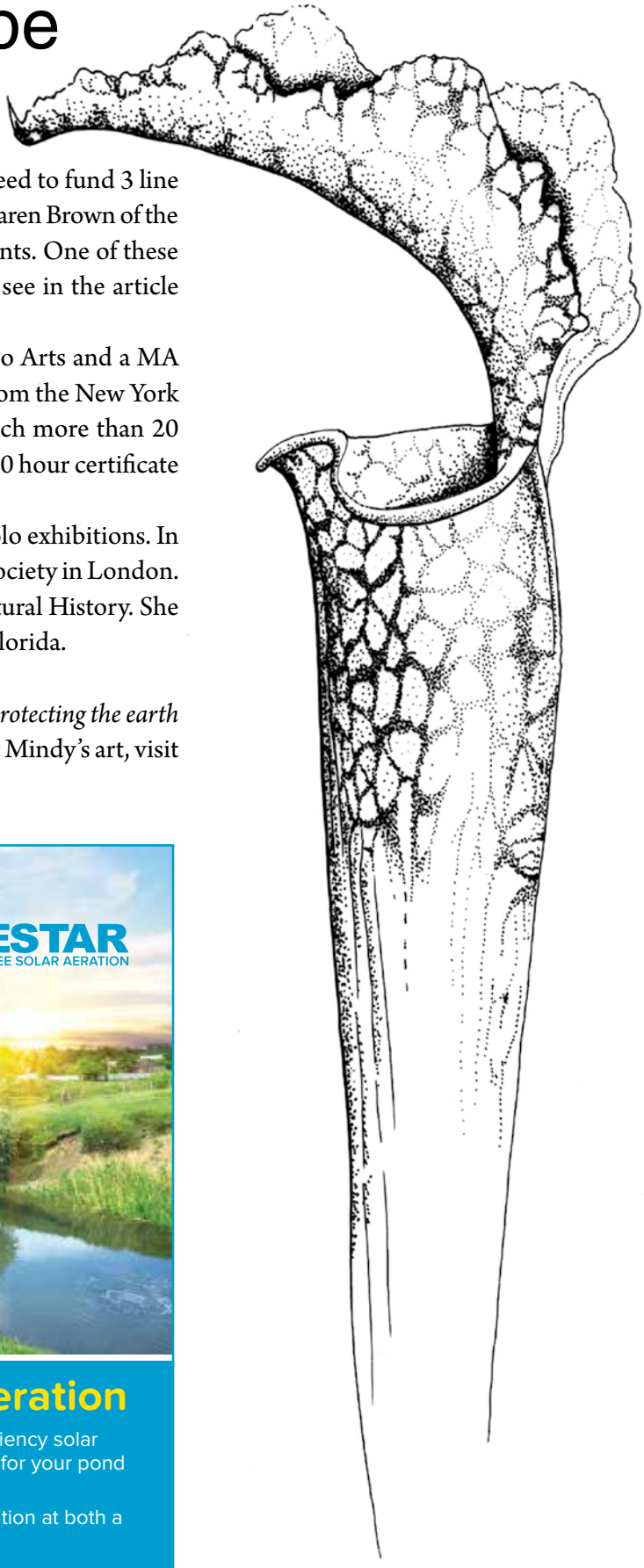

Figure 1. Mindy's beautiful line drawing of a pitcher plant. Image courtesy Mindy Lighthipe.

Aquatic Plant Problems and Management Necessity in Florida Public Lakes and Rivers

Note: this "white paper", written by Jeffrey D. Schardt, was commissioned by the Florida Aquatic Plant Management Society to highlight the importance of aquatic plant management in Florida waters.

Introduction

This report summarizes aquatic plant management in Florida public water bodies: describing the important role of native aquatic plants for fish and wildlife habitat; explaining how quickly non-native invasive plants can impair water body uses and functions; recognizing the most invasive aquatic plants in Florida and the economic and environmental harm they cause without intensive management; and identifying management accomplishments and the recurring funding necessary to sustain current levels of invasive plant maintenance control.

The Florida Fish and Wildlife Conservation Commission (FWC) is authorized by the Florida Legislature as the state's lead agency to direct aquatic plant management activities (S369.20, FS). There are approximately 460 public lakes and rivers in Florida (sovereignty lands accessible via public boat ramp) that comprise more than 1.26 million acres of fresh water. Collectively, these waters are worth billions of dollars to Florida's economy.

Uses and Values of Florida Public Waters

Florida's public lakes and rivers provide a variety of economic uses and ecological functions, including:

- recreational boating, fishing, hunting, and swimming
- ecotourism
- flood control
- potable water supply
- agricultural and residential irrigation
- commercial fishing
- commercial navigation
- fish and wildlife habitat (including threatened and endangered species)
- hydropower
- enhanced property values

Several economic studies have been conducted by the federal government and the state of Florida related to the values of Florida waters at risk if waters are impaired by aquatic plants.

- $1.5 billion in annual revenues to Florida from freshwater fishing and wildlife observation (1985 U.S. Fish and Wildlife Service Report)
- Orange and Lochloosa Lakes (Alachua County) generated $10 million each year to local economies; a ten-fold reduction in annual revenues was identified when invasive waterhyacinth and hydrilla covered the water surfaces (1986 University of Florida Study)
- $13 million annual value for Lake Jackson (Leon County) (1996 FSU Economic Report)
- $50 million annual value for Lake Tarpon (Pinellas County); more than 700 jobs generating $9 million in wages (1997 FSU Economic Report)
- $40 million in economic values at risk for 27,000-acre Lake Istokpoga (Highlands County) (2004 FSU Economic Report)
- $50 million in economic values at risk on the 67,000-acre Kissimmee Chain of Lakes (Osceola County) (2006 FSU Economic Report)

Aquatic Plants

Most of Florida's public lakes and rivers are shallow, nutrient-rich, and capable of supporting aquatic plants with favorable growing conditions nearly year-round. Diverse aquatic plant communities provide important ecological services, including:

- fish and wildlife habitat
- substrate for invertebrates supporting fish foraging
- direct food source for some waterfowl species
- nutrient assimilation
- shoreline stabilization

Native vs. Non-native vs. Invasive Aquatic Plants

Native aquatic plants are species that evolved in Florida and are usually held in check via environmental factors like temperature, light, nutrient availability, or by direct competition with other plant or animal species. There are hundreds of native aquatic and wetland plant species and most only occasionally interfere with the uses or functions of Florida's public waterways.

Approximately 25 non-native plants are routinely encountered during FWC's annual aquatic plant inventories in public waters. About 95% of public waters in Florida support at least one non-native aquatic plant species. Half of the non-native aquatic plant species found in Florida public waters are considered invasive, and more than 95% of Florida public waters host at least one invasive aquatic plant species. An invasive species is defined as one that is non-native to the ecosystem and capable of rapid expan-

sion, causing economic or environmental harm or harm to human health or welfare.

Invasive Plants

Invasive plants share several characteristics, including:

- ☐ rapid growth to reproductive maturity
- ☐ multiple reproductive methods
- ☐ wide dispersal and survival
- ☐ broad environmental tolerance
- ☐ difficult to manage and sustain control

These traits, coupled with Florida's shallow, nutrient-rich waters, year-round growing conditions, and the lack of biological and environmental controls that kept invasive plants under control in their home ranges, allow invasive plants to quickly expand and impair Florida public water uses and functions.

Plant Growth Patterns

Aquatic plants exhibit several growth forms, including floating, submersed, and emergent, and there are examples of widespread invasive plants for each type. Floating plants drift freely on the water surface with the roots suspended in the water column as opposed to being anchored in the sediments. Submersed plants grow mostly underwater; occasionally, a very small portion of the plant (for example, flower stalks) extends above the water surface. Emergent plants are rooted in the sediments, with much of their mass at or extending above the water surface.

Floating Plants

Florida's most invasive floating plants are waterhyacinth and waterlettuce; both were introduced to the state from South America. Waterlettuce is thought to be an accidental introduction, perhaps as a contaminant in ship ballast or water storage containers during colonial times. Waterhyacinth was introduced intentionally in the 1880s as a horticultural plant because of the beautiful flower.

Waterhyacinth populations can double their coverage in as little as two weeks. If left unmanaged, just a few acres of plants can expand to cover hundreds of acres by the end of the growing season. Both waterhyacinth and waterlettuce reproduce via budding and prolific seed production. Seeds can lie dormant in the sediments, with millions of seedlings germinating upon re-flooding after drought conditions. Thousands of acres of waterhyacinth and waterlettuce germinate as the dry marshes of Lake Okeechobee refill after seasonal drought or drawdowns.

The edges of floating plant mats provide cover for fish, and the suspended roots harbor invertebrates, which supplies food for fisheries. However, light is suppressed just inside the edge of the mat, shading out native submersed vegetation. Dissolved oxygen drops below levels required for fish to breathe and for microbes to break down accumulating detritus falling from the floating plant mass. Leaf, shoot, and root material continually slough from floating plants and can accelerate sedimentation more than twice as fast than if plants are managed on a routine basis to keep levels low.

Waterhyacinth is listed as one of the world's worst weeds. Even small patches of floating plants can coalesce in wind or flowing water, clogging irrigation water intakes, flood control pumps, jamming against bridges, uprooting native plants, and blocking navigation and access to boat ramps, which can strand boaters. Floating plants, especially waterlettuce, also harbor

Waterhyacinth floating on Lake Okeechobee

Early hydrilla infestation in Crystal River

Torpedograss smothering Lake Okeechobee marsh

certain species of mosquitoes.

In addition to waterhyacinth and waterlettuce, three other floating plant species have been introduced into Florida, most likely as curiosities in water gardens. The FWC, through its contractors, funds management programs to contain two species – red root floater and feathered mosquitofern – in isolated watersheds of Southwest and South Florida, respectively. In addition, the FWC sponsors eradication efforts for giant salvinia in about a half-dozen locations from Bay to Collier County. Giant salvinia is also listed as one of the world's worst weeds and is causing millions of dollars of impacts, especially in Texas and Louisiana.

Hydrilla surface mat on Lake Toho

Submersed Plants

Hydrilla is by far the most invasive submersed plant growing in Florida public waters. Hydrilla was introduced intentionally through the aquarium trade during the early 1950s. Plants were discarded in canals and planted in rivers and spring runs for harvest, sale, and shipment as needed. In early infestations, hydrilla mimics the low growth and open nature of native submersed plants, providing fish and wildlife habitat, especially in deep water/low light areas where native submersed plant species do not grow. However, because of its rapid growth rate and canopy forming nature, hydrilla quickly smothers native submersed plants and impairs public lake and river uses and functions.

Waterlettuce covering channel on Rodman Reservoir

Although the variety of hydrilla in Florida waters does not form seeds, it has numerous methods by which it reproduces, spreads, and persists. Even small fragments can break loose, drift to other areas, form roots, and start new plants. Stolons spread across the sediments, generating new plants as they grow. Stressed plants produce small winter buds (turions) in the leaf axils that float, drift, and start new populations elsewhere. Hydrilla also produces pea-size buds (tubers) in the sediments by the millions per acre that sprout throughout the year. When the standing crop is controlled, subterranean tubers sprout and renew the infestation.

Perhaps hydrilla's most invasive traits are its growth pattern and rate. Hydrilla needs far less sunlight than native submersed plants for growth. Therefore, it can colonize deeper waters, and its growth season starts before and extends later in the year than native plant species. Hydrilla grows about an inch or more per day from the apical tips, but stems can elongate by eight inches or more per day during the peak growing season from July through September. Growth slows but continues laterally when hydrilla stems reach the

Explosive waterhyacinth seed germination and growth on Lake Okeechobee following drought

Dense hydrilla growth

water surface to form dense tangled mats. A single stem sprouting from one tuber can branch up to 200 times and there can be millions of tubers per acre.

In early stages of infestation, hydrilla mimics native submersed plants by providing cover and substrates for invertebrates fed upon by sport fish. Mature hydrilla stands can provide an edge or reef effect to shelter fish or provide ambush cover for largemouth bass. Without intensive management, hydrilla can fill the water column in Florida's shallow waters within a few months, which ultimately suppresses the fishery it first enhanced. Even when infestations are intense, hydrilla provides easily accessible forage for some waterfowl species.

Most of the biomass in a mature hydrilla stand is in the upper two feet of the water column. These dense mats cause extreme fluctuations in water temperatures, pH, and dissolved oxygen content, making it difficult for fish and their invertebrate forage to survive. Oxygen content can approach zero in dense hydrilla mats by early morning or during prolonged cloudy days when plant respiration exceeds photosynthesis. Photosynthesis is a plant process during which carbon dioxide is converted to oxygen under sunlight conditions. During dark conditions or extended cloudy days, plants respire, consuming oxygen and producing carbon dioxide. Some of the largest fish kills in Florida waters are attributable to the oxygen-consuming properties of dense hydrilla mats. Similar to waterhyacinth, the organic material that sloughs from live hydrilla mats builds up about twice as fast as in open water, covering valuable habitat and accelerating muck buildup on lake and river bottoms.

Emergent Plants

Emergent plants are rooted in the sediments with stems or leaves extending above the water surface. Several invasive emergent plant species threaten native marsh and wetland plant communities. Torpedograss was introduced into Florida as a cattle forage in the 1920s and now is one of the most widespread invasive plants in the state, infesting the shores and marshes of more than 80% of Florida's public lakes and rivers. Two more recent invaders – large-flower primrose and bur-head sedge – are

Large flower primrose covering fish and wildlife habitat on Lake Toho

expanding and covering diverse native grass and bulrush communities (which provide valuable cover and food sources for fish and waterfowl) and forming floating masses of

Floating cattail tussock drifting toward the Lake Apopka flood control structure

Hurricane Charley broke this 35-acre floating island of 4 feet thick peat and trees up to 25 feet on Lake Pierce

vegetation from Central to North Florida. Both of these plants were identified during FWC's annual plant inventories during the 1980s, but had little impact on water uses and functions until recent years. Each species is quickly expanding both within infested waters and into adjacent waters, causing problems to the extent that they have become high management priorities.

Floating Islands and Tussocks

The FWC characterizes tussocks as floating masses of herbaceous emergent plants that are not anchored to the sediments. Tussocks can cover a few square yards to more than 1,000 acres. Floating islands consist of sediments like muck or peat that are up to four feet thick and can support emergent plants or trees up to 40 feet tall. Historically, periodic droughts compacted organic sediments and associated fires burned off accumulations of plant material on exposed lake bottoms. Additionally, periodic flood events thinned emergent and submersed vegetation and flushed organic material into surrounding marshes and uplands. Today, water levels are stabilized in most public lakes in Florida by active flood control gates or passive weirs, causeways, or spillways, or through channelization to connecting lakes and rivers. Residential development surrounding most public lakes precludes flooding and large-scale prescribed fires for safety and economic reasons. Residents and business owners usually object to periodic drawdowns because they may lose the use of the water body for several months. Stabilizing water levels in Florida's shallow, nutrient-rich lakes creates ideal conditions for increased plant growth and at the same time removes the natural processes that used to retard floating island and tussock formation.

When fixed in place, floating islands and tussocks are usually not a problem and provide wildlife habitat. However, when they drift, they can damage docks, bridges, and flood control structures. They can also block boat ramps and navigation channels, which can strand boaters. Management costs range from a few hundred dollars per acre to apply herbicides to small tussocks to more than $20,000 per acre to harvest, transport, and dispose of thick peat islands with overlying tree growth. Managers spent up to $10 million per year for several years after the 2004 and 2005 hurricanes broke thousands of floating islands and tussocks loose in nearly 50 Central Florida lakes and rivers.

FWC Aquatic Plant Management Strategy

The FWC aquatic plant management approach is to work with stakeholders to identify the primary uses and functions of all Florida public waters and to manage plants to conserve these attributes. This includes managing native as well as non-native and invasive aquatic plant species. FWC attempts to eradicate invasive aquatic plants that have not become established in the state to prevent spread into Florida public waters. FWC contractors also work to eradicate newly discovered populations of invasive aquatic plants in a public water body that may already be present elsewhere in Florida, but were not previously established in that system. In both cases, the intent is to prevent long-term and costly management programs. If an invasive plant becomes well-established in a Florida water body, the management strategy shifts to maintenance programs to keep invasive plants at low enough levels to conserve or enhance the primary uses of the water body.

FWC is designated by the Florida Legislature as the lead agency with both the responsibility and accountability to develop and implement statewide, consistent, and cost-effective aquatic plant management strategies. This requires sufficient and well-trained staff to assess conditions, implement operations, and monitor results, both in terms of contract compliance and efficacy in controlling target plants while conserving non-target plants and animals. Appropriate contractors and materials are necessary to quickly respond to any aquatic plant management-related issue and to adapt to control new plants, changing conditions, and to apply new technologies. The FWC has at least two contractors available to immediately implement management operations on any Florida water body.

Research to integrate new control technologies and to adapt to changing

conditions, as well as outreach to inform and train biologists and control crews with latest management strategies, are essential for long-term management stability. See below for the types and numbers of FWC aquatic plant management-related contracts. Also essential is sufficient, dedicated, and recurring funding to sustain the current low levels of invasive plant infestations in Florida public waters.

FWC Aquatic Plant Management Contracts (total: 55 in 2015)

- ☐ 27 contracts with private sector companies
- ☐ 14 aquatic plant control contracts with Federal, state and local governments
- ☐ 11 research contracts to develop control methods and evaluate management strategies
- ☐ 3 contracts to develop and distribute education, training, and outreach materials

Management Results and Funding Requirements Overview

With few exceptions, invasive plants and nuisance growth of native aquatic plants are under maintenance control in Florida public lakes and rivers. Sustaining this level of control requires

frequent management efforts throughout the year. That management is contingent upon sufficient, dedicated, and recurring funding and ongoing research to adapt to ever-changing conditions and management challenges.

Prior to 1999, aquatic plant management funding was generated primarily from boat registrations and fuel taxes; however, this funding was insufficient to keep pace with invasive plant colonization and expansion. Consequently, hydrilla spread within and among Florida's largest and most important water bodies, reaching its apex of nearly 100,000 acres during 1994. Stopgap funding was obtained from other programs for several years, but this piecemeal approach did not allow for long-range planning and management. The Florida Legislature resolved the funding dilemma in 2000 by providing sufficient, recurring funds for aquatic plant control via the Florida Forever Act. The rationale was that a portion of the funds used to acquire sensitive lands was to be used to control aquatic plants to conserve economic and environmental attributes of state-owned aquatic and wetland sites.

Aquatic plant management plans were authorized by the FWC on more than 430 public waters in FY 2014-2015. Over the past five years, an average of nearly 70,000 acres of aquatic plants have been controlled per year at an average annual cost of $19.2 million. That level of control and corresponding funding needs to be consistent to sustain management achievements, or plants will re-grow and the gains of the past decade will be lost in a matter of one or two growing seasons.

Floating Plants

Once established, invasive aquatic plants have proven difficult to impossible to eradicate from Florida public waters. However, negative impacts can be minimized when invasive plants are managed on a frequent and consistent basis to prevent small infestations from expanding across hundreds or thousands of acres. This concept is known as maintenance control and has been the cornerstone, as well as Legislative mandate (S.369.22(3), FS), of Florida's invasive aquatic plant management program since the mid-1970s.

Figure 1 shows the benefits of floating vegetation maintenance control along the Suwannee River from 1974-2014. Until the early 1970s, floating plants were often allowed to grow until conditions became intolerable, resulting in the need to control

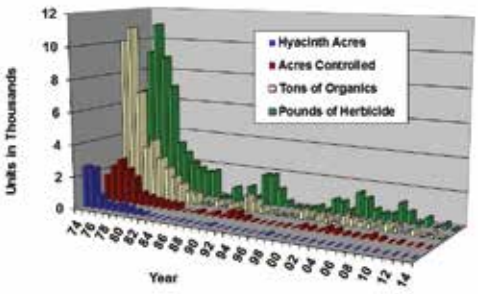

Figure 1. Suwannee River waterhyacinth presence and management - 1974 - 2014

hundreds of acres of plants to restore water body uses and functions. Plants quickly recovered and the cycle repeated. This type of crisis management not only leads to impaired waters from floating plants, but also results in higher management costs, higher herbicide use, and increased sedimentation from controlled plants (in addition to material sloughing from live plants). The maintenance control management strategy was implemented statewide – including the Suwannee River – by the late 1970s. Nowadays, only a few acres of floating plants ever infest the Suwannee River at any one time. Any plants flushed into the river from adjacent marshes or private lands are quickly and economically brought back under control to conserve the native plant communities along the river.

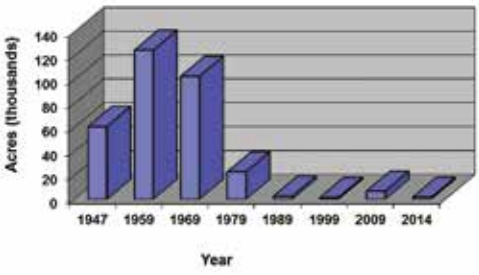

Figure 2. Waterhyacinth acres in Florida public waters: 1947-2014

Figure 2 demonstrates the results of waterhyacinth maintenance control on a statewide level. Nearly 125,000 acres of floating plants infested Florida public lakes and rivers in the early 1960s. Nowadays, the cumulative statewide standing crop ranges between 5,000 and 8,000 acres. Waterhyacinth and waterlettuce collectively are present in about 60% of Florida's public waters; however, 85% of these waters support fewer than 10 acres of floating plants. Floating plants are considered to be under maintenance control in about 99% of Florida's public lakes and rivers. However, these waters can be quickly impaired by remnant plants and the long-lived seed bank within Florida waters and by plants flushing in from adjacent marshes and canals that are often inaccessible to FWC management crews. Managers need between $4.5 and 5.5 million annually to keep floating plants under control in Florida public waters.

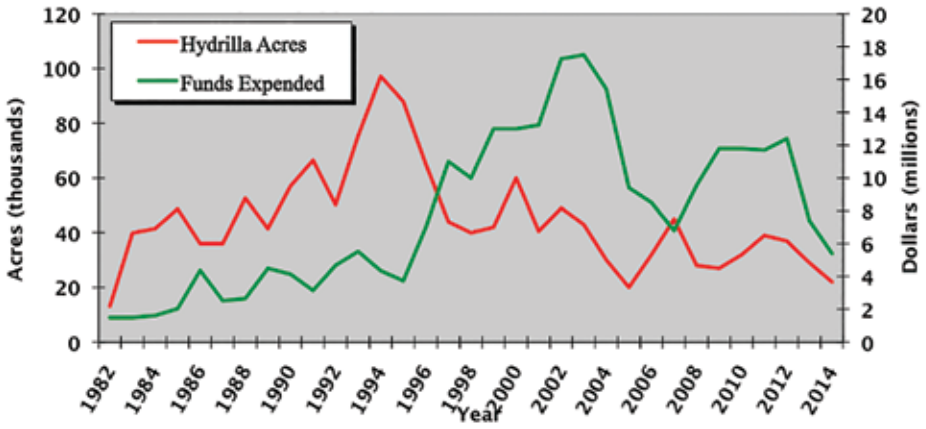

Figure 3. Relationship between hydrilla and management funds in Florida public waters 1982-2014

Submersed Plants

Hydrilla is by far the most problematic of the invasive submersed plants in Florida public waters; it is found in more waters, covers more acreage, and requires by far more management efforts and funding to keep under maintenance control than any other species. Figure 3 shows the relationship between available funding and hydrilla cover in Florida waters over the past 32 years.

When funds are sufficient, hydrilla can be managed at a low level. When funds decline, hydrilla expands to a higher level within infested waters and to adjacent waters, requiring additional recurring funding for control. Hydrilla reached its apex in Florida public waters in 1994, when the species covered nearly 100,000 acres. Although the standing crop in the collective 185 waters where hydrilla was reported in 2014 totaled about 21,836 acres, underground tubers, which represent hydrilla's ability to immediately sprout and refill the water column, are estimated at about 60,000 acres. Therefore, the FWC must remain diligent in controlling this highly invasive aquatic plant to prevent it from impairing Florida's public waters. Suppressing hydrilla allows diverse native plant communities to flourish and conserves recreational uses. Additionally, sustaining low levels of hydrilla through time reduces taxpayer management expenses and allows the FWC to meet its federal obligations to reduce herbicide use in Florida waters.

Hydrilla has been reported during annual aquatic plant inventories in 365 (80%) of Florida's 460 public waterways over the past 32 years. The highest acreage (97,000 acres) was reported in 1994 and the highest management cost of $17.5 million reported in 2003. Persistent management, consistent funding, and improved research and technology have allowed managers to reduce hydrilla to 185 (40%) of Florida's public waters and a standing crop of about 22,000 acres, which is comparable to levels reported in the early 1980s. Annual management costs continue to decline while meeting management objectives. The average hydrilla control cost over the past five years is about $8.5 million per year.

Other Plants, Tussocks, and Floating Islands

About $3.5 to 4.0 million are required each year to control about 8,000 acres of aquatic plants other than waterhyacinth, waterlettuce, and hydrilla. In recent years, most of that amount has been spent controlling two invasive emergent plants – bur-head sedge and giant flower primrosewillow. These plants are expanding into valuable fish and wildlife habitat throughout the Kissimmee Chain of Lakes and other important resources in Central Florida. Research is underway to learn more about the physiology of these plants and to develop cost-effective and selective control measures.

Jeff Schardt (jeff.schardt@gmail.com) recently retired from the Florida Fish and Wildlife Conservation Commission and is now the APMS Secretary.

The Historical Introductions of Waterhyacinth and Hydrilla into the United States

by Don C. Schmitz

During the summer of 1988, I conducted research for a paper I eventually presented at the first Exotic Pest Plant Council (EPPC) Symposium which was held in November 1988 in Miami and was later published in a U.S. National Park Service Document (Schmitz et. al, 1991). I combed through historical documents and conducted interviews with employees and owners of Florida's aquarium plant farms and a former U.S. Department of Agriculture scientist to determine how invasive non-native aquatic plant species were first introduced into our state. At that time, I was a state regulatory inspector of the aquarium plant industry and regularly visited these farms in Central and South Florida and got to know the farmers. Many of them freely shared their memories of when their industry was new just after World War II and when the importation of live tropical plants from other parts of the world became possible with the availability of air cargo shipments.

After I presented my paper at the EPPC symposium, I retained a strong interest in determining how these invasive plants that we commonly control today were first introduced into North America. With a new research tool available to me in the 1990s, the internet, I continued to add to my knowledge about their introduction history. The following is the information I gathered through the years regarding the introduction of waterhyacinth and hydrilla into the U.S. and Florida.

Figure 1. That "beautiful bloom" of waterhyacinth. Photo courtesy Lyn Gettys.

Waterhyacinth

Waterhyacinth may have been present in New Orleans before the World's Industrial and Cotton Centennial Exposition, which has historically been linked with its introduction into North America. Waterhyacinth (*Eichhornia crassipes*), a native of South America, is commonly believed to have been first introduced into the United States at this Exposition which was held in 1884-85 in New Orleans, Louisiana (Klorer, 1909; Anonymous, 1956; Tabita and Woods, 1962; Weldon et al., 1969; Vietmeyer, 1975). Klorer (1909) was the first person to link waterhyacinth's introduction to the Exposition, but not specifically to the species being imported by any of the South American exhibits or

being shown at the Exposition. To quote Mr. Klorer from his 1909 paper:

> *"It made its appearance here at the time of the Cotton Centennial Exposition in 1884, being shown then as an exotic plant which readily made friends on account of its beautiful bloom and the little difficulty experienced in growing it. From New Orleans some of the plants were taken to the surrounding parishes and cultivated in ponds and in gardens as admirable aquatic specimens."*

Other published papers reported that waterhyacinth was imported from the Orinoco River in Venezuela by members of the Japanese exhibit at the same World's Industrial and Cotton Centennial Exposition and were given away to Exposition visitors as souvenirs (Gowanloch, 1944, 1945). Curiously, there is no mention of waterhyacinth in the informational brochures and catalogs from the Exposition's Japanese and Venezuelan exhibits, which contain extensive information regarding imported horticultural species. Furthermore, there was no mention of waterhyacinths from the other Central and South American exhibits and/or their displays, or at Tulane University and Louisiana State archives. Similarly, magazine articles and a book published about the Exposition do not mention this beautiful and unusual floating water plant (Fairall, 1885; Smalley, 1885a, b). Gowanloch's papers include statements assigning the responsibility for introducing the waterhyacinth at the Exposition to the Japanese. These are the first and earliest references pointing to the Japanese as accountable. Coincidentally, it should be noted that anti-Japanese public sentiment was high when these papers were published in the mid-1940s.

There are other reports that waterhyacinth was in North America twenty years earlier (United States Congress, 1898; Tabita and Woods, 1962), and may have been cultivated as a greenhouse and landscape exotic plant shortly after the U.S. Civil War (Penfound and Earle, 1948). Seidenberg (1990) found information pointing to a wealthy amateur botanist and plant collector who may have had it before the Exposition. Dr. Tobias Richardson, the **Dean of the School of Medicine** at Tulane University (from 1865 to 1885), and his wife, Ida, were amateur botanists, plant collectors, and world travelers and spent time in the Amazon and Peru sometime during the 1870s and early 1880s. They traveled to the Amazon River Basin and collected exotic plants, one of which may have been the waterhyacinth, and brought them to their home in New Orleans before 1884.

Their residence in New Orleans was known as "Palm Villa" and once contained a world collection of palms and ferns and a greenhouse with orchids (Seidenberg, 1990). They also introduced many foreign plant species into New Orleans (Ewan, 1965). Their property had a water garden with several plant species obtained from South America, one of which was the Amazon water lily (*Victoria regia*) and another being waterhyacinth. Note the description of the flora in a pond on his property written by Dr. Richardson for an article he wrote in a horticulture journal (Richardson, 1886):

> *"In our pond, which is cemented, we grow several species of* Nymphea*, of which* devoniensis *and* rubra *are the most satisfactory; also* Nelumbiums (speciosum *and* luteum*),* Pontederia crassipes, Limnocharis humboldti, Pistia, *and* Trapa*."*

Pontederia crassipes is a synonym for *Eichhornia crassipes*. This confirms that he had waterhyacinth on his property although the article was published a year after the Exposition closed. But remember, he traveled and collected plants from South America during the 1870s and early 1880s, several years before the Exposition. More evidence suggesting that Dr. Richardson collected waterhyacinth from South America and introduced it into the New Orleans area was that the species was commonly known for a while as the "Richardson Lily" (Seidenberg, 1990).

In addition, Palm Villa was located just off St. Charles Avenue—a major thoroughfare between the Exposition and the French Quarter (about 2 miles from the site of the 1884-85 Exposition, now Audubon Park). Even back then, the French Quarter was a tourist attraction and included many hotels where attendees

St. Johns River - 1931

Figure 2. Waterhyacinths clogging the St. Johns. Image courtesy UF/IFAS Center for Aquatic and Invasive Plants.

Steamer Alligator - Palatka - 1899

Figure 3. A steamer named "Alligator" trying to work its way through the waterhyacinths. Image courtesy UF/IFAS Center for Aquatic and Invasive Plants.

of the Exposition would likely have stayed during their visit to New Orleans. Palm Villa exotic flora was well-known in the New Orleans area during that time and at least some of the visitors to the Exposition may have gone there during their stay. By the time the Exposition concluded in May 1885, the Expo had attracted more than 1 million visitors, including an estimated 36,000 the week of Mardi Gras. Considering how prolific waterhyacinths can grow in a small water garden, if Dr. Richardson had them on his property during the Exposition and entertained Expo visitors, he may have been giving away a few waterhyacinths on a weekly basis.

The introduction of waterhyacinth into Florida is better documented. It apparently occurred after Mrs. W. F. Fuller brought waterhyacinths home from New Orleans in two tin pails (Barbour, 1944) and placed the plants in her fish pond located on the banks of the St. Johns River, near Palatka, in 1884 (Anonymous, 1896; Tabita and Woods, 1962). It should be noted that there are other reports that she actually obtained waterhyacinth from Europe instead of New Orleans (Anonymous, 1896; United States Congress, 1898). The plants in her pond fountain quickly multiplied and the excess plants were innocently discarded into the St. Johns River. The owner of a farm grove who claimed to have introduced this exotic plant into Florida was interviewed in 1896 (Anonymous, 1896) and stated "the people of Florida ought to thank me for putting these plants here."

The ultimate result of this introduction was an economic and ecological catastrophe. By 1893, waterhyacinth was already becoming a nuisance by hindering boat navigation on the St. Johns River (Buker, 1982). A few years later (1896), the species had spread throughout most of the river system, assisted by cattlemen who introduced waterhyacinth from water basin to water basin because they thought waterhyacinths would make good cattle feed (United States Congress, 1957). By the late 1950s, it was estimated that waterhyacinth occupied over 51,000 hectares of Florida's waterways (United States Congress, 1965).

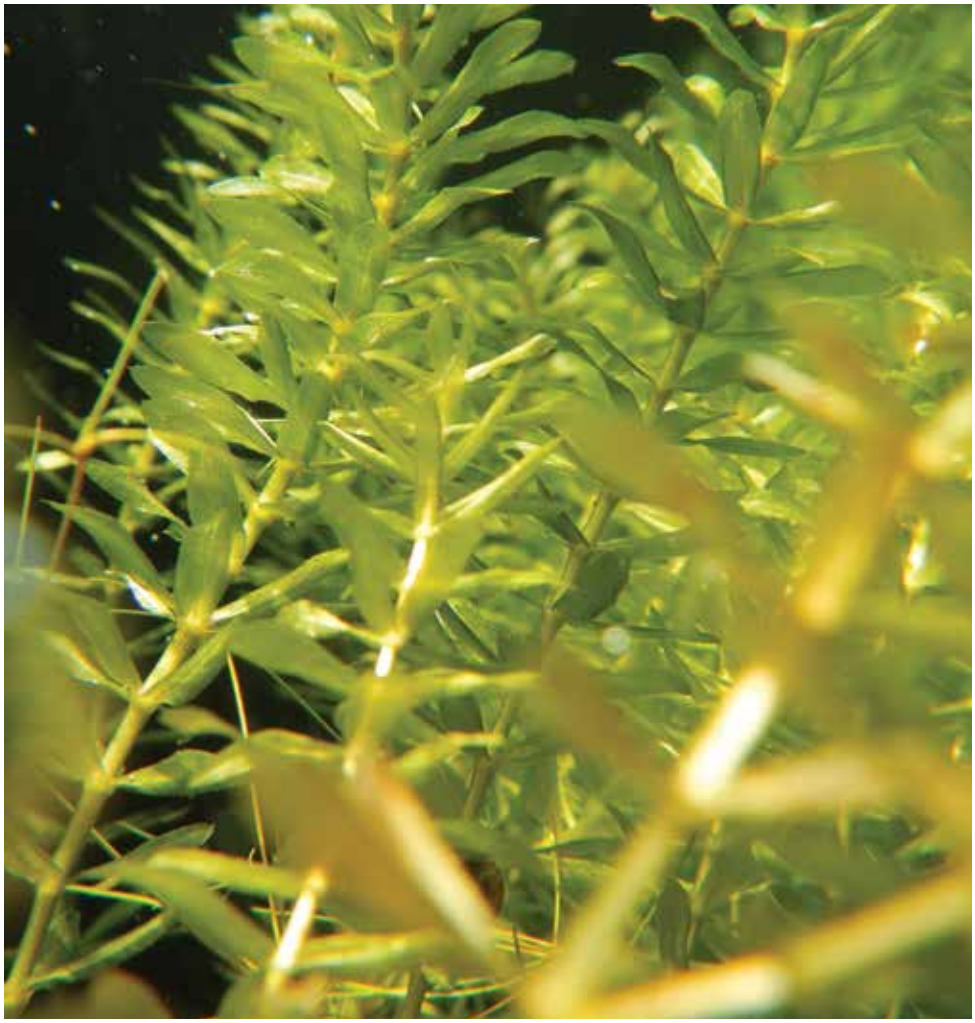

Figure 4. Hydrilla. Photo courtesy Lyn Gettys.

Hydrilla

The following information regarding the first introduction of hydrilla into Florida is based on an interview I conducted with Mr. Don Jennings in 1988, a man then in his late 70s, who managed an aquarium plant farm located in the outskirts of Tampa. According to Mr. Jennings, hydrilla was first introduced into the U.S. in Missouri. Mr. Otto Beldt of St. Louis, Missouri, one of the early pioneers in the tropical fish/aquatic plant mail-order trade in the U.S., imported from Ceylon (now Sri Lanka) what he thought was another species of *Anacharis* (a submersed plant commonly sold in aquarium stores). Laboratory molecular tests conducted in the 1990s indicate a Southern India/Sri Lanka origin of Florida hydrilla (Madeira, P. T. et al., 1997), confirming Mr. Jennings' account.

Because Mr. Beldt enjoyed sharing his new finds with others in his profession, the St. Louis tropical fish and plant farmer sent six small bundles (about 10 inches long and 6 inches wide) in either 1950 or 1951 to another aquatic plant farmer, Mr. Albert Greenburg, in the Tampa Bay area. Mr. Greenburg had established the first tropical fish and aquarium plant farm in Florida in 1932; he was also the first inductee into the Florida Agriculture Hall of Fame. Mr. Greenburg conducted his business from two locations: one to grow plants on the outskirts of the city and the other near the Tampa airport on Cypress Street for shipping and receiving plant material.

Mr. Greenburg was not impressed with the color and overall appearance of this new, potential aquarium plant sent by Otto Beldt. Believing that he had little commercial use for this species, the Tampa Bay farmer told his employee (Mr. Jennings) at the shipping and receiving location to do whatever he liked with them. Mr. Jennings

Figure 5. A re-creation of the six bundles of hydrilla that started it all. Photo courtesy Don Schmitz.

almost threw the six bundles into the trash. At the last moment, before ending his work day, he decided to keep the plants alive by storing them in a small wire cage in a canal located at the back of their business off of Cypress Street. Then he forgot about them.

Several months later, when a shipment of live plant material destined for the northern U.S. missed its flight, Mr. Jennings traveled out to the canal to store these aquatic plants overnight for shipment the next day. Much to his surprise, the vine-like submersed plant species that he had placed into the wire cage months before had escaped and spread throughout the canal. The Tampa Bay farm then decided to market this plant under the name "Indian Star Vine." The first south Florida farmer to receive "Indian Star Vine" was located near Old Cutler Road in southeastern Miami. A former employee of this farm recalled that "Indian Star Vine" was being grown and sold as an aquarium plant when she started this job in 1955. Substantial quantities of their aquarium plants were also collected from Black Creek not far from their farm. Although another former employee denies the deliberate planting of "Indian Star Vine" into the creek, it had become established there by 1959.

In 1960, the Central and Southern Flood Control District (now the South Florida Water Management District) contacted personnel from the U.S.D.A. Plantation Field Station regarding a severe aquatic weed infestation in the Snapper

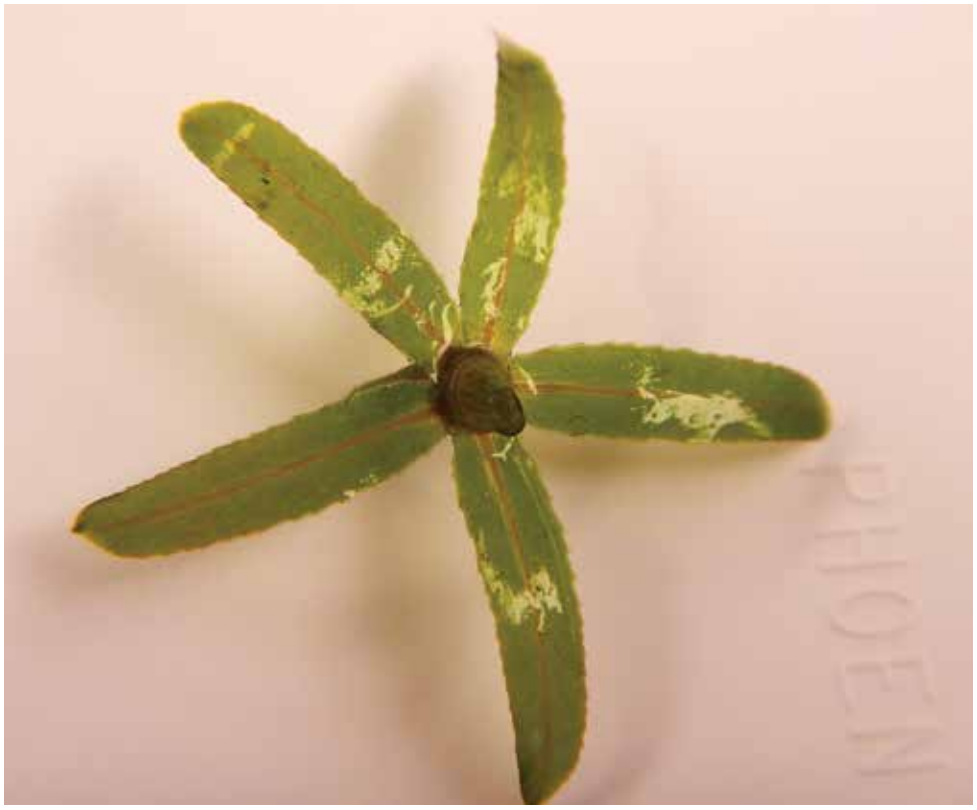

Figure 6. A likely reason hydrilla was referred to as "Indian Star Vine." Photo courtesy Lyn Gettys.

Creek Canal located in southern Miami (Blackburn et al., 1967). Dr. Lyle Weldon and Dr. Bob Blackburn, then U.S.D.A. scientists, obtained samples of this new submersed aquatic plant species and sent them to the University of Florida in Gainesville, Florida and the Smithsonian Institution in Washington, D.C. for identification. Unfortunately, the samples were misidentified by both institutions as *Elodea canadensis*, a common water plant native to the U.S.

By 1965, Dr. Weldon and Dr. Blackburn noticed something odd about this species that had been identified as *Elodea canadensis*. A plant obtained by them from Lake Osborne in Palm Beach County had a subterranean tuber attached to its roots. They speculated that the original identification was incorrect because *Elodea canadensis*, and for that matter, another look-alike species, *Egeria densa*, do not produce tubers or subterranean vegetative propagules. Almost immediately, they sent another sample of "Indian Star Vine" to Dr. Harold St. John, a recognized authority on the genus *Elodea*. This time, it was correctly identified as *Hydrilla verticillata*. Ironically, Dr. Weldon, the U.S.D.A. scientist who was instrumental in confirming the first hydrilla infestation in North America, lost his life entangled in hydrilla in a SCUBA diving accident in 1972.

Hydrilla rapidly spread throughout Florida during the 1960s and throughout the South in the 1970s. By 1988, hydrilla infested over 22,000 hectares of Florida's water bodies, with more than 6,000 hectares being controlled annually. Only the female biotype of hydrilla is known to be infesting Florida's waterways. But in 1982, hydrilla obtained from a northern plant nursery produced male and female flowers, confirming the monoecious biotype had been introduced into North America (Steward et al., 1984).

Sometime in the early 1970s, legend has it that former Florida Congressman Louis Frey's favorite fishing hole in Central Florida had become clogged with hydrilla, preventing him from fishing as he always had. Supposedly, he was so outraged that he filed and sponsored a Congressional Bill in 1973 that eventually became the U.S. Federal Noxious Weed Act, which was signed into law in 1975 and established the U.S. Federal Noxious Weed list. Adding some credibility to this legend was a

sentence about hydrilla in the report that accompanied the Senate Bill for the U.S. Federal Noxious Weed Act (United States Congress, 1974):

"…hydrilla, which was imported for use as an ornamental in home aquariums and accidentally released into Florida waterways… the weed clogs waterways and is ruinous to fishing."

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Don C. Schmitz (dcschmitz@comcast.net) is Executive Director of the North American Invasive Species Network headquartered in Gainesville, Florida.

Aquavine

AERF – What Is It Wednesday!?!?

Are you a social media junkie? Need to add to your wardrobe? Good with aquatic plant ID? Well, we have the game for you! Next time you are perusing your timeline on a Wednesday, stop by the Aquatic Ecosystem Restoration Foundation's Facebook page and test your identification skills. Each and every Wednesday, AERF posts a photo of something aquatic-related. The first person to guess correctly will receive a FREE AERF t-shirt. Answers will be announced each Thursday, so the next time you are bored on a Wednesday, stop by and play!

Florida APMS Student Scholarships

The Florida Aquatic Plant Management Society offers two types of scholarships.

The William L. Maier Jr. Memorial Scholarship (application deadline August 1)

- is available to U.S. citizens who are enrolled in an accredited graduate program at a Florida university or college and are majoring in a field of study directly related to the management of freshwater aquatic vegetation for the ecological benefit of aquatic or freshwater environments.

The Paul C. Myers Applicator Dependent Scholarship (application deadline June 1)

- is open to deserving dependents of FAPMS members who are (or will be) enrolled in college. Both scholarships are competitive. For more information and application materials, go to fapms.org and click on the "Scholarships" tab at the top of the page.

Northeast APMS Student Scholarship

The Northeast Aquatic Plant Management Society provides scholarship funds designed to encourage and involve exceptional graduate students in the field of aquatic plant management. Awards may be used as a stipend, for research budget expenses (travel, supplies, etc.), to defer fees, to defray living expenses for summer research, or any combination of these items. Applicants should be enrolled in a Master's or Doctoral level research program with a college or university in the northeast region of the United States, with a research focus in the area of aquatic plant management. There are no deadlines for application. Applications that are received by the Scholarship Committee will be held until the next scheduled Board of Directors meeting for review. NEAPMS will review applications twice annually, once in September and once in January, and make awards based on candidate qualifications and funding availability. For more information, visit www.neapms.org/graduate-student-scholarship-award/

Call for Papers – Aquatic Plant Management Society

The Aquatic Plant Management Society is accepting abstracts for their 2016 Annual Meeting, which will take place July 17-20 in Grand Rapids, MI. Abstracts are due April 29 and should be submitted online through the WSSA Title and Abstract Submission website at wssaabstracts.com/. More information about abstract submission can be found in the Call for Papers at apms.org/wp/wp-content/uploads/2014/09/APMS-Second-Call-for-Papers.pdf. More information about the meeting is located on the 2016 meeting website at apms.org/annual-meeting/2016-annual-meeting/

Call for Papers – Florida Aquatic Plant Management Society

The Florida Aquatic Plant Management Society 40th Annual Training Conference will be held October 17-20, 2016 at the Daytona Beach Hilton in Daytona Beach, FL. We are looking for papers on herbicide application and mechanical techniques (aquatic, natural area and right-of-way), mixtures, innovative control measures, re-vegetation projects, new exotic plant introductions, research projects, etc. We welcome talks from researchers, scientists, applicators and other field personnel – in short, anyone involved in aquatics or uplands! You don't have to be a professional speaker in order to present a paper! Remember, FAPMS was formed for the aquatic plant manager and the annual training conference is a chance to share what you have learned with other members. Each year all field personnel who present a paper receive a plaque from the Society. This year the top three applicator papers will also receive cash awards: first place $300, second place $200, and third place $100. Abstracts should be submitted by August 15, 2016 – please visit the FAPMS website at fapms.org for more information.

Calendar of Events 2016

May 2-5
UF/IFAS Aquatic Weed Control Short Course (www.conference.ifas.ufl.edu/aw); Coral Springs, FL

June 7-10
Florida Lake Management Society 27th Annual Symposium (www.flms.net); Daytona Beach Shores, FL

June 19-25
7th International Weed Science Congress (www.iwss.info); Prague, Czech Republic

July 17-20
Aquatic Plant Management Society 56th Annual Meeting (www.apms.org); Grand Rapids, MI

July 27
FTGA/UF-IFAS Great CEU Roundup (www.ftga.org/ceu-round-up); multiple sites in FL via MediaSite

August 21-25
American Fisheries Society 146th Annual Meeting (2016.fisheries.org); Kansas City, MO

September 12-14
MidSouth Aquatic Plant Management Society 35th Annual Conference (msapms.org); Baton Rouge, LA

October 5-7
South Carolina Aquatic Plant Management Society 38th Annual Conference (scapms.org); Myrtle Beach, SC

October 17-20
Florida Aquatic Plant Management Society 40th Annual Conference (fapms.org); Daytona Beach, FL

November 1-4
North American Lake Management Society 36th Annual Symposium (nalms.org); Banff, Canada

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The Florida Aquatic Plant Management Society Scholarship and Research Foundation, Inc. is pleased to announce the availability of the *Paul C. Myers Applicator Dependent Scholarship*, which provides up to $1,500 to deserving dependents of FAPMS members. The scholarship is based on:

1. The applicant's parent or guardian having been a FAPMS member in good standing for at least three consecutive years

2. Financial need, which will be determined based on need and the expected family contribution amount indicated on the processing results of a Student Aid Report (OMB No. 1845-0008). This report is available by completing a Free Application for Federal Student Aid Federal Form available online at fafsa.ed.gov

3. The applicant being a high school senior entering college the next academic year, attending community college, or being a college undergraduate

4. An evaluation of the quality of the application and required essay by the Scholarship Selection Committee, which is composed of three FAPMS members and four FAPMS Scholarship and Research Foundation members

5. Submission of a completed application by June

More information and the application packet are online at http://fapms.org/scholar/myers_scholar.html or contact Keshav Setaram at 407-891-3562