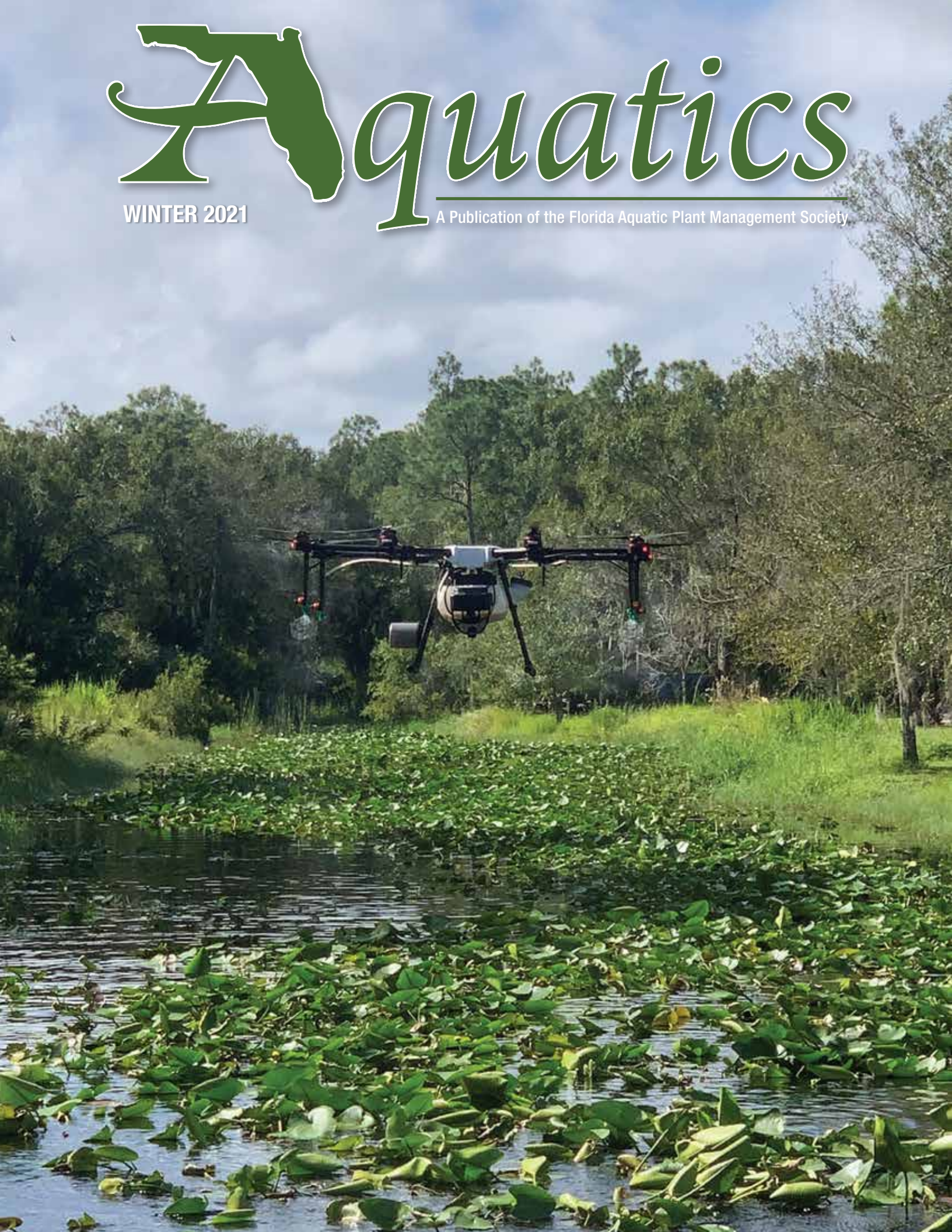


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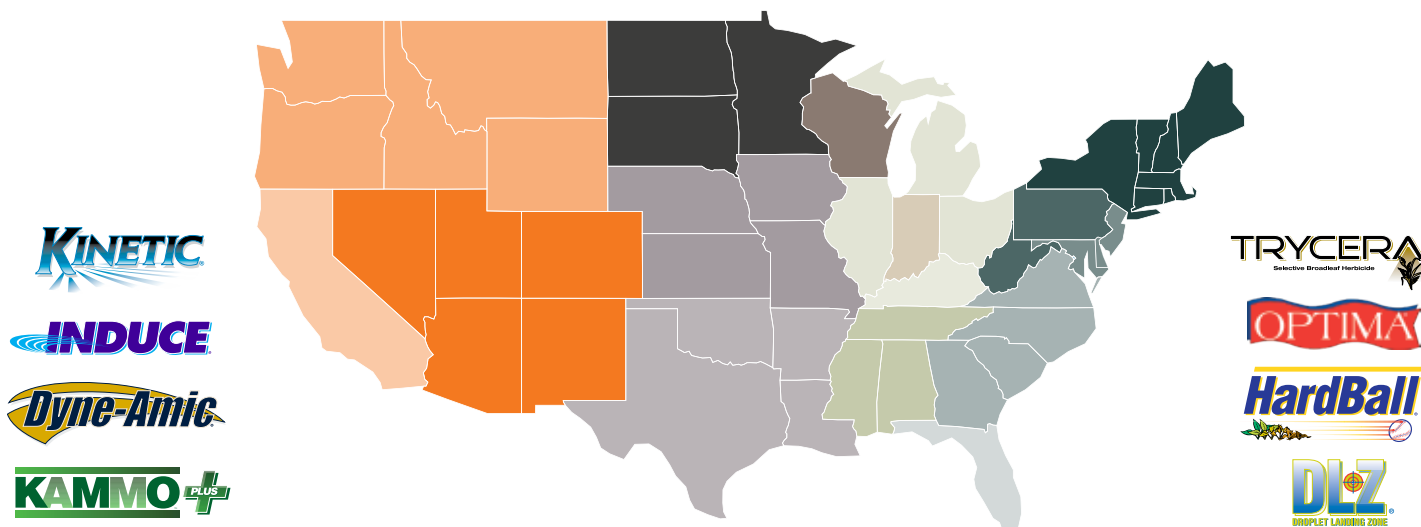
WINTER 2021

A Publication of the Florida Aquatic Plant Management Society



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Jonathan Glueckert (jglueckert@ufl.edu) received **FIRST PLACE** in Aquatic Scene category of the FAPMS Photo Contest. This image was taken at Arthur R. Marshall Loxahatchee NWR, Florida. The refuge is a 145,000 acre remnant of the northern Everglades. Tree islands are a prominent feature on the landscape, and they are heavily impacted by Old World climbing fern (*Lygodium microphyllum*). Jonathan was doing post-treatment monitoring of Old World climbing fern on a tree island using an unmanned aerial system (UAS) to document the change in the tree canopy. A US Fish and Wildlife employee was passing by on his way to prepare a unit in the refuge for a prescribed fire, and Jonathan was lucky enough to have the UAS in the air at the right moment to get this shot. This photo was taken prior to the ban of drones on Department of the Interior property, and all flights were approved through a Special Use Permit.

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Message from the President:

Hello Florida APMS members! 2020 has been an *interesting* year, to say the least. Covid-19 has shaken up every aspect of our lives and I believe we're ALL already for the world to go back like it was although all indications are we're going to continue dealing with this pandemic into 2021. Nevertheless, regardless of what's going on in the world, problematic plants and algae continue to plague our water resources and the members of this Society do a great job combatting these nuisances to provide excellent recreational opportunities, preservation of native habitat and clean sources of water. Your level of professionalism and understanding of aquatic plant management is also recognized.

Another Annual Training Conference is in the books! The first virtual tele-conference hosted by Syngenta with a very good Program put together by Dr. Brett Bultemeier turned out very well in my opinion. So, special thanks go to Scott Jackson, Brett Bultemeier, all of the speakers and you, the participants! Thank you to the conference sponsors as well. Next year's training conference is scheduled to be back in St. Pete Beach at the Hilton St. Petersburg Bayfront so mark your 2021 calendar for October 5th-8th! Also related to this year's conference, congratulations to our award winners in the categories of President's Award, Michael D. Netherland Exemplary Colleague Award, Applicator of the Year, Paul C. Myers Student Scholarship Recipients, Duck Races, and Photo Contests.

Every year at the annual conference "retirements" and "new hires" occur on the Board of Directors. These changes included four Directors rotating off the Board who have served their three-year term and four new Directors joining the Board. The "retiring" Directors were Ms. Kelli Gladding, Dr. Lyn Gettys, Mr. Thomas Calhoun and Mr. Tim Harris, and the



"new hires" are President-elect Stephen "Monty" Montgomery and Directors Ms. Alex Onisko, Mr. Jason Cull and Dr. Jay Ferrell. Thank you for your service to the Society Kelli, Lyn, Thomas and Tim and welcome to the Board Monty, Alex, Jason and Jay! If you have interest in becoming a Board member, please reach out to a current Board member.

In closing, Thank You for allowing me to the President of such a great Society. I look forward to what 2021 brings. If you have any questions, comments or concerns, please let me know and the FAPMS Board of Directors will discuss them. This Society is yours and as such your participation is crucial in keeping it active and successful.

Everyone please have a safe Happy Holidays and New Year, and I look forward to seeing everyone in 2021!!

Jeremy Slade
FAPMS President 2021

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Hydrilla Tubers – A Review

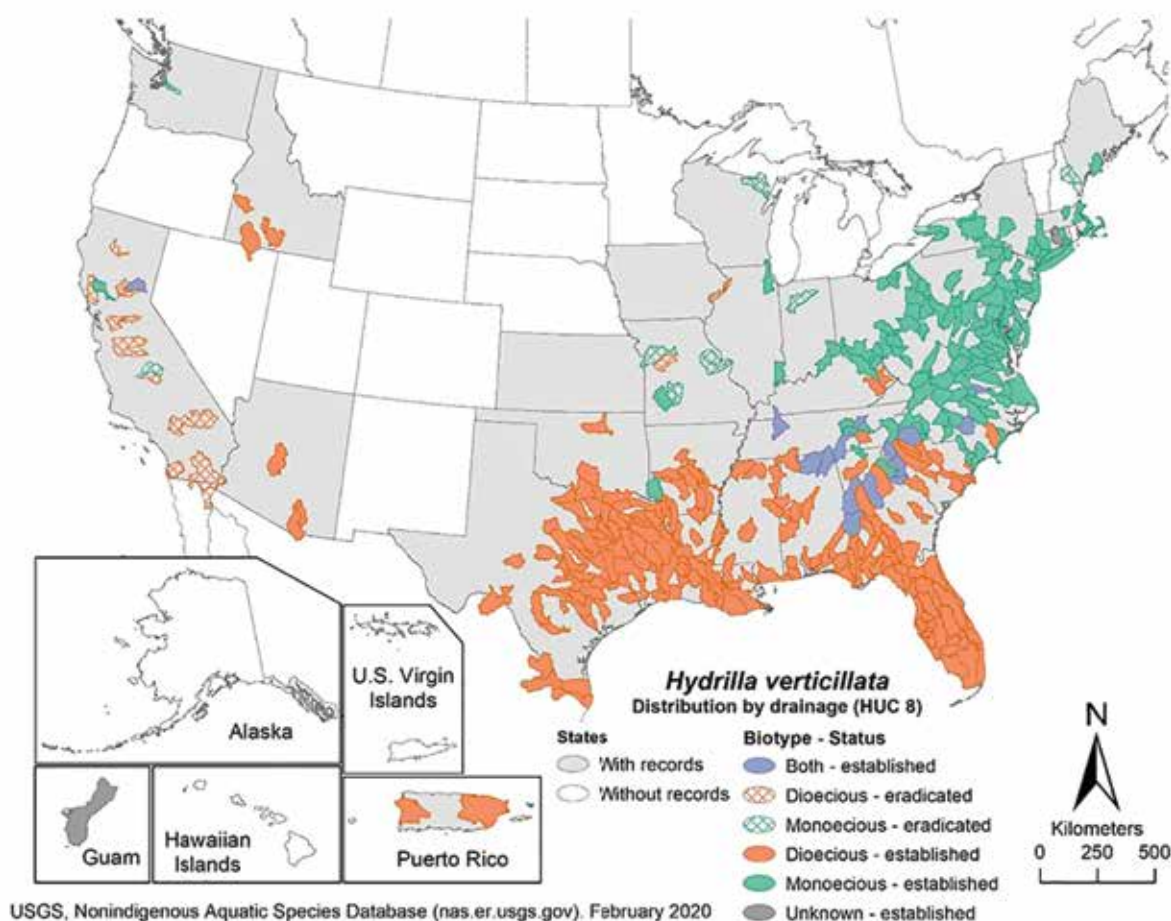


Figure 1. The distribution of hydrilla biotypes in the US as of February 2020 (USGS 2020).

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Background

Hydrilla [*Hydrilla verticillata* (L.f.) Royle] is found on every continent except Antarctica and is one of the most aggressive and troublesome submersed aquatic weeds in the US. Hydrilla exists in the US as either a dioecious or monoecious biotype which were both introduced through the

aquarium trade and have since spread to at least 25 states. Monoecious hydrilla was first found in the US in the early 1980s in the Potomac River and has both male and female flowers on the same plant. Monoecious hydrilla is more frequently found in northerly latitudes with the northern boundary occurring around 50 or 55°N (Figure 1). Dioecious hydrilla was first discovered in the late 1950s in South Florida canals and exists solely as the female form in the US (Poovey 2010). Dioecious hydrilla is more frequently found in southern latitudes (Figure 1). While both biotypes share similarities, they are quite different in their survival strategies.

Hydrilla's invasiveness is partly attributed to its ability to reproduce in four different ways: seeds (not observed in Florida), fragmentation, axillary turions (hereafter turions), and subterranean turions

(hereafter tubers). Tubers may remain viable for several years and are important for the long-term survival of hydrilla in a waterbody. But what exactly are hydrilla tubers, and how should we consider them for hydrilla management? In this article, we explore the biology of tubers and discuss their management. We primarily focus on dioecious hydrilla due to its prevalence in Florida.

What are turions and tubers?

Axillary turions and subterranean turions (Figure 2) are both simply compressed apical meristems (densely stacked clusters of potential new growth); however, they differ in where they occur on the plant. Turions are produced in the junctions of the leaves and stems, are usually dark green, and are approximately 0.25 inches in diameter (Figure 3). These propagules break off,

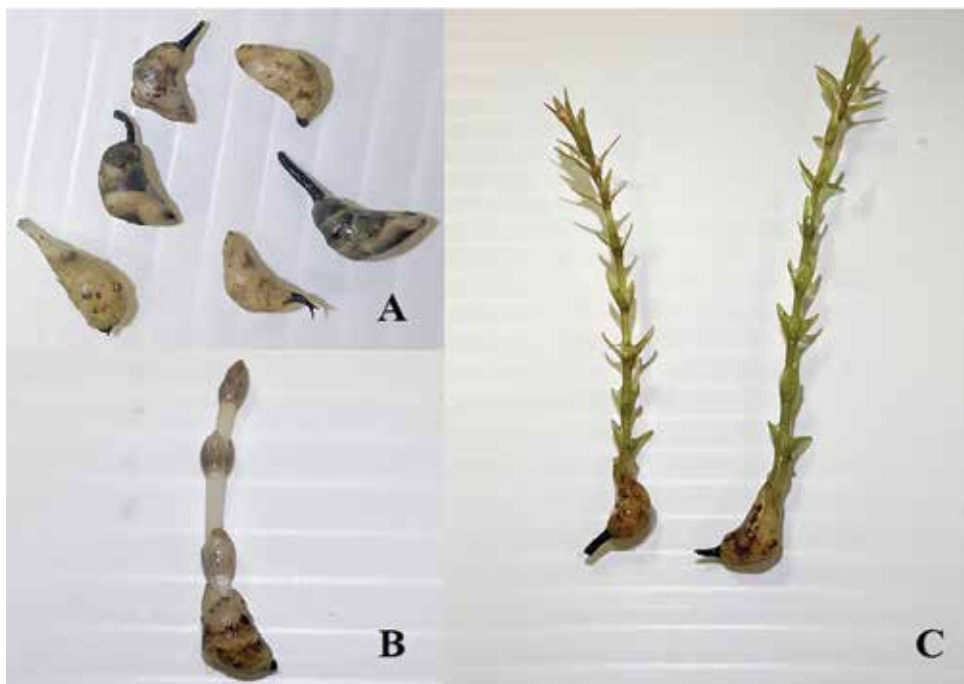


Figure 2. Unsprouted tubers (A), recently sprouted tuber without light exposure (B), and a fully formed dioecious hydrilla plantlet (C). Photos from T. Darnell.

forming plantlets with pre-formed roots that settle to the bottom (Madsen 1999). Axillary turions have a relatively short life span of about 6 to 8 months in ideal growing conditions. Tubers, on the other hand, are much larger than axillary turions due to a greater accumulation of nutrients, which allows tubers to survive in the sediment for over three years (Langeland 1996; Netherland 1999).

Tuber production

Hydrilla tubers form when a shoot tip grows downward and contacts the sediment. Once in contact with sediment, the plant moves carbohydrates (starches and sugars) into the shoot tip which swells and becomes a tuber. After 1 to 2 months of building its carbohydrate stores, the tuber forms a blackened layer at the connecting stem and breaks off the mother plant. When a tuber breaks off, it enters a state of induced dormancy or quiescence.

Luckily, tuber production does not occur all of the time. Instead, the formation of hydrilla tubers is day-length dependent process. Monoecious hydrilla produces tubers under long days (June through July) and has a germination period of late fall through early spring (Figure 4; Netherland 1997). The seasonality of these propagules

reflects their growing climate. Conversely, dioecious hydrilla produces tubers under short days, with a critical day length (a required amount of sunlight exposure) of 13 hours (Van et al. 1978). This roughly translates to the “cooler” months of the year in southern regions (November through March, with some production in October and April) (Figure 4). Tuber production depends on periods of darkness, and interruptions in the dark cycle of the photoperiod may inhibit tuber production. This is why there are few tubers in the sediment surrounding bridge and dock pilings that have exterior light sources (Spencer & Anderson 1986). Sediment samples taken from nightly illuminated areas show very few (if any) tubers.

Tuber sprouting

Oxygen plays a key role in tuber sprouting. Oxygenation prompts tubers to break quiescence and start sprouting, while a lack of oxygen (anaerobic conditions) may cause tubers to lie dormant for long periods. Tubers remain dormant until exposed to oxygen or other environmental cues, which have yet to be discovered. Dormancy is a state of reduced or no growth in environmentally favorable conditions. Dormant tubers can accumulate in the



Figure 3. Axillary turion from a dioecious hydrilla plant. Photo from T. Darnell.

sediment over time, creating a “tuber bank”. This is similar to a soil seed bank, where dormant seeds are stored in the soil.

The thick sediment layers where tubers exist are often anaerobic, which both discourage sprouting and preserves tubers from deterioration. Disturbances such as hurricanes can completely turn over the sediment layers, and either remove the tubers through flushing or induce germination due to rapid oxygenation. This may cause all of the sprouted biomass to detach and die, potentially killing the tuber.

There is currently some debate about the effects of hydrilla management on tuber sprouting. Some scientists suggest that tubers sprout consistently regardless of management while others suggest that management allows greater light penetration and oxygenation in the water column. Herein lies a question of how many times a tuber can sprout or resprout until it truly is dead. Greater light penetration results in more photosynthesis. With more photosynthesis, dissolved oxygen levels increase in the water column which could promote tuber sprouting. Miller et al. (1976) reported that neither nitrogen, light quality, nor air regime affects tuber sprouting; however, light duration (photoperiod) was found to stimulate sprouting.

Tuber sampling

Tuber sampling yields mixed results due to the irregularity of tuber distribution, rate of decomposition, and rate of tuber germination. Therefore, tuber core samples provide a better estimate of the tuber bank depth rather than the population density. Typically, hydrilla tubers are found within the top 5 inches of a sediment core; that is not to say that

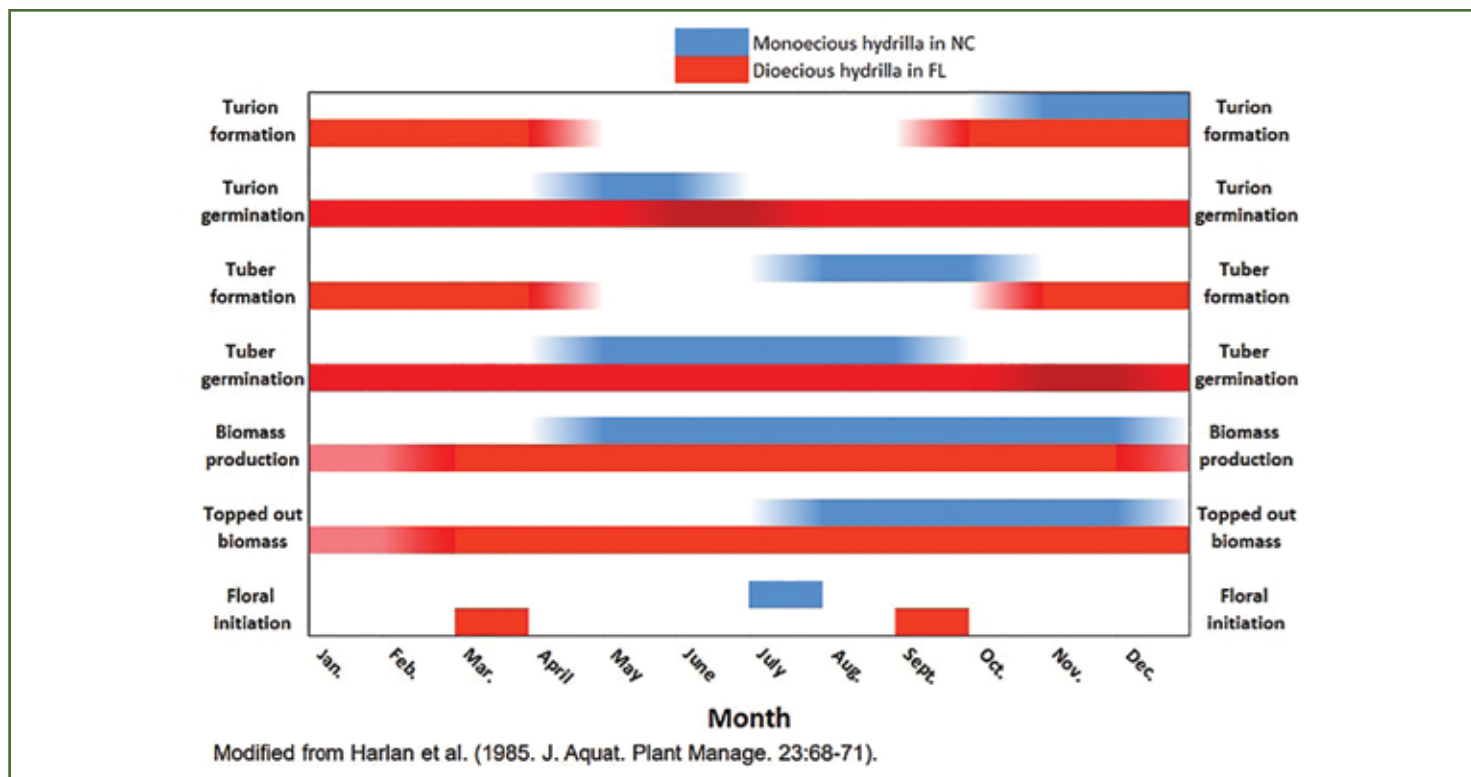


Figure 4. A comparative schematic as to how biotypes of hydrilla compare in growth, asexual reproduction, and biomass accumulation across a calendar year (Richardson 2016).

they cannot be deeper, but the survival rate under the 5-inch depth is uncertain (Netherland 1997). A conservative estimate of tuber density is about 3 million per acre (Haller 1976). Northern Florida lakes experience their highest tuber densities in the late fall, whereas Southern Florida lakes have higher tuber densities year-round (Bowes et al. 1979).

Dioecious hydrilla’s large tuber size limits its dispersal pattern but allows for greater environmental persistence. On Lake Ocklawaha, tuber size and density increased with increasing water depth (Miller et al. 1976). In contrast, the smaller tubers of monoecious hydrilla allow for greater dispersal but decreased persistence. This inherent size difference allows for greater competition (nutrients, sunlight, and space) between both monoecious and dioecious hydrilla in the same waterbody and allows for increased population pressure against native submerged aquatic vegetation. (Richardson 2016).

Tuber management

Short-term hydrilla management often focuses on the removal of shoot biomass from the water column. For long-term

management, the tuber bank must be depleted by reducing tuber production. Several long-term management strategies have been identified from decades of research; however, all require significant dedication to consistent management efforts. These long-term management strategies show promise, yet the overarching question of how to best manage a population of tubers exists.

Drawdowns can be used to reduce tuber populations when precisely timed to disrupt tuber production and scheduled over several years (Doyle & Smart 2001; Haller et al. 1976; Netherland 1997; Poovey 1998). Likewise, tuber sprouting is induced by drawdowns. If a drawdown is maintained long enough, newly sprouted tubers may desiccate and die. However, research suggests that sprouted tubers must be desiccated below the minimum moisture content (approximately 50%) to result in death (Doyle and Smart 2001; Netherland 1999). This is sometimes challenging when sediments contain clay layers near the tuber bank which can hold moisture for extended periods (Doyle and Smart 2011). If tubers are not killed during the drawdown, they may potentially germinate and establish (Netherland 1999).

The effect of drawdowns on tuber germination may depend on sediment type. For example, short-term drawdowns induce sprouting of up to 90% of propagules in well-drained sediments, while sprouting may only reach 70% in more compacted and poorly drained sediments (Doyle & Smart 2001; Netherland 1999). In addition, drawdowns may be ineffective without chemical management of tubers that have germinated or that have failed to break through the soil surface (Doyle & Smart 2001). A cycle of flooding/drawdown, combined with herbicide application after establishing a normal water level, may be effective at controlling newly germinated plant material.

Herbicide treatments can also be used during a drawdown to control hydrilla tubers similar to a preemergence herbicide application in terrestrial cropping systems. The herbicides fenac and dichlobenil (no longer registered for aquatic use) both previously demonstrated exceptional hydrilla control when applied during a drawdown (Steward 1980). While we no longer have these two herbicides in aquatics, several currently registered herbicides are showing drawdown activity on hydrilla tubers in current studies at the University of Florida.

Conclusion

Hydrilla tuber biology is important to understand in order to effectively manage the tuber bank. However, there are still basic questions such as how many times a tuber can (re)sprout, are there specific cues that cause a tuber to break dormancy, and how to best manage the tuber bank over time. A deeper understanding of tuber biology will answer many of these posed questions. Though we have a general idea of how tubers work, a better understanding of their biology will be advantageous to better manage this species from the ground up.

The mission of CAIP is to develop and disseminate strategies for addressing the impact of invasive plants. For more information about the UF/IFAS Center for Aquatic and Invasive Plants, please visit <https://plants.ifas.ufl.edu>. Be sure to follow us on social media @UFIFASCAIP.

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Further Reading

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APPLICATORS CORNER

In the last issue of Aquatics magazine we reviewed the label for Reward herbicide and posed several questions, and in this article we provide what we believe to be the correct answers. Pesticide labels provide specific directions (requirements) along with suggested directions and change on a regular basis, so applicators need to review them often to note any significant changes. There are several diquat products registered for aquatic use, but to ask specific questions we needed to refer to one label, so we chose the Reward Landscape and Aquatic Herbicide Section 3, or Federal label, available from www.cdms.net as directed in the last issue. Answers are underlined and numbered in the following discussion.

The signal word for Reward is **1. Caution** and the signal words for pesticides from least hazardous to most are **2. Caution, Warning, and Danger**. Signal words are important to applicators because they indicate the potential hazards to the applicator or the environment when mixing, loading, applying, and using of pesticide. Some applicators believe that the signal word also indicates the extent and types of PPE (personal protective equipment) that should be worn while using the pesticide, but this is NOT always true. For example, the label for Glyphosate Custom carries the “Caution” signal word and the PPE required is minimal: long sleeved shirt and long pants, shoes and socks. As noted above, Reward also has the “Caution” signal word, but requires **3. Extensive PPE** for handling: coveralls, chemical resistant gloves and boots, plus socks, protective eyewear, chemical resistant apron, and face shield when mixing and loading. Just one more reason to always review the label before application even if you have read it a dozen times before!

Diquat, the active ingredient in Reward, is very strongly and essentially irreversibly bound (adsorbed) to clay, silt, and organic matter due to its chemical properties. Diquat is broken down by photolysis (light) and by microbes when adsorbed to soil particles. Diquat is inactivated when it is bound to soil particles and is likely to not be effective for weed control. This is why using turbid diluent water in the tank mix, or applying

to water in which the boat movement has created turbidity, is not a good practice. In fact, the label clearly indicates that you should expect **4. Reduced or no weed control** under these conditions. Several years ago, we were treating limnophila in a canal with diquat; the near-surface plants were covered with silt and caused a turbid trail behind the boat. We decided to avoid using transom mounted short hoses for the application, but instead drove the boat down the center of the canal while surface spraying the canal edges with a handgun. Apparently, the herbicide was able to get into the plants and was not affected by any organic material on the plants, which doesn’t make a lot of sense, but by golly it worked! Diquat is considered to be **5. A contact herbicide that is not translocated in the plant**. The label clearly indicates that the most effective weed control occurs when actively growing green plants are exposed to complete or near complete coverage and a “wetting agent” is required when making foliar applications.

The label statements referring to foliar applications (page 12) direct the applicator “apply Reward... with an approved aquatic wetting agent...”. The key words here are “apply” and “with”, which mandates that the addition of a wetting agent (surfactant) is required. An **6. unlicensed private pond owner may apply** Reward to their pond which has “minimal or no outflow to public waters”. The application of Reward to public waters is limited to federal or state agencies or applicators or licensees authorized by the state or local governmental agencies (page 11). **NOTE THE FOLLOWING APPLIES TO ALL AQUATIC HERBICIDES:** Some states require private individuals to obtain a permit, which authorizes them to treat public waters, and other states require permits for treating even private ponds. It is the applicator’s responsibility to know and follow all label directions, but you also must know and comply with local and state regulations as well.

Many aquatic herbicide labels state that when treating dense weed infestations you should treat only a portion of the weeds and wait 2 to 3 weeks to apply additional treatments. This usually applies to submersed

applications, is meant to reduce the chances of oxygen depletion, and appears on page 11 of the Reward label. On page 12 under the directions for treating Floating and Marginal Weeds, a statement indicates that the applicator can **7. “re-treat as needed”, thus allowing duckweed** and other foliar treatments at any time after the initial application. Common sense suggests waiting to re-treat until you can recognize the areas missed in the initial application. The maximum foliar application rate (page 12) for Reward on waterlettuce is **8. 2 gallons per surface acre as a foliar spray**, but note that the maximum application rate of Reward (page 13) for submersed weed control is more restrictive and based upon water depth, allowing only 0.5 gallons of product per acre foot to a maximum application rate of 2 gallons in 4 feet or more of water average depth. Some other diquat labels allow the application of more diquat based upon water depth, but you still cannot exceed 0.5 gallon or 1 pound per acre foot of depth. The higher application rate of Reward allowed for foliar treatments is the result of the emergent foliage of floating and marginal aquatic plants intercepting most of the applied chemical, thus reducing the amount of product reaching the underlying water column. Reward contains **9. 2 pounds of the active ingredient diquat per gallon** of formulation. The maximum amount of Reward that can be applied for submersed weed control is **10. 2 gallons per acre in 4 feet or greater** average water depth (see the table on page 13 of the label). Thus, the maximum application rate for submersed weed control with Reward is 0.5 gallons per acre foot to a maximum of 2 gallons/surface acre in four-acre feet or greater water depths. You cannot exceed 2.0 gallons/acre of Reward even if the water is 6, 8 feet deep or greater average depths.

Just below the word “herbicide” on the front page of the Reward label is a direct statement specifically and clearly prohibiting the transfer of Reward from its original container into another container, which would include the transfer of Reward from a tote. The wording used is to **11. Never put into food, drink or OTHER CONTAINERS**. The label prohibits even filling emptied or used 2.5-gallon Reward containers from a tote – see page 14, last paragraph [container

handling (less than 5 gallons)]: “do not re-use or refill”.

The answer to Question 12 is a difficult one and it's not an uncommon experience to have recreational boaters appear in the area in which you intend to treat. Herbicide labels, including the Reward label, have some direct wording that addresses the applicator's responsibilities to not expose people to herbicide drift. On page 5, the fifth line under DIRECTIONS FOR USE is the statement, “Do not apply this product in a way that will contact workers or **other persons**, either directly or through drift”. On page 6 under NON-AGRICULTURAL USE REQUIREMENTS there is another statement that applies to aquatic applicators which says, “For aquatic uses, do not enter treated areas while treatments are in progress”, which we interpret to mean, “Do not apply anywhere near recreational boaters”. The area is not defined and it is the responsibility of the applicator to stop application if a boat enters your work area. Also on page 6, under SPRAY DRIFT MANAGEMENT first line, “avoiding spray drift at the application site is the responsibility of the applicator...”. So

similar to other herbicide labels, the Reward label makes it clear that **you** are responsible from protecting people and preventing them from being exposed to spray drift. Spray drift is not a concern in most submersed applications when the herbicide is being injected into the water column, but is a concern in foliar applications via handgun, and could apply to granular applications to submersed plants as well. Most importantly, you should be aware of your surroundings and note any incoming boats and recognize that you may well have to deal with the situation. Be aware of the wind speed and direction and as the boat gets closer stop your application; it may simply be someone wanting to fish who would like to know where you have already treated and which direction you are going. If the boater stays in the area, then go to another location where you are certain that drift will not contact them.

Let's conclude by adding that we have read Reward labels many times over the past decade or two and even reading it again for this article have learned a few more nuances previously missed. Pesticide labels are written to allow their use for

needed pest control with one main objective: minimizing risk to the applicator, the public, and the environment. Remember that labels contain mandatory statements that the applicator must adhere to, with wording such as “*you must*”, “*you will*”, “*do*”, and “*do not*” indicating the applicator is required to follow these instructions. This is in contrast to more arbitrary directions, with wording such as “*may*”, “*might*”, and “*could*” that are suggestions but not requirements. A great source of information regarding any questions on label wording is the company representative because it is likely that others have asked similar questions. Other sources of information (in Florida) include the UF/IFAS Pesticide Information Office <https://pested.ifas.ufl.edu> or the Florida Department of Agriculture and Consumer Services <https://www.fdacs.gov>. Applicators in other states can contact their Agricultural College or pesticide regulatory agency for more information.

Footnote 1. Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product and does not imply its approval to the exclusion of other products or vendors that also may be suitable.



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Sea Grant: An overview of conservation efforts in Florida

The National Sea Grant College Program was proposed in 1963 by oceanographer, inventor and writer Dr. Athelstan Spilhaus. He described an organization that would provide America's fishing and coastal industries with university research, much in the same way that land-grant universities inform and advance agriculture.

More than 50 years later there is now a Sea Grant program in each of the coastal and Great Lakes states, Puerto Rico, Guam and even Vermont (Lake Champlain Sea Grant)! While we still focus on fisheries, our extension, research and education programs also help address the broad range of issues — from harmful algal blooms to sea level rise — that affect coastal communities and environments.

In Florida, 20 Florida Sea Grant extension agents live and work in coastal counties providing educational programming and technical assistance to communities, businesses, resource managers and residents. Holding to Spilhaus' vision, we work closely with partners at the University of Florida's Institute of Food and Agricultural Sciences extension service, or UF/IFAS Extension.

Beside our agents, Florida Sea Grant also supports six University of Florida researchers that are dedicated to creating and synthesizing research — in areas such as seafood safety, economics of coastal and marine industries, and coastal planning — useful to Florida's coasts. And while hosted at UF, Florida Sea Grant serves the entire state-wide university network, making research funding available to the 17 major universities and ocean research laboratories in the State University System of Florida.

Like the range of issues affecting Florida's coasts, the range of research we fund and the programs our extension agents conduct is immense and diverse. Below is a list of current programs that may be of interest to *Aquatics* readers:

Living shorelines and seagrass-safe boating

In Cedar Key and surrounding areas, Dr. Savanna Barry, a UF/IFAS Regional Specialized Florida Sea Grant extension agent, is working to restore and protect coastal habitat and submerged aquatic vegetation. For the past few years, Barry has been working with partner organizations and volunteers to establish living shoreline demonstration areas. Traditional seawalls and bulkheads are expensive and can drastically disrupt coastal and estuarine ecosystems. The living shoreline demonstration areas show that restored saltmarsh and oyster reefs can be a cost-effective alternative to seawalls, protecting coastal land from erosion while providing habitat and improving water quality.

"These demonstration areas also illustrate the importance of engaging community members in shoreline management decisions," notes Barry, "as the living shoreline project designs were formulated during a series of stakeholder workshops."

Barry also leads the Be Seagrass Safe program, informing boaters of ways to reduce their impact on seagrass beds that are home to coastal species like scallops and snook but are easily damaged by propellers.



Dr. Savanna Barry

Harmful algal blooms, or HABS, plague many of Florida's waterways impacting the state's economy, environment and public health. Florida Sea Grant is tackling the problem by helping determine research needs, conducting and funding research, engaging coastal citizens, and participating in the statewide Harmful Algal Bloom Task Force.

In 2019, UF/IFAS Extension Florida Sea Grant agents Betty Staugler and Dr. Lisa Krinsky convened a meeting of 75 harmful algal bloom experts. During the



Harmful algal blooms (HABS)

two-day meeting, researchers discussed what is known and what needs to be known about the two most prevalent harmful algal blooms affecting Florida, blue-green algal blooms and red tide. Results from the symposium have helped direct research in the state and informed the Harmful Algal Bloom Task Force, on which Sea Grant director Dr. Sherry Larkin serves.

Krinsky and Staugler are also part of research teams that look at public perception of harmful algal blooms and have developed outreach material to help answer questions about HABS.

"Our strength is distilling technical information into user-specific formats," notes Staugler. "We try to fill in the holes, synthesizing where all the information is, how to access it (as sometimes the websites are not intuitive), and how to interpret it."

They and other members of the Florida Sea Grant HABS Work Action Group help run citizen science efforts that monitor

blooms. As such, they are an excellent resource for the latest on HABs affecting the state and the science that is being conducted to address them.

Mangrove pruning

In Sarasota and Miami-Dade counties, UF/IFAS Extension Florida Sea Grant agents Armando Ubada and Ana Zangroniz conduct mangrove trimming workshops for landscapers, arborists and natural resource managers. These training sessions deliver information about the biology of the salt-tolerant trees, their role in coastal ecosystems, and the historical loss of mangrove cover in Florida. As a direct result of the latter, mangroves are now a highly protected species in the state, afforded by the Mangrove Trimming and Protection Act, or MTPA, which is administered by the Florida Department of Environmental Protection and local counties or municipalities.

“Since mangroves can grow quite tall and their canopy cover can potentially interfere with the viewscape along the coast, potential maintenance trimming or alteration projects must follow very specific and sometimes challenging criteria as delineated by the MTPA,” notes Zangroniz.

Working in concert with local government representatives, Ubada and Zangroniz also feature a segment within their workshops in which participants can run through project scenarios with personnel representing regulatory agencies. These sessions are vital to the success not only of the workshop, but to the long-term goal of mangrove preservation in Florida.



Mangrove trimming workshop

Sargassum

While often sought by fishers out on the ocean, closer to shore the floating seaweed sargassum can clog canals, ruin beaches and be a problem for counties. UF/IFAS Extension Florida Sea Grant agent Shelly Krueger in Monroe County is working with Sea Grant affiliate researcher Ashley Smyth on a program that looks at the suitability of the seaweed for compost. Currently, municipalities in South Florida spend an estimated \$150,000 to \$4M every year to remove the seaweed. Composting may be a cost-effective way to repurpose sargassum, but concerns about arsenic contamination currently force municipalities to dispose of the sargassum rather than repurposing this organic material.

“This is a great example of extension faculty working in partnership with their local counties and municipalities to valorize sargassum into a value-added product that can be used as a soil amendment for



Floating seaweed sargassum

landscape applications, instead of paying high fees to transport and dispose of the seaweed in landfills,” says Krueger.

Invasive Species

Many Sea Grant agents actively work to combat invasive species through educational activities and by leading removal efforts. In Escambia County, UF/IFAS Extension Florida Sea Grant agent Rick O'Connor, has been working to address invasives, both on land and in the water. Two of the most pernicious and high-profile invaders in his area are Beach vitex and lionfish.

Beach vitex was initially used in dune restoration in the Carolinas where it became a monoculture in some areas and altered beach ecosystems. O'Connor was alerted about its presence in Escambia County in 2014 and has since worked with volunteers and partners to find and eradicate this plant before it becomes established. His efforts with the Florida Invasive Species Partnership, UF IFAS Assessment, and the UF IFAS Center for Aquatic and Invasive Plants led to it being listed as a Category I Invasive Plant and a State Noxious Weed. His education activities through the Florida Master Naturalist Program have helped identify locations where the weed is growing, with an estimated 80 percent of the weeds in the Pensacola area either removed or in the process of treatment.

Lionfish is another invader. O'Connor helps inform the public about the threat lionfish pose to local snapper and grouper



Lionfish



populations and reef ecosystems more broadly. He has co-hosted the Lionfish Removal and Awareness Days with the Florida Fish and Wildlife Conservation Commission and other local agencies that have averaged over 3,000 participants each year. Based on a study conducted by the University of Florida, these and other efforts have reduced lionfish densities in shallow waters of the northern Gulf of Mexico over the last five years.

By teaching classes, partnering with a wide range of organizations, and leading volunteer efforts, Sea Grant agents like

Rick O'Connor are helping fight invasive species that can damage coastal ecosystems. O'Connor hosts a list of Florida invasives on the Florida Sea Grant website and is available for presentations or to talk about resources and strategies to combat invasive species wherever they are found.

Bite-sized Science and Speakers Bureau

While changes associated with COVID-19 have greatly reduced the amount of in-person training that agents are able to do, it has allowed us to expand the reach of

some of our trainings by conducting them virtually. Our Bite-sized Science webinar series has reached hundreds of people in Florida and beyond. The 30-minute presentations are conducted by Florida Sea Grant agents or specialists as modified versions of their popular in-person trainings that they conduct around the state. Many of the programs mentioned above have been discussed in one or more Bite-sized Science webinars.

Archived recordings include sections on "water quality and harmful algal blooms" and "ocean/coastal habitats and habitat restoration." Visit

bit.ly/bite-sizedscience to view recordings and register for upcoming webinars.

Florida Sea Grant agents are also available to give customized presentations to groups. The Florida Sea Grant Speakers Bureau site (<http://flseagrant.ifas.ufl.edu/environmental-education/bite-sized-science-webinar-series/florida-sea-grant-extension--speakers-bureau/>) lists potential topics and provides a form for requesting speakers.

"Those working with aquatic plants may find the Bite-sized Science series a useful resource to direct people to with questions about the biology and ecology of coastal plants and algae," notes Dr. Maia McGuire, Florida Sea Grant Associate Director for Extension and Education and creator of the Bite-sized Science series.

Florida Sea Grant, like all Sea Grant programs, strives to provide research and programming that helps solve pressing coastal problems. If you take away only one thing from this article, I hope that it is to locate and contact your local Sea Grant agent. They have a wealth of knowledge about coastal issues and access to the latest research findings available on coastal topics. To learn more about Florida Sea Grant and to find an agent nearest you, visit: www.flseagrant.org.

Rhett Register (h.register@ufl.edu) joined Florida Sea Grant as a communicator in 2019. Prior to that he was communications program leader at Michigan Sea Grant. He is a native of Jacksonville, Florida.



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APMS President's Update

I hope this email finds you and your families well during this time of quarantine, masks, and social distancing. COVID-19 has taken its toll on society during the past eight months in countless ways, and I would imagine many of our members have felt the pain of loss, financial burdens, and increased stress as we continually adapt to life with this virus. I am sure we all could dwell on the negatives, though there has been some good that has come out of all of this, well good from my perspective. In my corner of the world, life has slowed just a little and schedules have opened up due to cancelations, postponements, etc. You may have to put down your phones or turn off your computers to realize it, but for most people it has allowed greater time with family and loved ones. It has been a time for me to reflect on what is important.

As such, APMS will also need to reflect on where it has been so we can chart a course for the future. The current Strategic Plan ends in 2021 so a thoughtful assessment of the current plan by the board of directors will need to occur with feedback from the membership. Over the next year I will be working with Drs. Heilman (Chair of the Strategic Planning Committee), Thum (President Elect), and Hartis (Vice President) to establish the next strategic planning cycle and discuss how we may want to focus our efforts. If you have specific input regarding the strategic plan or other society business, please reach out to me or another board member. One important aspect of the plan will be the financial stability of the society for the coming years ahead.

As you all know we did not have our annual meeting in Texas this past July. The annual meeting is the most important source of revenue (outside of memberships) for the society and not having the meeting puts some financial burden on our operating expenditures. Fortunately, the board of directors established an emergency fund several years ago that would cover operating expenses for two years. We were fortunate this past summer that we did not have to cover any contractual meeting costs from the emergency fund due to our cancellation,

but it would be prudent given the current uncertainties to do everything possible to avoid utilizing those funds. In light of this, expenditures are being reviewed and ways to achieve cost savings are being sought. One such cost savings will be realized by moving the Journal of Aquatic Plant Management from print to an online platform. The board understands that this move may not be popular with everyone as the hard copy of the journal is a welcome site for many of our members. The board also realizes that besides the annual meeting, JAPM is our best product. However, the move to an online platform should be beneficial from a cost savings and visibility point of view.

During the July board meeting Editor Dr. Ferrell proposed moving the journal online as it would result in approximately a 50% cost savings each year. So beginning with the January 2021 issue, members will not be receiving a printed copy of the journal. In order to help transition the journal online and to bring awareness to the journal, plans are being made to send out member directed emails alerting when a new issue is available. The emails will contain a table of contents for each issue with hyperlinks to the articles. Articles will also be available on the APMS website as they have been for many years. Social media platforms will also be used to bring attention to the journal and new issues. Members will have access to all of the latest issues and articles and non-members can search the issues that are two years old or older. Additionally, the decision to move the journal online has led to the society having been contacted by a few large database companies. These companies have royalty payment structures in place that would pay APMS each time these articles are viewed or downloaded.

The online journal has many benefits as outlined above, however it has raised some concerns with how we handle member vs. non-member journal subscriptions; and how those large database companies gain access to issues and articles. It was brought to our attention this past summer that our website is woefully obsolete and needs to be upgraded for security reasons and to



address the needed functionality. Dr. Hartis and the website committee are pursuing cost estimates with our current web designer APEX Web Studio to re-design and re-launch the website. So keep an eye out for a new website, maybe by next summer.

Looking to the future, I would challenge all of us to find new opportunities to engage folks who manage aquatic resources and invite them to get involved and work with APMS. There are some efforts underway to work more closely with the North American Lake Management Society, but other strategic partnerships are needed to grow APMS and our reach. A recent good example of society outreach is the co-sponsored webinars offered by APMS and the US Army Corps Engineers. Topics included monococious hydrilla, harmful algal blooms, giant salvinia, tough emergents, flowering rush, and invasive watermilfoils. The webinars to-date have been well attended with over 140 participants at each talk. Thank you to Dr. Heilman, the ad-hoc committee, and speakers of the webinars.

Lastly, I would also challenge the membership to volunteer and serve on committees or the Board of Directors. We are constantly looking for new faces and new ideas to make the Society better. Ultimately, this is your Society, your Profession, and it will be as good as the people who lead. So please get involved. It is a good thing to do and, trust me, you will enjoy the time spent and the friendships made.

Sincerely,

A handwritten signature in black ink, appearing to read "Ryan M. Wersal".

Ryan M. Wersal, Ph.D.

President

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Expanded details of progress made to the FWC's Aquatic Plant Management Programs since February 2019

There has been much progress made since the FWC temporarily paused control operations to listen to stakeholders in the winter of 2018-19. This is a summary of many of the changes that have been made to management programs.

Fish, Wildlife, and Habitat Management Plans for Individual Lakes

The draft Lake Istokpoga Management Plan was presented to stakeholders on January 14th. FWC contracted The University of Florida (UF) to write this plan. UF collected feedback from stakeholders over a 4-week period and delivered the final document to FWC on February 22nd. This plan utilizes stakeholder input to set management targets for habitat, identify improvements to management operations, and gather recommendations for improving communication between FWC and the public. The finalized plan was forwarded to the Directors of Habitat and Species Conservation and Freshwater Fisheries Management for review and was approved in April. Staff has modified management operations to reflect the goals and objectives of the plan as they begin implementing this plan.

In December, internal working groups with staff from DFFM, HSC, HGM, and FWRI were formed to work together on stakeholder engagement for the Harris Chain, Kissimmee Chain, and Lake Okeechobee Fish, Wildlife and Habitat Management Plans. These engagements include stakeholder input workshops, surveys, focus groups, and public meetings all with the goal of engaging with stakeholders in order to draft stakeholder endorsed management plans.

In February, FWC began enacting the stakeholder engagement plans by holding introductory public meetings for Lake Okeechobee and the Kissimmee Chain. An introductory public meeting for the Harris Chain occurred on March 10th. This coincided with a regularly occurring public meeting to discuss ongoing hydrilla

management. Covid-19 shut down our ability to conduct in-person meetings and staff adapted by getting input online through video conferences and email.

Stakeholder Input Workshops and Stakeholder Interviews were part of the next round of engagement. Interviewees included bait and tackle shops, local businesses, and marinas, as well as partner agencies (WMD's, ACOE, DEP, etc.). Due to Covid-19, interviews were delayed and changed to an online format through video conference. These workshops and interviews were completed by the end of August. Staff are now finalizing an RFP that will provide writing and facilitation services for all three management plans.

DFFM and HSC staff have been collaborating to create a new online presence to share information on these plans. The webpage is up and running and can be found at the link below. Here we will be able to share meeting summaries, presentations, and other information on the progress of the respective plans.

<https://myfwc.com/conservation/management-plans/lake/>

Additionally, the communications strategies implemented for Habitat Management Plans are in the Communications section below.

Technical Assistance Group for Aquatic Plant Management

Staff hosted the 1st Aquatic Plant Management Technical Assistance Group (TAG) meeting on September 20, 2019. The kick-off meeting allowed members to introduce themselves, revise their charter and prioritize issues they would like the TAG to explore. The top four issues identified included, lack of communication, alternative methods to herbicide, applicator accountability, and money and funding. Staff hosted the 2nd meeting on December 17, 2019 and structured the agenda to allow for more group dialogue on two of the priority issues, communication and fund-

ing. Staff also provided progress updates on Commissioner directed improvements to the Aquatic Plant Management Program focusing those updates on harvesting research efforts and the development of habitat management plans for individual lakes. The next meeting occurred on May 27, 2020 and focused on applicator accountability and mechanical harvesting efforts. Finally, the September 8, 2020 TAG meeting focused on Fish health concerns and what the Commission is doing to address them. Also on the agenda for discussion were habitat management plans and the floating plant problems on Lake Okeechobee. We are coordinating with the Florida Department of Agriculture and Consumers Services (FDACS) and the Florida Department of Health (DOH) to provide presentations on how Florida approves new herbicide registrations and toxicology/epidemiology assessments at future meetings. Staff will continue providing progress updates to the TAG, allow members to prioritize topics for subsequent meetings, and engage with TAG members in-between meetings on important issues. Danielle Kirkland serves as the FWC representative on the TAG.

Improved timing of herbicide-based treatments

Invasive Plant Management Staff are working under a new approval process whereby they are required to submit a detailed treatment plan showing the problem areas and detailing the need for management. Regional FWC SMEs review and comment on the proposed treatment plans. After regional approval, the treatment plans are submitted to the Invasive Plant Management Aquatics sub-section leader who reviews, approves, and forwards to the Division Director for review and approval before a treatment plan can proceed. This takes a considerable amount of time to prepare and process but ensures that necessary treatments are getting the full attention of the agency before being conducted.

HSC staff work with stakeholders and

staff within the Division of Hunting and Game Management to identify priority waterfowl lakes or priority areas within those lakes. Staff work to have floating plants under excellent control and hydrilla treatments completed in areas within waterbodies that are high use for duck hunting so that minimal, or preferably no treatments, are occurring during hunting season. If treatments must occur, staff are required to communicate with our partners (waterfowl biologists, key waterfowl stakeholders, etc.) and the Invasive Plant Management Section Leader before conducting these activities. Our Division of Freshwater Fisheries staff also works with our Aquatic Plant Management team to avoid on-water activities during major tournament events.

Increasing coordination (and use) of mechanical harvesting

State-wide harvesting efforts have increased. In calendar year 2019, FWC funded harvesting projects on 632 acres spending \$2,973,322. In year 2018, only 179 acres were targeted for harvesting at a cost of \$888,858. As of November 2020, FWC has already controlled 820 acres (\$2.02 Million) mechanically. Partnering with the South Florida Water Management District (SFWMD) and utilizing their existing hourly contracts, mechanical harvesters are presently working within the Harney Pond region of Lake Okeechobee, removing hyacinths. FWC has set aside about \$500,000 dollars for this project. Additional projects are planned on Okeechobee at Coot bay, Kissimmee eastern shore, Istokpoga at Henderson Park cove and Lake Helen. We are requesting additional harvesters into the Harney pond area of Lake Okeechobee and will continue to expand these operations where appropriate. We are collecting data on mechanical operations to further expand our knowledge of this important control method and have summarized our findings thus far in the research section of this document.

Staff also coordinated on-water fieldtrips on Lake Okeechobee with fishing guides and local clean water advocates to identify areas where mechanical harvesting can be used to manage aquatic plants most effectively. Specific actions taken from these

trips will be discussed in the research and outreach section of this update.

Herbicide application contractors – accountability and compliance

Testing continues on a new, near real-time, automated tracking system for herbicide applications to further increase oversight and accountability of aquatic plant control contractors. Data collected from these efforts was presented to the Aquatic Plant Management TAG in May.

FWC met with leadership and staff of the Florida Department of Agriculture and Consumer Services to discuss ways we can better coordinate our respective oversight responsibilities for herbicide applicators to improve accountability and ensure compliance with State regulations.

HSC requested that FWC Office of Inspector General (OIG) conduct an audit on a master herbicide contract. The Audit was completed and found that HSC had implemented best management practices in our management of the contract and noted only minor deficiencies. The OIG provided a few recommendations for improvements. Additionally, the state auditor general is conducting an operational audit of the entire invasive plant management program, including all management and regulatory programs, with a report expected by the end of 2020.

Pilot projects to explore better integrated plant management tools and related research

Request for Information (RFI)

In January 2020, FWC published an RFI to solicit new ideas for alternative methods of managing aquatic plants in Florida waterbodies without the use of herbicides. The RFI closed on the 7th of January with nearly 60 replies with 21 responses to the questions in the RFI. Staff reached out to partners and independent experts to review the submissions. At the December 2019 Commission meeting, staff were directed to set aside \$1 million to further explore ideas generated through the RFI process. External reviewers provided comments with respect to the responses.

FWC combined and summarized all of the reviews and had internal staff rank each response. Internal staff have completed their summaries of the responses and, in general, FWC did not receive anything that would significantly change how approach invasive aquatic plant management is conducted, but there are some ideas or concepts that warrant additional investigation so virtual meetings were scheduled with the top three respondents to further investigate their technology or approach. These meetings will help procure these types of services in the future, but unfortunately there was not a “silver bullet” that would significantly improve operations without the use of herbicides. In an effort to leave no stone unturned, FWC is writing an RFP to ensure every available alternative is considered. The RFP will solicit a national or international environmental consulting company to provide a summary of all the aquatic plant management strategies being used world-wide, to ensure that we are capturing any potential new technology that would improve upon what we are currently doing. We expect this RFP to come out by the end of September and would expect the process to take a year or more before we receive a report of findings.

FWRI created a summary of the State of Aquatic Plant Management in Florida.

Lake Harris User Survey and opinions of hydrilla and hydrilla management link to seminar: <https://youtu.be/HM9k-w6N3hvs>

- The use at Lake Harris was split between angling (45%) and boating (55%).
- Boaters had a more negative overall opinion of hydrilla than bass anglers.
- Crappie and sunfish anglers tended to be more similar to boaters.
- 94% of all users wanted to see native vegetation expand in the absence of hydrilla.
- 35% of users voiced some concern about the use of herbicides as a control method.
- 86% of users thought that hydrilla would expand greatly or cover the entire lake if treatment was discontinued.

- Overall, users had a somewhat positive (3.48 on a scale of 1 – 5) opinion with FWC’s management of hydrilla.

Okeechobee Weedoo bycatch assessment: FWC staff provided assistance in December 2019 for an Army Corps of Engineers (COE) evaluation of animal by-catch from the mechanical harvesting of floating vegetation using Weedoo harvesting equipment in an approximately 10-acre area in the Harney Pond area of Lake Okeechobee. A subsample of harvested plants was sorted by hand and the presence of any animal, invertebrate or non-floating plant species observed was documented. Results have not been reported to FWC IPM office; however, the field crew relayed that bycatch was minimal.

This event was part of a larger evaluation of bycatch from mechanical harvesting conducted by the USACE on Lake Okeechobee.

Fish Health Investigations:

- Implemented fish health screening into LTM state-wide beginning Spring 2020 using standardized fish health codes developed by the Fish and Wildlife Health lab to monitor prevalence, distribution, trends, and types of fish disease in freshwater lakes.
- Fish and Wildlife Health Lab accompanied FWRI Fresh Fish Research on spring bass sampling at Lake Okeechobee. Approximately 700 bass were sampled, and 19 had abnormalities that were taken back to St. Petersburg for further analysis. Final results are still pending, but it appears the most common cause of lesions is parasitic infections.
- Fish with potential lesions and/or tumors will continue to be transported to the lab in St. Petersburg for analysis from lakes state-wide.
- Social media content is being prepared for the FWRI FB page.

Annual emergent plant mapping via satellites and submersed plant mapping via sonar (Biobase) are continuing this FY and begins around June every year.

Evaluation of environmental impacts of herbicide applications

In response to stakeholder concerns, the FWC contracted University of Florida to investigate three critical hypotheses:

1. Legacy herbicides accumulate in sediment and prevent plant growth.
2. Glyphosate is a synthetic phosphonate herbicide and Cyanobacteria can use the phosphorous portion of the glyphosate molecule for growth thus causing harmful algal blooms.
3. Herbicides are toxic to fish and when used in lakes herbicides hurt Largemouth Bass populations.

During the development of the Lake Istokpoga habitat management plan, stakeholders expressed concerns regarding the lack of submersed vegetation in the lake and hypothesized that legacy herbicides accumulated in the sediments were preventing plant growth. The University of Florida in cooperation with FWC conducted a bioassay experiment using sediments collected from nine stations on Lake Istokpoga where Hydrilla had previously grown (Hoyer et al. In press). Sediment samples were analyzed by a private laboratory for nine different herbicides used on the lake over that past ten years. Results from the bioassay showed “non-detect” for all nine of the herbicides tested.

Hoyer (2019) utilized FWC herbicide treatment data, long-term monitoring fish data, and TrophyCatch citizen-science data, along with Lakewatch water quality data to investigate the concerns about Glyphosate causing harmful algal blooms and herbicides negatively impacting Largemouth Bass populations. An empirical analysis using multiple merged databases suggest that glyphosate treatments are not responsible for creating significant algal blooms in lakes, thus the analyses do not support the stakeholder concern (Hoyer 2019). Additionally, an empirical analysis of multiple data sets evaluating six different Largemouth Bass metrics suggests that lakes with the highest herbicide usage showed no suppressed Largemouth Bass population characteristics, thus the analyses do not support the stakeholder concern. “The FWC Plant Management Program

is sound and based on the best available science” (Hoyer 2019).

Staff coordinated fieldtrips on Lake Okeechobee, in January 2019 with local fishing guides and clean water advocates. During these trips, staff made a commitment to establish a no spray zone on Bird Island near the Harney Pond boat ramp where water hyacinths are mixed with native bulrush and eelgrass. HSC, DFFM and FWRI staff are coordinating research efforts to document current conditions, develop a monitoring plan and to generate outreach materials from this effort. The research proposal, prepared by Craig Mallison, Associate Research Scientist, FWRI is attached. This project is currently being implemented and there have been at least two sampling events thus far.

Communication

We have recognized the need for improved communication both internally and externally and are working on a revised communication plan which, to date, has focused on disseminating communication pieces associated with the changes we are making to improve our programs. We have a small group working to become more proactive in our communications and develop strategies that better explain the science behind our programs. Our current communications spreadsheet is attached, and we will continue to meet until we have finalized communication strategies to better meet our goals.

Internal communications have been enhanced with the creation of the Aquatic Systems Coordinating Team that consists of Kipp Frohlich, Jon Fury, George Warthen, Jason Dotson, Matt Philips, Danielle Kirkland, Ryan Hamm, Carli Segelson, Tom Graef and other staff as needed. This team meets every other week.

Communication Overview for Lake Management Plans

Communication has been a central tenant of the lake management planning process to date. FWC’s desire is for these plans to be informed and guided by stakeholder input and feedback. The following are the techniques FWC has used to identify and

engage with an array of stakeholders.

- Stakeholder email lists have been developed over multiple years, preceding Lake Management Planning efforts. These email lists were generated through past commenting or engagement with local FWC on the various resources. There are approximately 2,000 unique email addresses spread across the 3 systems we are actively planning.
- FWC also uses GovDelivery as a system to send out information (insert how GovDelivery works)
- A combination of our email lists, GovDelivery, press release and social media was used to notify the public about introductory public meetings. At these public meetings the process in which stakeholder input and feedback would be gathered and incorporated into the plans was described.
- At these public meeting FWC also distributed a questionnaire meant to identify stakeholders who were interested in participating in stakeholder workshops.
- These questionnaires and the management plan process were also shared via social media (Facebook and Twitter)
- Stakeholder were contacted via phone and email to participate in input workshops and interviews.
- Approximately 60 interviews and 30 virtual workshops have been conducted since May.
- We are in the early stages of this process and plan to continue to engage with stakeholders through surveys, focus groups, and informational meetings.
- The FWC has created web pages with information about each of the Lake Management Plans. These pages also include information on how to provide feedback, presentations from meetings, frequently asked questions and other resources.
- Staff continue to engage with stakeholders and make improvements in operations and functions to better serve the citizens of Florida. If you have any questions or concerns with respect to any of our management programs you can go to MyFWC.com.

2021 Calendar of Events

***With the disruption of meetings due to COVID-19, please see links to upcoming meetings and conferences. Some of these may have virtual learning options available and some may change entirely since this issue of Aquatics went to print, so please check the websites for updated information. Updates and announcements are also made on the various social media channels, so monitor those for information, too.*

February 22-25, 2021

Midwest Aquatic Plant Management Society
<https://www.mapms.org/conferences/2021-conference/>

March 1-4, 2021

Western Aquatic Plant Management Society Annual Meeting (Virtual)
<https://wapms.org>

July 12-15, 2021

Midsouth Aquatic Plant Management Society (in conjunction with Aquatic Plant Management Society Annual Meeting)
 New Orleans, LA
<http://www.msapms.org/conferences/2020/>

October 6-8, 2021

South Carolina Aquatic Plant Management Society Annual Meeting
 Myrtle Beach, SC
<http://scapms.org/meetings.html>

Need CEUs but don't see anything that fits your schedule? Visit the FDACS website and search for available CEU classes here: <http://aessearch.fresh-fromflorida.com/AvailableClassSearch.asp>. For more information about licensing, certification and finding Florida CEUs, check out "CEUs just for you" in the Summer 2014 issue of Aquatics magazine (<http://fapms.org/aquatics/issues/2014summer.pdf>)

amazon smile

Make your Amazon purchases count!! Log on to your Amazon account via smile.amazon.com, and select **"Florida Aquatic Plant Management SOC Schshp & Res Foundation Inc"** as your charitable recipient organization of choice! Our FAPMS Scholarship and Research Foundation will receive 0.5% of all purchases you make! Please share with friends and family, too!



Staying Socially Connected While Physically Distant: Where Can I Learn More?

CEUs during this time of necessary physical distancing. Social media platforms are an excellent way to stay connected in aquatic plant management.

Many organizations, scientists, agencies, and industry have active social media platforms to promote their missions, provide scientific information

about aquatic plant and invasive species management, announce upcoming events and seminars, and to foster protection of ecological resources. For most, social media content is coordinated and managed across three platforms — Facebook, Twitter, and Instagram — with mentions and hashtags to attract a wider audience.

These three platforms make it easy to connect with scientists, government agencies, educational outreach outlets, conservation organizations, research entities, industry, and the general public.

Social media allows users to follow hashtags like, #aquaticplantmanagement, #waterhyacinth, #biocontrol, etc., in order to keep up with content specific to your interests. It is also helpful to learn from the campaigns dedicated to a particular day or week to raise awareness, like #NationalInvasiveSpeciesAwarenessWeek, #NationalMosquitoWeek, etc.. And lastly, it is fun to watch the creative posts that organizations use to promote featured content, like #MimicMonday, for example, featuring aquatic plant lookalikes, or #TechnicalTuesdayAPM to learn about the technical aspects of aquatic plant management methods, etc. etc.

For the last 9 months, COVID-19 has significantly disrupted our work environments, supply chains, and opportunities for learning. Despite the fact that in-person conferences and meetings have been cancelled or delayed indefinitely, there are still many ways to continue to learn about aquatic plant management, network with colleagues, and even earn

Subscribe to **AQUAPHYTE** Coming January 2021

Aquaphyte is an electronic newsletter of the University of Florida/Institute of Food and Agricultural Sciences Center for Aquatic and Invasive Plants (UF/IFAS CAIP). The newsletter is sent to managers, researchers, agencies and other interested stakeholders. The purpose of Aquaphyte is to share research, accomplishments and other news from the Center. To subscribe, simply email the phrase **"subscribe to Aquaphyte"** to **caip-website@ufl.edu**.

It is always important to make sure accounts you are following are credible sources of information. Unfortunately, since anyone can have a social media account, this means that there is a lot of misinformation circulating about our industry. The accounts recommended here should get you started, but these are by no means exhaustive. Once you connect

with or follow some of these accounts, you will be introduced to others with similar missions or content, thus expanding your network of people, organizations, agencies, and companies involved in aquatic plant management.

Amy L. Giannotti, MS, CLM (amy@aquastemconsulting.com) is a consulting

environmental scientist with AquaSTEM Consulting and serves as a science communicator/social media manager for several different organizations. Amy earned an M.S. degree from the University of Virginia and has been actively involved in marine and aquatic plant management for the last 25 years. She is a certified aquatics herbicide applicator in Florida.

Active Accounts to Follow on Social Media for Information about Aquatic Plant Management and Habitat Conservation

	Facebook	Twitter	Instagram	Website
Universities				
University of Florida, Center for Aquatic & Invasive Plants	@UFIFASCAIP	@ufifascaip	@ufifascaip	https://plants.ifas.ufl.edu/
University of Georgia, Bugwood Center for Invasive Species	@bugwoodcenter	@bugwood	@bugwood_uga	https://www.bugwood.org
University of South Florida Water Atlas	@wateratlas	@wateratlas	--	https://wateratlas.usf.edu
University of Georgia - CyanoTracker	@cyanotracker	@CyanoTracker	@cyanoTRACKER	https://scistarter.org/cyanotracker
University of Florida, Invasive Plant Education Initiative	@UFIFASFloridaInvasive	@UF_IFAS_IPEI	@invasive_plant_education	https://plants-archive.ifas.ufl.edu/education/
Minnesota Aquatic Invasive Species Research Center	@maisrc.umn	@AISresearchMN	--	https://www.maisrc.umn.edu
University of Wisconsin, Center for Limnology	@centerforlimnology	@WiscLimnology	@wisclimnology	https://limnology.wisc.edu
Louisiana State University	@LSUAgCenter	@LSUAgCenter	@lsuagcenter	https://www.lsuagcenter.com/topics/environment/invasive%20species/
Texas A&M University	@Texas A&M AgriLife Extension Service	@txextension	--	https://aquaplant.tamu.edu/plant-identification/
Agencies				
South Florida Water Management District	@SFWMD	@SFWMD	@sfwmd_gov	https://www.sfwmd.gov
St. Johns River Water Management District	@sjrwmd	@SJRWMD	@sjrwmd	https://www.sjrwmd.com
Florida Department of Agriculture & Consumer Services	@FDACS	@FDACS	@fdacsdpi	https://www.fdacs.gov
Lee County Mosquito Control District	@LeeCoMosquito	@LCMosquitoEd	--	https://www.lcmcd.com/mosquitoed-com/
Florida Department of Environmental Protection - News	@FLDEP	@FLDEPNews	@fl.dep	https://floridadep.gov
US Army Corps of Engineers - Jacksonville	@JacksonvilleDistrict	@JaxStrong	--	https://www.saj.usace.army.mil
Florida Fish and Wildlife Conservation Commission	@MyFWC	@MyFWC	@myfwc	https://myfwc.com
United States Environmental Protection Agency	@EPA	@EPA	@epagov	https://www.epa.gov
Organizations				
Florida Aquatic Plant Management Society	@Florida Aquatic Plant Management Society	--	--	https://www.fapms.org
Aquatic Plant Management Society	@APMS1961	@APMSociety	@apmsociety	http://www.apms.org
Florida Native Plant Society	@FLnativeplants	@fl_native_plant	@fl_native_plants	https://www.fnps.org
PlayCleanGo	@PlayCleanGo	@PlayCleanGo	@play.clean.go	https://www.playcleango.org/help-stop-invasive-species-with-playcleango
Florida Exotic Pest Plant Council	@fleppc	@FL_EPPC	@fl_eppc	https://www.fleppc.org
Florida Invasive Species Partnership	@floridainvasives.org	@Protect_Florida	@protect_florida	https://www.floridainvasives.org
Responsible Industry for a Sound Environment	--	@pestfacts	--	https://www.pestfacts.org
North American Lake Management Society	@NALMS1980	@NALMStweets	@nalmsphotos	https://www.nalms.org

*Remember to check regional chapters, affiliations, CISMAs, municipalities, & our industry partners for more information!

**This list is by no means exhaustive; there are many resources out there.

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EXAMPLES OF VEGETATION COMPATIBLE WITH WILDLIFE

within the electric transmission right of way in State Game Lands 33 Project Area are:

TREES AND TALL SHRUBS (border zone)

Witchhazel, *Hammamelis virginiana*
Bear oak, *Quercus ilicifolia*

LOW-GROWING SHRUBS (both zones)

Sweet fern, *Comptonia peregrina*; Blueberry, *Vaccinium spp*; Blackberry, *Rubus allegheniensis*

FORBS AND GRASS (both zones)

Rough goldenrod, *Solidago rugosa*
Narrow-leaf goldenrod, *Euthamia graminifolia*
Bracken fern, *Pteridium aquilinum*
Hay-scented fern, *Dennstaedtia punctilobula*
Whorled loosestrife, *Lysimachia quadrifolia*
Poverty grass, *Danthonia spicata*

PLANT AND ANIMAL COMMUNITY RESPONSE to Long-Term Vegetation Management Practices on Rights-Of-Way

Results of 65 years of ecological research on Pennsylvania electric transmission rights-of-way demonstrate that plant communities can be selectively managed to support reliable electric service and a diverse plant community for wildlife habitat.

KEY RESEARCH FINDINGS

PLANT AND ANIMAL RESPONSE TO RIGHT-OF-WAY TREATMENTS

The Pennsylvania State Game Lands 33 (SGL33) research project in central Pennsylvania began in 1953 in response to public concern—particularly from hunters—about the impact of vegetation management practices on wildlife habitat within electric transmission rights-of-way. Today, SGL33 is the site of the longest continuous study measuring the effects of herbicides and mechanical vegetation management practices on plant diversity,

wildlife habitat, and wildlife use within a right-of-way. Similar studies have been conducted at a companion site, Green Lane Research and Demonstration Area (GLR&D), in southeastern Pennsylvania since 1987. Both projects provide invaluable information for understanding the response of plants and animals to vegetation management on rights-of-way.

This on-going research is funded cooperatively by Corteva Agriscience™,

Asplundh Tree Expert, LLC; FirstEnergy, and PECO Energy Company with researchers at the Pennsylvania State University.

THE ORIGINAL RESEARCH OBJECTIVES OF THE PROJECT REMAIN THE SAME TODAY

1. Compare the effectiveness of commonly used vegetation management practices on controlling trees incompatible with management objectives for right-of-way function;
2. Develop tree-resistant plant cover types; and
3. Determine the effect of vegetation management practices on wildlife habitat and select wildlife species of high public interest.

WIRE ZONE-BORDER ZONE METHOD

Since the mid-1980s a vegetation management approach called the wire zone-border zone has been applied at SGL33 and GLR&D sites. With this approach the zone located directly under the line (wire zone) is managed for a plant community consisting of grass, forbs, and low growing shrubs to minimize re-invasion of tall growing trees and shrubs that could interfere with the power lines. The “wire zone” adjoins a narrower “border zone” of low to mid-size shrubs where the right-of-way meets the natural forest.

This management technique is part of an integrated vegetation management (IVM) approach. IVM is recognized as an industry best management practice and includes a systematic approach which often uses a variety of mechanical, chemical, and/or biological approaches to vegetation management.



LEARN MORE ONLINE, GOTO:

<http://sites.psu.edu/transmissionlineecology>
WIRE ZONE-BORDER ZONE METHOD
• TREATMENT HISTORY • FOUNDING RESEARCHERS
• REFERENCE LIBRARY • AND MORE!

Researchers began documenting game species such as white-tailed deer and eastern cottontails on treated SGL33 sites in the 1950s, and continue to monitor and measure plant and animal biodiversity within both study areas. From 1982 to the present, there has been a concerted effort to examine wildlife usage of rights-of-way through a series of studies focusing on songbirds, large and small mammals, butterflies, amphibians and reptiles. Key findings from these studies are described below.

PLANT COMMUNITY KEY FINDINGS

1. Plant communities can be changed with the use of an appropriate herbicide and application method.
2. Vegetation management practices that include the use of selective herbicides result in diverse vegetation that provides forage and habitat for wildlife on rights-of-way.
3. Plant communities can be created that inhibit tree establishment, thereby reducing maintenance costs for utility companies and mitigating the potential for power outage.
4. IVM that combines the use of herbicides with a variety of application methods (e.g., low volume basal bark, hydraulic foliar, etc.) is more effective at limiting incompatible vegetation than mechanical methods (e.g., hand-cutting and mowing) alone.
5. Over 120 species of plants have been documented on the right-of-way project area with plant species richness as high on herbicide-treated as mechanically-treated sites.

When a transmission right-of-way is initially cleared, a short-term decrease in total vegetative cover occurs. Following tree canopy removal, plants that tolerate high levels of sunlight increase in dominance, and tree seeds present in the soil germinate and grow. Thus, follow-up management is necessary to maintain a low-growing plant community to optimize safe and reliable transmission of electricity.

Data collected from SGL33 and GLR&D sites indicate that herbicide treatments to remove incompatible species (e.g., tall-statured trees) produce a distinct change in the plant community.

Post-treatment vegetative cover ranges from grasses, to herbicide-tolerant wildflowers, shrubs and small trees. These new plant communities are relatively stable and have diversity that equals or exceeds non-treated areas.

The data also shows that right-of-way vegetation managers can predict cover types and develop the kind of vegetation desired in a particular situation by prescribing appropriate maintenance. Management units that were treated with herbicides alone or in combination with mowing had fewer incompatible trees per acre within the wire zone compared to units with mowing alone or hand-cutting treatments. The diverse plant community created within the right-of-way as the result of vegetation management practices produces a variety of native species important for wildlife food and cover.



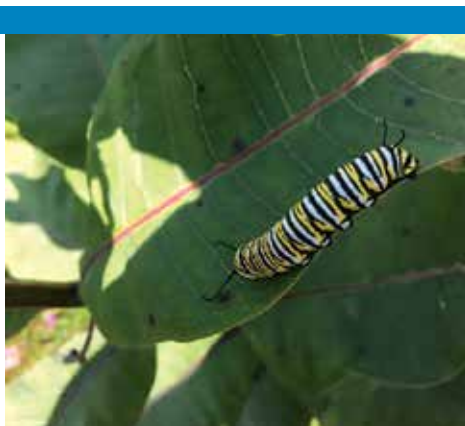
BEE POPULATION AND POLLINATION STUDIES KEY FINDINGS

Bee surveys were conducted monthly for four months on SGL 33 sites following six different vegetation management practices. The practices included the following treatment methods: hand-cutting, mowing, cut stubble, low volume basal, low or ultra-low volume foliar, and high volume foliar.

1. The most diverse communities of native bees were collected from sites where herbicides were used selectively to treat incompatible vegetation versus sites where mechanical methods or non-selective application of herbicides were used.
2. Several species of specialist bees were collected on the right-of-way and include rare species such as the yellow bumble bee (*Bombus fervidus*) and a rare oil-collecting bee, *Macropis ciliata*.

With at least 4,000 species of bees in North America, bees pollinate roughly 75% of the fruits, nuts and vegetables that are grown in the United States alone, and conservation of bees has become a worldwide priority.

There are a number of factors leading to the decline in native bee populations, species richness, and diversity, one of the greatest threats is the loss or fragmentation of habitat. There are millions of acres of transportation and power line rights-of-ways in the United States. Routinely managed vegetation within these corridors are and could serve as valuable habitat for native bee species. Understanding the impacts that commonly used vegetation management practices have on bees will allow vegetation specialists to develop improved strategies for promoting native flowering plants and suitable nesting habitat in these spaces.



BUTTERFLIES KEY FINDINGS

1. Flowering herbaceous plants (forbs/wildflowers) occurring

within the right-of-way provide excellent habitat for butterflies.

2. With the exception of hand-cutting, all herbicide and mowing plus herbicide treatments provided habitat for a diverse butterfly community within the right-of-way.
3. The use herbicides on the right-of-way did not have a detrimental impact on butterfly species or total number of butterflies.

Butterflies are important indicators of environmental changes and are barometers of a healthy ecosystem. They are valuable pollinators to many wildflowers and are a food source for songbirds, small mammals, and other wildlife. Habitat loss has caused some butterfly populations to decline nationally.

A two-year study on the SGL33 and a companion study on GLR&D sites compared butterfly populations on hand-cutting units versus herbicide-treated units. Results show that the same or slightly more butterfly species occurred on the right-of-way than in the adjacent forest, and were more common in herbicide-treated units than on hand-cutting units.

A major factor affecting the abundance and diversity of butterflies on the right-way was the presence and use of flowering plants as nectar (food) sources during the growing season. The use of herbicides as part of integrated vegetation management practices promoted a rich wildflower community and habitat that supports a diverse butterfly community on the right-of-way.

BIRD POPULATION AND NESTING STUDIES KEY FINDINGS

1. IVM provides valuable habitat for early successional bird populations during the spring and summer months.
2. Bird abundance, richness, and breeding productivity was higher on herbicide treated units compared to those that were mechanically treated.
3. Bird abundance, richness, and

breeding productivity was higher in shrubby border zones than within the wire zone along rights-of-way. Hence, the border zone is a very important habitat, with its combination of herbaceous, shrub, and tree species.

4. The diversity of native plant species on the right-of-way provides a variety of nest sites for different bird species that depend on early successional habitat for breeding.



Bird populations have been extensively studied on the SGL33 right-of-way since 1982. Anywhere between 31 and 45 different bird species have been noted on the right-of-way during a given year, with the most common being those that nest in herbaceous or shrubby vegetation created by integrated vegetation management practices. Most common species include chestnut-sided warbler, common yellowthroat, indigo bunting, eastern towhee, field sparrow, and gray catbird. Throughout the history of the research conducted along the right-of-way, numerous studies have indicated that proper use of herbicides via integrated vegetation management practices have been beneficial to plant and animal communities. Sections of right-of-way managed using herbicides were comparable or more beneficial to bird communities in terms of abundance, species richness, indices of productivity, and nesting success than sections maintained via mechanical treatments both at the

end and during the first breeding season post treatment of integrated vegetation management cycles. In areas treated with herbicides, there were 712 birds observed per day per 100 acres compared to 552 birds on areas mechanically maintained.

Breeding bird productivity can fluctuate quite dramatically from year to year and the presence of border zone vegetation may help to retain birds following extensive management within the wire zone. Nesting success rates have varied along the right-of-way throughout the history of the project with a low of 36% in 2017, 39% in 2002, 49% in 2016, 65% in 2003, and a high of 68% in 1991-92.

For comparison, nesting success was 42% along the GLR&D during 2003-04 and success rates average around 50% for different managed landscapes within Pennsylvania and Maryland. Native plant species including blueberry, blackberry, witch hazel, mountain laurel, hay-scented fern, and poverty grass provided a diversity of vegetative cover and structure within the right-of-way for different bird species that depend on early successional habitat for breeding.

Early successional habitats and components of their ecosystems (e.g., breeding bird communities) are dramatically declining throughout the United States. Properly maintained vegetation within a right-of-way benefits many bird species especially those adapted to brushy, early successional habitat. In the northeastern United States, bird species using early successional vegetation are declining faster than other groups such as forest or wetland birds. Since artificial disturbances not created solely for natural resource conservation now make up a majority (approximately 80%) of early successional habitats, rights-of-way maintained using integrated vegetation management will be vital to and can be used as examples of early successional habitat management for bird conservation.

SMALL MAMMAL POPULATIONS

KEY FINDINGS

1. Small mammals contribute to the diversity of wildlife within a right-of-way.

2. Small mammal population and diversity is greater within the treated right-of-way than the adjacent forest.
3. Cover types that benefit small mammals can be predicted through the implementation of specific right-of-way maintenance techniques.
4. Small mammals use a diversity of cover types from grass to shrub that result from integrated vegetation management on the right-of-way.
5. Small mammals are important in reducing tree reinvasion by feeding on tree seeds and seedlings.



Small mammals are important components of any ecosystem, including rights-of-way. From an ecological perspective, small mammals serve as prey for predators and are major links in the food chain.

A two-year study was conducted on SGL33 to determine relative abundance and species richness (number of species) of small mammals on the right-of-way compared to the adjacent forest. Results of the study showed that eight species of small mammals were noted on the right-of-way compared to only two in the adjacent forest. Five species of mice [whitefooted mouse (*Peromyscus leucopus*), meadow vole (*Microtus pennsylvanicus*), red-backed vole (*Clethrionomys gapperi*), woodland jumping mouse (*Napaeozapus insignis*), and meadow jumping mouse (*Zapus hudsonius*)], two shrew species [short-tailed (*Blarina brevicauda*) and masked (*Sorex cinereus*)], and a short-tailed weasel (*Mustela erminea*) occurred on the right-of-way.

The findings of this study and a companion study conclude that specific treatments on the right-of-way produce cover types

that benefit small mammals compared to the adjacent forest cover type. In addition, small mammals use a diversity of cover types found on the right-of-way from grass to shrub. Evidently, the right-of-way serves as a large forest clearing, which provides habitat for forest species (e.g., white-footed mouse and woodland jumping mouse) in border zones and habitat for early successional species (e.g., meadow vole and meadow jumping mouse) in wire zones.



DEER POPULATIONS

KEY FINDINGS

1. Integrated vegetation management treatments within the right of way caused a shift in vegetation, but suitability of the habitat for deer remained high.
2. Deer use of woody plants was greater in the adjoining forest compared to the right-of-way where more herbaceous vegetation was browsed.
3. Deer use in the right of way was 48 percent greater than in the adjacent forest.
4. Deer can have a positive impact on a right-of-way by browsing on incompatible trees in wire and border zones, and by providing aesthetic value to a right-of-way.

White-tailed deer (*Odocoileus virginiana*) habitat and its use were evaluated on the SGL33 right-of-way before and after vegetation management treatments and compared to the adjoining forest. Deer presence increased post-treatment on the right-of-way between 1982 (treatment year) to 1984 (post-treatment). The right-of-way continued to provide desirable habitat for deer following herbicide treatment.



REPTILES AND AMPHIBIANS KEY FINDINGS

1. Plant diversity and cover type within the right-of-way provided preferred habitat for most reptiles (snakes) and amphibians (salamanders).
2. With exception of the red-backed salamander (*Plethodon cinereus*), amphibians and reptiles were more common within the right-of-way compared to the adjacent forest.
3. Reptiles and amphibians were more prevalent on herbicide treated units compared to hand-cutting units.
4. Properly maintained rights-of-way do not appear to be a barrier to movement of native snakes.

Forest-management practices, such as clearcutting, can have negative impacts on some species of amphibians and reptiles. A two-year research study of amphibian and reptile populations on SGL33 and GLR&D sites concluded that the right-of-way contained a diverse assemblage of these species. Depending on the location, eight to nine different species were recorded on the right-of-way versus only two recorded in the adjacent forest. The most common species were red-backed salamander (*Plethodon cinereus*), Jefferson salamanders (*Ambystoma jeffersonianum*), northern redbelly snake (*Storeria occipitomaculata occipitomaculata*), and northern ringneck snake (*Diadophis punctatus edwardsii*). Border zones were valuable habitat to salamanders, whereas wire zones were used most often by snakes. The right-of-way contains a much more diverse community of reptiles and amphibians than the adjacent forest and provides an acceptable habitat for these important species of wildlife.



GROUND BEETLES KEY FINDINGS

A new area of research is focused on ground beetles. The purpose of this research is to evaluate the impacts, if any, of common vegetation management techniques on the diversity and populations of ground beetles.

Ground beetles provide a unique

opportunity to understand the ecosystem from the ground up. Ground beetles (*Carabidae* insect family) are a diverse group of insects with 2,000 species found in North America and more than 40,000 species worldwide. Found on the soil surface in nearly every habitat type, some species are associated with specific types of habitats such as meadows and woodlands. Habitat specificity makes these species useful biological indicators for ecosystem and habitat changes. Ground beetles are an easy assessment tool by also providing biological control of other insects and plant weed species while being a food source for higher animals in the food chain. Populations of ground beetles and diversity further our understanding of integrated vegetation management in power line rights of ways.

Long-term studies conducted on SGL33 and GLR&D sites have shown economic, aesthetic and wildlife habitat benefits associated with IVM practices on transmission line rights-of-way.

This information is critical to help right-of-way managers implement proper vegetation management practices that meet the needs of their industry, the public, and wildlife. Future research will be shaped based on the needs of the utility industry to address conservation issues, new vegetation management techniques, and concerns generated by the public and scientific community.

For details on all of the studies that lead to these finds and for more information, be sure to visit <https://sites.psu.edu/transmissionlineecology/>

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Planthopper and pathogens associated with dieback of elephant ear in Baton Rouge, Louisiana



Veronica Manrique¹, Rodrigo Diaz², Rodrigo Valverde³

¹ Department of Urban Forestry and Natural Resources, Southern University, ²Department of Entomology, and ³Department of Plant Pathology and Crop Physiology, Louisiana State University Agricultural Center

Elephant ear or taro (*Colocasia esculenta*), a native to Asia, is considered an invasive plant of wetlands, streams, and riverine forests in the southeastern US. It out competes native species and reduces biodiversity resulting in complete habitat modification. Taro has invaded natural areas in Louisiana including wetlands at the Bluebonnet Swamp Nature Center in Baton Rouge. Scientists and park managers have used this site to demonstrate the negative impacts of taro monocultures in relation to habitat loss. But recently, park volunteers noticed that taro health was declining, leaves were turning yellow and bending, and many plants were dying. Upon a closer look, large numbers of planthoppers and symptoms of plant diseases were observed.

The planthopper was identified as *Tarophagus colocasiae* which belongs to the family Delphacidae. This taro planthopper has also been reported in North Florida in 2015. It is known to be a major pest of cultivated taro in the native range in Asia. Adults and nymphs of this planthopper feed by piercing and sucking sap from xylem and/or phloem, resulting in wilted leaves and petioles curling downwards. Taro leaves have also shown disease symptoms characterized by feathering patterns and yellowing-brown necrotic spots. Diagnostic testing using PCR has identified the presence of dasheen mosaic virus on the leaves, and plant bait techniques found *Pythium* and *Phytophthora* from soil and roots. Thus, taro dieback reported in Baton Rouge may be a result of several stressors including insect damage and plant diseases. Additional field observations in the Fall 2020 of taro dieback in North Florida (Leon Co.) and Southern Georgia (Decatur Co.) suggest that this may be more widespread than currently reported.

Taro planthopper and pathogens may provide prospects for managing invasive

taro in Louisiana and elsewhere. However, the potential impact of this insect and pathogens on ornamental taro in the genera *Colocasia*, *Alocasia*, and *Xanthosoma* remains to be determined. More studies are needed to determine the extent of taro dieback in Southeastern US. We invite the public to help us understand the distribution of the planthopper and taro dieback. You can download the free app Inaturalist and upload pictures of your observations. For more information about the dieback and many more pictures, please visit www.lsuagcenter.com/colocasia

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A – Evidence of impacted wild taro leaf from *Tarophagus colocasiae*



B – Presence of taro planthopper on underside of leaf



C- Closeup of the taro planthopper *Tarophagus colosiasiae*

**All photos, courtesy of John Hartgerink

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