

Aquatics

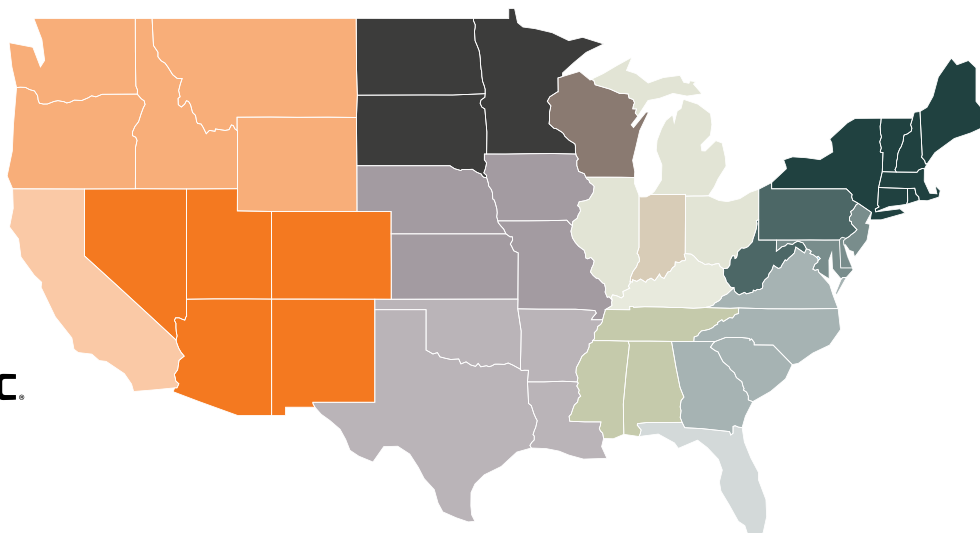
WINTER/SPRING 2022

A Publication of the Florida Aquatic Plant Management Society



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Aerial applications allow natural resource managers to protect habitat from invasive plants like hydrilla (*Hydrilla verticillata*). These helicopters were treating 2,100 acres of hydrilla on Lake Yale (Lake County) in February 2022. Photo, courtesy of Nathalie Visscher, Biological Administrator, FWC Invasive Plant Management

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New Podcast on Aquatic



and Invasive Plants

Introducing the Working in the Weeds Podcast

The UF/IFAS Center for Aquatic and Invasive Plants (CAIP) is excited to announce its new podcast: Working In The Weeds. This series will connect scientists with stakeholders to clarify and discuss issues surrounding aquatic and invasive plants while also highlighting the research being conducted at the Center.

“What I’m hoping is that this podcast will elevate us to have better conversations about invasive plants,” said Jay Ferrell, UF/IFAS CAIP center director. “Our listeners can expect a series of good conversations from really good scientists coming together and talking about these complex topics.”

In the first season, Ferrell sits down with education and training specialist Christine Krebs to discuss what invasive plants are, why Florida and other areas are prone to invasive species, the history of plant management, and how the Center fits into all of it.

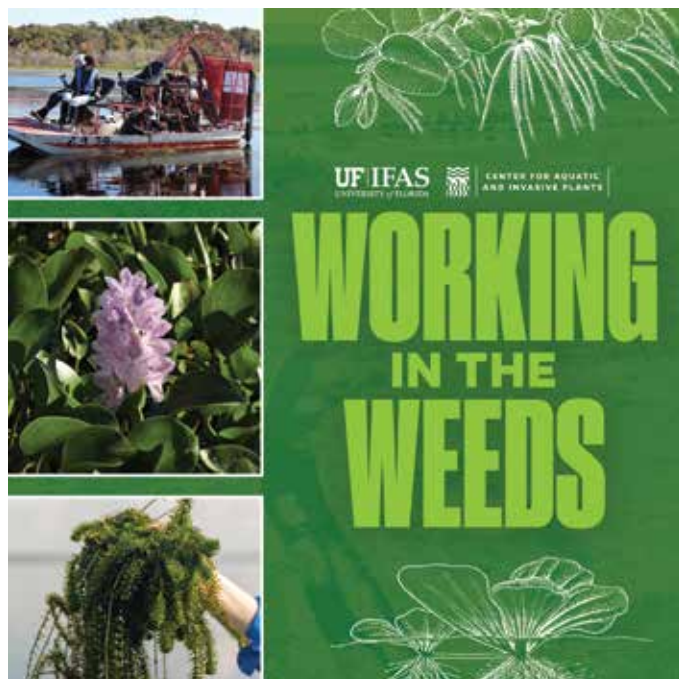
The Working In The Weeds podcast is available now on Apple Podcasts, Spotify, Google Podcasts, Overcast, and Stitcher. Or listen directly on the podcast webpage at anchor.fm/

ufifascaip.com. New episodes of this series will be released every other Wednesday.

Do you have topics or questions you would like us to discuss on this podcast? Email us at caip@ifas.ufl.edu.

About the Center

The UF/IFAS Center for Aquatic and Invasive Plants is a multidisciplinary research, teaching, and extension unit. The mission of the Center is to develop and disseminate strategies for addressing the impact of invasive plants. Follow UF/IFAS CAIP on Instagram, Facebook, and Twitter.



Cuban Bulrush Response to Herbicide Treatments in Field Sites and Potential for Integrated Control with Prescribed Fire

Gray Turnage, PhD

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Research Institute

Background

Cuban bulrush (*Oxycaryum cubense*) is currently invading many multi-use lakes, reservoirs, and flowing waters across the southeastern United States. These waterbodies provide the public with drinking water, hydro-electric power, navigation for commercial and military vessels, food in the form of fish and other aquatic life, and quality of life services such as outdoor recreational opportunities. The dense growth of Cuban bulrush can also prevent the growth of more desirable aquatic plant species which will impact the aquatic food web, especially economically important fish species.

In the last 20 years, Cuban bulrush has become more prevalent in the southeastern U.S. (Figure 2) and is therefore receiving more attention from resource managers. In 2020, the state of FL spent over \$625,000

to manage Cuban bulrush. However, operational control methods for nuisance Cuban bulrush populations have been lacking as the species has been overlooked for decades by more pressing management concerns and existing management strategies only deliver short-term reduction of Cuban bulrush infestations. As a result, resource managers are having difficulty controlling Cuban bulrush populations. Previous work at the mesocosm scale has identified a number of potential chemical control techniques that need to be tested in field locations.

Herbicide applications may provide an effective control mechanism; however, herbicide treatments are usually applied after mid-summer when new foliage has emerged from the thatch layer from the previous year's growth. This thatch layer shields new growth in the spring and early-summer potentially decreasing herbicide contact with emerging foliage. Late season herbicide applications may be an effective control mechanism for Cuban bulrush but will likely require more herbicide as more plant foliage is present than earlier months.



Figure 1. Image of monoccephalous (left) and umbellate (right) Cuban bulrush biotypes. Photo by G. Turnage

Therefore, thatch removal may allow for less herbicide use while still attaining control of Cuban bulrush.

Prescribed fire is a useful method of thatch reduction in terrestrial systems but is rarely used in wetland and aquatic settings due to the obvious over-abundance of water. However, some emergent aquatic plant species (torpedograss, common reed, giant reed) maintain a dense aerial thatch layer that is not hydrated by the underlying water. Reduction of the thatch layer in winter months via prescribed fire may provide a cost-effective mechanism to enhance herbicide contact with new Cuban bulrush foliage in the spring for greater tussock reduction compared to mid- or late-season herbicide applications.

The purpose of this project was to 1) investigate short and term control of Cuban bulrush with mid-season herbicide applications at field sites in Florida and 2) test the efficacy of integrating prescribed fire as a means to reduce Cuban bulrush thatch in an effort to increase herbicide uptake in new foliage in a Mississippi population.



Figure 2. Image of a Cuban bulrush tussock growing on Orange Lake, FL; water depth under the tussock is approximately 8 ft. Photo by G. Turnage

Methodology

Chemical control:

Research sites in Florida were selected on Lake Fannie, Lake Rousseau, Flying Eagle Preserve, Orange Lake, Lake Talquin, Lake Carr, and Deer Pointe Reservoir. Four treatment plots and a reference plot were delineated in each waterbody (35 plots total). Herbicide treatments were administered late summer 2021 (Table 1). Eight weeks after treatment (WAT), biomass samples were harvested from each plot. Data collection will occur again in summer 2022 to determine long term effects of herbicides on Cuban bulrush.

A mixed model analysis of variance (ANOVA) using herbicide treatment as a fixed effect and lake as a random effect was conducted to assess Cuban bulrush biomass response to herbicide treatments 8 WAT. If differences were detected, a Fishers LSD test was utilized to separate treatment means.

Table 1. Herbicide treatments administered to Cuban bulrush plots in Florida; each treatment included 0.5% v:v NIS.

| HERBICIDE | RATE |
|--------------------------|---------------|
| Reference | - |
| Triclopyr | 128 oz/ac |
| Diquat | 96 oz/ac |
| Florpyrauxifen-benzyl | 1.35 oz/ac |
| Glyphosate + Flumioxazin | 120 + 3 oz/ac |

All statistical tests were conducted at the $\alpha=0.05$ significance level.

Prescribed fire:

Cuban bulrush tussocks infest nearly 800 acres of habitat on the northern end of the Ross Barnett reservoir near Jackson, MS. In early March, approximately 20 acres of tussock was burned (Figure 3) to remove the thatch layer so that subsequent herbicide treatments can be applied in April or May (Table 1). The

fire was ignited along a gravel access road on one side of the site and allowed to move across the tussock to open water. Spray boats were situated nearby to control the flame front if needed.

Prior to treatment, 12 WAT, and 52 WAT, biomass samples will be collected and processed from each treatment site in the same manner as Florida samples. Final biomass collection will occur in the summer of 2023.



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Left: Figure 3. Image of prescribed fire moving across a Cuban bulrush tussock on the Ross Barnett reservoir near Jackson, MS; water depth under the tussock is approximately 5-6 ft. Photo by R. Jones.

Below: Figure 4. Emergent (top panel) and submersed (bottom panel) Cuban bulrush biomass 8 WAT; error bars are one standard error of the mean; bars sharing a letter are not different at the $\alpha=0.05$ significance level.

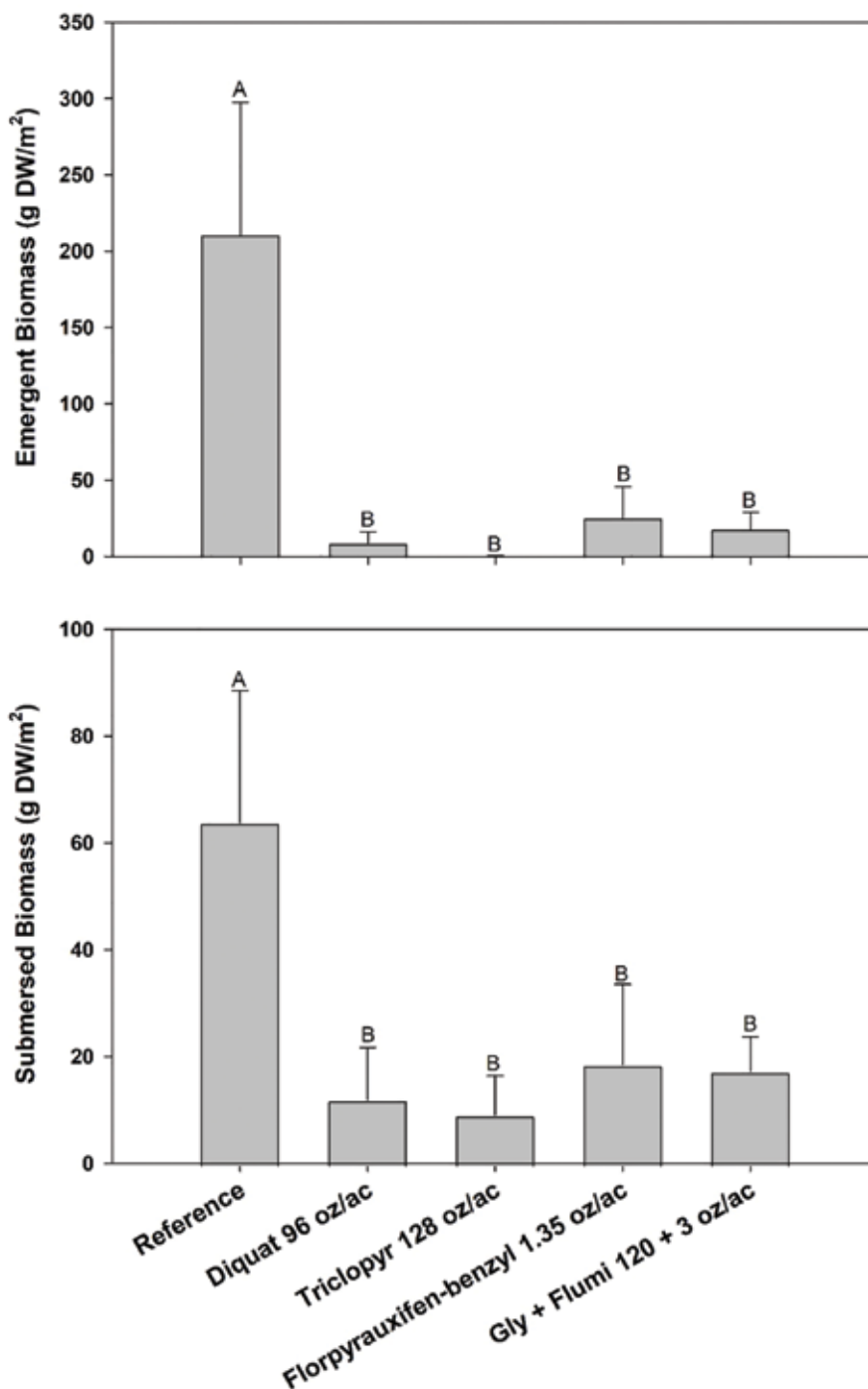
Results and Discussion

All herbicide treatments in Florida reduced Cuban bulrush emergent biomass 87 to 99% ($p=0.0109$) and reduced submersed biomass 70 to 85% compared to reference plants 8 WAT ($p=0.0026$; Figure 4). Final biomass assessment will occur in the summer of 2022.

Visual assessment of treatment plots suggests that tussocks treated with triclopyr may be degrading faster than those treated with other herbicides. Triclopyr is a broad-spectrum systemic herbicide that moves through plant leaves to the roots. Degradation of root biomass by triclopyr treatments may be sufficient to control Cuban bulrush and cause the degradation of tussocks by killing root tissues that are holding tussocks together.

Effective thatch removal occurred with the use of prescribed fire. Follow up herbicide treatments will be applied after Cuban bulrush foliage has sprouted. If successful, this integrated control technique may enhance management across the southeastern U.S. by providing resource managers a low-cost solution to reduce herbicide input while further increasing reduction of Cuban bulrush biomass.

Gray Turnage (gturnage@gri.msstate.edu) is an Assistant Research/Extension Professor with Mississippi State University's Geosystems Research Institute. He has over a decade of research experience with aquatic and wetland ecosystems with an emphasis on invasive aquatic and wetland plant management and restoration of native species.



“There is no such thing as insignificant hearing loss. Any type and degree of hearing loss will have a substantial impact on many aspects of living.”

Listen Up!

The National Institute for Occupational Safety and Health (NIOSH) estimates that 22 million people in the United States are exposed to hazardous noise levels on the job annually. Hearing loss limits our interactions with each other and affects much of our daily activities. It is also permanent, and while we have technologies to help improve hearing, we cannot medically correct damage that has occurred. Therefore, safety precautions are necessary to preserve hearing throughout our lives.

Aquatic plant managers and scientists are frequently exposed to equipment that can be damaging to our hearing. Airboats, helicopters, outboard motors, and pumps are some of the tools in the resource management toolbox that require extra auditory attention to prevent damage and hearing loss.

How do we hear?

Our ears are made up of many tiny intricate structures that are responsible for our ability to hear. Sound waves are caused by vibrations in the air around us and are funneled into the ear canal to the eardrum. The eardrum then transfers these vibrations from three tiny bones in the middle ear to the cochlea in the inner ear. Small hair-like cells in the cochlea capture the wave-like vibrations headed their way, and they respond to differing pitch and frequency of the entering sounds.

Hearing is made possible by the 25,000 nerve endings in the inner ear that detect vibrations and transform them into electrical impulses that are sent to the brain on the auditory nerve. The brain then interprets and deciphers these signals, and this is how we hear.

All of this happens in just a fraction of a second, but damage to any part of this complicated pathway interrupts how effectively these signals are transmitted and interpreted...and ultimately impacts our hearing. Now that we know a bit about the complex physiology, let's look at how these noises on the job can affect hearing and what can be done to prevent hearing loss in our profession.

How is noise measured?

Noise is measured in decibels (dB), and the louder the noise, the higher the decibel level. Just like plants respond to herbicide based on dose and duration of exposure, our ears are also affected by both the decibel level (dose) and exposure time of the sound.

Sound intensity is measured on logarithmic, not linear, scale. This represents an effective way to quantify how a large range of sounds changes in intensity and how that feels in our ears. Most measurements in our day-to-day lives are based on a linear scale — like length or height. For example, if we build a building that is 80 feet tall, and we add another story (10 feet), we will have increased the building height by 12.5%, and the difference in height will be hard to notice visually.

On a logarithmic scale, however, the difference is significant. For example, if a sound that is normally 80 dB is increased to 90 dB, the sound will be ten times more intense and seem twice as loud to our ears. (Excerpt from <https://www.noisyplanet.nidcd.nih.gov/have-you-heard/how-is-sound-measured>). Other data measured using logarithmic scales include light intensity, earthquake strength, spreading

rates of epidemics, and pH.

For those who are familiar with water quality, pH is also measured using a logarithmic scale. This means that water with a pH of 6 is ten times more acidic than water with a pH of 7. To give some perspective to this, tomato juice has a pH of 4. But orange juice has a pH of 3, making orange juice ten times more acidic than tomato juice. Lemon juice has a pH of 2, making it 100 times more acidic than tomato juice. So, one unit of change on the pH scale equals a ten-fold increase or decrease in concentration.

Audiologists, or healthcare professionals who specialize in managing hearing loss and disorders of the ear, measure sound using A-weighted decibels, or dBA, as this incorporates both the sound intensity and its effect on the human ear. So, dBA provides a more accurate assessment of how sound can damage hearing. Even small increases in dBA can have a profound effect on hearing health.

According to NIOSH, a safe workplace has a legal limit of 85 dBA or less for continuous exposure in an eight-hour workday (85 dBA as an 8-hr TWA using a 3-dB exchange rate). This is referred to as the Recommended Exposure Limit, or REL, and exposures at or above this level are considered hazardous. Research has shown that extended exposure beyond eight hours at 85 dBA results in increased heart rate, increased blood pressure, nausea, fatigue, muscle tension, insomnia...and hearing damage. If the sound intensity is increased to 90 dBA, the exposure time is cut in half — to four hours. Damage occurs at 100 dBA after just 14 minutes, and 110 dBA after only two minutes. In general, for every 5 dBA increase in volume, the maximum exposure time is cut in half.

Communication on the job is also affected by noise pollution and sound intensity...and this plays into safety, too. If background noise levels exceed 80 dB, people must speak very loudly to be heard. When levels are between 85 and 90 dB, shouting is necessary. And if noise registers more than 95 dB, people must be in very close proximity to be heard. Given that communication is integral for safe boating and aerial operations, being able to hear is necessary for keeping you, your crew, and others on the water safe.



Airboats

Noise associated with propeller engines typically exceeds 120 dB. At this level, damage occurs after just 15 minutes of exposure. Airboats are usually measured at 100-110 dB, which is comparable to a jet airplane (120 dB) and much louder than a car engine (75 dB). As the revolution of the propeller increases with increased throttle, the noise pollution also increases. When an airboat is being gunned, the engine produces sound around 120 dB or higher, which is very dangerous to hearing. Eardrum rupture occurs at 150 dB.

Helicopters

Helicopters are rotary aircraft and, like airboats, produce sound from the engine

| | Level | |
|--|-------|---|
| Jet takeoff (at 25 meters) | 150 | Eardrum rupture |
| Aircraft carrier deck | 140 | |
| Military Jet aircraft take-off from aircraft carrier with afterburner at 50 ft (130 dB). | 130 | |
| Thunderclap, chain saw. Oxygen torch (121 dB). | 120 | Painful. 32 times as loud as 0 dB. |
| Steel mill, auto horn at 1 meter. Turbo-fan aircraft at takeoff power at 200 ft (118 dB). Riveting machine (110 dB); live rock music (108 - 114 dB). f | 110 | Average human painthreshold. 16 times as loud as 70 dB. |
| Jet take-off (at 305 meters), use of outboard motor, power lawn mower, motorcycle, farm tractor, Jackhammer, garbage truck. Boeing 707 or DC-8 aircraft at one nautical mile (6080 ft) before landing (106 dB); jet flyover at 1000 feet (103 dB); Bell J-2A helicopter at 100 ft (100 dB). | 100 | 8 times as loud as 70 dB. Serious damage possible in 8 hr exposure |
| Boeing 737 or DC-9 aircraft at one nautical mile (6080 ft) before landing (97 dB); power mower (96 dB); motorcycle at 25 ft 90 14 times as loud as 70 dB. (90 dB). Newspaper press (97 dB). | 90 | 4 times as loud as 70 dB. Likely damage 8 hr exp |
| Garbage disposal, dishwasher, average factory, freight train (at 15 meters). Car wash at 20 ft (89 dB); propeller plane flyover at 1000 ft (88 dB); diesel truck 40 mph at 50 ft (84 dB); diesel train at 45 mph at 100 ft (83 dB). Food blender (88 dB); milling machine (85 dB); garbage disposal (80 dB). | 80 | 2 times as loud as 70 dB. Possible damage 8 hr exposure. |
| Passenger car at 65 mph at 25 ft (77 dB); freeway at 50 ft from pavement edge 10 a.m. (76 dB). Living room music (76 dB); radio or TV-audio, vacuum cleaner (70 dB). | 70 | Arbitrary base of comparison. Upper 70s are annoyingly loud to some people. |
| Conversation in restaurant, office, background music, Air conditioning unit at 100 ft | 60 | Half as loud as 70 dB. Fairly quiet |
| Quiet suburb, conversation at home. Large electrical transformers at 100 ft | 50 | One-fourth as loud as 70 dB. |
| Library, bird calls (44 dB); lowest limit of urban ambient sound | 40 | One-eighth as loud as 70 dB. |
| Quiet rural area | 30 | One-sixteenth as loud as 70 dB. Very Quiet |
| Whisper, rustling leaves | 20 | |
| Breathing | 10 | Barely audible |

(modified from <http://www.wenet.net/hpb/dblevels.html>) on 2/2000. SOURCES: Temple University Department of Civil/Environmental Engineering (www.temple.edu/departments/CETP/environ10.html), and Federal Agency Review of Selected Airport Noise Analysis Issues. Federal Interagency Committee on Noise (August 1992). Source of the information is attributed to *Outdoor Noise and the Metropolitan Environment*, M.C. Branch et al., Department of City Planning, City of Los Angeles, 1970.

as well as from the blades moving through the air. Noise from the helicopter depends on the flying altitude, but in general, the helicopters used in aerial resource management register at around 100 dB between the ground and 100' altitude. Sound intensity varies at takeoff, landing, with the weight they are carrying, and with each model being flown, etc.

Outboard Motors

We may not typically associate outboard motors with hearing loss, but these engines can cause hearing loss over time. Boats at idle speed produce sound registering around 60 dB. As speed increases and the boat planes out, noise levels are about 70 dB. High speed cruising is generally producing about 80 dB of noise, and sound generated from a wide-open throttle can

approach 90 dB. Sound is generated by the engine, by wind, and by the interaction of the hull and the water.

How do these compare?

This chart from Purdue University illustrates how different types of noise compare in intensity relative to one another.

www.chem.purdue.edu/chemsafety/Training/PPETrain/dblevels.htm

Hearing loss prevention

Even small increases in dBA levels can have a big impact on hearing, hearing loss, and damage that may result in conditions like tinnitus (persistent ringing or buzzing in the ears from repetitive loud sound). So, it is up to you to reduce the intensity and duration of exposure to noise pollution to protect your hearing.

The first step in preventing hearing loss is to have a baseline audiogram by an audiologist so they can track changes over time and recommend specific hearing protections as needed. Without a baseline exam — which many never get — it is impossible to know if changes to hearing are related to noise exposure, genetics, or the general aging process. Unfortunately, we lose a half a percent of cochlear hair cells each year of life starting at age 40, so taking precautions not to exacerbate this process of aging with additional noise exposure is critical.

While at work, it is best to utilize Personal Protective Equipment (PPE) to



minimize the vibrations that register as noise/sound to your brain and ears. Here are some suggestions for protective gear:

Invest in a good set of earplugs. These can be disposable or reusable, but it is important to select a model that is rated for airboat or helicopter use, comfortable, and always carry a backup.

Earmuffs, particularly when worn over earplugs, help protect hearing by preventing sound from entering the ear canal. These, too, should be durable and rated for sound produced by airboat/aircraft use.

Ideally, having hearing protection custom-fitted is best to avoid errors in insertion and judgement.

Remember noise pollution is caused by sudden vibrations in the air around us. Helmets are not just protective gear for your brain in a collision; they can help prevent hearing loss, too. You can reduce vibrations/noise entering the ear canal by using a solid Kevlar helmet that fits securely.

Amy L. Giannotti, MS, CLM, (amy@aquastemconsulting.com) is an environmental scientist, Certified Lake Manager, and founder of AquaSTEM Consulting. Amy has 20+ years of experience working in temperate and subtropical marine and freshwater systems, including airboat operations for lake and aquatic plant management in Florida. She is an airboat pilot, outboard motor operator, certified diver, and a licensed aquatics herbicide applicator. This article was authored in cooperation with Dr. Julie Prutsman, Au.D., FAAA, CH-TM, of Sound Relief Hearing Center (<https://www.soundrelief.com>). Julie earned her doctoral degree in audiology from Salus University College of Audiology, and she serves on the Board of the American Tinnitus Association (ATA), is a member of the Academy of Doctors of Audiology, the American Academy of Audiology, and the Colorado Academy of Audiology. Amy and Julie are both alumni of Marietta College's (OH) Department of Biology.



Yep, there's an APP for that!

You can download this app from NIOSH <https://www.noisyplanet.nidcd.nih.gov/have-you-heard/cdc-niosh-app> to measure dBA levels yourself. The app is capable of registering dBA levels from 0 dBA to 140 dBA, and it enables us to monitor sounds we have grown accustomed to hearing without realizing the potential for damage that is occurring.

While some communities are enacting legislation to force equipment operators to incorporate noise reduction modifications on engines (e.g., mufflers, etc.), it is ultimately up to you to take the necessary precautions to protect your hearing. Remember, these tools — baseline and regular exams, proper PPE, and awareness about the noise pollution around us — are all necessary for protecting against hearing loss. Taking these steps now will ensure healthy hearing in the future.





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USACE Mechanical Harvesting Project at Torry Island, Lake Okeechobee, FL



Figure 1. Mechanical harvesting operation at Torry Island Boat Ramp Basin.

Benjamin P. Sperry¹, Jessica Fair², Ian Markovich²

Mechanical harvesting is the oldest form of aquatic plant management. Prior to the discovery of modern synthetic herbicides (1940s to present), invasive aquatic plants like waterhyacinth caused massive damages to aquatic infrastructure and obstructed navigation in our waterways. In that era (late 1800s to ~ 1950s), transportation of people and goods was primarily accomplished via boats/ships on the St. Johns and Kissimmee Rivers.

The US Army Corps of Engineers (USACE) was the first Federal agency

charged with aquatic weed control (River's and Harbors Act 1899). Aquatic plant management (APM) was first viewed by the USACE as an engineering problem which led to a massive effort engineering, testing, and implementing a multitude of barge, grapple, harvester, and cutter boat designs. Herbicides in this era were not regulated and many consisted of heavy metals that were toxic to humans, cattle, and various other organisms in the environment. Additionally, cattle were still free-range and relied on natural water bodies for their drinking water which resulted in a heavy reliance on the USACE's mechanical control technologies.

As time went on, what we refer to as modern herbicides (non-toxic to cattle) were developed, tested, and implemented for APM. This technological advancement caused a paradigm shift in APM that essentially replaced USACE-developed me-

chanical control equipment with efficient, cheaper, and more effective technology (herbicides). To this day, chemical control largely remains the most effective and economical management tool for many of our APM issues. However, there are still scenarios that require mechanical control today in APM because no other suitable options are available. These scenarios where mechanical control is still used primarily consists of tussock removal and large plant infestations that need to be removed immediately. The need for mechanical control of floating plant infestations that have gotten out of hand occurs from time to time in Florida. More important is the documentation of such events to serve as reference for future issues and new managers faced with these problems for the first time. Therefore, the purpose of this article is to do exactly that — document a unique mechanical harvesting scenario.

¹Research Biologist, US Army Engineer Research and Development Center, Gainesville, FL; ²Biologist, US Army Corps of Engineers, Jacksonville District, Clewiston, FL



Figure 2. Transfer site and barge on shoreline near Torry Island Boat Ramp.

In 2021 the USACE-Jacksonville District partnered with the City of Pahokee to alleviate a waterlettuce infestation near the Torry Island Boat Ramp on Lake Okeechobee. This infestation was blocking navigation, limiting recreational use of the area, and completely covering the water surface which causes other environmental issues. Waterlettuce is a free-floating aquatic weed that is usually part of most APM programs across the state/region. There is some argument surrounding the native range of this species (native or exotic); however, those arguments are erroneous when this plant grows to large populations that cause issues with human waterway usage and the environment which was the case at Torry Island. Due to the severity of the infestation (vegetation jam) and desire of local stakeholders, mechanical harvesting was chosen as the management tool.

An estimated 3 acres of waterlettuce was mechanically removed at the Torry Island boat ramp from April 27 to May 13 (12 total workdays) using a single Weedoo harvester with no reported breakdowns, downtime, accidents, or near misses

(Table 1; Figure 1). Weedoo boats are small shallow-draft harvesters that were chosen because of the site's shallow water depth and narrow canals that likely would not have accommodated conventional-sized

harvesters from entering/maneuvering in the area.

The capacity of most harvesting or herbicide application operations have been described on the basis of acres treated per day (e.g., a spray boat covering 5 acres per day); however, data from this project indicated that the average harvest rate was 0.25 acres per day or 4 days per acre. This is much slower than previously documented harvesting contracts; however, this could have been due to the low payload of these small harvesters and the uniqueness of the site (Figure 2). At this pace, it is highly likely that these plants were growing faster than the harvesters could remove them (waterlettuce can double in surface area in a matter of days to a couple weeks).

This operation removed approximately 125 tons (42 t/acre) of biomass which was equivalent to 18 garbage truck loads. The operator averaged 46 Weedoo buckets (66" x 25" x 25" or ~24 ft³) per hour, although bucket fullness was not measured (Figure 3). Additionally, the contract involved of a total of 324 man hours of subcontractor work (108 hours x 3 person crew) which consisted of one Weedoo boat and operator, one small excavator and operator, and one barge (pontoon boat) which was tied up to the bank. Also included in the cost were

Table 1. Details from Torry Island waterlettuce harvesting project.

| | |
|--|---|
| Dates | = April 27 to May 13 = 12 total workdays |
| Total area treated | = ~3 acres |
| Type of harvester | = Weedoo TC series |
| Number of harvesters | = 1 |
| Other equipment | = Small excavator and barge (pontoon boat) |
| Number of workers | = 3 |
| Total labor hours | = 324 |
| Treatment rate (by workday) | = 0.25 acres/day <u>or</u> 4 days/acre |
| Treatment rate (by labor hour) | = 0.0093 acres/ hour <u>or</u> 108 labor hours/acre |
| Estimated biomass removed | = 125 tons = ~42 tons/acre = 18 garbage truck loads |
| Size of bucket | = 24 ft ³ (Dimensions 66" x 25" x 25") |
| Number of buckets | = 46 buckets/hour = ~ 4968 total buckets |
| Mass per bucket | = ~50 lbs wet weight/bucket |
| Total cost (without disposal) | = \$68,000 |
| Cost per acre (without disposal) | = \$22,667 per acre |
| Cost per labor hour (without disposal) | = \$209.88 per hour |

administrative duties including but not limited to contractor oversight from project managers and USACE employees. The contract price from the harvesting portion alone was ~\$68,000. Disposal was covered by the City of Pahokee of which the cost is unknown. Disposal is usually a significant portion of the total mechanical harvesting operation cost. Documentation of this small harvesting project will hopefully serve as a reference to those faced with similar unique APM problems or those considering this technology.

Dr. Benjamin Sperry (bpsperry@ufl.edu) is a research biologist for the US Army Corps of Engineers — Engineer Research and Development Center stationed at the University of Florida Center for Aquatic and Invasive Plants in Gainesville where he also holds a courtesy faculty appointment. Jessica Fair and Ian Markovich are biologists based in Clewiston, Florida, with the US Army Corps of Engineers Jacksonville District.



Figure 3. Transfer site at Torry Island Boat Ramp.

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| 0.50 | 1.50 | 1.70 |
| 0.67 | 2.00 | 2.26 |
| 0.83 | 2.50 | 2.84 |
| 1.00 | 3.00 | 3.40 |

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Hoyt Lake- Photo by P. Filice

Right: Aquatic Plant Identification course participants learn to key out aquatic plants.

Diving in with Extension Programs

Michigan State University Extension encourages stewardship of freshwater environments by connecting people to their local lakes and streams.

Paige Filice and Jo Latimore

In Michigan we are the proud stewards of thousands of inland lakes, rivers, and a vast groundwater resource. Regardless of their size, these bodies of water enhance Michiganders' quality of life by providing clean drinking water, food, beauty and recreational enjoyment. For communities, these water resources are an invaluable asset and offer a sense of place and a rich economic resource. However, with such astounding resources comes responsibility.

Michigan residents can support

the protection, wise use and long-term monitoring of their favorite waterways by becoming involved with Michigan State University (MSU) Extension water programs. Local communities are largely responsible for protecting and managing these valuable aquatic resources and need to incorporate the best available knowledge when making decisions. MSU Extension offers numerous educational programs to help communities address these concerns.

Dive in and learn what the MSU Extension inland waters team has to offer!

Lake learning made easy with the Introduction to Lakes Online course

We are fortunate enough to have more than 11,000 inland lakes in Michigan and each one offers unique recreational, scenic, and environmental benefits. Our Introduction to Lakes Online course provides anyone who has a passion or curiosity for inland lakes practical knowledge and resources to make informed lake management decisions.

Introduction to Lakes Online is a six-week program and course topics include lake ecology, watersheds, shorelines, aquatic plant management, Michigan water



MiCorps Cooperative Lakes Monitoring Program volunteers use a sampling rake to survey aquatic plants in their lake.

law, and community involvement. The course is cohort-based, so all participants advance through the program together in a collaborative manner. Each unit includes closed-captioned video lectures, interactive activities, additional learning resources, discussion forums, and a quiz. Students spend on average two hours each week exploring the course website. Every week a new unit becomes available, and participants must receive an 80% or higher on the weekly unit quiz to move onto new content and to receive a Certificate of Completion. We

also host three Ask-an-Expert webinars featuring Michigan State University experts and state agency staff allowing participants to ask questions related to the content in the course.

Introduction to Lakes Online is one of our most popular educational programs and more than 1,500 people across the country have participated since it was first offered online in 2015. For most of our participants, it represents their first engagement in an MSU Extension program, and most state their intention to continue their lake



We partner with groups across Michigan to host boat washing events. Our mobile boat wash uses hot water and high pressure to spray boats and trailers. Photo credit Paige Filice.

learning with us. The course was recognized by the North American Lake Management Society (NALMS) with their Leadership and Service Award for Community Education and Outreach in 2017.

Creating citizen scientists – the Michigan Clean Water Corps

The Michigan Clean Water Corps (MiCorps) combines Michigan's statewide lake and stream volunteer monitoring programs along with a small grants program to support stream cleanup events. Data collected by volunteers are used in their local communities, by researchers, and by the Michigan Department of Environment, Great Lakes, and Energy (EGLE) for use in water resources management and protection programs. Michigan State University Extension provides leadership to MiCorps in partnership with EGLE, the Michigan Lakes and Streams Association, and the Huron River Watershed Council.

Launched in 1974, the MiCorps Cooperative Lakes Monitoring Program is the second oldest volunteer lake monitoring



program in the US. Dedicated volunteers monitor the water quality of their lakes to document changes over time. Participants collect data on a variety of different parameters including Secchi disk transparency, phosphorus, chlorophyll, dissolved oxygen, temperature, shoreline habitat, and invasive and native aquatic plants. We provide training, equipment, support, and laboratory analytical services to our volunteers and create individual data summary reports for each participating lake annually.

MiCorps also offers a Volunteer Stream Monitoring Program, providing support to nonprofit organizations and local units of government for monitoring the health of streams and rivers. Volunteers regularly evaluate benthic invertebrate communities and physical stream habitat. As with the lakes program, we provide training, support, and assistance with developing quality assurance project plans to the participants, along with a competitive grants program to help fund their efforts.

In 2021, volunteers from 272 Michigan lakes and hundreds of stream sites submitted data into the MiCorps open access database, adding another year of long-term monitoring data available for local management planning and regional research and assessment.



The Black Lake Preservation Society received a Clean Boats, Clean Waters grant in 2021 and installed several decontamination stations with hand removal tools at public boat launches. Pictured is Black Lake Preservation Society member Linda Sandvik alongside two Michigan Department of Natural Resource Conservation Officers. Photo credit Teri Wild.

Engaging professionals and property owners on the benefits of shoreline plants

Shorelines are critical transition zones between land and water that provide habitat, protect water quality and serve as a gateway for people enjoying Michigan's many lakes. Unfortunately, the hardening of our natural shorelines with seawalls and maintaining manicured lawns next to lakes can have many negative impacts. As a collaborator within the Michigan Natural Shoreline Partnership, MSU Extension assists with a variety of shoreline programs that help individuals, professionals and lake communities understand and implement best practices on lake shorelines.

We offer a Natural Shoreline Profession-

als certification program which provides contractors and landscape professionals with the information and skills needed to implement natural shoreline and bioengineered erosion control techniques to protect inland lakes. We also have a free online self-assessment through the Shorelands Stewards Program that enables lakefront property owners to see how well they are protecting their lake through environmentally friendly shoreline practices and provides ideas on how to improve their shoreline.

Over 350 people who have earned the title of Michigan Certified Natural Shoreline Professional with statewide representation. As a result, property owners don't have to look far to find technical assistance for their shoreline protection



The Michigan Shoreland Stewards Program recognizes lakefront property owners who are protecting inland lakes through best management practices on their property with signage. Photo credit: Mark Bugnaski Photography

projects. There's plenty of interest in natural shorelines among our lakefront property owners - 1280 people have completed the Michigan Shoreland Stewards survey to determine whether they qualify as a Shoreland Steward, and 71% of them do qualify, representing approximately 370,000 feet of inland lake shoreline statewide.

Preventing aquatic invasive species one source at a time

With our abundant water resources, it is no surprise that aquatic invasive species are an issue in our state. MSU Extension's role in aquatic invasive species management is to conduct research-based outreach and education. MSU Extension coordinates two statewide aquatic invasive species programs: Clean Boats, Clean Waters and Reduce Invasive Pet and Plant Escapes ("RIPPLE") in cooperation with state agencies and the USDA Forest Service.

Clean Boats, Clean Waters is a comprehensive boater education program designed to prevent new aquatic invasive species introductions and limit their dispersal from water recreation activities through outreach and engagement. The program promotes understanding of boat cleaning practices and regulations through the distribution of educational materials, an online resource

library, a reservable mobile boat washing unit, and a small grants program. We partner with statewide and local organizations including the Michigan Lakes and Streams Association, Cooperative Invasive Species Management Areas and lake associations to share the clean, drain, dry message. The program is coordinated in partnership with the Michigan Department of Environment, Great Lakes, and Energy and the Huron-Manistee Forests of the US Forest Service and receives funding from the Great Lakes Restoration Initiative.

In 2021, the first year of the Clean Boats, Clean Waters small grants program, seven organizations received \$19,800 to conduct invasive species education. Further, the mobile boat wash program supported two student interns during the 2021 summer season who gained valuable public outreach experience while offering free boat washes and information at forty-six events in twenty-nine Michigan counties. They spoke with nearly 1500 boaters and washed nearly 400 boats — making a big difference in stopping the spread of invasive species.

While most non-native animals and plants available in pet stores and garden centers are environmentally benign and economically valuable, some become invasive and cause significant harm if released into the wild. To address this issue,

we coordinate the Reduce Invasive Pet and Plant Escapes (RIPPLE) program and offer educational information to aquarium hobbyists and water gardeners about what to do with pet fish and overgrown plants, so they do not get accidentally or purposely introduced into lakes and streams. Through RIPPLE, hobbyists and retailers receive aquatic plant and animal handling and disposal information, trainings, and free educational materials. The program is financially supported through the Michigan Invasive Species Grant Program.

RIPPLE is Michigan's first statewide organisms in trade program specifically working on aquatic invasive species issues specific to the pet and garden industry. Since launching in 2015 over 65 locally owned pet and garden retailers, 8 aquarium and pond clubs, 30 environmental organizations, 3 zoos and aquariums, 20 state and county park systems, and 22 school systems have partnered with RIPPLE.

Encouraging aquatic plant appreciation and knowledge

Growing interest in submersed aquatic plants among professionals and the public in Michigan spurred us to develop an intensive, two-day Aquatic Plant Identification course. Class begins in the laboratory, where the first morning is spent learning about the identifying characteristics of Michigan's aquatic plants and their habitats with plenty of fresh and dried specimens. We then head to the field to collect specimens, practice identification and explore a nearby aquatic habitat. The schedule is flipped on the second day, with the morning spent in the field collecting at a new site, and the afternoon spent the lab with further identification practice and guidance on creating one's own pressed plant collection.

We typically offer this course in partnership with a local host organization or facility and have had no trouble filling seats. To date, over forty Michigan aquatic management and conservation professionals have completed the Aquatic Plant Identification course, along with several highly enthusiastic laypeople. After a pandemic-induced hiatus, we're excited to begin offering this popular course again.



Paige Filice

Creating partnerships to advance aquatic stewardship

In addition to providing research-based education, MSU Extension strives to facilitate communication and partnerships that advance stewardship and conservation of our aquatic resources. One outstanding example is our facilitation of the Michigan Inland Lakes Partnership (Partnership). The Partnership was built out of the realization that Michigan's major lake stakeholders — managers, users, property owners, governments, educators, researchers — rarely had opportunities to discuss lake topics



Jo Latimore

together, unless a conflict arose.

Today, the Partnership has a fifteen-year history of convening quarterly in an inclusive dialogue among representatives from the professional lake management community, natural resource agencies, academia, and the public. Members learn from one another, build relationships, and grow to understand and respect one another's perspectives on the often-complex issues of inland lake management and conservation.

Inland lakes and streams are an enormous financial and environmental asset to

Michigan. The good news is that demand for our educational programs has only grown in recent years. Our work at MSU Extension is based on the needs of our stakeholders and we anticipate expanding our programs and resources to meet their growing concerns. We welcome opportunities to collaborate with partners outside of Michigan on topics and programs of shared interest — please reach out to us with your ideas. Visit the MSU Extension website (<http://extension.msu.edu>) to explore these programs and much more.

Paige Filice, M.S. Natural Resources Educator Michigan State University Extension filicepa@msu.edu

Paige Filice is a Natural Resources Educator at Michigan State University Extension. Her work focuses on promoting the wise use and protection of Michigan's freshwater ecosystems through outreach and engagement. Her current responsibilities include coordinating two statewide aquatic invasive species education programs and co-leading the Introduction to Lakes Online course. Paige has a master's degree in Fisheries and Wildlife from Michigan State University and a bachelor's degree in Conservation Leadership from Lake Superior State University.

Jo Latimore, Ph.D., Senior Academic Specialist, Michigan State University, Department of Fisheries and Wildlife latimor1@msu.edu

Dr. Jo Latimore is an aquatic ecologist in Michigan State University's Department of Fisheries and Wildlife. She specializes in the protection and management of lakes, rivers, and the landscapes that support them. As an outreach specialist, she works collaboratively with natural resource managers, communities, and the public to develop innovative solutions to the complex challenges facing aquatic systems. Her current work includes guiding Michigan's statewide volunteer lake and stream monitoring program and developing creative approaches to prevent the introduction and spread of aquatic invasive species. Dr. Latimore has a Ph.D. in Fisheries and Wildlife from Michigan State University, a master's degree in Biological Sciences from the University of Notre Dame, and a bachelor's degree in Biology from Albion College.



Pickeral Lake. Photo credit Paige Filice

Regional Chapter Updates



APMS UPDATE

(Jay Ferrell, PhD – University of Florida)

APMS Website: <https://apms.org>

- Annual meeting scheduled for July 18-22, 2022, in Greenville, SC: <https://apms.org/2022-annual-meeting/>



FAPMS UPDATE

**(Kelli Gladding – University of Florida;
Steve Montgomery – Allstate Resource Management)**

FAPMS Website: <https://fapms.org>

- FAPMS is beginning to prepare for our annual conference in Daytona this year in October. Details: <https://fapms.org/conference/2022-conference/>
- Reminder that *Aquatics* magazine will not be circulated in hard copy to non-members this year. Chapters will receive a digital copy they can circulate to their members electronically. Issues will be posted to the FAPMS website on a two-issue delay.

FAPMS 2022 Scholarship Announcements:

The Paul C. Myers Applicator Dependent Scholarship application due date is quickly approaching and

needs to be submitted by June 1st, 2022. This is such a great opportunity for our FAPMS member's children to benefit with a monetary stipend to help support their higher education. With the level of inflation, we are all experiencing in 2022, any financial assistance is a blessing to support our college bound children. Visit the new FAPMS website for details about qualifications and to find the application page. <https://fapms.org/scholarships/scholarship-foundation/>

In addition to the Myers Dependent scholarship, the FAPMS Scholarship Foundation is also accepting applications for the William L. Maier Jr. Memorial Scholarship. This scholarship is designed to help support Graduate students attending a university in Florida with a broad focus on freshwater habitats. The deadline for submission is August 31st, 2022. Please share this information with your family and friends, it's another great opportunity to support conservation management of the next generation for our freshwater aquatic environments.

Since the establishment of the FAPMS Scholarship and Research Foundation in 1986, the FAPMS membership's children have been awarded \$130,650.00, through the Paul C. Myers Applicator Dependent Scholarship. Plus, another \$19,900.00 awarded to graduate students with the William Maier Jr. Memorial Scholarships. The primary mission of the Foundation is to continue to support the members of FAPMS as well as promote academic interest in the field of aquatic plant management. The primary fundraising events are during the FAPMS conference with raffle tickets and duck races. However, you can support the Foundation all year long when you purchase through Amazon. Just simply select

the FAPMS Scholarship Foundation through the Amazon smile charity list.

We look forward to receiving many applications over the next couple of months and please contact us if you have any questions.

Sincerely, FAPMS Scholarship Foundation BOD.



MAPMS UPDATE

(Garrett McClain – Cygnet Enterprises)

MAPMS Website: <https://www.mapms.org>

- MI EGLE ANC has implemented new (2021) restrictions on copper sulfate use in the spring with the basis being protecting fish spawning. The MI industry has supplied numerous studies contradicting their arguments and had a handful of meetings, but it appears not much consideration was taken.

New copper usage conditions for protection of spawning fish:

As part of its ongoing charge to protect natural resources in lakes, the ANC program has developed a new permit condition for the protection of spawning fish from copper algicides and herbicides. The following two conditions will be included in standard permits and some individual permits:

Due to the toxicity of copper to spawning fish, do not apply copper products within 20 feet of a known, or suspected, active spawnin9 bed.

Except for waterbodies with a

total surface area of less than 10 acres and canals and marinas on the Great Lakes and connecting waters, copper treatments for algae, macroalgae, and submersed macrophytes are restricted to chelated copper products during May and June. No more than a cumulative total of 25 percent of the potential spawning area (the area of the waterbody within the 0-10 feet depth contours) may be treated with copper products during May and June. Treatment of starry stonewort with chelated copper may exceed a cumulative total of 25 percent of the potential spawning area. If starry stonewort is treated under this exemption, then treatment of filamentous algae, planktonic algae, and native macroalgae is not allowed during May and June; and treatment of starry stonewort during May and June is restricted to one lime only per starry stonewort treatment area. In the event of a harmful algae bloom (HAB) during May or June (documented by positive algal toxin test results, positive identification of HAB species, or other approved EGLE methodology), alternative treatment patterns may be considered by EGLE to protect public health.

In relation to this new condition and because of its relevance to waterbody management, the permit applications for standard and individual permits have a new question to capture an estimate of the surface area of the potential littoral zone (surface acres of a lake that are within the 0-10 feet depth contour). This information will also be required to be submitted as part of treatment reports starting in 2021.

- Not much going on in the Midwest of note in terms of new species or successes.
- WI DNR has proposed some new rule changes for APM and conducted an economic impact study on these changes. There were a few public comment periods that we participated in.

I think there has been some pushback from the regulated community on the validity of their data for the rule changes. I think they are getting close to the stages of implementation.

- Draft Rule: <https://dnr.wisconsin.gov/sites/default/files/topic/Rules/WY2919DraftRule2.pdf>
- Draft EIA: <https://dnr.wisconsin.gov/sites/default/files/topic/Rules/WY2919FiscalEstimate2.pdf>



MSAPMS UPDATE

(Carl Della Torre – Orion Solutions)

MSAPMS Website: <http://www.msapms.org>

- MSAPMS planning annual conference Oct. 24-26, 2022 in Mobile, AL.
- MSAPMS struggles with student attendance; does APMS (or other chapters) have guidance regarding student recruitment.
- New species infestations - Giant Salvinia invaded new site in northern AL, big leaf pondweed becoming problematic in AL power reservoirs.
- Metsulfuron-methyl (MSM) has two 24c labels in the southeastern U.S. targeting giant salvinia:
 - Cimarron Max Part A labeled in TX, LA, MS, AL, and SC.
 - Alligare PRO MSM 60 labeled in TX and LA.



NEAPMS UPDATE

(Will Stevenson – SOLitude Lake Management)

NEAPMS Website: www.neapms.org

- The board and members have been talking about the need for more people in the industry at all levels/roles. The market demand for managing waterbodies continues to grow. Factors are many and varied, including climate change and Covid. Most industry folks have noted that more people working at home are paying more attention to their local water. There are not enough contractors to do the work that needs to be done. We need to foster our students and engage more in the profession.
- The major news in the NE is hydrilla in the CT River. This will be an all-hands-on-deck effort, once organized, to better understand how best to manage this new strain. CT State was recently able to get an AIS sticker fee established to help raise some funds for AIS management/outreach.

New for NEAPMS was our **Winter Webinar Series** – Boats are the number one vector for the spread of aquatic invasive species in inland waters and prevention is the best tool for dealing with this spread. Our inaugural webinar series featured an overview of New Jersey Water Supply Authority's efforts to prevent the spread of AIS by building and expanding a watercraft inspection steward program in New Jersey, a social science perspective on interactions with boaters, and a regional approach to AIS education and outreach involving Great Lakes states and Canadian provinces. And the second session highlighted tips for how to create your own spider diagrams to track boater movement among water bodies and assess the risk of aquatic invasive species introductions.

Registration for Plant Camp goes live on May 2, 2022. Join us as we help educate teachers about the threats that invasive plants pose in our lakes and waterways. A preliminary agenda is available at: <https://static1.squarespace.com/>

static/61efc467da0db26e60cd32cb/t/6228f7a7137a104c237f7285/1646852007885/NEAPMS+Plant+Camp+2022.pdf



SCAPMS UPDATE

(Justin Nawrocki, PhD – UPL)

SCAPMS Website: <http://scapms.org/index.html>

- The SCAPMS annual meeting was

held in person in Oct 2021 in Myrtle Beach, SC. We had a better-than-expected turnout and enjoyed the chance to meet and exchange ideas and research.

- Giant salvinia has become a growing concern in the Southeast, now infesting numerous backwater areas on the Santee Cooper Chain of Lakes. Santee Cooper recently finished construction on their new greenhouse to rear the giant salvinia weevils. Hopefully much success and knowledge will be gained with this endeavor.



TAPMS UPDATE

(Brittany Chesser – Texas A&M Extension)

TAPMS Website: <https://www.tapms.org>

- 2021 Annual Meeting Attendance = 74

- 2022 Annual Meeting will be held in person November 7-9, 2022, at the Embassy Suites by Hilton in San Marcos, TX
- Student Scholarship has been renamed in memory of David Allen Bass, a former BOD and member
- Triploid grass carp updates (more information explained in the 10/21 newsletter avail at <http://www.tapms.org/wp-content/uploads/2021/10/On-the-Water-Newsletter-fall-2021.pdf>)
- Newsletter URL: <https://www.tapms.org/newsletter/>
- Triploid Grass Carp Stocking Permits Period of Validity
- Transfer of Triploid Grass Carp with Property Sale/Transfer
- This year hoping to focus on increasing membership and the communicating the benefits that come with membership (i.e., professional development webinars/workshops and other activities).

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WAPMS UPDATE

(Tom Warmuth – Biosafe Systems)

WAPMS Website: wapms.org

- Just conducted 2022 annual conference in Tucson, AZ (March 7-11).
- Follow us on social media on Twitter, Facebook, Instagram, and LinkedIn for updates, information, and meeting details.

2022 Calendar of Events

July 18-22, 2022

**62nd Annual Meeting of the
Aquatic Plant Management Society
& Joint Meeting with SCAPMS**
Greenville, SC
(updates coming soon)

August 22-25, 2022

**UF/IFAS Aquatic Weed Control
Short Course**
DoubleTree by Hilton Orlando at
SeaWorld
Orlando, FL
<http://sfyl.ifas.ufl.edu/aw/> (updates
coming soon)

October 3-6, 2022

**46th Annual Florida Aquatic
Plant Management Society
Training Conference**
Hilton Daytona Beach
Oceanfront Resort
Daytona Beach, FL

<https://fapms.org/conference/2022-conference/>

October 24-26, 2022

**41st MidSouth Aquatic Plant Manage-
ment Society Conference**
Battle House Renaissance Mobile
Hotel & Spa
Mobile, AL
<http://www.msapms.org/conferences/2022/>

November 7-9, 2022

**Texas Aquatic Plant Management
Society Annual Conference**
Embassy Suites by Hilton San Marcos
Hotel Conference Center and Spa
San Marcos, TX
<https://www.tapms.org/2022-annual-meeting/>

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