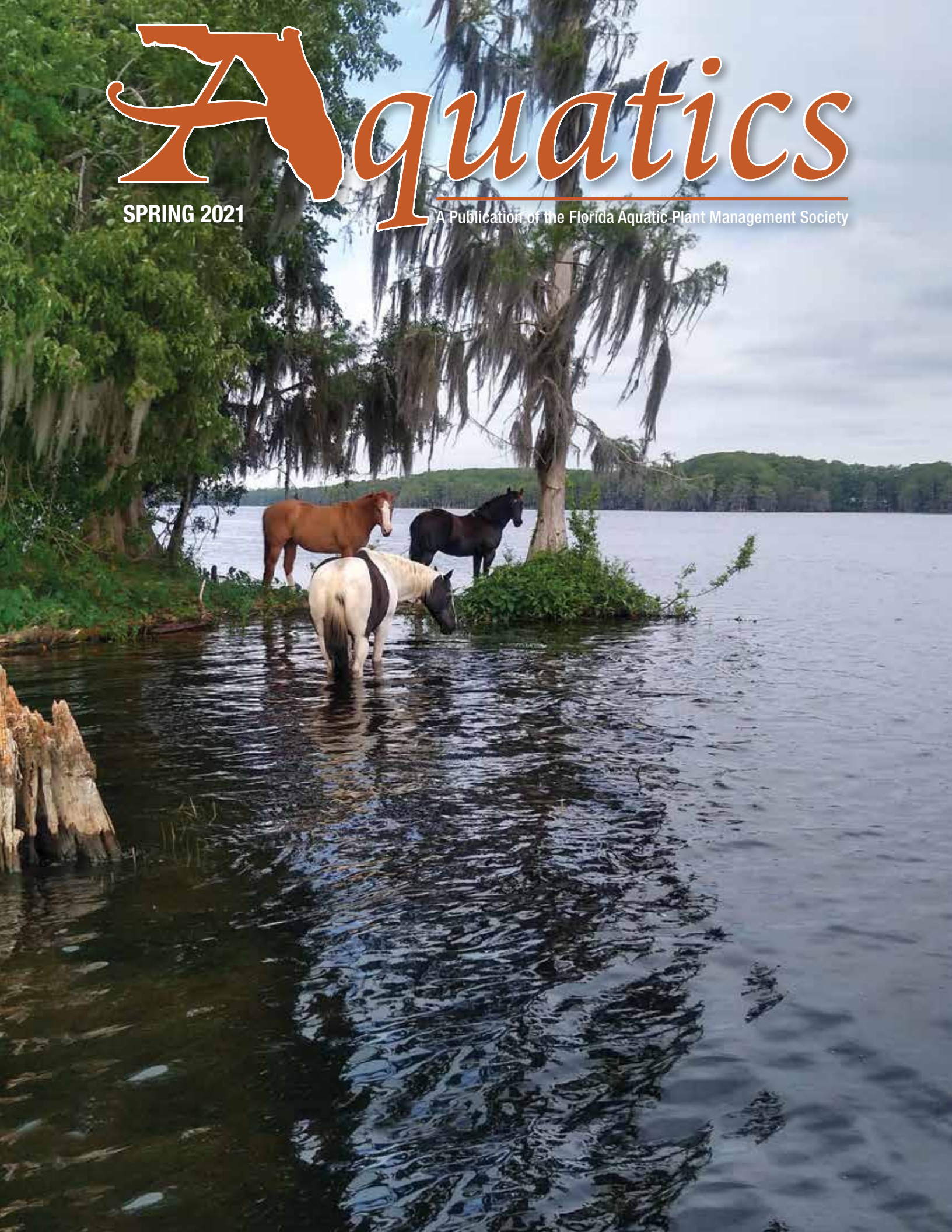


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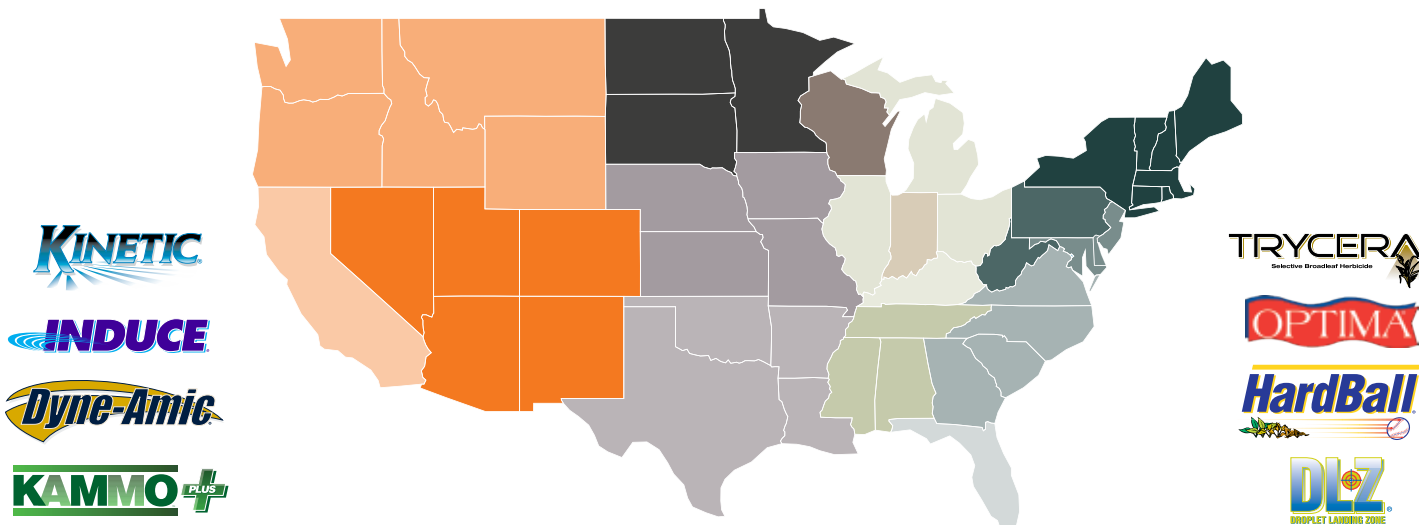
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Horses grazing on *Vallisneria americana* in Tsala Apopka Chain of Lakes near Floral City, FL. Image, courtesy of Tim Mullin, Lead Aquatic Spray Tech, Citrus County Aquatics.

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History, Biology, and Management of Alligatorweed

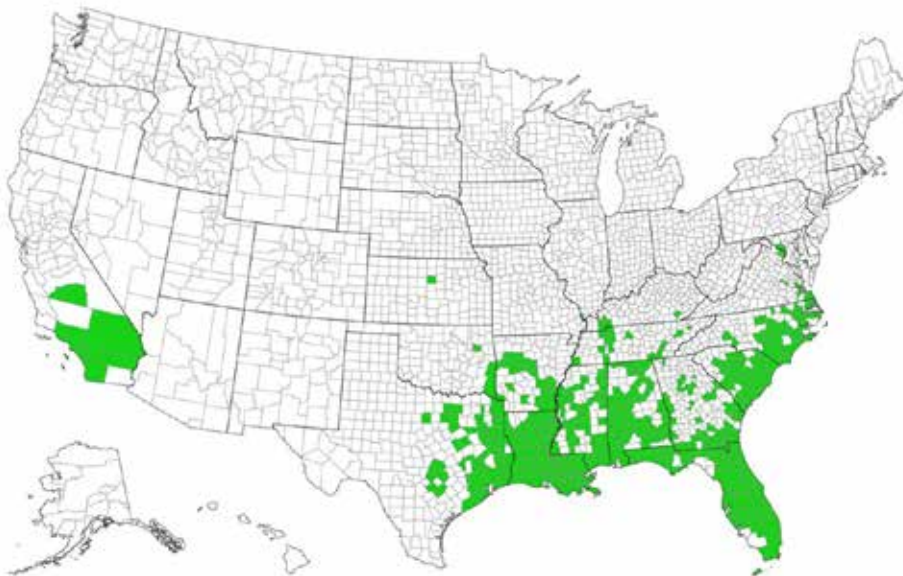


Figure 1. Distribution of alligatorweed in the US (Puerto Rico not shown). Image from <https://tinyurl.com/y3bulon8>.

History and Biology

Alligatorweed [*Alternanthera philoxeroides* (Mart.) Griseb.] is a perennial dicot of the Amaranthaceae family native to semi-aquatic areas of the Parana River Region of South America. This plant was introduced to the US from ship ballasts in Florida in 1894 and documented shortly after in Mobile, Alabama (1897). It has since spread across much of the south (Buckingham 1996; Kay and Haller 1982; Maddox 1968). Like many invasive plants, alligatorweed spreads very quickly if left unmanaged and can disrupt ecological and human activities in both aquatic and terrestrial environments.

Globally, alligatorweed is an aggressive invader in over 32 countries across the Americas, Asia, and Australia (Julien *et al.* 1995). While it is at the northern end of its range in the US and China, there are concerns of a continued expansion in Australia. In the US, alligatorweed is distributed across the southeast and California with small populations in Illinois and Kansas (Figure 1). Seven states list alligatorweed as a noxious weed (Barreto and Torres 1999; Erwin *et al.* 2013; Tanveer *et al.* 2018; USDA 2020).

Alligatorweed thrives at temperatures

between 60 and 86° F but can survive short periods below freezing (Julien *et al.* 1982; Kay and Haller 1982; Shen *et al.* 2005; Tanveer *et al.* 2018). Based on computer modeling and meteorological data, the forecasted distribution of alligatorweed in tropical regions has reached maximum capacity; however, further invasion in temperate areas is possible (Julien *et al.* 1995; Julien and Broadbent 1980).

Alligatorweed can reproduce both sexually and asexually. In its native range alligatorweed will flower when temperatures exceed 80° F and will produce seed in mid-summer until early fall; however, seed production in the US is rare as vegetative reproduction is more common (Buckingham 1996; Tanveer *et al.* 2018). Alligatorweed can double its biomass via vegetative growth and adapt to new environments in less than two months (Buckingham 2002; Julien *et al.* 1995; Martin 1972; Tanveer *et al.* 2018).

Identification

Alligatorweed often stands out from surrounding plants. Its leaves are oppositely arranged, five to ten cm long and one to three cm wide, with lightly colored midribs



Figure 2. Aboveground stem of alligatorweed. Notice the pinkish green stem, elliptic leaves and the characteristic light green midvein. Image: <https://tinyurl.com/y5rqo7bw>.

(Figure 2). Stems are hollow and can range from dark green to pink in color. Inflorescences arise on long stalks with clover-like round whiteheads that are comprised of four to five papery bracts (Figure 3). Stems can reach up to 10 meters in length and form



Figure 3. Left denotes the papery white inflorescence and the right shows the alternate leaf arrangement. Image: <https://tinyurl.com/y2djjhvjv>.

dense mats. Roots are yarn-like and emerge from nodes producing new plants (Figure 4; Hofstra and Champion 2010; Julien *et al.* 1992).

Unlike many other aquatic plants, alligatorweed can inhabit both aquatic and

terrestrial sites. Alligatorweed commonly roots in banks or shallow areas and sends out rhizomes and stolons that form dense, interwoven mats (Buckingham 1996; Schooler *et al.* 2008; Sainty *et al.* 1998; Tanveer *et al.* 2018). Stems are often thin-walled and hollow which allow it to float (Figure 5). These stems can break from mats and establish new colonies (Buckingham 1996). Terrestrial alligatorweed has tougher, highly lignified stems with shorter internode cavities (Kay and Haller 1982). This plant has abnormally thick leaves and cuticles that allows it to tolerate moderate to high salinity (Kay and Haller 1982). These growth habits lend to its invasiveness. Left to grow unchecked,



Figure 4. Yarn-like root structure of alligatorweed. Notice the roots protruding from the nodes. Image: T. Darnell.



Figure 5. A cross section of an alligatorweed stem. Image: <https://tinyurl.com/yy7dmoot>.



Figure 6. (left) Alligatorweed blocking a drainage canal. Image: <https://tinyurl.com/y4d2x32w>.



Figure 7. Alligatorweed Flea Beetle (*Agasicles hygrophila* Selman and Vogt [Halticinae]). Image: <https://tinyurl.com/y6dgalye>.

alligatorweed can block canals and flood structures as well as harbor vectors for human diseases (Figure 6; Sculthorpe 1967).

Mechanical Control

Mechanical harvesting was used for alligatorweed management before the advent of effective chemical and biological control. Mechanical harvesting provides immediate biomass removal; however, this practice releases plant fragments which can contribute to alligatorweed dispersal. Prior to adopting chemical management practices, the US Army Corps of Engineers used widespread mechanical harvesting, which proved to be costly, inefficient, and time consuming. As a direct result, competition with waterhyacinth [*Eichhornia crassipes* (Mart.) Solms] kept alligatorweed populations mildly in check (Coulson 1997).

Chemical Control

Chemical control of aquatic plants via herbicides is often the most economical and reliable management technique. When 2,4-D was first used in aquatics in the 1940s, practitioners quickly discovered waterhyacinth was highly susceptible but alligatorweed was tolerant. Since these species were commonly found in mixed stands, 2,4-D treatments essentially resulted in reduced waterhyacinth competition and allowed alligatorweed populations to explode (Buckingham 1996). However, the phenoxy herbicides Silvex and 2,4,5-T were discovered shortly after 2,4-D and provided excellent alligatorweed control (McGillvrey and Steenis 1965). These herbicides were heavily relied on for alligatorweed control until their removal from the market in the early 1980s. Historically, dichlobenil, glyphosate, and metsulfuron-methyl could provide alligatorweed control but required several treatments to manage reoccurring biomass; however, dichlobenil and metsulfuron-methyl are no longer registered for aquatic use (Ensby 2001; Gunasekera and Bonilla 2001). The currently registered herbicides triclopyr, flumioxazin, glyphosate, imazapyr, imazamox, and bispyribac-sodium can provide alligatorweed control but often require multiple applications (Schooler *et al.* 2008; Tanveer

et al. 2018). Current research is evaluating the newly registered florpyrauxifen-benzyl for alligatorweed control.

Biological Control

Alligatorweed is the 'poster child' of successful biological control. The release of several biological control agents in the mid-1960s resulted in management of alligatorweed populations in several southern states. In 1959, the US Army Corps of Engineers (USACE) collaborated with the USDA Agricultural Research Service to search for potential alligatorweed biological control agents (Buckingham 1996). Dr. George Vogt (1933-1991) made several expeditions throughout South America in search of potential biological control agents which resulted in three agents that were later introduced. These agents included the Alligatorweed Flea Beetle (*Agasicles hygrophila* Selman and Vogt [Halticinae]), Alligatorweed Stem Borer (*Arcola malloi* Pastrana [Phycitinae]), and the alligatorweed thrip (*Amynothrips andersoni* O'Neill [Phlaeothripidae]) (Buckingham, 1996).

Alligatorweed flea beetle is an attractive, 5mm long, black and yellow beetle that acts as a defoliating agent in both larval and adult stages. Larvae produce many feeding scars that are characterized as transparent windows into plant tissues (Buckingham 1996). Beetle larvae (Figure 7) are deposited on the underside of leaves in clusters during spring and mature by early summer

(Maddox *et al.* 1971). Activity of this beetle and sexual reproduction is limited to the aquatic alligatorweed biotype (Buckingham 1996). The flea beetle was first released in 1964 in California (a failed attempt) and South Carolina (successful colonization). Releases continued throughout the late 1960s up to the 1970s across the entire southern US (Coulson 1977). In regions with winter temperatures less than 52°F beetles will not survive without constant reintroduction (Coulson 1977; Vogt *et al.* 1992).

Alligatorweed stem borer is a small, tan moth with a ~30mm wingspan. Both adults and larvae feed on alligatorweed; however, the majority of damage is from emerging larvae which bore directly into stems (Buckingham 1996). As the larvae grow, they bore deeper into the leaves and stems until they finally emerge. The characteristic signs of the alligatorweed stem borer moth are dead, intact leaves (Buckingham 1996). Initial introductions of the stem borer occurred in 1971 in Florida and Georgia and were later released in Alabama, North Carolina, and South Carolina (Brown and Spencer 1973; Coulson 1977). These initial populations gave rise to populations in Arkansas, Louisiana, Mississippi, and Texas (Vogt *et al.* 1992).

Alligatorweed thrips are a small, narrow, solid black insect that has bright orange larvae that feed on apical growth and stunt plants through continuous feeding

on the meristem (Buckingham 1996). Alligatorweed thrips are the least effective in managing alligatorweed populations, but prey on both aquatic and terrestrial forms and exhibit the greatest cold tolerance of the biological control agents (Buckingham 1996; Vogt *et al.* 1992). Thrips were released by the USDA between 1967 and 1971 in Alabama, California, Florida, Georgia, Mississippi, South Carolina, and Texas with successful colonization only occurring in Florida, Georgia, and South Carolina (Buckingham 1996; Cofrancesco 1988; Coulson 1977).

Alligatorweed control has been best defined through its success as the first truly successful incorporation of a biological control agent to manage a population of an invasive species in the world. Of the above-listed biocontrol agents, the Flea beetle is the most effective at controlling larger populations of the macrophyte followed by the Stem Borer and finally the thrip species. All three biocontrol agents preferentially attack aquatic alligatorweed plants.

Integrated Approaches

Hofstra and Champion (2010) advocate for an integrated approach to alligatorweed management. When used alone, biological and chemical control techniques do not provide sufficient control; however, when these techniques are integrated superior control can be achieved.



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There's no doubt that 2020 was a rough year... between travel restrictions, budget cuts, and uncertainty about so many things, you may have not been able to attend what has become an annual tradition for many in the aquatics world. Even though the October version of the Aquatic Weed Control Short Course has come and gone, you still have the opportunity to attend most of the Short Course – and get those precious CEUs. We're pleased to announce that for the first time ever, most Short Course sessions – and the special pre-Short Course aquatic and wetland plant identification session – are available as "encore" presentations! Register today and you'll be able to earn up to 22 FDACS-approved category CEUs from the comfort of your home or office.



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Conclusion

Alligatorweed populations in Florida are well managed by biological control agents; however, this macrophyte requires other management techniques in other parts of the country. Collaborative efforts from aquatic plant managers, academic and governmental agencies, as well as practitioners, management of this species has been successful in many locations throughout the southeast.

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Literature Cited

Barreto RW, Torres ANL. 1999. *Nimbya alternantherae* and *Cercospora alternantherae*, two new records of fungal pathogens on *Alternanthera philoxeroides* (alligator weed) in Brazil. *Australas. Plant Pathol.* 28:103–107.

Brown JL, Spencer NR. 1973. *Vogelia malloii*, a newly introduced phycitine moth (Lepidoptera: Pyralidae) to control alligatorweed. *Environ. Entomol.* 1:519-523.

Buckingham GR. 1996. Biological Control of

Alligatorweed, *Alternanthera philoxeroides*, the World's First Aquatic Weed Success Story. *Castanea.* 61(3):232-243.

Buckingham GR. 2002. Alligator weed. pp. 5-16. In Van Driesche R, Blossey B, Hoddle M, Lyon S, Reardon R (editors). *Biological control of invasive plants in the eastern United States*, USDA Forest Service publication FHTET-2002-04.

Cofrancesco AF. 1988. Alligatorweed survey of ten southern states. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Misc. Paper A-88-3, 69 p.

Coulson JR. 1977. Biological control of alligatorweed, 1959-1972. A review and evaluation. *USDA Tech. Bull.* 1547. 98 p.

Ensby R. 2001. Alligatorweed. *Agfact* P7.6.46. 2nd ed. NEW, Agriculture

Erwin S, Huckaba A, He KS, McCarthy M. 2013. Matrix analysis to model the invasion of alligatorweed (*Alternanthera philoxeroides*) on Kentucky lakes. *Plant Ecol.* 6:150–157.

Gunasekera L, Bonilla J. 2001. Alligator weed: tasty vegetable in Australian backyards? *J Aquat Plant Manage.* 39:17–20.

Hofstra DE, Champion PD. 2010. Herbicide Trials for the Control of Alligatorweed. *J Aquat Plant Manage.* 48:79-83.

Julien MH, Bourne AS, Low VHK. 1992. Growth of the weed *Alternanthera philoxeroides* (Martius) Griseb. (alligator weed) in aquatic and terrestrial habitats in Australia. *Plant Protection Quarterly* 7:102–108.

Julien MH, Broadbent JE. 1980. The biology of Australian weeds 3. *Alternanthera philoxeroides* (Mart.) Griseb. *The Journal for the Australian Institute of Agricultural Science* 46:150-155.

Julien MH, Skarratt B, Maywald GF. 1995. Potential Geographical Distribution of Alligator Weed and its Biological Control by *Agasicles hygrophila*. *J Aquat Plant Manage.* 33:55-60.

Kay SH, Haller WT. 1982. Evidence for the Existence

of Distinct Alligatorweed Biotypes. *J Aquat Plant Manage.* 20:37-41.

Maddox DM, Andres LA, Hennessey RD, Blackburn RD, Spencer NR. 1971. Insects to control alligatorweed: An invader of aquatic ecosystems in the United States. *BioScience* 21:985-991.

Maddox DM. 1968. Bionomics of an alligatorweed flea beetle *Agasicles* sp., in Argentina. *Ann. Entomol. Soc. America* 61:1299-1305.

Martin AC. 1972. *Weeds*-Golden Press. Western Publishing Company, Inc, New York

McGillvrey FB, Steenis JH. 1965. Control of Alligatorweed in South Carolina with Granular Silvex. *Weed Science.* 13:66-68.

Sainty G, McCorkelle G, Julien M. 1998. Control and spread of alligator weed *Alternanthera philoxeroides* (Mart.) Griseb., in Australia: lessons for other regions. *Wetlands Ecology and Management* 5:195-201.

Schooler S, Cook T, Bourne A, Prichard G, Julien M. 2008. Selective Herbicides Reduce Alligator Weed (*Alternanthera philoxeroides*) Biomass by Enhancing Competition. *Weed Science.* 56:259-264.

Sculthorpe, C. D. 1967. *The Biology of Aquatic Vascular Plants*. London, UK: Edward Arnold. 610 p.

Shen, J., M. Shen, X. Wang, and Y. Lu. 2005. Effect of environmental factors on shoot emergence and vegetative growth of alligator weed (*Alternanthera philoxeroides*). *Weed Sci.* 53:471–478.

Tanveer A, Ali HH, Manalil S, Chauhan BS. 2018. *Eco-Biology and Management of Alligator Weed [Alternanthera philoxeroides] (Mart.) Griseb.]: a Review*. *Wetlands.* 38:1067-1079.

USDA, NRCS. 2020. The PLANTS Database (<http://plants.usda.gov>, 2 December 2020). National Plant Data Team, Greensboro, NC 27401-4901 USA.

Vogt GB, Quimby PC, Kay SH. 1992. Effects of weather on the biological control of alligatorweed in the lower Mississippi Valley region, 1973-83. *USDA Tech. Bull.* 1766. 143 p.

CORRECTION FOR WINTER ISSUE: The cover photo on the Winter issue of *Aquatics* was taken by Colin Lewis, an Aquatic Biologist I with Lee County Hyacinth Control District, and mistakenly had an incorrect caption associated with it. It should have included:

“The Lee County Hyacinth Control District (LCHCD) has been conducting herbicide treatments via sUAS as of September 1, 2020. The photo here features an application drone with a 2.5-gallon tank applying Florpyrauxifen-benzyl (ProcettaCOR SC) to spatterdock. The District is currently utilizing application drones to manage areas that were previously difficult or impossible to access with conventional equipment. As the program and technologies continue to advance, LCHCD will be incorporating granular applications via sUAS in areas with limited boating access and invasive SAV.”

Colin's photo received 1st place in the Aquatic Operations category of the Vic Ramey Photo Contest at FAPMS 2020. In addition, Colin was honored as the 2020 FAPMS Aquatic Plant Manager of the Year. Colin is a graduate of Florida Gulf Coast University and earned his Bachelor of Science degree in 2017. He has developed the aquatic drone spray program for LCHCD and is active in invasive plant management education and outreach initiatives in southwest Florida.

Thank you for all you do, Colin!



Call for Papers – Aquatic Plant Management Society

Present Your Original Research

You are invited to submit a title and abstract for the 61st Annual Meeting of the Aquatic Plant Management Society. Oral presentations are solicited for original research on the biology or ecology of aquatic and wetland plants, control methods (biological, chemical, cultural, mechanical) for invasive, exotic or nuisance plant or algal species, and restoration projects involving wetland or aquatic plants and algae. Presentation of original research will be given preference, and should be indicated by including results in the abstract. This year's meeting is in the region of the MidSouth Aquatic Plant Management Society, so regional presenters are strongly encouraged to submit an abstract.

Hybrid In-Person and Virtual Format

Participants and attendees for this year's conference can attend in-person or virtually. APMS will hold an in-person conference at the Riverside Hilton in New Orleans, Louisiana, from July 12-14, 2021. In addition, APMS will hold a virtual conference July 27-29, 2021.

All in-person talks will be recorded and either played during the subsequent virtual conference, or made available on demand. All presentations for the virtual conference will be pre-recorded, and additional instructions for those will be forthcoming. All talks at the in-person conference will be live; we will not play pre-recorded presentations at the in-person conference.

Acceptance of contributed papers or posters will occur after the abstract deadline, and will be confirmed by a separate e-mail. Additional details on presentation format will be provided at that time.

Students

The society will provide complimentary registration to presenting students (in person or virtual). We plan to hold a graduate

student session for the virtual conference, and any graduate student presentations given in-person will be recorded and included in the virtual session. Students that choose to attend in-person will be responsible for covering their travel and hotel accommodations. Students may contact the Program Chair (Dr. Ryan Thum; ryan.thum@montana.edu) or the Student Affairs Committee Chair (Samantha Sardes; sam.sardes@solitudelake.com) with any questions.

Poster Presentations

The in-person conference will not have our traditional poster reception. However, we will offer a poster presentation format virtually. Details about virtual poster formatting will be forthcoming.

Abstract Submission Information

Abstracts must be submitted on the WSSA abstract system at <http://weedscimeetingabstracts.com/>. Instructions for abstract submittal are below. The WSSA Title and Abstract Submission System is now active and will remain open until May 15, 2021.

Acceptance of contributed papers will not occur until after the abstract deadline, and will be confirmed by a separate e-mail.

Logging in to the WSSA System

If you have used this system before, enter your e-mail address and password to sign on to the system. If you cannot remember your password, click "Forgot your password?" to reset the password.

If you do not have an account with the WSSA abstract submission system, click "Register as a new user" and follow the instructions.

Once you are logged in, you will see a list of conferences that are open for Title and Abstract submissions. Click on "My Titles" at the top, and then click on "Create



New". You will be prompted to select a conference. Select "2021 APMS" and hit the "Continue" button.

Entering a Title: Type in the title capitalizing key words (e.g., Response of Eurasian and Hybrid Watermilfoil to Five Auxin-mimic Herbicides). Please do not submit your title in bold typeface or all caps. Just capitalize the major words in the title.

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Section: Indicate whether you are presenting an oral or poster presentation using the "Type" dropdown menu. For oral presentations, under "Section 1", please indicate whether you will be presenting in-person (June 13-14) or virtually (June 27-29). We will not have in-person posters, but posters may be presented virtually.

Presenter Biography: Please provide a short biography of the presenting author (200 word maximum).

Abstract: Type or copy the text of your abstract into the abstract box (300 word maximum).

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If you have any questions, please contact:
Dr. Ryan Thum
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ryan.thum@montana.edu

Applicators' Corner

Understanding ProcellaCOR¹ Herbicide Labels

Benjamin P. Sperry,
William T. Haller

Background

The newest registered aquatic herbicide, florpyrauxifen-benzyl, under the trade name ProcellaCOR, has introduced a new term in its use directions compared to the older registered aquatic products. The ProcellaCOR use rates are based upon "PDU's" or Prescription Dose Units which are essentially the same as the other herbicides since the units of a PDU are actually "fluid ounces per acre" for foliar applications and "fluid ounces per acre foot" for submersed treatments.

¹ProcellaCORTM is a registered trademark of SePro Corporation. This should not be considered an endorsement by the University of Florida for this product.

There are two formulations: an emulsifiable concentrate (ProcellaCOR EC) and a soluble/suspension concentrate (ProcellaCOR SC). It is not uncommon for the same active ingredient to have multiple formulation types or formulation concentrations (e.g., glyphosate, fluridone, endothall, 2,4-D, etc.). What is new and uncommon though is ProcellaCOR's "Prescription Dose Unit" or PDU which is used throughout the label for use-rate instruction. At first, the concept of a PDU was confusing for us as scientists and many applicators and resource managers because every previous herbicide we have worked with described use-rates in lbs, quarts, fl oz, etc. Arguably, ProcellaCOR products are not "magic" in that they do not have these gravimetric and volumetric units. However, these units have to be

derived from the label. Consequently, we constructed this document in response to several questions from aquatic managers to serve as a guide to clarify understanding of these product labels.

What's the difference between ProcellaCOR EC and ProcellaCOR SC?

These two products share the same active ingredient (ai), florpyrauxifen-benzyl, but are formulated as two different types of liquids. Furthermore, they are formulated as completely different ai concentrations (Table 1). Essentially the EC formulation is more dilute and has less ai per gallon than the SC formulation. This is nothing new with herbicides, it just changes your calculations a bit. One huge consideration for ProcellaCOR is that PDUs are **NOT** the

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same across formulations and states usually only have one formulation registered and not the other. As shown in Table 1, an EC PDU is 3.17 fl oz and an SC PDU is 1.35 fl oz; however, 1 PDU of EC (3.17 fl oz) and 1 PDU of SC (1.35 fl oz) do not contain the same amount of ai. Therefore, applicators must pay special attention to match the correct label with the product they are using as use-rates, based on PDUs and liquid volumes, change drastically in application rates. To make things slightly easier, the SC

formulation is generally only registered in southern-tier states whereas the EC is used in the northern states.

The typical use rates for ProcellaCOR are not much different from applications of other products such as fluridone, bispyribac, topramezone, and penoxsulam which are also commonly used in the 15-45 ppb range for submersed weed control. Even the maximum annual application or annual loading rates for ProcellaCOR (3 times at 48.2 ppb) are similar to those of fluridone

and penoxsulam. Although we rarely use the maximum allowable annual rates, make sure to check the labels because they are subject to change. Be sure when you search for labels online you pick the correct one and always double check your math!!!

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Table 1. Active ingredient concentrations and PDU information from product labels.

Parameter	ProcellaCOREC	ProcellaCOR SC
Formulation concentration	0.21 lbs ai/gal	2.5 lbs ai/gal
1 PDU equivalent	3.17 fl oz product	1.35 fl oz product
1 PDU equivalent	0.0052 lbs ai	0.026 lbs ai

Table 2. Foliar applications

Parameter	ProcellaCOREC	ProcellaCOR SC
Use-rate range (PDU)	5-10 PDUs/acre	1-2 PDUs/acre
Use-rate range (fl oz)	16-32 fl oz/acre	1.35-2.7 fl oz/acre
Use-rate range (lbs ai)	0.026-0.052 lbs ai/acre	0.026-0.052 lbs ai/acre
Maximum application rate	10 PDU or 32 fl oz/acre	2 PDU or 2.7 fl oz/acre
Maximum load per year (PDU)	20 PDU/acre/year	4 PDU/acre/year
Maximum load per year (fl oz)	64 fl oz/acre/year	5.4 fl oz/acre/year
Maximum load per year (lbs ai)	0.104 lbs ai/acre/year	0.104 lb ai/acre/year

Table 3. In-water submersed applications

Parameter	ProcellaCOREC	ProcellaCOR SC
Concentration of 1 PDU/acre ft	1.93 ppb	9.63 ppb
Max rate per acre ft (PDU)	25 PDU	5 PDU
Max rate per acre ft (fl oz)	79.25 fl oz	6.75 fl oz
Maximum concentration/single application	48.2 ppb	48.2 ppb
Maximum applications/year	3	3
Maximum PDU/acre/year	75 PDU/acre/year	15 PDU/acre/year
Maximum fl oz/acre/year	237.8 fl oz/acre/year	20.25 fl oz/acre/year

Table 4. Label directions for Eurasian watermilfoil and hydrilla.

Species	Parameter	ProcellaCOREC	ProcellaCOR SC
Eurasian watermilfoil	Max rate (PDU)	1-4 PDU/acre ft	not listed on label
	Max rate (fl oz)	3.17-12.68 fl oz/acre ft	-
	Max rate (ppb)	1.93-7.7 ppb	-
Hydrilla	Max rate (PDU)	Up to 25 PDU/acre ft	2-5 PDU/acre ft
	Max rate (fl oz)	Up to 79.25 fl oz/acre ft	2.7-6.75 fl oz/acre ft
	Max rate (ppb)	Up to 48.2 ppb	19.3-48.2 ppb

Revisiting “The Distribution of Licensed Restricted Use Pesticide Applicators in Florida”

Lyn A. Gettys and William T. Haller

The Florida Department of Agriculture and Consumer Services (FDACS) oversees the licensing of pesticide applicators in Florida. A search of the FDACS licensee database (<https://ceu.freshfromflorida.com/LicenseeReport.aspx>) revealed that there were more than 81,000 FDACS-issued licenses as of March 22, 2021! Wow, that’s a huge number... but that includes pesticide dealers, more than 4,600 pest

control companies, 15,516 “limited” (lawn and ornamental, fertilizer) license-holders, and nearly 48,000 fumigation and public health folks. If you’re reading this article in *Aquatics*, you’re probably one of the 8,290 applicators in Florida with a commercial or public license issued under Chapter 487 – meaning you kill weeds as opposed to mosquitoes, termites, and other critters (those fall under Chapter 482). And if you’re like most of your colleagues, you’d rather renew your license by earning continuing education units

(CEUs) instead of taking exams every four years.

It’s helpful for the organizers of in-person training programs such as the UF/IFAS Aquatic Weed Control Short Course, the FAPMS annual conference, and other events to identify where the highest number of CEU-seeking applicators are located so events can be scheduled with geography in mind. Back in 2012, Vernon Vandiver, Jr. and Karen Brown reported the distribution of Florida Restricted Use Pesticide (RUP) Applicator License holders that were certified in

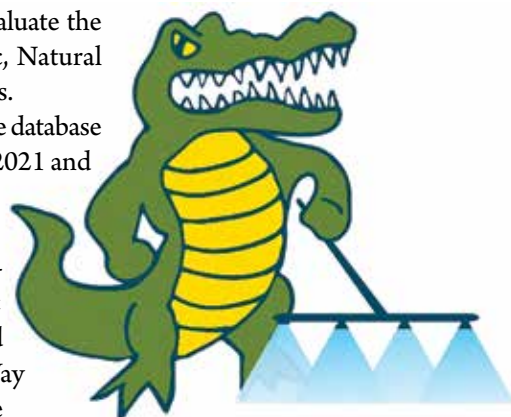
Table 1. Regional distribution of Florida applicators licensed in Aquatic, Natural Areas, and/or Right-of-Way categories.

Central: 2,188	
Central east: Brevard (192), Volusia (121), St. Lucie (94), Martin (69), Indian River (50)	526
Central inland: Polk (246), Orange (124), Lake (98), Seminole (87), Okeechobee (67), Osceola (56), Highlands (38), Marion (38), Hardee (32), DeSoto (29), Sumter (24)	839
Central west: Hillsborough (221), Pinellas (175), Sarasota (168), Manatee (115), Pasco (81), Citrus (38), Hernando (25)	823
South: 1,183	
Southeast: Palm Beach (282), Broward (227), Miami-Dade (146)	655
Southwest: Lee (303), Charlotte (79), Collier (64), Hendry (49), Glades (18), Monroe (15)	528
North: 806	
Northeast: Duval (119), St. Johns (48), Flagler (46), Nassau (12)	225
North central: Alachua (79), Putnam (45), Clay (32), Columbia (28), Suwannee (27), Levy (12), Gilchrist (10), Bradford (6), Union (4), Baker (2), Dixie (2), Hamilton (0), Lafayette (0)	247
Panhandle: Santa Rosa (58), Leon (49), Okaloosa (45), Walton (32), Bay (28), Escambia (26), Jackson (15), Washington (14), Liberty (13), Holmes (10), Madison (10), Wakulla (8), Gadsen (7), Calhoun (6), Gulf (5), Jefferson (5), Taylor (2), Franklin (1)	334

three categories (Aquatic, Right-of-Way, and Natural Areas) (see Aquatics 34(2): 5-7 for the full article). Nearly a decade has passed since that information was published, so it seemed like a good time to re-evaluate the distribution of Florida's Aquatic, Natural Area and Right-of-Way applicators.

We went to the FDACS licensee database mentioned above on January 29, 2021 and pulled a "Licensee Report with Categories". We included holders of commercial and public applicator licenses, and I selected "Aquatic Pest Control", "Natural Areas Weed Management", and "Right-of-Way Pest Control" from the license categories dropdown list. This search showed 4,474 individuals hold an FDACS-issued RUP license with Aquatic, Natural Areas and/or Right-of-Way categories. Most of these (4,177) are held by Florida residents, but 232 were issued to people in other states and 65 are held by individuals that listed their county as "unknown". The majority (59.9%) of licenses are commercial (applicators working for a company) and 41.1% are public (applicators working for state, local, or other public agencies and districts).

Vandiver and Brown listed applicators by county, but the question we're really trying to answer is, "What REGION in Florida has the greatest density of applicators?" We grouped the counties by area into South (subdivided into east and west), Central (subdivided into east, inland, and west), and North (subdivided into east, central, and Panhandle). And the winner is... CENTRAL! Of the 4,177 Florida residents that are FDACS-licensed in Aquatic, Natural Areas, and/or Right-of-Way categories, 2,188 (more than 52%) of those residents are based in Central Florida (Table 1).



AQUATIC WEED CONTROL SHORT COURSE

This, folks, is news you can use – in fact, we're already using it! The 2021 UF/IFAS Aquatic Weed Control Short Course, scheduled for August 16-19, is moving north from Coral Springs to Orlando! The information in this article played a big part in that decision, plus we want to try a bigger venue so everyone has plenty of breathing room. We'll be at the Renaissance Orlando at SeaWorld, which has 700+ guest rooms, gigantic meeting spaces, and plenty of restaurants in the hotel and nearby. I know what you're wondering – is this "August in Orlando" thing permanent? Who

knows... we'll see how it goes and make a decision about 2022 after this year's Short Course wraps. For now, we encourage you to visit the Short Course website at <https://conference.ifas.ufl.edu/aw/> to find out more and to register for this *in-person* event.

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Is Hydrilla Good for Fishing?

Benjamin Sperry¹, Jason Ferrell², Mark Hoyer³

Sound science and stakeholder input are essential when setting management goals for any public water body. Once management activities are moving forward, however, misinformation and anecdotal evidence often lead some stakeholders to claim certain lakes are being mismanaged. One example of misinformation-driven concerns is the statement that some forms of hydrilla management negatively impact recreational fishing. This article was developed to briefly address four of the most common unsubstantiated claims related to hydrilla management and fishing.

Claim #1: “When an area is sprayed with herbicides fish leave the area and never come back.”

Fishermen often claim fish move away from areas that have been treated with herbicides. This claim usually includes a statement that the sprayed area was a favorite fishing spot that yielded and abundance of fish for 25 years and now it is ruined. While there is evidence that fish temporarily evade an area when it gets sprayed with herbicide, fish also leave when areas get sprayed with plain water. A study conducted by Bettoli and Clark (1992) showed that bluegill and redear sunfish nest abandonment duration, rim circling, fanning, and agonistic behavior was similar among areas sprayed with endothall, 2,4-D, or water. Likewise, largemouth bass spawning behavior, reproductive success, and progeny abundance were not different among ponds treated with endothall or treated with water (Maceina *et al.* 2008). Sometimes people just have bad days of fishing and need to blame something for their lack of success. Although, the literature suggests that applying herbicides

to water are not the reason for decreased fishing success.

Claim #2: “Hydrilla provides fish habitat. Spraying hydrilla is habitat destruction.”

There is truth to this claim. Fish can use hydrilla for cover and habitat. As many know, however, fish did exist in Florida lakes prior to the introduction of hydrilla. The point is fish can use hydrilla for habitat, but they can utilize other habitats as well. Refer to the Sammons *et al.* (2003) to support this concept. Largemouth bass occurrence using multiple habitats (bare sediment, emergent, floating leaved, native submersed aquatic vegetation (non-hydrilla), hydrilla, and large woody debris) in Spring Creek, Lake Seminole, GA was measured before and after a fluridone treatment to control hydrilla. Prior to treatment, when a hydrilla infestation was present, bass occurrence was greatest in hydrilla habitat (~60%). However, after hydrilla was controlled, bass occurrence in every other habitat increased compared to pretreatment. While fish do use and maybe prefer hydrilla for habitat, they can also use many other types of structure, too. As a side note, this concept and the data presented suggest during the timeframe that hydrilla has been prominent in several systems that support largemouth bass, anglers have learned to fish the hydrilla habitat. Perhaps this has led to lack of experience fishing non-hydrilla habitats. Therefore, one could speculate that during times of low hydrilla infestation, anglers suggest fishing is bad because they are unaccustomed to fishing without hydrilla.

The previous example in Spring Creek indicated bass were abundant prior to hydrilla management. However, Colle *et al.* (1987) told a slightly different story. In the 1970s on Orange Lake, Florida, harvestable largemouth bass, bluegill, and redear sunfish abundance was inversely proportional to hydrilla coverage. In other words, harvestable fish numbers were low when hydrilla coverage was high.

Conversely, in the same study harvestable black crappie numbers were independent of hydrilla coverage. Therefore, hydrilla presence and abundance may differentially impact different species of fish; however, a lot of hydrilla does not always mean there will be a lot of harvestable fish.

Claim #3: “Before they came in and sprayed all the hydrilla, there were more fish and they were bigger.”

This claim is often accompanied with pictures of tournament weigh-in charts with low bag weights or a picture of a monster bass caught in another state because “they don’t spray hydrilla up there”. Well, we looked around in the literature and actually found just the opposite happens. Johnson *et al.* (2014) compared largemouth bass sizes pre- and post-2004 hurricane season from Lake Walk-in-Water and the St. Johns Water Management Area. Hurricanes during 2004 caused high, turbid water in these systems that lead to reduced hydrilla presence. Average largemouth bass size increased in both systems post-hurricanes when hydrilla was either gone or occurrences were few and far-between. Independent of hurricanes or management, just the presence of hydrilla in a system does not seem to play a major role in fish population dynamics. For example, Hoyer *et al.* (2008) compared fish species densities, richness, evenness, and diversity among 11 lakes with hydrilla and 16 lakes without hydrilla and concluded fish populations did not differ as a function of hydrilla presence. As for comparing the Florida situation to other states, Bain and Boltz (1992) also reported no difference in bass abundance, size, condition, or movement between herbicide-treated and non-treated sites in Guntersville Reservoir in Alabama.

Claim #4: “Continuing to spray hydrilla will keep anglers from traveling to lakes and supporting the local economy”

Every person is concerned about the productivity of their local economy. The

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fishing tourist industry, while it has changed over the years, is a significant industry in Florida. However, if we stop and think about what role hydrilla actually plays in the local economy we must consider all aspects. Are there some anglers that only target hydrilla habitats? I am sure there are. Does hydrilla provide some type of positive effect on a local economy? Maybe in some places. However, can hydrilla have negative effects on a local economy? Absolutely. Does hydrilla need to be managed? YES!

Refer again back to Colle *et al.* (1987)'s study of Orange Lake. From the fall of 1974 to the spring of 1977 the number of fishing hours was zero. For 2.5 years no one could run a boat through the thick hydrilla and fish. Coincidentally, hydrilla increased in coverage of the lake during this time until it peaked at around 90% coverage near the fall of 1977. After the fall of 1977 (in which management occurred) total fishing hours on the lake increased to over ~150k in 1979. While each system is different in terms of angling effort related

to hydrilla presence, Colle *et al.* (1987) is a good reminder of what can happen if hydrilla is left un-checked.

So, what has this information taught us? Hydrilla at moderate levels can concentrate largemouth bass and make fishing a bit easier, but too much hydrilla can adversely affect access to fishing areas and even fish size. So instead of saying "hydrilla is good for fishing", maybe we should say, "properly managed hydrilla can be good for fishing".

Literature Cited

- Bain MB, Boltz SE (1992) Effect of aquatic plant control on the microdistribution and population characteristics of largemouth bass. *Transactions of the American Fisheries Society* 121:94-103
- Bettoli PW, Clark PW (1992) Behavior of sunfish exposed to herbicides: A field study. *Environmental Toxicology and Chemistry* 11:1461-1467
- Colle DE, Shireman JV, Haller WT, Joyce JC, Canfield DE (1987) Influence of hydrilla on harvestable sport-fish populations, angler use, and angler expenditures at Orange Lake, Florida. *North American Journal of Fisheries Management* 7:410-417

Hoyer MV, Jackson MW, Allen MS, Canfield DE (2008) Lack of exotic hydrilla infestation effects on plant, fish and aquatic bird community measures. *Lake and Reservoir Management* 24:331-338

Johnson KG, Dotson JR, Pouder WF, Trippel NA, Eisenhauer RL (2014) Effects of hurricane-induced hydrilla reduction on the largemouth bass fishery at two central Florida lakes. *Lake and Reservoir Management* 30:217-225

Maceina MJ, Marshall, Sammons SM (2008) Impacts of endotoxin applications on largemouth bass spawning behavior and reproductive success. *North American Journal of Fisheries Management* 28:1812-1817

Sammons SM, Maceina MJ, Partridge DG (2003) Changes in behavior, movement, and home ranges of largemouth bass following large-scale hydrilla removal in Lake Seminole, Georgia. *J Aquat Plant Manage* 41:31-38

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Lakes from Space:

How Satellite Remote Sensing Can Enhance Aquatic Plant Management

**James Leary¹, Alex Dew²,
Kelli Gladding³, Jake Thayer⁴,
Jonathan Glueckert⁵**

The lakes of Florida are dynamic, complicated systems that are constantly changing over space and time. Thus, proper, year-round management necessitates accurate, timely information on the biophysical environment of these aquatic systems. Lake surveys have been an institutional tenet of sound aquatic plant management for generations. This is the art and science of live observation connecting the biologist to ecosystem, using their intuition and training to intimately note the familiar and unfamiliar. This is a highly skilled practice that is labor-intensive yet is an indispensable intelligence gathering activity. These documented events are an invaluable source of data and information critical to developing work plans that include aquatic plant management actions and are an archive of long-term trends and historical contexts. With the balance of other responsibilities, and limited resources, lake surveys have traditionally been performed on an annual cycle. While more frequent surveys within

the year would update the intelligence and improve the management decision-making process, this must be considered against other management priorities.

Lake management biologists and practitioners in Florida have historically embraced technologies that improve efforts and enhance outcomes. The advents of GPS and hydroacoustic sonar are examples of such technologies that have greatly enhanced aquatic plant management (APM) planning and evaluation with spatial comprehension of macrophyte species abundance and community structure and, in particular, with the mapping of invasive species infestations (e.g., hydrilla,

Here, we would like to introduce to our readership the **next epoch** of technological adoption with remote sensing of satellite images.

hyacinth and water lettuce). Even with these technologies, monitoring is still a labor-intensive process.

Here, we would like to introduce to our readership the next epoch of technological adoption with remote sensing of satellite images. In many ways this is a story of what was old is new again. It's common knowledge that Sputnik was the first satellite launched into space by the former Soviet Union in 1957. However, did you know that the first images recorded from space was achieved by the good 'ol US of A in 1946 from a V2 rocket in sub-orbital

flight? Let's just say the data was not very informative but a seminal moment none the less. Inherently, satellite technology cut its teeth in military applications which eventually trickled down to the civilian world. The Landsat program launched by the USGS and NASA in 1972 was the pioneer in Earth observation for scientific purposes that today has expanded into a global endeavor.

Earth observation (EO) satellites are designed to do just that; Observe Earth from space. Today there are over 1800 EO satellites in orbit, many in the public domain, collecting petabytes of data (that's a byte with fifteen zeros) every year. There are a multitude of sensors collecting a wide range of environmental information, with optical sensors (i.e., digital cameras) being the most intuitive to the end-user. While EO images have been collected for decades, it's really the advent of the internet and cloud computing that is now allowing for equitable access to these exceptionally high-value data sources.

In this article, we hope to inspire our readership to learn more about the possibilities of remote sensing with EO imagery. Here, we recommend Landsat and Sentinel data sources curated by the USGS and the European Commission's Copernicus program, respectively. These orbital satellite constellations cover the globe several times a month with image resolution measured in meters. The Landsat satellite constellation covers the globe every 16 days collecting images with 30 m pixel resolution (also known as ground sampling distance or GSD). The

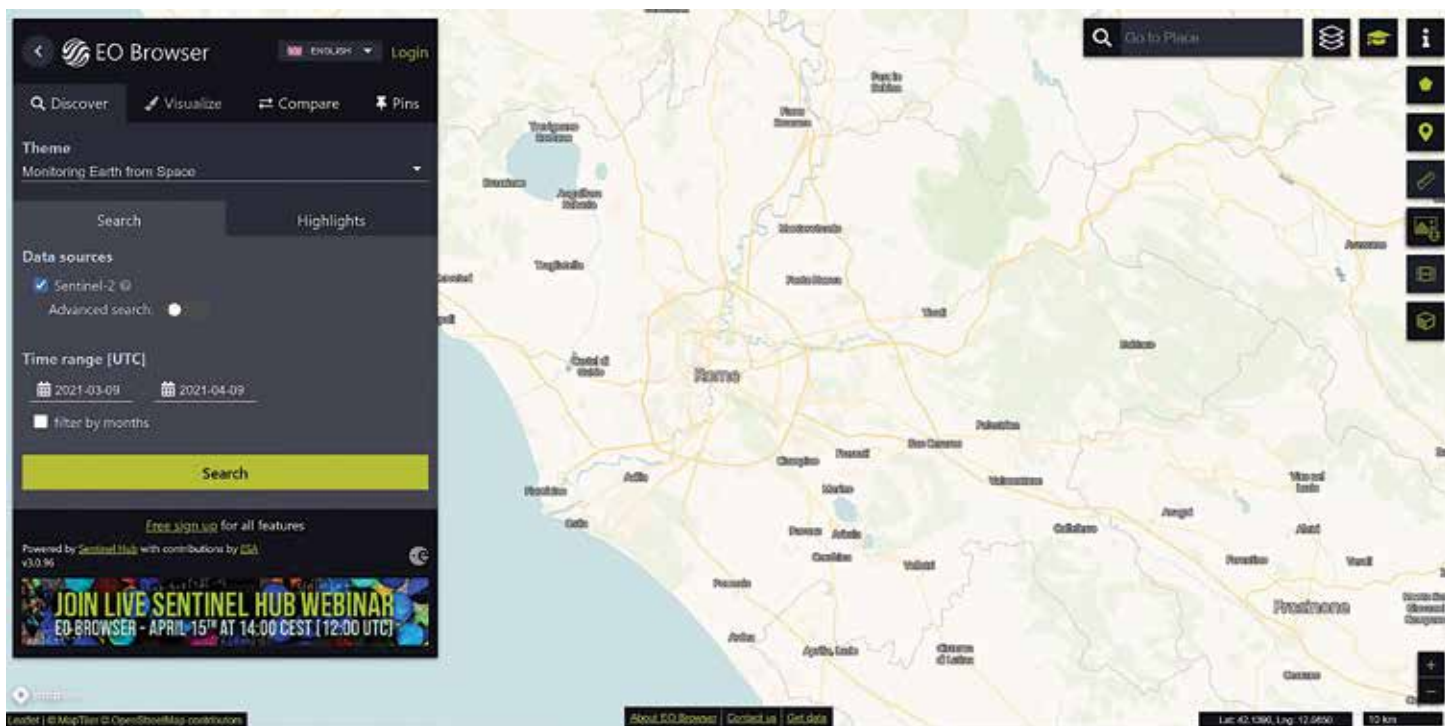
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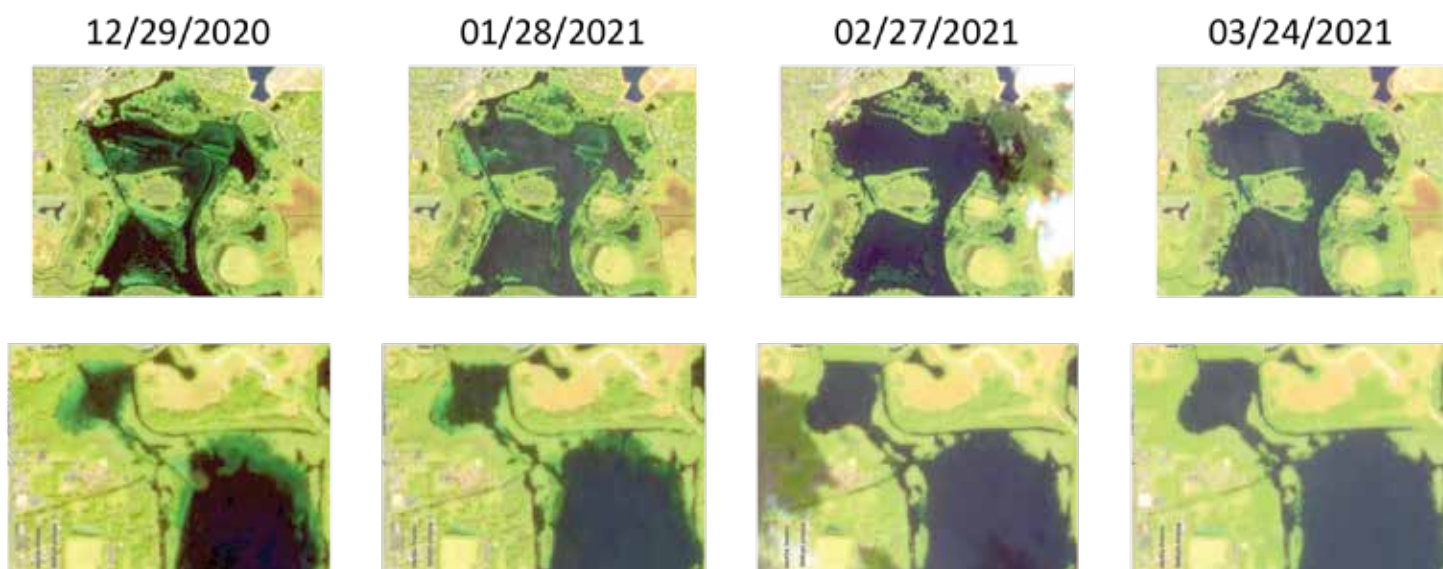


Screenshot of the EO Browser with the discover and visualization panel on the left. Login is not required but definitely preferred to enjoy the full functionality of the data portal

Sentinel-2 optical satellites cover the globe every 5 days collecting 10 m resolution images. These sensors are multi-spectral imagers (MSI) that include the red, green and blue wavelengths in the visible range and several other bands in the non-visible region, including the near-infrared range for discriminating vegetation communities

in the landscape. There are many different vegetation indices that combine different bands with simple mathematics. The index most utilized is the Normalized Difference Vegetation Index (NDVI), which exploits the principles of vegetation and water selectively absorbing the red and NIR wavelengths, respectively.

These meter-resolution images are excellent for mapping emergent and floating vegetations, but obviously not able to discriminate at the species level. Depending on the conditions and time of year these images are also able to detect hydrilla and other submersed aquatic vegetation, particularly the surface growth in the fall. The



Timeline of in-water hydrilla treatments in the north coves of Lake Toho (top) and Parker Lake (bottom). Artificial color with the 11, 8, 2 band composites. Note how surface mats of hydrilla appear slightly florescent and stand out from the emergent vegetation. Images derived from Sentinel-2 MSI (European Space Agency)

best time to view cloud-free images of your lake of interest typically starts in September and extends to April, before the monsoon starts. However, with frequent return cycles it is common to capture cloud-free conditions at least once a month, which is more than adequate to monitor and evaluate an APM action.

To initiate the uninitiated, we recommend exploring the Sentinel EO browser. Here are six easy steps to access, view and download satellite images as a basic learning experience with remote sensing and satellite data

1. Go to Copernicus Sentinel Hub website at <https://apps.sentinel-hub.com/eo-browser/>
2. Create a login account. Its free. While viewing images doesn't require a login, it is needed for downloading images and to use other basic features.
3. Pan and zoom to your area of interest in the map display
4. Enter search criteria. On the left panel, check Sentinel-2 satellite and a time range of your interest. We recommend limiting to one month to limit the number of images to scroll through.
5. Visualize the image date. Click "visualize" in the image icon. This will start with showing the true color image (RGB). Select any one of the available options, including NDVI. Our personal preference is the custom section with bands 11, 8 and 2 dragged into the R, G and B channels respectively. We have found this to highlight hydrilla the best. The imagery usually appears to be under-exposed to the naked eye. We recommend going into the effects and advanced options settings (equalizer

09/25/2020



09/30/2020



Ocklawaha in late September 2020 showing massive flotilla of water lettuce migrating across the reservoir over a 5-day period.

icon at the top) and reduce the gamma (i.e., mid-tones) to 0.5-0.3.

6. Download image data. The image you are viewing can be downloaded as a compressed folder containing all 13 bands as geotiff files encompassing the 100x100 km² tile selected, along with a plethora of corresponding metadata and other technical details. There often are two file types for each tile to choose from. LC1 and L2A. L2A is atmospheric correction to ensure the accuracy of the reflectance data. This is important for analysis and be thankful someone else is doing it for you. The downloaded compressed folder is approximately 1GB, which can add up as you start to build your own library.

Once you've gained access to the web-site, you should soon realize the multitude of other functions: image comparison, time lapse, area measurements, change statistics. Remote sensing with these satellite products does not replace the current survey conventions, but instead greatly enhances interpretations with comprehensive, spatially accurate data and monthly or weekly updates that can fill the gaps between annual survey events. In

many ways, checking satellites can become as routine as checking the weather, supporting decisions to proceed or postpone APM actions, adjust locations and achieve better calculations of the treatment area. This technology is further proving to be an excellent platform for short- and medium-term evaluation of APM actions with sustained performance measured over time. Finally, this information is free to the public, which makes it a very cost-effective approach to building intelligence in APM.

Additional reading:

Tatem, A.J., Goetz, S.J. and Hay, S.I., 2008. Fifty years of earth observation satellites: Views from above have led to countless advances on the ground in both scientific knowledge and daily life. *American Scientist*, 96(5), p.390.

Union of Concerned Scientists. Satellite Database. Jan 2021. <https://www.ucsusa.org/resources/satellite-database>.

Sudmanns, M., Tiede, D., Lang, S., Bergstedt, H., Trost, G., Augustin, H., Baraldi, A. and Blaschke, T., 2020. Big Earth data: disruptive changes in Earth observation data management and analysis? *International Journal of Digital Earth*, 13(7), pp.832-850.

Liu T. and C. Ding. April 2020. A Bird's-Eye View of Earth: Petabytes of satellite data at our fingertips.

<https://sitn.hms.harvard.edu/flash/2020/a-birds-eye-view-of-earth-petabytes-of-satellite-data-at-our-fingertips/>

To learn more about the Sentinel EO Browser go to: <https://www.sentinel-hub.com/explore/eobrowser/>

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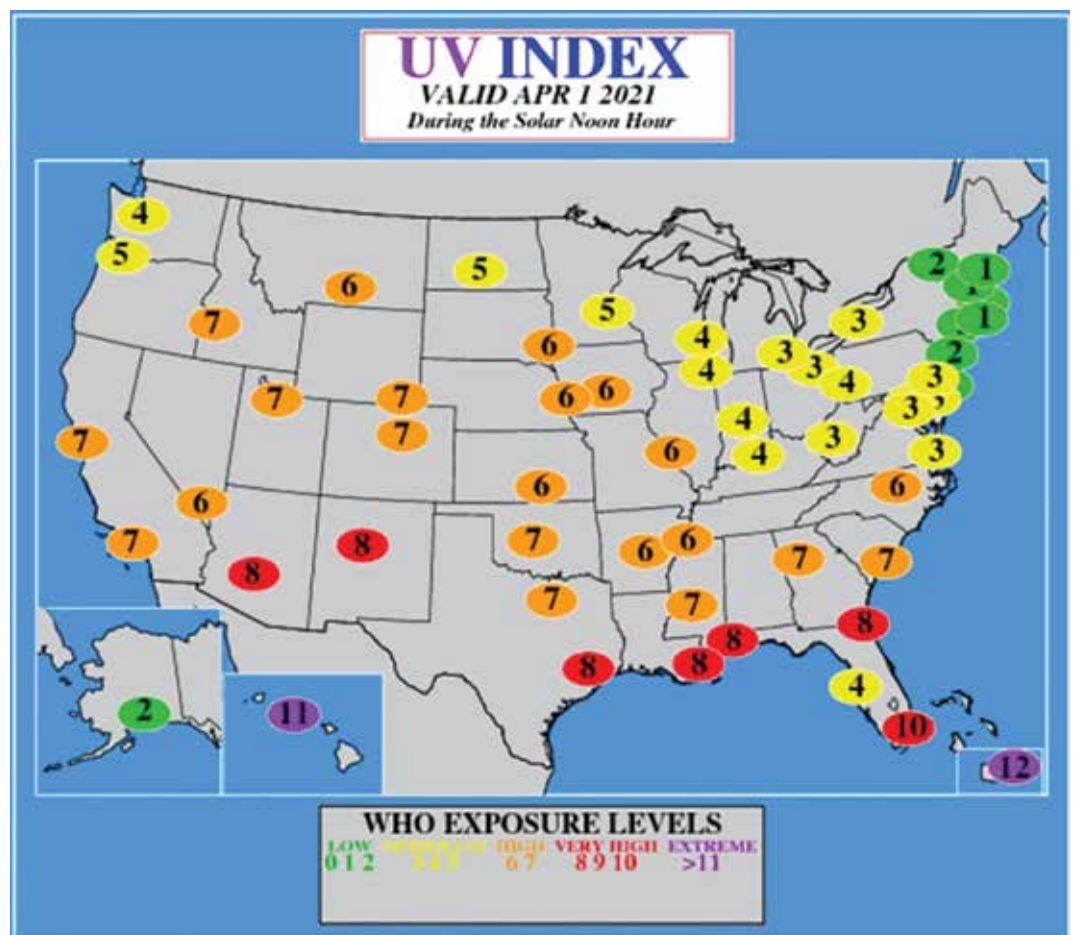
Living and Working Safely in the Florida Sun

Living and working in Florida's sunny subtropical climate poses challenges both to our health and our environment. As we learn more about sun exposure's detrimental effects, sun protection is becoming ever more crucial. With the myriad of new products, it's very easy to feel lost in the sunscreen aisle wondering which would be the best fit for you or why we even need them in the first place. In this article, I will briefly walk you through the basics of UV exposure, sunscreens, their environmental impact, UPF clothing, and what it is they protect you against.

Let me start by taking us briefly, and hopefully not too painfully, back to earth science class. Sunlight actually consists of multiple wavelengths of electromagnetic energy that radiates from the sun, through our atmosphere and into our environment. These wavelengths include infrared, visible, and ultraviolet light. Ultraviolet (UV) light is further subdivided into UVA and UVB. 95% of the UV radiation that reaches earth consists of UVA waves, which penetrate the bottom-most layer of skin causing skin thinning, wrinkles, tanning and, to a lesser extent, skin cancer. The remaining 5% of UV waves are comprised of UVB, which radiate the top layers of the skin, causing sunburn and most skin cancers. But before I leave you thinking sunshine is all bad, it is only fair to note that it also helps our skin activate vitamin D (which is very important for bone health) and is helpful for mental health and wellbeing.

However, sun exposure in Florida can be especially damaging due to our proximity to the equator, which is the part of the earth closest to the sun. The national weather service regularly tests the strength of UV radiation in many major

US cities, which is listed in the National Ultraviolet Index. This information is also included on most smart phone weather apps under "UV index," usually next to the air quality rating. What you will see is a number between 0 and 15 indicating the severity of radiation exposure in your area for that day. The higher the rating, the shorter the time in direct sunlight required to cause skin damage/burn to most people, which is known as "Time to burn." A quick look at the abbreviated national list will show you that the two cities in Florida, Jacksonville and Tampa, have the highest radiation rating of all of the continental US. Here in Florida, it only takes 15-25 minutes unprotected in the sun to cause cellular damage to your skin. This cellular damage triggers your pigment cells, melanocytes,



https://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uvi_map.gif

to release more pigment, which is why people “tan” after sun exposure. This pigment, called melanin, helps protect skin cells from radiation by deflecting the UV rays, similar to how darker curtains block incoming light in a window better than lighter curtains. No matter your complexion though, the intense radiation of the Florida sun makes using protection an absolute necessity for anyone working outdoors.

Sunscreen is a mainstay of sun protection, along with wearing UPF clothing, seeking shade, and avoiding mid-day sun. Sunscreen acts by either deflecting or absorbing UV radiation before it can penetrate and damage our skin. Sunscreens that have titanium or zinc oxide listed under active ingredients work by deflecting light and are known as “physical/mineral blockers.” These earth metals work very well as they can be compounded into creams giving us all the benefits of a suit of armor with none of the bulk. They are, however, more difficult to “rub in” and leave a white sheen on the skin, which may be especially bothersome for darker complected people. The other type of



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sunscreen, “chemical blockers/organic filters,” acts by absorbing the energy of the UV radiation into their chemical structure and releasing the energy as heat. They typically contain avobenzone, homosalate, octisalate, and octocrylene (usually all four together, in that order). Understandably these can be irritating to sensitive skin and occasionally can cause a rash or allergic reaction. On the other hand, they are easier to rub in, lighter weight, and less greasy.

It is also important to note that not all ingredients block both UVA and UVB, in fact, of the ones discussed above only zinc, titanium, and avobenzone protect against UVA.

Now that we have the types of sunscreens down choosing the SPF is the next big step. SPF stands for sun protection factor and tells us how many times longer we can remain in the sun without burning. For example, an SPF of 15 means your “time to burn” is extended 15 times which in Florida will roughly cover you for 4-5 hours and SPF of 30, 7-10 hours. But why would anyone buy SPF 100, which would cover you for 30 hours? Another way to evaluate sunscreen is the percent of UVB waves blocked, which increases with increasing SPF though not in a one-to-one fashion.




SPF 15 blocks 94% of UVB waves, and SPF 100 blocks 99%. So, increasing SPF does marginally increase your UVB protection. Unfortunately, SPF tells you nothing about UVA protection. To make sure your sunscreen is also protecting you against damage from UVA radiation, look for a “broad spectrum” designation on the label, which is an FDA-regulated designation that can only be used if the sunscreen provides equal UVA to UVB protection. In terms of the official recommendation, the American Academy of Dermatology recommends using 30 SPF or greater, broad spectrum, water resistant sunscreen. The sunscreen pictured is my personal favorite and I have highlighted the parts of the label I use to inform my choice (mineral/physical blocker, broad-spectrum, and reef-friendly).

What about sunscreen and the aquatic environment? This is certainly an important consideration when choosing a sunscreen, and especially pertinent in this field. It is estimated that 7 to 14 thousand tons of sunscreen enter our oceans per year and have been linked to the global decline and loss of coral reefs. In 2015 the US National Aquarium and US National Oceanic and Atmospheric Administration published a cornerstone study, led by Dr. Craig Downs, which found that oxybenzone (a common chemical sunscreen ingredient) even in concentrations of 62 parts per trillion, caused coral cell toxicity. More recent studies have found oxybenzone in higher concentrations decreases fish fertility and impede chlorophyll



Francesco Ungaro



Skin Cancer Type	Photographic Examples
Basal-Cell Carcinoma - Most common - Rarely deadly	 <p>By Dr. James Heilman</p>
Squamous Cell Carcinoma - Occasionally deadly	 <p>By Dr. James Heilman</p>
Melanoma - Least common - Most likely to spread - Most deadly	 <p>National Cancer Institute</p>

formation in algae (5 parts per million). In response to this new information, Hawaii has recently successfully banned the sale of all sunscreens containing oxybenzone or octinoxate, another environmentally hazardous chemical sunscreen, on January 1, 2021. Though zinc and titanium are typically considered aquatic safe, newer “clear zinc,” formulations break down the elements into nanoparticles which may pose a problem as they can be easily absorbed into the cells of aquatic organisms. More research is being done to determine these nano-particles’ impacts, but some “reef safe” sunscreen formulations exclude these ingredients. Though most research has been conducted in salt-water organisms, it is likely to be equally damaging to their fresh-water counterparts. Additionally, oxybenzone is very difficult to remove from wastewater, and even land-bound people would do well to avoid increasing environmental exposure to these chemicals.

This brings us nicely to the benefits of UPF clothing. UPF stands for ultraviolet protection factor and describes both UVA and UVB protection conferred by clothing.

A UPF rating of 50 indicates that 1/50 of UV rays reach your skin, or conversely, 49/50 (98%) of rays are blocked. These products are now widely sold, tailored to specific activities, and have affordably priced options. Fabric’s ability to block UV radiation is determined by the density of the weave or thread count and the types of dyes used. In fact, many darker articles of loose fitting, synthetic clothing offer good sun protection. As a rule of thumb, holding a fabric up to the light will give you a good idea of how much light will reach your skin. For example, a white cotton shirt has a UPF of 5 (80% of UV rays blocked) compared to a dark-colored polyester shirt with a UPF of 30+ (97% of UV rays blocked). A quick look into most of our wardrobes will show us that we have some sun-protective clothing already. If you are worried about the heat, ventilated, quick-dry UPF clothing can be a great option. All-together, UPF clothing provides an environmentally safe, low hassle option that is my personal favorite and go-to. Though you may not get style points for a large, brimmed hat and full-coverage clothing, the ease and environmental benefits are unparalleled.

Lastly, let’s discuss why we care about sun protection: skin cancer. Prolonged exposure to UV radiation causes alterations in the DNA of our skin cells. This occurs either through free radical damage, which leads to mutations in the DNA, or ionizing damage that causes kinks in the DNA and prevents replication. In the US, skin cancer is the single most common cancer, and one in five people will develop it according to the American Academy of Dermatology. Risk factors include occupational exposure, tanning bed use, lighter complexion, and having immune problems. The three most common types of skin cancers are basal cell, squamous cell, and melanoma, and they are named after the types of skin cells affected. The deadliest, and fortunately, most rare, is melanoma, a cancer of the pigment-producing melanocytes that can invade lymph nodes and spread if untreated. Additionally, if you have had more than 5 blistering sunburns before the age of 20, you have an 80% increased risk of developing melanoma, according to a recent study by Dr. Wu et al. in 2104. The American



Cancer Society reports that in the US, it is responsible for 20 deaths a day and more than 100,000 cases of invasive melanoma were diagnosed last year. According to the American Academy of Dermatology, relative to other cancers, skin cancer has a very good survival rate of >92% if caught early and treated. Because early detection is key, it is important to establish care with a dermatologist both for timely treatment and to learn how to preform self-exam.

To summarize our key points, sunlight contains ultraviolet radiation that causes cellular damage/burn in a matter of 15-25 minutes here in Florida. UPF clothing or dark, loose-fitting fabrics are a convenient and environmentally safe way to protect your skin. For the exposed parts of your skin, look for reef-friendly, water resistant, broad-spectrum, 30+ SPF sunscreen. When it comes to sun exposure, skin protection equals cancer prevention. Skin cancer impacts one in 5 people in the US. Take the time to protect yourself.

Dr. Lindsey Warner is a pediatric physician who received his MD at the University of Central Florida and M.S. at Georgetown University in Complementary and Integrative Medicine. A Florida native, he has taken great interest in sun safety and skin cancer prevention. He has worked to organize Miles for Melanoma, a 5K run/walk community event to raise awareness and funding for the Melanoma Research Foundation locally in Lake Nona. Outside of medicine, Dr. Warner enjoys bird watching, scuba diving and spending time on the water.

Pesticide Updates

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Water depth and growth of torpedograss

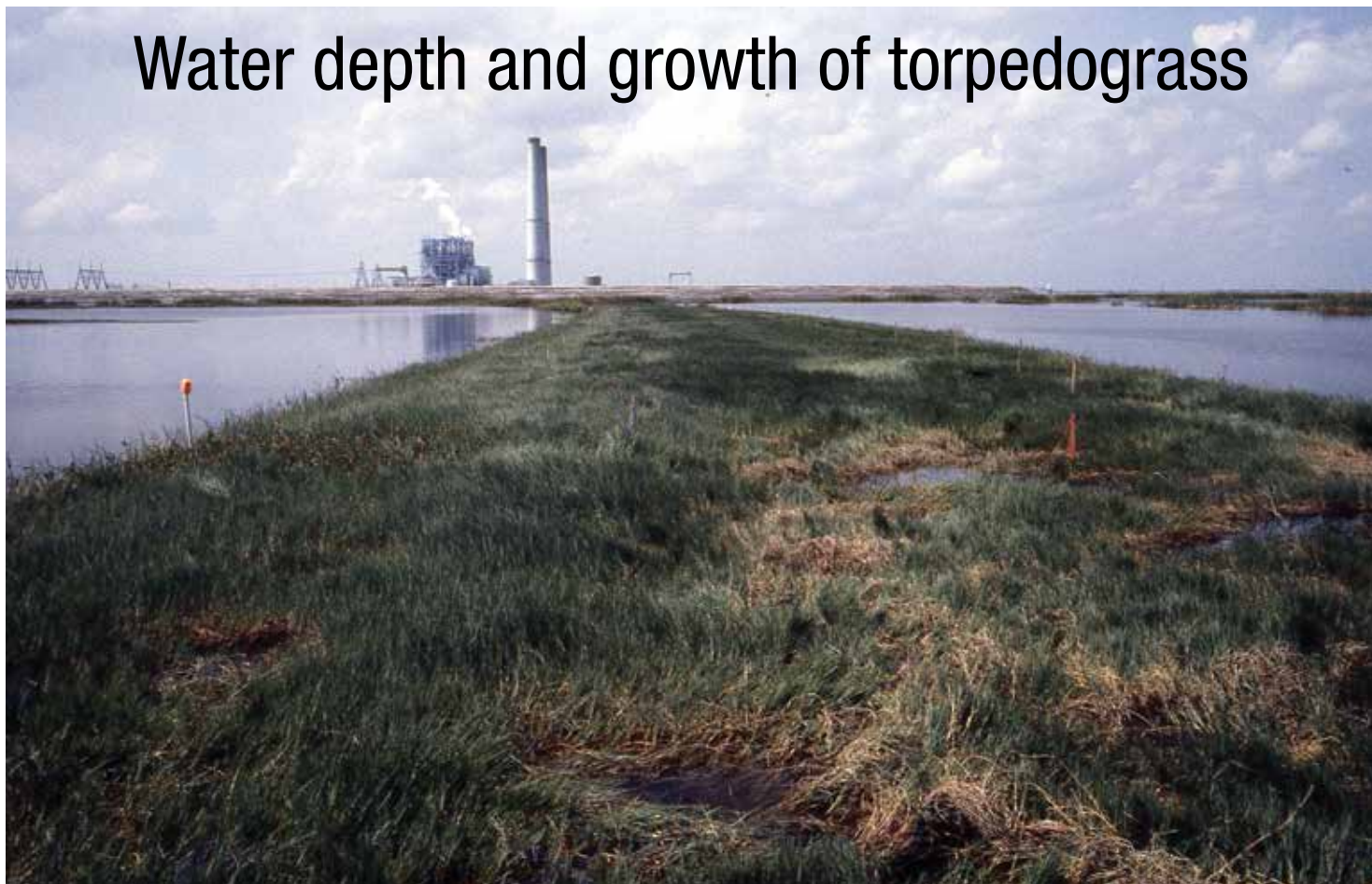


Figure 1. Underwater levee at the Florida Power and Light Martin County cooling reservoir where torpedograss was rooted in 1 to 2 feet of water with surface mats extending 25 to 30 feet on each side of the shallow water.

Paul L. Thayer, William T. Haller and Lyn A. Gettys

Torpedograss (*Panicum repens* L.) is a non-native aquatic and wetland species commonly found growing in moist soils and shallow waters throughout the world, including Australia, Africa, southern Europe and Asia. The species grows not only on wet soils, but also in water 2 to 4 feet deep. Torpedograss was first reported in the US in the mid-1870s near Mobile, Alabama and currently found in North Carolina, Georgia, the Gulf Coast states to Texas and in California. However, due to its tropical origins, it is most problematic in peninsular Florida (Tarver, 1979 and USGS website). Tarver also reported that the species was planted throughout southern Florida in the mid-1900s by farmers as a potential forage crop for cattle.

During an aquatic vegetation survey on the Florida Power and Light cooling water reservoir near Indiantown, Florida,

biologists reported they found torpedograss growing in 12 to 14 feet of water (Figure 1). This seemed unusual since if it was truly rooted and growing in water that deep, torpedograss would likely completely cover many lakes in the state because the average depth of many Florida lakes is only

6 to 8 feet. Upon further investigation, it became clear that torpedograss was rooted on an old flooded levee where water depth was 1 to 2 feet, but produced lateral stolon growth that resulted in a dense surface mat that reached 25 to 30 feet from both sides of the levee (Figure 2). Water levels in the



Figure 2. Diagram of torpedograss rooted in moist soil or shallow water with stolon growth producing floating mats over much deeper water at the Florida Power and Light cooling reservoir.

cooling reservoir increased just a few inches annually and the torpedograss had never been treated. This experience indicated that growth can occur in 2 feet of water, plus or minus a bit, but can it root and grow in deeper water? There has been very little published in the literature on torpedograss biology and growth limits, so a study was conducted to determine what water depths might limit its growth.

Materials and methods

Twenty torpedograss stem sections with nodes were sprigged in spring (April) into each of 60 12-quart plastic dishpans containing 2 inches of commercial topsoil (16% organic matter) and covered with 2 inches of masonry sand. Dishpans were fertilized with 10 grams of 10-10-10 fertilizer and placed outside until June (eight weeks) to allow plants to establish; by that time, the torpedograss had reached 12 to 16 inches in height and planted dishpans were moved to one of five depths. The dishpans were suspended by ropes from four styrofoam rafts (Figure 3) in a small

(0.1 acre, 4.5 to 5 feet deep) pond at the University of Florida. Each raft held three replicates of each of the five depth treatments, resulting in 15 dishpans per raft and 12 replicates per treatment. Dishpans held at the water surface (depth 0 feet) had small holes drilled into the pan bottoms and were suspended with the soil surface just above the water to provide moist growing conditions. Dishpans suspended at the 0.5-foot level contained water at that depth above the soil surface. Dishpans to be held at water depths of 1, 2 or to 4 feet were gradually lowered over a three-week period so the tops of the plants were always above the water surface.

Following 11 weeks of growth (August), plant material was clipped 4 inches above the soil surface, dried and weighed. After plants were harvested, the dishpans were immediately returned to their original water depth and allowed to grow for 12 weeks (until November). Live torpedograss growth was again harvested by clipping plants 4 inches above the soil surface, then harvested plant material was dried and

weighed. Following this second harvest, the dishpans were placed in a greenhouse and kept moist to evaluate survival of the initial 20 stems in each dishpan. Stems producing new growth were counted four weeks later (in December). Statistical analyses were conducted using analysis of variance, followed by means separation with the Duncan's multiple range test.

Results

Established torpedograss that had been slowly lowered into the water column over a three-week period grew at all water depths before the first harvest (Table 1). Growth at the depths of 0 and 0.5 feet were similar to one another and there was no difference in growth of plants held at depths of 1, 2 and 4 feet. Dry weights of plants grown at the 4-foot depth were less than weights of plants grown at depths of 0 or 0.5 feet but were not different from plants grown at 1 or 2-foot depths. Thus, it appears that established torpedograss can grow successfully in water depths of up to 4 feet if lowered into those depths over time (as



Figure 3. One of four floating rafts in the pond where dishpans planted with torpedograss were suspended at water depths of 0, 0.5, 1, 2 and 4 feet.

Table 1. Effect of water depth on growth of torpedograss cultured under one of five water depths. Harvest 1 is growth (g dry weight) of established plants and Harvest 2 is regrowth (g dry weight) from stems clipped for Harvest 1 and returned to their growing depth. Live shoots is the number of live stems four weeks after Harvest 2 (initial number of shoots = 20).

Water depth (ft)	Harvest 1 ^a	Harvest 2 ^b	Live shoots ^c
0 foot (surface)	180 ab	28 a	32 b
0.5 foot	234 a	41 a	63 a
1 foot	137 bc	5 b	28 b
2 feet	122 bc	< 1 c	9 c
4 feet	92 c	0 c	5 c

a Growth period 11 weeks (June-August) in a pond

b Growth period 12 weeks (August-November) in a pond

c Growth period 4 weeks (November-December) in a greenhouse

done before the first harvest), or in the field, if they are flooded slowly enough that some leaves are always above the water surface. The pond used in this study was only 4.5 to 5 feet deep so greater depths could not be evaluated; also, it is unclear whether an 11-week study is indicative of long-term growth at these depths.

The second harvest (in November) occurred 12 weeks after the plants were clipped and immediately (not gradually) placed back into their respective water depths. Torpedograss during this period produced much less growth, which is likely due at least in part to cooler fall temperatures. However, we found that regrowth of plants that were clipped and returned to water depths of 1 foot or deeper had much less growth than plants grown in moist soil (depth 0 feet) or at a water depth of 0.5 feet. There was essentially no new growth from plants held in 2 or 4 feet of water.

Some stems of plants held at these two greatest depths were noticeably discolored, brown or black at the time of the second harvest, when plants were moved into the greenhouse for the four-week grow-out period. After four weeks in the greenhouse, plants originally grown at depths of 2 or 4 feet produced significantly fewer new stems than plants originally grown at shallower depths. Recall that 20 stem sections were initially planted in each dishpan in April. Live stem counts in December (after two harvests and a four-week greenhouse grow-out period) clearly showed that new rhizome production occurred in plants

grown at the three shallowest depths, but there was no new rhizome or stem production in plants grown at 2- or 4-foot depths. In fact, between 50 and 75% of the original 20 stems planted in dishpans held at these depths completely died, which most likely occurred after the first harvest when the clipped plants were abruptly returned to their original water depths.

Another relevant observation was that plants growing at water depths greater than 1 foot had more stems and leaves infected by a fungal disease compared to plants growing at shallower depths. These diseases were ultimately identified as members of the genera *Fusarium* and *Phoma* and were later studied as potential biocontrol agents for torpedograss (Thayer and Haller 2000). The occurrence of these pathogens on plants growing in deeper water was likely the result of plant growth under less-than-optimal conditions, since subsequent studies found little to no occurrence of these pathogens on healthy plants.

It might seem that simply measuring the depths at which torpedograss takes root and grows in the field would easily provide answers to this question. However, as simple as it seems, these data do not define the maximum water depths at which torpedograss will take root and survive. Florida lake and canal levels rise and fall at least annually, so those measurements may not accurately predict torpedograss survival and establishment because this species (and likely many other emergent grasses) can certainly survive flooding

(recall harvest 1 data). Smith, Smart and Hanlon (2004) conducted extensive studies to predict the potential maximum coverage of torpedograss in the marshes of Lake Okeechobee, and like our study, they reported that established torpedograss can grow in water depths greater than 2 feet deep depending upon the rate of the rising water and length of inundation. They also planted stem sections in different water depths and also concluded that torpedograss will likely not take root and grow in static water that is maintained at a consistent depth of 2 feet. Based on their observations, they concluded that the spread of torpedograss in Lake Okeechobee occurs during low water periods (when water levels are < 20 inches deep) in plant beds under which growth and rhizome production are highest, but the plants can survive long, but undetermined, periods of inundation if water rises slowly enough to not completely cover mature plants.

The results of our studies, along with those conducted by Smith, Smart and Hanlon, strongly suggest that the rooting and growth of torpedograss is limited to moist soils with water depths of 2 feet or less when water levels are held static, but plants can survive in much deeper water for long periods of time if water levels rise slowly enough that plants are not totally inundated.

Paul L. Thayer is a retired Research Associate at the University of Florida. William T. Haller is Professor Emeritus and former Director of the Center for Aquatic and Invasive Plants at the University of Florida. Lyn A. Gettys is an Associate Professor of Agronomy at the University of Florida Ft. Lauderdale Research and Education Center.

Relevant references

- Smith DH, RM Smart and CG. Hanlon. 2004. Influence of water level on torpedograss establishment in Lake Okeechobee, Florida. *Lake and Reservoir Management* 20(1):1-13.
- Tarver DP. 1979. Torpedograss (*Panicum repens* L.). 1979. *Aquatics* 1(2):5-6.
- Thayer PL and WT Haller. 1990. Fungal pathogens, *Phoma* and *Fusarium*, associated with declining populations of torpedograss growing under high water stress. *Proceedings of the 8th International Symposium on Aquatic Weeds*, Uppsala, Sweden, pp. 209-214.



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***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.*

July 12-14

Midsouth Aquatic Plant Management Society (in conjunction with Aquatic Plant Management Society Annual Meeting)

New Orleans, LA

<http://www.msapms.org/conferences/2020/>

<http://www.apms.org/annual-meeting/2021-annual-meeting/>

August 16-19

University of Florida Aquatic Weed Control Short Course

Renaissance Sea World, Orlando

<https://conference.ifas.ufl.edu/aw/>

October 6-8

South Carolina Aquatic Plant Management Society Annual Meeting

Myrtle Beach, SC

<http://scapms.org/meetings.html>

November 15-17

Texas Aquatic Plant Management Society

Bryan, TX

<https://www.tapms.org/2021-annual-meeting/>

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