

**2018 Annual Conference of the
Texas Aquatic Plant Management Society**



Texas Aquatic Plant Management Society

**San Antonio, TX
November 26-27, 2018**

ABOUT THE TEXAS AQUATIC PLANT MANAGEMENT SOCIETY (TAPMS)

The TAPMS is a sub-unit of the Aquatic Plant Management Society—an international organization of scientists, educators, students, commercial pesticide applicators, administrators, and concerned individuals interested in the management and study of aquatic plants. The Texas Aquatic Plant Management Society consists of aquatic vegetation management professionals, companies, researchers, students, and Extension specialists dedicated to aquatic vegetation management issues in Texas. Our focus is informing youth and adults about aquatic vegetation management and preservation of natural aquatic environments, including control of invasive aquatic plant species and conservation and propagation of native aquatic plant species including rare or threatened species.

Webpage: <http://www.tapms.org>

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Special Acknowledgments: The 2018 Texas Aquatic Plant Management Society Annual Conference would not have been possible without the efforts of Bill Torres (TAPMS Executive Director), Tom Warmuth (vendor coordination), Joshua Flowers (4th Annual Golf Tournament organization), Kelly Duffie (audio-visual assistance), Zack Pritchard (student presentation judging coordination), Emily Griffith (Women of Aquatics meeting coordination), Carlton Layne / AERF (student presenter travel support), the TAPMS Board of Directors, and the many presenters and exhibitors who helped to make this conference an outstanding event. We are especially grateful for the support of our conference sponsors, which are acknowledged in this program.

Special thanks to our sponsors for making
Texas Aquatic Plant Management Society
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DAILY EVENTS-AT-A-GLANCE

See Agenda on the following pages for event times.

SUNDAY - NOVEMBER 25, 2018

Golf Tournament – *Sponsored by: WinField United (Diamond Sponsor)*
Conference Early Check-In and Onsite Registration
“Unofficial” Cocktail Hour (El Colegio - Hotel Bar)

MONDAY - NOVEMBER 26, 2018

Morning

TAPMS Pre-Conference Board of Directors Meeting & Work Session
Exhibits Setup
Conference Check-In and Onsite Registration

Afternoon

Meeting Opens – President’s Welcome – Diamond Sponsor Welcome – APMS Update - General Session
TAPMS Annual Business Meeting
Presidents’ Reception -- *Sponsored by: WinField United (Diamond Sponsor),
Applied Biochemists (Platinum Sponsor)*

TUESDAY - NOVEMBER 27, 2018

General Session (Adjourns – 5:10 p.m.)
Luncheon – *Sponsored by: WinField United (Diamond Sponsor), Applied Biochemists (Platinum Sponsor),
Syngenta (Gold Sponsor), Outdoor Water Solutions (Gold Sponsor),
UPI (Gold Sponsor)*
Pesticide Applicators Receive CEU Certificates
Women of Aquatics Meeting
Awards Banquet - TAPMS Awards Presentations & Election Results –
Sponsored by: WinField United (Diamond Sponsor)
Closing Cocktail Hour

WEDNESDAY - NOVEMBER 28, 2018 (POST-CONFERENCE EVENTS)

Post-Conference Board Meeting

*Breaks sponsored by: WinField United (Diamond Sponsor), Applied Biochemists (Platinum Sponsor),
Syngenta (Gold Sponsor), Outdoor Water Solutions (Gold Sponsor), UPI (Gold Sponsor), and
Key Colour (Break Sponsor)*

AGENDA-AT-A-GLANCE

SUNDAY - NOVEMBER 25, 2018

- 1:00 PM - 9:00 PM 5th Annual TAPMS Golf Tournament (*The Quarry Golf Course*)
4:00 PM - 6:00 PM Conference Early Check-In and Onsite Registration (*Iberian Foyer*)
4:00 PM - 6:00 PM “Unofficial” Cocktail Hour (*El Colegio - Hotel Bar*)

MONDAY - NOVEMBER 26, 2018

- 8:00AM - 11:00 AM Pre-Conference Board Meeting/Work Session (*Board Room*)
8:00AM - 12:00 PM Exhibits Set-up (*Iberian Ballroom*)
11:00 AM - 1:00 PM Conference Check-In and Onsite Registration (*Iberian Foyer*)
1:00 PM – 3:20 PM President’s Welcome & Session 1: Updates & Overviews (*Iberian Ballroom*)
3:20 PM - 3:40 PM Afternoon Refreshment Break & Raffle (*Iberian Ballroom*)
3:40 PM - 5:00 PM Session 2: Chemical Control Innovations & Research (*Iberian Ballroom*)
5:30 PM - 6:15 PM 2018 TAPMS Business Meeting (*Iberian Ballroom*)
6:30 PM - 8:30 PM President’s Reception (*El Capistrano*)

TUESDAY - NOVEMBER 27, 2018

- 7:00 AM - 8:00 AM Conference Check-In and Onsite Registration (*Iberian Foyer*)
7:30 AM - 8:30 AM Continental Breakfast (*Iberian Ballroom*)
8:00 AM - 10:00 AM Session 3: Herbicide Application Techniques (*Iberian Ballroom*)
10:00 AM - 10:20 AM Morning Refreshment Break (*Iberian Ballroom*)
10:20 AM - 12:00 PM Session 4: Tools & Technology (*Iberian Ballroom*)
12:00 PM - 1:10 PM Luncheon (*Iberian Ballroom*)
1:10 PM - 3:10 PM Session 5: Aquatic Plant Ecology & Restoration (*Iberian Ballroom*)
3:10 PM - 3:30 PM Afternoon Refreshment Break & Raffle (*Iberian Ballroom*)
3:30 PM – 5:10 PM Session 6: Integrated Pest Management Strategies & Research (*Iberian Ballroom*)
5:10 PM - 5:30 PM TDA Applicators – CEU Certificates (*Iberian Ballroom*)
5:15 PM - 6:00 PM Women of Aquatics Meeting (*El Colegio - Hotel Bar*)
6:30 PM – 8:00 PM Banquet Dinner & Awards (*Concepción*)
8:00 PM – 9:00 PM Closing Cocktail Hour (*El Capistrano*)

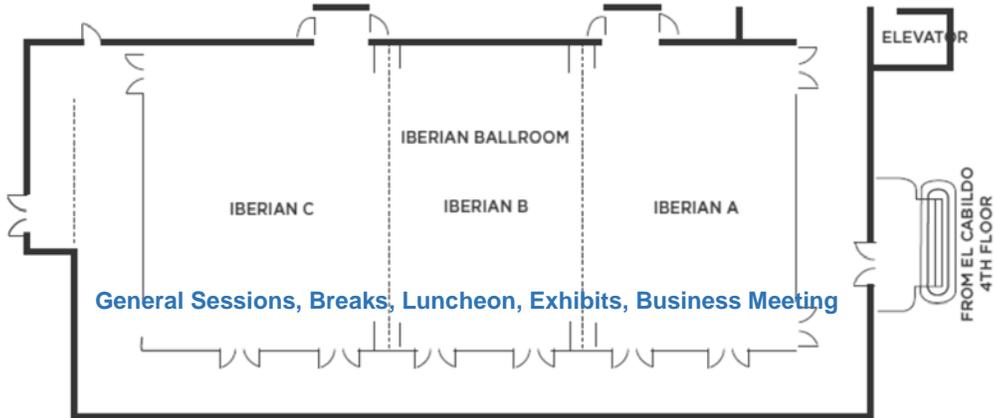
WEDNESDAY - NOVEMBER 28, 2018 (POST-CONFERENCE EVENTS)

- 9:30AM - 11:00 PM Post-Conference Board Meeting (*Board Room*)

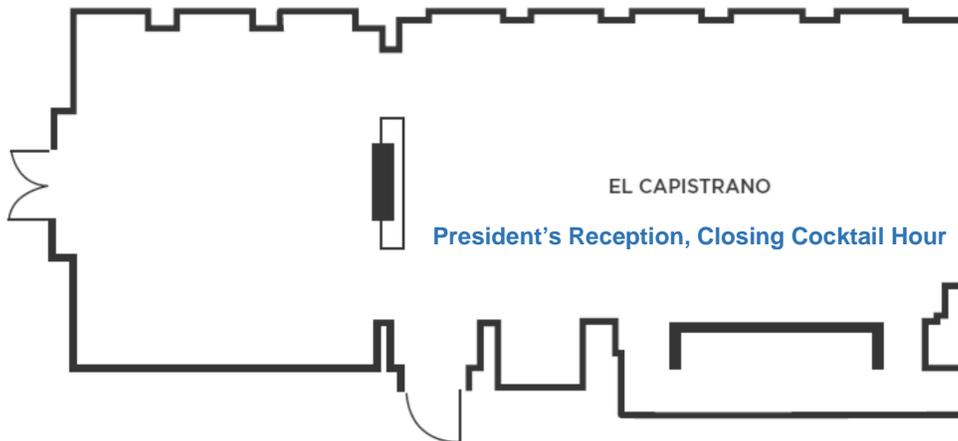
SITE INFORMATION & MAP

Omni La Mansion Del Rio
112 College St., San Antonio, TX
Phone: (210) 518-1000

La Mansion del Rio Fifth Level_Part II



La Mansion del Rio First Level



La Mansion del Rio Second Level

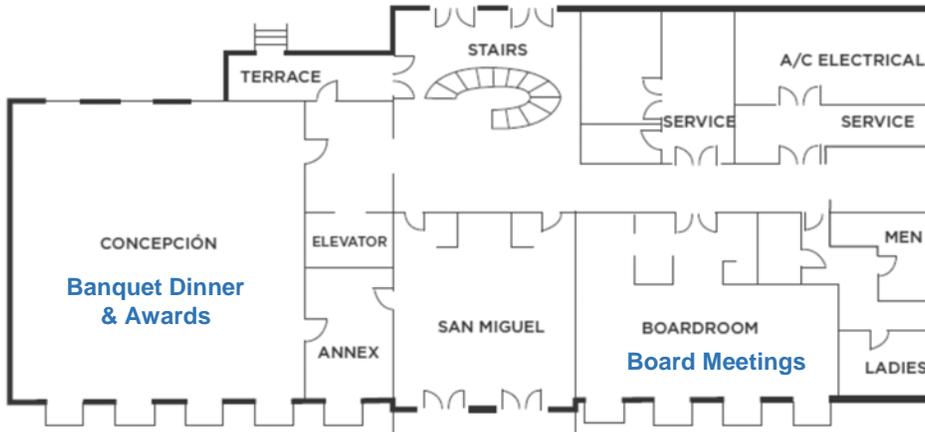


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DETAILED EVENTS INFORMATION

GOLF TOURNAMENT: *Sunday, November 25, 1:00 pm to 9:00 pm, The Quarry Golf Course*

The 5th Annual TAPMS Golf Tournament will be held at The Quarry Golf Course, 444 E. Basse Rd., San Antonio, TX. *Sponsored by: WinField United (Diamond Sponsor)*

PRESIDENT'S RECEPTION: *Monday, November 26, 6:30 pm to 8:30 pm, El Capistrano*

Join your TAPMS friends and colleagues at the Presidents' Reception to network and socialize while enjoying hors d'oeuvres and beverages. The President's Reception is open to all registered attendees. Non-registered guests may purchase tickets at the meeting registration desk.

Sponsored by: WinField United (Diamond Sponsor), Applied Biochemists (Platinum Sponsor)

ANNUAL BUSINESS MEETING: *Monday, November 26, 5:30 pm to 6:15 pm, Iberian Ballroom*

All TAPMS members are encouraged to attend the TAPMS Annual Business Meeting for Society updates.

WOMEN OF AQUATICS MEETING: *Tuesday, November 27, 5:15 pm to 6:00 pm, El Colegio – hotel bar*

Emily Griffith will host a TAPMS Women of Aquatics meeting to discuss issues and opportunities for women in the field of aquatic plant management, science, and industry. This will be an informal, networking get-together. Please contact Emily (emily@sprayco.us) prior to the event to confirm your attendance.

BANQUET DINNER & AWARDS: *Tuesday, November 27, 6:30 pm to 8:00 pm, Concepción*

Registered attendees are invited to attend the Awards Banquet. During/after dinner, we will recognize those who have served TAPMS, welcome new officers and directors, and present this year's student presentation award and scholarship recipients. *Sponsored by: WinField United (Diamond Sponsor)*

CLOSING COCKTAIL HOUR: *Tuesday, November 27, 8:00 pm to 9:00 pm, El Capistrano*

Bid farewell to your TAPMS friends and colleagues at the closing social while enjoying beverages. The President's Reception is open to all registered attendees. Non-registered guests may purchase tickets at the meeting registration desk.

BREAKS SPONSORED BY: *WinField United (Diamond Sponsor), Applied Biochemists (Platinum Sponsor), Syngenta (Gold Sponsor), Outdoor Water Solutions (Gold Sponsor), UPI (Gold Sponsor), and Key Colour (Break Sponsor)*

DETAILED AGENDA

* Indicates student presentation.

^{CEU} indicates attendance credit of 1.0 CEU except in session 6 each is 1/3 CEU (pending TDA confirmation)

SUNDAY - NOVEMBER 25, 2018

- 1:00 PM - 9:00 PM 5th Annual TAPMS Golf Tournament (*The Quarry Golf Course*)
Sponsored by: WinField United (Diamond Sponsor)
- 4:00 PM - 6:00 PM Conference early check-in and onsite registration (*Iberian Foyer*)
- 5:00 PM – 7:00 PM Unofficial” cocktail hour (*El Colegio - Hotel Bar*)

MONDAY - NOVEMBER 26, 2018

- 8:00AM - 11:00 AM Pre-conference board meeting/work session (*Board Members; Board Room*)
- 11:00 AM - 1:00 PM Conference check-in and onsite registration (*Iberian Foyer*)

Monday General Session (*Iberian Ballroom*)

- 1:00 PM - 1:15 PM President's welcome
(*Brad Vollmar; Vollmar Pond & Lake Mgmt., TAPMS President*)
- 1:15 PM - 1:25 PM Welcome from Diamond Sponsor, WinField United, and update on research & operations related to aquatic plant management (*Chris Smith; WinField United*)

Session 1: Updates & Overviews (Moderator: Brad Vollmar)

- 1:25 PM - 1:40 PM Aquatic Plant Management Society update (*Craig Aguillard; APMS*)
- 1:40 PM - 2:30 PM ^{CEU} Overview and updates on state & federal laws and regulations
(*Carlton Layne; Aquatic Ecosystem Restoration Foundation*)
- 2:30 PM - 3:20 PM ^{CEU} Statewide integrated pest management of aquatic and riparian invasive species
(*John Findeisen & Monica McGarrity; Texas Parks & Wildlife Department*)
- 3:20 PM - 3:40 PM Afternoon Refreshment Break; Applicators complete 2 CEU roster for Session 1

Session 2: Chemical Control Innovations & Research (Moderator: Jason Chapman)

- 3:40 PM - 4:00 PM Technical overview of successful use patterns with ProcettaCOR and Galleon aquatic herbicides for control of major invasive aquatic plants found in Texas
(*Mark Heilman; SePro Corporation*)
- 4:00 PM - 4:20 PM AMP® Activator a new adjuvant for aquatic plant management
(*Doug Pullman, Ph.D., William Ratajczyk & Paul Westcott; Applied Biochemists*)
- 4:20 PM - 4:40 PM * Torpedograss control via submersed applications of systemic and contact herbicides
(*Gray Turnage; Mississippi State University*)

MONDAY - NOVEMBER 26, 2018

Session 2: Chemical Control Innovations & Research (Continued)

4:40 PM - 5:00 PM * Chemical control of the floating aquatic plants common duckweed (*Lemna minor* L.) and watermeal (*Wolffia* spp.)
(Gray Turnage; Mississippi State University)

Monday Post-Session Events

5:30 PM - 6:15 PM 2018 TAPMS business meeting (*Iberian Ballroom*)

6:30 PM - 8:30 PM President's reception (*El Capistrano*)
*Sponsored by: WinField United (Diamond Sponsor),
Applied Biochemists (Platinum Sponsor)*

TUESDAY - NOVEMBER 27, 2018

7:00 AM - 8:00 AM Conference check-in and onsite registration (*Iberian Foyer*)

7:30 AM - 8:30 AM Continental breakfast (*Iberian Ballroom*)

Tuesday General Session (*Iberian Ballroom*)

8:00 AM - 8:15 AM Welcome & announcements
(Brad Vollmar; Vollmar Pond & Lake Mgmt., TAPMS President)

8:15 AM - 8:20 AM Welcome from Platinum Sponsor, Applied Biochemists, and update on research & operations related to aquatic plant management. (Paul Westcott; Applied Biochemists)

Session 3: Herbicide Application Techniques (Moderator: Stan Smith)

8:20 AM - 9:10 AM ^{CEU} Pump Selection and Sprayer Calibration
(George Howell, Springer Spray Systems)

9:10 AM - 10:00 AM ^{CEU} Drift minimization: maximizing your chemical investment... When bad things happen to good droplets! (Chris Smith; WinField United)

10:00 AM - 10:20 AM Morning Refreshment Break; Applicators complete 2 CEU roster for Session 3

Session 4: Tools & Technology (Moderator: Kristy Kollaus)

10:20 AM - 10:40 AM The drones are coming! Aerial application of herbicide
(Lucia Marshall, Ph.D.; Biosorb, Inc.)

10:40 AM - 11:00 AM * Consumer-available sUAS (small Unmanned Aircraft Systems) for macrophyte mapping and management
(Andrew Howell & Robert J. Richardson; North Carolina State University)

TUESDAY - NOVEMBER 27, 2018

Session 4: Tools & Technology (Continued)

- 11:00 AM - 11:20 AM * Incorporating advanced robotics into aquatic plant management: development of an autonomous aquatic application system (*Andrew W. Howell, Robert J. Richardson, Greg Buckner, Scott Ferguson, Staphan Jernigan, Steve T. Hoyle, and Justin J. Nawrocki; North Carolina State University*)
- 11:20 AM - 11:40 AM Management of aquatic plants and ecosystems: an update on tools and resources (*Todd Sink, Ph.D.; Texas A&M University – AgriLife Extension*)
- 11:40 AM - 12:00 PM The Role of Citizen Science in Aquatic Invasive Species Monitoring and Management in Texas (*Hans Landel, Ph.D.; Lady Bird Johnson Wildflower Center & Texasinvasives.org*)
- 12:00 PM - 1:10 PM Luncheon (Iberian Ballroom)
Sponsored by: WinField United (Diamond Sponsor), Applied Biochemists (Platinum Sponsor), Syngenta (Gold Sponsor), Outdoor Water Solutions (Gold Sponsor), UPI (Gold Sponsor)

Session 5: Aquatic Plant Ecology & Restoration (Moderator: Melani Howard)

- 1:10 PM - 1:35 PM Growth and interactions of *Hygrophila polysperma* and *Ludwigia repens* grown in saturated soil and shallow water in no flow conditions (*Jeff Hutchinson, Ph.D.; University of Texas - San Antonio*)
- 1:35 PM - 2:00 PM * Growth rates and photosynthesis characteristics of knotgrass (*Paspalum distichum*) (*Tiffany Fogel & Jeff Hutchinson, Ph.D.; University of Texas - San Antonio*)
- 2:00 PM - 2:20 PM Depth Effect on Germination and Growth of Texas Wild Rice (*Christopher R. Hathcock & Leah Murray; U.S. Fish and Wildlife Service*)
- 2:20 PM - 2:40 PM * Evaluating phenological patterns in rates of nitrogen removal and re-release among three mat-forming invasive aquatic plants (*Autumn Dunn, Mississippi State University*)
- 2:40 PM - 3:00 PM Aquatic plant nursery operations and restoration techniques (*Andrew Labay; Southwest Aquatic Services*)
- 3:00 PM - 3:10 PM Announcements (*Brad Vollmar; Vollmar Pond & Lake Mgmt., TAPMS President*)
- 3:10 PM - 3:30 PM Afternoon Refreshment Break; Applicators complete 1 CEU roster for Session 6

TUESDAY - NOVEMBER 27, 2018

Session 6: Integrated Pest Management Strategies & Research (Moderator: Tom Warmuth)

- 3:30 PM - 3:50 PM *CEU* Invasive, Exotic Plant Removal in the Texas Hill Country and Beyond
(Eric Ruckstuhl; EBR Enterprises)
- 3:50 PM - 4:10 PM *CEU* Where do the small-leaf forms of giant salvinia come from?
(Shiyu Li, Ph.D.; Stephen F. Austin State University)
- 4:10 PM - 4:30 PM *CEU* *Cyrtobagous salviniae* (salvinia weevil) and its role in salvinia control in Texas
(Thomas Decker, Texas Parks & Wildlife Department)
- 4:30 PM - 4:50 PM Management of problematic native aquatic vegetation to enhance multi-user benefits in
southeastern waterbodies (Kennedy Calhoun, * Gray Turnage & Gary Ervin; Mississippi
State University)
- 4:50 PM - 5:10 PM Conference Final Address
(Brad Vollmar; Vollmar Pond & Lake Mgmt., TAPMS President)
- 5:10 PM - 5:30 PM Applicators receive CEU certificates

Tuesday Post-Session Events

- 5:15 PM - 6:00 PM Women of Aquatics Meeting (*El Colegio - Hotel Bar*)
- 6:30 PM – 8:00 PM Banquet Dinner & Awards (*Concepción*)
Sponsored by: WinField United (Diamond Sponsor)
- 8:00 PM – 9:00 PM Closing Cocktail Hour (*El Capistrano*)

WEDNESDAY - NOVEMBER 28, 2018

Post-Conference Events

- 9:30AM - 11:00 PM Post-Conference Board Meeting (*Board Room*)

PRESENTATION ABSTRACTS

Abstracts are listed alphabetically by **presenting / first author** last name.

* Indicates student presenter

^{CEU} indicates attendance credit of 1.0 CEU except in session 6 each is 1/3 CEU (pending TDA confirmation)

Aquatic Plant Management Society update

Aguillard, Craig

Aquatic Plant Management Society

Originally the Hyacinth Control Society when founded in 1961, The Aquatic Plant Management Society, is a respected source of expertise in the field of biological, mechanical and chemical aquatic plant and algae management. The Society has grown to include seven regional chapters. Through these affiliates, annual meetings, newsletters, and the Journal of Aquatic Plant Management, members are kept abreast of the latest developments in the aquatic plant and algae management field. APMS undertook Strategic Planning exercises in 2017, inviting key participants from Regional Chapters. This effort resulted in adding algae management to the Society's Vision and Mission Statements as well as developing comprehensive financial, outreach, and sustainability plans. The results as well as the planning process relevant to TAPMS will be discussed. This presentation will provide a summary of scientific, operational and educational materials provided by APMS for aquatic plant managers as well as TAPMS and Chapter members. A brief update will be provided on the 2018 Annual Meeting held in Buffalo, NY.

***Management of problematic native aquatic vegetation to enhance multi-user benefits in southeastern waterbodies**

Calhoun, Kennedy, Gray Turnage & Gary Ervin

Mississippi State University

Biologists at the Noxubee National Wildlife Refuge (NNWR; Starkville, MS) have identified the dominance of four problematic native aquatic plants (*Nelumbo lutea*, *Nymphaea odorata*, *Brassenia schreberi*, *Limnobiium spongia*) as a significant obstacle to achieving lake management objectives. Unfortunately, there are few methods known that allow the control of these problematic aquatic plant species while also maintaining water quality and promoting diverse aquatic habitats. To address this need, we set up a mesocosm trial to evaluate six systemic herbicides and one contact herbicide (at two dosage levels each) for ability to control these four target species. Herbicides were applied in early August, after providing the plants approximately one month to establish and acclimate to experimental conditions. During the first three weeks after treatment (WAT), we have observed rapid response to some of the herbicides and dosages being evaluated. Thus far, all three modes of action included in the study have shown at least 50 percent mortality on all four of the species included in the study, with only two chemical × species combinations not yet reaching 50 percent mortality. In fact, 2,4-D, Glyphosate, Triclopyr, and Flumioxazin had caused 50 percent mortality of *Nelumbo lutea*, *Nymphaea odorata*, and *Brassenia schreberi* during the first week, with the high dose of 2,4-D and both Triclopyr dosages reaching 50 percent mortality of *Limnobiium spongia* within the first WAT. Treatments showing the highest levels of persistent control after six months will be field tested on lakes at NNWR during 2019.

^{CEU} ***Cyrtobagous salviniae* (salvinia weevil) and its role in salvinia control in Texas**

Thomas Decker

Texas Parks & Wildlife Department

The Texas Parks and Wildlife Department's integrated pest management (IPM) approach aims to control invasive aquatic plants through a combination of chemical, mechanical, and biological control. While chemical control (i.e. herbicide application) is TPWD's main means of controlling invasive aquatic plants, biological control is an important part of the strategy. TPWD raises and releases large numbers of salvinia weevils (*Cyrtobagous salviniae*) to help control giant salvinia (*Salvinia molesta*) in Texas's infested water bodies. This presentation gives an overview of the salvinia weevil as a biological control organism and TPWD's weevil program.

***Evaluating phenological patterns in rates of nitrogen removal and re-release among three mat-forming invasive aquatic plants**

Dunn, Autumn

Mississippi State University

Nitrogen runoff from agriculture is a significant environmental concern that not only causes water quality degradation (i.e., eutrophication) but also can create conditions conducive to invasion of aquatic habitats by invasive plant species. In many instances in the southeastern US, areas are not invaded by a single nuisance species, but often mixtures of two or three species that may interact synergistically to dominate the invaded habitat. Despite these issues, there is little research on the relationships between many invasive aquatic plant species and water quality parameters, such as nitrogen concentration, in invaded systems. This study will investigate the interaction between nitrogen loading and growth and establishment of three mat-forming invasive aquatic plant species, alone and in mixtures, as well as the ensuing removal (and potential re-release) of nitrogen by established plant stands. We will quantify plant growth and development throughout the growing season, under a gradient of water column nitrogen concentrations. Results from this work should have implications for the management of invasive plant populations, in the context of potential cascading effects of management actions on local water quality.

^{CEU} **Statewide integrated pest management of aquatic and riparian invasive species**

Findeisen, John & Monica McGarrity

Texas Parks & Wildlife Department

This presentation will provide an update on Texas Parks and Wildlife Department's aquatic vegetation and invasive species management efforts in Fiscal Year 2018 (Sept. 2017 – Aug. 2018), with a focus on implementation of an Integrated Pest Management (IPM) strategy. Texas' IPM strategy employs a combination of prevention, herbicide treatments, biological control efforts, and outreach for not only prevention but also to promote environmental stewardship (e.g., enhancing creek health) and involvement in citizen science monitoring efforts. Early Detection and Rapid Response (EDRR) capacity is vital to efforts to monitor for new infestations of the most problematic species such as giant salvinia (*Salvinia molesta*) and zebra mussels (*Dreissena polymorpha*) and mount a rapid response when feasible. Management efforts continue to focus on floating, aquatic invasive plants and riparian invasive plants that crowd or shade out native plants, degrade habitat for fish and wildlife, and inhibit boater access. Management of aquatic and riparian invasive species using an IPM approach plays a key role in conserving Species of Greatest Conservation Need (SGCN) and providing hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

*** Growth rates and photosynthesis characteristics of knotgrass (*Paspalum distichum*)**

Fogel, Tiffany & Jeff Hutchinson, Ph.D.

University of Texas - San Antonio

Knotgrass (*Paspalum distichum*) is a native perennial grass that occurs infrequently in the San Antonio River. This species has a widespread native distribution ranging from the southern half of the United States into Chile and Argentina, and has been introduced into parts of Africa, Asia, and Europe. Knotgrass is an amphibious creeping perennial that produces new shoots at nodes and exhibits indeterminate growth. The UTSA Department of Environmental Science and Ecology is evaluating knotgrass for planting in the San Antonio River to increase habitat diversity within the river. A greenhouse experiment was conducted during the summer of 2018 to evaluate growth rates of knotgrass propagated from apical tips over 0-6 weeks and 12 weeks. Plants were propagated from 20 cm apical tips in the UTSA greenhouse. Each week, 16 plants were measured for shoot and root length, number of leaves and shoots, flowers, and leaf and root area. Following measurements, plants were harvested for root and shoot dry weight biomass. An additional 16 plants were evaluated at 12 weeks. Gas exchange rates for knotgrass were evaluated to determine its photosynthesis characteristics. The objectives of this study were to evaluate asexual propagation by apical tips, growth rates, and basic life history characteristics of knotgrass. The study results will be presented at the conference.

Depth Effect on Germination and Growth of Texas Wild Rice

Hathcock, Christopher R. & Leah Murray

U.S. Fish and Wildlife Service

Zizania texana is a federally endangered aquatic macrophyte restricted to the first 4.3 km of the spring-fed, thermally constant San Marcos River in San Marcos, TX, USA, where it occurs in both shallow, low velocity and deep, high-velocity water. The optimal depth for germination and early seedling growth of *Z. texana* is unknown. Further, although viable seeds and vegetative reproductive parts are frequently observed in the wild, their ability to become established at the site to which they are dispersed may be limited by the water's depth at that site. Understanding this influence would allow more effective restoration-site selection and management, as well as greater productivity in the greenhouse. We measured germination and early growth of *Z. texana* at three distances from the water surface (64 cm, 38 cm, and 14 cm) under controlled conditions in 3,400 L fiberglass aquaculture tanks. Among all depths, germinability ranged from 33.3 to 62.5% and mean germination time ranged from 9.2 to 54.2 days (N = 72). We detected no significant difference in germinability, mean germination time, germination time variability, or uncertainty of the germination process among water depths (one-way ANOVA; $P \geq 0.05$); however, compared to plants at each of the other two levels, average longest-leaf growth and mean absolute biomass was greater in deeper plants. Results suggest that, under our experimental conditions, *Z. texana* exhibits similar germination rates at various depths but develops greater vegetative growth in deeper water. Therefore, increasing the water depth at which plants are propagated could aid in producing larger, more robust plants prior to their transplantation into restoration sites. Larger transplants would likely have greater establishment success compared to smaller transplants. Also, unlike smaller transplants, they could be effectively transplanted into deeper parts of the river, which afford better protection from catastrophic events and recreational activities.

Technical overview of successful use patterns with ProcellaCOR and Galleon Aquatic Herbicides for control of major invasive aquatic plants found in Texas

Heilman, Mark

SePro Corporation

The habitat quality and water uses of aquatic ecosystems in Texas are challenged by a variety of invasive aquatic plants including hydrilla, giant salvinia, floating hearts, and many more. Improved management strategies for these invasive species should seek to increase longevity of control, improve selectivity of control to promote native aquatic vegetation, and reduce herbicide discharge and overall environmental risk. The USEPA reduced-risk herbicides ProcellaCOR® (a.i. florypyrauxifen-benzyl) and Galleon SC (a.i. penoxsulam) have a weed control spectrum well-suited for control efforts in Texas. Registered earlier this year, ProcellaCOR has unique, low-rate, short-exposure systemic activity, provides a new mode of action for spot/partial treatment of hydrilla and provides excellent control of floating hearts, alligatorweed, invasive primrose, nuisance American lotus, water hyacinth, and several other problem species. Since its recent registration, ProcellaCOR has been adopted as an alternate management strategy in many public and private US sites. This technical presentation will review ProcellaCOR control outcomes, non-target plant responses, and recommended combination strategies for Texas managers. Since 2007, Galleon SC has been a useful tool for managers of aquatic invasive plants and other nuisance vegetation. Galleon has high activity on floating aquatic weeds such as giant salvinia and water hyacinth and has shown excellent large-scale control outcomes on these species when used for in-water treatment. While there are strong foliar uses of Galleon on these target plants, often in combinations with PPO herbicides like Stingray (a.i. carfentrazone-ethyl), the most compelling uses of Galleon on plants like giant salvinia utilize in-water exposures of up to several months for notably more thorough control outcomes than can be achieved with any scale of foliar spray operations. This presentation will review some of the latest field outcomes of Galleon treatment of giant salvinia, assess the overall status of giant salvinia management and provide perspectives on improved, near-future strategies.

*** Consumer Available sUAS (Small Unmanned Aircraft Systems) for Macrophyte Mapping and Management**

Howell, Andrew & Robert J. Richardson

North Carolina State University, Crop and Soil Science

Invasive exotic macrophytes, such as *Hydrilla verticillata* and *Salvinia molesta*, often have undesirable effects on native aquatic ecology and the associated local economy within invaded regions. It is well accepted that timely monitoring and efficient mapping strategies are essential for evaluating native and exotic aquatic vegetation, and also provide management direction for rapid response or gauge management effort success. While many aquatic plant survey techniques are well-established, most assessments require a skilled workforce and there is often subjectivity among surveyors which can lower survey accuracy and efficiency. Likewise, these methods require considerable labor and time inputs, as the extent of waterway evaluations are correlated with the precision, spatial coverage, and duration spent evaluating each monitoring location. The recent popularity of low-cost off-the-shelf sUAS platforms generate multiple paths for aquatic plant researchers and managers to explore. In addition to providing a platform for small optical imagers, sUAS potentially provide opportunities to remotely deliver herbicide applications. This research describes the use of consumer available sUAS to summarize varying macrophyte components among waterways in North Carolina and New Zealand and discuss how unmanned equipment may be incorporated in treatment programs and post-treatment monitoring.

*** Incorporating Advanced Robotics into Aquatic Plant Management: Development of an Autonomous Aquatic Application System**

Howell, Andrew¹, Robert J. Richardson¹, Greg Buckner², Scott Ferguson², Staphan Jernigan², Steve T. Hoyle¹, & Justin J. Nawrocki³

¹North Carolina State University, Crop and Soil Sciences

²North Carolina State University, Mechanical and Aerospace Engineering

Aquatic vegetation surveys and aquatic herbicide applications are integral components of vegetation management programs that protect water resources. However, surveys and herbicide applications can be labor intensive and provide opportunities for introducing cost saving measures. The goal of this project was to design, prototype, and demonstrate a small fleet of autonomous aquatic vehicles (AAVs) capable of detecting, quantifying, and selectively applying herbicide to manage invasive aquatic weed infestations. To date, three AAVs have been developed to evaluate performance, durability, and operational capacity. Field testing of these units has been conducted. Utilization of a trolling motor provided approximately 9x increased thrust over an air propeller and also improved turning radius. Incorporation of a lithium iron phosphate battery significantly reduced weight and increased carrying capacity while also allowing for rapid charging. Autonomous tracking of two AAVs concurrently has been implemented and demonstrated. Successful collection of hydroacoustic data as well as herbicide application through the AAVs has also been verified. Further research is being conducted to optimize the current systems prior to commercialization.

^{CEU} **Pump Selection and Sprayer Calibration**

Howell, George

Stinger Spray Systems

This presentation will provide expert insights on a variety of technical topics related to sprayer selection, maintenance, and calibration. Topics will include (1) how a pump works (positive displacement, passive pump systems, bypass systems, and pressure switch systems), (2) how to select a pump (power supply, application distance, delivery method, tank size, type of chemical, and maintenance cost), (3) maintenance of piston, diaphragm, roller, and centrifugal pumps, and (4) calibration techniques (flow and travel speed calculations and compliance with label requirements).

Growth and interactions of *Hygrophila polysperma* and *Ludwigia repens* grown in saturated soil and shallow water in no flow conditions

Hutchinson, Jeff, Ph.D.

University of Texas - San Antonio

Ludwigia repens and *Hygrophila polysperma* are perennial macrophytes with similar morphologies belonging to different families. Both species are present in aquatic systems in Texas and Florida. *Hygrophila polysperma* is a non-native, invasive species in rivers, lakes and ruderal sites in Texas and Florida. *Ludwigia repens* is native to the southern portion of the United States and is widespread in Texas. In San Marcos and Comal springs, the two species are often found in the same habitat but *H. polysperma* is dominant. In other spring runs where *H. polysperma* is not present, *L. repens* occurs sparsely and is not dominant. No study has examined interactions between the two species grown in saturated soil with water depths < 0.05 cm and shallow water at water depths of 18 cm under no flow conditions. This study evaluated the interaction of the two species grown at ratios of 0:1, 1:0, 1:1, 1:2, 2:1, 2:2, 1:4, and 4:1 for 5 weeks with six replicates per treatment. The study was performed during June-July 2017 and repeated August-September 2017. Variables measured at 5 weeks included root and shoot dry-weights, root-to-shoot ratios, and relative growth rates. Photosynthesis measurements were made on emergent leaves of five random plants per species for each treatment between weeks 3 to 5 to evaluate each species'

Hutchinson, Jeff, Ph.D. (Continued)

tolerance to various levels of photosynthetically active radiation. The results of the study will be presented at the conference.

Aquatic plant nursery operations and restoration techniques

Labay, Andrew

Southwest Aquatic Services

Native plants play an important ecological role in aquatic ecosystems and can be an integral part of the lake management industry. Family-owned Southwest Aquatic Services, includes a licensed wetland plant nursery and is experienced in the use of native emergent plants in a variety of projects ranging from mitigation to enhancing pond aesthetics. This presentation will discuss experiences with the role of native emergent plants in our industry and the ups and downs of the wetland plant market in Texas. Additional topics will include Texas' permitting and treatment proposal requirements related to restoration work.

The Role of Citizen Science in Aquatic Invasive Species Monitoring and Management in Texas

Landel, Hans, Ph.D.

Lady Bird Johnson Wildflower Center & Texasinvasives.org

Monitoring and managing invasive species is a huge task, one that is much larger than what local and state agencies can perform on their own. Enlisting citizen scientists to help is a good way to extend the agencies' abilities. This presentation will describe two citizen science programs of Texasinvasives.org, a program that address many aspects of the invasive species problem in Texas. Invaders of Texas is a 13-year program designed to train citizen scientists to identify and report the locations of invasive plants in Texas. Their verified reports become part of an online database that is searchable, downloadable, mappable online, and is part of the national Early Detection and Distribution Mapping System (EDDMapS) database. The Sentinel Pest Network is an early detection and rapid response (EDRR) program designed to train citizen scientists to identify and report the locations of species of high regulatory significance in Texas. Their reports are sent to taxonomic experts and natural resource managers who verify the report and respond accordingly.

^{CEU} Overview and Updates on State & Federal Laws and Regulations

Layne, Carlton

Aquatic Ecosystem Restoration Foundation

This presentation will provide valuable information on laws and regulations governing our industry, including pesticide use/misuse, the safe use of pesticides, Federal Government standards, NPDES/WOTUS updates, and label changes and warnings.

^{CEU} Where do the small-leaf forms of giant salvinia come from?

Li, Shiyu, Ph.D.

Stephen F. Austin State University

Giant salvinia (*Salvinia molesta*) is known to have primary, secondary, and tertiary growth forms, which are also commonly hypothesized as growth stages. The identification of these forms is primarily based on the size and folding status of the floating leaves. However, we identified 12 forms in the greenhouse and the field. Our experiments showed that the folding of floating leaves is a reversible trait dependent on water access. The floating leaves quickly fold in response to water shortage, reducing water loss and needs, decreasing growth, and avoiding damage to trichomes (i.e., leaf hairs). The leaves reopen to allow

Li, Shiyou, Ph.D. (Continued)

trichomes repel water and enhance growth when having adequate water supply. Larger secondary or tertiary forms do not produce small-leaf primary forms without high intensity stress. These results do not support the hypothesis that three growth forms represent sequential growth stages. The abnormal small-leaf forms are the result of endocide-induced autotoxicity and some of them never grow into other forms. The development of abnormal forms and reversible leaf folding strategy in response to high stress along with rapid asexual reproduction are major adaptive traits contributing to the invasiveness of *S. molesta*.

The Drones are Coming! Aerial Application of Herbicide

Marshall, Lucia, Ph.D.

Biosorb, Inc.

With climate change, more algae and invasive aquatic species are entering our water resources. New technology using low toxicity, biological products, and drones are the upcoming smart way to manage waterways. Dr. Marshall will review the current chemistry and biological products available for aquatic management, as well as, the advantages of using the current drone technology.

AMP® Activator a New Adjuvant for Aquatic Plant Management

Ratajczyk, William

Applied Biochemists

AMP® Activator is a new patent-pending adjuvant that combines proteins and surfactants to improve control of both aquatic vascular plants and algae. The use rate of the adjuvant in combination with aquatic herbicides and algaecides is density dependent and ranges from 0.25 gal/acre to 1 gal/acre. In small scale aquaria trials on Eurasian watermilfoil (*Myriophyllum spicatum*) using an 8 hr exposure it was observed that the LC50 for Eurasian watermilfoil treated with 2,4-D alone was 0.77 mg/L ($r^2=0.91$). When AMP® Activator was added to the 2,4-D treatments the LC50 was decreased to 0.34 mg/L ($r^2=0.87$). AMP® Activator resulted in the reduction in exposure time needed to control hybrid watermilfoil with of 2,4-D. When 2,4-D was applied alone it required at least 24 h of exposure time, however only 12 h was needed when AMP® Activator was added to the treatment. Algal Challenge Test (ACT) results demonstrated that AMP® Activator applied to *Lyngbya* from Lake Gaston, NC first followed 2 days later by Algimycin® PWF elicited the greatest response among algaecide treatments. Additionally, *Anabaena* sp. And *Aphanizomenon* sp. subjected to an ACT resulted in the recommendation of 0.5 gal/acre-ft. of AMP® Activator followed 4 days later by 20 lbs/acre-ft of Phycomycin® SCP based on chlorophyll a and cell densities. When Phycomycin® SCP was applied alone it required 60 lbs/acre-ft to achieve the same results. AMP® Activator has shown promise at multiple scales on several plants and algae in enhancing the efficacy of both herbicides and algaecides.

^{CEU} Invasive, Exotic Plant Removal in the Texas Hill Country and Beyond

Ruckstuhl, Eric

EBR Enterprises

EBR Enterprises is a contractor that removes invasive, exotic plant species from riparian and natural areas in the State of Texas. We have over 20 years of experience in this field. Current projects include Habitat Conservation Plans for the San Marcos River and the Old Channel of the Comal River in the Texas Hill Country, and several places in the Houston area. We are licensed Pesticide (Herbicide) Applicators with Aquatic and Land Management categories. We will explore our techniques and how we developed them. Removing invasive, exotic plant species requires a multi-tiered approach that includes: identification,

Ruckstuhl, Eric (Continued)

initial passes for removal, and several “mop up” runs. Selective keep of native volunteer plants and some replanting are also necessary. In the case of the Comal and the San Marcos Rivers, invasive, exotic plants and animals are being removed to help Threatened and Endangered species survive. In many areas, the invasive, exotic species greatly outnumber the native species. This puts the future of many species that we currently consider common, in question. Will they also become Threatened or Endangered? This is not a subject that we can afford to be wrong about.

Management of aquatic plants and ecosystems: an update on tools and resources

Sink, Todd, Ph.D.

Texas A&M University – AgriLife Extension

An update on the aquatic plant management tools and resources of the Texas A&M AgriLife Extension Service Wildlife and Fisheries Sciences Extension Unit will be given. Updates will include the newly redesigned and upgraded AquaPlant website, status of the AquaCide and AquaPlant apps, digital and print algae management resources, participation in the Arundo prevention program, aquatic vegetation management programming delivered over the last year, changes in Extension fisheries personnel, and involvement of the TAMU Department of Wildlife and Fisheries Sciences and the Texas AgriLife Extension Service in aquatic vegetation management in coming years.

***CEU* Drift Minimization: Maximizing your chemical investment... When bad things happen to good droplets!**

Smith, Chris

WinField United

There is a need to make sure spray applications reach their target. Maximum coverage is needed for optimal pesticide performance. Maximum coverage is needed to reduce the movement of pesticides to non-target areas. There are many factors that affect whether a spray application reaches its target. Actions can be taken to reduce spray movement and ensure spray applications reach their target. Topics covered in this presentation include: What is spray drift? Why is reducing drift important? What factors affect spray drift? What can be done to limit spray drift?

*** Chemical control of the floating aquatic plants common duckweed (*Lemna minor* L.) and watermeal (*Wolffia* spp.)**

Turnage, Gray

Mississippi State University

Floating plants are increasingly becoming widespread problems in waterways in the southern United States. Nuisance problems are often exacerbated with increased nutrient inputs into waterbodies from point and non-point sources. Common duckweed (*Lemna minor* L.) and watermeal (*Wolffia* spp.) are both floating aquatic plant species that can be problematic in southeastern waterbodies. Infestations of these species can reduce the use and aesthetics of waterbodies and can shade out submersed aquatic plants potentially causing oxygen depletions in which may result in fish kills. Duckweed and watermeal are some of the most difficult aquatic species to control due to their high rate of reproduction. Most management options utilizing chemical control methods produce inconsistent results when used on these species. This work analyzed the effects of the contact herbicide diquat and a new liquid formulation of the contact herbicide flumioxazin when used to control duckweed and watermeal. Each species was established in 20 40L aquaria in a greenhouse and were allowed to grow for one month prior to herbicide applications. Diquat was applied to each species at the maximum label rate while flumioxazin was applied to each species at low, medium, and high rates. All herbicides and rates reduced duckweed by four weeks

Turnage, Gray (Continued)

after treatment (WAT) when compared to an untreated control. Diquat and the high and medium rates of flumioxazin reduced watermeal when compared to the untreated control at four WAT, however the low rate of flumioxazin did not.

*** Torpedograss control via submersed applications of systemic and contact herbicides**

Turnage, Gray

Mississippi State University

Torpedograss (*Panicum repens*) is a perennial invasive aquatic plant species native to South America that is spreading across the southeastern US. Torpedograss can survive in terrestrial and aquatic environments rooted to hydrosol or form large floating islands (tussocks) that can limit human and wildlife uses of waterbodies. Portions of tussocks can break off, float away, and start new torpedograss infestations in other locations thereby making the problem worse. Limited data exist concerning submersed chemical control (herbicides) methods that are effective at controlling torpedograss. This work was conducted to investigate short- and long-term submersed chemical control options of torpedograss grown in outdoor mesocosms near Starkville, MS. Nine herbicides labeled for use in aquatic environments and a non-treated reference were evaluated. Eight weeks after treatment (WAT), harvested plants were separated into root/rhizome and shoot/leaf tissues, placed in labeled paper bags, dried in a forced air oven for five days at 70C, then weighed. None of the herbicides significantly reduced root/rhizome tissues for torpedograss eight WAT, however penoxsulam, topramezone, flumioxazin, and carfentrazone-ethyl had reduced root/rhizome tissue by 52 WAT. Triclopyr, diquat, flumioxazin, and carfentrazone-ethyl had reduced shoot/leaf tissue at eight WAT. At 52 WAT, penoxsulam, topramezone, flumioxazin, and carfentrazone-ethyl had reduced shoot/leaf tissues. This work suggests that submersed applications of penoxsulam, topramezone, flumioxazin, or carfentrazone-ethyl can control populations of torpedograss short- and long-term.

PRESENTER BIOGRAPHIES

*Biographies are listed alphabetically by presenter last name; * Indicates student presenter.*

Aguillard, Craig – Email: caguillard@landolakes.com

President - Aquatic Plant Management Society & Aquatic Market Segment Leader - WinField United

Craig graduated from Louisiana State University with a Bachelor's of Science in Agronomy, with a focus on crop production and soil management in 1982. After graduating from LSU, Craig worked as a field salesman for Bell Chemical and was then employed by Pennwalt Corporation, currently known as UPI. His territory included southern states from Texas to the Carolinas. From 2009 to the present, Craig has been the Aquatic Market Segment Leader for Winfield United's professional products business. In this role, he is responsible for developing treatment recommendations to manage algae, weeds and other conditions in lakes and ponds and for direct sales in Louisiana, Mississippi, Alabama and Georgia.

*** Calhoun, Kennedy - Email: klc922@msstate.edu**

Graduate Student, Mississippi State University

Kennedy Calhoun is a Master's student in Biological Sciences studying aquatic ecosystems at Mississippi State University. Kennedy attended the University of Arkansas at Monticello School of Forestry and Natural Resources, receiving a bachelor's degree in Natural Resources Management with a Wildlife Management option. Kennedy aspires to a career as a wildlife biologist in an aquatic setting.

Decker, Thomas – Email: thomas.decker@tpwd.texas.gov

Assistant Biologist, Aquatic Habitat Enhancement Team, Texas Parks & Wildlife Department

Thomas Decker is the assistant biologist in Texas parks and Wildlife Department's Aquatic Habitat Enhancement office. He received his bachelor's degree in Wildlife and Fisheries Science and Entomology from Texas A&M University. He received his master's degree in Natural Resource and Environmental Management from the University of Hawaii at Manoa, focusing in the economic impacts of invasive species. Thomas has worked to control invasive aquatic plants with the AHE office for over five years.

*** Dunn, Autumn - Email: autumn41095@gmail.com**

Graduate Student, Mississippi State University

Autumn completed three Bachelor of Science degrees at the University of Nebraska-Lincoln in 2017 in Fisheries and Wildlife, Grassland Ecology and Management, and Environmental Restoration Science. She also received two minors, in English and Water Restoration Science. She has worked on a variety of research projects in her undergraduate studies focused on topics related to soil, plant, and wetland ecology. She is currently pursuing a Master of Science degree in biology at Mississippi State University.

Findeisen, John – Email: john.findeisen@tpwd.texas.gov

Aquatic Habitat Enhancement Team Lead, Texas Parks & Wildlife Department

John Findeisen is currently the Team Leader for the Texas Parks and Wildlife Department's Aquatic Habitat Enhancement (AHE) Team in Brookeland, Texas. He earned a B.S. in Wildlife and Fisheries Sciences from Texas A&M University and a M.S. in Biology (emphasis in Aquatic Biology) from Southwest Texas State University. John has been employed by the Texas Parks and Wildlife Department for 20+ years as a fisheries management biologist and transferred from the Corpus Christi District fisheries management team to the AHE team in February 2016.

*** Fogel, Tiffany - Email: gpn122@my.utsa.edu**

Undergraduate Student, University of Texas - San Antonio

Tiffany Fogel is an undergraduate student at the University of Texas at San Antonio (UTSA) in the College of Science's Environmental Science Program. She spent eight years in the United States Air Force as a Knowledge Operations Manager before pursuing her degree in Environmental Science. Her research interests are in aquatic sciences, invasive species, and the conservation and restoration ecology of native aquatic plants.

Hathcock, Christopher R. - Email: chris_hathcock@fws.gov

U.S. Fish and Wildlife Service, San Marcos Aquatic Resource Center (SMARC)

Chris Hathcock is Regional Botanist for the U.S. Fish and Wildlife Service at the San Marcos Aquatic Resources Center in San Marcos, TX. His research focus is on applied techniques for restoring Texas wild-rice and other plants in and along the San Marcos River. Prior to his current position, he was Assistant Manager at Lower Rio Grande Valley National Wildlife Refuge and Wildlife Biologist for Texas Parks and Wildlife Department. He holds a B.S. in Fisheries and Wildlife from the University of Missouri – Columbia and a M.S. in Biology from the University of Texas – Pan American.

Heilman, Mark - Email: markh@sepro.com

SePro Corporation

Dr. Heilman is Senior Aquatic Technology Leader for SePRO and oversees the company's research and development efforts to bring forward new technologies for managing water resources. He also directly assists many public and private natural resource managers in the US and some international colleagues with challenging projects managing aquatic invasive species with an emphasis on aquatic plants. Dr. Heilman holds a B.S. in Biology and Ph.D. in Aquatic Ecology from the University of Notre Dame. He received the Northeast Aquatic Plant Management Society's (NEAPMS) Aquatic Plant Science Award in 2011 and the national Aquatic Plant Management Society's (APMS) Outstanding Research and Technical Contributor Award in 2013. He is immediate Past President of NEAPMS and President Elect of APMS.

*** Howell, Andrew - Email: awhowell@ncsu.edu**

Doctoral Student, North Carolina State University

Andrew Howell is a PhD student and graduate research assistant at North Carolina State University in the Department of Crop and Soil Sciences, under the direction of Dr. Rob Richardson. He received his BS in Crop Production, and MS in Crop Science at NC State where he focused on the early detection, mapping, and monitoring of invasive submersed vegetation using traditional sampling regimes, and boat-based remote sensing technologies. For his PhD research, Andrew is currently investigating the utilization of unmanned systems in aquatic and non-cropland vegetation management and how these platforms will contribute in making prompt and informed management decisions. Andrew's passion is for the outdoors and spends most of his free time in the field or wading trout streams.

^{CEU} **Howell, George – Email: ghowell@stingersprayers.com**

Owner, Springer Spray Systems

George Howell has been owner and operator at Stinger Spray Systems for the past seven years. Offering a full line of sprayers as well as custom sprayers, Service and Parts. Initial experience was obtained by working at Estes Chemicals in the early 90's. He graduated from Tarleton State University in 1997 and left the chemical and sprayer business until the opportunity to purchase Stinger Spray Systems in 2011. Since then the business has presented challenges and opportunities to learn and grow.

Hutchinson, Jeff, Ph.D. - jeffrey.hutchinson@utsa.edu

Assistant Professor, University of Texas - San Antonio

Dr. Jeff Hutchinson is currently Assistant Professor at UT-San Antonio, and specializes in freshwater ecology and natural resource policy and administration. Jeff holds a B.S. in Forest Resources and Conservation (University of Florida), a M.S. in Wildlife Ecology (University of Kentucky), and a Ph.D. in Agronomy (University of Florida). Prior to coming to UTSA, he conducted post-doctoral research at the University of Florida Center for Aquatic and Invasive Plants, Gainesville and worked as a botanist with the United States Fish and Wildlife Service, San Marcos Aquatic Resources Center (SMARC; San Marcos, TX). His primary research interests are focused on the species and landscape of the Edwards

Aquifer, and includes topics such as nutrient uptake by aquatic plants, aquatic invertebrates as bioindicators of aquatic health, effects of runoff on aquatic organisms, phenological plasticity in plants such as the endangered aquatic macrophyte Texas wild rice, floods and droughts, and the impacts of non-native species on aquatic and riparian structure and function. The long range goal is to develop applied management techniques to improve stream and river health conditions that are applicable to real world situations in aquatic environments on a national and international level.

Labay, Andrew – Email: southwestaquatic@gmail.com

Fisheries Biologist, Southwest Aquatic Services

Andrew Labay is a certified fisheries professional, accredited through the American Fisheries Society, and the principal fisheries biologist of the family-owned Southwest Aquatic Services. Andrew has experience in a range of disciplines, including fisheries management, water quality, and environmental consulting. Andrew and his wife, Holly, have worked together for over 18 years, providing quality and affordable lake management services. Southwest Aquatic Services includes a licensed wetland plant nursery as well as a fish hatchery and provides a variety of consulting and pond management services.

Landel, Hans, Ph.D. – Email: hlandel@wildflower.org

Lady Bird Johnson Wildflower Center & Texasinvasives.org

Dr. Hans Landel is the Invasives Species Program Coordinator at the University of Texas Lady Bird Johnson Wildflower Center, where he manages the Texasinvasives.org program—including its associated Invaders of Texas citizen scientist program, website and invasives database—and provides outreach on invasive species across the state. He has performed field research in the U.S. and abroad, including on endangered species in China and the Philippines. Prior to coming to the Wildflower Center, Dr. Landel spent over 15 years teaching college level general biology, marine biology, environmental science, field studies, wildlife management, and natural history. Dr. Landel holds a B.S. in Zoology and a Ph.D. in Ecology and Evolutionary Biology.

^{CEU} **Layne, Carlton – Email: clayne@aquatics.org**
Executive Director, Aquatic Ecosystem Restoration Foundation

Carlton R. Layne received his BA Degree in Biology from Clarion State University, Clarion, PA and an MS Degree in Criminal Justice from Rollins College in Winter Park, FL. Carlton spent 5 years with the USDA, Agricultural Marketing Service, and 30 years with the US EPA in the Pesticides & Toxic Substances Branch. While with US EPA, Carlton was an Inspector, Grant Monitor, and Regional and National Training Officer (1973-1990), Chief of the Region 4 Pesticides Section (1990-1999), and a National Pesticides Expert (2000-2003). Currently, Carlton is the Executive Director of the Aquatic Ecosystem Research Foundation. Carlton is Past President of the Florida Aquatic Plant Management Society and Past Director Aquatic Plant Management Society.

^{CEU} **Li, Shiyou, Ph.D. - Email: lis@sfasu.edu, Phone: 936-615-6268**
Director and Research Professor, National Center for Pharmaceutical Crops (NCPC), Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University

Dr. Shiyou Li is research professor and director, National Center for Pharmaceutical Crops, Arthur Temple College of Forestry and Agriculture, Stephen F. Austin State University (SFA), Nacogdoches, Texas, USA. His team has isolated over 2,000 natural products including 186 new compounds from the native and invasive plants. Dr. Li recently discovered the endocidal regulation of secondary metabolites in the producing organisms. His endocides (endogenous biocides) theory provides a novel approach to induce mutations and selectively inhibit growth, development, and reproduction of producing organisms. The application of endocides has led to develop six high-yielding pharmaceutical crop varieties and several other desirable dwarf cultivars of trees and herbaceous plants. Endocide technology has also shown promising potential in controlling invasive species in the greenhouse and field tests of tens of plant and insect species. He is the author or coauthor of four books and 68 articles. He is the inventor or co-inventor of 17 issued or pending patents.

Marshall, Lucia, Ph.D. - Email: LMarshall@Biosorb-Inc.com
Founder & CEO, Biosorb, Inc.

Dr. Marshall received her Ph.D. in Biochemistry from Rice University, followed by a NIH Post-doctoral Fellow at the University of Texas Medical School, Houston, and a Research Associate at the University of Pennsylvania. She was a Visiting Scientist/Faculty at Bell Laboratories, California Institute of echnology, and Washington University Medical School. Her industrial career began at Monsanto, where she worked as a research scientist group leader in both pharmaceutical and agrochemical product development. In 1994, Dr. Marshall established Trans America Product Technology, Inc. (TAPT), a consulting firm specializing in developing new products for pharmaceutical, nutraceutical, horticultural and agricultural formulations. Working with natural products, the Biosorb® Microsponge™ technology was developed and patented. Dr. Marshall has published over 50 journal articles and patents, and is a member of several professional organizations.

^{CEU} **McGarrity, Monica – Email: monica.mcgarrity@tpwd.texas.gov, Phone: 512-552-3465**

Aquatic Invasive Species Team Lead, Texas Parks & Wildlife Department

Monica holds a Bachelor of Science in Biology from Old Dominion University in Virginia and a Master of Science in Biology from Florida Atlantic University and has 12 years of experience working with invasive species management, research, and outreach from plants to pythons. Monica is currently TPWD's Austin Aquatic Invasive Species Team Leader; the team focuses on adaptive management of riparian invasive plants, zebra mussel early detection and prevention, invasive fish ecology and distributions, and permitting for exotic species (as well as most other freshwater aquatic resource permits). Monica represents TPWD on the Western, Mississippi River Basin, and Gulf and South Atlantic States Regional Panels of the Aquatic Nuisance Species Task Force, the Texas Invasive Species Coordinating Committee, Texas Invasive Plant and Pest Council, and the Texas Aquatic Plant Management Society.

Pullman, Doug, Ph.D. - Email: doug.pullman@lonza.com

Applied Biochemists

Dr. Pullman holds a Ph.D. from Michigan State University and brings more than 30 years of scientific experience in Aquatic Plant and Cyanobacteria Management to Applied Biochemists®. As the Aquatic Plant Scientist at the Alpharetta Innovation and Technology Center (AITC), Dr. Pullman will focus on supporting the Applied Biochemists® product portfolio and innovation of new solutions using rigorous science, helping customers solve today's aquatic problems. Dr. Pullman replaces Dr. Ryan Wersal who left Lonza at the end of July 2018 to begin a career as a Professor at Minnesota State University-Mankato.

^{CEU} **Ruckstuhl, Eric - Email: eruckstuhl@aol.com**

Owner, EBR Enterprises

Eric Ruckstuhl is the owner of EBR Enterprises. He is a native Texan that has lived in the Houston and Austin areas, and presently lives in Cypress Texas with his wife and two sons. He is a Fluvial Geomorphologist, wetland specialist, and a native plant grower. He holds a Pesticide Applicator's License with Aquatic and Vegetation Management Categories. His passion is in restoring the native habitats of Texas by removing invasive, exotic plants and replanting natives.

Sink, Todd, Ph.D. - Email: todd.sink@tamu.edu

Texas A&M University – AgriLife Extension

Dr. Sink is the Associate Department Head for Extension in the Wildlife and Fisheries Sciences Department at Texas A&M University where he is also an Associate Professor and Aquaculture and Fisheries Extension Specialist for the Texas A&M AgriLife Extension Service. His professional experience in aquaculture and fisheries spans 22 years, four states, four universities, two state agencies, and positions at three private companies. He has extensive experience in aquaculture, fisheries, and aquatic vegetation research and extension including his work on the newly redesigned AquaPlant website and various aquatic vegetation management mobile apps. He has served as the Chair of the USDA-Southern Regional Aquaculture Center's Publication Committee for the Publications, Videos, and Computer Software project and as a member of the Technical Steering Committee for Extension since 2013. He served as the co-Chair of United States Aquaculture Society awards committee from 2008-2010 and on the Student Subunit Formation Committee from 2008-2009. Dr. Sink served as a Director of the Texas Chapter of the Aquatic Plant Management Society from 2013 to 2016 and Chair of the Website Development Committee from 2015 to 2017. He served on the Texas Aquaculture Association Conference Planning Committee in 2014. He also served on the 4-H Wildlife Habitat Education Program National Committee from 2014 to 2017 where he won an award for meritorious service on the national committee.

Smith, Chris - Email: CJSmith@landolakes.com

Senior Professional Sales Representative-Aquatics & Vegetation Management, WinField United

Working in the Aquatics and Vegetation Management markets in Texas, Chris has serviced lake management companies, industrial herbicide applicators, river and water authorities, utility companies, and various governmental agencies for the last 10 years. He is also the Editor for the Texas Aquatic Plant Management Society. Chris attended Texas A&M University, where he earned a B.S. in Agronomy. He currently resides in The Woodlands, Texas with his wife Tammy and their three children, Drake, Charlotte and Owen.

*** Turnage, Gray - Email: Gturnage@gri.msstate.edu**

Student, Mississippi State University

Gray Turnage holds B.S. and M.S. degrees in Biological Sciences from Mississippi State University (MSU) in 2009 and 2013, respectively, and is currently pursuing a PhD in Weed Science from MSU. His M.S. work studied the effects of human activities on freshwater ecosystems; specifically fish and mussel interactions in an altered environment. In 2011, he began work at the MSU Geosystems Research Institute (GRI) with Dr. John Madsen investigating invasive aquatic and wetland plant species across the U.S. in waterbodies ranging in size from small ponds or streams to entire watersheds. In 2014, he took over management of all research associated with the Aquatic Plant Research Facility (APRF) located at MSU where he continues to investigate the ecology and management of aquatic and wetland plant species with an emphasis on invasive species. His work at GRI and APRF regularly includes consulting with resource managers and landowners, writing management plans for public and private entities, monitoring plant community dynamics over time through vegetation surveys, as well as GIS mapping of treatment sites and plant species locations. Also in 2014, he joined the MSU GRI unmanned aerial systems (UAS or drone) as the team lead on all wetland and aquatic projects. His work for the GRI drone team includes identifying research needs in natural areas, determining appropriate study designs, coordinating UAS flights, and follow up data analysis. Much of his UAS work involves the investigation of optimal use protocols for UAS technology in natural areas and species differentiation and mapping using UAS imagery. Gray is also a current member of the MidSouth and National Aquatic Plant Management Societies (APMS), the Weed Science Society of America, the Mississippi Cooperative Weed Management Association (CWMA), the Mississippi Vegetative Management Association, the Society for Wetland Scientists, and a founding board member of the Mississippi Aquatic Invasive Species Council. He currently serves on the Board of Directors for the CWMA, is the chairman of the CWMA Research committee, and serves on committees for the MidSouth and National APMS chapters.