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Florida LAKEWATCH
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Dedicated to Sharing Information About Water Management and the Florida LAKEWATCH Program

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Volunteer collected water quality data can be used for science and management

Florida LAKEWATCH Director Mark Hoyer and founder Daniel Canfield have just finished the third in a series of manuscripts comparing data collected by LAKEWATCH volunteers with data collected by professionals. This manuscript addresses recent concerns that previous comparisons studies between professionally and volunteer collected data are of limited scope, conducted under experimental conditions and results may not be applicable to existing large-scale and long-term volunteer monitoring data sets. The manuscript has just been submitted for review and hopeful publication in North American Lake Management Society's journal called Lake and Reservoir Management.

The following is a summary of the manuscript showing once again that well trained LAKEWATCH volunteers do an excellent job collecting and processing samples creating data that can be used for science and management (Great Job Volunteers!)

Abstract: This manuscript addresses concerns that comparisons studies between professionally and volunteer collected data are of limited scope, conducted under experimental conditions and results may not be applicable to existing large-scale and long-term volunteer monitoring data sets. Historical (2008 to present) overlapping data (total phosphorus, total nitrogen and chlorophyll) collected by five professional organizations with National Environmental Laboratory Accreditation Conference (NELAC) laboratories are compared with Florida LAKEWATCH volunteer collected data from 216 Florida lakes (approximately 650 independent overlapping annual geometric mean pairs), covering central Florida (23 different counties) with lake data ranging from oligotrophic to hypereutrophic. Paired t-tests comparing logarithmic transformed data pooled from all organizations with annual mean overlapping volunteer collected data showed significant ($p < 0.05$) differences for phosphorus, nitrogen but not chlorophyll, however, significant differences when reported arithmetically were only 1.0 µg/L and -1.1 µg/L, respectively. Regression analyses on the same data showed strong significant ($p < 0.05$) relations with coefficient of variation (R2) values of 0.91, 0.98 and 0.79 for phosphorus, nitrogen and chlorophyll, respectively. Analyses of covariance on pooled data also showed that the slopes for each paired regression were not significantly different from one. These results show LAKEWATCH data were equivalent to data professionally collected by five Florida organizations with NELAC-certified laboratories. This manuscript is the third in a series of professional versus volunteer produced data comparisons again showing that the data produced by Florida LAKEWATCH volunteers are of the highest quality and thus are adequate for both research and management.

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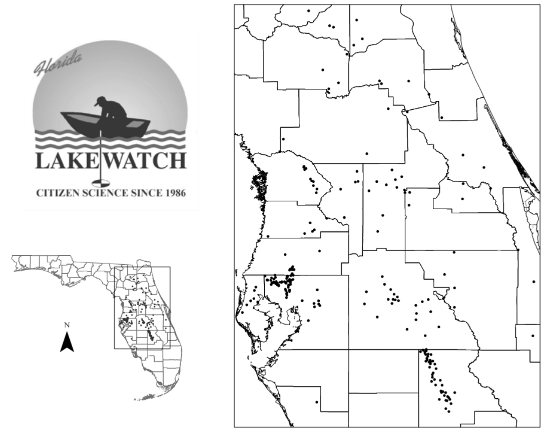


Figure 1. Location of 216 Florida LAKEWATCH lakes used in data comparison study.

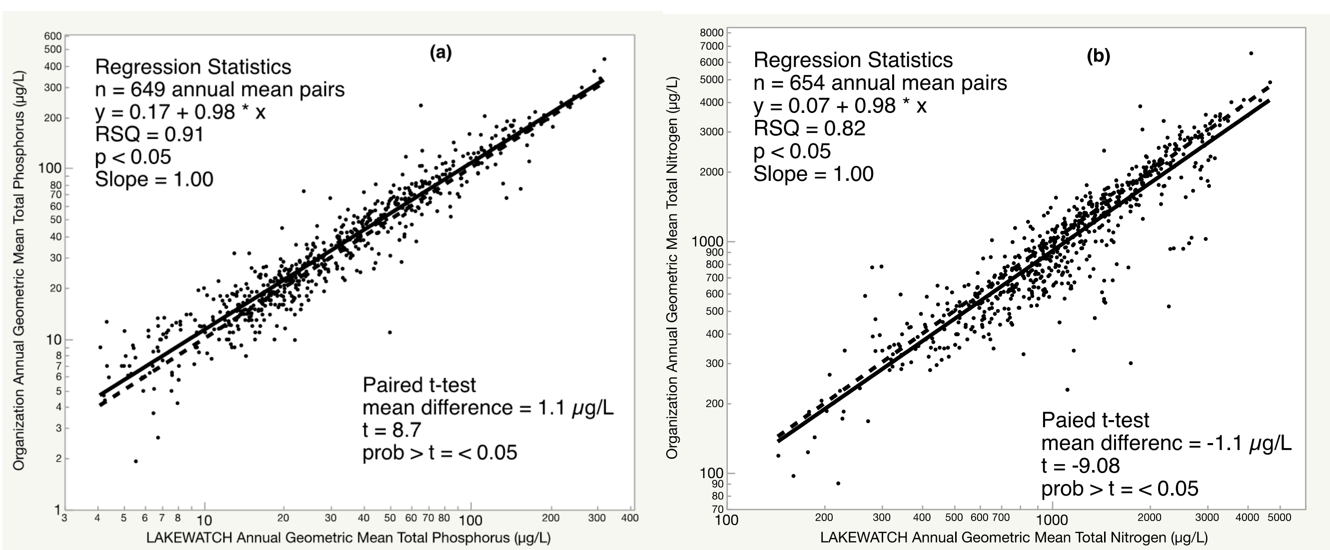
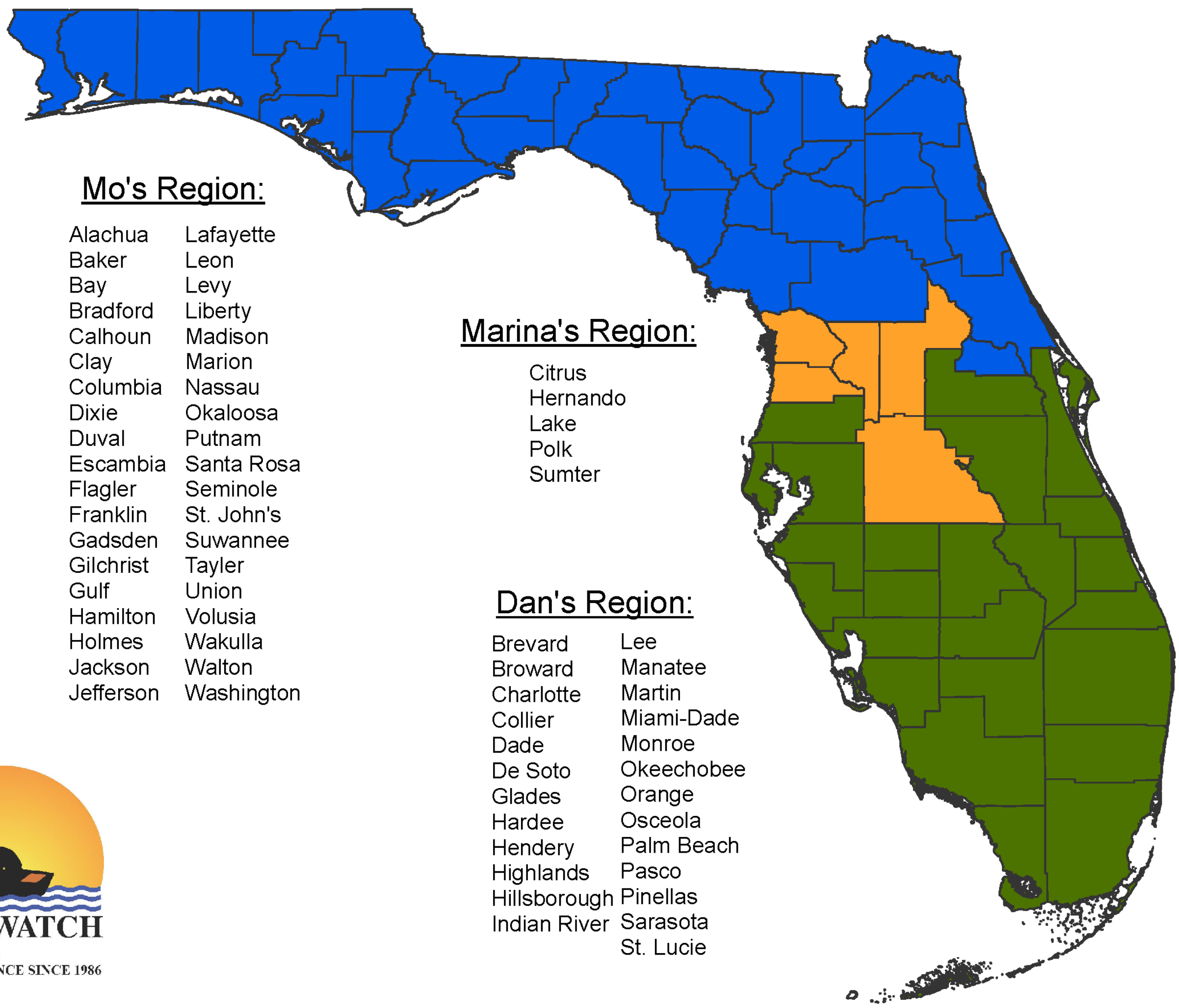


Figure 2. Paired t-test comparison and regression statistics for annual geometric mean total phosphorus (a), total nitrogen (b) data collected by Florida LAKEWATCH and pooled overlapping data collected by FDEP and the following Water Management Districts : South Florida (SF), St. Johns River (SJ), Suwannee River (SU), Southwest Florida and FDEP: Southwest Regional Office (DEP). The dashed line represents a one-to-one relation and an analysis of covariance was used to determine if the slope was significantly different from 1.00. Data are from 216 Florida lakes, located across 23 different counties collected from 2008 to 2020

Changes to LAKEWATCH contacts

With the retirement of our long serving office assistant, Mary Lettelier, we have lost the primary person monitoring our toll free (1-800-525-3928) and main phone lines (352-392-4817). These numbers are still active and all messages will be acknowledged. However, if you'd like to speak with someone faster please reach out to the Regional Coordinator for your county. A complete list of the counties within each Coordinator's region is shown below along with their contact info:



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Water Sampling Using Unmanned Aircraft

By Colin Lewis,

In early 2019, the Lee County Hyacinth Control District (LCHCD) began developing a small Unmanned Aircraft System (sUAS) program with the goal to improve efficiency and efficacy of aquatic plant management. Since the program's inception, LCHCD has acquired three drones which supplement various aspects of the District's mission to provide sound aquatic plant management through integrated techniques, education, research and public outreach. Integration of drone technology has enhanced the district's ability to assess vegetation growth patterns throughout our jurisdiction in both large scale canal systems and difficult-to-access waterbodies. The district also plans to begin herbicide treatments with a large application drone in coming months in order to access waterbodies which cannot be treated with conventional equipment. However, perhaps the most novel application of sUAS technology comes in the form of a retro-fitted waterproof drone being used to collect water samples for water quality analysis.

Figure 1. Aircraft with water sampling bottle attachment shown

LCHCD's water quality laboratory has been in operation since the mid 1980's with the aim of providing scientific data on local waterbodies to the citizens of Lee County. Currently the lab processes monthly samples for our PondWatch program from approximately 116 storm water ponds, along with multiple samples collected in the Caloosahatchee River beginning at the Franklin Lock and ending at the Moore Haven Spillway. Additionally, LCHCD's aquatic technicians frequently collect water samples while in the field in order to develop a more appropriate management plan based on the waterbodies specific water chemistry characteristics. However, the challenge with many water sampling efforts is the lack of direct physical access to the waterbody such as a fringe of dense vegetation or steep banks.

To overcome these issues, LCHCD began development of a water sampling platform that could be attached to a SwellPro SplashDrone 3+. This drone has the ability to both land and float on the surface of the water. All electronic components of the drone are sealed, including the camera, allowing the pilot to get pictures and video of submerged aquatic vegetation (SAV) growth (when water clarity allows). The SplashDrone 3+ is also fitted with a payload release mechanism as it is frequently used by beach fishermen to drop lures or bait directly into schools of fish from the air. This feature gives the SwellPro a relatively high payload capacity for a drone of its size at 2.2 pounds. This provided an opportunity to construct a lightweight sampling frame that would mount directly to the drone's existing landing gear. After a few weeks of drawing prototype sampler frames, a design was agreed upon and brought to LCHCD's head machinist for construction.

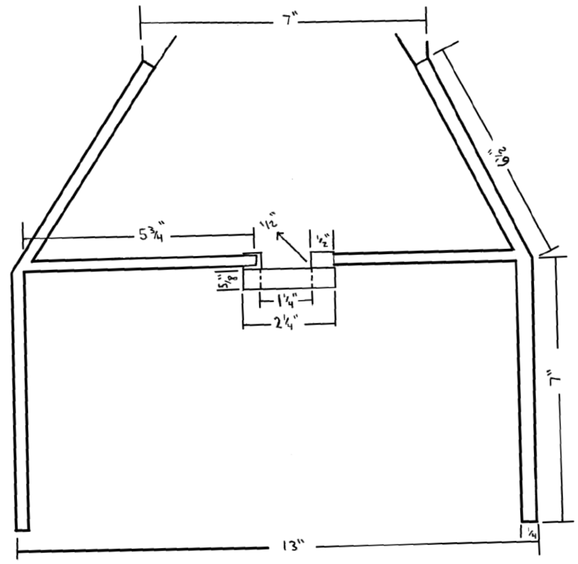

Figure 2. Prototype of lightweight sampler frame design

In order to maximize the amount of water to be carried, the sampler was built using Delrin®, a lightweight, high tensile strength plastic along with a few aluminum components for added rigidity. The sampling apparatus was based off of a simple A-frame design with a center-mounted bottle holder. The bottle holder is threaded for easy and reliable coupling and has the ability to mount both 250 mL and 500 mL bottles. To reduce buoyancy issues when lowering the drone sampler into the water, the bottle holder is mounted on a swivel which allows the bottle to tip into the water and rapidly fill with minimal lateral displacement.

Standard sampling protocols are being developed to ensure that no cross contamination occurs between samples. At the beginning of each flight the bottom of the drone and the bottle holder are rinsed with deionized (DI) water, then a clean bottle is threaded into the mounting apparatus. Once the pilot has completed a pre-flight checklist to ensure that all conditions are favorable, the drone launches and moves to the sampling location. The pilot then slowly lowers the drone into the water until the entire sampler is submerged and allows the bottle to fill for approximately 5 seconds. To ensure the bottle is filled, the camera on the drone should be faced downward so that the pilot can see when it stops bubbling. After the sample has been collected, the pilot slowly raises the drone out of the water and brings the drone back to the landing zone where the bottle is removed and capped off. The drone and sampler are then rinsed with DI water to remove any contaminates and a fresh bottle is threaded into the mounting apparatus for additional samples.

To verify that these procedures did not affect the quality of samples collected, a preliminary study was performed where samples collected using traditional methods were tested against samples collected by LCHCD's drone sampler. Five locations were selected at a local storm water pond, which were then sampled by both methods. All samples occurred on the same day in the same location with the traditional method occurring first, immediately followed by the drone sample. Upon analysis, no significant difference was found in any factor of the water chemistry between the five locations. These preliminary findings offer support to the fact that this is a viable sampling method that could provide great benefit to any institution tasked with water quality monitoring.

While additional studies need to be conducted to further confirm these results, it is important to note the widespread development of this technology to affirm its legitimacy. Researchers from various institutions including the University of Nebraska, Rutgers University, Clemson University, Colorado State University, Galway-Mayo Institute of Technology, Hatch Ltd. and many others are also currently developing drone sampling devices. Although LCHCD's sUAS program is still in its infancy, the use of this technology has proven to be an invaluable tool by providing a unique and innovative approach to aquatic plant management.

Colin Lewis is an Aquatic Biologist with the Lee County Hyacinth Control District

Filtration Time Reminder

We want to remind everyone about the new data sheets that should be used from this point forward. The new versions (both fresh and salt) each contain a new table for filtration date and time and continue to have the column for sampling time. Below is an example of how these sheets should be filled out:

Vanishing Point		Sun Code Number	Sun Code Key *Use the codes from below to fill in the Sun Code Number column.*	Water Depth	Sampling Time
Sta 1	6 ft. 1/4 1/2 3/4	1	1 = full sun	10 ft. 1/4 1/2 3/4	9:35 AM
Sta 2	8 ft. 1/4 1/2 3/4	1	2 = haze over sun	10 ft. 1/4 1/2 3/4	9:40 AM
Sta 3	6 ft. 1/4 1/2 3/4	1	3 = thin cloud	10 ft. 1/4 1/2 3/4	9:45 AM
Sta 4	ft. 1/4 1/2 3/4		4 = medium cloud cover	ft. 1/4 1/2 3/4	
Sta 5	ft. 1/4 1/2 3/4		5 = heavy cloud cover	ft. 1/4 1/2 3/4	

Date and Time of Chlorophyll Filtration:

Station	Filtering Date	Filtering Time
Sta 1	10/2/2019	10:00 AM
Sta 2	10/2/2019	10:15 AM
Sta 3	10/2/2019	10:30 AM
Sta 4		
Sta 5		

Scientific Laboratory Manager, Christy Horsburgh receives Outstanding Program Staff Member award from the School of Forest Resources and Conservation at UF. Christy has been a valuable member of Florida LAKEWATCH since its inception in 1986. This past year her perseverance and willingness to learn has been above expectation earning her the Outstanding Program Staff Member award from the School of Forest Resources and Conservation.

Update for LAKEWATCH Coastal Volunteers:

LAKEWATCH volunteers that sample saltwater sites for the program use 500ml bottles to collect water for total phosphorus and total nitrogen at each sampling site. The analyzer used when the program originally started taking samples needed more water for the analysis of saltwater than freshwater samples. That analyzer is no longer used by the LAKEWATCH lab so the larger bottles used in taking the saltwater samples are not needed.

LAKEWATCH will start switching out the large 500ml bottle packets at the collection centers with 250ml bottle packets. The saltwater packets will be distinguished from the freshwater packets by the datasheet. The saltwater packets will have a **BLUE** data sheet. The freshwater packets at the collection centers will continue to have a white data sheet. This change will not only save the program financially, because the 500ml bottles are more expensive, but this will save freezer space for everyone! LAKEWATCH will not waste all the larger bottles we use for saltwater sampling, the bottles will be converted to desiccant bottles for storing the algae filters.

If you have any questions on this change, please contact LAKEWATCH staff.

FWC's TrophyCatch celebrates 10,000 catches

The Florida Fish and Wildlife Conservation Commission's (FWC) TrophyCatch program, now in Season 8, has awarded prizes for the catch and release of more than 10,000 largemouth bass since the program began in 2012. Thus far, 8,006 Lunker Club, 1,966 Trophy Club and 78 Hall of Fame fish comprise this landmark occasion.

"If Florida is to remain the big bass capitol of the world, Florida anglers need to be part of our research team. The FWC receives valuable data from TrophyCatch anglers and this information will continue playing a crucial role in management decisions," **said FWC Commissioner Gary Lester**. "Their participation is vital in keeping bass fishing in Florida great!"

Learn more at TrophyCatch.com

FWC Press Release

Are coastal plants the marsh loss "canary in the coal mine"?

By Stephanie Verhulst,

Coastal salt marshes are found along many temperate coastlines around the world include the Atlantic and Gulf coasts of Florida and are unique habitats in which plants thrive in usually inhospitable conditions due to high salinity levels and daily tidal flooding. In Florida, salt marshes are along the Atlantic coastline from Jacksonville south to Daytona Beach and the Gulf Coast from Apalachicola Bay south to Tampa Bay. These salt marshes protect against storm surges and tidal flooding, serve as nursery habitat to over 70% of Florida's coastal fish, shellfish, and crustaceans supporting Florida's fishing industry, and generate economic benefits through recreation and tourism. However, salt marshes are experiencing die-off and conversion to open water. If we could identify salt marshes that were about to disappear, management efforts might be guided by this knowledge.

Coastal forests in Florida are found on the upland boundary between salt marshes and upland habitats. Cabbage palms tolerate tidal flooding and salinity and thus able to grow at the transition between salt marsh and forest but have been dying off in recent decades leaving standing dead palms and few regenerating seedlings coining the term "ghost forests" (Figure 1). Driven by my concern for the loss of the coastal forest and the valuable services provided by salt marshes, my study objectives are to better link plant stress to salt marsh conditions by 1) determining black needlerush stress (measured as growth, productivity, and physiological response) in specific spatial locations within the salt marsh and 2) identifying soil salinity conditions that limit cabbage palm seed germination.

Figure 1. Ghost forest comprised of living and dead cabbage palms in the background and black needlerush salt marsh in the foreground.

Influences of spatial locations within salt marshes on plants

Tidal processes in salt marshes create environmental patterns along two gradients: 1) distance from the coast and 2) distance from the creek bank. Closer to the coast, tidal flooding duration is longer and exposure to elevated salinities is greater. As a result, the marsh grasses are forced to adapt to anoxic soil conditions. Creek banks commonly see greater sediment deposition, and thus higher elevations, as tidal water drops sediment as the banks are overtopped and water velocity is slowed by the marsh vegetation creating bank levees. The marsh interior receives tidal flooding with each high tide, yet for a shorter duration, and soil salinities can reach toxic levels as the water recedes, evaporates, and deposits salt. We may be able to measure vegetation stress in response to these spatial gradients, hinting at the mechanism for marsh loss and clues to its prevention

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In 12 salt marshes, I sampled plots at different distances from the coast and the tidal creek banks I examined soil and black needlerush samples and measured local tidal flood height, duration, groundwater salinity with automated continuous recording water dataloggers. I expected black needlerush to exhibit reduced growth and productivity and increased physiological signs of stress when located closer to the coast due to longer flooding and in the marsh interior due to elevated soil salinity.

Several black needlerush parameters showed patterns along the environmental gradients, as hypothesized. One of the most pronounced physiological responses observed was the significantly higher levels of proline, an enzyme produced as a stress response, closer to the coast and closer to the creek bank (Figure 2a). Other responses (stem length:mass ratio, stem density, and stem water content) showed elevated signs of stress when located closer to the coast and, surprisingly, on the creek banks. Naturally, I expected soil salinity would increase vegetation stress. Soil salinity levels were generally higher closer to the coast and at the creek bank few exceptions (Figure 2b). Ultimately, responses matched our expectations in some cases, but not in others.

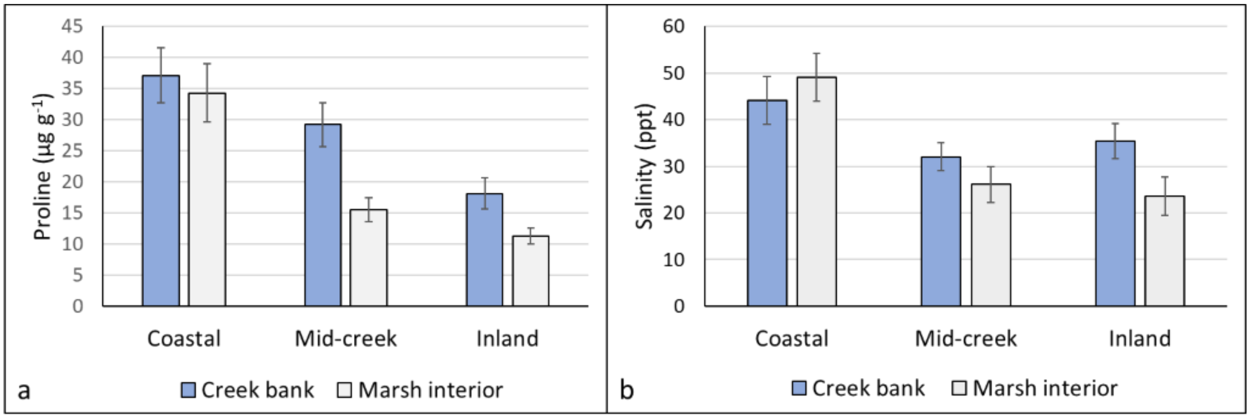

Figure 2. Response in a) average proline concentration in black needlerush and b) average soil salinity to distance from creek bank for the three distances from the coast within the tidal marsh systems.

When it comes to salinity stress, one size doesn't fit all

Not only is growth and productivity of black needlerush influenced by spatial locations within the marsh, but stress response also varies between individual salt marshes. My study included 12 different tidal salt marsh creek systems along the Gulf Coast from Cedar Key north to Hagen's Cove. These systems varied in size, proximity to freshwater rivers and creeks, and sediment composition, all of which may play a large role in salt marsh stress associated with sea-level rise. I ranked the marshes along a stress gradient, based on the black needlerush stress responses I measured, which revealed that three marsh systems with the lowest levels of stress are located within 1.5 km of the mouth of the Suwannee River. Marshes farther from large freshwater inputs and smaller in size showed the higher levels of stress, indicating that these systems may be more likely to convert to open water.

Salinity holding back seeds may be the start of ghost forests

The formation of ghost forests is due to the death of mature trees and the lack of new seedlings in the understory, which is possibly tied to greater occurrence of tidal flooding and soil salinity. I tested the impacts of soil salinity on cabbage palm germination with seeds collected from coastal forests adjacent to my salt marsh sites. Ungerminated cabbage palm seeds were incubated at 35°C for 13 weeks at salinities of 0, 4, 8, 12 ppt to determine seed germination success. I expected reduced germination success and longer time to germination as salinity increased. These hypotheses were confirmed; at 12 ppt seed germination was significantly lower (50% compared to 97% at 0 ppt) and significantly delayed (over 66 days compared to 28 days at 0 ppt) (Figure 3). These results link the presence of ghost forests to a lack of germination in higher salinity conditions.

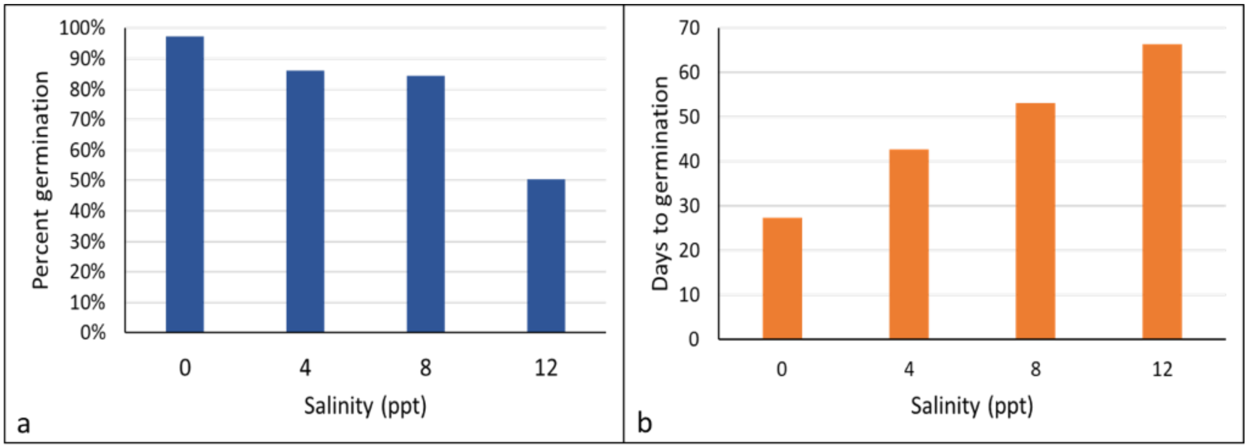

Figure 3. Cabbage palm seeds showing a) reduced average seed germination percentage and b) delayed germination with elevated salinities.

Conclusion

Coastal plant communities and ecosystems are adapted to high salinity soils and periods of tidal flooding. However, there are natural limitations of these systems to changes in the physical environment. Understanding the barriers to coastal forest regeneration from low seed germination success and highlighting the importance for freshwater input to reduce salinity in salt marshes can assist land managers in decision making and help predict coastal areas prone to salt marsh die-off. Further analysis of soil characteristics, marsh flooding, and vegetation response will continue to help us better understand the impacts the physical environment has on the salt marsh vegetation.

I would like to thank Lake Watch and the Department of Wildlife Ecology and Conservation for the use of their boats to access my tidal creeks, NCBS for supporting me as a graduate fellow, Dr. Carrie Adams for advising my work, and FWC for funding this study.

Stephanie Verhulst is a PhD candidate with the Nature Coast Biological Station (NCBS) in the Environmental Horticulture Department working with Dr. Carrie Adams.

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