

## **Guiding Successful Implementation of Floating Wetlands in Brackish Ponds**

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### **Statement of Work**

In January 2022, I began a Ph.D. in Plant & Environmental Science at Clemson University. The overall goal of my research project is to determine the suitability of using floating treatment wetlands (FTWs) in brackish stormwater ponds along the coast of South Carolina to improve water quality. Stormwater runoff carry pollutants such as nutrients for fertilizers, bacteria, chemicals and sediment into surrounding waterbodies such as lakes, wetlands, and coastal waters. Possible consequences of excessive nutrient loading into waterbodies from runoff may include eutrophication and increased, uncontrolled algal growth. Eutrophic brackish ponds are increasingly sources of harmful algal blooms in coastal South Carolina that can disperse to tidal creeks and estuaries (Lewitus et al., 2008).

FTWs, where plants are installed on buoyant mats that allow the plant to grow above the water while their roots extend downward into the water column, can provide water quality benefits by allowing additional nutrient uptake through plant roots and increased sedimentation of larger particulates. However, most studies have been performed and geared toward use in freshwater systems and the plants typically used and recommended are not suited for brackish environments. My research looks to understand the unique considerations that are needed to utilize FTWs in brackish systems and if similar water quality results are observed compared with freshwater ponds. To realize this goal, my research will occur in several phases: (1) Plant salinity screening in a greenhouse; (2) field scale trials in coastal ponds; and (3) focus groups and interviews with homeowners along the coast.

First, plant screenings will occur in a greenhouse to determine which plants survive best over a range of salinity levels and can uptake nutrients under stressed conditions. Ten plant species have been selected based on several key factors: (1) known salt tolerance described in past literature; (2) emergent wetland plant species that can handle a wet root system; (3) native to South Carolina; and (4) common availability at most nurseries around the to ensure that is easy to obtain for the average homeowner or pond manager. These plants are screened over 8 weeks with four different constant salinity treatments (0.5 ppt, 5 ppt, 10 ppt, and 18 ppt) and two variable treatments where salinity is either increased every two weeks or salinity is randomly assigned every week to simulate how ponds salinity may fluctuate throughout the year based on precipitation, runoff and tides. Water quality samples and plant measurements are collected weekly for eight weeks to determine how well they grow and uptake nutrients under varying levels of salinity stress. The results from the greenhouse trials will help guide plant selection for our field scale trials.

Three brackish stormwater ponds were selected along the coast of South Carolina in Mt. Pleasant. These ponds (one oligohaline, one mesohaline, and one polyhaline) are currently being monitored monthly for one year to determine baseline water quality conditions in the

pond. After one year, FTWs will be deployed at each site and monthly monitoring will continue for another year to determine if any changes occur in the pond between pre- and post- FTW installation. Plant species used in the floating wetlands will be chosen based on the results of the earlier greenhouse experiments and the baseline conditions observed in the ponds (i.e. average salinity of the pond and nutrient values). The ponds will also serve as an outreach opportunity where we can host workshops on FTW function, installation, and maintenance, as well as create educational signage for community members.

Finally, I have a strong interest in outreach and extension work that can help bridge results

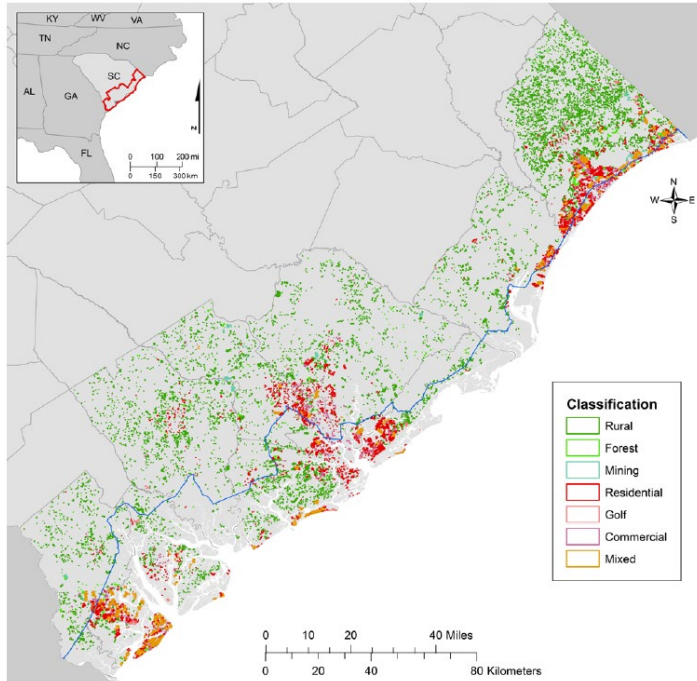


Figure 1. Pond inventory from 2013 imagery (Cotti-Rausch et al., 2019). Ponds identified in red are located in residential communities.

from research efforts into educational materials geared for larger audiences. The majority of stormwater ponds along the coast in South Carolina are located in residential subdivisions (Figure 1), so it is important to understand the residents' priorities and perceptions of FTWs to help guide our final recommendations at the end of the project. For this reason, I am conducting focus groups with coastal homeowners and interviews with pond managers. Focus groups are held in different locations along the coast and questions are centered around what communities think about their current pond and what information is important to them when deciding to implement a new practice in their

community. We also want to learn the opinions of pond managers who may be tasked with maintaining FTWs to learn if they have encountered any problems with use of FTWs in ponds and lakes and/or if they need additional training or information to feel confident installing and maintaining FTWs. We hope that talking to these groups early, in addition to greenhouse and field trials, will help us understand important questions and concerns the homeowners and professionals may have about FTW implementation so that we can address these questions throughout our project. The results from these interviews, as well as the greenhouse and field scale trials will help guide successful implementation of FTWs along the coast in brackish ponds. Results from this research will be delivered through journal publications, conference presentations, and extension and outreach materials as discussed in the extension and outreach section below.

## **Completed Work**

The following work has been already completed towards my research project along with upcoming work to be performed this Spring and Summer 2023:

- Greenhouse trials have been completed for six out of the ten plant species that will be screened to determine salinity tolerance and suitability for brackish ponds (completed Spring and Summer of 2022). The remaining four plants will be screened in Spring and Summer of 2023.
- Three coastal stormwater ponds were chosen for our field study sites in Mt. Pleasant, SC. Preliminary water quality monitoring began in May 2022 and has been occurring monthly to determine baseline conditions in each pond. FTWs will be installed at each site in the Spring of 2023 and then monthly monitoring will continue for another year post-FTW installation.
- An initial round of focus group meetings was held virtually in the Summer of 2022. In-person focus group meeting will occur in the Winter of 2023, as well as the launch of the online survey to reach a larger homeowner audience.

## **Benefits to Coastal Wetlands**

Coastal stormwater ponds are often the last line of defense before stormwater reaches sensitive tidal wetlands and estuaries. Utilizing wetland plants to improve nutrient removal efficiency within stormwater ponds can help improve overall water quality along the coast. Floating wetlands can provide many of the same ecosystem services of traditional and constructed wetlands such as increased habitat for migratory birds and sediment capture and increased settling. An increased adoption of FTWs in stormwater ponds will help expand these ecosystem services along the coast as well as increase awareness on benefits of wetlands by having floating wetlands in highly visible stormwater ponds. In addition, as sea level continues to rise, coastal wetlands and waterbodies will become more brackish and tidally influenced. It is important to know which plants are suitable for brackish conditions that can be used for future wetland restoration projects.

## **Budget**

The majority of funds would be used to support overnight travel to my field sites along the coast (4-5 hours to travel to the coast). The remaining funds would go towards paying tuition and fees to support my Ph.D. studies. A budget estimate is included below:

- Overnight travel to field sites (\$3,500)
- University tuition & fees (\$1,500)

## **Extension and Outreach Plans**

Extension and outreach are key deliverables for my research project. Successful extension and outreach can help support long-term success of any project, particularly one where homeowner support will be key in implementing my research findings in coastal ponds. Besides sharing results at professional conferences and journal publications, I also plan to create materials geared toward larger coastal homeowners and pond managers. Extension materials that will be generated throughout this project include, but are not limited to:

- Website to house all materials created, as well as share resources from other entities working in FTW research projects.
- Plant guide that documents plants suitable for brackish waterbodies and their recommended salinity range. The guide will also include recommended plant combinations based on aesthetic and maintenance goals.
- Videos describing how to install and harvest FTWs.
- Photo story of FTW field site to show how FTWs develop and grow in a pond.
- A workshop for pond managers that demonstrates how to install and maintain FTWs.

## **References**

Cotti-Rausch BE, Majidzadeh H, Devoe MR, Stormwater Ponds in Coastal South Carolina: 2019 State of Knowledge Full Report. S.C. Sea Grant Consortium, Charleston, SC, 2019. 4-6.

Lewitus AJ, Brock LM, Burke MK, DeMattio KA, Wilde SB. Lagoonal stormwater detention ponds as promoter of harmful algal blooms and eutrophication along the South Carolina coast. *Harmful Algae*. 2008. 8(1): 60-65.