The Effect of Floating Treatment Wetlands as a Phytoremediation Strategy to Treat Nutrients in a Stormwater Pond by Tampa, FL

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INTRODUCTION

Stormwater ponds are manmade wetlands that mimic natural wetlands to treat urban runoff and rainfall from urban ecosystems, prevent flooding by slowing down stormwater surges, and filter nutrients that come from these landscapes and non-point sources to diminish nutrient concentrations from entering rivers and oceans.

Floating Treatment Wetlands (FTW)

Floating Treatment Wetlands (FTW) are a type of phytoremediation technique used to:

- mimic biogeochemical processes in stormwater ponds
- reduce nutrient loading in different water bodies through plant uptake
- Aquatic plants grow hydroponically and take up nutrients from the water column through their roots
- Rhizosphere microbiomes promote healthy root growth and allow them to take nutrients over time

Figure 1. Vern Jansen Park project by Beemats http://www.beemats.com/vern-jansen-park-pond.html

Floating Mat

The floating mat consists of a closed cell, cross linked polyethylene foam mat, and are ½ inches thick with pre-cut planting holes at a density of 2.4 plants per square foot. The seamless construction provides later, tensile strength, and the light weight, polyethylene foam supplies excellent floatation.

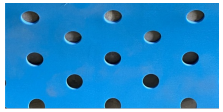


Figure 2. Mat used to support plants http://www.beemats.com/mat-construction.html

Aquatic Plants Being Tested

Canna Flaccida (*Golden canna*) → native herbaceous perennial wetland plant that grows in marshes, wetlands, and around the edges of lakes and ponds.

Fakahatchee grass (*Tripsacum dactyloides*) →
Normally found growing along river banks, swamps, and wet sites. It forms clumps between 4 to 6 ft tall and wide.

Media

Coco Coir Fiber Liner and Biochar

Coconut coir is a natural fiber made from the husk of ripe coconuts. It is commonly used in hanging baskets and planters, and its low decomposition rates allow for nutrients' uptake. Biochar is a stable, porous, carbon-rich material that originated from different types of inexpensive biomass that are set to thermochemical conversion of waste biomass through thermochemical processes. The biochar used for the project is made from cypress trees and treated above 800C.

METHODS

Preliminary Study: Single Pilot Mat Study

Figures 3,4,and 5. From left to right. Aquatic plants and grasses from Aquatic Plants of Florida LLC. Coir fiber with pieces of biochar in a Beemats pot. Set up with plant and pots with media.

Figure 6. Mat design used for the project with 30 holes, 28 holes will be used, leaving two to take water samples and water quality parameters.

Figure 7. Pilot mat displayed at Aarans Pond

Plant species were determined by unofficial surveys that were provided to the communities based on which aquatic plants and grasses they found the most attractive for the pond.

Project Pilot Study Set Up at Aarans Pond

Figures 8 and 9. from left to right. Design of the pilot study of floating treatment wetlands. How would the mats look like In a eutrophic environment https://terrapinwater.com/floating-treatment-wetlands/

TREATMENTS

Mat	Plant	Media
1	None	Coir + biochar
2	None	Coir
3	Golden canna	Coir + biochar
4	Golden canna	Coir
5	Golden canna + Fakahatchee grass	Coir + biochar
6	Fakahatchee grass	Coir + biochar

Figure 9. treatments for each mat for the pilot study

Water samples every 2 weeks → middle of mat and outside

Water quality parameters → YSI Pro, pH, conductivity

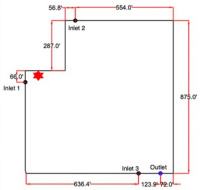
Plants
Two harvest
Total fresh mass after harvest
Oven dry and grind them for TN, NH3, NH4, TP nutrient analysis

Biochar and Coir → net nitrification rate method (extraction method) and analyze for TN, TP, NH3, NH4

PROJECT COMPONENTS

Aarans Pond in Temple Terrace, FL

Aarans pond is a stormwater pond located in Temple Terrace. FL at about 10 min away from the University of Florida (USF) main campus. The stormwater pond is considered a zombie pond because it is not well maintained and does not provide quality of living to the low-income communities around the pond.



Figures 10 and 11. Left to right. Aerial image of Aarans pond with different inlets and the outlet. Pond measurements and the area of study for FTW are highlighted in red

Tasks in the Project

- Task 1: Community stormwater infrastructure co-design and assessment of perceptions → outreach activities and workshops with the Temple Terrace community
- Task 2: Multiscale hydrology and water quality monitoring (hydrologic models applied to the pond → Hydrologic models applied to the pond
- **Task 3:** Bio-infiltration design, installation, and monitoring → Design of bio pods to install at the pond
- **Task 4:** Aarans' pondsccape, redesing, monitoring, and bioassays → Monthly water quality monitoring, Floating Treatment Wetlands Bioassays

HYPOTHESIS

Questions

Do Canna flaccida and Fakahatchee grass species uptake more nutrients when mixed rather than as monocultures?

- Mixed species will perform better on removing nutrients from the water column.

Does biochar absorb nutrients at similar concentrations during the absence of both the plants and grasses at the floating mat?

- Biochar will have an efficient absorption capacity but not at similar concentrations when compared to plants, but it will still be considered efficient to use when absence of plants

OBJECTIVES

General Objective

The overall objective is to see if the performance of Floating Treatment Wetlands (FTW) is enhanced by mixing a type of perennial wetland plant and a perennial grass over monocultures in the system and to see if the use of biochar would help uptake nutrients from the water column to implement it as a media for FTW to limit the number of plants where harvesting could be challenging in certain communities.

Specific Objectives

- Determine if Canna flaccida and Fakahatchee grass remove more nutrients when mixed
- Identify if biochar absorbs more nutrient when absence of plant species
- Provide plant native to Florida that could be used in FTW
- Study if a mixture of biochar and coir will promote bigger plant roots compared to treatment with coir only

REFERENCES

Beemats. Vern Jansen Park Pond, City of Titusville, Florida. Beemats.http://www.beemats.com/vern-jansen-park-pond.html

Beemats. How Beemats are Constructed. http://www.beemats.com/mat-construction.html

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