

How effective are artificial floating wetlands in improving ecosystem health?



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Introduction

- Over the past century, the Chicago River has endured many changes due to human expansion; sections of the river have been channelized and dredged to help with issues such as boat traffic and erosion.
- The river has become polluted due to wastewater effluents and runoff from the city.
- To tackle some of these issues, Urban Rivers, a non-profit river conservation group in Chicago, has decided to incorporate Artificial Floating Islands (AFIs) to help beautify the river and to enhance ecosystem health by creating riverside habitat for flora and fauna and by filtering pollution (e.g., Nakamura et al. 2008).
- However, it is not well known how much of an ecological benefit these AFIs provide.

Research Questions

- 1) Can we successfully mimic AFIs growing in the river using a mesocosm setup to quantify their ecological effects?
- 2) What are the effects of planted AFIs on:
 - Environmental variables (Dissolved Oxygen, Temperature, and Conductivity)?
 - Microbial functional diversity?

Mesocosm Setup



Fig. 1. All four mesocosms 6 weeks after initial planting. Noticeable differences in turbidity levels between unplanted and planted treatments



Fig. 2. Plant roots underneath one of the planted AFIs (left) as well as a close-up of how plants were inserted into the islands (right)



Fig. 3. Water pump attached to the side of a mesocosm used to simulate river flow

Methods

Mesocosms

- Four mesocosms were filled with 1,000 gallons of Chicago River water and an AFI was placed in each (Fig. 1).
- Two AFIs received plants (5 individuals of 4 species per island; Fig. 2) while the other two remained unplanted.
- Water pumps (Fig. 3) were placed in mesocosms to simulate river flow.

Data collection

- Phenology data were collected by measuring plant height along with stem and leaf counts in planted mesocosms.
- Environmental parameters were measured using a YSI probe.
- Microbial functional diversity was quantified using EcoPlates (Biolog®, Fig. 7). Mesocosm water was inoculated to determine the percentage of carbon substrates utilized (out of 31 possible ones) by microbial communities. Three water replicates were averaged per mesocosm.

Results

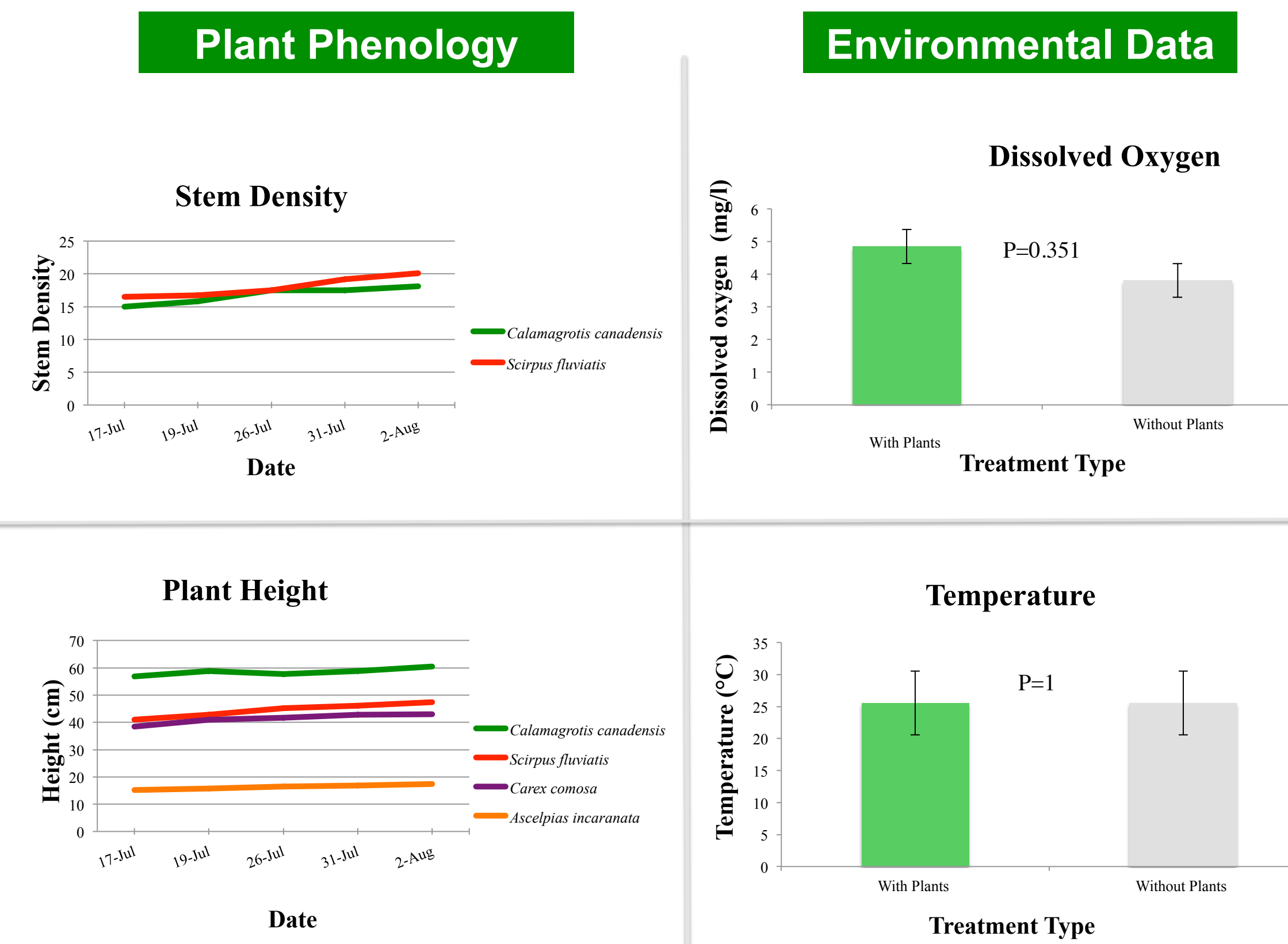


Fig. 4. Stem density and plant height for planted mesocosms. Data are averages of both replicate mesocosms

Fig. 5. Mean (+/- 1 S.E.) for two environmental parameters in mesocosms

Microbial Functional Diversity

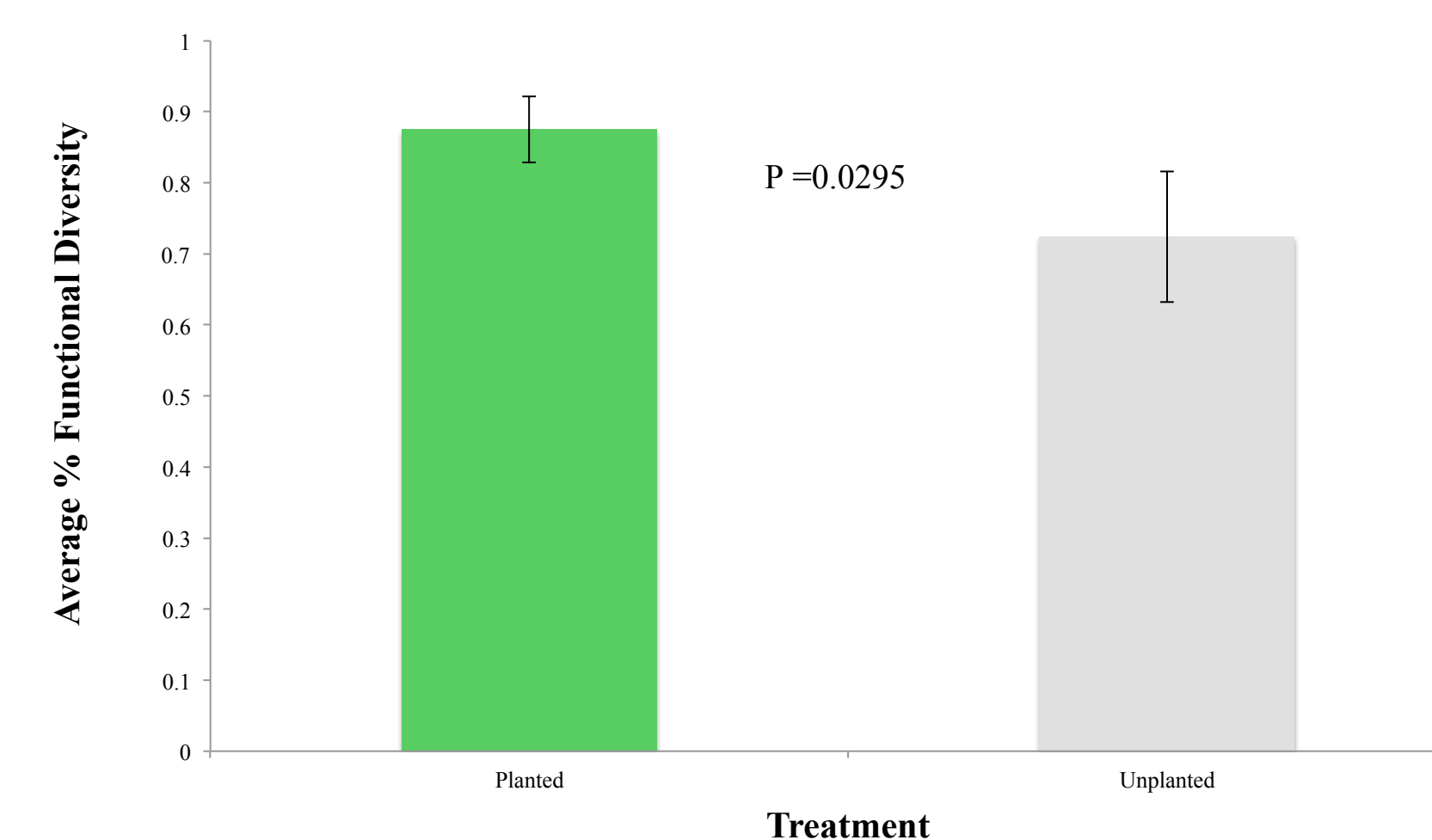
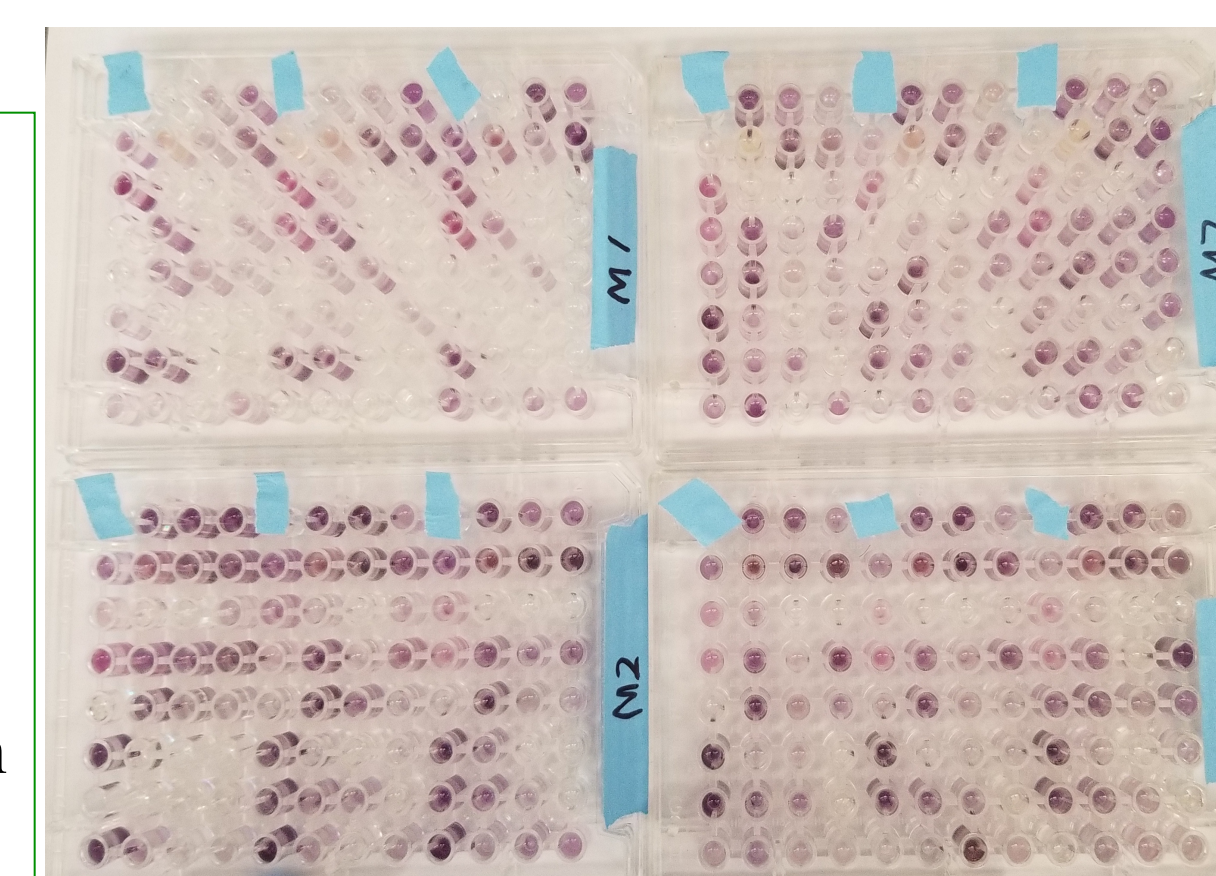


Fig. 6. Microbial functional diversity (mean +/- 1 S.E.) calculated after scoring EcoPlates

Fig. 7. EcoPlates used to determine microbial functional diversity. Purple color indicates positive metabolism of carbon substrate in that well. Top: plates from mesocosms with no plants; Bottom: plates from planted mesocosms



Discussion

- Plants had positive overall increases in stem density and height (Fig. 4)
 - Plants are growing and thriving
 - Mesocosms are a viable option to mimic the AFI river setup
- Environmental data (Fig. 5) showed no significant differences between planted and unplanted mesocosms for DO and temperature, or conductivity (data not shown)
- There was a significantly higher microbial functional diversity in planted mesocosms (Fig. 6)
 - Planted mesocosms exhibited a higher mean percentage of carbon substrates utilized
 - Plants are key in promoting microbial activity within river water

Future Directions

- Test for algal growth, biomass, and composition changes
- Test for water chemistry differences (nitrate, phosphate)
- Further samplings for environmental data, and % functional diversity

Literature Cited

- Nakamura, Keigo & Mueller, G. (2008). Review of the Performance of the Artificial Floating Island as a Restoration Tool for Aquatic Environments. World Environmental Water Resources Congress 2008 Ahupua'a. 1-10.
- Yellin, J.M. (2014). Evaluating the Efficacy of an Artificial Floating Island as Fish Habitat in the Chicago River: A Pilot Study. Unpublished Master's capstone project. University of Illinois, Urbana-Champaign

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