Evaluating the Impacts of Hybrid Cattail and European Frog-Bit on Northern Wild Rice Growth and Germination

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Introduction

Zizania palustris (northern Wild Rice) is a source of food and provides habitat for fish, birds, and amphibians in Great Lakes coastal wetlands (GLCWs) (McAtee 1917). *Zizania* populations have decreased steadily due to wetland loss the arrival of aggressive invasive plants such as the hybrid cattail *Typha* × *glauca* (*Typha*) (Barton 2018, Dysievick 2019) and *Hydrocharis morsus-ranae* (European Frog-bit).

This study determines the extent of the impacts of these two invasives through a mesocosm study simulating the litter of *Typha* and the shading effect of Frog-bit.

Question

Q1: How does the presence of invasive *Typha* litter influence the germination, survival, and growth of *Zizania palustris?*
Prediction: I predict that the *Typha* litter will negatively impact the growth and development of ZP seedlings due to high shade and substrate cover, and the impacts of litter decomposition.

Q2: How does shading by EFB floating mats influence the germination, survival, and growth of *Zizania palustris*?
Prediction: I predict that the simulated EFB cover will negatively impact ZP growth.

Photos 1-3: watering mesocosms, cutting shade circles, and sifting substrate

Methods

In the Summer of 2023, I conducted a fully factorial mesocosm experiment at the University of Michigan Biological Station (UMBS). I used previously established 0.5m^2 outdoor wetland mesocosms to simulate abiotic *Zizania palustris* (ZP) growing conditions. Seven replicates were established, with four separate treatments in each mesocosm. These treatments included a control (0% shade and litter), high shade (80%), low shade (40%), and *Typha* litter. Litter was collected Cheboygan Marsh, Cheboygan, MI, dried and cut to uniform pieces. Litter was measured and added to *Typha* mesocosms. To simulate the *European frog-bit (EFB)* shade cover treatment, insulation foam was cut into uniform circles and added to mesocosms in amounts equal to 80% or 40%, respectively. Wetland soil was collected from French Farm Lake, MI. The soil was sifted, and plant litter was removed.

In each mesocosm, thirty (30) ZP seeds were sown in each replicate. Seeds were grown from July 21 to August 9, and water levels were maintained with groundwater from a UMBS well. A separate growth chamber germination project was established to determine viability of ZP seeds. Each week seed germination, seed survival, and Exo Sonde multiparameter water chemistry was collected for pH and temperature. After the experiment, I counted and removed surviving rice seedlings, washed roots, and measured shoot length and root length. Seedlings were then dried and weighed to collect the dry weight of roots, roots without seeds, and shoots. Data was analyzed using a two-way ANOVA in R.

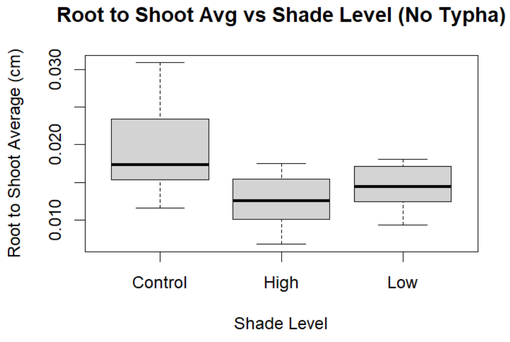

Fig 1: Root to shoot average between shade treatments

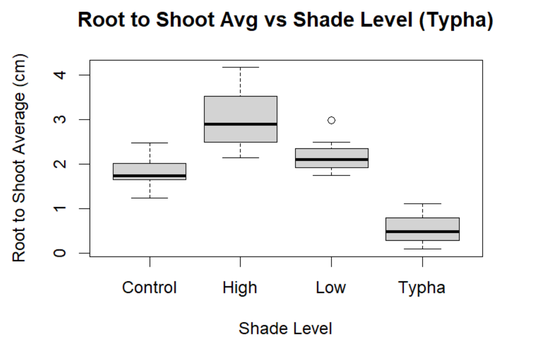

Fig 2: Root to shoot average between shade treatments and *Typha* application (1/y transformation)

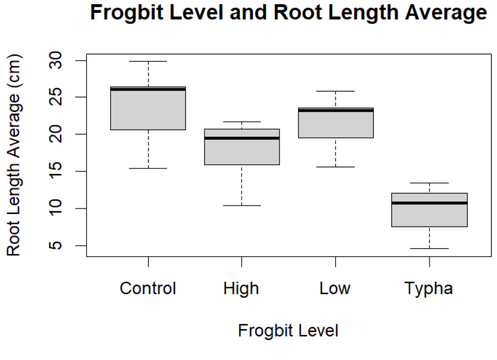

Fig 3: Root length average between treatments

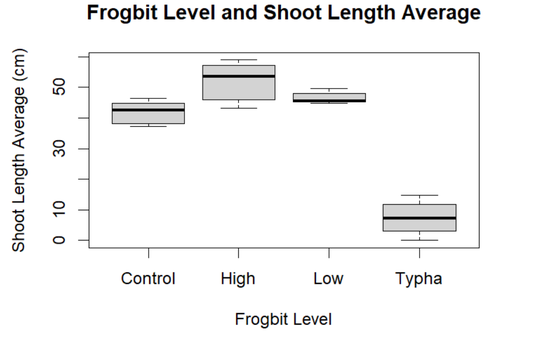

Fig 4: Shoot length average between treatments

Results and Discussion

My results conclude that there was a correlation between higher shade and lower shoot and root weight in ZP seedlings. (p-value 1.18e-07 and 1.14e-06). The average shoot length of plants under high shade was also much higher than the low and control shade levels. (p-value 1.39e-11). Meanwhile, the average root length of seedlings was lower in higher shade levels (p-value 1.12e-05).

Higher shade resulted in high shoot length, lower root length, and lower seedling weight. This suggests that high shade has a significant impact on the development of ZP seedlings.

Overall, seedlings grown with *Typha* application were significantly impacted in their development. *Typha* seedlings were lower in root to shoot average (p-value 2.34e-05), shoot length, shoot weight, and root weight. Seedlings had root lengths almost comparable to the other treatments.

Future Plans

My next steps include completing water and plant sample chemistry tests to determine the impact that addition of shade and *Typha* have on the nutrient contents of seedlings. Specifically, the impact that high shade and *Typha* treatments have, as they had the highest development differences. This will help me better understand the developmental impacts that plants like *Typha* and EFB can have on native wetland plants. I will communicate my final findings at the Loyola Undergraduate Research Symposium. Team Typha will continue evaluating the impacts of invasives on ZP in larger-scale projects.
Continuing my work on wetlands, I plan to conduct a new experiment over two years, looking at the diversity and distribution of native *Utricularia* species in Michigan.

Acknowledgements and References

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