

Analysis of Restored versus Native *Cirsium pitcheri* Sites

Christina J. Bohnet, Lauren B. Ebels, and Madison B. Springer, Calvin College

Abstract

C. pitcheri is a native and federally threatened species exclusive to the Great Lakes region. This study analyzed characteristics and environmental factors that affect two *C. pitcheri* populations in P.J. Hoffmaster State Park. Our group recorded data from both native and restored *C. pitcheri* populations, observing plant and environmental characteristics in each area. Density, rosette width and plant height were notably greater within the restored site. Comparing the quantity and quality of *C. pitcheri* between native and restored sites may provide data for more effective restoration strategies in the future.

Introduction

Prior research on *Cirsium pitcheri*, a threatened dune plant [1], has indicated relationships between dune elevation, surface soil pH, and bare sand area with *C. pitcheri* health [2]. Our study investigated two populations of *C. pitcheri*: one native and one restored.

The objectives of this study were to:

- 1) record the physical characteristics of native and restored *C. pitcheri* populations
- 2) identify environmental factors that influence the success of *C. pitcheri*
- 3) evaluate the effectiveness of greenhouse raised and strategically placed juvenile *C. pitcheri* as a restoration effort.

Study Sites

Our study sites were located in P.J. Hoffmaster State Park on Lake Michigan (Figure 1). The restored population was on Dune 4 and the native population was on Dune 3.5. The restored population was the second generation of a population planted in the early 2000's.

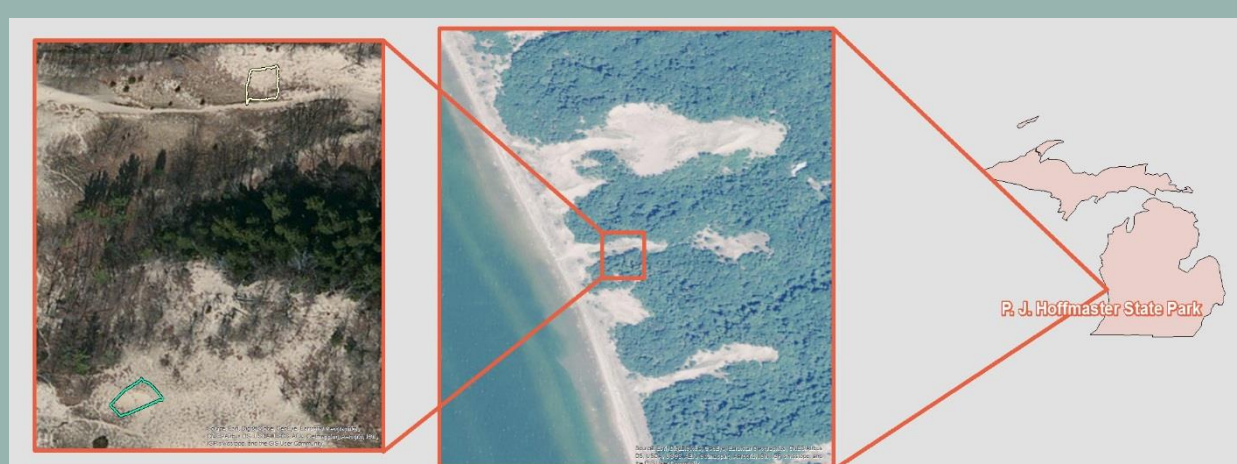


Figure 1: Dunes 4 and 3.5 in Hoffmaster State Park are located on the western shore of Michigan.

Methods

In October-November 2015, our methods included GPS mapping of *C. pitcheri* individuals and measuring key characteristics such as height, longest leaf and plant width (Figure 2). We also recorded presence or absence of herbivory, counted the number of green leaves and assigned a health rating for each plant on a scale of 1 to 5 with 1 being the least healthy. Additionally, pH was recorded at five randomly selected locations at both sites.



Figure 2: Researchers measure a flagged *C. pitcheri* plant.

Results

The two sites had equal areas with dimensions of 11m x 15m. The restored site had 66 *C. pitcheri* plants whereas the native site only had 48. The plants at the restored site had a density of .40 plants/m² as opposed to the native population having a density of .29 plants/m² (Table 1).

	Total no. of plants	Plant Height	Leaf Width	No. of Leaves	pH	Density	Herbivory
Restored	66	11.3 cm	1.0 cm	5.3	7.2	.40 p/m ²	5
Native	48	7.4 cm	2.5 cm	5.3	6.7	.29 p/m ²	4

Table 1: This chart displays average measurements collected in each location.

There was a large difference in plant characteristics between the two sites (Table 1). The restored site had a greater average plant height, density and was considered more healthy on the 1-5 scale than native site (Figure 3). Oppositely, the average leaf width of the native population was larger than that of the restored population. While the average number of leaves between sites was identical there was one more case of herbivory in the restored population. pH was also greater in the restored research area by .5.

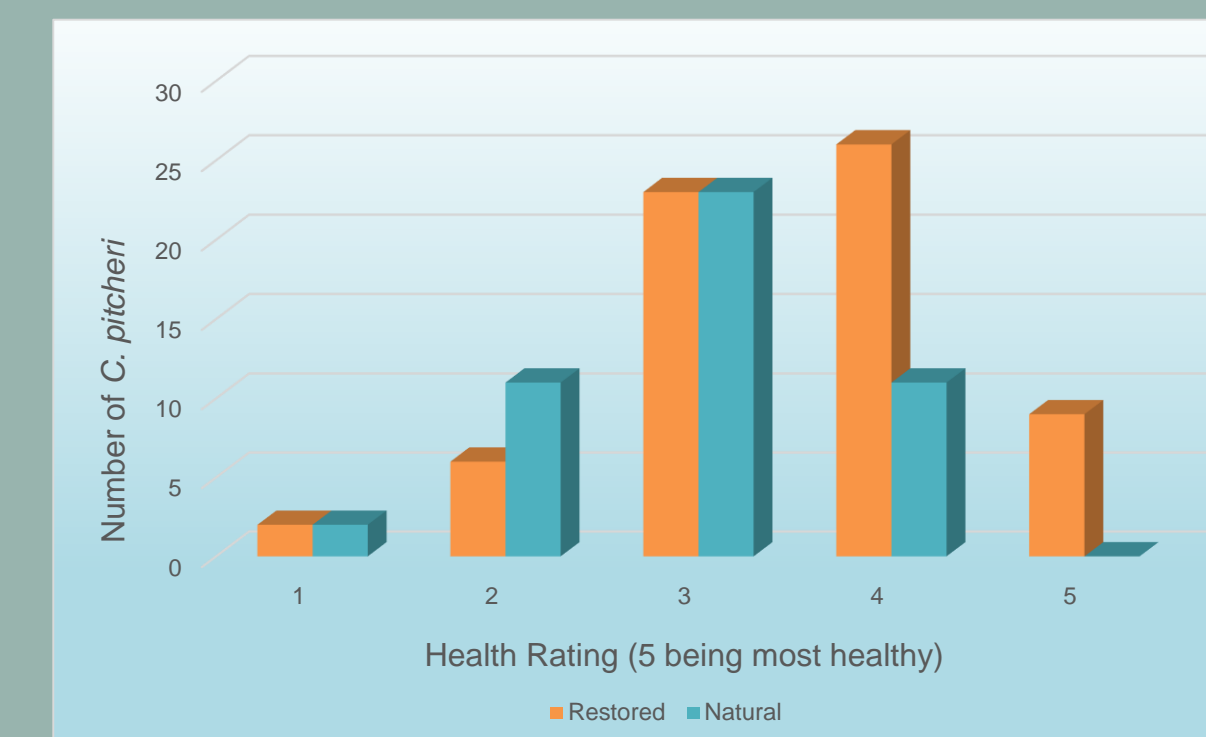


Figure 3: Health ratings of *C. pitcheri* for natural and restored populations.

Discussion

Our data suggests that planting *C. pitcheri* as a restoration method is effective. Adversely, a smaller average leaf width in the restored population may indicate a lower probability for success in future generations, as discussed in prior studies [1].

The greater average pH in the restored area may be correlated to the more dense vegetation (Figure 4), while an identical average leaf number suggests the plants within both populations are a similar age [1]. Previous studies show that herbivory has no direct correlation with plant density but may be affected by root size which is also related to the age of the plant [3].

Although the restored population appears to be thriving beyond the native population, it is difficult to fully evaluate its actual comparative success rate without knowledge of the first generation plant quantity or future generation reproduction rates.



Figure 4: *C. pitcheri* surrounded by vegetation.

Conclusions

Greater *C. pitcheri* density, height and overall health at the restored site suggests that planting strategies for species restoration have been effective (Figure 5), while smaller leaf width could be interpreted as the opposite. Herbivory, pH, and location may affect juvenile success. Further research of restored populations could gain a greater understanding of the effectiveness restoration methods. More extensive data collection of dune and environmental conditions would allow a greater understanding of this restoration method.



Figure 5: Flagged plants show density at restored research site.

Acknowledgements

We would like to thank the Michigan Space Grant Consortium and Calvin College for providing funds for this project, and especially the department of Geology, Geography, and Environmental Studies at Calvin College for organizing and providing the necessary tools. We are grateful for our professor, Deanna van Dijk, for her knowledge and helpful counsel and also to our research mentor, Kathryn Gerber, for her time and effort in helping us complete this project. Finally, we thank God who has given us this wonderful and fascinating world to study.

Works Cited

- [1] D'Ulisse, A., Maun, M. 1996. "Population ecology of *Cirsium pitcheri* on Lake Huron sand dunes: II. Survivorship of plants." *Canadian Journal of Botany* 74: 1701-1707.
- [2] Marshall, J. 2014. "Influence of topography, bare sand, and soil pH on the occurrence and distribution of plant species in a lacustrine dune ecosystem." *Journal of the Torrey Botanical Society* 141(1): 29-38.
- [3] Stanforth, Lynn, Svata Louda and Robert L. Beville. 1997. "Insect herbivory on juveniles of a threatened plant, *Cirsium pitcheri*, in relation to plant size, density and distribution." *Ecoscience* 4 (1): 57-66.