

Variables affecting *Cirsium pitcheri* at Rosy Mound Natural Area, Michigan

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Abstract

Endemic to the Great Lakes dunes, *Cirsium pitcheri* is threatened at the state and federal level because of both natural and anthropogenic variables. This study examines these variables affecting *C. pitcheri* at Rosy Mound Natural Area on Lake Michigan's eastern shore. In fall 2014, we analyzed *C. pitcheri* in three open dune study areas, collecting species and bare sand composition, and slope in each. Site A, with 2-7% slope, was closest to the shore and adjacent to a boardwalk. Site B, with 10-20% slope, was on a windward slope adjacent to an unmanaged trail. Site C, with 25-30% slope, was on a leeward slope with a trail-free buffer. For each plant, leaf length and GPS location was recorded. For a random selection of individuals, a point-quarter vegetation survey was used to identify the nearest species neighbor. Results show similar species and bare sand composition in all areas. Site A had the fewest *C. pitcheri* and smallest average leaf length. At sites B and C, plant locations showed clumping patterns influenced by the site topographies. These results suggest spatial distribution of *C. pitcheri* is directly affected by topography and indirectly affected by anthropogenic effects.

Introduction

The Great Lakes coastal dune ecosystems are diverse and unique, but decreasing due to development. Subsequently, endemic dune plants, including *Cirsium pitcheri* (federally threatened), are disappearing. *C. pitcheri* (figure 1) is threatened by a variety of natural and anthropogenic environmental variables [1,2]. Our study investigated the different characteristics and variables affecting *C. pitcheri* at a Lake Michigan dune site.

Our **study objectives** were to:

- Measure *C. pitcheri* characteristics and environmental variables at 3 study sites with different characteristics;
- Analyze and compare patterns within and between each study site.



Figure 1. *Cirsium pitcheri* in full bloom

Study Area

Our 3 study sites are located on the southeast shore of Lake Michigan at Ottawa County Parks (figure 2). Rosy Mound Natural Area is a coastal park with an established boardwalk system through a variety of dune ecosystems.

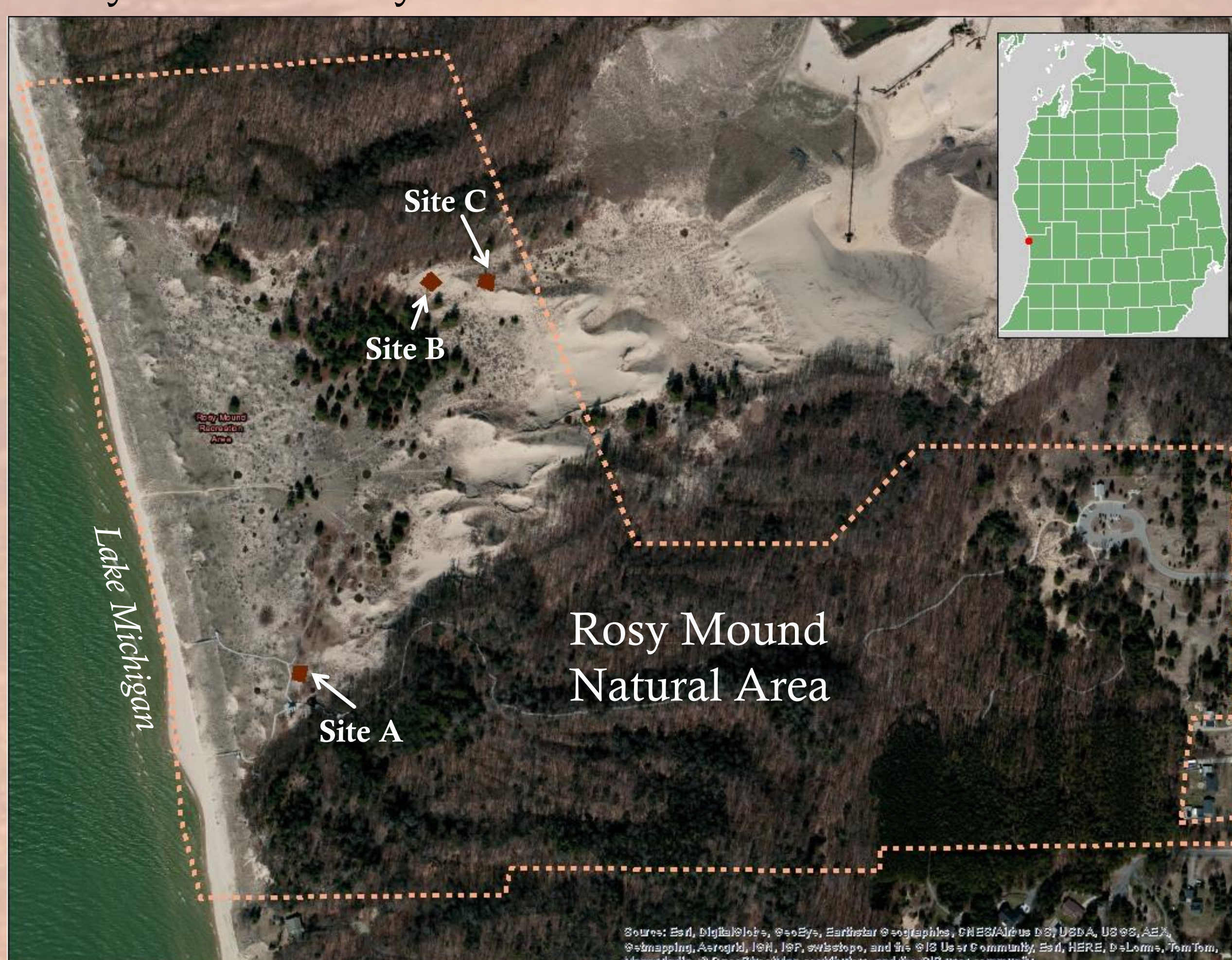


Figure 2. Study sites at Rosy Mound Natural Area, Ottawa County, Michigan

Methods

In Autumn 2014, we identified three 16mx16m study sites, containing populations of *C. pitcheri*, based on proximity to a trail or boardwalk, topography, and the surrounding environment (table 1).

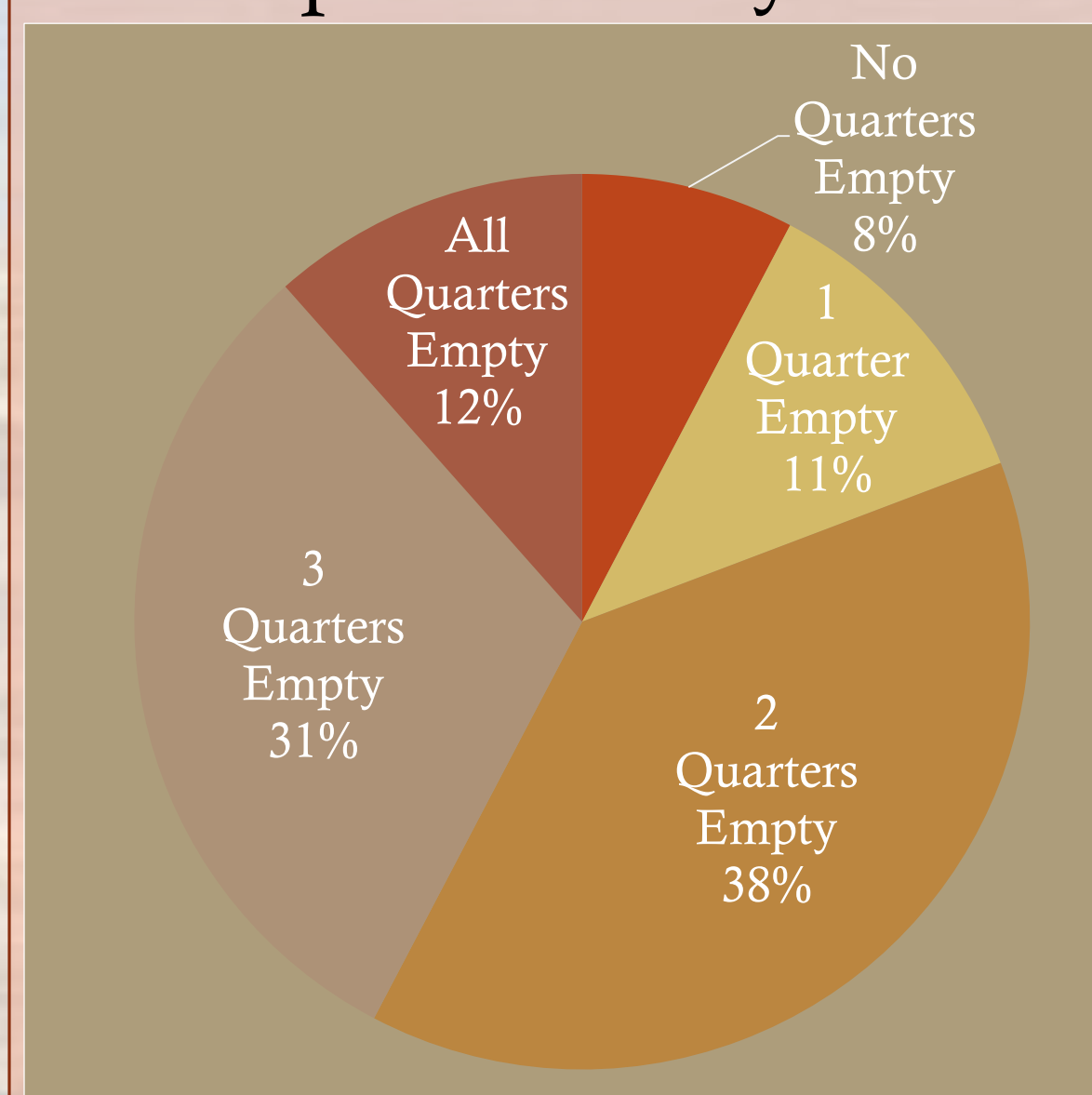
Site Characteristics:			
Site A	adjacent to boardwalk	minimal slope	no trees bordering site
Site B	adjacent to unmanaged trail	medium slope	trees on 2.5 sides
Site C	no adjacent trail	high slope	trees on one side

Table 1. Individual site characteristics based on slope and proximity to trees and a trail or boardwalk.

At each site we mapped park trails and the *C. pitcheri* population using a Trimble Juno GPS unit, measured longest leaf length of every *C. pitcheri* plant, and, for randomly selected individuals, took nearest neighbor data using a 39cm radius point-quarter vegetation survey. We also took a site-wide vegetation survey and placed and measured 4 erosion pins per site. ArcGIS and GPS Pathfinder Office were used to analyze the GPS data. The ArcGIS near analysis tool was used to determine the distance between *C. pitcheri* plants.

Results

A total of 82 *C. pitcheri* plants was recorded. Sites B and C had similar numbers at 36 and 35 respectively and site A had fewer with 11 plants. 80% of the plants surveyed had no nearby vegetation in two, three or all four quarters in the point quarter survey (figure 3).



The most common nearest plant in all three sites was *Calamovilfa longifolia*. Site C included *Leymus arenarius*, an invasive species. Spatial patterns of *C. pitcheri* (figure 4) and site characteristics (table 2) differed between the three study sites.

Figure 3. Point-quarter vegetation survey results show that no vegetation was the most common quarter result.

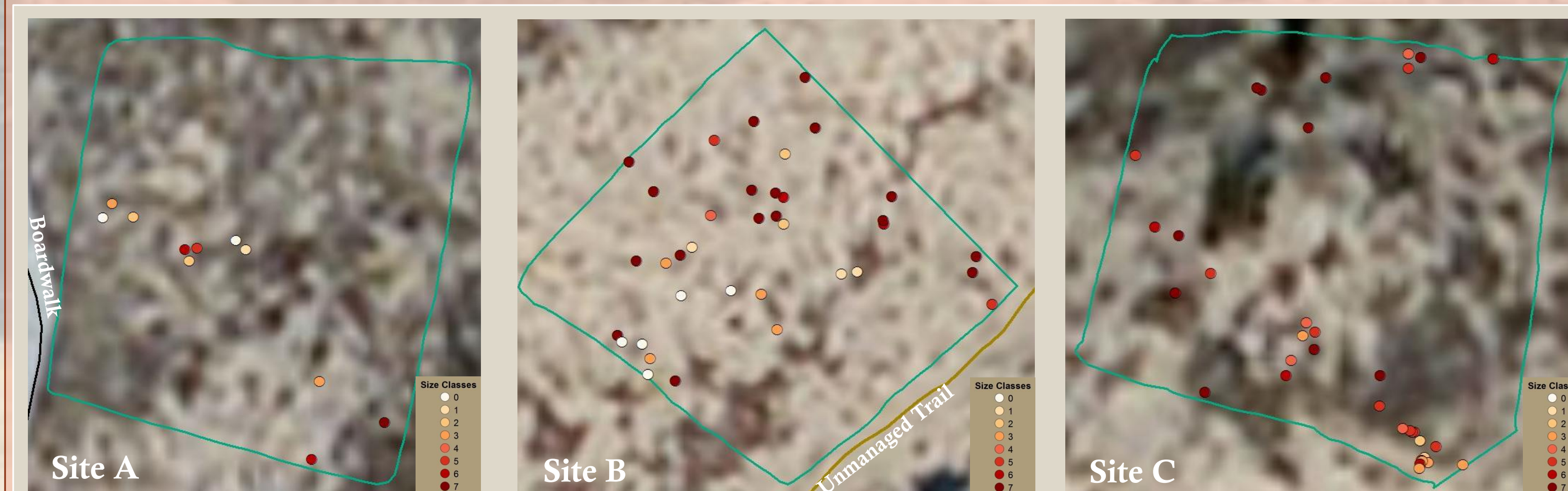
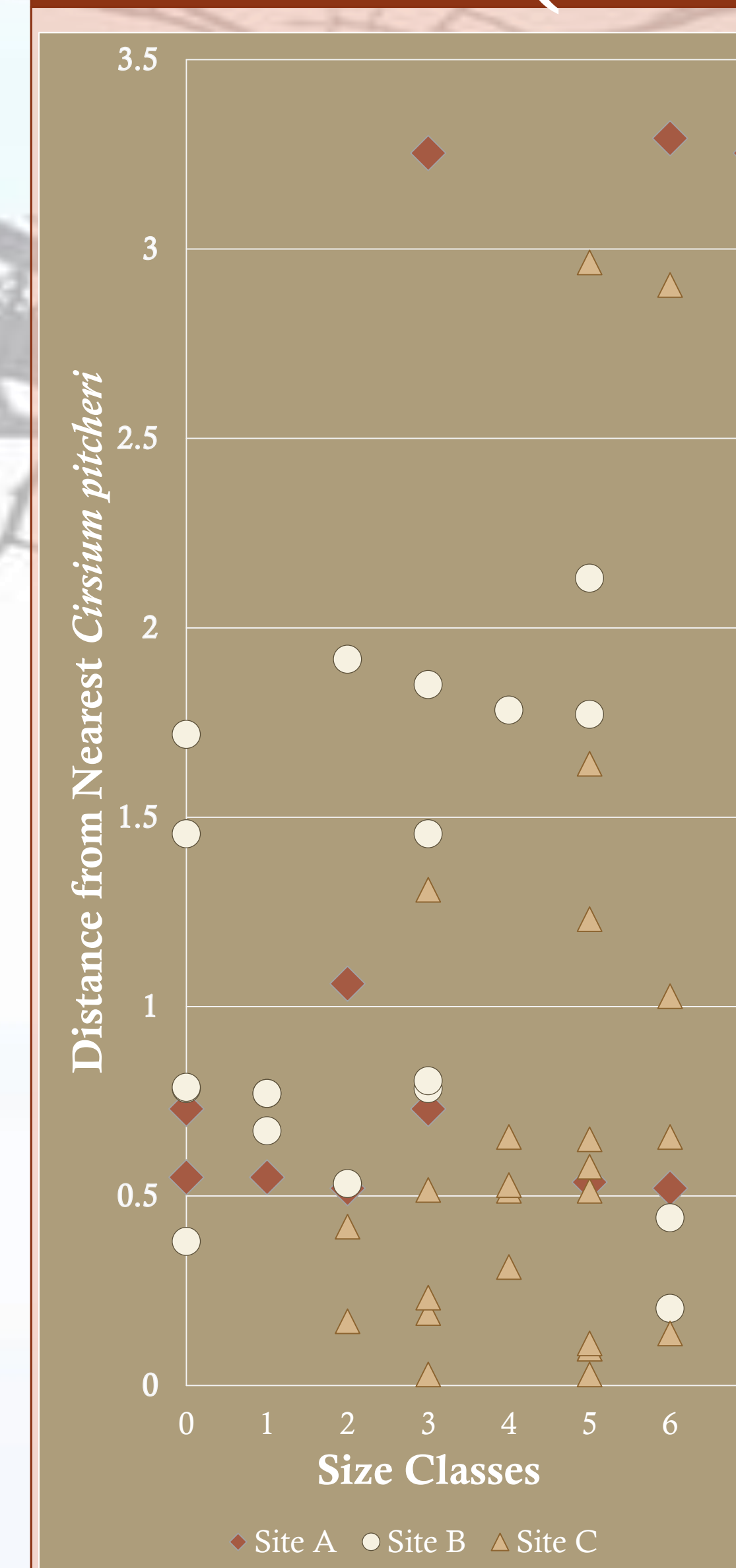


Figure 4. Study sites A, B, and C with documented *C. pitcheri* plants. Class sizes represent age groups based on longest leaf and each point represents an individual *C. pitcheri* plant.

	Slope	Dune Type	Human Impact	Grazing	Spatial Pattern*	Sand Movement†
Site A	2.7%	open dune	minimal	none	arc	>1cm
Site B	12.3%	blowout	moderate	1	scattered	>1cm
Site C	18.7%	slipface	moderate	none	clumped	no data

Table 2. Observed characteristics of each site. Notes: *of *C. pitcheri* † measured in 2 weeks

Results (continued)



Results of plant size measurements show that not all size classes (table 3) were present at all sites. Site A was missing class 4 and site C was missing class 1 and dead plants (figure 5). Distance of *C. pitcheri* plants from each other ranged from 0.03 to 3.24m.

Size Class	Longest leaf
1	2-5 cm
2	6-8 cm
3	9-11 cm
4	12-14 cm
5	15-18 cm
6	19-22 cm
7	23cm+
0	Dead

Table 3. (right) Size class groupings for *C. pitcheri* according to Girdler and Radtke (2006) [3].

Figure 5. (left) Graph of size class and distance from nearest *C. pitcheri* plant by site.

Discussion

The *C. pitcheri* population at Rosy Mound seems to be healthy due to the variety of locations and size classes present. According to our point quarter survey results, vegetation density surrounding individual *C. pitcheri* plants must be moderately vegetated.

Site A had the fewest *C. pitcheri* plants and had the least evidence of human presence while site B and C had the most evidence of human impact and more *C. pitcheri* plants. This suggests that human presence and number of *C. pitcheri* is not directly connected.

At sites B and C, topography was steep in areas without *C. pitcheri* suggesting that there is a maximum angle at which *C. pitcheri* thrives.

Conclusion

The *C. pitcheri* population at Rosy Mound is diverse in age and location. While anthropogenic impacts have a large scale effect on the species of *C. pitcheri*, direct human impact does not seem to have the most significant impact. Topography and vegetation density seem to have the highest impact on where and how *C. pitcheri* grows [3].

Acknowledgments

Ottawa County Parks and Calvin College for their facilities, Michigan Space Grant for funding, and Deanna van Dijk for continued support and mentorship.

Works Cited

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