Effects of Sand Fences on Two West Michigan Dunes

Caleb Betten, Andrew Hill, Onyinyechi Iheme, Joshua Newhouse, and Grace Prom

Calvin UNIVERSITY 1876

Abstract

Sand fences are an effective dune management strategy for reducing trampling and building sand deposition and vegetation. Our study investigated the efficiency of sand fences at two West Michigan parks. Our main objectives were to: map the sand fences, map damage points on the fences and trails, and assess the characteristics of the fences. We also gave the fences a grade on a scale from one to five, five being the most damaged. Porosity, height, and angle of the fences were measured and recorded as well. Sand fences are least effective at reducing foot traffic when most damaged. Most of the sand fences are located on the windward slope of crest. The majority of fences are in good condition and the damaged fences are least effective.

Introduction

Sand fences (Fig. 1) can alter dune morphology [1]. Few studies have investigated how effective sand fences are on West Michigan dunes.

In this study we:

- Map the sand fences
- Map damage points on the fences
- Map managed and unmanaged trails
- Assess the characteristics of the fences in order to determine their efficiency at promoting dune stability.

Figure 1: Sand fence at Mt. Pisgah

Study Location

Our study took place at two parks in Ottawa County: Mt. Pisgah and North Beach Dune (Fig. 2).

Figure 2: Map of study locations

Methods

We measured dune characteristics, sand fence locations and damages as well as unmanaged trails (Table 1).

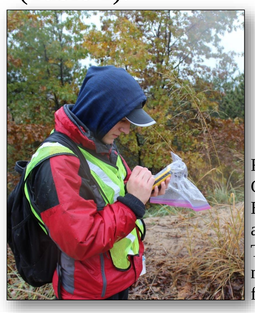

Figure 3: Caleb Betten uses a Juno Trimble to map dune fences.

Study Objectives	Methods	Equipment
-Map the sand fences and points of damage	-Record sand fence locations	-Juno Trimble GPS (Figure 3)
-Measure the characteristics of the sand fences	-Record fence characteristics -Record fence height, angle, and porosity	-Scale: 0-5 where 0 is the least damage -Clinometer -Measuring stick
-Investigate patterns between unmanaged trails and the location of sand fences	-Mapped unmanaged trails and sand fence damage location	-Juno Trimble GPS (Figure 3) -ArcGIS software

Table 1: Study objectives and methods

Results

Unmanaged trails (Fig. 4 and 5) intersect with the sand fences where they are the most damaged. This damage over time has caused an increase in foot traffic from a previous study [2].

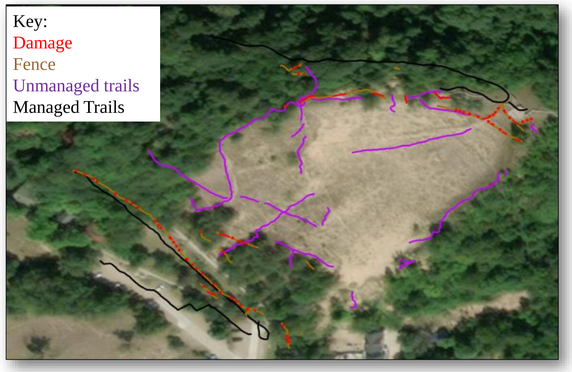

Figure 4: Map of Mt. Pisgah

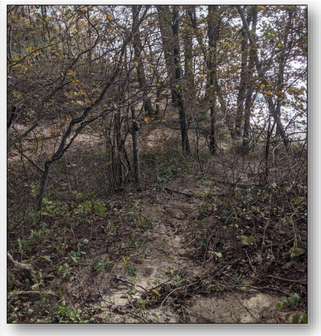

Figure 5: Unmanaged trail at Kirk Park

Figure 6: Map of sand fences at North Beach Dune

	Number of fences	Avg. Grade (0-5)	Avg. Height (cm)	Porosity (%)	Avg. Angle (degrees)
Mt. Pisgah	20	3.2	114	62.8	87.8
North Beach	28	1.7	109	63.7	86

Table 2: Table of fence characteristics at Mt. Pisgah and North Beach Dune

The majority of sand fences were located on the windward slope or crest of the dunes. North Beach Dune had more fences located on the slip face of the dune than Mt. Pisgah (Fig. 4 and 6).

Fences at North Beach are in better condition than Mt. Pisgah. Both sites have very similar angles and porosity percentages (Table 2). Porosity is the measure of open area compared to total surface area of the fence.

Discussion

The good conditions of the sand fences (Fig. 7), which are mainly located on the windward slope or crest, have kept people off the dunes and helped with deposition for plants that require sand burial like Pitcher's Thistle [3]. The damaged fences are ineffective at reducing foot traffic that have led to unmanaged trails. When first introduced, the sand fences effectively stabilized the dune surface. But after time they have become worn and less effective [2].

Replacing these fences would promote deposition and limit human impacts.

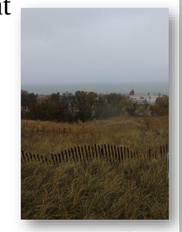

Figure 7: Sand fence at Mt. Pisgah

Conclusions

While the fences were mainly in good condition, damage to the fences has caused an increased amount of unmanaged trails. The fences are also effective in increasing vegetation diversity. We were able to conclude that the sand fences were least effective when they were heavily damaged. The damage most directly impacted the amount of unmanaged trails.

Acknowledgements

We thank Professor van Dijk for giving us the opportunity to study the dunes. We would also like to thank our mentor Peter Duimstra for his guidance. We would like to thank Calvin University as well as the Michigan Space Grant for providing funding for our research. In addition we would like to thank the Ottawa County Parks for providing access to the dunes.

Works Cited

[1] Grafals-Soto, R., and K. Nordstrom. 2009. "Sand Fences in the Coastal Zone: Intended and Unintended Effects." *Environmental Management* 44, no. 3: 420-29.

[2] Etienne K., A. Crevier, J. M. Davis, S. A. Praamsma, and A. Tauscheck. 2016. "Evaluating Sand Fence Placement, Purpose, and Efficacy on West Michigan Dunes." FYRES: Dunes Research Report #20. Grand Rapids (MI): Department of Geology, Geography and Environmental Studies, Calvin College. p.1-17.

[3] Dong, Z., G. Qian, W. Luo, and H. Wang. 2006. "Threshold Velocity for Wind Erosion: The Effects of Porous Fences." *Environmental Geology* 51: 471-475.