Intended and Unintended Effects of Sand Fences in Ottawa County Parks

Alejandra Crevier, Jack M. Davis, Stephanie Praamsma, Adrienne Tauscheck

Calvin COLLEGE 1876

Abstract

Many sand fences are present on Lake Michigan dunes but little scientific research has been conducted on their true purpose and effects. This study investigates intended and unintended effects of these sand fences on dunes in West Michigan, USA. Our group conducted numerous studies in the fall of 2015 at four different Ottawa County Parks. We measured the heights of fences above the sand level and the slope of the dune. We also GPS mapped sand fences in our study sites and took numerous in-depth photos and depositional/porosity ratings. After all of this data was taken, analysis provided us with various correlations between variables studied. We found sand fence quality was directly related to the amount of deposition of sand behind the fence. The location of the fences throughout the dune environment also affected deposition, particularly the amount of vegetation around the fences. Our findings will provide dune managers in west Michigan with information to better manage the dunes near Lake Michigan.

Introduction

Sand fences play a large role in human management of coastal dunes [1], and they are commonly used on the dunes of the Lake Michigan coast; however these effects have not been investigated in Michigan. Sand fences are installed in order to preserve the environment by controlling the flows of water, air, sediments, people, and animals, but they do not always cause the dunes to change naturally as they should [1]. Our study investigates the effects of sand fences on the surrounding dune environment at West Michigan sites.

Our **study objectives** were:

- To document and map sand fences on the dunes of Lake Michigan in parks in Ottawa County
- To compare characteristics of sand fences at each site
- To determine the intended and unintended effects of the sand fences on the surrounding dune environment.

Study Area

We chose four Ottawa County Parks on the east shore of Lake Michigan for our study (Fig. 1).

Figure 1: Study areas on the southwest coast of Michigan, USA.

Methods

In each park, we measured the characteristics of sand fences (Fig. 2) including:

- Location, length and presence of unmanaged trails by GPS mapping
- Deposition near the sand fence (custom ranking scale)
- Damage to fences (custom ranking scale)
- Slope angle measurements of the dune face beside the fence using a compass with an inclinometer
- Porosity (custom ranking scale).

Figure 2: Research team at Mt. Pisgah.

Results

A total of 32 sand fences were studied: 2 in Tunnel Park, 9 on Mount Pisgah, 14 on North Beach Dune, and 9 in Kirk Park.

- *Location of sand fences affect human accessibility and create trails on the dunes.*

The two main purposes of sand fences are to prohibit access to certain parts of dunes to prevent destruction of vegetation and to trap sand for dune stabilization. However, a strong correlation between the location of the sand fences and the unmanaged trails on the dunes was observed. Many times throughout our study sites, alternative human pathways appeared to have been a byproduct of the installation of sand fences, appearing through or around the fences (Fig. 3).

- *Sand fence location affects sand deposition.*

Observed sand deposition ranged from 0 cm to 69 cm. Sand fences in unvegetated areas had more deposition than fences in vegetated areas. Sand fences placed near parking lots also showed signs of lesser deposition (highest height 48.5cm).

Figure 3: GPS map of the sand fences and unmanaged trails in Kirk Park. Red lines represent sand fences, purple lines represent unmanaged trails.

- *Sand fences are prone to damage, affecting effectiveness.*

In our study we found that 50% of the fences were heavily damaged, 32% were lightly damaged, and 18% were new. 83% of all the fences observed were damaged (Fig. 4 and 5). The damage inflicted on the fences affected the porosity of the fences and the value they have in preventing human traffic. 85% of the sand fences had a porosity of 60% or above.

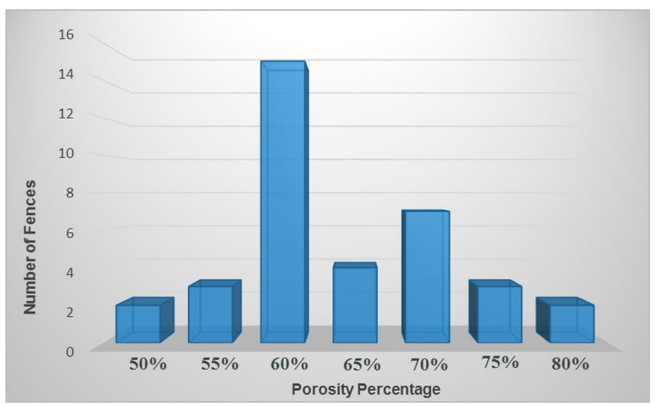

Figure 4: Porosity of studied sand fences. No fences observed at the study sites had porosities of less than 50%.

Types of Damage	Probable Causes
Broken/snapped wooden slats	Human traffic, weather conditions (such as rain, snow, and wind)
General weathering	Weather conditions, vegetation overgrowth, moving sand
Missing wooden slats	Human traffic, weather conditions, falling trees/branches
Fallen over wooden slats	Human traffic, weather conditions, erosion of sand
Detached wooden slats from wire	Human traffic, weather conditions, erosion of sand
Entire fence detachment from metal poles	Human traffic, weather conditions

Figure 5: Types of damages observed on sand fences and probable causes.

Discussion

Throughout the dunes observed in this study, sand fences are clearly causing intended effects, but more times than not the fences have unintended effects as well. Sand fences are intended to misdirect human traffic in some areas, but are unintentionally causing lightly trafficked paths which have lead to widespread destruction of vegetation. Sand fences are also most effective when installed in areas with little to no vegetation, and will be ineffective in depositing sand when placed in stable, vegetated areas. The damage inflicted on the fences by various external factors affected the porosity of the fences and the value they have in preventing human traffic and deposition. The ideal fence porosity for maximum prevention of wind erosion is between 30% and 60% [2,3]. Damaged fences, such as the ones we observed, lose porosity, and therefore are rendered less effective in their ability to prevent erosion on the dunes. The damage to fences also affects human traffic, as damaged fences are much more likely to be traveled through, which could result in even greater damage to the fence, which affects the vegetation and dune overall. The fences observed in our study were weathered, damaged, and placed in areas which caused them to cause unintended effects on the dunes.

Conclusions

Our results found from our four different study sites that fences are commonly used to control human access, as well as control sand. Although most of the effects of the sand fences we observed were positive, there were many unintended consequences. Some of these consequences included broken down fences, misdirected human traffic, and the absence of sand deposition. We strongly feel that from our study local dune managers will be able to use our data to better manage fences and in turn help the Ottawa County dune environment as a whole.

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