Investigating Sand Fence Placement and Condition across Lake Michigan Dunes

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Abstract

Adding sand fences to a dune can significantly impact morphology, ecology, and human interactions with the landscape. Although the effects (intended and unintended) of sand fences have been documented on ocean coasts, no such study has focused on the Great Lakes region. In autumn 2015, we visited four Ottawa County Parks along Lake Michigan's coast to map the locations of fences and unmanaged trails. We photographed each site to capture fence settings and conditions. We estimated porosity and recorded damage intensity and type for each fence. We categorized the amount of deposition near each fence using a ranking system. Our results show that fence locations affect human accessibility and sand deposition. Unmanaged trails often appeared to be a byproduct of fence placement. The greatest deposition on average was observed at the least vegetated site closest to the shore. The greatest variation in deposition was observed at a vegetated site on the windward slope of a parabolic dune. Most fences were damaged, lowering their ability to deter human traffic or trap sand. Our study results add to the body of knowledge on sand fence location, orientation, and condition, providing information that can aid management practices to promote a healthy dune environment.

Introduction

Sand fences are human-made structures that are placed on a dune landscape primarily with the intent to alter or control its morphology [1]. While multi-site studies of fence placement have been conducted in other settings in the past, no such study has focused on dunes in West Michigan.

The objectives of this study were to:

- Document and map sand fences on dunes in four coastal parks
- Compare characteristics of sand fences at each site
- Determine the intended and unintended effects of the sand fences on the surrounding dune environment

Study Area

Our study focused on four parks in Ottawa County on the eastern coast of Lake Michigan (Fig. 1). We chose an area within each park and mapped all of the fences in that area.

Figure 1- Study areas in Michigan, USA

Methods

We assessed characteristics of wooden slat sand fences and their surrounding environment at each park (Table 1). Custom ranking scales were developed to estimate deposition and damage to fences. Rankings were performed at each site by the same team member for consistency. One or multiple installation purposes were estimated for each fence.

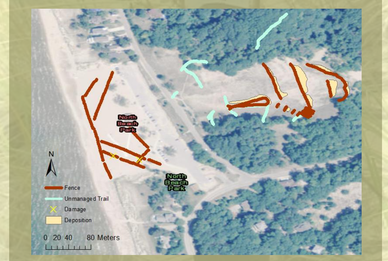
Variable	Procedure	Purpose
Location	Mapped with GPS	Document presence and spatial patterns
Setting	Observed vegetation and setting Mapped nearby unmanaged trails	Assess impact of location Evaluate traffic control effectiveness
Orientation	Analyzed with GIS software	Assess arrangement
Purpose	Estimated fence purpose	Identify motivations for installment
Deposition	Ranked deposition amount Measured fence height	Evaluate deposition near the fences Document patterns of deposition
Damage	Estimated porosity Ranked damage amount	Assess sand-trapping capability Evaluate efficiency in erosion prevention

Table 1- Methods used to examine fence characteristics

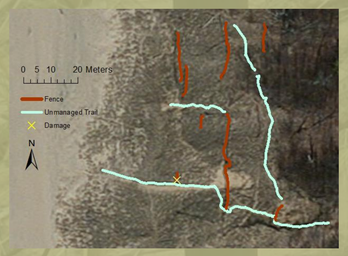
Results

Fences and Unmanaged Trails

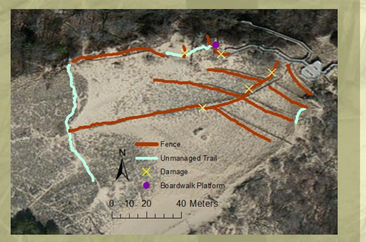
We mapped 32 fences in total (Figure 2). Unmanaged trails were often observed going around the edge of a row of fences or traveling along the length of a fence. Some unmanaged trails went through damage in fences.



North Beach Dune



Kirk Park



Mt. Pisgah

Figure 2- Fences and unmanaged trails at three sites

Orientation and Purpose

More fences were oriented parallel to the shore than in any other direction (Fig 3). Estimated purposes for installing fences varied, with the most likely reason being to slow sand (Table 2).

Purpose	Frequency
Slow Sand	32
Protect Vegetation	17
Control Access	16

Table 2- Frequency of purposes for installing fences

The greatest deposition on average was observed at the least vegetated site closest to the shore.

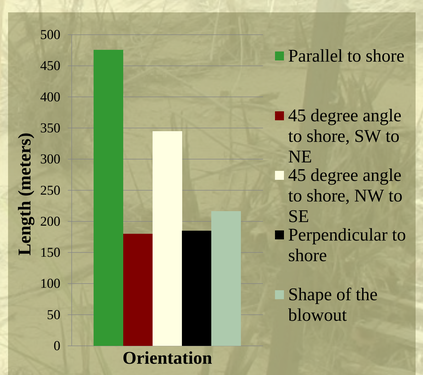


Figure 3- Total length of fences observed and their orientation to the shore

Damage and Porosity

Most of the fences we observed were damaged in some way (Table 3). The most common causes were human traffic and weather conditions. The most frequent fence porosity was 60% (Fig. 4), slightly more than the porosity of a brand new fence.

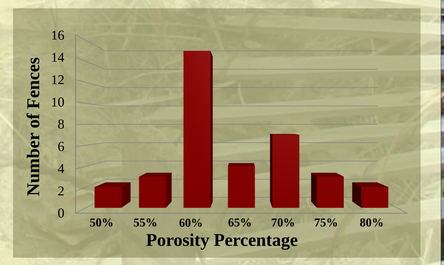


Figure 4- Estimates of sand fence porosity across the various sites

Types of Damage	Probable Causes
Slats broken or snapped	Human traffic, weather
General weathering	Weather, vegetation growth, sand erosion
Slats missing	Human traffic, weather, falling trees/branches
Slats fallen over	Human traffic, weather, sand erosion
Slats detached from wire	Human traffic, weather, sand erosion
Fence completely detached from poles	Human traffic, weather

Table 3- Fence damage observed and probable causes

Discussion

Most fences were damaged and could not trap as much sand as newly installed fences. Measured porosity was generally higher than the 30-60% porosity identified by previous research as ideal for the prevention of wind erosion [2,3].

The location of unmanaged trails relative to fences suggests the fences may restrict access to certain areas, but not always to the dune as a whole (Fig 5).

Previous research suggests straight fences parallel to the shore encourage a more natural dune morphology than do angled fences [1]. The variety of fence orientations that were not parallel to the shore may be affecting the dune environment in unnatural ways. Further research is needed.

Figure 5- A damaged fence at Mt. Pisgah. Bare sand indicates an unmanaged trail going through the fence.

Conclusions

Most of the sand fences we studied were oriented parallel to the shore and likely intended to slow sand. The fences seemed to have mixed effectiveness in controlling traffic. Our observation of fence damage suggests better maintenance could lead to more erosion prevention.

Acknowledgments

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