Considering Management for a Blowout in Kitchel-Lindquist-Hartger Dunes Preserve

Peter Duimstra, Christopher H. Anderson, Katherine C. Benedict, Haleigh I. Bos, Kees VanDerAa, Lesley Vargas, April Volzer

Calvin College 1876

Abstract

Active dunes can cause property damage if they move onto developed property. The southernmost blowout in Kitchel-Lindquist-Hartger Dunes Preserve is currently posing a threat to two developments: the preserve outdoor classroom and the North Shore Marina. To advise the management planning, we studied the current state of the blowout, including the dune features, the activity level and current management. We inventoried dune features, gathering data about vegetation coverage and areas of bare sand. We used erosion pins on the windward and leeward slopes of the blowout to measure how much erosion was occurring. We surveyed topography to analyze the shape and structure of the dune. Results from the erosion pin data made it apparent that the dune was active. The presence of early colonizers in the bowl of the blowout and bushes on the slipface suggest that the dune is stabilizing to some degree. A sand fence is stabilizing the midsection of the dune. More sand fences, or the implementation of some barriers with lower porosity, could significantly stabilize the dune and would decrease the likelihood of any future threats to the nearby developments.

Introduction

Dunes are capable of causing significant damage if they advance onto developed property. This is a cause for concern for dune managers who must balance managing a dune versus letting processes occur naturally [1, 2]. To inform management, this study focuses on collecting data about dune characteristics and activity for a blowout threatening nearby infrastructure.

Study Objectives

1. To inventory the natural and anthropogenic dune features
2. To investigate dune activity

Study Area

Kitchel-Lindquist-Hartger Dunes Preserve is located in Grand Haven, MI (Fig. 1) near the mouth of the Grand River. The southern blowout (Fig. 2) was the focus of this study and is located next to the preserve parking lot, an outdoor classroom and the North Shore Marina.

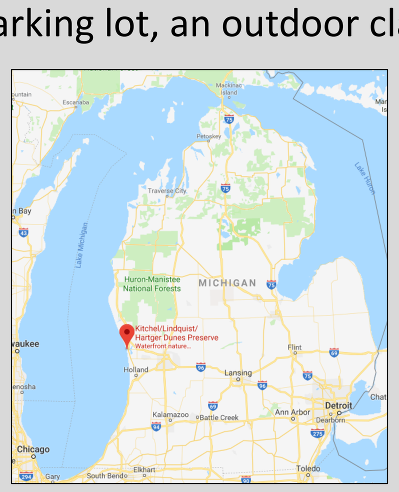

Figure 1: Study location is shown on the Lake Michigan coast.

Figure 2: The blowout is shown in the context of nearby infrastructure (blowout circled on aerial view) and as viewed from the west (ground view).

Methods

We used GPS mapping and observations to inventory dune features (Table 1, Fig. 3). We also measured erosion and deposition in the blowout (Table 1, Fig. 4).

Research Objective	Method	Details (Equipment, Etc.)
Inventory Natural Dune Features	• Mapped blowout topography with a total station • Inventoried vegetation communities in blowout areas • Recorded significant dune features such as erosion or wetlands	• 300 points surveyed with Sokkia SET530R total station • Used categories in Dune Features Inventory checklist • Mapped features with GPS and photographed them
Inventory Anthropogenic Dune Features	• Mapped unmanaged trails [2] • Mapped current management (such as sand fences)	• GPS data imported to ArcGIS • Photographed features
Investigate Dune Activity	• Measured erosion and deposition with erosion pins • Compared surface changes to wind data	• 27 erosion pins at 2 m intervals transecting the dune • Analyzed wind data from reference measurements 5.8 km north of blowout

Table 1**:** Study methods for each research objective.

Figure 3: For the topographic survey, the total station was set up on the dune crest.

Figure 4: Erosion pin measurement by an unmanaged trail on the upper leeward slope of the dune.

Results

Natural Dune Features

The saucer blowout has a height of 14 m and an average diameter of 62 m (Fig. 5). The blowout's main axis is oriented SE-NW. The leeward slope is steeper than the windward slope, with a steep scarp at the crest of the dune.

Most of the blowout's deflation area is bare sand (Fig. 6). At the bottom of the deflation area there is a small dune wetland surrounding some standing water. The leeward slope is covered by dune grasses and some shrubs.

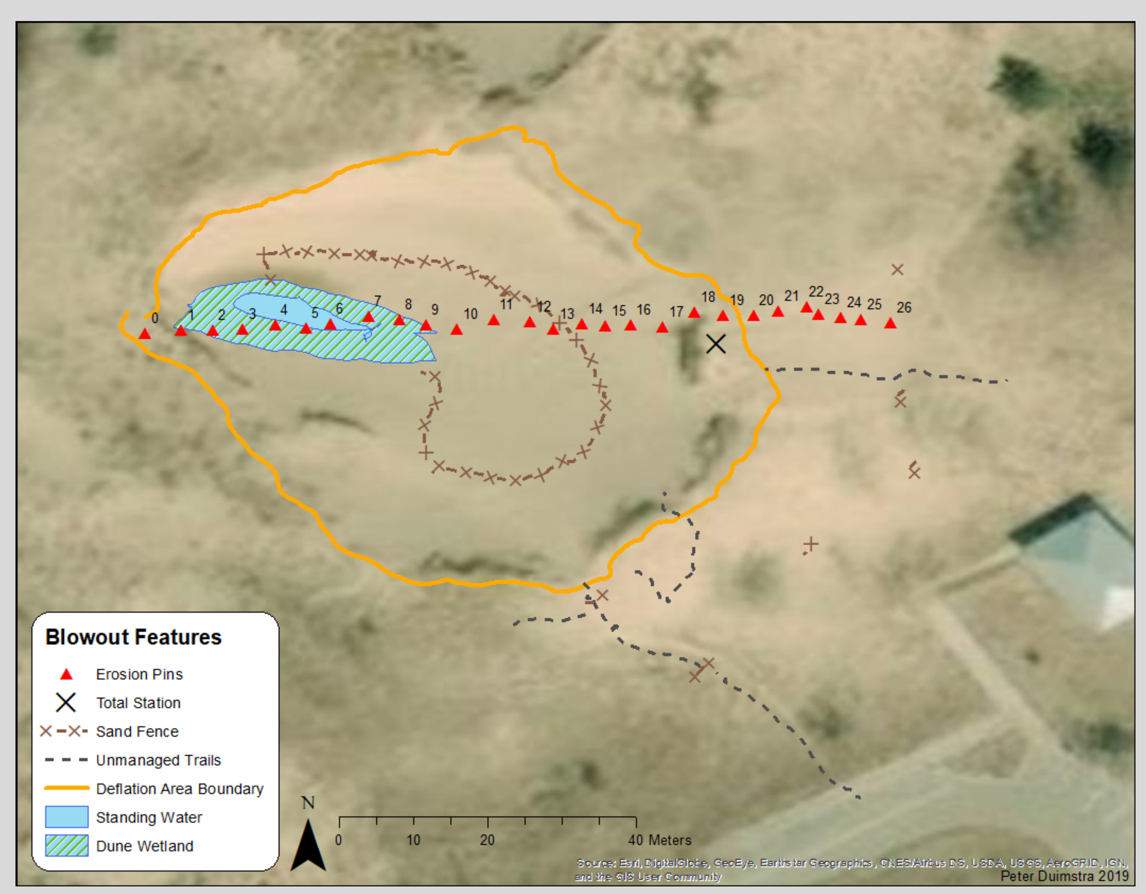

Figure 6: Blowout features (mapped with GPS) are shown on an aerial image of the site.

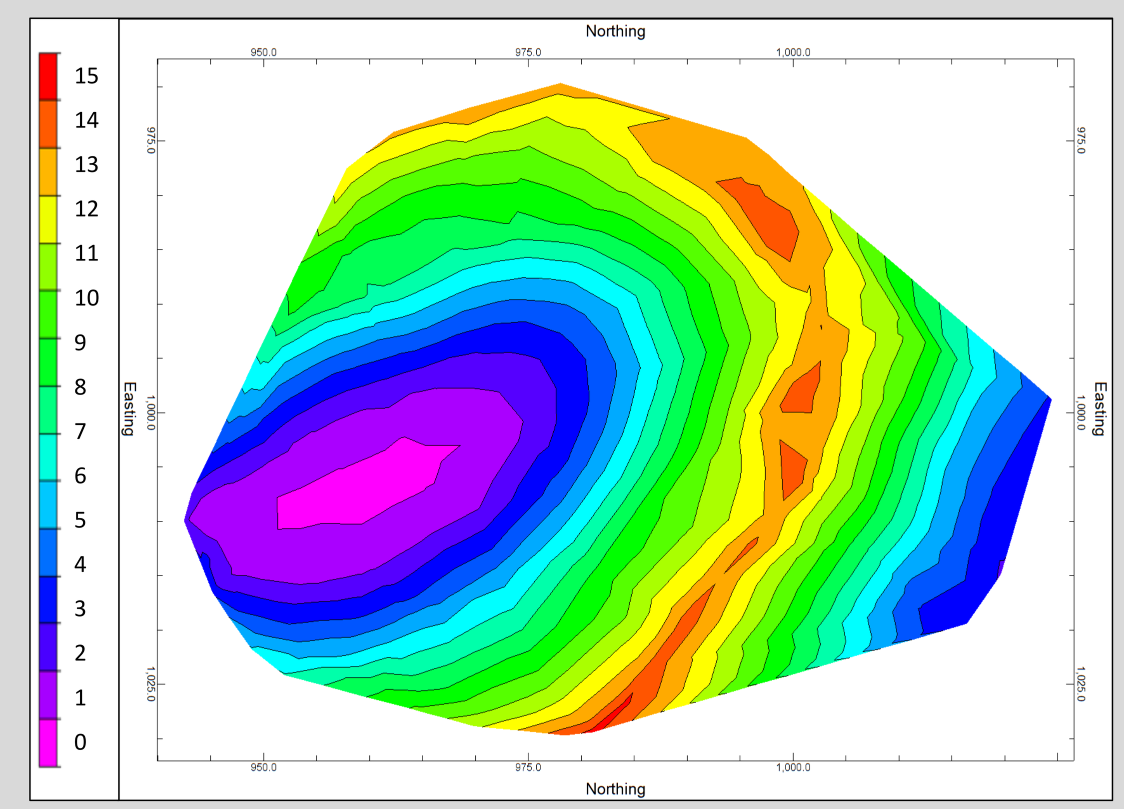

Figure 5: Topographic map of study area. Units are in meters where 0 is the lowest elevation recorded and 15 is the highest.

Anthropogenic Dune Features

Management is present on the blowout in the form of 6 sand fences: 1 long one in the middle of the windward slope and 5 smaller fences on the leeward slope (Fig. 6). The only vegetation on the windward slope is downwind of the main sand fence (Fig. 7).

Human impacts are visible in the form of unmanaged trails on the leeward slope.

Figure 7: Blowout deflation area and small dune wetland as viewed from the crest.

Dune Activity

Results show sand movement over the entire length of the blowout (Fig. 8). Most of the surface change was erosion on the windward portion below the sand fence as well as the slipface. There was deposition between the sand fence and the dune crest, with the largest gain in sediment measured at the crest.

Evidence of erosion was observed on the lower windward slope and just below the dune crest (Fig. 9).

Measurements and observations took place in the context of several strong wind events (Fig. 10). Wind energy was highest during the week of Nov. 1-8.

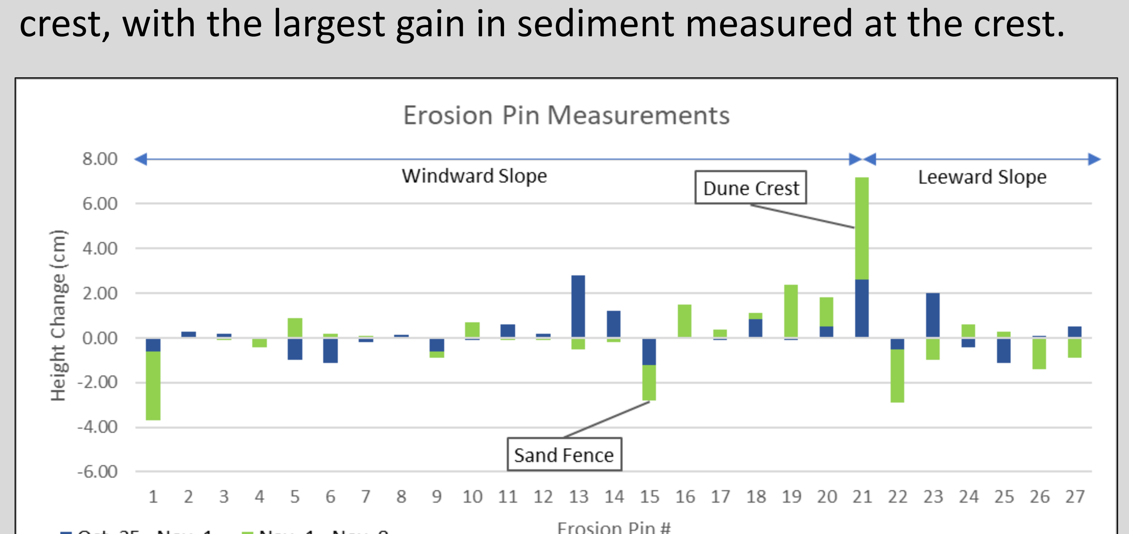

Figure 8: Surface changes as recorded at erosion pins between October 25 and November 8, 2018.

Figure 9: Erosion in action on the windward slope near the crest.

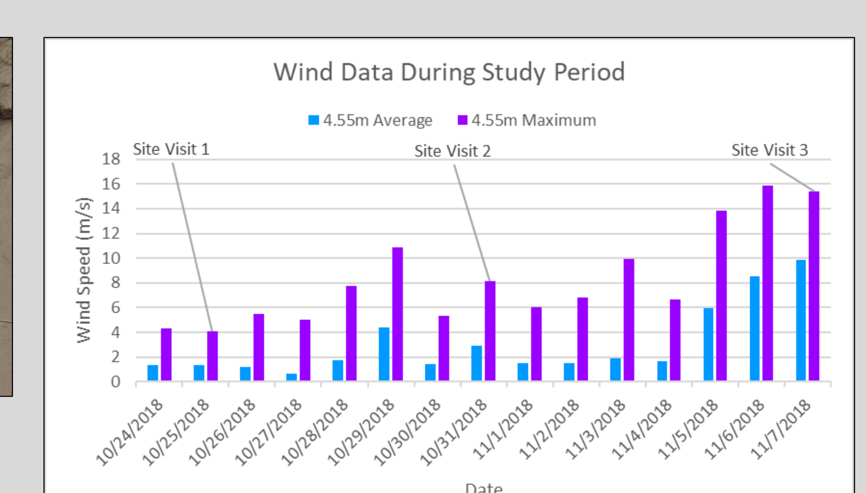

Figure 10: Wind velocities measured at reference dune site (Hoffmaster State Park) north of our study area.

Discussion

The active status of the dune is indicated by the presence of bare sand in the deflation area and early-succession vegetation on the leeward slope. Erosion and deposition measurements along the main axis of the blowout provide additional evidence of dune activity. Our results are consistent with autumn storm winds causing seasonal changes to Michigan dunes.

Figure 11: Position of grasses relative to sand fence suggests management effectiveness, but some parts of sand fence are collapsing.

Management is effectively stabilizing parts of the dune with sand fences. On the dune's windward slope, the strip of *Ammophila breviligulata* growing downwind from the sand fence suggests that conditions have stabilized sufficiently for the dune grass to grow (Fig. 11). Additional management in the form of sand fences, or other barriers with lower porosity, could further stabilize the dune.

The main axis of the blowout points towards the outdoor classroom, which makes it likely that the dune is advancing in that direction [3]. Information from the dune managers suggests that the dune is advancing at a rate of 0.1 meters per year. The leading edge of the dune is roughly 25 meters from the outdoor classroom. Damage from the blowout is unlikely in the near future, but additional management could reduce the risk of damage.

Figure 12: Distance between the blowout and the outdoor classroom can be seen in this view from the blowout crest.

Conclusions

The moderately-sized saucer blowout shows widespread signs of movement and an advance direction towards the outdoor classroom. Current management is stabilizing the upper windward slope with a sand fence. Additional fences or other barriers could increase stabilization and decrease future problems from dune advance.

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Works Cited

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