Dune Advance and Vegetation on an Active Blowout

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Abstract

Few dunes have direct measurements of dune advance rates and directions. Our research explores whether it is possible to estimate dune advance through investigating patterns of vegetation. Our study focuses on an active blowout in the Kitchel-Lindquist-Hartger Dunes Preserve north of Grand Haven, Michigan. Sand movement, erosion, and deposition were measured with sand traps and erosion pins over two weeks to determine sand transport rates and common directions of movement. In order to assess blowout activity, vegetation communities were mapped with handheld GPS units and species were recorded with random quadrat sampling. We mapped sand movement from Oct. 24 - Nov. 7, 2019. There was active sand transport over the dune crest towards the northeast, away from the outdoor learning center. The least sand movement was observed in stable dune areas with dense *Ammophila breviligulata.* Our results show that patterns of vegetation can be possible indicators of rates and directions of dune advance.

Introduction

Dune advance is a hazard which can become a concern for park managers when anthropogenic structures are in the way. Olson's [1] work on the relationship between vegetation and dune advance suggests that vegetation types and patterns might be useful as indicators of dune advance. Our research explores whether it is possible to estimate dune advance through investigating patterns of vegetation.

Research Objectives

1. Measure dune activity and advance for an active blowout
2. Record vegetation patterns on the blowout
3. Look for connections between vegetation characteristics and dune advance patterns

Study Area

Our study area is an active blowout in the Kitchel-Lindquist-Hartger Dunes Preserve in Grand Haven, Michigan (Figure 1). A previous study concluded that there were widespread signs of activity within the blowout, which was believed to be advancing toward an outdoor learning facility [2].

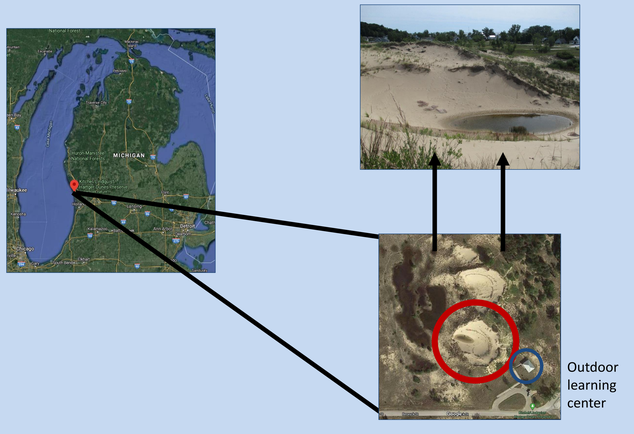

Figure 1. Study location on the east coast of Lake Michigan, with aerial and ground images of the blowout.

Methods

We measured dune activity and vegetation patterns on the blowout (Table 1, Figure 2). Field data was collected between Oct. 24 and Nov. 7, 2019.

Objectives	Measurements	Methods
Measure Dune Advance and Sand Movement	• Measured erosion and deposition in the blowout • Collected sand on the crest to measure rates of aeolian transport • Mapped wind directions relative to surface change and sand transport data • Looked for evidence of dune advance at slipface edge	• Erosion pins (16 locations) • Leatherman sand traps (4 locations) • Wind measurement site at Hoffmaster State Park • Boundary points (3)
Record Vegetation Patterns	• Mapped distinctive vegetation communities • Visually surveyed species within communities • Sampled vegetation characteristics at 40 random sites on blowout's leeward slope	• Vegetation community classification • GPS Trimble units • Quadrats (40 locations) • Photo documentation • Density count, height measurement with ruler
Investigate Connections	• Visualized and compared dune activity results with vegetation patterns	• GPS Trimble units • Data processing programs (Excel, ArcGIS)

Table 1. Objectives, methods, and equipment used.

Figure 2. Measurement locations in the blowout

Results

Blowout Activity

The blowout had very little sand transport during our study except for sand trap 3 which recorded 39.1 kg/m-width/week during the second week. Erosion pin 3 was the only pin that experienced significant deposition (Figure 3). Wind direction matched sand measured with sand traps and erosion pins (Figure 4).

From September through November no evidence of dune advance was recorded at the bottom of the leeward slope.

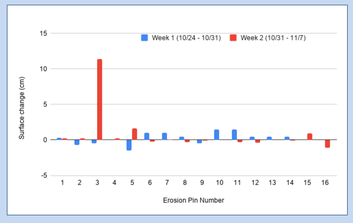

Figure 3. Surface change measured at erosion pins (+ = deposition; - = erosion).

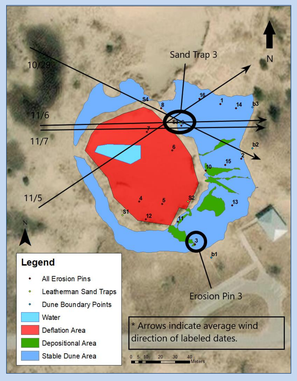

Figure 4. Wind directions mapped over the study area.

Vegetation

Grasses were the most populous and dense community, taking up most of the northern and southern parts of the leeward slope (Table 2, Figure 5). Near the learning center areas of grass and trees were observed along with bare sand areas.

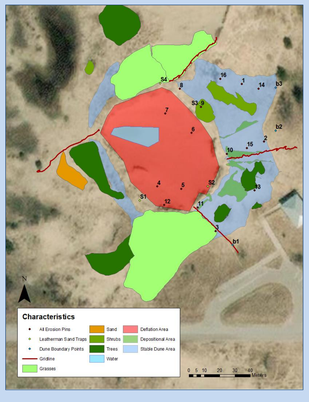

Figure 5. Vegetation communities mapped against blowout characteristics.

Community Type	Density plants/m²	Predominant Species	
Grasses	32	*Ammophila breviligulata* (American beach grass)	*Calamovilfa longifolia* (Prairie sandreed)
Shrubs	4	*Salix Myricoides* (Bayberry willow)	*Cornus sericea* (Red osier dogwood)
Trees	4	*Populus deltoides* (Cottonwood)	

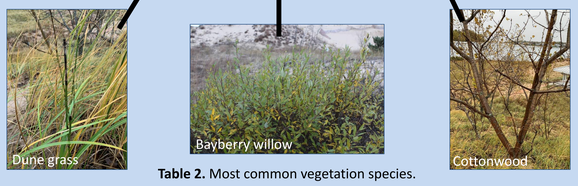

Table 2. Most common vegetation species.

Connections

Tree and shrub communities are areas of little sand movement during our study and these areas had the smallest plant densities. Grasses were the most widespread on the upper leeward slopes where there was more sand transport and deposition (Figure 5).

Discussion

The direction of wind and sand movement during our study does not support dune advance towards the learning center. Our data does match the strong west winds common during fall and winter on west Michigan dunes [3].

No evidence of sand reaching the bottom of the slipface during our study does not mean there is no dune advance. During fall and winter, wind-blown sand may accumulate on the upper slipface and not reach the bottom of the slipface until late spring after snow and ice thaws [4].

Bare sand areas on the upper leeward slope are likely from trampling rather than wind-blown sand movement (Figure 6).

Figure 6. Bare sand area on the leeward slope

Flourishing *A. breviligulata* on the upper leeward slope may indicate burial by sand from wind or trampling (Figure 7). Trees and shrubs indicate more stabilized parts of the leeward slope, which do not thrive on sand burial like grasses.

Figure 7. *A. brevigulata* on the leeward slope

Conclusion

The blowout had active sand transport over the dune crest, but no sand reached the bottom of the slipface. Grasses on the upper leeward slope indicated deposition, and trees and shrubs were in more stabilized areas. Our results show that patterns of vegetation can be indicators of dune activity and advance.

Acknowledgements

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Works Cited

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