Effects of Planted Vegetation and Sand Fence Management at Castle Park Dune

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Abstract

Coastal dunes are dynamic ecosystems where management strategies are necessary to maintain stable and healthy ecosystems. This study took place at Castle Park Dune where as a result of previous human impacts, sand fences and planted vegetation were used in attempts to preserve the dune. We used erosion pins, quadrats, GPS and transect surveys to assess the effects of these management strategies on the dune. Vegetation data showed that proximity to sand fences correlated with vegetation density. The least amount of sand movement occurred in areas with greater vegetation, suggesting that more densely planted vegetation could further stabilize the dune system.

Introduction

A stabilized dune plays an important role in its surrounding environment. However, there has been little previous research regarding management methods on dunes with steep slopes in the Great Lakes Region. A previous study done at Castle Park Dune looked at the effectiveness of sand fences as a method of stabilization (1). The goal of our study was to further evaluate the effectiveness of sand fences and planted vegetation at the same site.

Objectives:

- Document location and condition of planted vegetation areas and sand fences.
- Measure sand movement in respect to sand fences and vegetation.
- Assess the characteristics of plants on the dune.
- Evaluate the effects of sand fences and vegetation on dune topography.

Study Area

Our study area is the windward slope of the active parabolic dune in Castle Park Reserve near Holland, Michigan (Fig. 1). Vegetation and sand-fences have been previously installed by the Land Conservancy of West Michigan at this site.

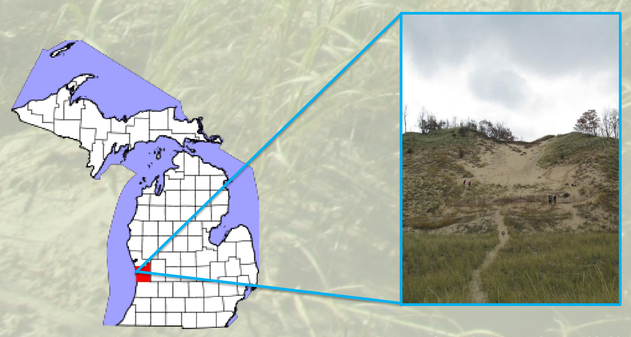

Figure 1: Castle Park Dune, October 30, 2014.

Methods

We took a GPS survey to document dune features and the areas where research was conducted. We used 42 erosion pins to measure sand deposition and created a transect line to evaluate the topography of the dune's windward slope (Fig. 3). We used quadrats to randomly survey the vegetation density, height and diversity of 26 plots (Fig. 2).

Figure 2: Researchers implement the quadrat method.

Figure 3: Researchers use erosion pins and flags to create a transect line.

Results

The average height in section B was greater than section A (Fig. 4). Section A has a higher average percentage of vegetation cover, double the average number of stalks, as well as longer average leaf length than found in section B. *Artemisia campestris*, *Ammophila breviligulata*, and *Calamovilfa longifola* were the three species that were found in the study area and were mostly concentrated on the section A side (Fig. 5).

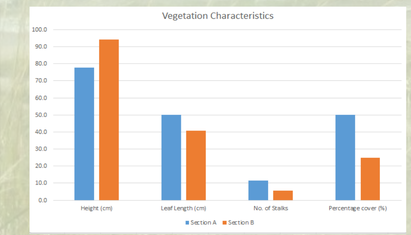

Figure 4: Average vegetation characteristics of sections A and B of Castle Park Dune.

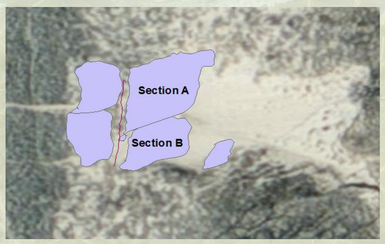

Figure 5: Location of vegetation characteristics of sections A and B correlating to figure 4.

There was a larger range of erosion measurements taken in front of the sand fences, with the largest having a range of 8.6 cm. The smallest range was documented in the area of medium amount of vegetation behind the sand fence, with the smallest range being 2.1 cm (Fig. 6). The area with the second highest amount of erosion and deposition was located behind the sand fence in an area without vegetation (Fig. 7). Vegetation was more dense on the eastern side of the sand fence.

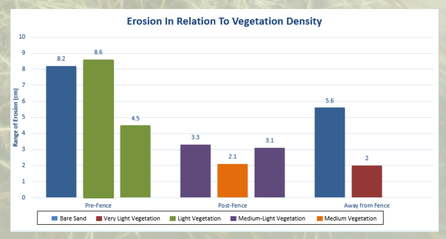

Figure 6: The relationship between vegetation density and erosion in relation to the sand fences .

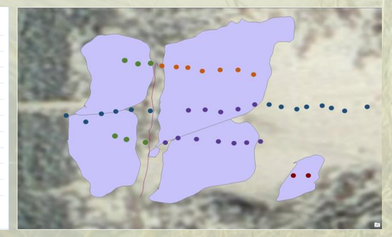

Figure 7: Location of erosion pins in relation to Figure 6.

The average slope of the dune was found to be 1.2 meters of elevation gain for every horizontal meter.

Discussion

Based on the results, there was the most erosion and deposition in the pre-fence zone where there was either bare sand or light vegetation. The least amount of erosion occurred in areas with medium-light to medium amounts of vegetation behind the sand fence (Fig. 8). Studies show that planting dune-building species is an effective method for dune stabilization (2). In addition, other studies concluded that sand fences were essential in dune systems where rapid sand accumulation occurred (3).

Figure 8: View from behind the sand fence

The majority of section A had a medium amount of vegetation (Fig. 9), double the percentage coverage and number of stalks of section B. Therefore, we can conclude that there is a correlation between the density of plants and the amount of erosion that occurs on a dune.

Figure 9: Vegetation behind the sand fence

Conclusion

In the end we found that the areas with the most amount of vegetation had the smallest range of erosion measurements. In addition, the areas of erosion measurement behind the sand fence had an overall smaller range of erosion measurements than the measurements taken in front of the sand fences. Therefore, the most effective management strategy would be to use sand fences and vegetation on a steep dune.

Acknowledgements

- Justin Heslinga of the Land Conservancy of West Michigan for allowing us to execute research at Castle Park Dune
- Michigan Space Grant Consortium for funding
- Deanna van Dijk for subject expertise and research guidance
- Mentor Katy Gerber for research and data evaluation support

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