First-Year Research in Earth Sciences: Dunes

# Effectiveness of Management Techniques Employed at Mt. Pisgah

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**ABSTRACT**

Although many Great Lakes coastal dunes possess some level of management, few studies examine whether or not the techniques employed are successful. This project evaluates the effectiveness of management techniques implemented on a highly popular dune on Lake Michigan. Mt. Pisgah is a large parabolic dune in Holland, Michigan that local residents suspected was being degraded by overuse, prompting the

## INTRODUCTION

Coastal dunes are dynamic environments, shifting in response to sediment, wind, flora, and fauna. Humans are naturally drawn to undeveloped areas, and the combination of sublime beauty and natural diversity found in dunes makes them especially popular. However, the overuse of dunes can diminish their recreational potential and threaten the viability of local ecosystems, prompting more intensive management (Carlson and Godfrey 1989). In the Great Lakes, Mt. Pisgah in Holland, Michigan is an example of a coastal dune that was shown to be changed by human activities and had management techniques implemented to try to mitigate those changes (van Dijk and Vink 2005). This study investigates whether the management techniques implemented at Mt. Pisgah have been effective at mitigating existing human impacts and whether they will be able to prevent future impacts.

The objectives of this study are:

- To map and assess the presence and quality of implemented dune management techniques,
- To measure dune activity and stabilization on the dune,
- To compare measured dune activity with dune activity in 2005 (as reported by van Dijk and Vink 2005), and
- To investigate visitor perception of dune management in Mt. Pisgah.

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perceptions of dune management techniques. Visitor compliance to guidelines was also gauged separately by analyzing mapped human impacts such as litter, broken and trampled fences, and unmanaged trails.

Questionnaire responses were compared to results of questionnaires given to dune visitors in 2005. Sections that were repeated in 2012 included questions on activities visitors participated in while on Mt. Pisgah and what visitors considered annoyances on the dune. Results from 2012 were graphed next to results from 2005 and compared.

Figure 2 – Erosion pin locations on Mt. Pisgah.

warning signs in the blowout and one near the windward base of the dune where there are also two informational signs.

The map of human impacts (Figure 4) shows a network of unmanaged trails on Mt. Pisgah. Mapped trails had a net length of 2,014 meters and are located throughout the dune, although the largest clusters are around the north slip face and the north and west portions of the blowout. Not all unma-4(m).314(m).314(m).314(4-2(ow))]TJ -0.4ts2h-5(t)-6( cl)-6(ups(n)-4.004 Tc 0.004 T0)(c

## Dune Activity

Amounts of surface change measured at erosion pins are small (Figure 5). All changes in height were less than 30 mm. Between October 25 and November 1 the largest change was 27 mm (deposition) at pin 5. Between November 1 and November 8 the largest change was -18 mm (erosion) at pin 8.

Comparison of 2005 and 2012 photos shows significant visual differences for five locations (Figure 6). Bare sand in the lower blowout has been mostly covered by planted vegetation (Figure 6a). The unusually angled ramp has been covered by elevated stairs with fences and planted vegetation (Figure 6b). The notch in the crest has been covered by the largest viewing platform (Figure 6c). Bare sand in the middle of the blowout has been mostly covered by planted vegetation (Figure 6d). The intersection of the notch and the unusually angled ramp has been covered by the intersection of the stairs and the viewing platform (Figure 6e).

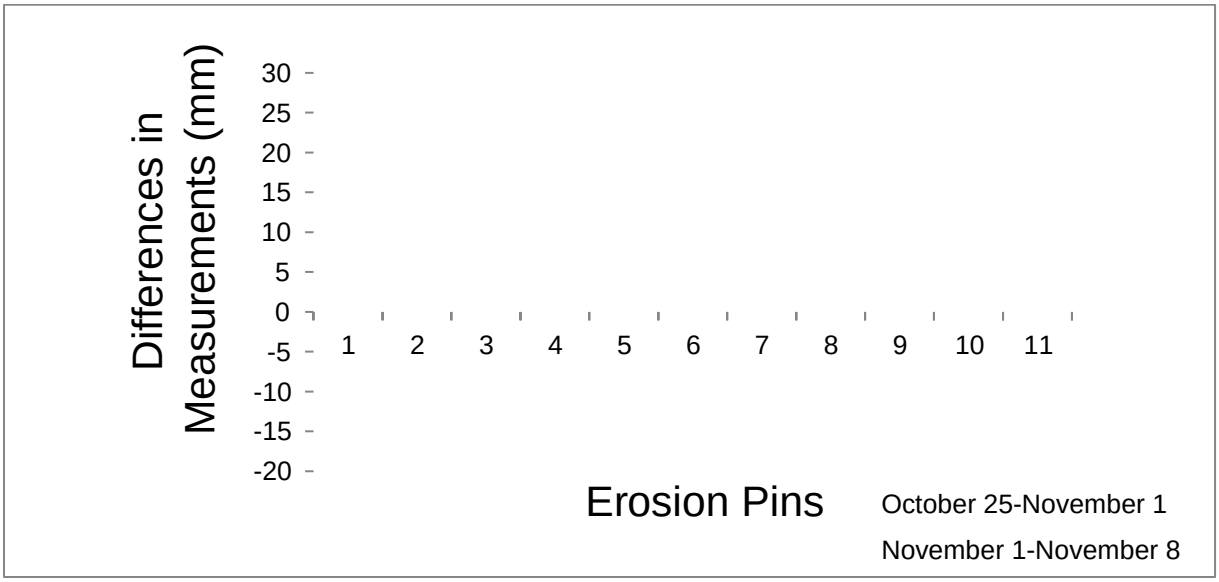


Figure 5 – Results from measurements of height at erosion pins. A positive difference means that there is less sand at the end of the week (erosion) ; a negative height means there is more (deposition).

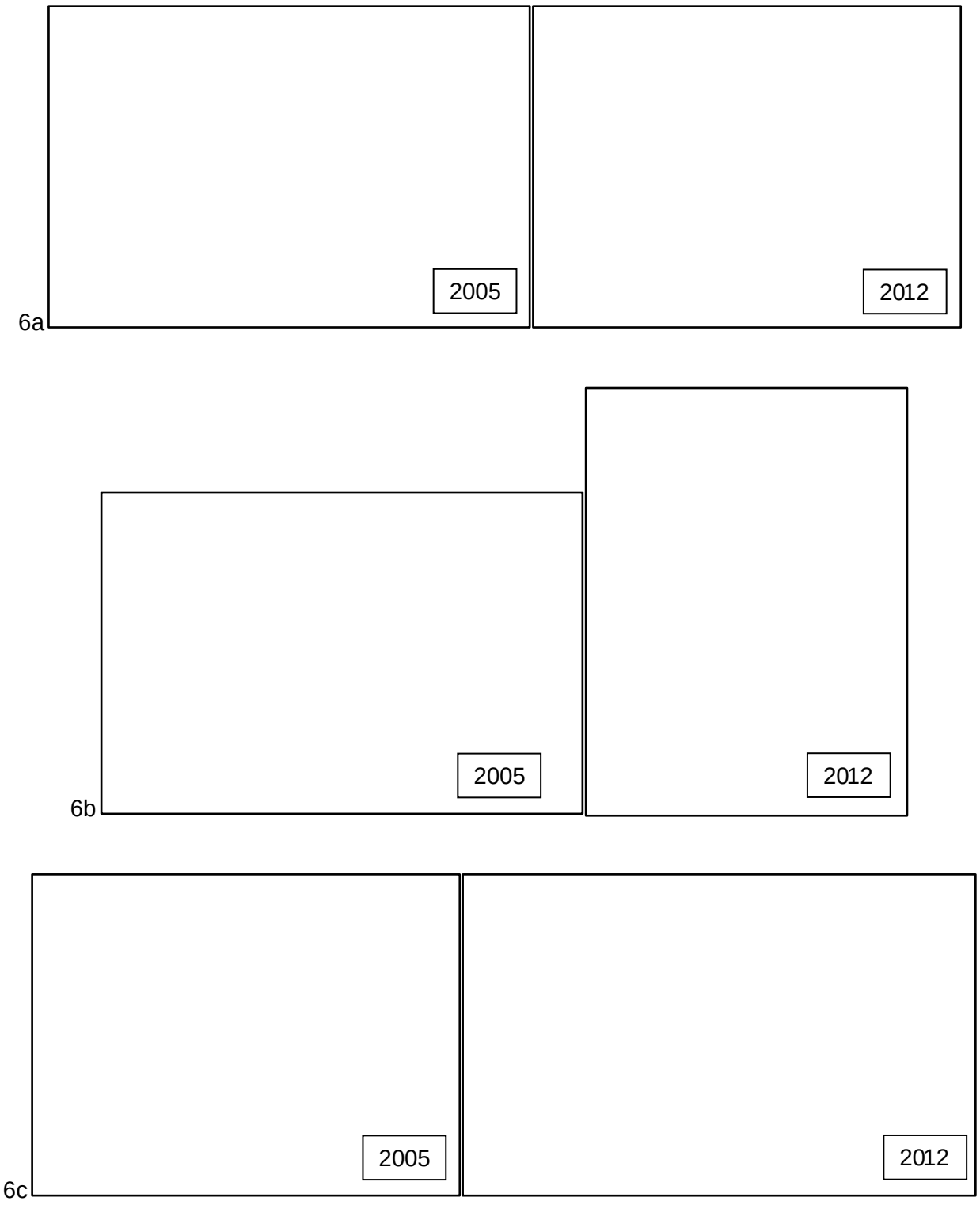


Figure 6 – Comparison pictures between 2005 on the left and 2012 on right. (Continued on next page.)

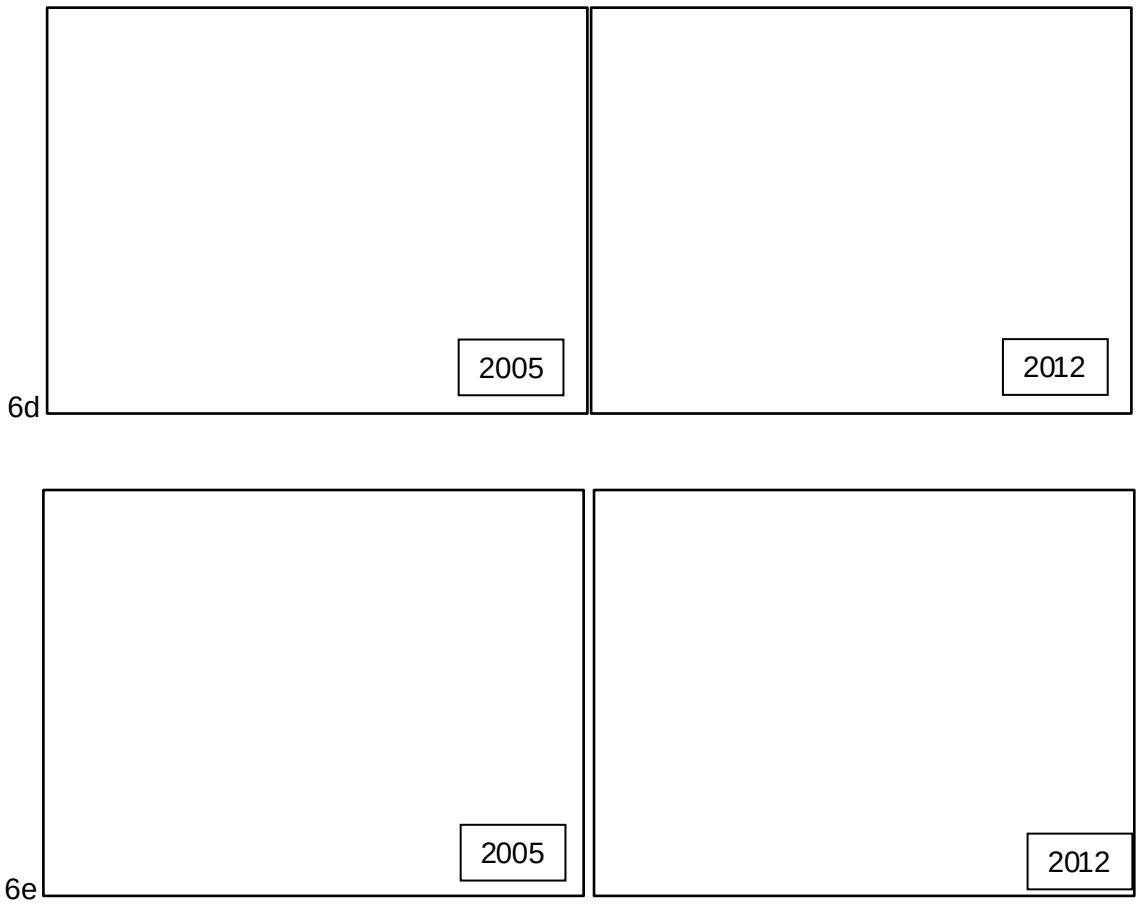


Figure 6 (continued) – Comparison pictures between 2005 on the left and 2012 on right.

## Visitor Perceptions

During the 7 hours and 52 minutes data was collected, 69 visitors came; 3 groups of visitors had dogs with them. 32 questionnaires were filled out, representing 65 visitors (Appendix B contains questionnaire results). The vast majority of dune visitors who filled out the questionnaire were from Holland (90.8%) and all were from somewhere within an hour of Holland (Figure 7). Visitors were predominantly in the 41-55 years old (26.2%) and 55+ years old (40%) age brackets. Visitors come to Mt. Pisgah during all seasons, but the most come in the

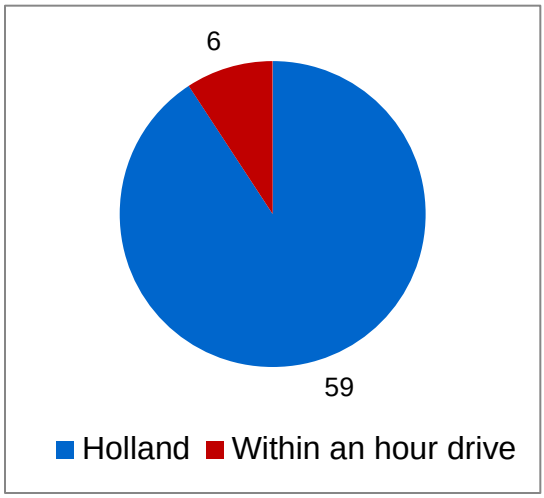


Figure 7 – Origins of dune visitors.

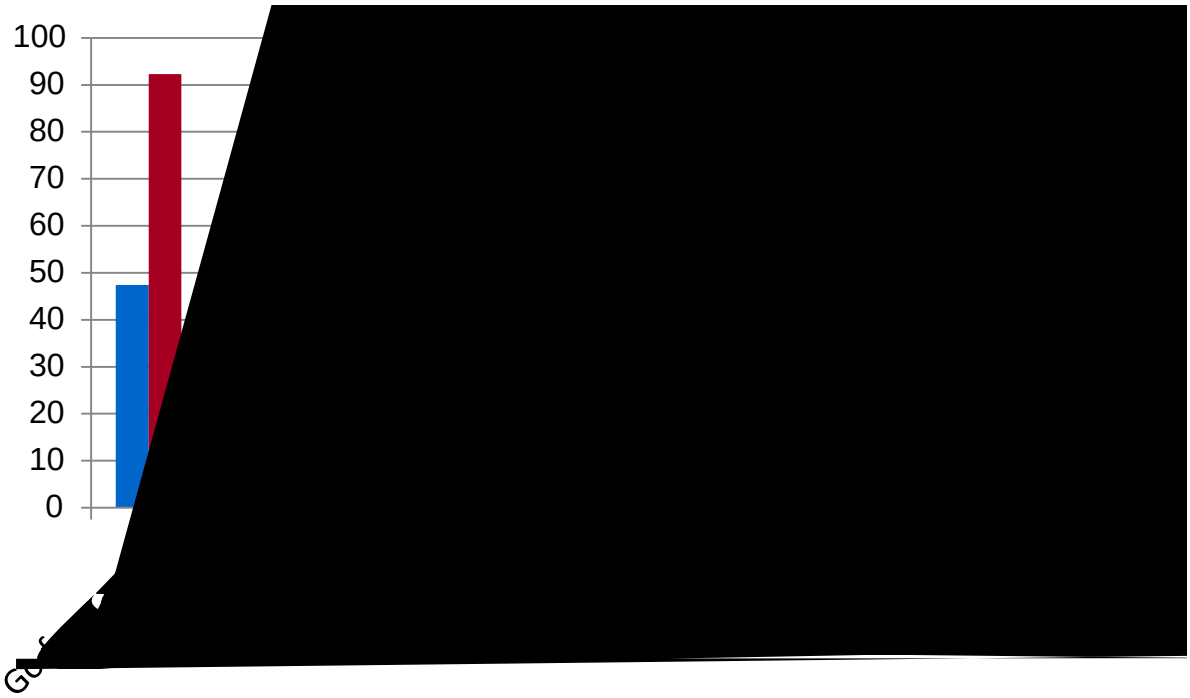


Figure 9 – Activities visitors participate in while on Mt. Pisgah, 2005 and 2012.

Figure 10 – Visitors' reported level of dune knowledge (in 2012).

While the impacts of noncompliance are significant, the study results show a greater trend toward compliance with management and overall dune recovery.

The low levels of height change recorded in the erosion pins indicate a stabilization of the dune. The results are not merely a product of low winds during the measurement period, as the remnants of Hurricane Sandy were affecting Michigan in the first week of the study. Though sediment is still being redistributed, the amount that is being moved is so low that noticeable changes to the structure of the dune are no longer occurring. Comparison pictures also show that activity on the dune itself has decreased enough to allow the vegetation to take hold and spread. In 2005 the noticeable notch presented a visual target for walking, but in 2012 someone entering from the base of the blowout would see no clear destination for traveling across the dune to the other side (see Figure 6c). These pictures and mapping show the significant increase in vegetation relative to before the management techniques were implemented. The low amounts of measured surface change combine with the comparison pictures to suggest there is less activity and more recovery in 2012 compared to

Ottawa County Parks & Recreation Commission. 2004. “Twelve Park Parcels at Ottawa Beach Master Plan Study.” West Olive, Michigan: Ottawa County Parks & Recreation Commission and Landscape Architects & Planners, Inc., 68 p.

Powers, T. 2007. “Holland State Park.” Michigan State and National Parks: A Complete Guide Holt, Michigan: Thunder Bay Press, 78–81.

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## Appendix A: 2012 Questionaire

# Mt. Pisgah Visitor Questionnaire

**Please answer these questions about the Mt. Pisgah sand dune. You do not need to write your name on this questionnaire, and your answers will not be used to identify you personally. You may choose to answer all, some, or none of the questions. The results from this questionnaire along with other data gathered from the sand dune will be incorporated into a final report to the Ottawa County Parks and Recreation Commission. This report may be obtained upon request. This study is being done by Calvin College students for a course called Geog 181 First-Year Research in Et34r]TJ 0 . [(AEt)3(34r]T**

**5. How much would you say you know about sand dunes?** (Please circle the corresponding number.)

I know almost
nothing

**9. How many people on the dune are in your group? _____people**

**10. What are the age categories of the people in your group?** (Give number of people for each.)

____0-16 ____17-25 ____26-40 ____41-55 ____55 and up

**11. Additional Comments:**

## APPENDIX B: Questionnaire Results

Have you v

Which activities do you participate in when visiting the dune? Go for a walk

| During which season(s) do visit the dune? Winter (Dec -Feb) | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No | 28 | 43.1 | 45.2 | 45.2 |
| | Yes | 34 | 52.3 | 54.8 | 100.0 |
| | Total | 62 | 95.4 | 100.0 | |
| Missing | No Response | 3 | 4.6 | | |
| Total | | 65 | 100.0 | | |

| During which season(s) do visit the dune? Spring (Mar -May) | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No | 8 | 12.3 | 12.9 | 12.9 |
| | Yes | 54 | 83.1 | 87.1 | 100.0 |
| | Total | 62 | 95.4 | 100.0 | |
| Missing | No Response | 3 | 4.6 | | |
| Total | | 65 | 100.0 | | |

| During whic h season(s) do visit the dune? Summer (June -Aug) | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | No | 1 | 1.5 | 1.6 | 1.6 |
| | Yes | 61 | 93.8 | 98.4 | 100.0 |
| | Total | 62 | | | |

| How much would you say you know ab out sand dunes? | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | 1.0 | 6 | 9.2 | 9.2 | 9.2 |
| | 2.0 | 8 | 12.3 | 12.3 | 21.5 |

| What is your opinion of these dune management and interpretation activities? Building a boardwalk to protect dune surface | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percent | Valid Percent | Cumulative Percent |
| Valid | Strongly oppose | 1 | 1.5 | 1.6 | 1.6 |
| | Oppose | 3 | 4.6 | 4.7 | 6.3 |
| | Neutral | 3 | 4.6 | 4.7 | 10.9 |
| | Favor | 22 | 33.8 | 34.4 | 45.3 |
| | Strongly favor | 35 | 53.8 | 54.7 | 100.0 |
| | Total | 64 | 98.5 | 100.0 | |
| Missing | No response | 1 | 1.5 | | |
| Total | | 65 | 100.0 | | |

What is your opinion of these dune management and interpretation activities?Total

What is your opinion of these dune management and interpretation activities? Educational programs such as public walks/talks

| Frequency | Percent |
|---|---|

Do you consider the following to be problems/annoyances on the dune ? Dog waste/noise

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | No problem | 38 | 58.5 | 61.3 | 61.3 |