

# Investigating a Boardwalk's Effects on a Lake Michigan Coastal Dune

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## Abstract

Boardwalks are a management strategy that protect dunes from negative human impacts. There has been little study, however, of how boardwalks themselves may harm dune vegetation. We studied this at a boardwalk on a Lake Michigan coastal dune in P. J. Hoffmaster State Park, Michigan. We recorded boardwalk characteristics of the two sections that were built along the dune crest and arm in 1975, and of the section that was built up the slipface in 2016. Other methods included GPS mapping, measuring light intensity under the boardwalk, measuring surface soil moisture, and recording vegetation characteristics. The newer section of the boardwalk has effective signage and barriers to prevent people from leaving the boardwalk. The older sections have insufficient signage and barriers. There are unmanaged trails stemming from the older sections, but not the new section. The condition of vegetation generally improves as distance from the boardwalk increases. This correlates with light intensity and the height of the boardwalk above the dune surface. Therefore, while the boardwalk reduces trampling along the ridge, it does not fully prevent trampling on other parts of the dune surface and there is a narrow corridor of vegetation impairment along the boardwalk.

## Introduction

Boardwalks can help prevent trampling of vegetation on the surface of dunes [1-3]. Not much investigation has been done, however, on how the presence and construction of boardwalks may impact vegetation. This study seeks to determine the effects of a dune boardwalk and its recent construction on the surrounding vegetation.

## Objectives

The objectives of the study are to:

- Map the boardwalk and its characteristics
- Measure vegetation characteristics
- Map any unmanaged trails near the boardwalk
- Analyze patterns to determine the impact of the boardwalk on surrounding vegetation.

## Study Area

Our research site is located at the boardwalk on a parabolic dune near the Visitor Center in P.J. Hoffmaster State Park in Muskegon, Michigan (Figure 1). Originally built in 1975, the boardwalk has undergone recent construction as the “Dune Climb” portion was rebuilt in 2016 (Figure 2).

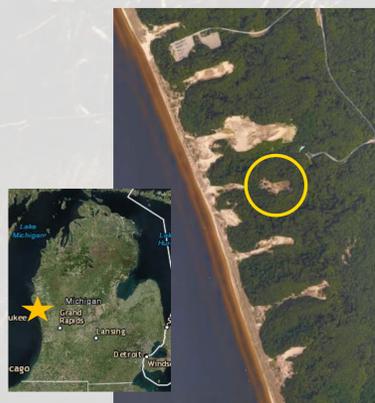


Figure 1: Study location within the lower peninsula of Michigan and within part of P.J. Hoffmaster State Park (Image source: Google Maps)



Figure 2: New Dune Climb (Image taken during data collection.)

## Methods

We collected data on boardwalk characteristics, vegetation characteristics, and unmanaged trails (Table 1).

To measure vegetation characteristics, transects perpendicular to the boardwalk were established at randomly selected locations along the boardwalk. Along each transect, data were collected in quadrats at 0m, 1m, and 5m from the boardwalk. GPS mapping was done with a Trimble Juno GPS.

	Variable	Methods
Boardwalk Characteristics	Amount of light passing through to dune surface	Light meter
	Boardwalk's height above dune surface	Measuring tape
	Presence of signs	GPS mapping
	Presence of leftover construction material	GPS mapping
Vegetation Characteristics	Layout of boardwalk	GPS mapping
	Height of vegetation	Ruler; quadrat
	Percent of vegetation covered	Observation, quadrat
	Number of species present	Counting; quadrat
Unmanaged Trails	Soil moisture	Soil collection and analysis
	Paths of unmanaged trails	GPS mapping
	Unmanaged trail entry points	GPS mapping

Table 1: Variables and methods

## Results



Figure 3: Mapped boardwalk and features in the study area. Vegetation height at 0, 1, and 5 meters from the boardwalk is shown in green.

**Boardwalk Characteristics:** The boardwalk has a total length of approximately 193 meters and is divided into three sections (Figure 3). Section 1 is the new Dune Climb, while the older sections 2 and 3 are built along the dune crest and north arm. Signage and barriers on the older parts of the boardwalk are scarce. The section with greater average height above the ground has a higher light intensity beneath it (Table 2).

**Vegetation Characteristics:** Height of vegetation, mostly dune grass, generally increases with distance from the boardwalk (Figure 5). Near the Dune Climb, there were some trees which appeared to be cut down fairly recently, perhaps due to construction. There were also unused boards left on the dune surface. The results of soil moisture analysis as it relates to vegetation are inconclusive.

**Unmanaged Trails:** There are three major unmanaged trails stemming from the ends of sections 2 and 3. On section 1, which no unmanaged trails stem from, there is mesh fencing and the boardwalk is higher from the dune surface.

	Boardwalk Height Above Ground (m)		Light Intensity (W/m <sup>2</sup> )	
Section	2	3	2	3
Average	2.16	1.45	12.66	6.03
Maximum	3.54	2.56	21.81	17.05

Table 2: Two variables at section 2 and 3. There is no corresponding data for section 1.

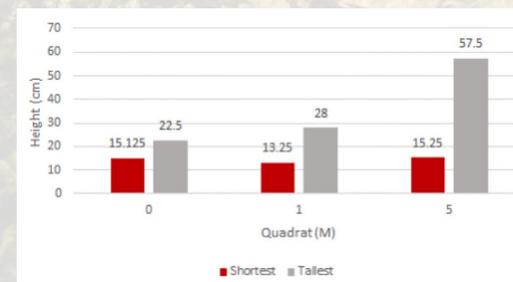


Figure 5: Average vegetation height at 0,1, and 5 meters from the boardwalk, at section 2 and 3

## Discussion

The decrease in the overall abundance of vegetation near the boardwalk suggests that the boardwalk has some negative effect on the amount and health of the surrounding vegetation.

The boardwalk can also provide an origin point for unmanaged trails (Figure 6). Some of the decreased vitality of vegetation along the boardwalk could be due to trampling originating from the same points.

While boardwalks can have some negative impact on vegetation, the human impacts on the dune surface would be greater if the boardwalk was not present. However, as other studies have shown, there are management techniques that could be used, namely:

- improving barriers at the origin points of unmanaged trails.
- increasing the size of the spaces between the boards of the boardwalk to allow light and water to reach vegetation underneath [2,3]
- educational signage with positive language [3], discussing how human traffic affects dune health.



Figure 6: Unmanaged trail entry point, with leftover construction material

## Conclusion

Overall the boardwalk is an effective management tool for protecting vegetation and encouraging visitor enjoyment. However, improvements to signage and barriers could be made that would make it better serve both of these purposes.

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## References

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