



## Abstract

Although Lake Michigan's coastal foredunes are predominantly vegetated with *Ammophila breviligulata* (American beachgrass), the natural characteristics of this species have not been documented. This study identified and analyzed the characteristics and environmental conditions of *A. breviligulata* populations in P.J. Hoffmaster State Park. We analyzed three areas of vegetation growth on the foredunes: one in which human influence was present (in the form of unmanaged trails), one in which wave erosion had created a steep scarp, and a control area with a slumped scarp and no significant human influence. In each area, we measured the height and density of *A. breviligulata*, recorded the presence of unmanaged trails and measured scarp characteristics. Density of *A. breviligulata* was consistently greatest on the foredune's leeward slope. The greatest density was observed in the site of human disturbance, while the greatest height was recorded in the control site. Scarping affects the vegetation near the scarp, but does not influence the vegetation beyond the foredune crest. Unmanaged trails negatively influence the height and density of vegetation only near the trails. Understanding *A. breviligulata*'s natural characteristics could provide a model for assessing the success of vegetation plantings—a common technique for moderating sand movement in managed sites.

## Introduction

*Ammophila breviligulata* (figure 1), despite its abundance and importance on the Great Lakes dunes [1], has not been thoroughly investigated in the region. We focused on three foredune areas of *A. breviligulata* growth: an area with human impacts in the form of unmanaged trails, an area with a steep scarp and a control area with low human impact and a slumped scarp.



Figure 1: *A. breviligulata*: a native grass species on Lake Michigan's dunes.

Our objectives were to:

- Measure the *A. breviligulata* height, density and health in each research area.
- Compare the characteristics of *A. breviligulata* between the three areas.
- Determine whether a link exists between level of disturbance in a site (as caused by human impacts and scarping) and the natural characteristics (height, density and health) of *A. breviligulata*.

## Study Area

We conducted our research in three study sites at P.J. Hoffmaster State Park (figure 2).

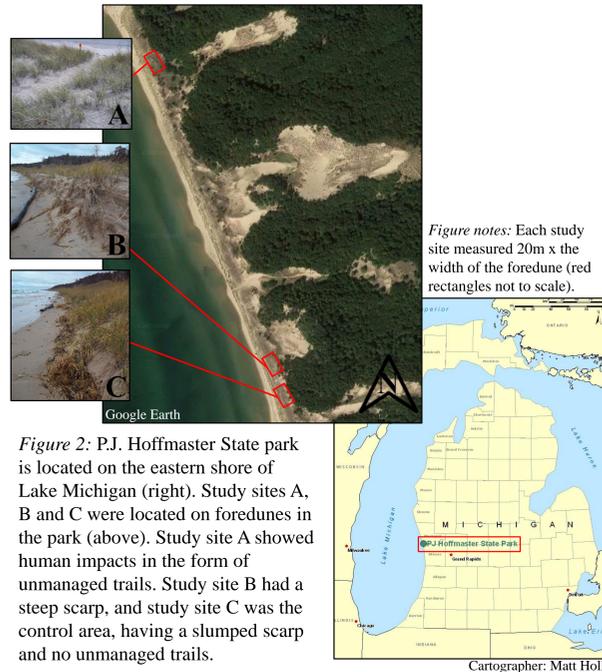


Figure 2: P.J. Hoffmaster State park is located on the eastern shore of Lake Michigan (right). Study sites A, B and C were located on foredunes in the park (above). Study site A showed human impacts in the form of unmanaged trails. Study site B had a steep scarp, and study site C was the control area, having a slumped scarp and no unmanaged trails.

## Methods

- We mapped unmanaged trails and scarps within each study site by GPS (figure 3).
- We measured height and density of *A. breviligulata* (sampled from 15 quadrats) in each study site.
- We used a scale to estimate overall health of *A. breviligulata* in each study site (table 1).
- We recorded the environmental conditions at each site.
- We identified all plant species observed in each study site.

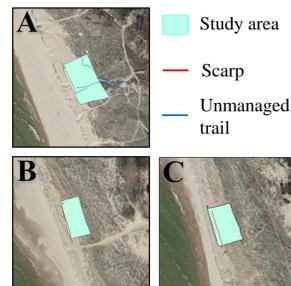


Figure 3: GPS maps of sites A, B and C as displayed by ArcGIS.

Category	Description
1 Poor	Complete discoloration, many missing stalks and/or significant trampling.
2 Below average	Considerable discoloration, missing stalks and/or some trampling.
3 Average	Occasional discoloration, parts of stalks missing and/or minor trampling.
4 Good	Minimal discoloration, occasional missing stalk segment.
5 Exceptional	None of the above damage or discoloration.

Table 1: Scale used to estimate *A. breviligulata* health.

## Results

The composition of foredune vegetation was almost entirely *A. breviligulata*. The average plant density across all sites was 32.7 plants/m<sup>2</sup>, while the health rating averaged 3.9 (on a scale of 1-5). The average height of *A. breviligulata* was 79 cm. While differences in plant density and health were negligible between the three sites, the greatest average height of *A. breviligulata* was recorded at the control site (figure 4).

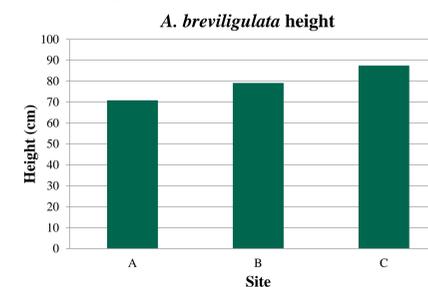


Figure 4: The average height of *A. breviligulata* at each site.

We found no significant differences between *A. breviligulata* health and density in the control site compared to the sites with scarping and unmanaged trails (figure 5). We did observe local effects of scarping on plant health (figure 6a) and unmanaged trails on plant density (figure 6b).

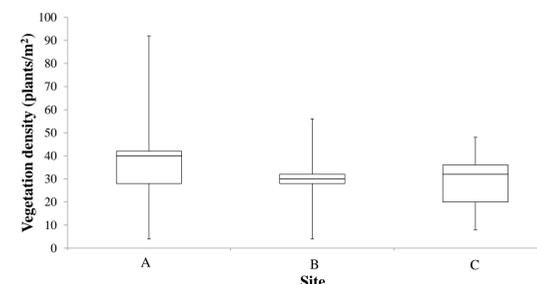


Figure 5: The median and quartile values at the human impact site (A) and scarp site (B) were not significantly different from those at the control site (C).



Figure 6a: Scarping pulls sediment from below vegetation.



Figure 6b: Unmanaged trails cut through vegetation.

The greatest number of species was observed in the control site, where four plant species were present. The fungal species *Phallus hadriani* (dune stinkhorn) was observed at all three sites.

## Discussion

*A. breviligulata* density did not vary significantly between sites. Decreased density due to unmanaged trails is confined to the trails. The average height of *A. breviligulata* was greatest in the control site. This is consistent with research citing dune vegetation's vulnerability to human impacts [2].

The presence of scarping and unmanaged trails did not affect the overall health of *A. breviligulata*. However, vegetation exhibited exposed roots—and noticeably decreased density—on scarps (figure 6) and was trampled on trails. The observed scarp is less than six months old;



long-term effects may yet be noted, as a dune's shape is tied to its vegetation assemblage [3].

Figure 6: Steep scarps expose the roots of *A. breviligulata* on the dune's lakeward edge and reduce vegetation density by eroding both sediment and plants.

## Conclusions

P.J. Hoffmaster State park's foredunes are populated by *A. breviligulata* with an average density of 32.7 plants/m<sup>2</sup>, height of 79 cm and health rating of 3.9.

Measurements suggest that neither human impacts (in the form of unmanaged trails) nor scarping due to wave erosion has a significant influence on *A. breviligulata* over the entire foredune, although each disturbance has local effects.

Since planting *A. breviligulata* is a common management strategy, an understanding of the plant's natural characteristics could serve as a model to analyze the efficacy of planted vegetation on managed dunes.

## Acknowledgements and References

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