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Oak Density and Dune Stability in North Ottawa Dunes

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Abstract

The fungus *ceratocystis fagacearum* which causes oak wilt has recently killed several oak trees in west Michigan. Our study was conducted in North Ottawa Dunes where our team looked at two independent areas containing a red oak killed by oak wilt infection. All other oaks within a 50 meter radius of them will be cut down, leaving the roots. To assess the proposed removals' effect on the stability of the dune, our study investigated the red (*Quercus rubra*) and white (*Quercus alba*) oaks as well as all non-oaks located within each area. GPS data points recording the relevant trees were collected using Trimble GPS systems. At each oak the dune characteristics were recorded, diameter at breast height and observable health were documented, and the oak species was distinguished. ArcGIS was then used to create thematic maps illustrating the tree density and the dune's spatial characteristics. The results show a higher percentage of healthy to non-healthy oaks and a higher concentration of oak wilt spread in the second study area than the first. Also the population percentage of red oaks and white oaks to non-oaks for the study area was found to be higher in study area 1 than in two. This research has provided an assessment of slope stability within these two sites after the oaks are truncated and provided predictions about future erosion in the area.

Introduction

Ceratocystis fagacearum, a fungus that causes the disease oak wilt, is responsible for oak tree deaths [1]. Root grafting is a prevalent way of spreading the disease, leading management to remove trees in the vicinity [2]. Our study focuses on the potential effects of the removal of oak trees on dunes and how this would affect the stability of a Lake Michigan wooded dune.

Objectives

- Determine oak tree density and spatial patterns in the study area with infected trees.
- Identify the ratio of oak trees to non-oak trees in each area.
- Predict the future of dune stability following dune management.

Study Area

The study was conducted near the park property line of North Ottawa Dunes (Figure 1) where dune managers previously found two trees infected with oak wilt. The circular treatment area is bounded by a 50m (150ft) radius centered around each infected oak. The park staff plans to remove all oaks, regardless of their health, within these areas.

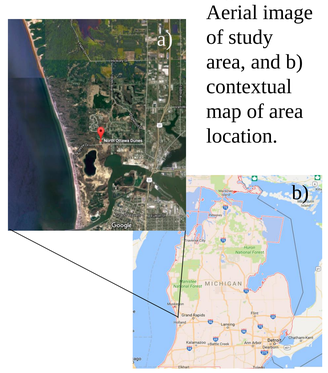

Figure 1: a) Aerial image of study area, and b) contextual map of area location.

Methods

- Lines of 50 meters were measured from infected oak trees in four directions and a circle created by connecting four points (Figure 2a). Two such circles were created. The eastern side was restricted by property lines.
- Using GPS all trees within each study area were mapped and recorded as white oak, red oak, or non-oak (Figure 2b).
- Diameter at breast height, relative health, and possible oak wilt infection were characteristics recorded for oaks (Figure 2c).
- General slope was also recorded.

Figure 2: Researchers a) measuring the study area's 50m radius, b) recording tree data using GPS, c) measuring the diameter at breast height of infected oaks.

Results

- The tree population in Study Area 1 is comprised of 15% oaks, in comparison to Study Area 2 where oaks comprised 59% of trees (Figure 3). Oaks overall comprised 30% of the tree population for both areas. In Study Area 1 red oaks comprise 85% of oak population. Comparatively in Study Area 2 red oaks comprise 99% of oak population.
- Of the red oaks, 42.4% were sick or infected compared with the 33.3% of white oaks that were sick (Figure 4).
- Oak density in Study Area 1 is 15.7 oaks/km^2 while oak density in Study Area 2 is 30.4 oaks/km^2 (Figure 5).

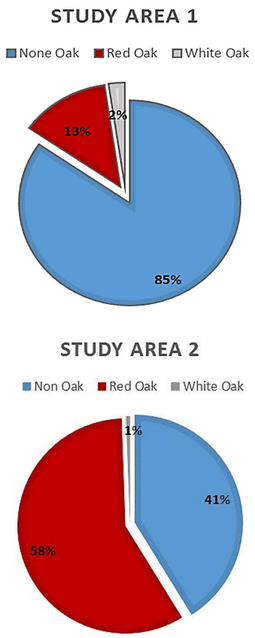

Figure 3: Concentrations of species of trees within the two study areas.

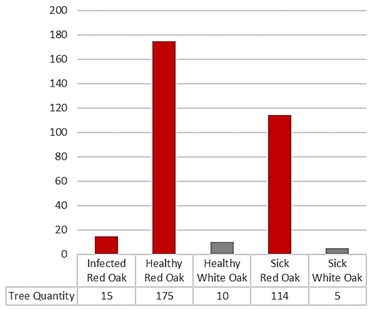

Figure 4: The number of trees represented for each health category.

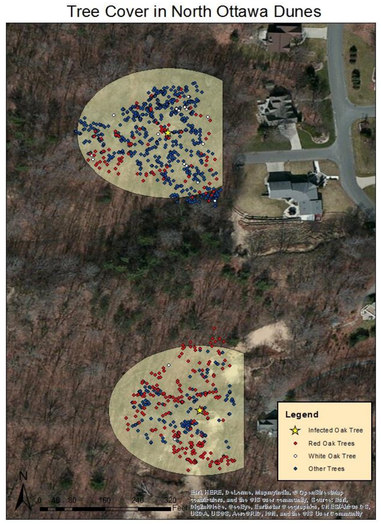

Figure 5: Spatial patterns of oaks within the two study areas.

Discussion

We predict that erosion will be significantly greater on the slopes that have an angle steeper than the angle of repose (30-35°). Study Area 2 has a greater density of oak and is predicted to experience more widespread erosion, while Study Area 1 has a steeper slope in general and is predicted to have more severe slope erosion (Figure 6). However, in Study Area 1 the percentage of oaks being removed is still relatively low (see Figure 4) so the erosion from root decomposition will be minimal due to the presence of non-oaks. There was also a greater percentage of red oaks that were infected compared to the percentage of white oaks in both areas; red oaks have a higher susceptibility towards oak wilt. The change in oak population may result in less erosion in the future due to death from oak wilt as white oaks can be resistant to the disease. Since less trees would die there would be less root decay in a concentrated area leading to less erosion. With the oaks removed, the dune has the opportunity to grow new pioneer species that will anchor the sand in place [3].

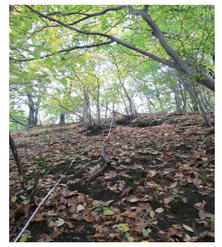

Figure 6: Oaks and non-oaks holding the slope in Study Area 1

Conclusions

The results show the spatial patterns of the percentage of the oak population to be 15% and 59% in area 1 and area 2 respectively. The density in area 1 was 15.7 oaks/km^2 and in area 2 it was 30.4 oaks/km^2. Therefore we can predict that the dune stability will be compromised as the oak roots decompose before reaching a new stabilized state from non-oak vegetation growth.

Acknowledgements and References

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References:

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[2] Menges, E. S., and O. L. Loucks. 1984, "Modeling a Disease-Caused Patch Disturbance: Oak Wilt in the Midwestern United States." *Ecology* 65 (2): 487-498.

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