

Oak Distribution on North Ottawa Dunes

Caleb E. Boraby, Cameron S. Doan, Tanner J. R. Huizenga, Hunter T. Pham

Abstract

The coastal dunes of Lake Michigan offer a varying landscape filled with diverse vegetation, including oak, with its red and white varieties. *Ceratocystis fagacearum*, better known as "Oak wilt," has recently been observed in North Ottawa Dunes. Our study includes areas from the active dune surfaces on the west side of the park and the inactive dune forests to the east side. In autumn 2016 we measured the percent of oak trees from all trees in randomly selected 100m² areas. The results show that the percent of oaks from trees on the inactive surfaces is higher than the percent on active surfaces ($p < 0.005$). We found oaks to compose less than half of the trees on active surfaces while composing more than half on the inactive surfaces. With this research, we can better understand where oak trees are likely to grow and can apply this to the overall oak wilt prevention efforts, which usually require complete removal of infected and nearby trees.

Introduction

Oak wilt (*Ceratocystis fagacearum*) is a spreading fungus causing mass deforestation in oak forests, posing both environmental and economical threats [1]. Impact of oak wilt on dunes is currently unknown. With the presence of two known infected trees in North Ottawa Dunes, Michigan, we have investigated the distribution of oak trees in the park. We intend to show the concentration of trees in North Ottawa Dunes and the percent of oak trees.

Study Area

We worked in three pre-designated sections of the North Ottawa Dunes, Ferrysburg, Michigan (figure 1).

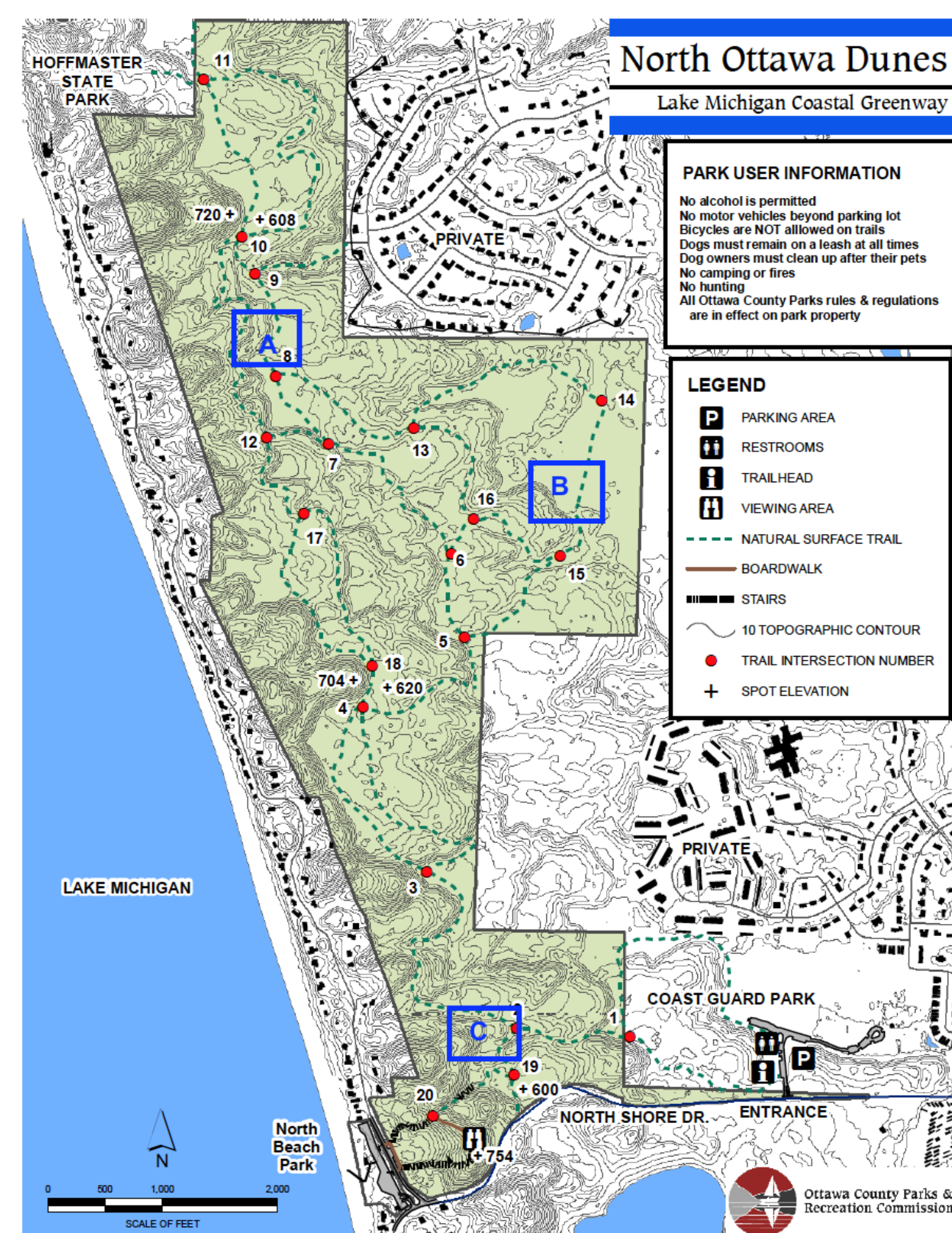


Figure 1. Pre-designated sections lettered from A to C.

Methods

We marked a rope with ribbon every ten meters until forty meters had been measured. This forty meter length allowed us to sector off roughly 100m² squares to survey (figure 2).



Figure 2. Measuring 100m² section

In each 100m² section, we used Trimble Juno GPS devices to map and record red oaks, white oaks, and non-oaks. We then calculated the percentages of oaks to total trees in the areas. Using the program *RStudio*, we calculated the P-value to test our hypothesis that oak proportions are higher on inactive dune surfaces than on the active dune surfaces.

Results

With area A and area C being from active dune surfaces, we combined their results to find the oak tree percentage (figure 3). Comparing the results, we found a difference of roughly 24% ($p < 0.005$).

	Number of Oaks	Number of Non-Oaks	Total Trees	Percent of Oaks	Number of 100m ² Sections Taken	Tree Count per 100m ² Section
Area A (active) (figure 3)	56	123	179	31%	7	26
Area B (inactive) (figure 4)	54	46	100	54%	4	25
Area C (active) (figure 5)	41	96	137	30%	5	27
Area A+C (active)	97	219	316	31%	12	26

Figure 3. Table of Results

We additionally found the tree concentration by taking the total number of trees in the area and dividing by the number of measured sections. Concentration did not vary, with average trees per 100m² section being 26. Having only sampled six white oaks in all seventeen sections, we acknowledge the extremely low proportion of white oaks to red oaks.

Results



Figure 4. Distribution from section A

Green dots: Non-Oaks. Red dots: Red Oaks. White dots: White Oaks.



Figure 5. Distribution from section B

Green dots: Non-Oaks. Red dots: Red Oaks. White dots: White Oaks.

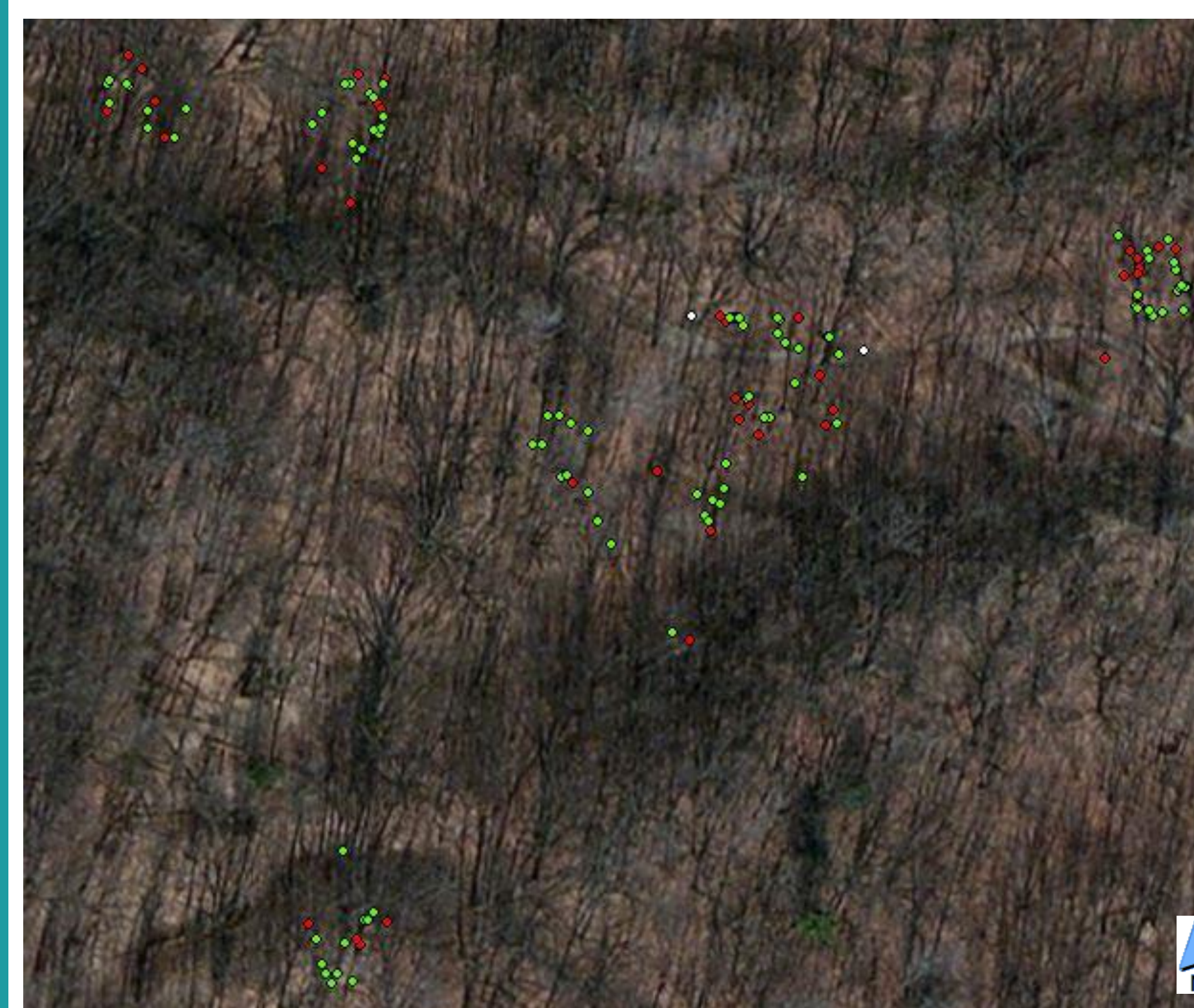


Figure 6. Distribution from section C

Green dots: Non-Oaks. Red dots: Red Oaks. White dots: White Oaks.

Discussion

We found the percent of oaks on the inactive dunes on the east side of the park to be significantly higher than the percent on the active dunes on the west side of the park ($p < 0.005$). This could mean that oaks, as a more slowly growing species, need to be established in an undisturbed ground [2]. Tree concentration remained constant across dune surface, measuring an estimated 26 trees per 100m² section. These results suggest that oak wilt spread could be inhibited on active dunes, where there are fewer oak trees.

Conclusions

We can conclude that percentages of oak trees are higher on inactive dune surfaces than on active dune surfaces, though overall tree concentration remains constant. Having only sampled six white oaks out of our entire oak population, we acknowledge the extremely low proportion of white oaks to red oaks (figure 7).



Figure 7. Red Oak leaf (left) vs. White Oak leaf (right) [3]

Acknowledgements

We would like to thank:

- Michigan Space Grant and Calvin College for funding our project
- Calvin GEO Department for providing the equipment and resources needed
- Ottawa County Parks and Recreation for allowing us to conduct the research on North Ottawa Dunes and Melanie Manion as the Natural Resources Management Supervisor
- Calvin College Professor Thomas Scofield as the statistics and *RStudio* consultant
- Dr. Deanna van Dijk as the professor of FYRES and the project overseer
- Matt Wierenga as the FYRES mentor overseeing our group

Works Cited:

- Haight, Robert G.; Homans, Frances R.; Horie, Tetsuya; Mehta, Shefali V.; Smith, David J.; Venette, Robert C.. 2011. "Assessing the Cost of an Invasive Forest Pathogen: A Case Study with Oak Wilt." *Environmental Management* 47: 506-517.
- Dey, Daniel C. 2014. "Sustaining Oak Forests in Eastern North America: Regeneration and Recruitment, the Pillars of Sustainability." *Forest Science* 60(5): 926-942.
- Image from <http://www.courageouschristianfather.com/wp-content/uploads/2009/09/RedOak-vs-WhiteOakLeaves.png>