

Distribution of Hemlock Trees and the Effect of Hemlock Woolly Adelgid on a Michigan Coastal Dune

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Abstract

In recent years, infection of hemlock woolly adelgid (HWA) has moved from the East Coast to the shores of Lake Michigan. The objective of this research project was to identify the distribution of healthy and diseased hemlocks at Hoffmaster State Park in Michigan. The methods included recording the distribution of individual hemlocks and hemlock stands using GPS, recording the health and diameter of selected trees, and documenting the extent of infestation found in the area. The results show that hemlocks are prevalent on the arms of the dune and that this area has been infested by HWA. This may affect the dune stability, as hemlocks provide structural support and may also affect other species of vegetation in the dune area.

Introduction

The hemlock woolly adelgid (HWA) pest, which has been affecting hemlock trees throughout the eastern U.S. for more than fifty years [1], arrived in west Michigan in 2015. Hemlocks are prominent along the forested slopes of Lake Michigan sand dunes (figure 1), and their loss could have significant impacts on the landscape. Using a large parabolic dune system as a sample, we investigated the distribution

hemlocks and noted signs of infestation.

Objectives Include:

1. Identify location, density, and health of hemlocks in the specified dune system.
2. Estimate disease prevalence in study area.



Figure 1. An eastern hemlock tree.

Study Area

This study took place in P.J. Hoffmaster State Park, located on the eastern shore of Lake Michigan (figure 2). A 210-meter-wide parabolic dune near the south end of the park was the focal point of data collection.



Figure 2. The study area was a dune in P.J. Hoffmaster State Park in Muskegon, MI.



Methods

We used GPS mapping to show the specific boundaries and locations of individual hemlocks and stands (figure 3). We also recorded the diameters of individual hemlocks and randomly sampled stands to document common characteristics.

In order to investigate infestation, we looked for discolored needles, sparse branches, a white sticky substance on the needles, and HWA itself. We documented the potential infestation using GPS units and cameras, and we recorded health of trees in field notebooks.



Figure 3. Hemlock data collection methods (left to right): Mapping hemlock stands, measuring tree diameters, determining HWA evidence and health, mapping individual hemlocks.

Results

Distribution of Hemlocks

There were 56 lone trees and 20 stands in our study area (figure 4).

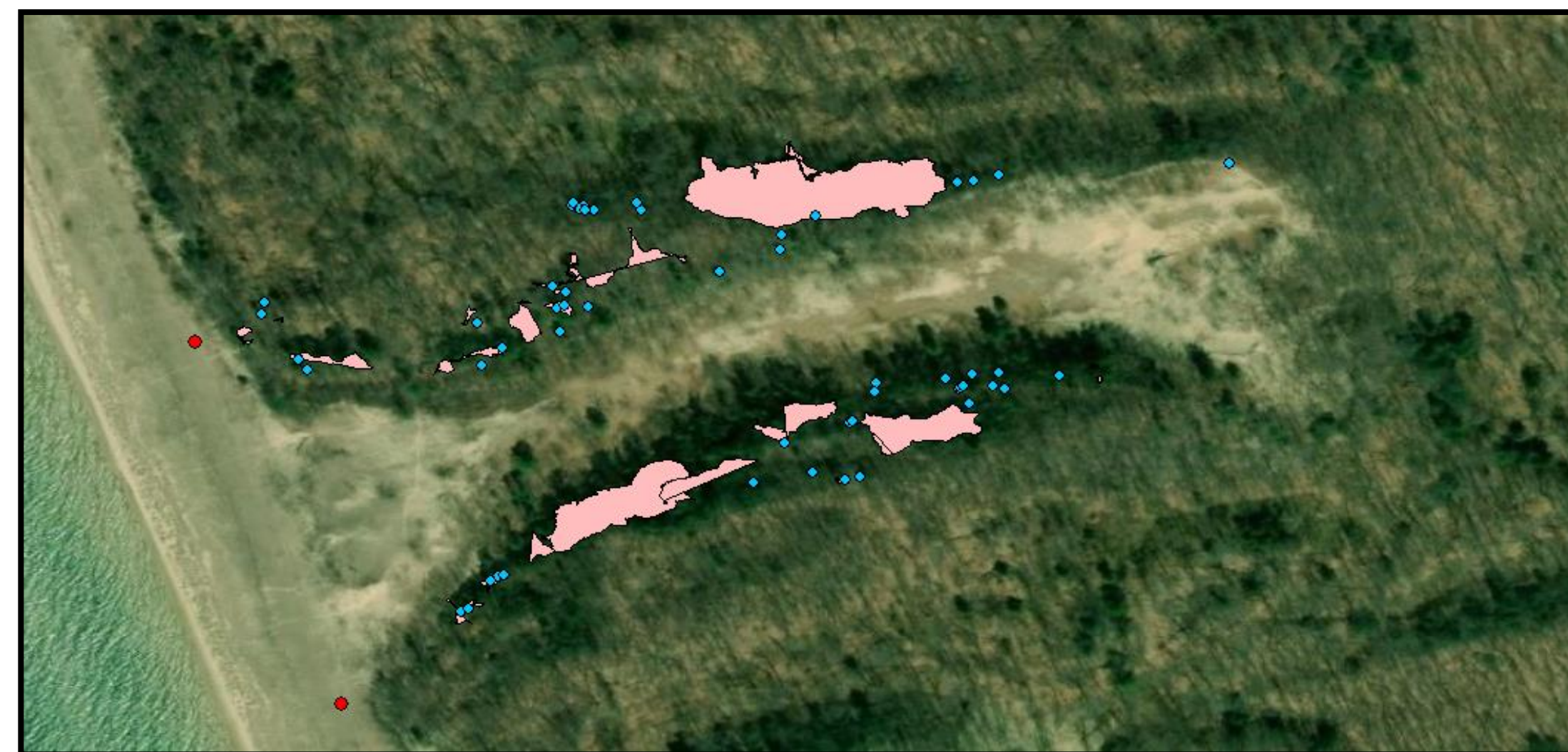


Figure 4. Distribution of hemlock trees in study area. Blue dots represent individual hemlock trees and red polygons represent hemlock stands.

Approximately 50% of the lone trees and 5 stands which we recorded were found on the steep sloped portions of the arms. Hemlocks were mainly found on the parabolic dune arms (table 1).

Table 1. Hemlock locations.

Area	Hemlocks Present
Beach	none
Foredune	none
Dune Ridge	none
Windward Slope	none
North Parabolic Arm	32 individuals and 12 stands
South Parabolic Arm	24 individuals and 8 stands
Dune Crest	none
Slipface	One individual hemlock

Disease Presence

Seventeen lone trees and five of the stands which we encountered were at least partially dead and appeared to be experiencing the effects of HWA (figure 5).



Figure 5. Discolored needles are a possible sign of HWA.

Discussion

We hypothesized that hemlocks would be in the trough area of the dune. However, our data indicates that hemlock growth is distributed on the arms of the parabolic dune (figure 6) but not on the foredune, dune ridge, dune crest, windward slope or slipface, as hemlocks do not thrive in areas of sand disturbance [2].

We can infer that the arms will destabilize as HWA damages the hemlock community located on the sloped arms. In addition, increased light due to tree loss could negatively affect other species of vegetation, leading to their death and causing increased sand movement due to the absence of vegetation as an anchor [3].

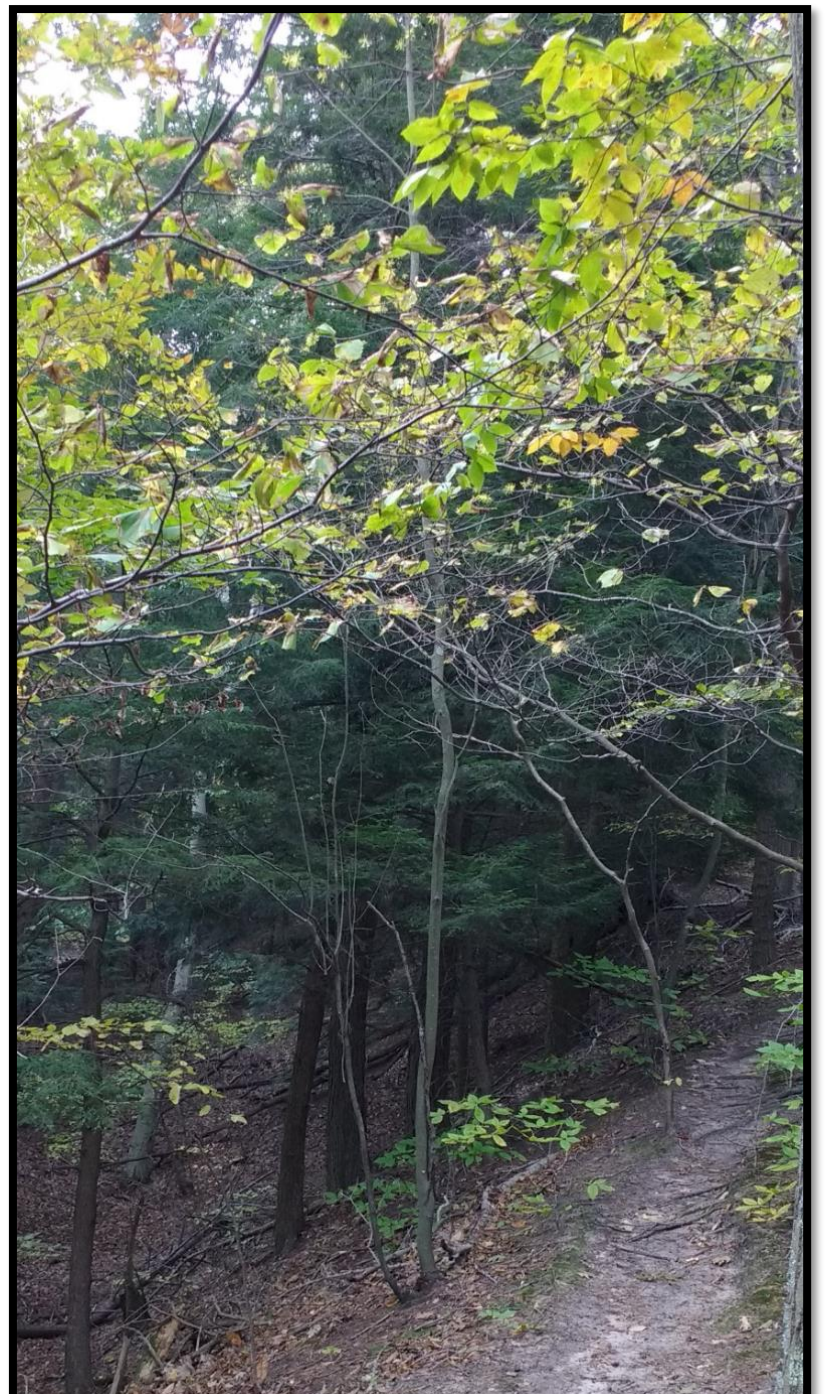


Figure 6. Hemlocks on a steep slope on the arms of the dune.

Conclusions

Hemlocks appeared individually and as part of large stands along the slope of the arms of the dune. Hemlocks were nonexistent on the dune crest and there was only one on the slip face. Evidence of HWA infestation was seen on approximately 70% of the individual hemlocks whose health we recorded in the study area.

Acknowledgements

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