Effect of Pathogens on a Wooded Dune Environment
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Abstract
Invasive insects and pathogens have long plagued North American forests, resulting in loss of native species and geomorphological change. This study evaluates the effects of these invaders on the wooded dunes of PI Hoffmaster State Park, Michigan and possible effects this invasion may have on dune stability and ecology. Tree density, composition, and girth were recorded across three visits utilizing point-quarter vegetation transects and large vegetation quadrats paired with wind measurements. American Beeches (Fagus grandifolia), Red Oaks (Quercus rubra), and Sugar Maples (Acer saccharum) constituted a majority of tree cover with Hemlocks (Tsuga Canadensis) occurring in concentrated groups. Wind speed was inversely correlated with tree density which generally increased with distance from the active dune slopes. There was no evidence of pathogenic infection found during fieldwork, suggesting that no infection has spread throughout the park as far as the coast. Due to the prevalence of Red Oak, oak wilt and its effect on dune stability may be a serious concern in the near future. The groupings of Hemlock may hinder the rapid spread of the woolly adelgid by limiting the contact between individuals.

Methods

- **Variable**
  - Tree Density
  - Tree Frequency
  - Tree Diameter
  - Tree Height
  - Erosion
  - Wind Speed
  - Species Importance

- **Method**
  - Counted trees in predetermined areas
  - Identified species within predetermined areas
  - Measured with diameter at-breast-height tape
  - Calculated using above level and measuring tape
  - Visually observed and assigned to a five point rating system
  - Measured using handheld anemometers
  - Calculated for each species by adding relative density, relative dominance, and relative frequency

Results

- **Physical Characteristics of the Coastal Dune Environment**
  - Tree height increased away from the coast with a noticeable dip at the base of the main parabolic dune (Fig. 4).
  - Wind speed typically decreased with increasing tree density (Fig. 5).
  - Erosion ratings against the average wind speed at the location (Fig. 6).

Discussion

Red Oak, Sugar Maple, and American Beech dominate the landscape due to their tolerance for well drained sandy soils [1]. The dip in tree height at the base of the dune’s slpitface may be the result of burial or harsher growing conditions (Fig. 7).

The relationships between wind speed, erosion, and tree density suggest that increased erosion may become a concern if large numbers of trees die. As Maples and Red Oakes are so dominant, an uncontrolled outbreak of Asian long-horned beetles or oak wilt could devastate the tree population, hurting the immediate stability of the dune and its ecosystem [2,3].

The pattern of infrequent hemlocks would be expected to hinder the spread of the woolly adelgid. The park has already seen an accelerated spread of the pathogen perhaps due to the help of unknowing park guests.

Conclusions

Red Oak, Beech, and Sugar Maples constitute the majority of trees within the park, with wind speed correlating to both erosional activity and tree density. While no major outbreaks or infestations of pathogens were found in the southern area of the park, which should be kept for oak wilt and long-horned beetles as their arrival could mean disaster for dune stability and ecology.

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References


Study Area

The study occurred in P.I. Hoffmaster State Park, Michigan (Fig. 1). The park has had problems with oak wilt and ash borers in the past and is currently struggling with an infestation of woolly adelgids. Focus was on the southern half of the park comprised of three large parabolic dunes. This area of the park receives fewer visitors and so was a more pristine environment and less likely to have a current outbreak of the various pathogens threatening the park.