

ASSESSING NATIVE SMALL MAMMALS' RESPONSES TO AN INCIPIENT INVASION OF BEECH BARK DISEASE THROUGH CHANGES IN SEED PRODUCTION OF AMERICAN BEECH

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INTRODUCTION

Exotic tree diseases have direct impacts on their host and may have indirect effects on native fauna that rely on host tree species. For example, American beech (*Fagus grandifolia* [Ehrh.]) is a dominant overstory component throughout its range and, like all tree species, is vulnerable to a broad array of insects and pathogens. These pests include beech bark disease (BBD), a disease complex consisting of an introduced scale insect (*Cryptococcus fagisuga* [Lind.]) and several species of native and introduced *Nectria* fungi. Due to the high levels of mortality sustained by American beech (50-85 percent in the areas of highest infection), it is likely that forests in the aftermath of BBD could differ greatly from pre-invasion beech forests. This abstract reports on small mammals' relative preference for European beech (*Fagus sylvatica* [L.]) and sugar maple (*Acer saccharum* [Marsh.]) seed, the direct impacts of BBD on seed production of American beech, and indirect impacts of this disease complex on native small mammals in the Upper Peninsula (UP) of Michigan.

METHODS

This project considered heavily infected forest stands (BBD and beech present; hereafter "Infected Beech"), forest stands containing healthy American beech (no BBD; hereafter "Healthy Beech"), and forest stands just outside the range of American beech (no beech or BBD; hereafter "No Beech"). Five study plots were established within each of the above stand types.

In 2005, a giving-up density (GUD) study was used to assess small mammal preferences for sugar maple and European beech seed. American beech seed was not used because this species was not available naturally or commercially at the time. However, we assumed that American and European beech are similar enough for the latter to be a valid substitute for the former. Subsequent lab-based analysis of seed characteristics and small mammal preference for these two species' seeds confirm the validity of this substitution.

Trays containing European beech and sugar maple seed were placed randomly within each study plot. Seeds were mixed with sand to provide foragers with diminishing returns the longer they remained at a food patch. Optimal foraging theory suggests that the longer a forager remains at a patch, the higher the costs it incurs. It follows that foragers should be willing to spend significant amounts of time only at high-quality food patches. Higher-quality food items (sugar maple or beech seed) should therefore be depleted to a lower GUD than the alternative. The small mammal portion of this study took place from 2003-2005. One 105-m x 105-m (8 traps x 8 traps with 15 m between each station) trapping grid was established on each of the study plots

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and was trapped repeatedly during each field season. Lincoln Peterson population estimates were determined based on the data collected. Comparisons of population estimates were made for the most common species among stand types: mice (*Peromyscus* spp.), eastern chipmunk (*Tamias striatus*), and southern red-backed vole (*Clethrionomys gapperi*). In addition, seed traps were placed randomly in each of the Healthy and Infected Beech study plots to provide annual estimates of seed production in these two stand types between 2003 and 2005.

RESULTS AND DISCUSSION

Results showed that seed predators in our study plots preferred European beech to sugar maple seed. While this result was not always statistically significant, it was consistent. Year-to-year effects were observed in small mammal population sizes, but we found relatively few significant differences among the stand types. The only exception was for southern red-backed voles, which were found in relatively high abundances in the No Beech stand type, occasionally in the Infected Beech stand type, and never in the Healthy Beech stand type. The mechanism behind this observation is unknown. Otherwise, it does not appear that mice species and eastern chipmunks have been negatively or positively affected by the incursion of beech bark disease into the UP. We were unable to obtain population estimates for other less common species.

Results of seed collections in the three stand types were inconsistent throughout this study. For example, in 2003, trees in the Infected Beech stands produced significantly more seed on average than trees in the Healthy Beech stands. One possible explanation for this observation is that trees in the Infected Beech stand type might have been producing a stress crop in response to the initial wave of infection by BBD. This pattern was reversed in 2004, when trees in the Healthy Beech stands produced significantly more seed than those in the Infected Beech stands. There are several possible explanations for this observation. First, it simply would have been difficult for trees to produce two large seed crops in sequential years. Second, trees in the Infected Beech stands might have begun to succumb to BBD, as infection often proceeds quickly. Although seed production was at a minimum in 2005, trees in the Infected Beech stands again produced significantly more seed than trees in the Healthy Beech stands.

It does not appear that small mammals have been strongly affected by the introduction of BBD into the UP, at least through changes in seed production by American beech. In part, this response may relate to these species' generalist tendencies; as one food source is diminished, they probably will find another. That said, there are other potential effects that could be significant (e.g., changes in light intensity in the understory as large overstory trees are lost, or increases in soft mast production), and a longer-term study is needed to get a more complete picture of changes that may be occurring in these forests.

The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.