

**Forest Health Monitoring, Evaluation Monitoring
FY 04 New (“regular”) Project Proposal**

Project Title: “Historical and regional analysis of beech bark disease impacts”

Expected Project Duration: 1 year

Principal Investigator(s):

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Project Objectives:

- Use historical phase II and phase III data along with historical GIS data on spread of beech bark disease to quantify regional impacts of beech bark disease. This will be accomplished by comparing estimates of dieback, decay, mortality and growth loss among areas identified as part of the uninfested, killing front, and aftermath areas.
- Use historical phase III data from areas to quantify relationships between weather (e.g., drought) and beech growth, dieback and mortality in the beech bark disease ‘aftermath’ area.
- Use historical phase III data to compare levels of coarse woody debris (and their potential as fuel) among areas identified as part of the uninfested, killing front and aftermath areas.

Project Description:

Also known as “beech scale” and “*Nectria* canker”, beech bark disease is an insect-fungus complex involving the exotic beech scale insect (*Cryptococcus fagisuga*) and the exotic canker fungus *Nectria coccinea* var. *faginata* or the native *Nectria galligena* that kills or injures American beech (*Fagus grandifolia*) (Houston 1994). The disease results when a *Nectria* fungus infects the bark through feeding wounds caused by beech scale insects.

Around 1900, the beech scale was accidentally introduced near Halifax, Nova Scotia from Europe. It has since spread southwestward into New England, New York, Pennsylvania, and West Virginia (Manion 1991, Houston 1994) (Fig. 1). An isolated infestation of beech bark disease was recently discovered in Michigan (O’Brien et al. 2001). Fungal invasion occurs about 3 to 5 years after the scale insects appear. Extensive mortality often occurs in the year that *Nectria* first becomes evident but some trees may survive for several years.

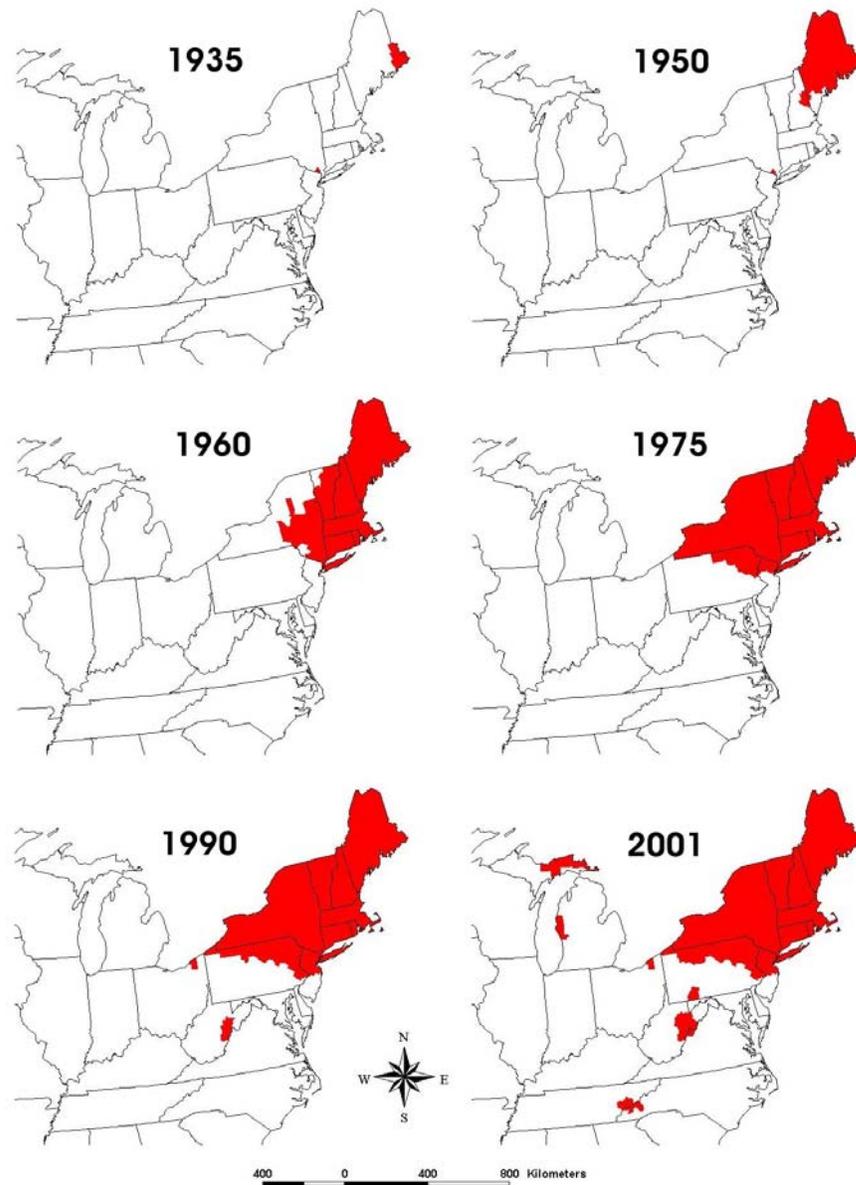


Figure 1. Maps of beech bark disease spread (1935-2001).

We recently (Morin et al. 2004) used Forest Inventory and Analysis (FIA) Eastwide plot data to derive a kriged map of American beech basal area/ha (Fig. 2). Beech is most abundant in the Adirondack Mountain region of New York, though other concentrations exist in Maine, New Hampshire, Vermont, West Virginia, and northern Pennsylvania. Beech also exists at very low levels over a large range extending through most forested regions of the eastern U.S.A. Morin et al. (2004) also used a GIS to map historical beech bark disease and estimate historical rates of spread (Fig. 1). Historical spread of beech bark disease was estimated at $11.7 \text{ km/year} \pm 0.18 \text{ km/year}$.

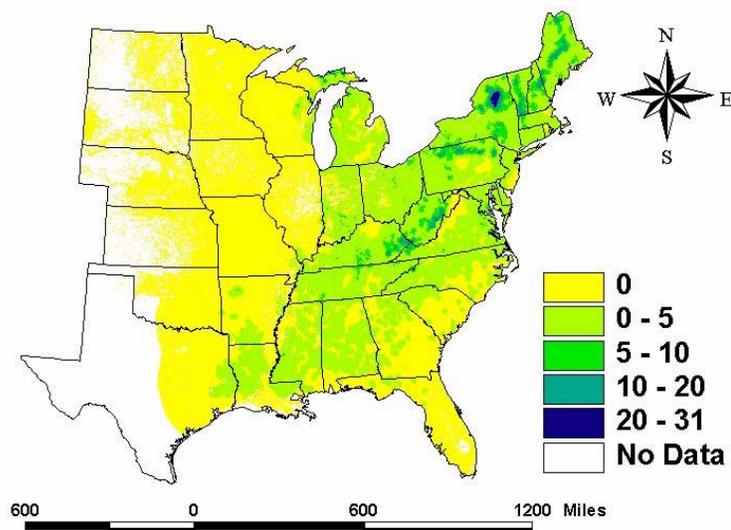


Figure 2. Kriged map of estimated American beech basal area adjusted for forest density (using NLCD derived forest density map) (Morin et al. 2004).

To date, information about beech bark disease impacts remains limited. When the beech scale first invades a new region and the *Nectria* fungus is present, extensive beech dieback and mortality may occur (Houston 1994, Twery and Patterson 1984, Mize and Lea 1979, Morin et al. 2001). Some of the distinctive impacts of beech bark disease include yellowing of the crown and 'beech snap' in which stems of mature trees break at ca. 5 – 10 m. This initial wave of mortality is referred to as the 'killing front' (Shigo 1964). Some trees survive the initial beech bark disease infestation; there may be a genetic basis for this resistance. In regions where the killing front has already moved through, scale populations typically continue to fluctuate and further dieback and mortality may occur. In these areas, beech bark disease may continue to sporadically cause substantial growth loss in surviving trees (Mize and Lea 1979, Gavin and Pert 1993). Anecdotal information indicates that beech bark disease impacts in these situations may be associated with drought, but this association has never been quantified.

In this study we plan to quantify beech bark disease impacts on a regional basis. This analysis will make use of both FIA (i.e. 'phase II data') and FHM (i.e. 'phase III data') plot data to quantify impacts. The analysis will also take advantage of our historical GIS layers on the spread of beech bark disease in order to differentiate regions as either part of the uninfested area, killing front, or aftermath area (*sensu* Shigo 1964). One advantage of using phase II data is that these data are intensively geographically sampled in all states. Furthermore, in areas where successive inventories are available, we will be able to directly estimate beech mortality. Elsewhere, our use of FIA data for measuring impacts will be limited to estimates of standing dead basal area per ha and frequency of tree condition codes. All of these variables will be

estimated at the county level and summarized regionally; the GIS layers of historical beech bark disease spread will allow us to associate these impacts with either baseline uninfested levels, killing front, or aftermath conditions.

Similar analyses will be conducted using phase III data. The availability of more extensive tree condition data (e.g., crown condition, decay, breakage, open wounds) will allow for more sensitivity in detecting impacts on crown dieback. Additionally, in many portions of the aftermath areas (i.e. the New England states), yearly phase III plot data have been collected for over 10 years. This extraordinarily detailed time series will provide us with more sensitive estimates of mortality rates and growth rates. Steinman (in press) included a preliminary analysis of beech damage, dieback, and mortality using phase III data. We anticipate that the work proposed here will build on that report by comparing damage levels among regions with varying histories of BBD presence.

An additional opportunity available with the New England phase III data is an analysis of associations of beech bark disease impacts (mortality and dieback) with yearly weather conditions. Yearly estimates of mortality and dieback will be statistically compared with time series (from permanent weather stations) of selected weather variables (e.g., Palmer drought index) in order to evaluate whether impacts are associated with drought or other conditions.

Another aspect of BBD impacts that will be evaluated using phase III will be a comparison of levels of coarse woody debris (and their potential as fuel) among areas identified as part of the uninfested, killing front, and aftermath areas. One consequence of beech mortality is the generation of coarse woody debris and we will investigate whether this effect can be detected in measurements taken on phase III plots. It is also possible that coarse woody debris will provide records of past mortality that are not available from the overstory records alone.

BUDGET REQUEST:

| Item | Requested FHM Funding | Contribution From RW NE-4557 |
|----------------|------------------------------|-------------------------------------|
| Salary/fringes | \$23,400 ¹ | \$24,500 ⁴ |
| Travel | 0 | \$2,000 |
| Equipment | 0 | |
| Supplies | \$1,000 ² | |
| Overhead | \$4,758 ³ | |
| Totals | \$29,158 | \$26,500 |

¹ Salary is 40% term GS-9 Statistical Assistant

² Supplies include IBM equipment usage fees and plotter ink and paper

³ Overhead is standard NE rate 19.5% of direct costs

⁴ Salary/fringes of Liebhold (10%), Gottschalk (5%), and Luzader (5%; GS-11 computer asst.)

Literature Cited:

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