Field Note

# Fifty-Year Impacts of the Beech Bark Disease in the Bartlett Experimental Forest, New Hampshire

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**ABSTRACT:** *Records from the early 1950s on the Bartlett Experimental Forest in New Hampshire showed that the percentage of American beech trees infected with heavy beech scale and Nectria was up to the 80 to 90% range. An inventory of beech bark disease conditions in three stands in 2004 showed that an older, uneven-aged stand managed by individual tree selection for 50 years had over 70% of the basal area in clean- (or disease-free) and rough-barked trees—trees that showed resistance or partial resistance to the disease; 15% of the basal area was clean. In contrast, an adjacent essentially unmanaged stand had well over 60% of the basal area in Nectria-damaged trees—those with sunken bark because of cambial mortality. A young unmanaged stand had a little over 60% of the basal area in mostly rough-barked trees. Records indicate that the amount of beech was not reduced by the disease in any of the inventoried stands. Apparently, single-tree selection over a 50-year period has substantially improved the disease resistance and merchantable potential of the stand. North. J. Appl. For. 23(2):141–143.*

**Key Words:** Beech bark disease, Nectria disease, beech scale.

The beech bark disease complex is the most serious pathogen affecting American beech (*Fagus grandifolia*) in the Northeast and, more recently, the Midwest. It is caused by feeding injury from the beech scale (*Cryptococcus fagisuga*), which allows infection by the Nectria fungi (*Nectria coccinea* var. *faginata*; Houston 1975). Beech is not a high-value timber species in New England, but healthy beech stands are valuable sources of mast for wildlife.

On the Bartlett Experimental Forest in New Hampshire, the beech scale was first discovered in 1939, and Nectria was observed soon after (data and reports by R.J. Hutnik and J.C. Bjorkbom on file in Durham, NH). Because of the lethal potential of this complex, several studies were begun in the 1950s, including remeasurements of scale and Nectria abundance, spraying to control the scale, and thinning practices with the hope of minimizing scale infestations. None of the spraying or thinning practices proved feasible or effective. However, this early work provided numerous records on the abundance of the scale and Nectria infestations in old and young stands on the Bartlett Forest. To assess the long-term impacts of the disease, a prism-plot survey was made in 2004 on three compartments representing young and managed/unmanaged old stands.

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## Methods

The three compartments included an old, uneven-aged northern hardwood stand that had been managed since 1952 by single-tree selection (32 acres, three harvests, Leak and Sendak 2002), an adjacent comparable stand that had received one cut in 1952–53 (while the disease was still spreading), but had remained unmanaged since then (63 acres), and a second-growth stand, about 100 years old in 2004, which was the site used for thinning plots to study beech-scale control in the early '50s (about 59 acres, including portions of an adjacent compartment). These areas are labeled old managed, old unmanaged, and young unmanaged in this article. The thinning studies in the latter area had not removed any beech, except for some cull removal in one 5.6-acre area, therefore the population had not been appreciably affected by the thinnings. In the old managed area, the harvests primarily targeted poor quality beech as well as lesser amounts of defective/risky yellow and paper birch.

Each of these compartments was prism-cruised (20-factor) in the summer of 2004 at an intensity of at least one plot per acre–a total of 164 plots. At each plot, the beech trees (10-in. dbh and over) were classified as clean, rough, or Nectria-damaged. The clean trees–sometimes described as "disease-free"–were perfectly clean and smooth with no evidence of cracked or rough bark from previous

**Table 1. Percentage of beech trees with heavy scale (scale occurring en mass, not individually) and Nectria in the young unmanaged area on Bartlett Experimental Forest (observations on 300+ trees).**

| Year | Heavy scale | | Nectria | |
|---|---|---|---|---|
| | Poletimber | Sawtimber | Poletimber | Sawtimber |
| 1952 | 38 | 79 | 0 | 1 |
| 1954 | 72 | 93 | 21 | 65 |
| 1955 | 59 | 92 | 26 | 81 |
| 1956 | 52 | 84 | 42 | 85 |

scale or Nectria infestation. The Nectria-damaged trees showed clear evidence of sunken lesions or dead patches of bark from earlier cambial mortality. The rough trees included everything in between, including trees with blocky bark from numerous cracks from scale injury as well as rough, raised bark lesions from successful walling-off of the Nectria. These are the same categories recognized by earlier work on beech bark disease injuries (Ostrofsky and Blanchard 1983, Burns and Houston 1987). Photos of these types of injury are found in Burns and Houston (1987). In addition, observations were made during the inventory on scale abundance and new Nectria infections.

## Results

In the young unmanaged area, historical records indicate that the percentage of trees with heavy scale (scale occurring in masses rather than singly) was at times above 70% in poletimber and 90% in sawtimber. Nectria was above 40% in poletimber and about 85% in sawtimber (Table 1). As expected, Nectria infection lagged behind the scale. Comparable records in two old, uneven-aged stands showed the incidence of scale-infested trees and Nectria-infected trees up to the 80 to 90% range. These two stands were comparable with the old stands examined in this survey. Scale/Nectria abundance and tree mortality were high in the old managed stand during the first marking in 1952 (personal recollection). There was concern at the time that the beech bark disease would decimate the beech population.

During the 2004 inventory, observations were made on the occurrences of scale and new Nectria infections. The scale occurrence was very light and scattered, requiring close observation to detect any at all. Fresh Nectria fruiting bodies were noted on a very few trees (about 11). These included trees classed as rough and Nectria damaged. However, in the old unmanaged stand, one clean 20-in. tree was noted with a moderate level of new fruiting bodies.

**Table 2. Basal area per acre ($ft^2$) of Nectria-damaged, rough, and clean trees by stand condition. Standard errors in parentheses.**

| Stand | Nectria | Rough | Clean | All |
|---|---|---|---|---|
| Old managed | 13.3 | 28.7 | 7.2 | 49.2 |
| | (2.8) | (4.1) | (2.6) | |
| Old unmanaged | 29.8 | 13.1 | 1.6 | 44.5 |
| | (3.3) | (2.2) | (0.7) | |
| Young unmanaged | 10.3 | 19.1 | 0.3 | 29.7 |
| | (1.9) | (2.6) | (0.3) | |

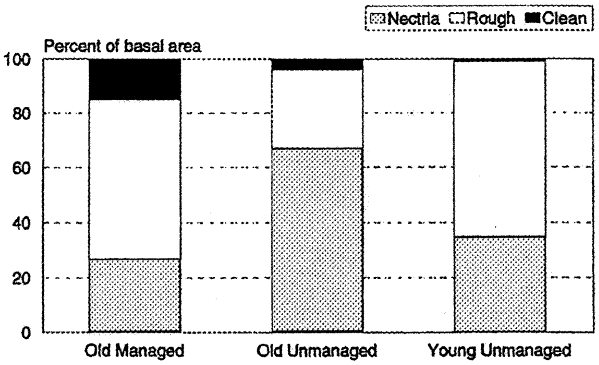


**Figure 1. Percentage of beech basal area in Nectria-damaged, rough, and clean trees in the old managed, old unmanaged, and young unmanaged stands.**

The 2004 inventory showed over 40 $ft^2$/acre of beech basal area in the old managed and unmanaged stands, and about 30 $ft^2$ in the young unmanaged (Table 2). In the old managed and young unmanaged, the rough category predominated; in contrast, the Nectria-damaged trees predominated in the old unmanaged stand. About 7 $ft^2$/acre of basal area in clean trees were present in the old managed stand. The relatively small standard errors suggest that these differences are not because of a sampling error.

In terms of percentage of basal area, the clean trees in the old managed stand accounted for 15%, and the clean and rough trees together comprised over 70%. The Nectria-damaged trees in the old unmanaged stand comprised over 60% of the basal area. Over 60% of the basal area in the young unmanaged stand was in rough trees with a few clean stems (Figure 1).

The old managed stand had about 40 $ft^2$/acre of basal area in beech in 1952, and now has about 49 $ft^2$/acre despite the heavy marking of beech during the three harvests; the basal area in large beech (20-in. dbh plus) about doubled (Table 3). The historical records on the other two stands are approximate because of some uncertainty about the boundaries used during the early surveys. However, there is no indication that beech presence standwide has declined because of mortality from the beech bark disease.

There is a perception that smaller trees may be less susceptible to beech bark disease. However, the 2004 inventory showed fairly consistent percentages of clean, rough, and Nectria-damaged trees in each of three size groups (Figure 2, A, B, and C).

**Table 3. Approximate historical basal areas per acre ($ft^2$) of beech by stand condition and size group compared with current basal areas.**

| Stand | Year | 10-in. dbh plus | 20-in. dbh plus |
|---|---|---|---|
| Old managed | 1952 | 40.8 | 2.4 |
| | 2004 | 49.2 | 5.1 |
| Old unmanaged | 1952 | 26.3 | 1.4 |
| | 2004 | 44.6 | 10.5 |
| Young unmanaged | 1950 | 18.9[a] | – |
| | 2004 | 29.7 | 1.9 |

[a] Trees 6 in. dbh and over.

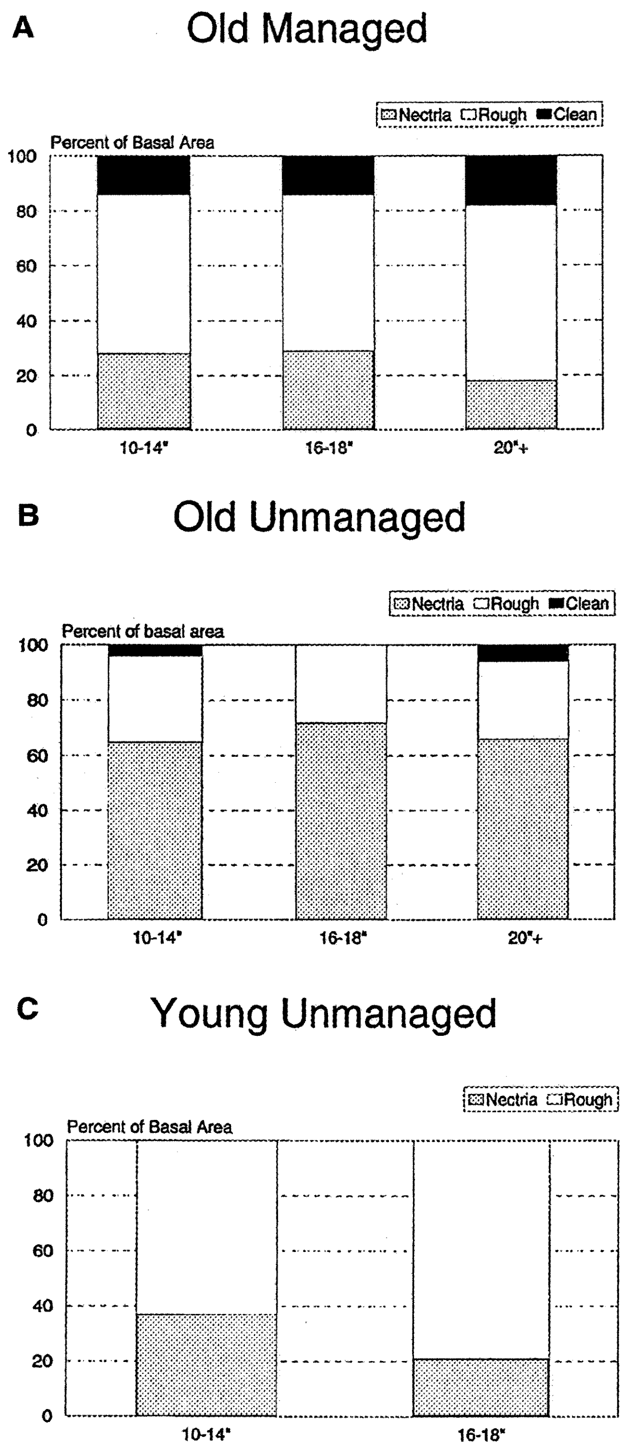


**Figure 2. Percentage of beech basal area in Nectria-damaged, rough, and clean trees by dbh size group in the old managed (A), old unmanaged (B), and young unmanaged (C) stands.**

## Management Implications

The results of this study have implications for the merchantability and disease resistance of beech stands. The old managed stand now has over 70% of the basal area (10-in. dbh and larger) in clean and rough trees. These are trees whose merchantability has not been severely limited by the beech bark disease (per the findings of Burns and Houston 1987), although other factors not recorded in this study—such as logging damage, internal defect, or crown condition—could limit value and productivity. Over the 50-year period, the proportion of grade 1 and 2 beech butt logs in the old managed stand increased from an estimated 21 to 30% of the sawtimber volume (Leak and Sendak 2002).

In addition, the clean and rough trees are those that have shown resistance or partial resistance to the disease. The old managed stand has a component (about 15% of the basal area) of clean trees, providing a nucleus for efforts to develop a high level of scale/fungi resistance. The old unmanaged stand has well over 60% of the basal area in Nectria-damaged trees, which limits potential merchantability as well as disease resistance. The young unmanaged stand has a little more than 60% of the basal area in clean and rough trees—not greatly different than the old unmanaged—although the proportion of clean trees is very small. One might think that the younger, smaller-sized trees in this stand might be more resistant. However, tree condition did not seem related to tree size in any of the stands. Possibly, the lower basal area of beech (a higher mixture of other species) could be involved. We just do not know.

The conclusion is that 50 years of management directed toward removing poor beech has produced a stand where the effects of the beech bark disease on potential merchantability and stand-level health have been significantly reduced. The application of these results to other areas must be viewed with caution. It is quite likely that other regions have different levels of genetic resistance to the beech bark disease, and possibly different strains of scale and Nectria as well. Possibly, trees in the Bartlett stands that we thought to be resistant could be reinfected by new strains of the disease complex. However, at this point, the possibilities for producing healthy beech stands in the Bartlett region of New Hampshire appear promising.

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