

MANAGING BEECH BARK DISEASE IN MICHIGAN

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Abstract

The year 2000 discovery of beech bark disease in Michigan's Upper and Lower Peninsulas marked the beginning of a major shift in the ecology of its northern hardwood forests. Michigan has 7 million acres of beech containing forests. About one-half of these forests have $\geq 20\%$ beech basal area. Estimates place initial killing front losses at 7.5 million pole size and larger beech, or 22.7 million cubic meters of sawtimber. Management strategies are influenced by the basal area and size of beech trees, and distance from BBD advancing fronts. Keeping a minor beech component ($<1 \text{ m}^2$ basal area) minimally affects stand vulnerability and productivity, and offers an extended period of mast production. All heavily scale infested trees are considered a high risk of beech snap and are removed if they pose a threat to human safety in parks and campgrounds. Information from evaluation monitoring plots established throughout the state will quantify and help predict short and long-term impacts of beech bark disease on forest composition, productivity, and wildlife values. Scale and BBD spread rates are also being evaluated. Newly detected, isolated scale infestations far in advance of the advancing front are being removed to evaluate potential impacts on spread rates. Not moving infested beech logs or firewood to or through uninfested beech areas from August to snowfall when crawlers are active is being promoted. Michigan is cooperating with national and state efforts to discover and define resistance to BBD, and to hopefully produce a source of resistant seedlings.

Introduction

The year 2000 discovery of beech bark disease (BBD) in Michigan's Upper and Lower Peninsulas marked the beginning of a major shift in the ecology of its northern hardwood forests. The forest management guidelines presented in this paper will hopefully assist forest resource professionals and recreation managers as we react to and prepare for this unfortunate and difficult ecological transition. As with all guidelines, this is a work-in-progress. We have much to learn as this new

exotic pest begins altering our beech resource in its many habitats and forest associations.

The Beech Resource

American beech (*Fagus grandifolia*) is the only native species of this genus in North America. It is a slow-growing, common, deciduous tree that attains ages of 300 to 400 years. Although beech is now confined to the eastern United States (except for the Mexican population) it once extended as far west as California and probably flourished over most of North America before the glacial period. Michigan is at the extreme northern and western edge of American beech range.

The American beech is easily recognized even in dense, complex forests by its thin, smooth, light gray bark. Unlike most other hardwood trees, it retains this smooth bark throughout its mature years. The smooth bark of the American beech presents a tempting surface for the carving of initials and names. Carvings into the beech bark persist for the life of the tree, as do bear claw marks produced as black bears forage for nuts in the fall.

Beech is an important nut producer in the northern hardwood type. The distinctive triangular nuts are eaten by people and are an important food for wildlife. Beech mast is palatable to a large variety of birds and mammals, including mice, squirrels, chipmunks, black bear, deer, foxes, ruffed grouse, ducks, and blue jays.

Beech wood is excellent for turning and steam bending. It wears well, is easily treated with preservatives, and is used for flooring, furniture, turned products and novelties, veneer, plywood, railroad ties, baskets, pulp, charcoal, and rough lumber. It is especially favored for fuelwood because of its high density and good burning qualities.

The 1993 USDA Forest Service Survey reports that Michigan has 7.16 million acres of Maple-Beech-Birch type containing 1.67 billion board feet of beech, or 138 million trees in all size classes. This includes 15 million beech trees greater than 9 inches in diameter at breast height (dbh), and 0.9 million greater than 21 inches dbh.

Hazard Tree Management

Michigan's state parks and state forest campgrounds were the first areas impacted by the beech bark disease. The

disease was first detected at Ludington State Park on the west shore of Michigan's Lower Peninsula, and at Bass Lake State Forest Campground just south of the southern Lake Superior shoreline in the Upper Peninsula. Both areas have abundant large, old beech trees. BBD infected beech began to structurally fail in these areas when stressed by high winds.

Many trees that are partially girdled by *Nectria* and often further weakened by ambrosia beetle galleries are broken by high winds. This breakage is called "beech snap." This creates a hazard situation to people and personal property where beech trees occur in campgrounds, other recreation areas or near homes. Hazard rating guidelines were developed recognizing this new threat to people and property. We currently recommend that heavily infested beech be removed if structural failure could cause personal or property damage. This does not presuppose visible signs of tree decline. If tree decline is associated with heavy scale infestation, the tree is removed immediately, or the area is closed until tree removal. This is a conservative, proactive approach. Heavily scale infested trees will eventually die or fail. This guideline reduces chances of missing hazard trees which quickly succumb to scale and BBD; helps ensure a safe environment for visitors, staff and property; and forces us to sooner face imminent tree loss and forest restoration issues.

Loss and Impact Estimates

The first wave of BBD in northern Pennsylvania forests killed roughly 50% of the beech trees larger than 25 centimeters in diameter at breast height (dbh). Another 25% of the trees lived, but were infected by *Nectria* (McCullough, et al., 2002). These live infected trees were weak, grew slowly and had patches of dead tissue. The remaining 25% of the trees either escaped scale infestation or *Nectria* infection, or were at least somewhat resistant.

It is estimated that once the Killing Front spreads throughout Michigan, we will have lost 7.5 million beech pole size and larger beech. This represents 800 million board feet of sawtimber.

Review of Factors Influencing Disease Development and Damage

The age, density (e.g. basal area) and size of beech trees, and stand tree species composition affect BBD

establishment rates and stand vulnerability. Older forests with a high component of large beech are most vulnerable. Management options should take into account the beech tree's thin bark which renders it highly vulnerable to injury by fire (large shallow roots are especially vulnerable), sunscald, logging, pruning, and disease.

If beech is a minor component of the overstory, mortality of beech trees may simply function as a selective thinning with little loss of timber value. Mortality of scattered large beech may actually increase the habitat available for birds, mammals and other wildlife. Beech is the only nut producer in the northern hardwood type. Thus, keeping a minor beech component offers an extended period of mast production and eventual habitat for cavity nesters and dens.

Growth of other tree species associated with beech will be enhanced as BBD removes beech from competition. Analysis of DNR Forest Health Monitoring plot data indicates that BBD spread rates are lower in stands with lower beech basal areas. Thus, the loss of beech basal area may be more gradual, and have less impact on stand stocking levels where there are fewer, more scattered beech.

Management Strategies

Management strategies are influenced by the amount of American beech in a stand and the distance from the BBD Advancing Front. Distance is used to estimate the amount of time before BBD impacts a stand. Estimates from northeastern forests suggest that the advancing front spreads at a rate of 6 miles per year. In addition, once scale reaches a new area, it often takes several years of scale infestation before *Nectria* is abundant. This is particularly true when a new scale infestation is a long distance from the Killing Front.

Management guidelines are presented for scale infested and uninfested beech stands. Guidelines for uninfested stands are suggested for areas projected to have more than five years before BBD related tree decline and mortality. The scale may arrive within this window, but again, it takes a few years before *Nectria* begins impacting tree growth and survival. Guidelines for uninfested beech are applied to stands greater than 40 kilometers from the Advancing Front. This figure may be modified as our understanding of rates of scale and *Nectria* movement are

enhanced via monitoring plots and yearly surveys. A current year map of the BBD advancing and killing fronts is published on the MDNR Forest Health Website at <http://www.mcgi.state.mi.us/foresthealth/>.

Uninfested Stands > 40 kilometers from the Advancing Front of Beech Bark Disease

Management plans for beech containing stands anywhere in Michigan should now consider BBD vulnerability. Stands dominated by beech ($\geq 20\%$ basal area) are highly vulnerable to damage. This is especially true if large trees (>25 cm dbh) are abundant.

American beech is not always evenly distributed in stands which have a minor American beech component. Hardwood stands often have inclusions of almost pure beech groves. In these cases, percent basal area may not accurately reflect overall stand vulnerability or susceptibility.

In general, these guidelines reduce the basal area of large diameter beech and increase tree species diversity in stands with a significant beech component. This reduces within stand rates of spread of the beech scale; reduces negative impacts on stand stocking levels; and provides more management options via non-host species abundance.

Management Guidelines

- 1) Consider reducing the amount of overstory beech present in the stand. For purposes of BBD management it is not necessary or desirable to eliminate beech from a stand. However, increasing tree species diversity provides more management options and may reduce rates of beech scale spread.
 - a. Discriminate against large, over mature trees with rough bark and signs of decay. These trees will be the first lost and will offer the fewest advantages in terms of prolonged mast production or survivability. Reduce stand to 70 -100 sq. ft. of basal area. There is time before BBD impacts beech growth and survival for stands to add basal area in expected increments relative to site quality and stand vigor.
 - b. Consider short-term and long-term impacts on wildlife food availability and habitat. Leaving scattered snag or den tree beech to enhance

wildlife habitat does not significantly increase the risk of tree loss. Oak or other mast producing tree species should be considered to replace beech where beech density is high.

- 2) Retain vigorous trees with smooth bark. Identification of potentially resistant trees is important for decreasing the long-term susceptibility and vulnerability of the beech resource to BBD. Vigorous trees with smooth bark are most often found to be resistant to beech scale establishment.
- 3) Use harvest systems that minimize injuries to beech root systems. Root injury is the primary cause of root sprouts in beech. Spring root injuries maximize sprouting response.
- 4) Survey stands regularly to detect the arrival of beech scale. Knowing when scale enters a stand will establish a rough timetable for future expected beech snap and tree mortality. Beech snap creates hazard, and can be responsible for large volume losses before salvage harvests are scheduled. Trees susceptible to snap do not always show signs of decline.
- 5) Favor regeneration of other tree species via selection or planting in canopy gaps. Some of the principal associates of beech are sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), American basswood (*Tilia americana*), black cherry (*Prunus serotina*), eastern white pine (*Pinus strobus*), and several hickories (*Carya* spp.) and oaks (*Quercus* spp.). On poorer, lighter soils conifer components (*Tsuga*, *Picea*, *Pinus*) are more common.

Beech is relatively shade tolerant and is often out-competed by other species in large canopy gaps where the ground is exposed to sunlight during much of the day. Birch, black cherry, red maple or other shade intolerant species will grow faster and overtop beech reproduction. However, beech is avoided by browsing deer which may decrease successful regeneration of more favored species in areas with high deer numbers.

The Michigan Department of Natural Resources currently recommends 30-foot average canopy gaps, and 60-ft. gaps to encourage intolerant tree species. Using 100-ft. gaps for group selection when intolerants are present (cherry, yellow birch, oak, ash) is also an option

to increase diversity. Regeneration success relies on placing gaps in areas of good advanced regeneration and seed source. Without this, gaps may become raspberry patches. With canopy gaps as big as 100 ft. it is very difficult to get an “accurate” BA reading, thus group selection may be the best choice.

Uninfested Beech Stands < 40 Kilometers from the Advancing Front

Management guidelines in this section address the influence of beech abundance within the following context:

- 1) Beech Stands without Scale
- 2) Beech Stands within the Advancing Front (e.g. with scale insects)
- 3) Beech Stands within the Killing Front (e.g. with decline, beech snap and/or tree mortality)

Beech Stands without Scale

Within 40 kilometers of the BBD Advancing Front, there is a risk of losing beech basal area during the current harvest cycle. This translates into less or no opportunity to improve tree species diversity prior to significant BBD impacts. Translated to forest management terms, there is a significant risk of BBD impacts reducing stand basal area to below minimum stocking levels. This is especially true in patches or stands with high densities of beech.

The only guidance for selecting residual beech to retain is to favor smooth barked, healthy, vigorous trees. Keep in mind that 50% of trees with a ≥ 25 cm dbh will be lost in the first few years as these stands enter the Killing Front. Many of the first trees to succumb will be less healthy and rough barked.

Beech Stands within the Advancing Front (with Scale Insects)

- 1) *Identify, mark and retain resistant trees.* In stands that are infested with beech scale, look for trees with few or no beech scales, especially when these trees are growing near heavily infested trees. These trees should be clearly marked, protected and reported to the Michigan DNR Forest Health Program for inclusion into tree resistance research. (Note: We train resource professionals to recognize resistant trees and provide a Cooperative BBD Resistance Tree

Survey Form which details tree marking and reporting details.)

Resistant trees may be found in groups due to root sprouting habits of beech. Identify and protect all trees in such groups. Sprouts and possible seed source from these trees offers an opportunity to regenerate a BBD resistant resource.

- 2) *Identify trees for salvage.* Discriminate against trees that are heavily infested with beech scale. Select large, over mature trees with rough bark, trees with evidence of decay, broken tops or other injuries first.
- 3) *Maintain some beech basal area.* Retain some large beech for wildlife habitat. This will not significantly affect the spread or impact of BBD. These trees will die first and most quickly, so should not be used in calculating minimum stand basal area. Generally, increasing species diversity and shifting the beech component towards smaller, more resistant size classes will reduce the impact of BBD. This will help prolong the beech resource’s ability to produce mast. In stands where oak, hickory or hazel are abundant, beech mast may be less important.
- 4) *Favor regeneration of other tree species via selection or planting.* Consider trees suited to the habitat type with special consideration for mast producing species.
- 5) *Do not transport scale infested beech firewood or logs to or through beech areas outside the Advancing Front between August and late Fall.* The mobile life stage of the beech scale known as crawlers are mobile in the fall. They are readily dispersed by birds and strong winds. Moving recently harvested wood from infested areas risks spreading beech scale to new areas at greater than expected rates.

Beech Stands within the Killing Front (with decline, beech snap or tree mortality)

Once beech begins declining, snapping and/or dying, BBD impacts progress at a rapid pace. Resistant trees will be more apparent. Once a large portion of the mature beech resource has been lost, beech stands enter the final stage of BBD impact known as the Aftermath Forest.

Management choices will depend on site productivity, habitat type, residual stocking levels and residual tree species. Heavily impacted stands may require artificial regeneration to restore acceptable stocking levels and/or acceptable tree species.

Statewide Education and Outreach

A high quality Michigan BBD Bulletin was created to inform and educate forest resource professionals and the general public (See McCullough et al., 2002). Many forest health training sessions have featured BBD biology, detection, evaluation, protection of putatively resistant trees and management guidelines. This has the added advantage of increasing the likelihood of detecting new BBD infestations as they appear in new areas, ahead of the advancing front. This is important when applying management guidelines which are dependant on years of BBD free growth. The statewide network of evaluation monitoring plots is, of course, the primary source of such information.

Fortunately, we have federal cost share programs to assist landowner reforestation efforts. Approximately 2,000 acres in the Upper Peninsula killing front were salvaged in 2004. Many of these hardwood acres were on lower quality hardwood sites. These poorer sites were replanted with oak, hemlock, red pine, white pine and hemlock with assistance for our Wildlife Divisions Landowner Incentive Program.

Conclusion

Management tactics will likely change as we gain new understandings of scale spread rates, BBD disease progression in different forest associations, and BBD forest resource impacts provided by yearly detection surveys and Michigan's extensive network of evaluation monitoring plots. We will continue to support efforts to produce resistant planting stock. We will work ahead of the BBD advancing front to increase the tree species diversity of forest resources dominated by American beech. Hazard tree training for park and campground managers has gone from an occasional session to several sessions per year. Much of our beech resource is unaffected by BBD, so many Michigan residents have yet to experience or understand the implications of having BBD in the neighborhood. The loss of these majestic, old trees baring the initials of their predecessors and the claw marks of grateful bears... of this unique, unparalleled,

park-like old growth forest is in Michigan's not too distant future.

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