

INTRODUCTION

Beech bark disease (BBD) is an exotic insect and disease complex that results from the interaction of the exotic beech scale insect, *Cryptococcus fagisuga* Lind., and at least two species of fungi in the genus *Neonectria* (Ehrlich 1934, Lohman and Watson 1943, Spaulding and others 1936). Impacted forests suffer high mortality of American beech (*Fagus grandifolia*), in some cases within a few years of first detection. American beech is an important component of many forests in Wisconsin, in particular along Lake Michigan where tourism is economically important, and in parts of the Menominee Reservation. BBD was first identified in Wisconsin in Door County in 2009, and the extent and severity of the disease in Wisconsin's forests are currently being evaluated. BBD was first identified in Michigan in 2000 and has spread throughout the range of beech in Michigan, with 100 percent mortality in the most significant areas of infestation. Approximately 18 million American beech (sapling sized and larger) are currently found in Wisconsin, and beech volume is estimated at 37 million cubic feet (USDA Forest Service 2015). Four million acres of forest that contain beech, primarily mixed with maple and birch, are growing on the eastern side of the State. Besides being an important timber species, beech nuts are highly valued by wildlife. Beech may be the only nut producer in some parts of its range.

BBD has caused heavy mortality of American beech throughout its range in Michigan and in the Northeastern United States (Hane 2003, Latty and others 2003, McGee 2000, Petrillo and others 2005, Runkle 1990, Twery and Patterson 1984, Witter and others 2005). Based on the significant beech resource present in Wisconsin, managers expect similar mortality in the future. Because BBD has not been present throughout the range of beech in Wisconsin for very long, results from this research can help managers determine how at risk their stand(s) may be and decrease the overall impact of BBD before mortality occurs.

PROJECT OBJECTIVES

1. Establish a long-term monitoring system of Type 1 (extensive—less detailed, greater number of plots) and Type 2 plots (intensive—more detailed, subset of extensive plots) based on the Beech Bark Disease Monitoring and Impact Analysis System in Wisconsin beech forests over a 3-year period.
2. Collect baseline data showing the current conditions of the beech resource and northern hardwood stands containing beech.
3. Develop GIS maps that delineate the occurrence of beech scale and beech bark disease presence and severity in Wisconsin.
4. Identify areas at high risk, develop a risk model, and prioritize research needs for BBD in Wisconsin.

CHAPTER 9.

Current Health Status of American Beech and Distribution of Beech Bark Disease in Wisconsin (Project NC-EM-B-11-01)

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METHODS

This project initiated the development of the Wisconsin Beech Bark Disease Monitoring and Impact Analysis System (WI-BBDMIAS), in response to the identification of the beech scale and American beech mortality in 2009 in Door County. The WI-BBDMIAS is modeled after a very similar monitoring system in Michigan, which comprises more than 200 monitoring plots throughout the State. The WI-BBDMIAS includes two plot types: Type 1 (extensive—less detailed, greater number of plots) and Type 2 (intensive—more detailed, subset of extensive plots).

Type 1 plots consist of 30 prism points, 2 chains 40 m apart from each other, along transects, typically 5 by 6 or 3 by 10 points depending on the layout of the stand. A 20BAF prism is used to calculate basal area of all species, live and dead, at each prism point. The nearest American beech tree to each prism point is then sampled, for a total of 30 beech measured in each stand. For each beech tree sampled, the following variables are measured: diameter at breast height (d.b.h.), live crown ratio, crown density, crown dieback, foliage transparency, crown light exposure, tree vigor/condition, crown class/position, up to three tree damages, and the percentage of beech scale coverage. Beech scale coverage is estimated

using a transparency frame 12.5 cm by 28 cm, placed 1.5 m above the ground on the north, south, east, and west sides of the tree. Other studies have found beech scale infestations to be higher on the protected north and east sides of the tree, especially in the early stages of infestation (Houston 1994). U.S. Forest Service Forest Inventory and Analysis protocols are used for all forest health metrics (USDA Forest Service 2015).

The number of plots located in each county is based on the amount of beech present in the county, the amount of publicly owned land in that county, and distance from current infestation. American beech is limited to the eastern part of Wisconsin, and plots were prioritized in areas where public visibility was greatest (along Lake Michigan, Door County, and State parks and recreation areas) and on the Menominee Reservation where American beech is an important part of the forest resource.

Areas at most risk for mortality from BBD were determined using the following criteria: (1) the average percentage of beech basal area present, and (2) the average percentage of beech scale present in each stand. These two factors were used to determine which stands had a low to high risk of mortality from BBD based on the current data.

Table 9.1—Number of extensive plots established and number and percentage with positive beech scale identification in Wisconsin counties, 2011–13

County	Total number of plots	Number of plots with scale	Percentage of plots with scale
Dodge	1	1	100
Door	30	20	67
Fond du Lac	1	0	0
Forest	3	1	33
Langlade	1	0	0
Manitowoc	4	2	50
Marinette	5	1	20
Menominee	22	8	36
Oconto	5	5	100
Ozaukee	6	4	67
Sheboygan	1	1	100

Based on the current distribution and severity of beech scale in Wisconsin, the areas of highest risk for mortality due to BBD are in the northern part of Door County, where the forests are dominated with American beech and there is currently an established beech scale population (fig. 9.2). Mortality from BBD has already occurred throughout Door County, and beech scale populations tend to decrease in stands with extensive mortality in what are called “aftermath” forests because of a lack of host material (Cale and others 2015, Houston 1994). Therefore, the risk map only categorizes stands that currently have high levels of beech scale and are at high risk of mortality in the future. Areas of moderate risk include southern Door County and locations on and adjacent to

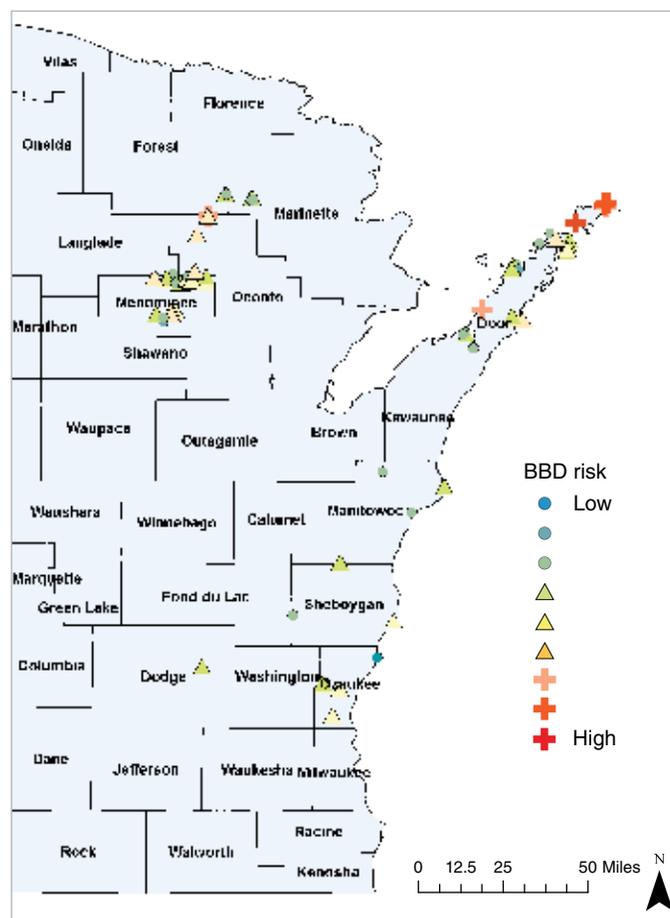


Figure 9.2—Risk map showing low to high risk of mortality from beech bark disease (BBD) in monitoring plots. The risk model for BBD was developed using the following criteria: (1) the average percent beech basal area (BA) present and (2) the average percent beech scale present in each stand. Plots with the highest risk are depicted with a cross symbol, dark red being the highest risk. Triangles represent plots with moderate risk; light orange is high-moderate risk and green is a low-moderate risk. Circles represent plots with low risk; green is moderate-low and blue is the lowest risk.

the Menominee Reservation, where beech is a significant part of the stand but scale populations are still relatively low.

Wieferich and others (2011) found that beech scale populations in Michigan can move 1.2–5.5 miles (3.3–14.3 km) per year. Rate of spread and dispersal of beech scale is highly influenced by the density of American beech within a stand and the direction of the prevailing winds (Griffin and others 2003, Houston 1994). Once in a stand, many factors may influence BBD severity, including presence of genetically resistant beech, nitrogen concentrations in bark tissue, density of hemlock (*Tsuga canadensis*), and local climate conditions (Houston and Valentine 1988, Latty and others 2003, Twery and Patterson 1984, Wargo 1988).

Very little data are available to predict how quickly mortality may occur once beech scale is found in a stand. Based on the Wisconsin risk map, the areas with highest risk are likely to experience mortality within the next 1–3 years, with the moderate risk areas of Door County likely to experience mortality shortly after that, possibly within 5–7 years. It could take decades for mortality to occur in the areas with low risk, based on the current very low beech scale populations and low densities of beech in some of the stands. Menominee Tribal Enterprises is actively reducing American beech basal area throughout the Tribal lands, and it is taking special precautions to leave trees likely to have resistance to BBD. Therefore, even though many

stands within Menominee County currently are showing a moderate risk of mortality from beech bark disease, those stands may never see aftermath forest conditions if the beech basal area is reduced enough and resistant trees are remaining. The infancy of BBD in Wisconsin may allow us to contribute to the small amount of knowledge regarding how rapidly mortality may occur once it enters a stand. Future research on BBD in Wisconsin should use the data gathered in this study as a baseline from which to determine mortality rates, so land managers may have a better idea of how long BBD may be present in a stand before mortality occurs.

CONCLUSIONS

Management guidelines for BBD in Wisconsin have recently been developed by the Wisconsin Department of Natural Resources. Management recommendations are based on the percentage of beech basal area in the stand. Land managers can use the risk map to determine at what level of risk their stand(s) may be, based both on beech basal area and also where beech scale is most prevalent. Monitoring plots established as part of the WI-BBDMIAS should continue to be visited to help determine not only where the beech scale is present and its density levels, but also its rate of spread to help managers determine how quickly beech scale may move into new areas or throughout a stand and how quickly mortality may occur.

CONTACT INFORMATION

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