Preparing Wisconsin's Forests for the Emerald Ash Borer

January 2008

The emerald ash borer (EAB), *Agrilus planipennis*, is an exotic insect that was first identified in southeast Michigan in 2002. EAB is very aggressive at attacking and killing all true ash species (*Fraxinus* sp.), and even healthy trees decline and die within several years. Since 2002, the insect has also been found at numerous sites in Illinois, Indiana, Maryland, Ohio, Pennsylvania, West Virginia and Ontario, Canada. Infestations in northern Illinois are about 35 miles from Wisconsin, and several infestations have now been found in the eastern Upper Peninsula of Michigan. EAB has not been found in Wisconsin as of January 2008.

Figure 1. Adult Emerald Ash Borer. Photo by Howard Russell.

Symptoms and Reporting Suspects

Figure 2. Serpentine larval gallery with larva at the base. Photo by Renee Pinski.

Symptoms of EAB infestation include thin foliage in the upper crown, dieback in the upper and outer crown, epicormic sprouts on the stem and at the base, bark cracks covering larval galleries, and small D-shaped exit holes. Extensive woodpecker activity is also a sign that EAB larvae could be present in the tree. EAB typically infests the top of the tree first, then moves down the stem. Adult beetles are approximately ½" in length and emerald green. However, there are native beetles that look very similar. Collecting a specimen is very important for proper identification; freezing the insect or preserving it in rubbing alcohol will maintain the specimen until an expert can examine it. In all stands with a significant ash component, monitor for symptoms of EAB infestation and report suspect trees and insects to the DNR regional forest health specialist or to 1-800-462-2803.

Risk of Introduction

EAB is virtually certain to arrive in Wisconsin, but it is difficult to accurately predict when or where the pest will become established. It is also possible that the insect is already present at very low population levels, but has not been detected. Natural spread of EAB is currently thought to be between ½ to 2 miles per year. However, numerous outlying populations have been established through accidental transport of the insect in firewood, nursery stock, and unprocessed logs. Campgrounds and urban areas are currently thought to be at highest risk of EAB introduction due to this accidental transport (Figure 3). Landowners may choose to consider the likelihood of introduction in the local area when considering management options.

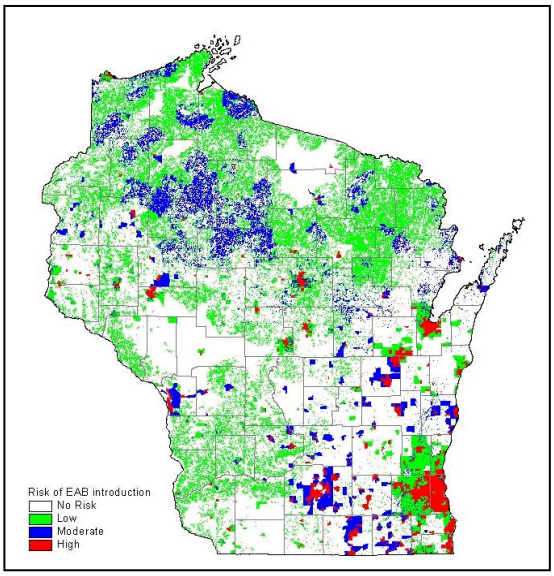

Figure 3. Risk of EAB introduction. Risk was determined by ARC GIS model that considered human population density, density of seasonal homes, number of campsites and basal area of ash.

Future Impacts

Early observations have revealed no obvious natural resistance to EAB in the native ash population yet it is too early to dismiss native resistance as a possibility. There are currently no completely effective treatments for eliminating the insect from infested trees. Figure 4 illustrates the extent of expected ash mortality, based on where ash is located and assuming no native resistance. There is very little data on the impacts of various population levels of EAB on the ash forest. Over time, predicting impact will be based on a better understanding of the insect's population dynamics.

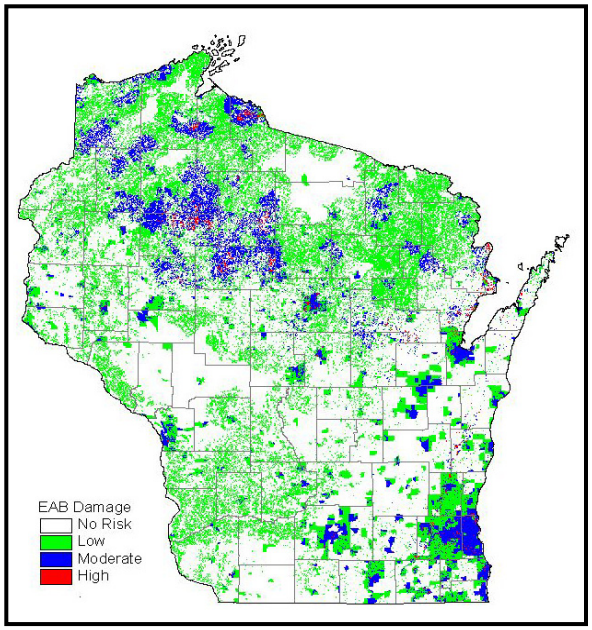

Fig. 4. Potential extent of ash mortality from EAB in Wisconsin. The level of ash mortality was predicted by the risk of introduction and number of ash trees.

It is important that landowners evaluate the potential impacts of EAB and take action if needed. Landowners should carefully evaluate long-term management options, and determine which silvicultural practices are suitable for their stands. Preparing a stand for EAB impacts may allow the stand to remain adequately stocked with non-ash species and able to meet management objectives if all of the ash dies or is harvested. **Removing all ash prior to EAB establishment in the local area is not recommended.** Research may reveal new management options, and maintaining an ash component will help to maintain species diversity and other benefits that ash provides.

EAB establishment in Wisconsin or the local area may lead to increased harvesting of ash and thus affect ash stumpage prices. EAB impacts may conflict with Managed Forest Law Program requirements. A professional forester can help to determine appropriate management options.

Regulatory Considerations

The Wisconsin Department of Agriculture, Trade and Consumer Protection, working with USDA Animal and Plant Health Inspection Service, will be the lead agency in establishing and enforcing a quarantine. Quarantine restrictions will be placed on an area (probably a county) surrounding a known infestation. This action will define how, if at all, wood and wood products must be treated before they may be moved out of the quarantined area**.**

Response Considerations

The Wisconsin Department of Agriculture, Trade and Consumer Protection and the Department of Natural Resources have developed a response plan for EAB. In the event that EAB is detected in Wisconsin, a delimitation survey will be conducted to determine the extent of the infestation. Following the delimitation, a plan of action will be recommended to manage or control the infestation. Each infestation will be individually examined and evaluated to determine the most responsible and reasonable course of action, based on the most scientifically sound information available at the time. In addition to collection of the scientific data, site surveys will be conducted to determine environmental sensitivity, endangered resources, and social impacts. These assessments will be done with guidance from the US Fish and Wildlife Service and DNR Endangered Resources. Where appropriate, Traditional Ecological Knowledge will also be taken into consideration. It is unlikely that there is a one-size-fits-all strategy for managing an infestation of EAB.

The Ash Resource in Wisconsin

There are an estimated 727 million ash trees >1" in diameter in Wisconsin's forests, comprising approximately 7% of all forest trees greater than 1" in diameter (Figure 5). Ash is also a common street and yard tree, comprising an average of 20% of urban street trees and 12% of all urban trees.

White ash (*Fraxinus americana*) is typically an associate in other forest cover types, and only rarely is a dominant tree. White ash is found throughout the state on a variety of sites, but is most frequently found on fertile, well-drained sites.

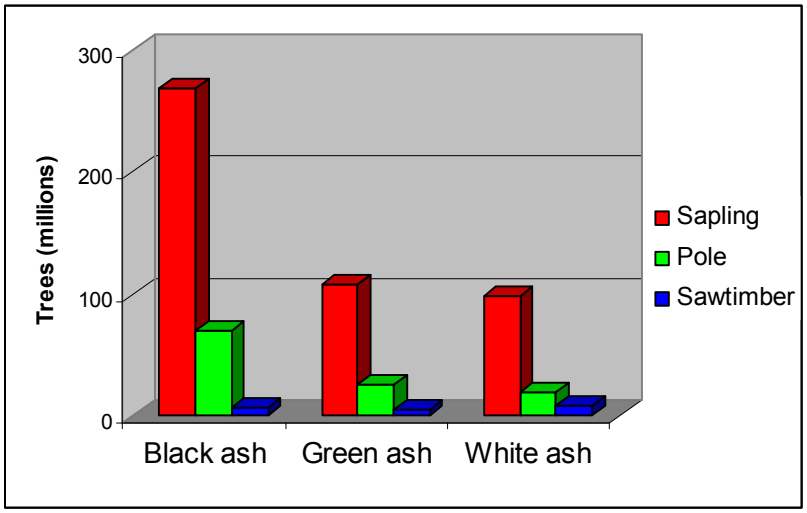

Figure 5. Number of black, green and white ash trees in Wisconsin. Data from USDA Forest Service Forest Inventory and Analysis plot network.

Green ash (*F. pennsylvanica* var. *lanceolata*) is found throughout the state, but is most common in southern Wisconsin. It may form pure stands or grow in association with black ash, red maple, silver maple, swamp white oak, and elm. It grows as an associate in upland hardwood stands, but is most common in and around stream banks, floodplains, and swamps.

Black ash (*F. nigra*) is fairly well distributed over the entire state but is most common in northern Wisconsin. It is most common in swamps, but is also found in other wet forest types.

Blue ash (*F. quadrangulata*) is a threatened species that is currently found only at a few sites in Waukesha County. The species is at the edge of its range in Wisconsin, but is common in states farther south. The species is not of commercial importance.

Mountain ash (*Sorbus americana* and *S. decora*) is not a true ash and is not susceptible to EAB infestation.

Management in Artificial Regeneration

Currently, it is recommended that ash be limited to less than 10% of a new planting. On sites where significant natural ash regeneration is likely, don't plant any ash. It is unknown how soon EAB will become established in Wisconsin or how quickly it will spread, but there is a high risk that ash in a new planting will be killed before maturity.

Management in Natural Regeneration

Continue current management practices in seedling and sapling stands and sites that are naturally regenerating. If the ash component represents >10% of all regeneration, then reduce the ash component during release and thinning operations, favoring non-ash species. Retain the most vigorous ash stems. Active treatment of ash regeneration through cutting or herbicide may be needed.

Supplemental planting of non-ash species is another option to increase the non-ash component. Where ash regeneration is predominant (>50%) and if feasible, implement practices that discourage young ash and encourage regeneration of non-ash species through natural or artificial techniques.

Management in Established Stands

Options for preparing forest lands will depend in part on the frequency of ash in the stand. As the proportion of ash rises, fewer options will be available. The management guidelines have been developed based on three ash basal area levels: 1) ash <20% of the basal area, 2) 20-40% and 3) >40%. Figure 6 illustrates the proportion of each species in each basal area category.

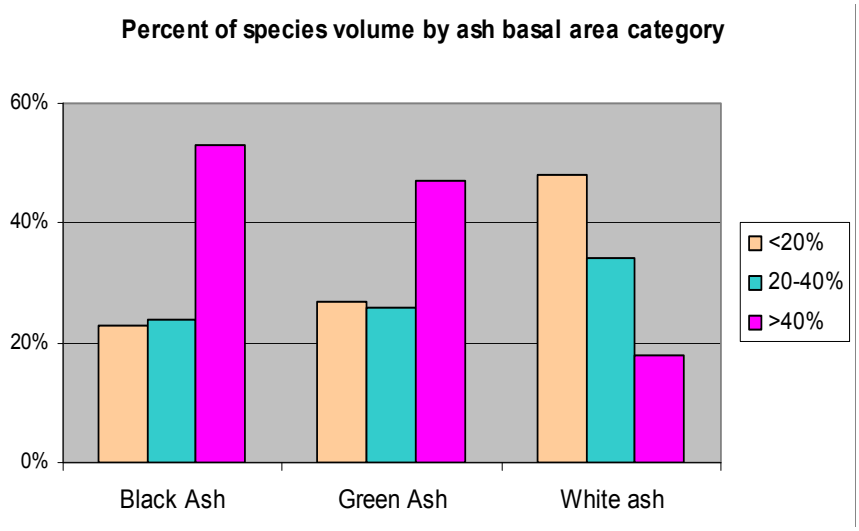

Figure 6. Percentage of species growing stock volume by ash dominance category. In stands in which black ash occurs, over 50% of black ash volume occurs in stands with at least 40% basal area in ash whereas in stands in which white ash occurs, less than 20% occurs in stands with at least 40% basal area in ash.

Management in Established Stands Where Ash is a Minor Component (< 20%)

Until EAB reaches the local area, continue normal long-term management activities. If needed, wait until the next scheduled entry to reduce the amount of ash in the stand. The residual stand should be adequately stocked and able to meet landowner goals if all the remaining ash were killed or harvested. Keep ash that are of good form and vigor and encourage species diversity. In most cases where ash is a minor component, management goals could still be met if all of the ash were to die or be removed.

Follow standard silvicultural guidelines when selecting trees to remove or retain. Removing low vigor and low quality ash will help to slow population buildup in the stand. In northern hardwoods stands, typical silvicultural practices such as creating gaps and shelterwood cuts tend to encourage ash regeneration. Thus, active treatment of ash regeneration through cutting or herbicide application may be necessary to keep the ash component to an appropriate level.

Management in Established Stands Where Ash is a Medium Component (20 - 40%)

Until EAB reaches the local area, continue normal long-term management activities. Reduce the proportion of ash during regularly-scheduled entries, aiming for a species composition that would leave the stand adequately stocked and able to meet landowner goals if all of the remaining ash were killed or harvested. Follow standard silvicultural guidelines when selecting trees to remove or retain. Removing low vigor and low quality ash will help to slow EAB population buildup in the stand. Individual trees of other species may also be removed at the same time as EAB management activities if appropriate for the stand's management plan. A mixed-species sale may bring more interest from timber buyers.

These stands are likely to need multiple entries to reduce the ash component to an appropriate level. In many forest types, typical silvicultural practices that create openings in the canopy tend to encourage

ash regeneration. Thus, active treatment of regeneration through cutting or herbicide application may be necessary to keep the ash component to an appropriate level.

The non-ash component may be primarily non-merchantable species or suppressed trees of commercial species. In this case, land managers should manage the stand using the recommendations below.

Management in Established Stands Where Ash is a Major Component (> 40%)

Stands with a large proportion of ash (such as a bottomland, swamp, or plantation) will be heavily impacted by EAB unless the ash component is drastically reduced. **Until EAB reaches the local area, continue normal long-term management activities but consider two alterations: changing the rotation age and what is considered to be a crop tree.** If practical, reduce the ash component during regularly-scheduled stand entries, keeping the stand adequately stocked. Removing low vigor and low quality ash will help to slow EAB population buildup in the stand. **Because ash is so prevalent, multiple stand entries will be needed to bring the ash component down to a suitable level where feasible.** Individual trees of other species may also be removed at the same time as EAB management activities if appropriate for the stand's management plan. A mixed-species sale may bring more interest from timber buyers.

In upland stands, attempt to reduce the amount of ash so that the residual stand would remain adequately stocked and continue to meet landowner goals if all the remaining ash were killed or removed. Favor non-ash during release and thinning activities. Active treatment of ash regeneration through cutting or herbicide application may be necessary.

In lowland stands, management of EAB will be more difficult because silvicultural options will be limited and stand conversion will frequently be impractical. EAB mortality or excessive harvesting may lead to understocking, conversion to undesirable tree species or non-forest cover, elevated water tables, or an increase in exotic plants such as reed canary grass. In bottomlands, reed canary grass frequently invades openings where established regeneration is absent. Keep the stand adequately stocked and favor species such as red or silver maple, swamp white oak, and swamp conifers during release and thinning treatments. Active treatment of ash regeneration through cutting or herbicide application may be necessary. Consider establishing non-ash regeneration through natural or artificial means.

If the ash-dominated stand is at or near rotation age, consider feasible rotation and regeneration alternatives that will leave the regenerating stand with limited representation of ash.

In many cases it will not be practical to reduce the proportion of ash because of harvesting impacts or lack of sufficient non-ash stems. EAB would still heavily impact the stand even if gradual species conversion were attempted, leaving it understocked and unable to meet landowner objectives. If a stand is in this situation, landowners may decide to:

- ✓ Allow EAB mortality to run its course
- ✓ Alter management to non-timber objectives
- ✓ Wait until rotation age, then convert to different species (if possible) prior to EAB establishing in the area. Shortening the rotation age may be appropriate.
- ✓ Harvest the stand and convert to different species (if possible) once EAB establishes in the area. Be aware of quarantine restrictions.

- ✓ Harvest the stand and convert to different species (if possible) once EAB impacts the stand. Be aware of quarantine restrictions.

Financial considerations, management objectives, regulatory actions, and quarantines will affect the suitability of each alternative. Where stand regeneration is chosen, follow the guidelines in the 'Management in Artificial and Natural Regeneration' sections of these guidelines.

Updated management guidelines and maps of EAB distribution will be available at emeraldashborer.wi.gov and dnr.wi.gov/invasives. Emerald ash borer is a relatively new pest in North America, and management guidelines will change over time due to changing insect distribution, new research findings, introduction of biological controls, and availability of funding for management.