

Ontario's Future with the Emerald Ash Borer

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The Emerald Ash Borer (*Agrilus planipennis*) is an invasive species whose native habitat spans throughout eastern Asia, particularly China and Korea. It most likely made its way to North America in the late 1990s via transport ships carrying infected merchandises. The first North American specimens were located in the summer of 2002 in Detroit, Michigan, and were found in Windsor, Ontario later that year. Since the initial discovery, this species has successfully spread to regions in Ontario, southern Québec, Wisconsin, Michigan, Ohio, Maryland, and Pennsylvania.

Measuring between 8 and 15 millimetres in length, the beetles have long, narrow bodies coated with an emerald-green colour and may seem to be a rather pretty insect to look at; however, their destructive nature defies their comely exterior. This species attacks and kills all ash trees of the genus *Fraxinus* (though blue ash has shown some resistance against the pest). It is very successful in North America because it has no natural predators and benefits from the widespread distribution of ash trees.



An Emerald Ash Borer adult and larva (courtesy of Ontario Ministry of Natural Resources)

The Borer's deadly nature

Adult Borers forage and lay eggs in the trunks of trees whose diameters are at least 2 centimetres. The resulting larvae feed upon the inner wood of the trees, disturbing the trees' vascular system (the way by which the tree transports nutrients to its tissues), leading to its eventual death. It may take two to four years for a tree to be killed from infestation. The identification of infestation is usually due to the D-shaped holes created by larvae as they emerge from the tree. Borers are usually detected about a year following the initial infestation.

Dispersal methods

The Emerald Ash Borer is an adept flier with wings that can carry it over long distances, and may expand its ranges by approximately three kilometres annually. Humans, however, indirectly help it to move from region to region; the beetles are often unknowingly transported in firewood supplies, nursery stocks, lumber, and wood chips. Its successful spread has also been attributed to human habit of planting ash trees for neighbourhood beautification purposes.

What do we have to lose?

Ashes are often planted for urban beautification purposes and allow for greater biodiversity, and ash wood is used in the manufacture of many products (e.g., hockey sticks, guitars, boats, furniture, etc.). Southwestern Ontario alone has lost millions of ash trees since its introduction. Management of the Borer could potentially cost Ontario municipalities a total of \$2 billion annually.

Anyone wishing to report suspected Emerald Ash Borer activity or to learn more may do so by contacting the Canadian Food Inspection Agency at 1-866-463-6017, or by visiting inspection.gc.ca.

Figure 1: Current Ontario range of the Emerald Ash Borer, and dates detected

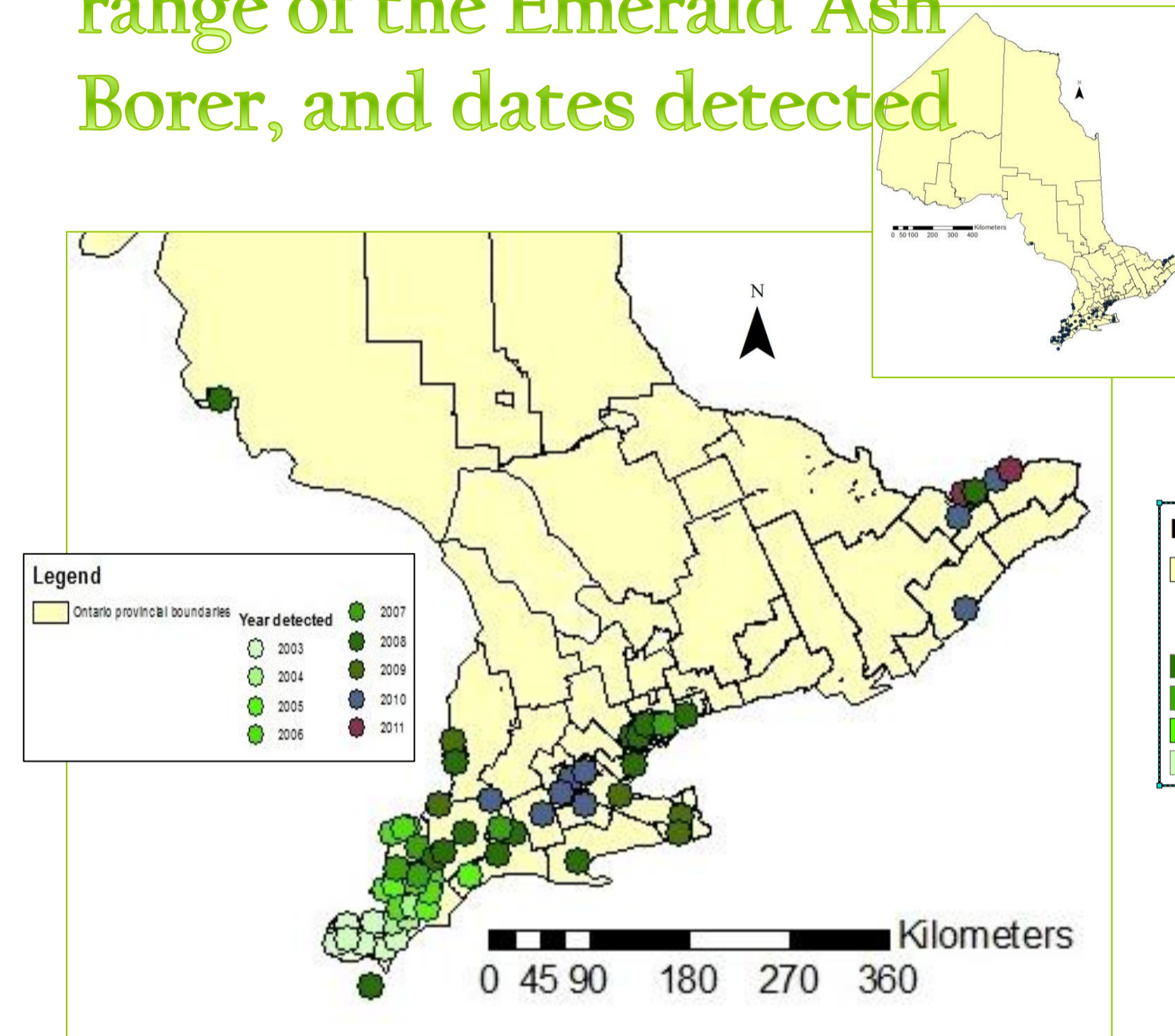


Figure 2: Future range following natural dispersal of 3 km/year

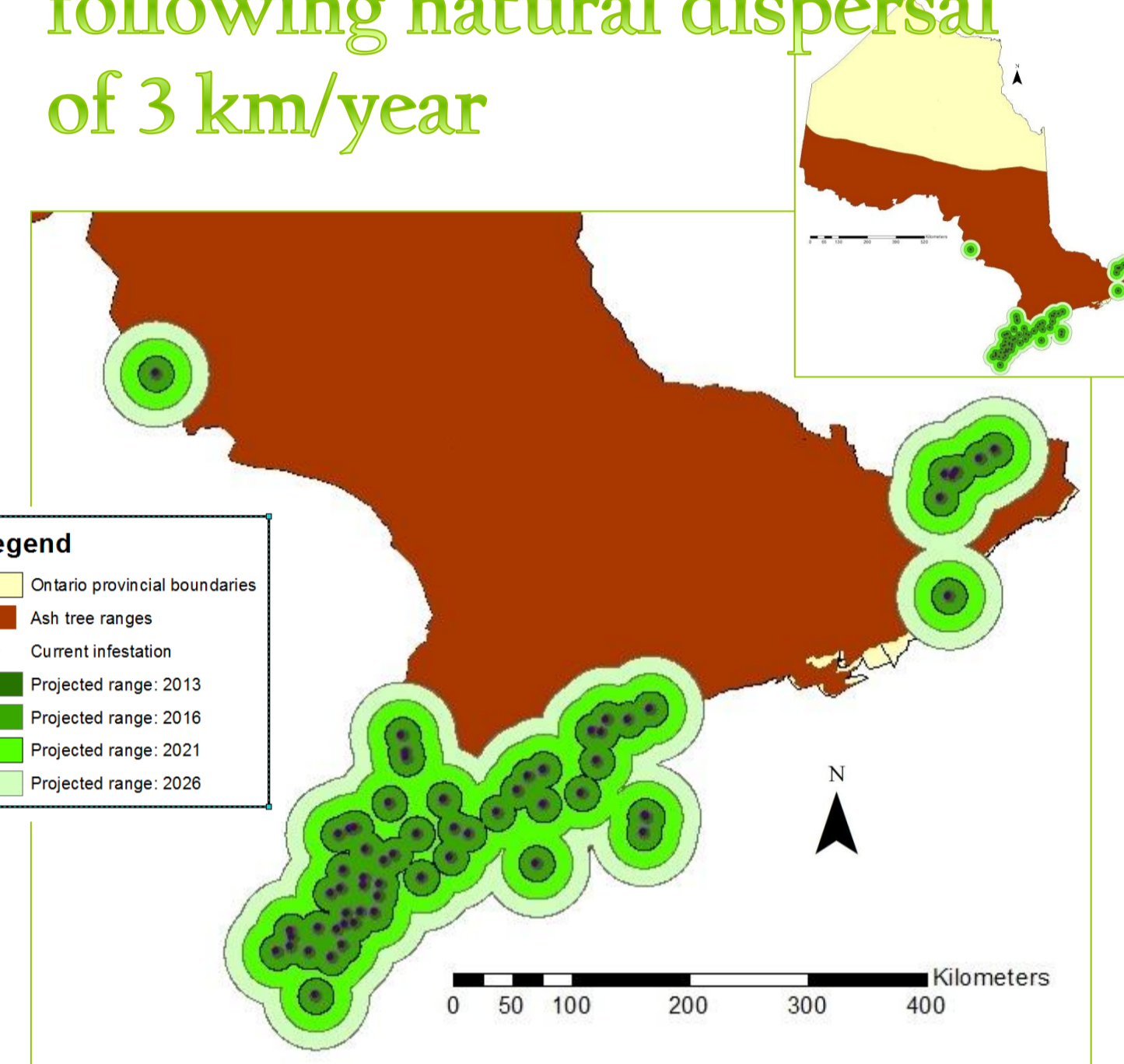
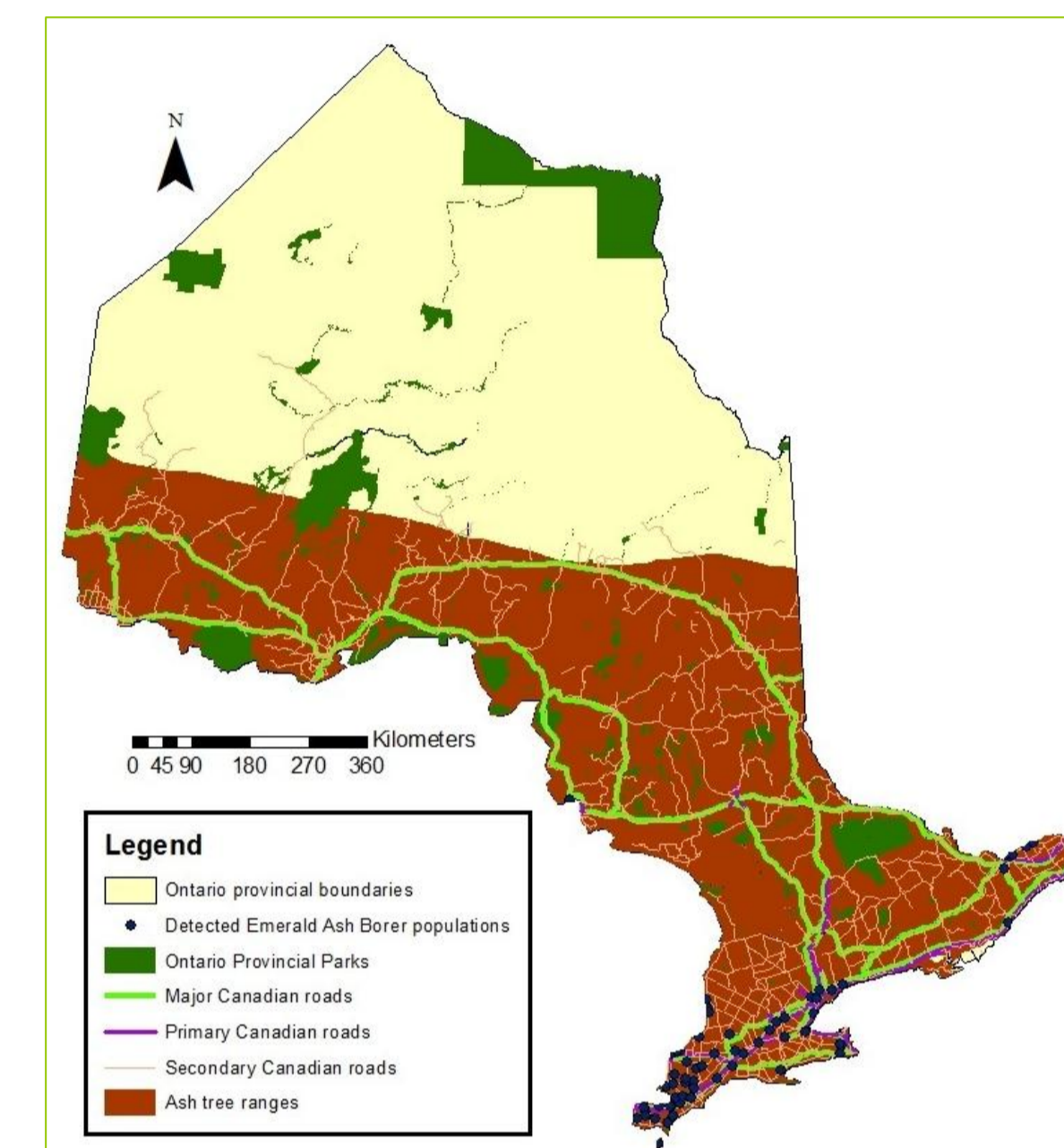


Figure 3: Anthropogenic factors in Borer dispersal



All maps are projected in the Lambert Conformal Conic projection (datum: NAD 83).

Analysis: Is preventing future spread truly possible?

Being able to predict the future range of the Emerald Ash Borer is imperative to managing its spread. Areas expecting to face infestations should take the precautions necessary to protect their tree stands. Knowing all this, we must examine the ways by which Borer populations may spread throughout Ontario. The purpose of this analysis is to determine whether preventing further spread is possible by examining and analyzing human and natural factors in dispersal. We mapped and compared natural and anthropogenic methods of Emerald Ash Borer dispersal.

Distribution ranges of Ontario's four *Fraxinus* ash species – Black Ash (*Fraxinus nigra*), Blue Ash (*Fraxinus quadrangulata*), Green Ash (*Fraxinus pennsylvanica*), and White Ash (*Fraxinus americana*) – were laid out in ArcMap 10 and unified to represent the full range of any of the Ash Borer's host trees.

Figure 1 represents the locations where Emerald Ash Borer populations have been detected, from 2003 up to October 2011. Clearly, the Borers are concentrated in southern Ontario, both in rural and urban areas, and seem to be spreading in a northeastern direction.

Figure 2 overlays potential future dispersal of Emerald Ash Borer in Ontario (following a natural dispersal of 3 kilometres per year) with current ash tree ranges. Natural spread will envelope all of southwestern Ontario within the next 15 years, as well as much of the area around Sault Ste. Marie and around Ottawa-Gatineau. Borers cannot live outside of ash tree reaches; however, because ashes grow throughout most of Ontario, there is much suitable habitat. The insect's range is still very much limited in terms of the speed of dispersal: we calculated the areas of ash tree and Emerald Ash Borer ranges, and found that, in 15 years, the area infested by Borers will be 95,874.74 km², which is 17.6% of Ontario's total ash tree range (543,723.47 km²). As a result, one can calculate that, at a rate caused by natural dispersal, 100% of Ontario's ash tree range will be infested in approximately 85 years:

$$15 \text{ years} \times \frac{100\%}{17.6\%} = 85.2 \text{ years}$$

Figure 3 demonstrates the potential for human-induced dispersal: the transportation of Borers in wood products (especially firewood and lumber). Provincial parks are mapped because they are camping destinations, which implies high transportation of firewood. Parks are located within the scope of ash trees, which means that there is a high chance that infested firewood may be moved throughout the park system. The road networks mapped show an interesting perspective because they correlate very much with ash tree ranges. This means that infested wood products could be accidentally or deliberately transported throughout the province within mere days.

From these maps, it is clear to see that prevention is possible to a certain extent: if regulations are taken seriously, human-induced dispersal can be slowed.

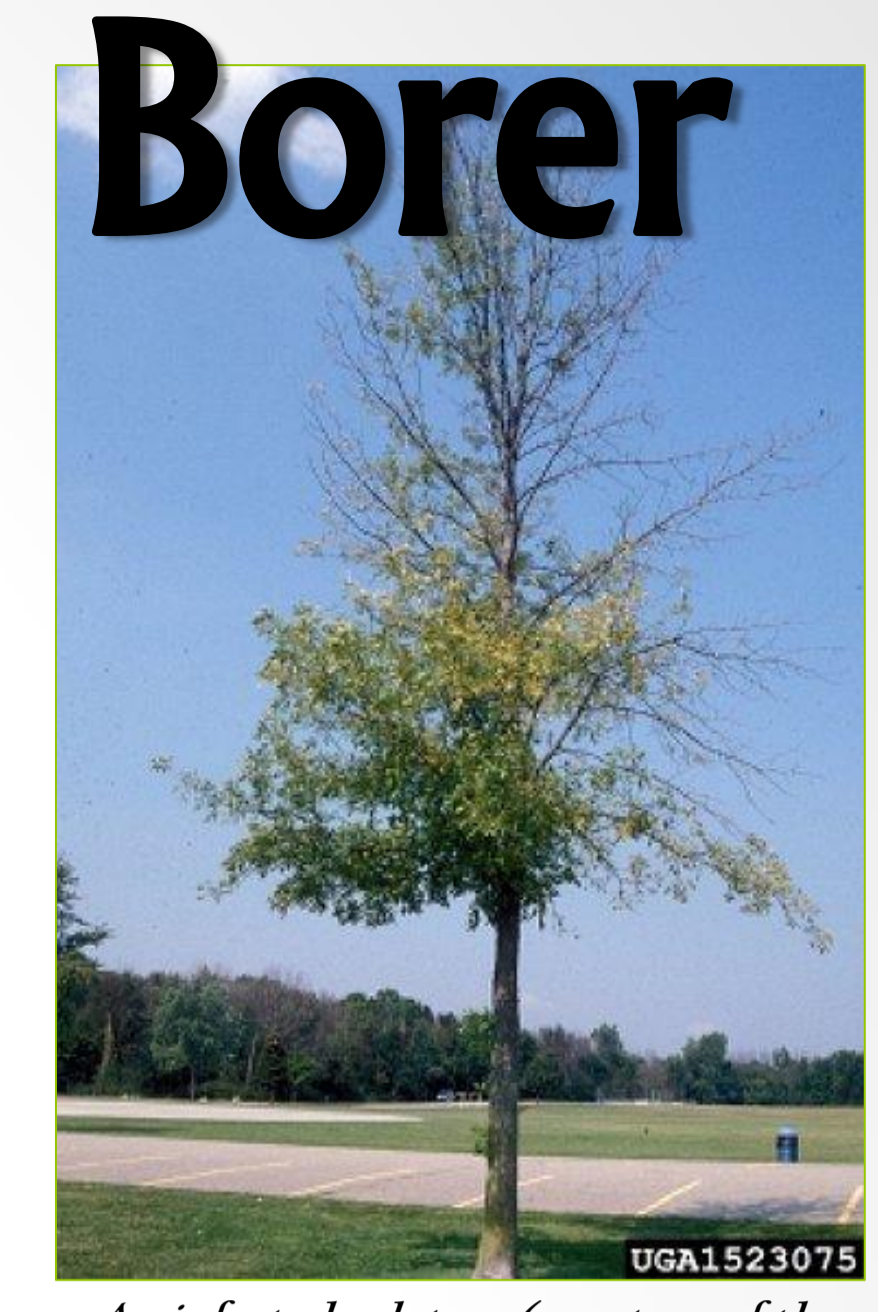
Conclusion

Unless preventative measures are taken immediately and strictly followed, it seems practically impossible to prevent further spread. Humans are to blame for the speed of dispersal; even so, the beetle can spread fairly significantly on its own. Preventing further spread necessitates complete removal of ashes from infested areas (and their surroundings) and meticulous monitoring of Borer activity through the use of traps and branch sampling. Biocontrol (using the fungal pathogens, *Beauveria bassiana* and *Metarhizium anisopliae*) is also being looked at as a means of eradication. The public must be educated about the dangers of the Borer and to be cautious not to move possible infected wood.

Sources of uncertainty

Our data assumes that the Emerald Ash Borer will extend its range at a dispersal rate of three kilometres annually, and in a radial pattern. It does not take into consideration the possibility of various biotic and abiotic factors that may increase or decrease this rate (for example, colder temperatures may decrease the survivorship rates in populations), and other patterns of dispersal.

The data also presumes that only major, primary, and/or secondary routes are used to move possibly-infected wood products.



An infested ash tree (courtesy of the Pennsylvania Department of Conservation and Natural Resources)



Tissue damage caused by Emerald Ash Borers (courtesy of the Pennsylvania Department of Conservation and Natural Resources)



D-shaped emergence holes (courtesy of the Pennsylvania Department of Conservation and Natural Resources)

Sources

- Canadian Food Inspection Agency (Emerald Ash borer data; valid as of October 2011)
- Ontario Ministry of Natural Resources
- Atlas of Canada Base Maps (road networks)
- Elections Ontario (Ontario boundaries)
- U.S. Geological Survey (tree range data)
- DMTI Spatial, Inc. (parks data)



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