Preparing for Emerald Ash Borer

A Landowner's Guide to Managing Ash Forests

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Introduction

The inevitable arrival of the emerald ash borer (EAB) presents a daunting challenge for many of Ontario's woodlot owners. This factsheet describes the ash forests of Ontario and discusses the emerald ash borer. Recommendations are provided to help landowners diversify their ash forests prior to an EAB infestation in order to lessen the impact of the insect.

Ash in Ontario

White ash, bark has deep furrows

There are five native species of ash in Ontario. They are: white ash (Fraxinus americana), black ash (Fraxinus nigra), green ash (Fraxinus pennsylvanica - also called red ash), pumpkin ash (Fraxinus profunda) and blue ash (Fraxinus quadrangulata). By far the three most common species are white, black and green ash. In Ontario, pumpkin ash and blue ash are uncommon and are found only in the southwestern part of the province. Woodland owners in these areas should note that blue ash seems to be showing a higher level of resistance to EAB attacks and therefore should receive greater priority for retention in management programs (see page 11 for further information).

Black ash, bark is loose, flaky

Ash species are mid-tolerant of shade and are most often found in early to mid successional forests or where gaps occur in mature forests (see page three for further information). White ash is the most common native ash in Ontario. It grows throughout most of the Deciduous Region and the Great Lakes-St. Lawrence Forest Region, but usually occurs as a minor component in upland hardwood forests (i.e., sugar maple and red oak). White ash grows best on deep, moist, well-drained soils (Farrar, 1995 and Burns et al., 1990).

Green ash, bark has shallow furrows

Even-aged red oak forest with white ash component, Lanark County

Black ash grows in swampy areas and in riparian zones (streamsides and shorelines) throughout Ontario and ranges from the southern-most portions of Ontario up into the boreal forest in the north (Farrar, 1995). Black ash will commonly grow in southern Ontario forests that include species such as red maple, silver maple, white elm, yellow birch, white cedar and spruce.

Richard David, black ash basket maker from Akwesasne (Photo: C Craig)

Green ash is the predominant ash species growing south of the Canadian Shield. It grows throughout the Great Lakes-St. Lawrence Forest Region, often in riparian areas. Green ash can also be found in upland sites if the competition is not too great (Burns et al., 1990). It is commonly found growing in fencerows and regenerating under established tree plantations in southern Ontario. Green ash can also seed into abandoned farmland and form nearly pure stands.

Even-aged green ash and soft maple lowland forest, Dundas County

Green ash is often used as an ornamental tree on city streets and in parks (Farrar, 1995).

Green ash and white ash wood products are marketed together. Both woods are valued for their durability and are used for flooring, sporting goods, tools and furniture. Black ash is used to make baskets which are an important cultural and economic component of some First Nations communities. Ash species are also locally important as firewood. Healthy ash trees are fast-growing and, if managed properly, can appreciate substantially in size and log grade as shown in the example below.

Years since first management	Diameter		Volume		Log grade
	(in)	(cm)	(fbm)	(m^3)	
1	12	30.5	68	0.299	3
10	15	38.1	140	0.616	2-3
20	18	45.7	259	1.14	2
30	21	53.3	430	1.892	1-2

Thirty year growth of a green ash tree in a managed forest (Streit, 2011)

Ash in Southern Ontario

The red line on the map on this page defines the southern boundary of the Canadian Shield, the part of Ontario underlain by Precambrian bedrock. On the Canadian Shield, ash is typically a minor component of the forest. The percentage of ash species in the forest tends to be much higher south of the Canadian Shield. In these areas, most land was cleared for agriculture in the late 1800s and early 1900s. Forest cover in many parts of southern Ontario was practically non-existent at that time. Over the years, many of the poorer quality fields were abandoned, allowing tree species to re-establish. Old field sites were often recolonized by pioneer tree species such as green ash, red maple, silver maple, white elm, poplar and cedar. Forests like these are called early successional forests. They are in transition from a disturbed landscape and will eventually evolve into forests with different tree species which are more adapted to a shady, closed-canopy environment.

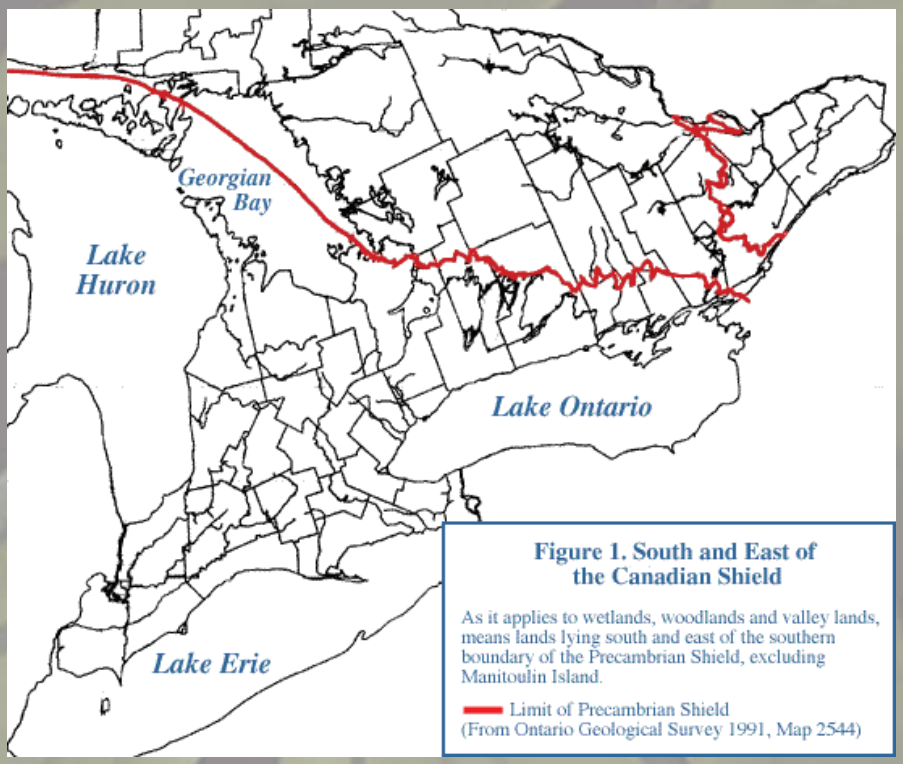
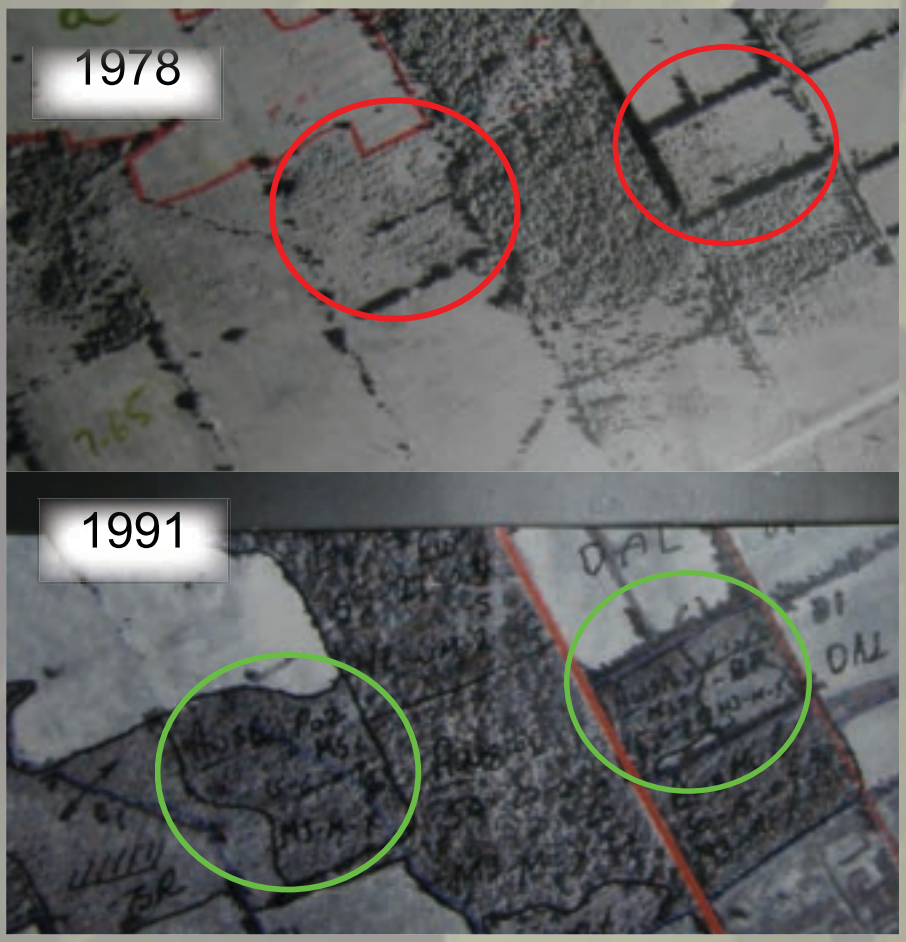


Figure 1. South and East of the Canadian Shield

As it applies to wetlands, woodlands and valley lands, means lands lying south and east of the southern boundary of the Precambrian Shield, excluding Manitoulin Island.

Limit of Precambrian Shield
(From Ontario Geological Survey 1991, Map 2544)



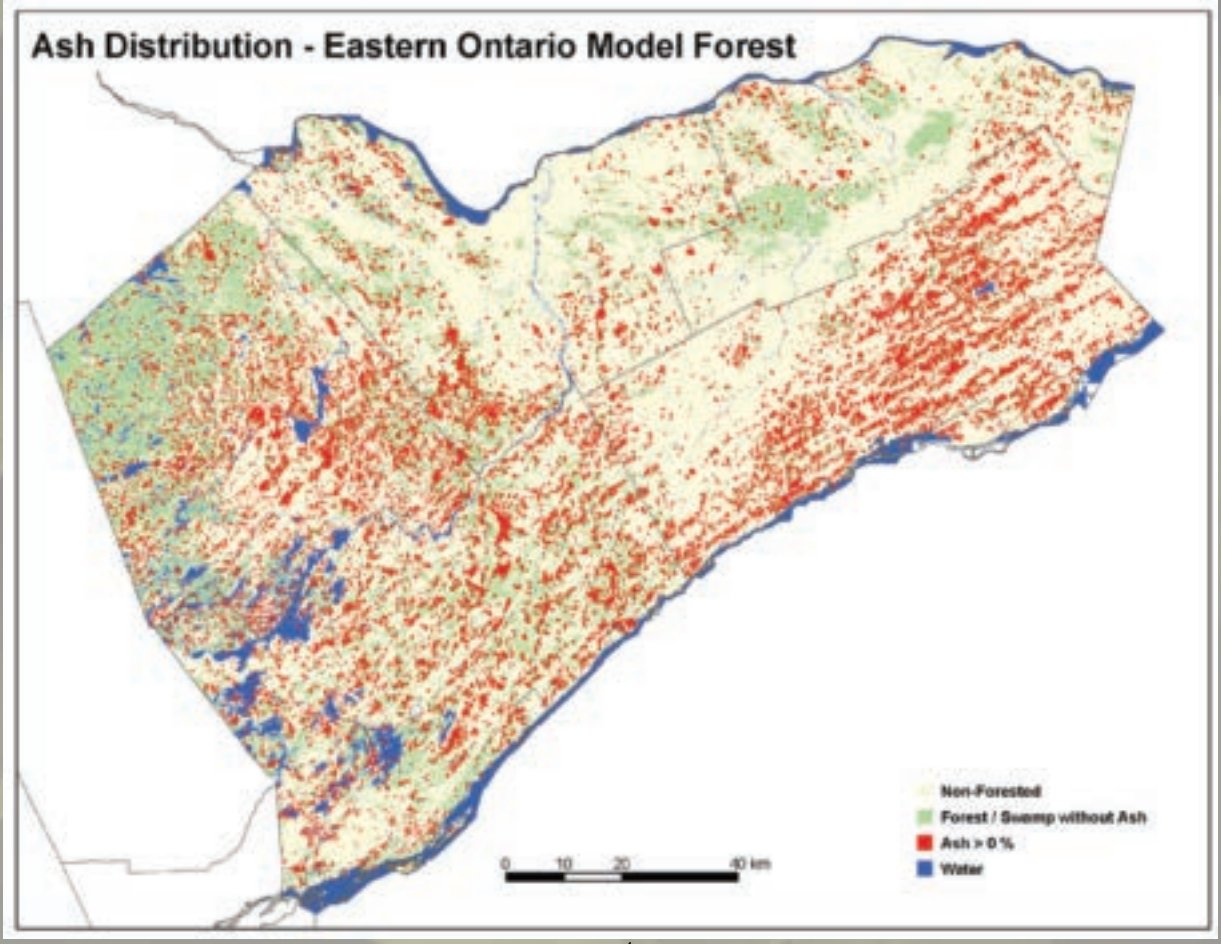
Colonization of abandoned fields over a 13 year period by green ash-soft maple-white elm-poplar forest in Dundas County

If you look in the understory of an ash-dominated forest you may already see a diversity of other tree species present as regeneration. The most common species that regenerate in ash-dominated forests on imperfect to poorly drained lowland sites include red maple, white elm, bur oak and shagbark hickory. Species such as sugar maple, basswood, bitternut hickory and ironwood will regenerate

on better drained upland sites. Regeneration of conifer species such as hemlock, white spruce and white pine is less common, but these species were more abundant on these sites at one time.

Early-successional green ash-white elm forest

The distribution of ash forests in a partially disturbed landscape can be extensive. For example, the Eastern Ontario Model Forest has mapped the extent of ash forests within its boundaries (shown in red on the map below). There are 215,000 hectares of forest with ash present, including 70,000 hectares of early successional forests dominated by ash within this area. This inventory does not include the substantial amount of ash found in fencerows, riparian areas, regenerating in the understory of other forests and plantations, or along municipal roadways.



The Emerald Ash Borer

The following is a brief summary of information regarding the emerald ash borer. For more information, there are a number of references listed at the back of this publication.

EAB adult and larva (Photo: Taylor Scarr, OMNR)

The emerald ash borer (Agrilus planipennis Fairmaire) is an invasive exotic beetle from China and other parts of Asia. It was first discovered in North America in 2002 in the Detroit area of Michigan and the Windsor area of Ontario. This insect has now spread to most of south western Ontario, with infestations from Oshawa west to Sarnia and Windsor. Separate infestations exist in Sault Ste. Marie and in the Ottawa area. Infestations also exist in Quebec in the Gatineau area and in and around Montreal.

The beetle attacks and kills all native species of ash, and is estimated to have killed as many as 100 million ash trees in southern Ontario, Michigan and surrounding states. It poses a major economic and environmental threat to urban and forested areas. The beetle has continued to spread despite some initial control efforts and on-going federal regulatory restrictions on the movement of ash material, ash trees, and firewood. Some of this spread has been through natural dispersal, with the insect capable of flying several kilometres per year. Long distance spread of the insect has mostly resulted from people moving infested firewood, logs, or nursery stock. In known EAB-infested areas, the Canadian Food Inspection Agency (CFIA) designates regulated areas, which restricts the movement of wood material.

Adult beetles emerge through the bark of ash trees in June to August. After emergence the adults feed on the margins of the leaves of ash trees. Although this can be a good indication of the presence of emerald ash borer, it has negligible impact on tree health. The beetles then mate and the females lay eggs in bark crevices on the trunk and branches. The larvae emerge in about ten days and tunnel into the bark to the cambial layers where they begin to feed in meandering S-shaped galleries. This feeding under the bark kills the tree by cutting off the flow of nutrients and water. The larvae overwinter under the bark and pupate, with the adults emerging a few weeks later to start the cycle again (NR Can, 2012).

D-shaped exit holes (Photo: Ed Czerwinski, OMNR)

Symptoms of an attack by the EAB are often very similar to other causes of tree decline. In fact, in many areas of Ontario ash have been showing signs of decline and general poor health for many years, primarily due to environmental stresses such as drought. To identify a tree under attack from the EAB look for 7 to 10 centimetre bark cracks on young trees, larval galleries under the bark of any trees that have been attacked in the last year or two, and tiny D-shaped adult

Ash mortality caused by emerald ash borer in the riparian zone along the Canard River (Photo: Ed Czerwinski, OMNR)

exit holes (4-5 mm wide) anywhere on the trunk or roots. Increased woodpecker activity is also a good indicator of EAB. An ash tree under attack may have dieback in the top half of the crown in the first year, followed by epicormic branching (new green shoots) along the bole. Foliage may turn yellow or wilt during the growing season.

The adults are metallic green, narrow in shape, and 8.5-13.5 mm long. The antennae are short and thin. Larvae are slender, creamy white, and flattened with a brown head on one end a pair of brown pincers at the other end.

In all cases, keep an eye out for signs of decline. See de Groot et al. 2006 for details on identifying EAB signs or symptoms.

If you think you have found EAB in your ash trees and you are in an area where the insect has not been previously reported, call the CFIA at:

1-866-463-6017

As emerald ash borer has moved into new areas in southern Ontario, it has killed approximately 99% of the ash trees. Ash trees of all sizes are vulnerable to attack. Blue ash is one exception, and shows some resistance similar to that of ash species in the insect's native range in China. While trees in woodlots are killed by the beetle, impacts in large contiguous forests are not yet known as the insect has not yet invaded these areas.

The insecticide TreeAzin™, derived from the neem tree of India, has been proven effective at controlling emerald ash borer (BioForest, 2012). Because it needs to be injected into the tree, it is used mostly to protect urban or ornamental trees. Research is on-going into long term controls that may eventually reduce the impact of the beetle. These projects include the use of native or imported parasites that attack the eggs or larvae, fungi that kill the adults, and breeding trees for resistance to attack.

Although visual surveys can find beetle infestations, by the time signs or symptoms of attack are visible the insect has been in the trees for at least 3-4 years. Plastic prism-shaped traps are used across the landscape to detect new infestations. The traps are baited with a lure derived from the volatiles produced by green leaves, and with a recently discovered pheromone produced by the females to attract the males. Branch sampling (Ryall et al. 2011) is being used to detect new infestations and to determine the severity and the boundaries of infestations.

Planning Ahead: Recommended Approaches to Managing Ash Forests

In the face of this destructive pest, many landowners with ash forests are left wondering what they can do to reduce the impact. If your ash forest is infested with EAB or located near a known infestation, you should seek expert advice specific to your local situation. Such advice is likely available from a forestry consultant, a member of the Ontario Professional Foresters Association (http://www.opfa.ca/consultants/consultants.php), or from staff of the local conservation authority, woodlot association, community forest or Ontario Ministry of Natural Resources (OMNR) office. Williams and Schwan (2011) provides guidelines and example prescriptions for use in these situations.

If your ash forest is further away from an EAB infestation, then you still have time to diversify your forest to lessen the eventual impact of this insect. The following sections of this factsheet provide recommended activities that a trained and experienced landowner can carry out. However, if the scale of operations is beyond your level of comfort or expertise then a skilled logger should be hired to do the work. It is also recommended that you seek advice from a forestry professional and have the trees to be harvested marked for removal by a tree marker certified by the OMNR according to these recommendations.

To reduce the spread of invasive pests, try to buy and sell your wood locally.

Please check the CFIA website to locate the current boundaries of regulated areas and associated legal restrictions on wood movement.

http://www.inspection.gc.ca/english/plaveg/pestrava/agrpla/regrestrice.shtml
http://www.inspection.gc.ca/english/plaveg/pestrava/agrpla/regmate.shtml

Enhancing Tree Species Diversity in the Woodlot

Increasing tree species diversity in your woodlot can help to mitigate the impact of the EAB threat. When EAB arrives the death of the ash trees will create very open conditions in ash-dominated forests. If large saplings of other tree species are present in the forest understory (advanced regeneration), they will respond to the increase in light conditions and dominate the new forest. However if advanced regeneration is small or sparsely distributed, there is a significant risk that light-loving species like raspberry and opportunistic species like buckthorn and other invasive plants will take over.

Woodlot owners can use good forestry practices to control the timing and size of canopy openings and the selection of trees to remain to encourage the regeneration and growth of tree species other than ash. Seven recommendations are provided below to help diversify your ash forest and better withstand an outbreak of emerald ash borer.

1) Thin the stand to reduce the ash component:

Carry out a low intensity thinning of ash forests to reduce the overall percentage of ash in the overstory. This thinning will also create the ideal light conditions in the understory for the regeneration and growth of other more shade tolerant tree species such as bur oak which are adapted to growing in small canopy openings. Ash flourishes in more open conditions present in large canopy openings. Depending upon the proximity of the infestation, landowners will have time to make one or more additional harvest cuts in the future.

Be careful to avoid over cutting ash-dominated stands, which may lead to:

- a proliferation of ash regeneration,
- an increase in undesirable or exotic species, such as buckthorn,
- a conversion to non-forest cover and/or,
- elevated water tables with increased risk of windthrow.

Raised water table and enhanced competing vegetation 20 years after over-harvest of a lowland hardwood forest

Lightly thinned green ash and soft maple stand with bur oak advanced regeneration. (Photo: D Hamilton)

2) Remove defective or diseased trees:

Trees to be removed in thinning operations are those with obvious disease or defects (unacceptable growing stock, or UGS). Trees to be retained are healthy, well-formed individuals (acceptable growing stock, or AGS). A complete description of tree classification and defects with colour pictures can be found in the Ontario Tree Marking Guide (Ontario Government, 2004).

Retain AGS trees of all tree species including ash and non-traditional species such as poplar, consistent with the residual stocking guidelines provided in recommendation number 3.

Tree removal should be carried out in all diameter classes, not just large trees.

UGS green ash marked for removal

3) Follow residual stocking guidelines:

For landowners familiar with silvicultural prescriptions, the following residual stocking guidelines should be used. (Detailed information on silvicultural prescriptions is provided in the Ontario Tree Marking Guide (Ontario Government, 2004))

A) Selection management:

If the ash content is less than 30% remove 33% of the pre-harvest basal area of all tree species. If the ash content is greater than 30%, remove 25% to 30% of the pre-harvest basal area. As seen in the picture below, the goal is to reduce the percentage of ash, but not to eliminate all ash trees.

B) Uniform shelterwood management:

In even-aged stands, the target canopy closure should be 70%. Marking will focus on thinning smaller diameter trees, although non-ash species which are developing in the understory should be considered for retention as part of the next forest. In an ash-dominated forest ash trees will still make up the majority of the canopy.

UGS ash marked for removal. AGS soft maple and ash retained (1/3 basal area removal)

Example of ideal 70% crown closure to encourage non-ash species; note the elm (upper left) has lost its leaves, but is healthy

4) Promote regeneration of non-ash tree species:

Where available, retain AGS non-ash tree species as a seed source for regeneration. In an ash-dominated lowland stand, priority species for retention include red maple, silver maple, bur oak, shagbark hickory, yellow birch, white pine, white cedar and white spruce. On better drained soils, sugar maple, red oak, beech, black cherry, bitternut hickory, basswood, white pine and hemlock are favoured as seed trees. Other less shade-tolerant minor species (e.g., butternut) may also occur sporadically in the forest. Remove competing UGS stems in areas where regeneration of these species is present, particularly where seedlings are greater than one metre in height.

If seed trees are limited or absent, planting of these species should be considered underneath canopy openings. There is a variety of suitable native tree species available at your local tree nursery. The selection of the species should be based upon the soil type (texture, depth and drainage). The nursery will be able

Natural white pine and red maple regeneration under lowland ash and red maple forests

to provide you with advice on the species to plant. Also, when planting tree seedlings the competition must be controlled in the first few years to ensure success.

5) Retain non-ash species as crop trees:

When comparing trees of similar quality for removal favour retention of non-ash species such as shagbark hickory, which is shown in the photograph below.

6) Conserve forest values:

Maintain and protect wildlife trees and other forest values including cavity and mast trees, isolated conifers, stick nests, riparian areas and species-at-risk and their habitat (see the Ontario Tree Marking Guide (Ontario Government, 2004)).

Cavity in green ash growing within protected riparian area

Green ash and shagbark hickory forest, Dundas County

AGS white elm

7) Consider retaining elm:

White elm trees are common in younger ash stands. Although prone to Dutch elm disease (and eventual mortality) AGS elm trees are candidates for retention. Isolated individual elms may prove to be resistant or tolerant to the disease. Even if they are not resistant, retained elms are prolific seed producers. Elms as young as 15 years of age may provide seed for future generations of elm trees (Burns et al, 1990).

In order of priority, tree species to retain should be AGS:

1. Other species and wildlife trees suited to the site

2. Elm species

3. Ash species (especially blue ash where present).

Enhancing Diversity in Linear Forests (Windbreaks and Riparian Buffers)

In rural and urban areas of southern Ontario, green ash and white elm are two of the most common tree species found in linear forests: windbreaks and forests that border waterways (riparian buffers). Windbreaks reduce soil erosion, increase crop yield and protect livestock. They shield buildings and help reduce heating costs. Windbreaks can also add beauty to landscapes and provide habitat for wildlife (Ontario Government, 1995). Riparian buffers shelter streams from the sun, which helps modify water temperature for fish species, slow rates of runoff and soil erosion into streams and provide wildlife habitat and travel corridors.

Sadly, local residents are accustomed to the regular death of elm trees killed by Dutch elm disease. Linear forests are now at further risk of attack from the emerald ash borer. Landowners who wish to maintain cover in their ash-dominated windbreaks and riparian buffers need to take decisive action in advance of the potential attack of the emerald ash borer.

1) Maintain other tree species

The best method to maintain a windbreak or riparian buffer is to foster the growth of diverse tree species. Healthy specimens of all species should be retained as seed sources and to create an environment for other tree species and shrubs to regenerate and grow. Small animals and birds such as squirrels and blue jays collect seed from trees such as oak, hickory, basswood, and butternut and distribute them as they move along the travel corridors. It is not uncommon to find seedlings of these trees in the understory of windbreaks and riparian areas hundreds of metres from the source of the seed.

Green ash windbreak, Morrisburg, Ontario.

Bur oak natural regeneration

2) Consider underplanting other tree species

White spruce and white pine planted under green ash windbreak, Morrisburg, Ontario

If your linear forest is composed primarily of ash or elm trees, and if there is limited regeneration of other tree species, then the linear forest can be diversified by establishing trees through planting before emerald ash borer arrives. When choosing a tree species to plant, consider the soil type (soil texture, depth and drainage) and the orientation of the linear forest. South and west-facing aspects experience more light penetration, allowing the landowner to plant tree species which require more light. Dense shaded areas and north and east aspects require species that tolerate more shade. Due to their shape, linear forests are susceptible to invasive trees and plants (eg buckthorn). Removal of invasives may be necessary prior to tree planting. More information on windbreaks can be found in the extension note listed in the references.

Landowner with planted hemlock seedling in a well- shaded windbreak

In Summary

Good forestry practices mean landowners shouldn't wait for the insect to arrive before taking steps to reduce its impact. The emerald ash borer infestation is a dynamic situation. The recommendations provided in this factsheet may change over time as we learn more about the spread and impact of this invasive insect. It is up to all of us to keep informed and up-to-date on this potentially devastating infestation.

EAB On-Line Resources

Check out the MNR's Forest Health Management webpage at http://www.mnr.gov.on.ca/en/Business/Forests/2ColumnSubPage/STEL02_166920.html for information on and photos of emerald ash borer and other forest health issues.

The Canadian Food Inspection Agency website has links to news releases about the latest distribution of emerald ash borer and other invasive species. Photos are also provided. Visit http://www.inspection.gc.ca/english/plaveg/pestrava/agrpla/agrp- lae.shtml

An international Canada/US website with the latest information on the EAB is at http://emeraldashborer.info/index.cfm

The south-central Regional Forest Health Update at http://www.foca.on.ca/xinha/plugins/ExtendedFileManager/demo_images/Forest_Health_Update_June_2010.pdf has information, starting on page five, on EAB surveys being conducted in Ontario.

The Wisconsin Department of Natural Resources website has information on many aspects of emerald ash borer, including symptoms and signs of the insect, and how to identify other ash tree pests http://datcpservices.wisconsin.gov/eab/index.jsp

The State of Minnesota has a detailed publication for landowners available on-line http://www.myminnesotawoods.umn.edu/wp-content/uploads/2011/07/103817-Ash-Booklet-5.pdf

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Photography Credits

Cover Photo: Bur oak and shagbark hickory advanced regeneration under a thinned green ash-soft maple stand.

All photographs taken by Martin Streit (unless otherwise noted)

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