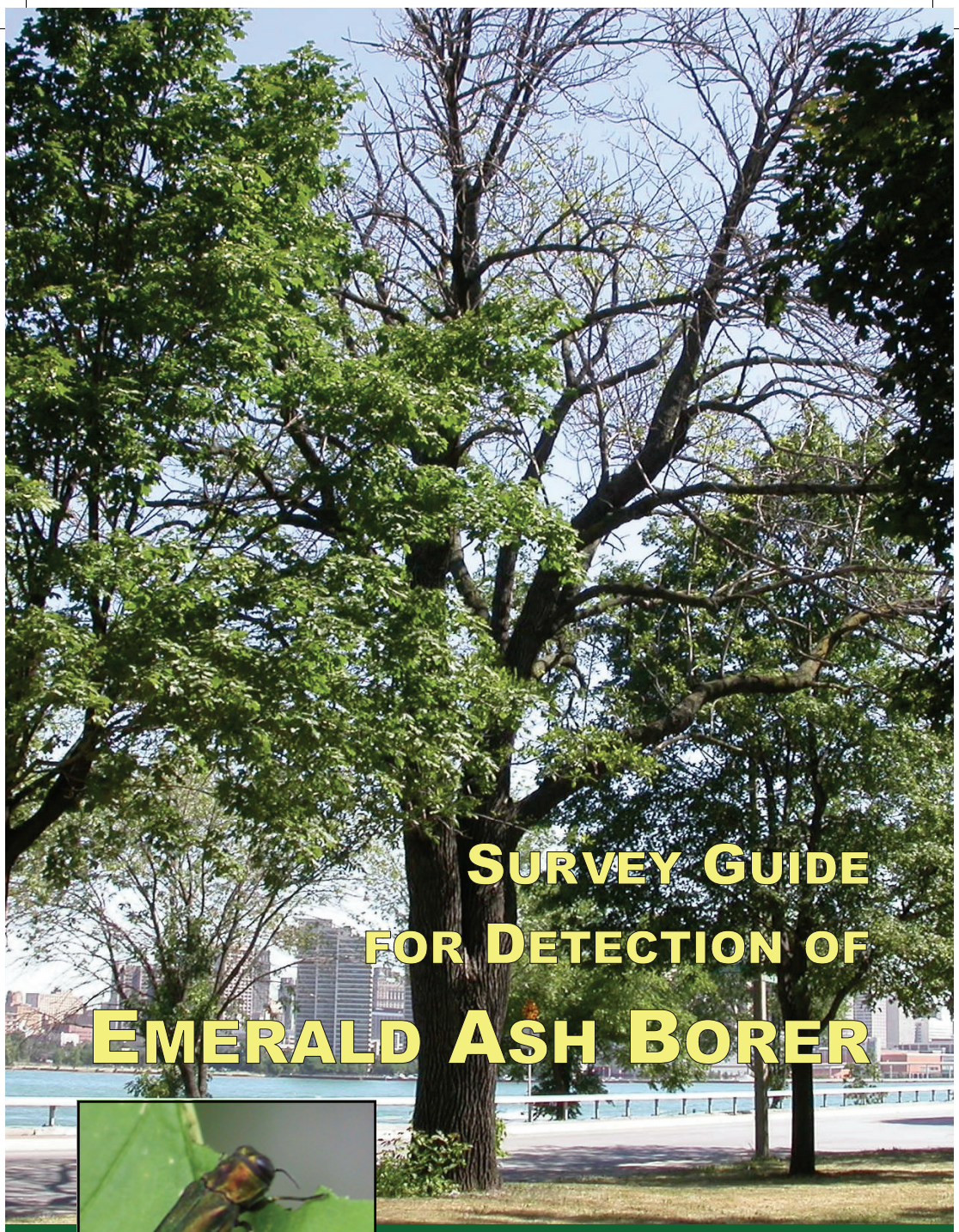

Survey Guide for Detection of Emerald Ash Borer

Canada

Survey Guide for Detection of Emerald Ash Borer

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1. INTRODUCTION

The emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an introduced metallic wood-boring beetle (Coleoptera: Buprestidae) native to China, Japan, Korea, Russia and Taiwan. This pest was discovered for the first time in North America during the summer of 2002 in Detroit, Michigan and Windsor, Ontario. In North America, the emerald ash borer has been observed attacking and killing species of ash trees (*Fraxinus* spp.). It is likely that all North American species of ash, as well as exotic species, are susceptible to emerald ash borer attack.

The purpose of this publication is to provide guidelines and protocols for conducting surveys for the detection of EAB. All techniques required to conduct such a survey are described herein. This guide should provide staff of the Canadian Food Inspection Agency (CFIA) and other interested agencies with the knowledge to undertake these surveys.

The manual begins with a description of the initial preparation for conducting surveys. A list of the tools and materials an inspector needs to undertake the surveys is provided. Inspectors are instructed to obtain maps and aerial photographs of the area to be surveyed. The next section deals with communication between inspectors, landowners and the media. The next section introduces the EAB and describes its life stages and biology. Other insects that might be mistaken for EAB are also described in this section. This is followed by a section on the signs and symptoms of EAB attack. Differentiating ash trees from other tree species and identification of individual ash species is the scope of the next section. The next two sections deal with examination methods and how to undertake surveys for EAB in different habitat types. Collection, preservation and shipping of specimens for identification and photo documentation of the suspect tree are then described. Data acquisition and recording is highlighted in the next section. The manual concludes with a glossary of relevant terms and a list of pertinent literature references.

For updated information about emerald ash borer and other Canadian quarantine issues visit the CFIA website at www.inspection.gc.ca.

2. PREPARATION

Prior to undertaking field surveys, inspectors must ensure that they are properly equipped and have all the required maps and aerial photographs.

2.1 SUPPLIES

Inspectors should verify daily that they have all the materials and supplies that they will require prior to departing from headquarters. Table 1 lists the essential materi-

Table 1. List of Survey Supplies and Equipment

- hat
- sunscreen
- safety glasses
- insect repellent
- water
- coveralls
- parka and winter pants
- safety boots
- safety vest
- non-slip and puncture-resistant gloves
- first aid kit
- drawknife
- knife and hatchet
- knife and hatchet sharpeners
- pruning shears
- forms
- pencil/pens
- maps
- compass
- global positioning system (GPS) unit
- flagging tape
- binoculars
- climbing sticks and harness
- hand lens
- 70% ethanol
- vials or collection bottles
- portable water heater
- soft forceps
- labels
- permanent marker
- CFIA contact information
- brochures (facts sheets, pest ID cards, etc.)
- door hangers
- measuring tapes (50 m)
- diameter tape
- clinometer
- ruler
- digital camera
- sweep net
- tally counter
- two-way radios
- cellular phone

als required for undertaking EAB surveys.

2.2 Maps and Aerial Photographs

Sample locations can be pre-selected using geographic information system (GIS)-generated maps and aerial photographs. For forested area surveys, GIS-generated maps must have pre-selected sample locations (Section 8.5).

3. Communication

While undertaking surveys for EAB, inspectors will frequently come into contact with the public. The following section outlines a general code of conduct that inspectors must adopt for most situations in dealing with landowners and other parties.

3.1 Authority of Inspectors

While CFIA staff has the authority under the Plant Protection Act and Regulations to survey on private property, the inspector must make every effort to talk to property owners to explain what they are doing.

3.2 Property Owner Contact

When conducting surveys it is im-

portant to make contact with the property owners and seek permission to enter and survey the properties. Although this may not be possible in all instances, the following instructions are intended as a guide to assist in this activity. You are often the first person that landowners will encounter concerning the EAB surveys, and it is essential that you make a good impression. Look and act professionally at all times.

Prior to undertaking a survey, inspectors should be provided with the contact information for the property owners. Property owners should receive notification in advance of the survey to make them aware of the survey process and its purpose (via mail-out flyers or media notices).

When you arrive at the property, introduce yourself and show identification. Identify yourself as working with the Canadian Food Inspection Agency or other agency. Survey uniforms help provide credibility. Inform the property owner of the purpose of the survey, how it will be completed and the value of the survey for their ash trees. Ask them if there are any current hazards (*e.g.*, aggressive dogs, live stock etc.). Leave all property as found and thank the owner for his/her co-operation. Provide fact sheets for those citizens that are interested in learning more. Program and policy questions should be directed to the Program Officer in your local office.

Survey results are confidential. Do not discuss the EAB status of any properties or areas. All questions from the public regarding the survey or the general status of the EAB program can be referred to the Regional CFIA-EAB office.

If you are unable to make contact with the property owner, do not enter any locked part of the property or those with potential hazards. Leave an information flyer or inform a neighbour that you have conducted a survey on the property.

If you encounter a difficult individual or are refused access to a property, listen to the individual's concerns and address them, offer as much information as possible and offer them your supervisor's contact information. If you can not gain access to the property inform your supervisor.

3.3 News Media Contact

Inspectors should never give statements to the news media. Members of the media should be directed to call the CFIA at 1-866-463-6017 for information regarding EAB programs.

4. Insect Life History Stages

The life cycle of EAB generally takes one year to complete, but some later developing individuals or individuals in cooler climates may take two years to complete a generation. The biology and description of each life history stage

of the EAB is described below. When the presence of EAB is confirmed for a specific site, stage-specific data based on these descriptions are entered on the EAB Suspect/Positive Tree Form (Section 10.2). If life stages of EAB are collected, a Pest Identification Report (CFIA / ACIA 1303) form must be completed (Section 10.3) and specimens must be prepared and shipped for identification (Section 9.1).

All developmental events in the life history of EAB are temperature-dependent. The higher the ambient temperature, the shorter is the duration of the stage. Conversely, in cooler years or at more northerly latitudes, development progresses more slowly and the onset of stages is later.

4.1 ADULT

Biology of Stage: Adults moult (eclose) from the pupal skin in the pupal chambers in the bark or outer portions of the sapwood of the host trees. Newly moulted (teneral) adults undergo a period, within these chambers, where they harden (sclerotize) and eventually become more active. This period may last for several days depending on temperature. During this teneral-adult period, fully formed adults may be found within the trees. Adults emerge from the pupal chambers through distinct D-shaped exit holes (Fig. 1) that they chew through the bark. In southwestern Ontario adult emergence begins towards the end of May and may continue into late July. Peak adult emergence is from mid- to late-June. Shortly after emergence the adults move up into the host foliage where they feed on the edges of the leaves. Adults can be observed flying on warm sunny days, but are inactive on cooler cloudy days. Adults may be observed on or flying near host trees from early June into August.

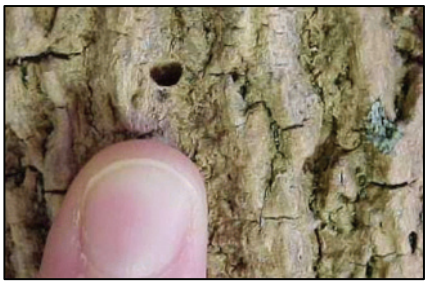


Fig. 1. D-shaped hole resulting from emergence of adult of EAB.

Description of Stage: Adults are 7.5 to 15.0 mm in length and 3.1 to 3.4 mm in width. The body is narrow and elongate, with a metallic coppery-green colour. The eyes are large, kidney-shaped and black- or copper-coloured (Fig. 2).

4.2 EGG

Biology of Stage: Female EAB undergo a prolonged period of maturation feeding during which they do not mate or lay eggs. Consequently, eggs are not deposited for several weeks after adults emerge. Females can deposit as many as 275 eggs over their lifetime. Eggs are laid singly

Fig. 2. Adult of EAB.

or in small clusters in bark crevices and under bark scales. Eggs are laid in summer, hatching after a few weeks. The newly hatched larvae chew through the outer bark and into the cambial layer beneath the bark.

Description of Stage: Eggs are extremely small (0.6 by 1.0 mm) flattened discs that conform to the shape of the surface on which they are deposited (Fig. 3). The eggs are creamy yellow when deposited and become reddish-brown as they develop. The eggs are usually laid in crevices or under bark scales and are very difficult to detect in the field. Thus, the detection of eggs in the field is not considered a valid survey tool.

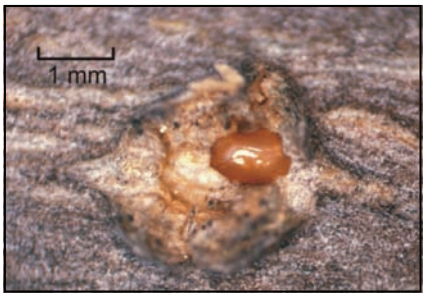


Fig. 3. Egg of EAB in a fissure on the bark of the host tree.

4.3 LARVA

Biology of Stage: The larva is the stage of EAB that feeds in the cambial layer under the bark and in the inner bark (phloem), which results in the decline and eventual death of the tree. The cambial layer is the actively-growing layer of cells between the bark and the sapwood from which the bark and sapwood develop. Larval feeding eventually interrupts the flow of nutrients in the inner bark (phloem), which girdles the tree. The larvae form distinct S-shaped galleries which become wider as they grow through four instars (stages). Larvae are mostly found under the bark during the summer months although some larvae may be present all year around.

Description of Stage: Mature larvae (Fig. 4) are 26 - 32 mm long and creamy white in colour. The body of the larva is 13-segmented (Fig. 5), the first three of which make up the thorax (prothorax, mesothorax and metathorax). The largest segment, which is behind

Fig. 4. Larva of EAB in feeding gallery exposed by peeling back the bark of the host tree.

and conceals most of the head, is the prothorax. The abdomen is 10-segmented; the first eight segments are bell shaped and each has a pair of spiracles. The larval head is small, brown and only partially visible as it is mostly retracted into the prothorax. The last abdominal segment bears a pair of brownish serrated appendages (urogomphi).

Although precise determination of the larval instars requires measurements of minute structures on the head of the larva, the stage of the larva can be estimated by comparing the larval size with the pictures in Fig. 6.

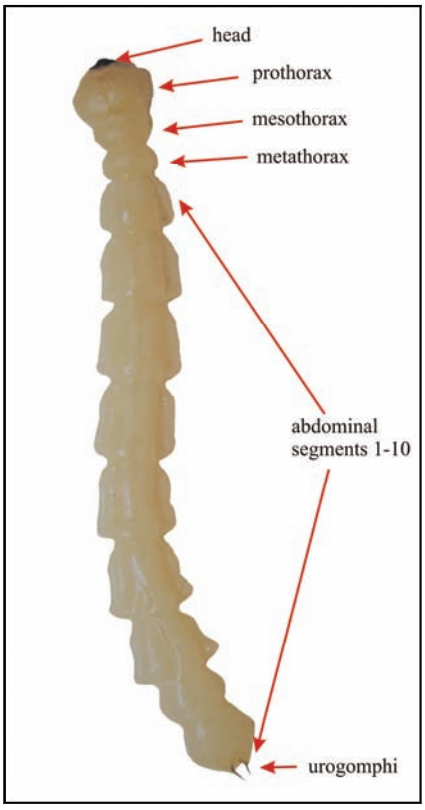


Fig. 5. Larva of EAB illustrating the 13-segmented body.

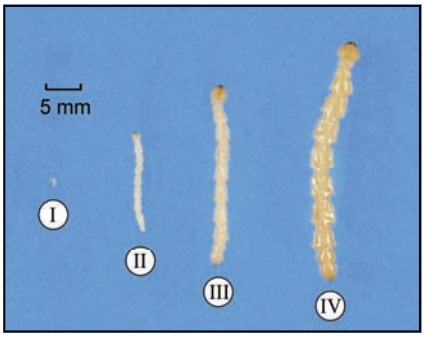


Fig. 6. The four larval instars of EAB.

4.4 PREPUPA

Biology of Stage: Prepupae are first observed in September and by October most of the population is in this stage. This is the stage in which most of the population of the EAB spends the winter, although some individuals overwinter as earlier-instar larvae. Although the larvae change shape when they become prepupae, this transition does not involve a moult. Thus, prepupae are fourth-instar larvae that have contracted in length, become thicker in cross section and have formed a kink in their bodies. Prepupae are found in chambers that the larvae excavate either in the bark or slightly into the sapwood. It is within these chambers that the insects moult into pupae during the spring and where they subsequently become adults.

Description of Stage: Prepupae of EAB have characteristic J-shaped bodies (Fig. 7). The cream-coloured prepupae have thicker and shorter bodies than do the larvae.

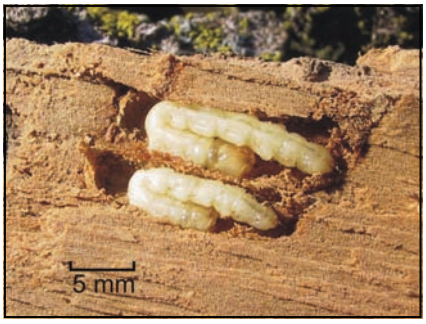


Fig. 7. Prepupae of EAB in what will become pupal chambers.

4.5 Pupa

Biology of Stage: Pupae develop within the pupal chambers in the bark or sapwood in the spring. Pupae are present in the host trees from late April until mid-June. Pupae have never been observed from late summer through the winter.

Description of Stage: The pupa (Fig. 8) is initially beige-coloured. It darkens as it develops until it looks similar in appearance and colour to the adult. (Fig. 9). Pupal appendages (*i.e.*, legs and wing pads) are not attached over their length to the body (*i.e.*, exarate pupa).

4.6 Other Wood-Boring Insects

A number of other insects bore into and infest ash trees; these may potentially be confused with EAB. The following is a description of the more common species. Generally these species only infest dead or dying trees, unlike EAB, which attacks living trees.

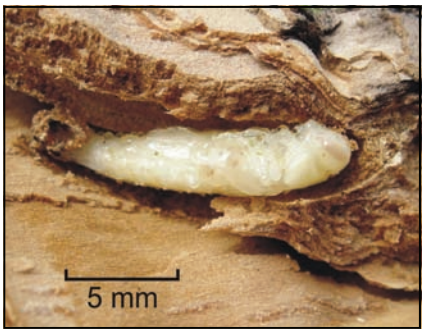


Fig. 8. Pupa of EAB in pupal chamber within the bark.

Metallic Wood-boring Beetles (Buprestidae) - This is the family to which EAB belongs. There are a number of other species in this family that are native to North America and use ash trees as hosts. Although some of these

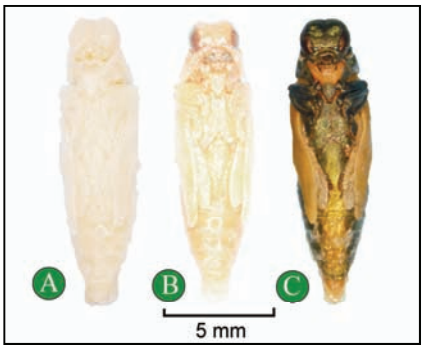


Fig. 9. Colour change of pupa of EAB as it develops from (A) beige to (B) dark-eyed to (C) adult shades.

have a greenish tinge to their body colouration, none of them is as green and brightly-coloured as EAB. Adults of these other beetles may be found under the bark prior to emergence in early summer or flying around host trees. Larvae may be found under the bark.

Chrysobothris sexsignata and *C. femorata* have both been reported attacking ash. The adults of the former species are 6.5 to 12.5 mm long, blackish in colour with bronzy green and purplish tinges, while adults of the latter are 7 to 16 mm long, greenish to purplish-black with a distinct red tinge. The cambium/phloem-boring larvae of these species differ in shape from EAB (Fig. 10). Another species, *Dicerca divaricata*, is a larger beetle (*i.e.*, adult length 15-22 mm) with brassy/coppery colouration. The larva of this species also burrows in the cambium/phloem of the host trees and has a similar body shape to the *Chrysobothris* spp. (Fig. 10). The body shapes of the adults of these species are quite different from the body shapes of *Agrilus* spp. (Fig. 11).

Only one native species in the same genus as EAB (*i.e.*, *Agrilus)* attacks ash trees. This species, *A. subcinctus,* is a much smaller species (*i.e.*, adult length 3.5 to 4.5 mm). Consequently, it has much smaller galleries and exit holes (D-shaped exit holes not exceeding 2 mm) than EAB and mostly infests smaller twigs and branches. The back of thorax (pronotum) and wing covers

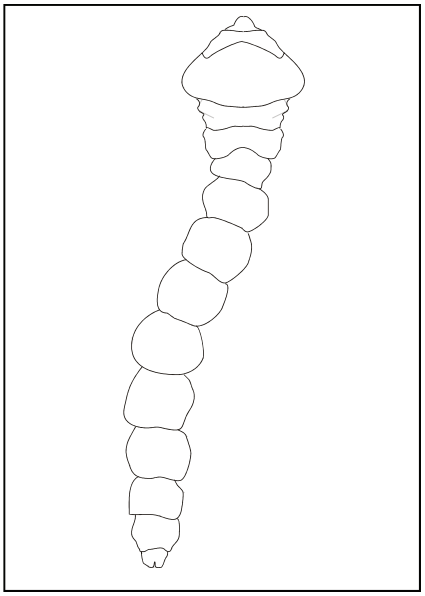


Fig. 10. Body shape of larva of *Chrysobothris* spp.

(elytra) of *A. subcinctus* are black with strong brassy or coppery re-

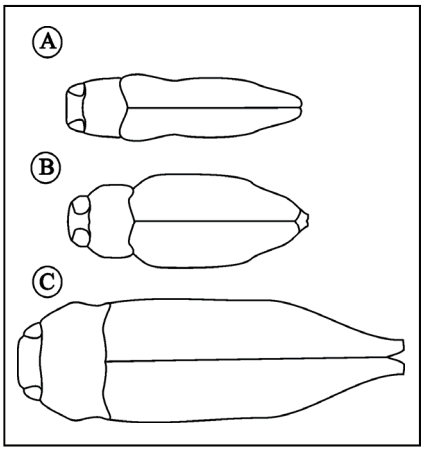


Fig. 11. Body shapes and relative sizes of ash-feeding Buprestidae A) *Agrilus planipennis*, B) *Chrysobothris* spp. and C) *Dicerca divaricata.*

flections. Other species of this large cosmopolitan genus attack other species of trees and shrubs and may be encountered in the same woodlots as EAB. Well-known members of this genus include the bronze birch borer (*Agrilus anxius*) and the two-lined chestnut borer (*Agrilus bilineatus*) (Fig. 12A). All species of *Agrilus* have a similar body shape (Fig. 11A). Other insects like the six-spotted tiger beetle, *Cicindela sexguttata* (Fig. 12B) have metallic green bodies, but do not have the same body shape as EAB.

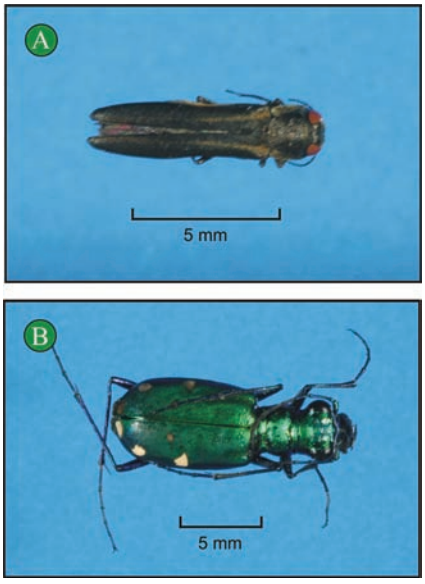


Fig. 12. Adult beetles that might be mistaken for EAB: A) two-lined chestnut borer, *Agrilus bilineatus* and B) six-spotted tiger beetle, *Cicindela sexguttata.*

Redheaded Ash Borer (*Neoclytus acuminatus*) - This is the most common species of wood-boring insect encountered during surveys for EAB in southwestern Ontario. This cerambycid (Fig. 13) (long-horned beetle), whose cream-coloured larva is a round-headed borer, has galleries that look quite similar to EAB in that they are also mainly in the cambial/phloem layer and are packed with fine frass. Generally these galleries are only found in dead or dying ash trees and don't show the serpentine or S-shaped form of EAB. The larva of this species also tunnels extensively in the sapwood. The exit holes are larger than those of EAB (about 5 to 8 mm) and are round. The larvae of this species lack the urogomphi (Fig.

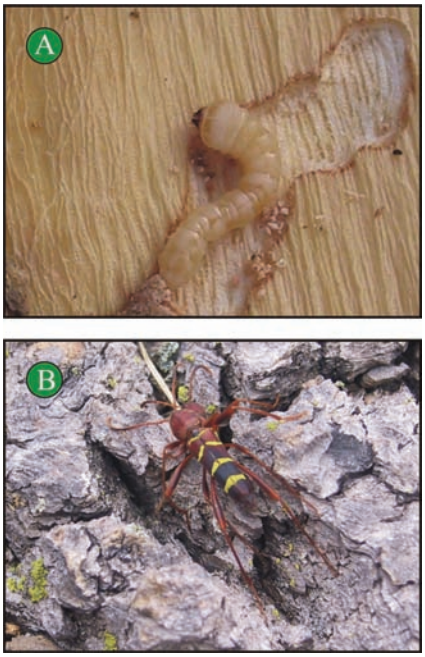


Fig. 13. A) Larva and B) adults of the redheaded ash borer, *Neoclytus acuminatus*.

5) found on the larvae of EAB. Another cerambycid that attacks ash, the banded ash borer (*N. caprea*), has a similar appearance and biology.

Ash Borer [or Lilac Borer] (*Podosesia syringae*) - This species is a day-flying clearwing moth (Sesiidae), which superficially resembles a wasp. The larvae usually bore into the heartwood of the tree (not just in the sapwood) and have a round exit hole about 5 mm in diameter. The pupal exoskeleton is often found still sticking out of the emergence hole. These are most commonly found on landscaped trees.

Carpenterworm (*Prionoxystus robiniae*) - This is a native moth in the family Cossidae that uses ash and other hardwood species as its host. The young pinkish larvae initially feed in the cambium and phloem. As they develop, they become greenish-white in colour and bore into the sapwood where they form galleries. In the northern part of its distribution, this insect takes 2-4 years to complete development. Initial signs of attack include sap and frass at the larval entrance holes, with additional frass accumulation on the bark as the larvae develop. The exit holes are large (up to 18 mm) and round. The empty pupal skin may protrude from the emergence holes. Green ash is the favoured host for this insect in the prairies.

Ash Cambium Miner (*Phytobia* sp.) - These insects are flies of the family Agromyzidae whose larvae mine through the cambium and inner bark towards the roots. The meandering and sometimes serpentine galleries of these miners are often seen under the bark on smaller branches and twigs. The threadlike galleries are most common in the lower bole and the upper roots. The larvae are long thin maggots and can be up to 25 mm in length. The adults emerge from the roots and do not produce an exit hole in the trunk or branches like EAB. This species is frequently encountered during EAB surveys in southwestern Ontario.

Bark Beetles (Scolytidae) - These beetles are members of the scolytid or bark beetle family. Five species, *Hylesinus aculeatus* (eastern ash bark beetle), *H. fasciatus*, *H. criddlei*, *H. californicus* (western ash bark beetle) and *Hylurgopinus rufipes* (native elm bark beetle) attack *Fraxinus* spp. in Canada. The galleries of these species have two horizontal arms connected by a short central tunnel or nuptial chamber associated with the adults' entrance holes. Larvae tunnel away from these egg galleries upward or downward with the grain of the wood. The exit holes are very small and round (1-2 mm). Galleries can be found in living or dead trees.

These are the most common species of wood-boring insects that may cause ash trees to show signs and symptoms similar to those caused by EAB. Other spe-

cies may also be encountered. The intent of this section was to highlight the need for positive identification of EAB life stages by CFIA entomologists before a tree or site is declared positive.

5. Signs and Symptoms of Infestation

Infestations of EAB in newly attacked trees are very difficult to detect. Once signs and symptoms become apparent, trees are often severely infested. There are a number of signs and symptoms that may or may not be present but which should alert the inspector to take a closer look at the ash trees. Signs are physical damage produced directly by the insect's attack, while symptoms are the result of the tree's physiological response to the attack. If an inspector suspects that a tree is infested based on the following signs and symptoms, an Emerald Ash Borer - Suspect/Positive Tree Form must be completed (Section 10.2).

5.1 Crown Dieback/Chlorosis

Biology of Symptom: Feeding by larvae of the EAB under the bark of the host tree results in damage to the vascular system (phloem tissue) disrupting the movement of nutrients from the leaves to the rest of the tree. This damage initially results in discolouration of the foliage (chlorosis) and death of portions of the crown (dieback) (Fig. 14). Once larval populations of EAB are sufficiently high, the feeding damage results in girdling of the tree and its subsequent mortality.

Description of Symptom: Thinning and discolouration of the ash tree crown are symptoms used to locate EAB-infested trees. These symptoms can often be seen from a considerable distance. Crowns can display wilting foliage, branches with reduced foliage, yellowing foliage, dead foliage-free branches, or all of the above.

Confounding Symptoms: Other conditions unrelated to EAB attack cause crown dieback and discolouration including the following:

Ash Yellows - This is an insect-vectored (leafhoppers) disease that is caused by a mycoplasma-like organism that invades the phloem tissue in ash trees. Most ash species are susceptible and trees in all types of habitats are affected. The presence of ash yellows can only be confirmed by microscopic examination of the affected tissue. The disease may also causes epicormic shoot formation (Section 5.2).

The main difference between ash yellows and EAB-caused dieback is that symptoms may be localized to a few branches in the former while whole crowns may be affected in the latter.

Anthracnose - Some fungal diseases (*e.g.*, *Aureobasidium apocryptum* and *Gnomoniella fraxini*), the causal agents of anthracnose,

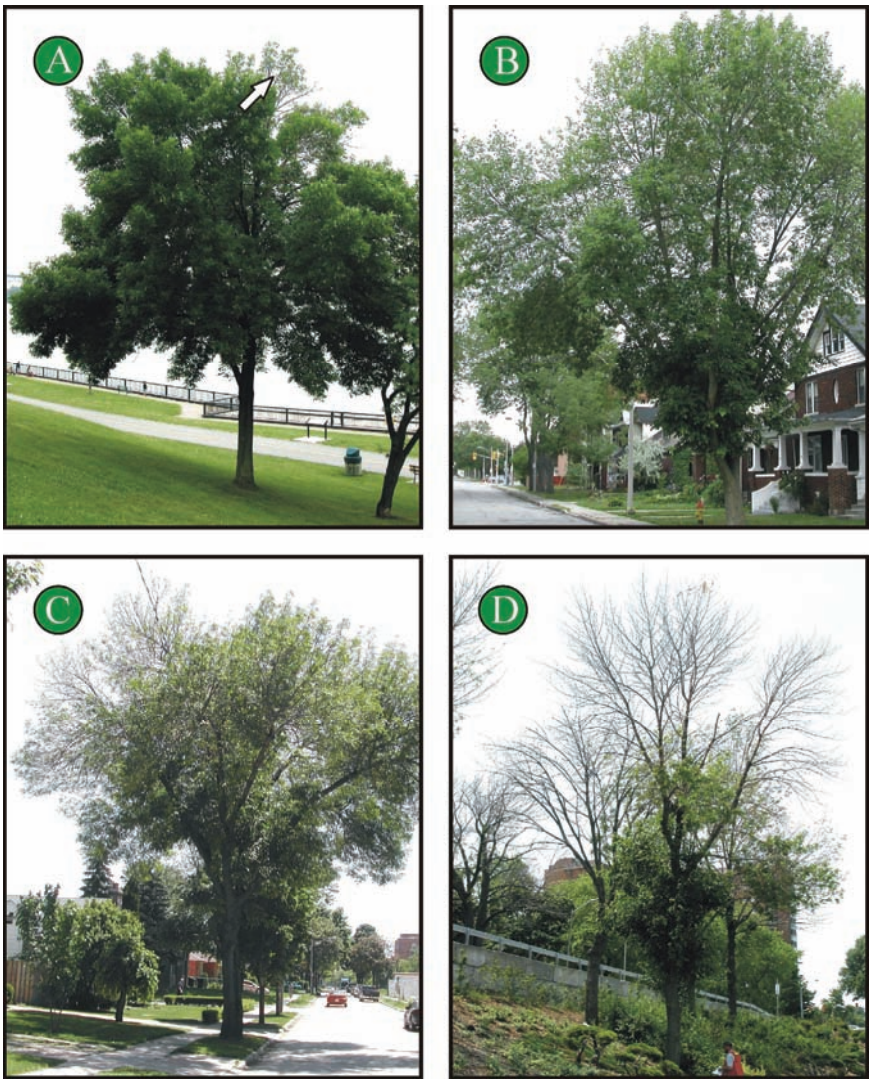


Fig. 14. Progressive degrees of thinning and chlorosis in crowns of urban ash trees resulting from EAB attack: A) flagging, B) thinning of crown, C) branch dieback, and D) dead branches.

also cause decadent-appearing crowns in ashes, usually in landscaped and nursery trees. Leaflets on diseased trees may appear scorched and prematurely drop from the tree. Unlike trees affected by EAB, leaves from anthracnose-infected trees exhibit leaf spotting and lesions, while twigs may contain small cankers.

Verticillium Wilt - This is another

fungal (*Verticillium alboatrum*) disease that causes wilting, chlorosis, sparse crown foliage and dieback in ash trees. Affected trees are usually confined to nurseries and landscaped plantings. Microscopic examination is also required to positively identify this disease. Leaves on infected trees may show scorching.

Ash Dieback - The condition known as ash dieback can be caused by a number of biotic and abiotic agents. Repeated years of low rainfall can cause trees to show signs of drought stress and exhibit thin crowns and dieback. Dieback may also be caused by other fungal and viral agents as well as by air pollution and low temperature (freezing) damage.

5.2 Epicormic Shoots

Biology of Symptom: Ash trees produce shoots on their boles in response to wounds caused by the feeding activity of EAB (Fig. 15).

Description of Symptom: Epicormic shoot production (*i.e.*, suckering, witches brooms, water sprouts) are a reaction by many trees when they are under stress. Epicormic branching can occur on EAB-infested trees.

Confounding Symptoms: In general, many trees, but particularly ash trees, send out epicormic shoots as a response to any stress or damage to the tree. The most common cause of suckering in landscaped (residential) trees is mechanical damage, usually caused by a lawnmower or trimmer.

5.3 Woodpecker and Squirrel Feeding

Biology of Signs: Woodpeckers are insectivorous and feed in part by extracting wood-boring insects from under the bark of trees. In the deciduous woods of eastern Canada, the hairy woodpecker and the downy woodpecker are the most common species encountered, while the red-headed woodpecker occurs less frequently. Increased woodpecker activity in the crowns of ash trees would suggest the presence of wood boring insects, but not necessarily EAB. Occasionally squirrels will peel back the bark and feed on the larvae.

Description of Signs: Woodpecker feeding may be an indication that there is a sizable population of EAB in a tree. Often irregular shaped light-brown holes (Fig. 16A) are present and sometimes strips of bark are found peeling from the tree. Woodpeckers are very adept at finding larvae, so feeding holes are an indication of the presence of larvae of some species. Squirrel feeding results in ragged strips of bark on the tree bole (Fig. 16B).

Confounding Signs: The presence of woodpecker and squirrel feeding damage indicates the presence of boring insects, but not

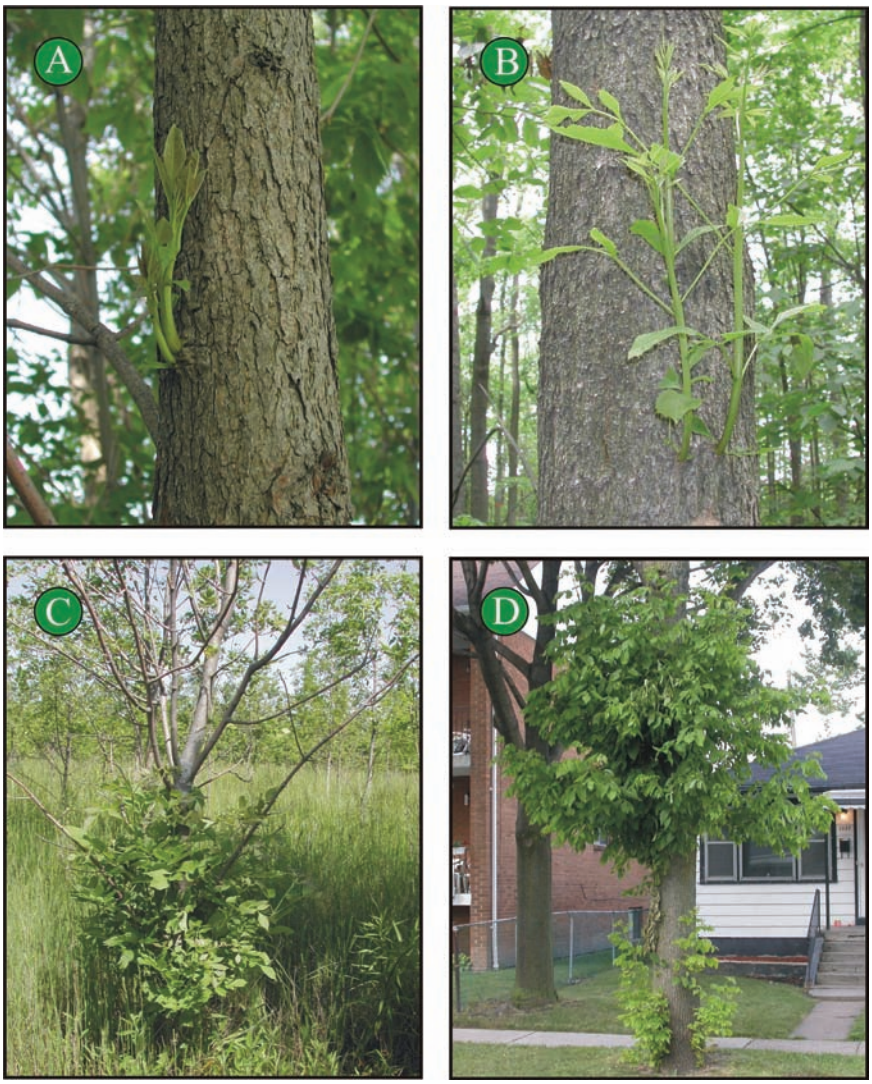


Fig. 15. Epicormic shoots on the boles of ash trees; A) and B) newly sprouted shoots on woodlot trees, C) at the base of the bole on a plantation-grown tree, and D) on the bole and roots of a suburban tree.

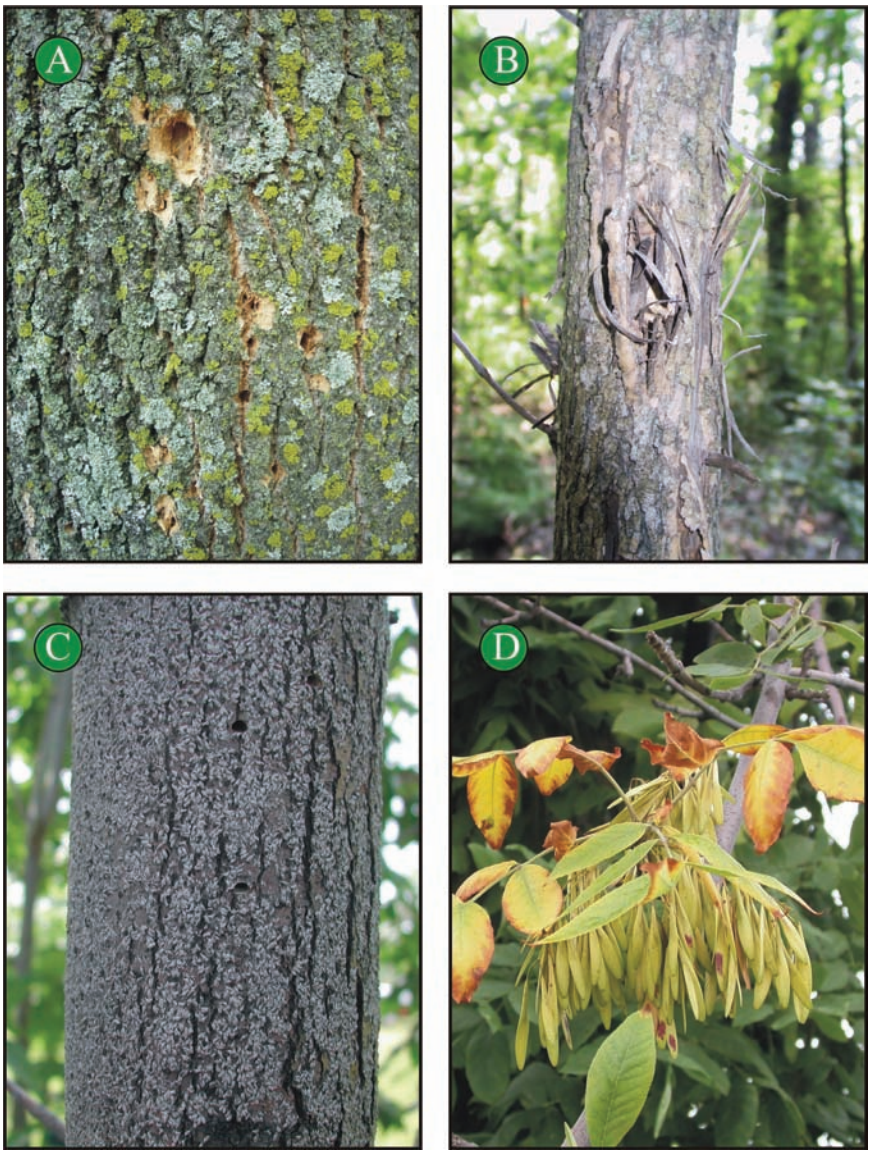


Fig. 16. Other signs and symptoms of EAB activity: A) woodpecker feeding, B) squirrel feeding, C) oystershell scale, and D) large seed crop.

necessarily the presence of EAB.

5.4 Other Symptoms

Biology of Symptoms: Trees under stress are often attacked by a variety of insects. Stressed trees often produce a surplus of seeds.

Description of Symptoms: The presence of oystershell scales (Fig. 16C) on the trunk of ash trees is an indication that they may be under attack by EAB. A large number of seeds (samaras) on an ash tree (Fig. 16D) may also be indicative of EAB attack.

Confounding Symptoms: Other stressors may stimulate attack by other insects and increased seed production in ash trees.

5.5 Bark Deformities

Biology of Symptom: The presence of EAB larvae tunneling under bark of the host tree causes a wound response by the tree. The tree often responds by producing scar tissue (callusing) around the wound. This results in bark discoloration, swelling and sometimes splitting at or near the wound site (Fig. 17).

Description of Symptom: In trees with first or second year EAB infestations, vertical splits, weeping and staining in the bark and bark swelling are often the only symptoms present in an otherwise healthy-looking tree. Vertical splits are often 5–10 cm in length and occur over a gallery. If there is a gallery present, it can be seen beneath the crack. In most cases it does not take too much effort to cut away enough bark under the crack to see if a gallery is present.

Confounding Symptoms: The other most common cause of cracking in the bark is from frost damage or freezing in the wintertime.

5.6 Foliage Feeding

Biology of Sign: Adults of EAB undergo maturation feeding prior to becoming sexually active and reproductive. This feeding period may last for several weeks under field conditions.

Description of Sign: Feeding adults of EAB chew ragged edges on the leaves of the host plant (Fig. 18).

Confounding Signs: Other species of insects also chew holes in leaves of ash trees, thus this sign is only an indication of potential infestation by EAB.

5.7 Emergence Holes

Biology of Sign: Adult EAB chew D-shaped holes (Fig. 1) in the bark as they emerge from the chambers in which they develop. The presence of D-shaped exit holes in an ash tree is a strong indicator that the tree is infested with EAB. The D-shaped exit holes are required to accommodate the flat back and rounded underside of the adult EAB.

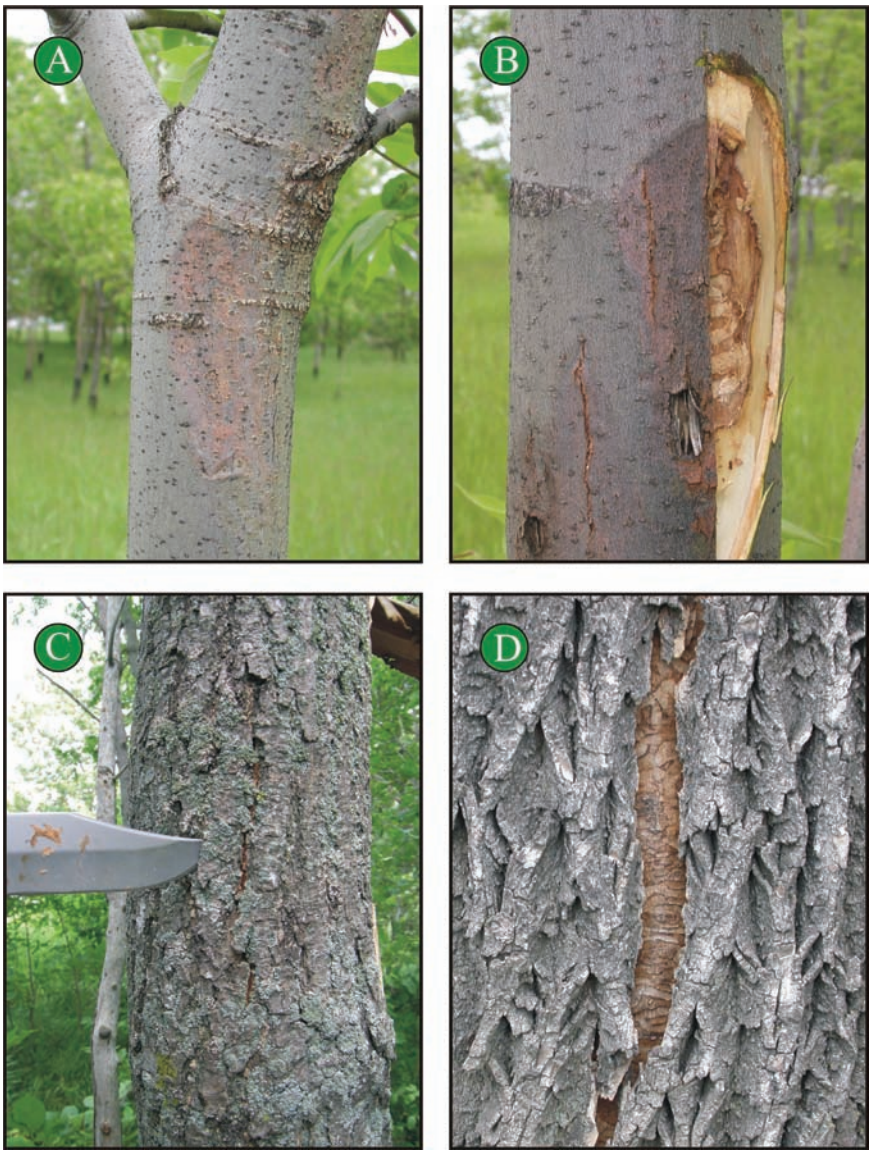


Fig. 17. Bark deformities caused by larval feeding and gallery development of EAB: A) stain, B) stain and cracks with bark removed to reveal gallery, C) crack in rough-barked tree, and D) large crack with gallery exposed beneath.

Fig. 18. A) Adult feeding on the foliage of the host tree resulting in B) defoliation that may be visible from the ground.

Description of Sign: The exit hole is shaped like the capital letter D on its side. Exit holes are 3.5 to 4.1 mm in diameter.

Confounding Signs: D-shaped holes are not unique to EAB, but are unique to the metallic wood-boring beetles (Buprestidae). There are a number of other insects that attack and infest ash trees (Section 4.6), but emergence holes made by these species are generally round.

5.8 Larval Galleries

Biology of Sign: Serpentine (S-shaped) galleries are typical feeding patterns for EAB (Fig. 19). Initially, galleries are very narrow, then gradually widen as the larva matures and becomes larger. These galleries are filled with fine frass (sawdust-like excrement) and easily seen on the outer sapwood after the bark has been peeled away. At low levels of infestation, the galleries tend to follow the grain up or down the trunk but once population levels become higher they meander in all directions, may crisscross each other, and/or may be straight. Older galleries may have swollen scar (callus) tissue around their edges where the tree has tried to wall off the insect damage (Fig. 20). Old uninhabited galleries become dark brown and usually have an emergence hole in the bark above them.

Description of Sign: Serpentine (S-shaped) larval galleries are usually packed with a light brownish frass. Initial tunnelling is very small, but gradually these zig-zagging tunnels increase to about 6 mm in width and up to 20 - 30 cm in length.

Confounding Signs: Other wood-boring insects make galleries under the bark of ash trees (Section 4.6)

6. Ash Species Identification

The trees targeted for the emerald ash borer survey are all true ash species in the genus *Fraxinus*. Ash trees are common trees on

Fig. 19. The serpentine larval galleries of EAB exposed by peeling back the bark of the host tree: A) early stage gallery, B) complete gallery with larva entering pupal chamber, C) many distinct galleries under bark, and D) intermingled galleries under bark of severely infested tree.

Fig. 20. An old EAB gallery that was walled off from the rest of the cambium with callus tissue. More recent galleries surround the old gallery.

the rural and urban landscape in Canada. It is essential that all survey staff be able to distinguish ash from other species that can look similar and be able to identify ash trees to species.

This part of the manual is divided into four sections. Section 6.1 provides a general description of trees that are similar to ash trees and how to distinguish ash from these similar trees. Section 6.2 provides a tree identification key to distinguish ash trees from other trees. In section 6.3, the distinctive features of different ash species (native and many of the introduced species) are described. Section 6.4 provides a tree identification key to distinguish the ash species from one another. Survey staff should use these sections together with a tree identification book, such as "Trees in Canada" (Farrar 1995), to aid in identification.

6.1 Identifying Ash Trees

Trees are broadly distinguished from each other according to whether the tree's leaves are opposite or alternate, and simple or compound. Using these characteristics allows for the differentiation of ash from many other tree species.

Twigs and branches can be used in winter to help identify trees. Ashes (*Fraxinus* spp.), maples (*Acer* spp.), catalpas (Catalpa spp.), horsechestnuts (*Aesculus* spp.), elders (*Sambucus* spp.), viburnum (*Viburnum* spp.), common lilac (*Syringa vulgaris*), amur corktree (*Phellodendron amurense*) and dogwoods (*Cornus* spp.) are deciduous trees with buds and branches in an opposite arrangement (Fig. 21A and B). Other tree species have buds and branches arranged alternately (Fig. 21C).

Ashes have blunt buds, stout twigs, and an upright growth habit with long branches. The branch tips look like tridents (3-pronged fork). Bark (Fig. 22) is variable and thus is not a feature upon which identification should be based. Maple buds are covered by folded scales and the twigs are more slender (Fig. 23A). Horsechestnuts have darker bark than ashes, large terminal buds that are dark and sticky. Catalpas, lilac and corktree have no true terminal bud and usually retain seeds into winter unless they are pruned off.

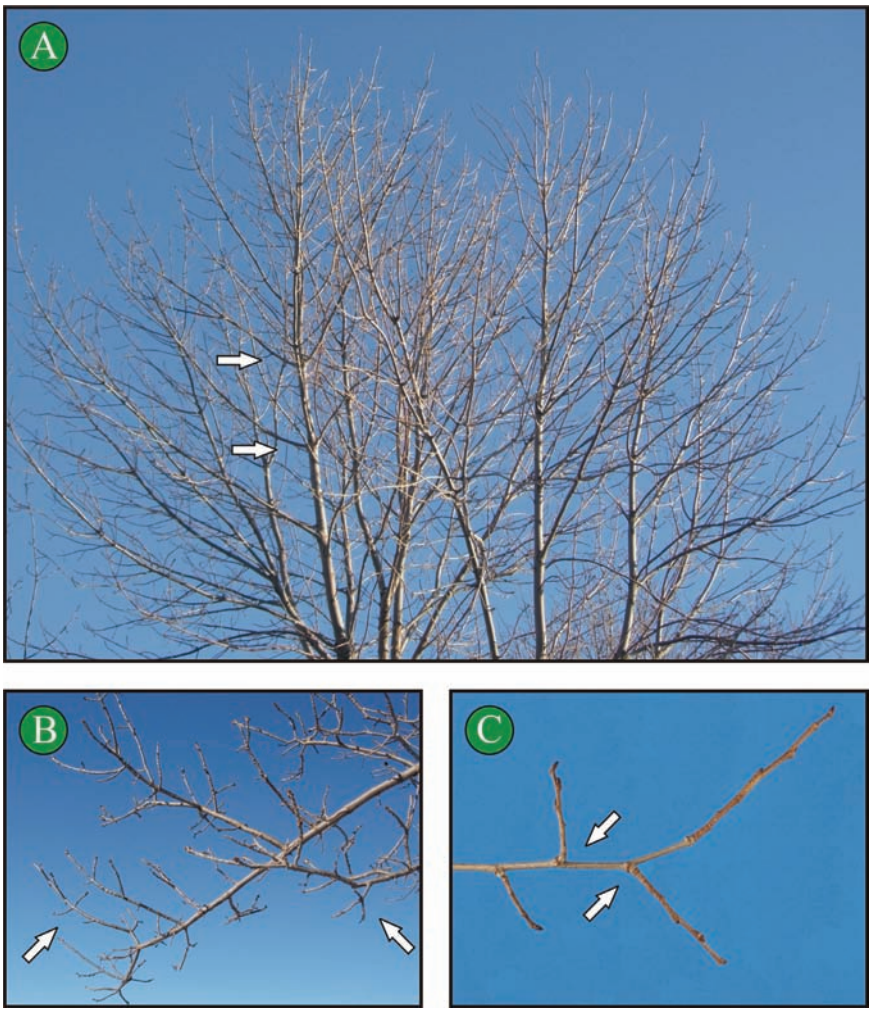


Fig. 21. A) Opposite branching on green ash, B) opposite twig structure on green ash and C) alternate twig structure on white elm.

In the winter, the tree species most commonly confused with ash are Norway maple (*Acer platanoides*), Manitoba maple (*A. negundo*) and black walnut (*Juglans nigra*). Norway maple is most often planted as a landscaped tree and must be examined closely. Norway maple has mahogany-coloured twigs, black branch collars and larger terminal buds than ash. The buds are a distinct red colour and covered by folded bud scales. The most reliable identifying feature is to find maple keys persisting on the tree.

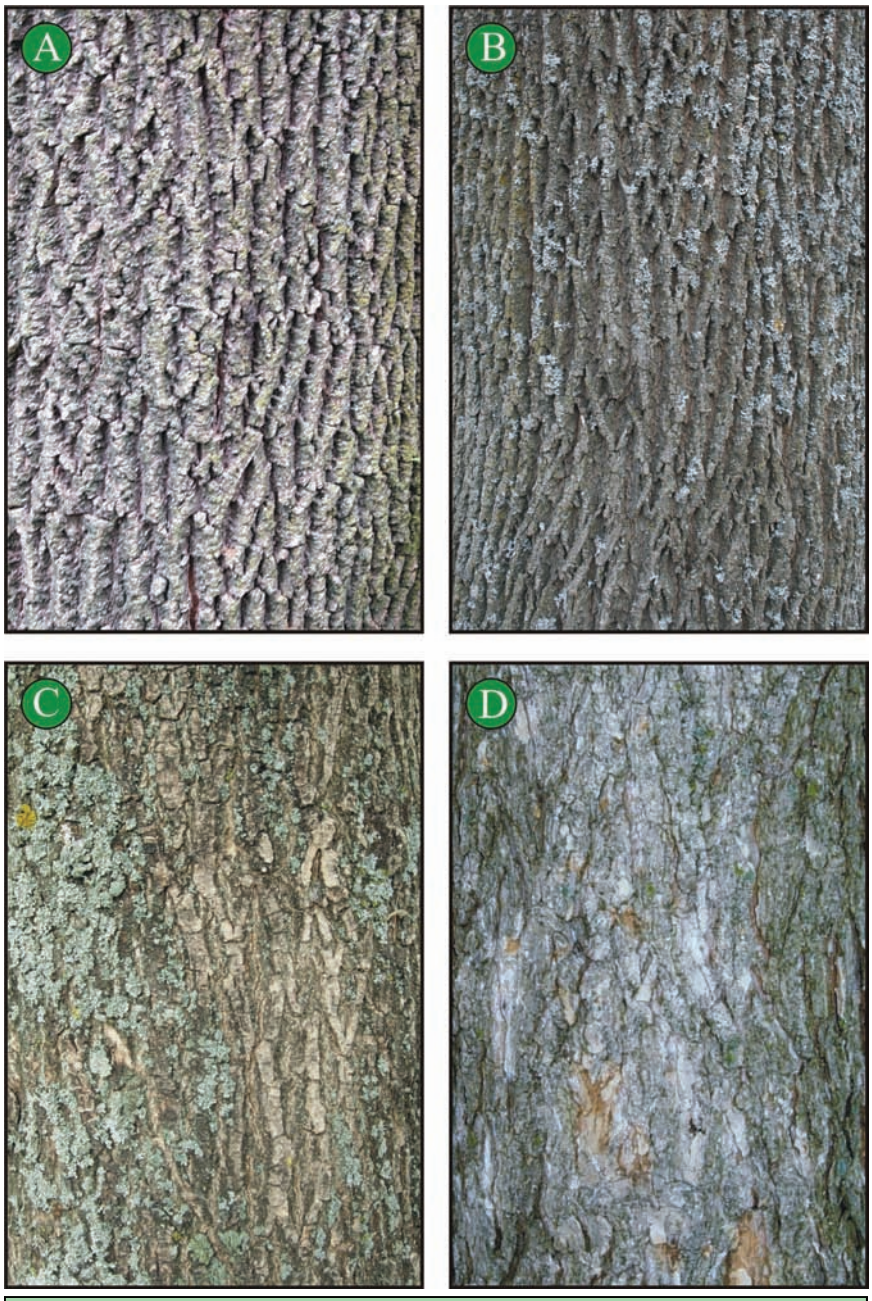


Fig. 22. Mature bark of A) green/red ash, B) white ash, C) black ash, and D) blue ash.

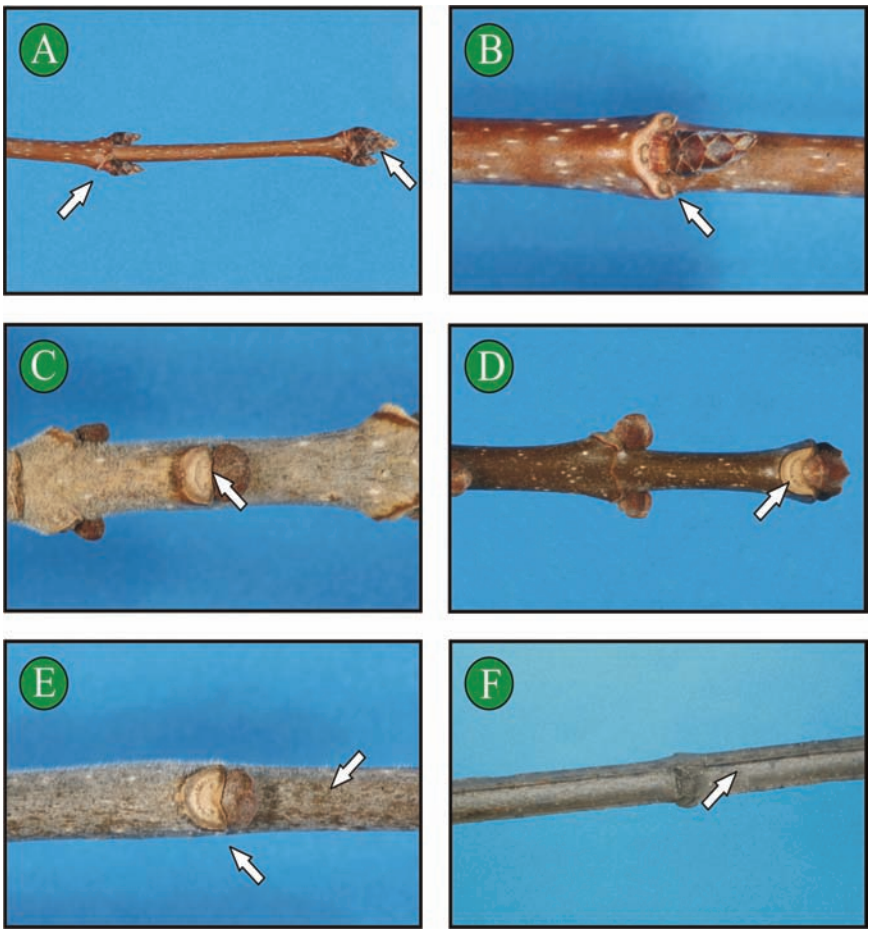


Fig. 23. A) Twig with buds of sugar maple, B) leaf scar on sugar maple, C) green/red ash buds and leaf scar, D) white ash buds and notched leaf scar, E) leaf scar and hairy twig of black ash, and F) square twig of blue ash.

Manitoba maple has grey buds on slender twigs that look relatively large. The twigs are purple and are coated with a white waxy powder that can be rubbed off. Manitoba maple has a crooked form. It is most easily identified when it retains its clusters of maple keys. From a distance, with their stout branches and form, black walnut, butternut, hickories (*Carya* spp.), cottonwood/poplar (*Populus* spp.), and tulip-tree (*Liriodendron tulipifera*) appear ash-like but all have alternately oriented branches and buds like white elm (Fig. 21C). The tulip-tree may still have its seed cones in the winter, and there is white dotting on the bark.

Some tree species, such as ash, have compound leaves (Fig. 24), that is two or more leaflets on a single leaf stalk and each leaf forms a bud at its base. Other trees such as maple, oak (*Quercus* spp.), elm (*Ulmus* spp.), poplar and beech (*Fagus* spp.)

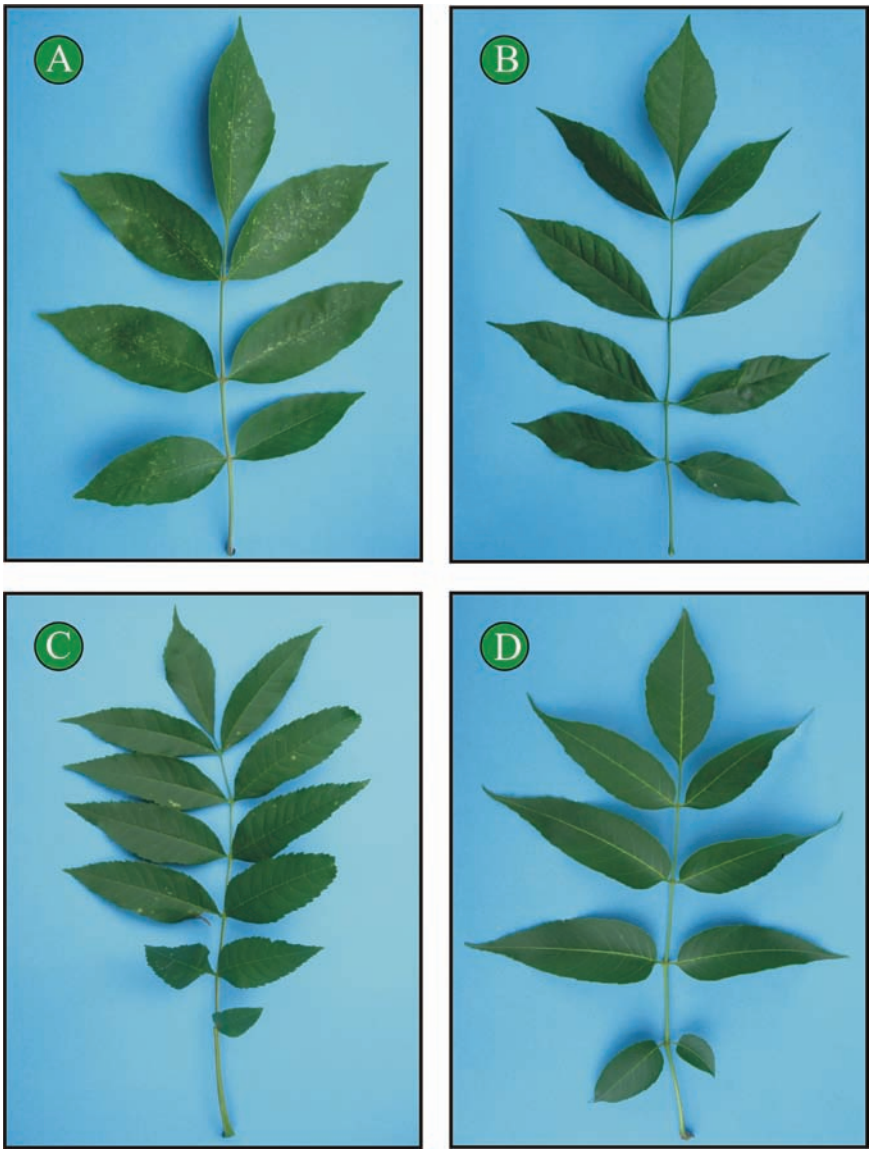


Fig. 24. Compound leaves of A) green/red ash, B) white ash, C) black ash, and D) blue ash.

have simple leaves (Fig. 25). If it does not have a compound leaf, it is not an ash.

Ash leaves (Fig. 24) usually have 5 - 9 finely-toothed leaflets (occasionally 11) of roughly equal size with the lowest (basal) two leaflets being slightly smaller than the other leaflets. Ash seeds are attached to a wing called samaras, which droop towards the ground and turn from green to brown throughout the summer.

Manitoba maple is the only native maple with a compound leaf. Manitoba maple generally has 3-5 leaflets (occasionally 7) with slight lobes, crooked form, and clusters of maple keys. Amur corktree is an uncommon tree species. Fruits are grape-like clusters of berries turning green to purple. Amur corktree has spongy-textured bark. Elder is a shrub-sized plant with hollow, easily breakable stems. The fruits are flat clusters of small berries turning from green to red or nearly black, depending on the species.

Fig. 25. The simple leaf of white elm.

The following trees have an alternating leaf and bud arrangement (Fig. 21C) as their main difference from ash (Fig. 23). Walnut and butternut have more than nine leaflets. Nuts develop inside of a large green husk on these trees. Leaves have a distinct citrus smell when crushed. Hickory leaves have a shiny upper surface and are aromatic when crushed. The terminal leaflet is much larger than the basal leaves. Honey locust (*Gleditsia triacanthos*) and black locust (*Robinia pseudoacacia*) have more than nine small leaflets of equal size. These are leguminous trees that develop seed pods. Mountain-ash, which are in the rose family, are not true ashes. Leaves of these species have distinct teeth. Showy white flowers on these trees develop into clusters of bright orange berries. The introduced ornamental, tree-of-heaven (*Ailanthus altissima*) has many more than nine leaflets.

6.2 A Key to Distinguish Ash from Other Trees

These simple keys will help you separate ash trees from other trees that have a similar appearance.

Trees can be identified in the summer using the leaves (Summer Key) or in the winter using the twigs and bark (Winter Key). It is more difficult to distinguish between tree species in the winter, so it takes some practice to become proficient. Twigs are used to identify trees without leaves. Make sure the twig examined does not have missing buds and is alive. We strongly advise that you examine at least two or three samples at each step of the key to be sure the decision is correct and to familiarize you with the variation that occurs within and among trees. Do not use the leaves and twigs from epicormic branches.

Summer Key

Step 1: Look at a branch in a tree where the branches are easy to see. Are the branches directly opposite (across from each other) (Fig. 21A), or are the branches alternate (staggered and not directly across from each other) (Fig. 21C)?

If the branches are alternate, it is not an ash tree.

If the branches are opposite, go to Step 2.

Step 2: Is the leaf a single blade (**Simple Leaf** – Fig. 25) joined by its stem to a woody branch, or does the leaf have many leaflets (**Compound Leaf** – Fig. 24) attached to a single leaf stem?

If the leaf is simple, then the tree is not an ash tree.

If the leaf is compound, go to Step 3.

Step 3: Does the leaf have 3 to 5 (rarely more) leaflets that are irregular in shape and with coarse teeth?

If yes, it is a Manitoba maple (boxelder).

If not, go to Step 4.

Step 4: Does the leaf have 5 to 9 (usually 7) leaflets arranged like the fingers in a hand (palmate), with the leaflets bigger above the middle and ending with a small point?

If yes, it is a horsechestnut or a buckeye.

If not, go to Step 5.

Step 5: Are the leaves covered with translucent dots (glands)? Are they fragrant, and do the twigs have prominent lenticels?

If yes, it is likely an Amur corktree, which is com-

monly planted in urban areas and looks a lot like ash.

If not, go to Step 6.

Step 6: Does the leaf have 5 to 11 leaflets all about the same size (the terminal leaflet can sometimes be slightly larger) and is the edge (margin) of each leaflet smooth or with small teeth (Fig. 24)?

If yes, it is likely an ash tree. Go to Sections 6.3 & 6.4 to distinguish the different species of ash.

Winter Key

Step 1: Look at a branch in a tree where the branches are easy to see. Are the branches directly opposite (across from each other) (Fig. 21A & B), or are the branches alternate (staggered and not directly across from each other) (Fig. 21C)?

If the branches are alternate, it is not an ash tree.

If the branches are opposite, go to Step 2.

Step 2: Are the twigs very stout with very large and sometimes sticky terminal buds with large shield-shaped leaf scars?

If yes, it is likely a horsechestnut or a buckeye.

If not, go to Step 3.

Step 3: Are the twigs slender, with three distinct vein (bundle) scars inside the crescent-shaped leaf scar (Fig. 23B)?

If yes, it is likely a maple.

If not, and the leaf scar has many (5 or more) small vein scars (Fig. 23C-E), it is likely an ash tree. Go to Section 6.3 & 6.4 to distinguish the different species of ash.

6.3 Identifying Ash Species

There are five native species (green/red, white, black, blue and pumpkin ash) of ash in eastern Canada and several more species that are introduced and planted as landscape ornamentals. What is known as red ash (*Fraxinus pennsylvanica*) in Canada, is called green ash in the United States. To make matters somewhat more confusing, in Canada, there are two varieties of red ash, the northern red ash (*Fraxinus pennsylvanica* var. *austini*) and the green ash (*Fraxinus pennsylvanica* var. *subintegerrima*). Green ash has become the predominant common

name in Canada in association with the emerald ash borer. Pumpkin ash is extremely rare and occurs in a few locations in southeastern Ontario near Lake Erie. Similarly, blue ash is also a rare tree but can easily be distinguished from the other ash trees by its four sided twigs. In urban areas, European ash and its golden twig cultivar, and sometimes Manchurian ash and its hybrids can also be encountered.

The description for individual species contains the characteristics of that species that allows for specific identification.

6.3.1 Green/Red Ash (*Fraxinus pennsylvanica*)

Key Features: In the spring and summer, twigs (Fig. 23C), buds and leaves on red ash (green ash is the hairless variety of red ash) are very pubescent, but in the fall, they are only slightly fuzzy. Twigs are less stout than in white ash (Fig. 23D). The outer bark (epidermis) does not flake or peel on older twigs like those on white ash.
Bud: The pubescent buds are raised on the leaf scar (Fig. 23C).
Leaf: Leaves (Fig. 24A) have 5-9 leaflets (most often 7) that are serrated (toothed) beyond the middle of the leaflet. Leaflets are attached to the leaf stalk by a short petiole.
Seed: The wing of the samara covers about half of the seed. The seed cavity is relatively thin and narrow.
Bark: Mature trees have an irregular diamond-shaped bark pattern (Fig. 22A). The bark on twigs often has a reddish tinge to it.

6.3.2 White Ash (*Fraxinus americana*)

Key Features: The buds are set into the leaf scar (Fig. 23D). This is the only ash that may turn purple in the fall. Twigs are stouter than those on green/red ash and exhibit a purple-grey colour. The growth habit is neat and upright giving the terminal leaders the shape of a trident.
Bud: The lateral buds are all set into a notch in the leaf scar (Fig. 23D). Leaf scars are raised giving the twig a knobby appearance.
Leaf: Leaves (Fig. 24B) have 5-9 hairless leaflets (most often 7). The leaflets are mostly smooth-edged, often with rounded serrations. The leaves are dark green above, but much paler on the under side. The leaflets are attached to the leaf stalk by a petiole that is slightly longer than those in *F. pennsylvanica*.
Seed: The wing of the samara covers only the tip of the seed. The seed cavity is relatively plump.
Bark: The bark has a distinct diamond-shaped pattern on mature specimens (Fig. 22B).

6.3.3 Black Ash (*Fraxinus nigra*)

Key Features: This is the only native ash that has its uppermost lateral buds spaced distinctly be-

low the terminal bud so that one can see bark between the two. The terminal twigs are stout. The species is rarely found on upland sites.
Bud: The very dark brown buds are raised above the leaf scar (Fig. 23E).
Leaf: Of the 7-11 leaflets, only the terminal leaflet has a petiole, the rest are sessile (attached directly to the leaf stalk) (Fig. 24C). Leaves are serrated along the margins.
Seed: The wing of the samara is wider than those on white or green/red ash, covering nearly all of the seed. The wing is notched at the end.
Bark: The bark (Fig. 22C) is corky and when cut into is tight to the sapwood.

6.3.4 Blue Ash (*Fraxinus quadrangulata*)

Key Features: This is the only ash species with 4-sided (square) twigs (Fig. 23F). The bark on a mature tree is scaly as opposed to the diamond-shaped bark of other *Fraxinus* spp. This is a medium-sized tree found on upland sites. The tree is often planted as an ornamental due to its rarity in Ontario.
Bud: The lateral buds are set above the leaf scar, which has the shape of a narrow crescent.
Leaf: The 5-11 leaflets (most often 9) are coarsely serrated with asymmetrical bases (Fig. 24D). The leaflets are attached to the leaf stalk by a short petiole.
Seed: The wing of the samara is broad, covering the whole, relatively flat seed. The samara is twisted in appearance and has a notched tip.
Bark: The bark (Fig. 22D) is distinctly grey and scaly.

6.3.5 Pumpkin Ash (*Fraxinus profunda*)

Key Features: This species has many similar features as white and red ash, but much larger features than any other native *Fraxinus* spp. On more mature specimens the base will be buttressed and swollen to look like a pumpkin. The species is rare in Ontario and is only found in moist bottomlands.
Bud: The buds are very pubescent and set into the leaf scar.
Leaf: The leaves are very long with 7-9 leaflets each one being 10-25 cm long (other *Fraxinus* spp.: 7-15 cm). The petiolules are relatively long (1 cm). Leaflets have rounded serrations and are pubescent underneath, with the midrib being densely hairy.
Seed: The wing of the samara is very broad and much longer than other *Fraxinus* spp. (5-8 cm) and covers most and in some cases, all of the seed cavity.

6.3.6 Exotic Ashes

Many species of ash in eastern Canada have been planted outside of their native range. The two most common species are Manchurian and European ash. The following is a list of some of the more common species of exotic

ashes that may be encountered during surveys with brief descriptions of their diagnostic characteristics.

F. excelsior (European Ash)

Key Features: The buds of this species are jet black. Twigs and upper branches may be yellow on some cultivars and the bark is often smooth, lacking the deep fissures of native species.

F. mandshurica (Manchurian Ash)

Key Features: The 11 lance-shaped leaflets have sunken veins, are coarsely toothed, and are hairy on both the upper and lower surfaces. Several Manchurian-black ash hybrids have been planted in Canada for their fall foliage.

F. ornus (Flowering Ash)

Key Features: This species has showy fragrant white flowers.

F. angustifolia (Narrow-leafed Ash)

Key Features: The three buds are arranged in a whorled fashion on the twig.

F. bungeana (Bunge's Ash)

Key Features: Leaves and flowers are downy when first emerging. This species is a small tree or shrub.

F. chinensis (Chinese Ash)

Key Features: The eight egg-shaped leaflets are downy beneath.

F. latifolia (Oregon Ash)

Key Features: This species is found in British Colombia. The twigs and buds are pubescent. The tips of the leaflets are pointed.

6.4 A Key to Distinguish Ash Species

This simple key will help you separate the five native species of ash and a common introduced ornamental (European ash) found in Eastern Canada.

Summer Key

Step 1: Does the leaf have smooth margins or a few rounded teeth along the edges (margin)?

If yes, and the twigs are hairless and stout (Fig. 23D) and the leaflets (5-9) are hairless below (except along the veins), the tree is a **White Ash (*Fraxinus americana*)**. The seed wing is tapered and surrounds only the tip of the seed case.

If yes, and the twigs are hairy and stout and the leaflets are hairy, large,

thick and with 1 cm long stems, it is a **pumpkin ash (*Fraxinus profunda*)**. The seed wing is widest at or above the middle.

If not, go to Step 2.

Step 2: Does the leaf have toothed margins and are the leaflets directly attached (without a stem) to the central leaf stalk (Fig. 24C)?

If yes, and there are 7-11 leaflets with dense tufts of reddish-brown hair near where the leaflet attaches to the central leaf stalk (Fig. 24C), the tree is a **Black Ash (*Fraxinus nigra*)**. The seed wing is often twisted and surrounds the seed case and sometimes has a small notch at the tip.

If yes, and there 9-15 leaflets that do not have tufts of hair where the leaflet attaches to the central leaf stalk, the tree is an **European ash (*Fraxinus excelsior*)**. The seed wing is wide, flat and surrounds the seedcase.

If not, go to Step 3.

Step 3: Does the leaf have toothed margins and are the leaflets attached by a small stem (petiole) to the central leaf stalk (Fig. 23A & C)?

If yes, and the twig has four prominent corky ridges, giving it a four-sided appearance (Fig. 23F), and the leaflets are asymmetrical at the base, the tree is a **blue ash (*Fraxinus quadrangulata*)**. The seed wing is broad and twisted and surrounds the flat seedcase.

If yes, and the twig lacks ridges and is round in cross section and the leaflets are symmetrical at the base (Fig. 24A), the tree is the **green/red ash (*Fraxinus pennsylvanica*)**. The seed wing is flat, sometimes with a small notch at the tip and surrounds about one-half of the seed case and stays on the tree almost all winter.

Winter Key

Step 1: Does the twig have four prominent corky ridges giving it a four-sided appearance (Fig. 23F)?

If yes, the tree is a **blue ash (*Fraxinus quadrangulata*)**.

If not, go to Step 2.

Step 2: Are the twigs round?

If yes, and the buds are noticeably deep inky black in colour, the tree is an **European ash (*Fraxinus excelsior*)**.

If yes, but the buds are reddish to dark brown, go to Step 3.

Step 3: Are the terminal buds conical and dark brown to black, and is there bark clearly visible between the terminal buds and the first pair of lateral buds just below?

If yes, and the twig is smooth with corky purplish lenticels, the tree is a **black ash (*Fraxinus nigra*)**.

If not, go to Step 4.

Step 4: Do the leaf scars underneath the buds have deeply U– or V–shaped notches and are the lateral buds set close up against the terminal buds leaving no visible bark between (Fig. 23D)?

If yes, and the twig is smooth, the tree is a **white ash (*Fraxinus americana*)**.

If not, go to Step 5.

Step 5: Is the tree in a very wet site with a swollen trunk (looks like a pumpkin) at the base, and are the twigs densely hairy?

If yes, the tree is a **pumpkin ash (*Fraxinus profunda*)**.

If not, the tree will be **green/red ash (*Fraxinus pennsylvanica*)**. The leaf scar underneath the bud will have a straight edge at the top and will look like the letter D when turned on its side (Fig. 23C). The twigs will be hairy to smooth or nearly so and tend to be somewhat flattened.

7. Examination Methods

Visual surveys can be conducted year round but slightly different methods are used in different seasons. The best time of year to see all or most of the symptoms is during late summer and fall.

From late July until leaf-drop in the fall is when the trees begin to show signs of stress due to the heaviest larval feeding activity. Epicormic shoots and thinning crowns start to become very evident during this period. This time period is best for observing all of the EAB signs and symptoms. Bark deformities are easiest to observe when the leaves are off the trees (October/November to

March/April). EAB symptoms are difficult to detect in spring during the period of leaf flush (April through June).

Any tree displaying all or some of the signs and symptoms (Sections 5.1 to 5.8) should be carefully examined from the root collar as far up the trunk as possible. In most cases, depending on the size of the tree, just using your naked eye will not be enough to conduct a thorough inspection. One, or a combination, of the following techniques may be necessary.

7.1 Visual Inspection

All visible portions of the bole and lower branches of ash trees should be examined from the ground for signs and symptoms of EAB. Higher portions of the bole can be examined using binoculars or spotting telescopes. We recommend that a set of at least 10 x 42 binoculars be used. Other sized lenses may be used if they are available, but it is important that they can focus at relatively short distances.

7.2 Crown Survey

In some cases, trained and experienced staff can use climbing sticks to get to a height of 3 to 6 m in the tree (Fig. 26). Exit holes or suspicious cracks or blemishes can then be cut into, to determine if galleries or life stages are present. A harness must be used at all times. A bucket truck or cherry-picker truck may be used to examine branches in the upper crown if available and circumstances permit their use. Bucket trucks should only be operated by certified and

Fig. 26. Inspectors using climbing poles to examine the boles of ash trees.

experienced staff.

7.3 Tree Felling

In some cases a tree may be cut down and the bark stripped by the inspector to determine the presence of galleries or larvae. Trees should only be felled when highly suspicious symptoms are viewed from the ground (*e.g.*, emergence holes or bark deformities). Trees should never be removed on residential properties during surveys. Chainsaws should only be operated by certified and experienced staff.

7.4 Bark Peeling

If there is a crack or an epicormic shoot, the bark should be cut away at that area to determine if galleries and/or larvae are present. The bark needs to be removed at least to the cambial layer. The inspector should not cut into the tree (especially residential trees) unless there is a crack or sucker present. Bark windows should be cut about hand size. Care must be taken in spring to remove only hand-sized windows, because large pieces of bark can be easily removed during this time of year. There is sufficient evidence to suggest that galleries are more likely to be present on the sun-exposed side of host trees. Thus, cutting bark windows on this side of the tree would have the highest probability of success.

If a cut is made in a tree to determine the presence of galleries or larvae, it should be "clean", which means there should be no bark or wood left attached to the wound and every effort should be made to prevent creating a wound where water can accumulate and disease can develop.

8. Survey Methods

At each site, the inspector should attempt to identify potential sources of EAB introduction, or the sites where beetles would emerge if they were present. These should include log or slab piles in a sawmill yard, or firewood piles at RV parks or residences. If a potential source is not obvious, the inspector should use any ash tree as a starting point. At all sites, the inspector should look for any dead and/or dying ash trees. Site selection should focus on public land wherever possible.

The ash trees in the closest proximity to these "source" sites should be carefully inspected first. Survey outward from these sites. Although insects do not like to fly great distances over open areas, EAB has been shown to be a good flier, so any ash trees within approximately 1 km of the "source" should be inspected.

For each site surveyed, a Survey Site Profile Form (Section 10.1) is completed.

8.1 Landscaped Tree Survey Methods

Landscaped trees are the free-

standing or clumped trees found in residential neighbourhoods, city parks, golf courses and other sites where landscaping practices have taken place. All ash trees on these individual properties should be examined for signs and symptoms of EAB. Upper boles, branches and crowns should be examined with binoculars or from climbing poles. For residential trees, bark peeling/removal should only be undertaken where trees have suspicious signs (emergence holes or bark deformities) of EAB or on portions of the stems or branches that are not readily visible from the ground. Tree felling should only be undertaken on these properties when directed by a supervisor. Firewood piles should be examined for the presence of ash bolts, and ash bolts should be carefully examined for evidence of EAB infestation. Site maps on the Survey Site Profile Form should show the locations of roadways, buildings and ash trees. The Universal Transverse Mercator (UTM) coordinates of the centre of a residential property should be determined with the GPS unit (set to datum NAD83) and recorded on the data form. For detection surveys, randomly located properties within a neighbourhood are pre-selected for examination.

8.2 Shelterbelt/Fencerow Survey Methods

Ash trees located within the fencerow should be examined for signs and symptoms of EAB. Trees should be viewed from both sides either by different inspectors walking along opposite sides of the fencerow or by the same inspector walking along one side of the fencerow on the outward trip and returning along the opposite side on the return trip. The number (or estimated number) of ash stems in the fencerow and their approximate size should be recorded. Particular attention should be directed at trees showing potential signs or symptoms of EAB. The UTM coordinates of a fixed point (end of fencerow or at roadway) along the fencerow or shelterbelt should be determined using the GPS unit and recorded on the Survey Site Profile Form (Section 10.1). The site map on the form should be completed showing the relative position of the fencerow to roadways, structures, land features and the GPS coordinates.

8.3 Riparian Zone Survey Methods

Riparian zones are forested areas along the banks of waterways (*e.g.,* rivers, streams, ponds, ditches etc.). These zones may represent the only forest stands in some agricultural areas. Tree species composition may also be quite different in riparian zones. Surveys in these zones are conducted in a similar fashion to surveys in small woodlots (Section 8.4) with the exception that zigzag walks are usually undertaken along the contour of the shoreline. Both sides of the streams must be examined.

8.4 Woodlot Survey Methods

For the purposes of EAB surveying, a woodlot is defined as a contiguously wooded zone with an area of less than 40 ha. Initial attention should be directed at the trees along the edge of the woodlots. These trees that are clearly visible from adjacent areas should be examined for signs and symptoms of EAB attack. If signs and symptoms (*e.g.*, crown dieback or epicormic shoots) are visible from a distance, the trees should be closely examined for more conclusive signs and symptoms (*e.g.*, emergence holes and galleries) or life stages of EAB. Once edge trees have been examined, inspectors (teams of 2-4) position themselves at approximately 10-m intervals along one boundary of the woodlot and proceed through the woodlot using a zig-zag walking pattern (Fig. 27). The spacing between intervals is regulated by understory density, topography, and shape and size of the woodlot. Inspectors keep within visual contact with each other and regulate their rate of advance to a common pace. The zig-zag walk traverses the woodlot from side-to-side or end-to-end. Once the area has been traversed in one direction the inspectors space themselves apart again along the boundary of the non-surveyed portion of the woodlot and continue in the opposite direction.

This process continues until all areas of the woodlot have been examined. Each time the inspectors exit or enter the woodlots the edge trees should be carefully examined. All ash trees within the woodlot are examined at a distance with binoculars but only stems closely encountered are carefully examined unless potential signs or symptoms of EAB are detected. Signs and symptoms notable at a distance (crown dieback or epicormic shoots) would trigger a close-up examination of an individual trunk. Hand-sized bark windows are cut on all trees that are closely examined using bark deformities to direct placement. The GPS coordinates of one corner of the woodlot should be recorded and its location indicated on the sketch map.

8.5 Forest Survey Methods

For large tracts of contiguously forested land it is difficult to visit all areas within the forest and yet survey large geographic areas. To overcome this problem, the area in question can be sub-sampled using systematically distributed sample plots. In addition, examination of aerial photographs or conducting aerial reconnaissance of the forest prior to the survey can pinpoint areas within the forest that have high concentrations of ash trees. These areas must be sampled. The following techniques are to be used in forested areas greater than 40 ha in area (Fig. 28).

The sample unit to be employed is a 10 by 10 m square. W-shaped transects are overlaid on maps of

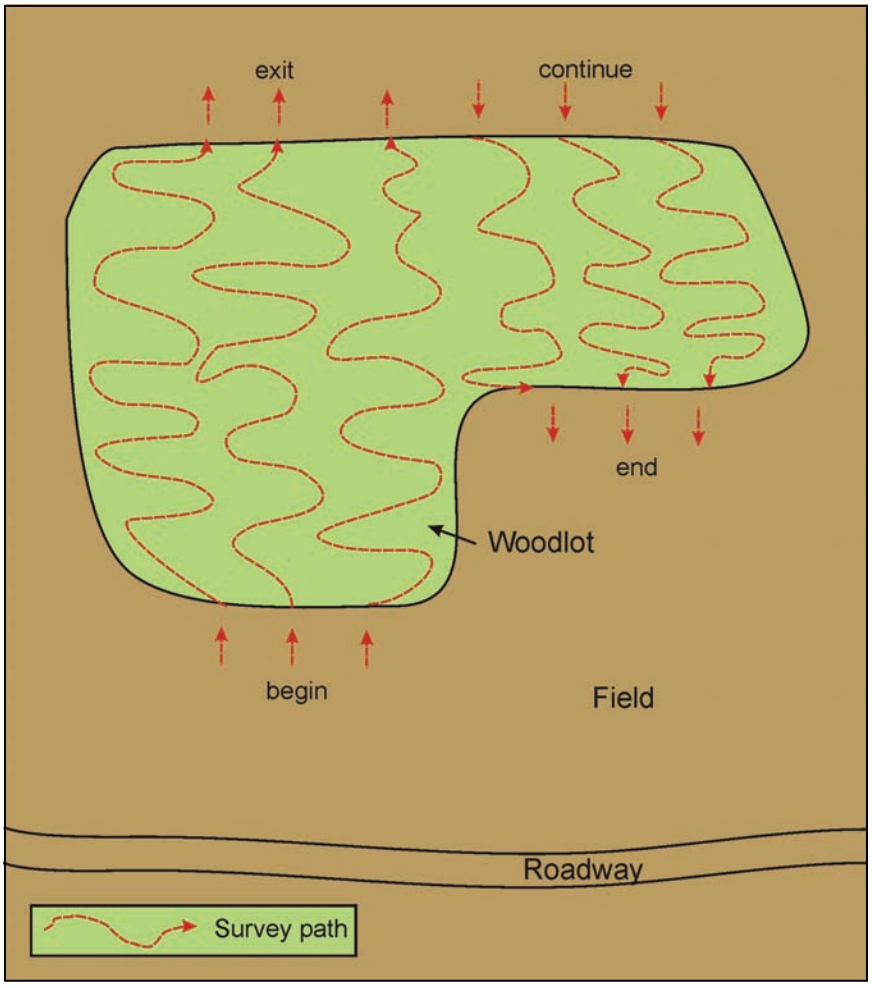


Fig. 27. Map showing the protocol for conducting a three-person survey in a hypothetical woodlot.

the forested area and the directional bearings for the transect lines are predetermined. The distribution of the 10 by 10 m sample plots along the transects is also predetermined using the GIS. In addition, edge plots are systematically selected at the entry and exit points of the transects along the boundaries of the forested area. Examination of these edge plots allows comparisons to be made between edge and interior locations. The southwestern corner of each sample unit, which is positioned on the transect line, is designated by a GPS coordinate. From this point, a compass and tape measures are used to delineate the extent of the sides of the square. All ash stems within the sample plots are carefully exam-

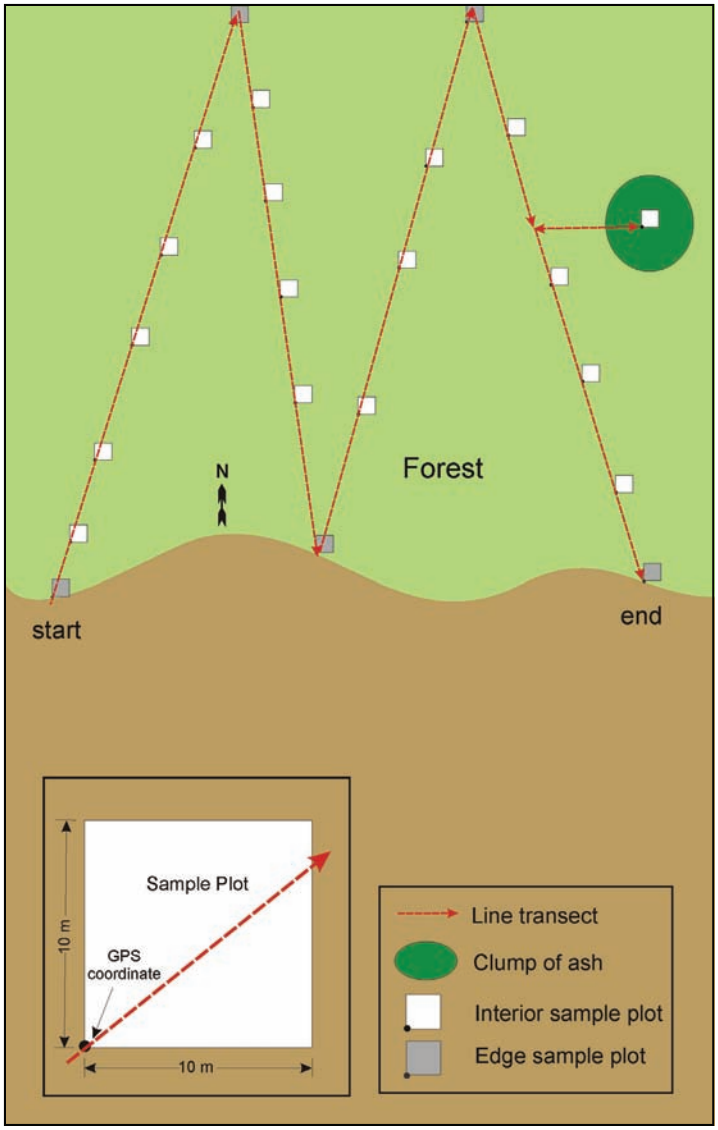


Fig. 28. Map showing the protocol for conducting a survey in a forested area.

ined. Crown conditions of ash trees are also examined at a distance while walking the transect lines. If signs and symptoms are observed, these trees should be closely examined. If aerial photographs or aerial reconnaissance pinpointed areas of high ash density, sample plots must also be surveyed within these areas.

8.6 High Risk Site Survey Methods

High risk sites are areas adjacent to point sources with high or moderate probability of infestation. Surveys of these sites are based on the risk of potentially infested ash material (firewood, logs and nursery stock) being moved into a new area and becoming established in the environment.

High-risk sites include hardwood sawmills, firewood distributors and permanent RV parks. These sites pose a greater risk of introducing EAB and should be given high priority. Smaller rural communities that depend on firewood as their main source of heat should also be considered a reasonably high risk.

Moderate-risk sites include parks and campgrounds (conservation authority, private, provincial or national park) that firewood may be taken to, but is usually burned during the visit. Nurseries, tree farms and garden centres could also pose a risk.

Lists of potential risk-makers are available from a number of sources such as conservation authorities, wood-lot associations, campground groups, and even by looking in the Yellow Pages.

In the GIS, draw a 0.5-km diameter circle around a potential point source of infestation, with the centre of the circle located at the high risk point (Fig. 29). The centre or the circle is defined and located by its UTM coordinates. All ash trees within the circle are examined until a suspect tree is encountered and/or possible EAB specimens are collected for identification. If these trees/specimens prove to be negative, the remainder of the site should be surveyed at a later date.

8.7 Audit Survey

At irregular intervals a random selection of survey sites should be revisited by different crews and surveyed again. This provides a check of the efficiency and accuracy of the survey protocols allowing for future correction of surveying inadequacies.

9. Confirmation of Positive EAB Infestation

A site will only be declared “positive” upon confirmed identification of EAB life stages by staff of the CFIA Centre for Plant Quarantine Pests (CPQP). Without a positive identification of a life stage of EAB, the site will remain “suspect”. Staff in the field should not alert property owners or any

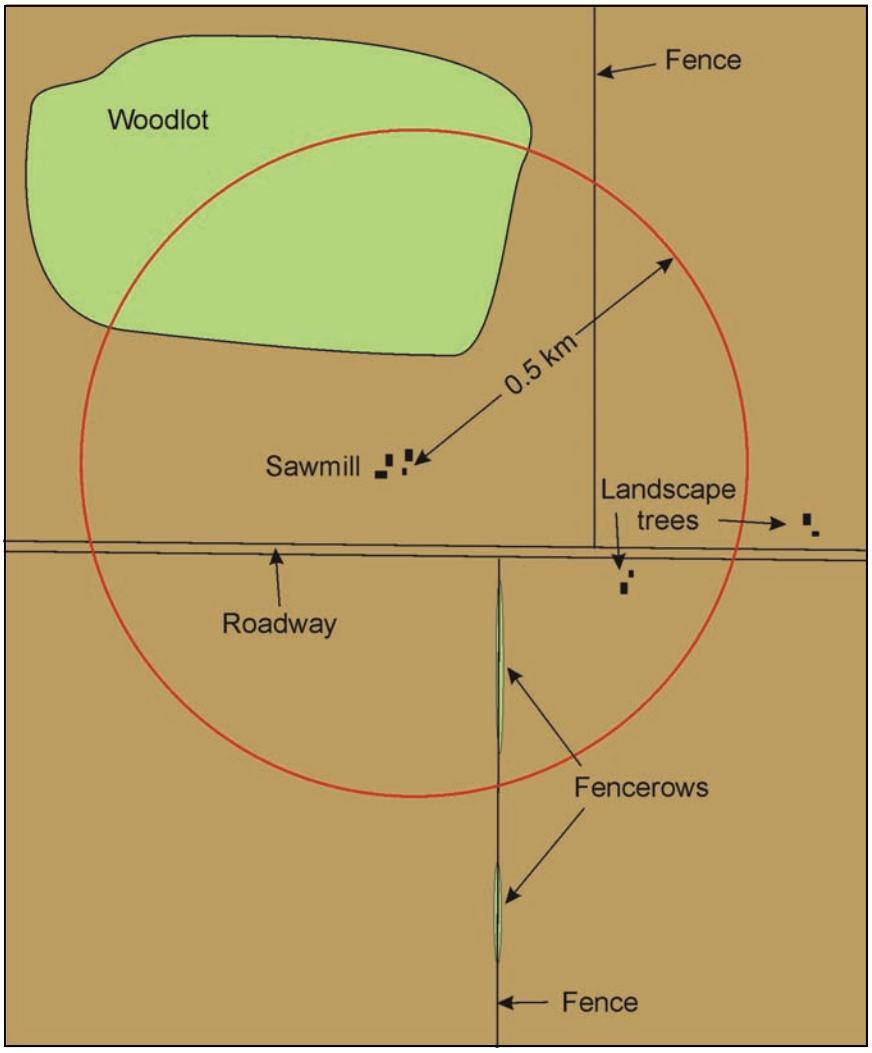


Fig. 29. Map showing the survey protocol for a high risk site.

other parties to the presence of the beetle without confirmation from CPQP.

9.1 Sample Collection, Preservation, Labeling and Shipping

All EAB suspect specimens and associated insect specimens will be preserved, labeled and shipped to CPQP for identification.

Adult beetles must always be immediately killed by placing them in a vial filled with 70% ethanol and tightly sealed. Live adults should never be transported from the suspected infestation site. Ideally,

larvae, prepupae and pupae should be heat-treated in near-boiling water as soon after collection as possible. Water can be heated on site using a portable coffee maker that plugs into the vehicle's cigarette outlet or auxiliary electrical jack. The water is heated to maximum temperature prior to immersing the insect specimen. The water-filled container is removed from the heat source and the insects are placed in the water for about one minute while the water is gently stirred a couple of times. The insects are placed directly into a vial of 70% ethanol upon removal from the water. If larvae, prepupae and pupae can not be processed in the field, they should be kept damp and cool prior to being preserved. These insects can be placed in vials or specimen jars with moist kimwipes or paper towels, securely sealed and transported in a cold cooler to the home office. Larvae, prepupae and pupae must be processed immediately upon return to the office using the same procedures outlined for field processing.

All specimens will be labeled as soon as they are collected. The labels must be written in pencil (preferably HB) and will contain the collection locale (both address and GPS coordinates), collection date, collector's name and Pest Identification Report (PIR) Number. Do not use ballpoint pen because the ink will dissolve in the alcohol. Labels must accompany the specimens throughout sample processing and must be placed inside the ethanol-filled vial. The vial is then tightly stoppered for shipment.

Preliminary identification may be made at the home office by inspection staff, but where EAB is suspected in a previously uninfested area, the Survey Coordinator must be notified immediately.

A completed PIR Form (Section 10.3) will accompany all specimens sent to CPQP for identification. Sample vials should be enclosed in sturdy shipping containers with adequate packing material to prevent breakage during shipping. All samples will be shipped by express courier to the Centre for Plant Quarantine Pests (CPQP) at the address below. Indicate "EAB Survey" on the sample box.

Canadian Food Inspection Agency
CPQP-Entomology
Rm. 4125, K.W. Neatby Building
960 Carling Avenue
Ottawa ON
K1A 0C6

9.2 VERIFICATION FEEDBACK

Once identification is completed by the entomological staff of the CPQP, a copy of the Pest Identification Report is returned to the submitting office with the results of the identification. The results of the identification and the CPQP Log Number are entered onto the Suspect/Positive Tree Form

(Section 10.2), the name and signature of the Supervisor verifying the identification are recorded, and the form is dated.

9.3 PHOTOGRAPHS

All suspect/positive trees and their signs and symptoms should be photographed with a digital camera. The first photograph in the series should show a card clearly labeled with the Site ID Number, Block ID Number, Date and Tree ID. All subsequent photographs until the next card image should be of the same tree. A profile view of the tree should be photographed from a distance to show the shape and condition of the crown and whether or not epicormic shoots are present. The entire tree should fill the photographic frame if possible. Galleries, emergence holes, and/or bark deformities should be photographed close enough to distinguish their shapes. A ruler should be placed in the photographic field so that the size of features can be determined from the photograph. All photographs should be downloaded from the camera to a computer at the end of the day and the photographs should be labeled with site identification information. Photographs should be stored and archived in the database/GIS and backed up on CD/DVD daily.

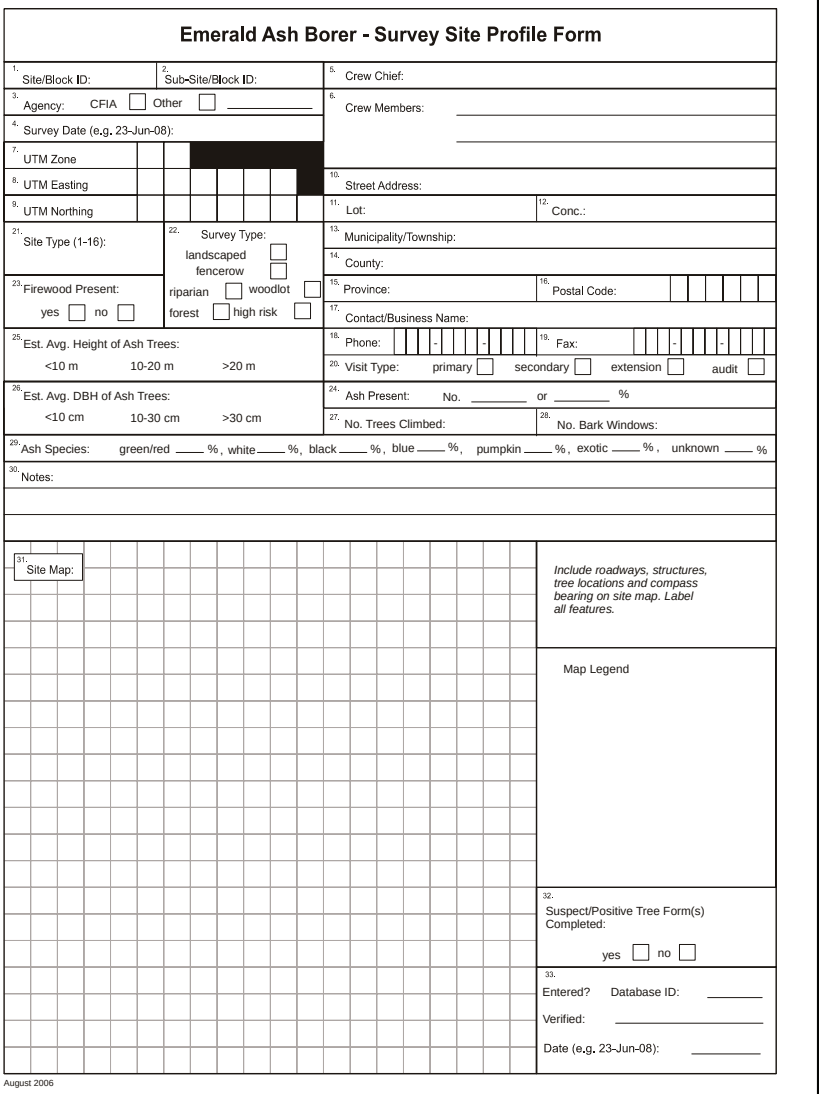
10. SURVEY FORMS

EAB survey data is captured on one of three data forms. The first form is used to document survey information for all sites visited. The second form is for survey locations that are suspect for the presence of EAB. The third form is the Pest Identification Report (CFIA / ACIA 1303). The latter is for submission of insect specimens from suspect trees to the taxonomic laboratory of the Centre for Plant Quarantine Pests for identification.

10.1 SURVEY SITE PROFILE FORM

The following data is entered into the Emerald Ash Borer – Survey Site Profile Form (Fig. 30). All sections should be completed if possible.

1. **Site/Block ID:** the unique Site or Block Identification Number (*e.g.*, 10019), as designated from the GIS/database.
2. **Sub-Site/Block ID:** the unique Sub-Site/Block Identification Number (*e.g.*, CK129), as designated for individual survey sub-blocks from the GIS or topographic maps.
3. **Agency:** the agency responsible for conducting the survey (*i.e.*, check CFIA or Other). If Other, then provide an acronym for the agency involved (*e.g.*, “OMNR”).
4. **Date:** the survey date in the format day, three-letter month abbreviation (*i.e.*, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec), year (*e.g.*, “23-Jun-08”).
5. **Crew Chief:** the first and last names of the person leading



Emerald Ash Borer - Survey Site Profile Form

1. Site/Block ID:
2. Sub-Site/Block ID:
3. Agency: CFIA ☐ Other ☐ _____
4. Survey Date (e.g. 23-Jun-08):
5. Crew Chief:
6. Crew Members:
7. UTM Zone
8. UTM Easting
9. UTM Northing
10. Street Address:
11. Lot:
12. Conc.:
13. Municipality/Township:
14. County:
15. Province:
16. Postal Code:
17. Contact/Business Name:
18. Phone: - -
19. Fax: - -
20. Visit Type: primary ☐ secondary ☐ extension ☐ audit ☐
21. Site Type (1-16):
22. Survey Type: landscaped ☐ fencerow ☐ riparian ☐ woodlot ☐ forest ☐ high risk ☐
23. Firewood Present: yes ☐ no ☐
24. Ash Present: No. _____ or _____ %
25. Est. Avg. Height of Ash Trees: <10 m 10-20 m >20 m
26. Est. Avg. DBH of Ash Trees: <10 cm 10-30 cm >30 cm
27. No. Trees Climbed:
28. No. Bark Windows:
29. Ash Species: green/red ___ %, white ___ %, black ___ %, blue ___ %, pumpkin ___ %, exotic ___ %, unknown ___ %
30. Notes:
31. Site Map:

Include roadways, structures, tree locations and compass bearing on site map. Label all features.

Map Legend

32. Suspect/Positive Tree Form(s) Completed: yes ☐ no ☐

33. Entered? Database ID: _____
Verified: _____
Date (e.g. 23-Jun-08): _____

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Fig. 30. Emerald Ash Borer—Survey Site Profile Form.

the survey crew.

6. **Crew Members:** the first and last names of all the members of the survey crew.
7. **UTM Zone:** the Universal Transverse Mercator (UTM) zone number (*e.g.*, 17).
8. **UTM Easting:** the six digit

UTM easting value from the GPS unit (NAD83).

9. **UTM Northing:** the seven digit UTM northing value from the GPS unit (NAD83).
10. **Street Address:** the street address of the property being surveyed. For rural dwellings and buildings, this may include the emergency (911) numbers. For rural addresses this should include the highway/road or concession/line name.
11. **Lot:** the lot number for rural properties (*e.g.*, 3).
12. **Conc.:** the concession number for rural properties (*e.g.*, IV).
13. **Municipality/Township:** the municipality or township name.
14. **County:** the county name.
15. **Province:** the province name or abbreviation (*e.g.*, ON).
16. **Postal Code:** the six character postal code in spaces provided (*e.g.*, P0R1G0).
17. **Contact/Business Name:** the first and last names of the resident or manager of the property being surveyed and/or the name of the business.
18. **Phone Number:** the complete phone number of the contact person, including area code, in space provided.
19. **Fax Number:** the complete fax number of the contact person including area code in space provided.
20. **Visit Type:** select the type of visit being performed. If this is the first visit to the site as part of a general area-wide survey check "primary", if this is a repeat visit to the site check "secondary", if the survey is the result of an inquiry from the property owner/manager check "extension", or if this survey is for the purposes of conducting an audit on a property previously surveyed check "audit".
21. **Site Type:** select one of sixteen site type codes (Table 2).
22. **Survey Type:** select one of six survey types (Section 8) (*i.e.,* landscaped, fencerow, riparian zone, woodlot, forest or high risk).
23. **Firewood Present:** indicate whether or not firewood is present on the property.
24. **Ash Present:** note the number and/or percentage of trees on the property/plot that are ash.
25. **Est. Avg. Height of Ash Trees:** note the estimated

Table 2. Site Type Codes

1. public park
2. residence
3. campsite
4. woodlot
5. fencerow
6. other
7. sawmill/ log yard
8. firewood vendor
9. golf course
10. landscaper
11. nursery
12. municipality
13. tree service
14. plantation
15. creek/river
16. road side

average heights in metres of the ash trees on the property/ plot (*i.e.*, circle one of "<10 m", "10-20 m", or ">20 m").

26. **Est. Avg. DBH of Ash Trees:** indicate the estimated mean diameter at breast height (DBH) in centimetres of the ash trees on the property/plot (*i.e.*, circle one of "<10 cm", "10-30 cm", or ">30 cm").
27. **No. Trees Climbed:** write in the number of ash trees climbed using climbing poles to examine above ground portions.
28. **No. Bark Windows:** record the number of windows cut into the bark to reveal the sapwood while searching for galleries.
29. **Ash Species:** record the percentage of each individual ash species on the property.
30. **Notes:** note miscellaneous information about the property/plot (*e.g.*, 'large dog', 'bull in field', 'owner requested information', etc.).
31. **Site Map:** draw a map of the property/plot being surveyed, indicating structures, roadways (with names), woodpiles, ash trees, etc.
32. **Suspect/Positive Form(s) Completed:** indicate whether or not a Suspect/Positive Tree Form was completed.
33. **Entered?** a signature is provided verifying that the data has been entered into the database/GIS system and a data entry date in the format: day, three-letter month abbreviation, year (*e.g.,* 23-Jun-08) is recorded. A Database ID is also entered at this time.

10.2 SUSPECT/POSITIVE TREE FORM

If you believe that a tree(s) is/are infested, take the exact coordinates (GPS-UTM), complete the Suspect/Positive Tree Form (Fig. 31), and if possible, take digital or other photographs. Pass this information on to the supervisor as soon as possible.

The following data is entered into the Emerald Ash Borer – Suspect/ Positive Tree Form. All sections should be completed if possible.

1. **Site/Block ID:** the unique Site or Block Identification Number (*e.g.*, 10019), as designated from the GIS/database.
2. **Sub-Site/Block ID:** the unique SubSite/Block Identification Number (*e.g.*, CK129), as designated for individual survey sub-blocks from the GIS or topographic maps.
3. **Date:** the survey date in the format: day, three-letter abbreviation of the month (*i.e.*, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec), year (*e.g.*, 23-Jun-08).
4. **Ash Species:** the species of the suspect/positive tree.
5. **Tree Height:** the height in metres of the suspect/positive tree.
6. **Tree DBH:** the diameter at breast height (DBH) in centimeters of the suspect/positive tree.

Emerald Ash Borer - Suspect/Positive Tree Form

1. Site/Block ID: | 2. Sub-Site/Block ID: | 3. Date (e.g. 23-Jun-08):

Tree Description

4. Ash Species: green/red ☐ white ☐ black ☐ blue ☐ pumpkin ☐ exotic ☐ unknown ☐

5. Tree Height (m): _____ | 6. Tree DBH (cm): _____

10. Tree Felled/Removed: yes ☐ no ☐

11. Bark Stripped: yes ☐ no ☐

Tree Location

7. UTM Zone

8. UTM Easting

9. UTM Northing

12. Photographs: yes ☐ no ☐

Signs and Symptoms

	nil	low	mod.	high	
13. Crown Dieback/Chlorosis:	☐	☐	☐	☐	percentage of crown: _____ %
14. Epicormic Shoots:	☐	☐	☐	☐	
15. Woodpecker Feeding:	☐	☐	☐	☐	
16. Bark Deformities:	☐	☐	☐	☐	cracking ☐ swelling ☐ staining ☐ height (m): ____
17. Adult Foliage Feeding:	☐	☐	☐	☐	
18. Emergence Holes:	☐	☐	☐	☐	no. new ____ no. old ____ compass direction(s): ____ height(s) (m): ____
19. Larval Galleries:	☐	☐	☐	☐	no. new ____ no. old ____ compass direction(s): ____ height(s) (m): ____

Life Stages

	No. observed	No. collected	
20. Adult(s):	_____	_____	
21. Larva(e):	_____	_____	instar(s): I _____ II _____ III _____ IV _____
22. Prepupa(e):	_____	_____	no. in bark ____ sapwood ____ bark thickness (mm): _____
23. Pupa(e):	_____	_____	no. in bark ____ sapwood ____ bark thickness (mm): _____
24. Other Borer(s):	_____	_____	

25. Specimen(s) Shipped: yes ☐ no ☐ No. _____ | 26. PIR No.:

27. Notes:

28. Tree Sketch:

29. Positive EAB Identification Confirmed? yes ☐ no ☐

Name: _____

Signature: _____ CPQP Log No.: _____

Date (e.g. 23-Jun-08): _____

Sketch Legend

30. Entered? Database ID: _____

Survey Site Profile Form Database ID: _____

Name: _____

Signature: _____

Date (e.g. 23-Jun-08): _____

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Fig. 31. Emerald Ash Borer — Suspect/Positive Tree Form.

7. UTM Zone: the Universal Transverse Mercator (UTM) zone number (*e.g.*, 17).

8. UTM Easting: the six digit UTM easting value from the GPS unit (NAD83) recorded at the suspect/positive tree.

9. UTM Northing: the seven

digit UTM northing value from the GPS unit (NAD83) recorded at the suspect/positive tree.

10. **Tree Felled/Removed:** whether or not suspect/positive tree was cut down and removed/destroyed.
11. **Bark Stripped:** whether or not the bark was stripped from the suspect/positive tree in search for EAB galleries/life stages.
12. **Photographs:** whether or not photographs were taken of the suspect/positive trees.
13. **Crown Dieback/Chlorosis:** a subjective estimate of the degree (*i.e.*, nil, low, moderate, high) of crown dieback or chlorosis and the percentage of the crown involved.
14. **Epicormic Shoots:** a subjective estimate of the number (*i.e.*, nil, low, moderate, high) of epicormic shoots.
15. **Woodpecker Feeding:** a subjective estimate of the degree (*i.e.*, nil, low, moderate, high) of woodpecker feeding.
16. **Bark Deformities:** a subjective estimate of the degree (*i.e.*, nil, low, moderate, high) of bark deformities, one or more types of the deformities (*i.e.*, cracking, swelling, staining) and the estimated height of the deformities in metres.
17. **Adult Foliage Feeding:** a subjective estimate of the degree (*i.e.*, nil, low, moderate, high) of adult maturation feeding on the foliage.
18. **Emergence Holes:** a subjective estimate of the number (*i.e.*, nil, low, moderate, high) of emergence holes of EAB, number of holes that are new or old, their height range above the ground and the compass direction(s) in which they occur.
19. **Larval Galleries:** a subjective estimate of the number (*i.e.*, nil, low, moderate, high) of larval galleries of EAB, number of galleries that are new or old, and the compass direction(s) in which they occur on the tree (*e.g.*, N, SW, NE, all) and their height range above the ground .
20. **Adult(s):** the number of EAB adults observed and/or collected.
21. **Larva(e):** the number of EAB larvae observed and/or collected, and the instar distribution (Section 4.3) of larvae collected.
22. **Prepupa(e):** the number of EAB prepupae (Section 4.4) observed and/or collected, the location of the prepupae (*i.e.*, number in the bark or in the sapwood), and the thickness of the bark where the prepupae are found.
23. **Pupa(e):** the number of EAB pupae (Section 4.5) observed and/or collected, the location of the pupae (*i.e.*, number in the bark or in the sapwood), and the thickness of the bark where the pupae are found.
24. **Other Borer(s):** the number of other wood-boring insects associated with infestations of EAB that were observed and/or collected.

25. **Specimen(s) Shipped:** whether or not collected specimens were shipped to the CPQP for identification and the number of specimens shipped.
26. **PIR No.:** the Pest Identification Report number assigned to the specimens shipped to the CPQP for identification.
27. **Notes:** any relevant information about the suspect/positive tree that is not captured elsewhere on the form.
28. **Tree Sketch:** the profile of the suspect/positive tree should be sketched showing the major branch configuration and relative positions of the observed signs and symptoms.
29. **Positive EAB Identification Confirmed?** whether a positive a negative species identification is received from the CPQP. A supervisor's name and signature are entered for verification when completed and a date in the format: day, three-letter month abbreviation, year (*e.g.*, 23-Jun-08) is entered. The CPQP Log Number from the completed and returned PIR is recorded.
30. **Entered?** a name and signature are entered for verification when the data has been entered in the database/GIS system and the data entry date in the format: day, three-letter month abbreviation, year (*e.g.*, 23-Jun-08) is recorded. The Database ID is assigned and entered here. The Database ID for the corresponding Survey Site Profile Form should also be entered here.

10.3 Pest Identification Report (CFIA / ACIA 1303)

A Pest Identification Report (PIR) form (Fig. 32) is completed for each sample vial to be submitted for identification. A paper label with the PIR number, date and location of collection, written in pencil, is placed in each vial. On each PIR form, indicate in the appropriate boxes the following information:

- **Report No.:** this is the unique number generated by the submitting office. Incorporated in the number should be a two-letter code for the originating office and a sequential number for the individual sample. The sample year should also be incorporated in the code (*e.g.*, LO-05-1332 for sample 1332 submitted from the London Office in 2005).
- **Office:** the location of the submitting office.
- **Collection Date:** the collection date in the format: day, three-letter abbreviation for the month (*i.e.*, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec), year (*e.g.*, 23-Jun-08).
- **Collector:** the first and last names of the collector.
- **Project:** the project name (*i.e.*, EAB Survey)
- **Program Officer:** the first and last names of the reporting supervisor.
- **Name and Address of Im-**

Canadian Food Inspection Agency / Agence canadienne d'inspection des aliments

PEST IDENTIFICATION REPORT / **RAPPORT D'IDENTIFICATION D'ORGANISME NUISIBLE**

Contract No. / N° de contrat

Report No. / N° du rapport

Control-Invoice No. / N° de contrôle-facture

Office / Bureau | Results Required by / Date résultats requis | Collection Date / Date de collecte | Program Officer / Agent de programme

Collector / Echantillonneur | Project / Projet

Action Taken / Mesures prises: ☐ Detained / Retenu ☐ Treated / Traité ☐ Released / Libéré ☐ Returned / Renvoyé ☐ Destroyed / Détruit ☐ Other / Autre _____

Name and Address of Importer/Establishment / Nom et adresse de l'importateur ou de l'établissement

Permit No. / N° du permis

Name and Address of Exporter / Nom et adresse de l'exportateur

Intended Use / Usage prévu: ☐ Consumption / Consommation ☐ Propagation / Reproduction ☐ Other / Autre _____

Transport: ☐ Air / Par avion ☐ Sea / Mer ☐ Land / Terre ☐ Mail / Courrier

Where Intercepted / Lieu d'interception: ☐ Baggage / Bagage ☐ Cargo / Marchandise ☐ Holds / Cales ☐ Other / Autre Specify / Spécifiez _____

HOST / HÔTE	DESCRIPTION OF SAMPLE / DESCRIPTION DE L'ÉCHANTILLON	# of Units / # d'unités			Severity / Gravité		
		TOTAL	Inspected / Inspecté	Affected / Atteint	Light / Faible	Moderate / Modéré	Heavy / Elevée

☐ Fruit / Fruit ☐ Seed / Semence ☐ Leaf / Feuille ☐ Stem / Tige ☐ Bulb/Tuber / Bulbe/Tubercule ☐ Root / Racine ☐ Soil / Terre ☐ Other / Autre _____

REASON FOR SUBMISSIONS/COMMENTS - RAISON DE PRÉSENTATION DE L'ÉCHANTILLON/COMMENTAIRES

☐ Nematode / Nématode
☐ Insect / Insecte
☐ Mollusc / Mollusque
☐ Disease / Maladie
☐ Other (specify) / Autre (spécifiez)

LABORATORY REPORT / RAPPORT DE LABORATOIRE | Reception Date / Date de la réception | Log No. / N° du registre

Signature of Lab Personnel / Signature du personnel de laboratoire | Date | Date of response / Date de la réponse

The information is collected by the Canadian Food Inspection Agency for the purpose of administering the *Plant Protection Act*. Information may be accessible or protected as required under the provisions of the *Access to Information Act*.

Les renseignements sont recueillis par l'Agence canadienne d'inspection des aliments afin de permettre l'application de la *Loi sur la protection des végétaux*. Les renseignements peuvent être accessibles ou protégés selon ce que prescrit la *Loi sur l'accès à l'information*.

CFIA / ACIA 1303 (2001/03)

Canada

Fig. 32. The Pest Identification Report (PIR) submitted with specimens for identification to the Center for Plant Quarantine Pests (CPQP) Laboratory.

porter/Establishment: the address of the property where the tree is located, from which the sample was collected.

- **Host:** the host tree species if known (*e.g.*, *'Fraxinus americana'* or 'white ash' or '*Fraxinus* sp.').
- **Description of Sample:** a description of the nature of the sample to be identified (*e.g.*, 'larvae in alcohol collected from galleries' or 'adults in alcohol collected from sticky bands on red ash tree')
- **Insect:** the box for insect must be checked.

11. GLOSSARY

bole – the main stem or trunk of a tree.

callus tissue – the scar-like tissue produced by a tree in response to a wound.

cambial layer – the very thin layer of cells between the bark (phloem and outer bark) and sapwood (xylem), from which the phloem and xylem develop.

detection survey – a survey designed to detect the presence (or absence) of an insect in a region it is not currently known to infest. This type of survey is generally less intensive than the delimitation survey.

diameter at breast height (DBH) – the diameter of the trunk of the tree measured 1.3 metres above the ground.

dieback – the progressive dying of the tree crown caused by disease or injury.

chlorosis – the yellowing of leaf tissue resulting from injury.

elytron (pl. elytra) – the hard thickened forewings of beetles that act as wing covers for the hind wings.

frass – excrement produced by feeding stages of insects.

instar – a developmental stage of some insect larvae the end of which is defined by a moult.

larva(e) – the active feeding stages in some insects during which the insect may moult several times and grow in size.

lenticel – spots (pores) on the bark of twigs used for respiration

petiolule – the leaflet stalk on a compound leaf.

phloem – the nutrient-conducting tissue in the trunk and branches of a tree, found under the outer bark.

prepupa(e) – a portion of the last larval stage in some insects during which some developmental changes take place in preparation for moulting into the pupa.

pronotum – the upper surface of the first thoracic segment (prothorax) behind the head in adult beetles. This segment contains the first pair of legs but not

wings.

pupa(e) – the developmental stage of some insects that follows the larval stage and precedes the adult stage.

samara – a winged tree fruit with a single seed, also known as a key.

sapwood – the outer portion of the woody tissue (xylem) of a tree branch or stem responsible for transportation of water from the roots to the leaves.

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