Emerald Ash Borer Program Manual

Agrilus planipennis (Fairmaire)

Marketing and Regulatory Programs

Animal and Plant Health Inspection Service

Cooperating State Departments of Agriculture

Emerald Ash Borer Program Manual, *Agrilus planipennis* (Fairmaire), ver. 1.6

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Purpose

The Emerald Ash Borer Program Manual contains information to guide a management program for the emerald ash borer (EAB) beetle, *Agrilus planipennis* (Fairmaire), (Coleoptera: Buprestidae).

The guidelines are intended to assist Plant Protection and Quarantine field operations and cooperators in implementing specific action plans to manage infestations and prevent the spread of EAB to other locations. This information provides strategies for detection and response to an infestation of EAB by presenting available information for implementing general and delimiting surveys, identification, regulatory, management, or containment procedures. Specific program activity should be based on information available at that time.

Plant Protection and Quarantine (PPQ) develops guidelines through discussion, consultation, or agreement with other Animal and Plant Health Inspection Service (APHIS) staff, State Plant Regulatory Officials (SPRO), U.S. Forest Service, Tribal governments, and other State and Federal agencies and cooperators directly involved in EAB management. The APHIS Emergency Response Programs Manual and other pest national response guidelines may be found at:

http://www.aphis.usda.gov/import_export/plants/manuals/emergency/index.shtml

Disclaimers

Document comprehensiveness: This document is not intended to be complete and exhaustive, but a foundation based on literature available to assist future EAB control efforts. As ongoing research and program efforts provide new information, the direction and strategies of the manual may change to reflect the best management practices for the control of EAB. For the latest updates on this pest, it is recommended to conduct periodic literature searches on the web and in other archives.
Commercial Suppliers or Products: References to commercial suppliers or products should not be construed as an endorsement of the company or product by the U.S. Department of Agriculture.

Program Safety

Safety of the public and program personnel has priority in preprogram planning and training, and throughout operations. Safety officers and supervisors must enforce on-the-job safety procedures.

Support for Program Decision-Making

The USDA APHIS PPQ Center for Plant Health, Science and Technology (CPHST) provides technical support, in consultation with other scientists, to emergency pest response program directors concerning risk assessments, survey methods, management strategies, regulatory treatments, and other aspects of the pest response program.

Systematic Placement

Phylum:	Arthropoda
Class:	Insecta
Order:	Coleoptera
Family:	Buprestidae
Genus:	*Agrilus*
Species:	*planipennis*
Entomological Author:	Fairmaire, Léon Marc Herminie

Approved Name: *Agrilus planipennis* (Fairmaire)

Synonyms: *Agrilus marcopoli* (Obenberger 1930)
Agrilus marcopoli ulmi (Kurosawa 1956)
Agrilus feretrius (Obenberger 1936)

Common Names: emerald ash borer (English)
agrile du frêne (French)
изумрудная ясеневая златка (Russian)

Background Information

Emerald ash borer (EAB) is a non-native phloem-feeding pest of North American ash trees. This devastating pest was first found in 2002 in North America where it was discovered in southeastern Michigan and adjacent areas in Windsor, Ontario, Canada. It is thought to have been introduced in the 1990's on solid wood packing material originating from Asia.

This extremely destructive beetle poses an enormous threat to all of North America's ash resources. Unlike many other wood boring beetles, EAB aggressively kills healthy and stressed trees; many dying within two to three years after becoming infested. Currently, EAB has no known effective natural enemies in North America. If it is not contained or its effects mitigated, this pest will continue to infest and kill all species of trees in the genus *Fraxinus*. The impact on ash in North America has been compared to the effects of chestnut blight and Dutch elm disease, which devastated rural and urban forests in the 20th century.

Historical Information

Upon initial detection in 2002, only two short papers occurred in the literature: Chinese Academy of Science (1986) and Yu (1992). These papers include brief morphology, biology, host range, and symptoms of infestation.

In 2002, shortly after EAB was confirmed as the cause of significant ash tree mortality observed in Detroit, Michigan, five counties were found to be infested and were placed under quarantine. Since that time, APHIS, U.S. Forest Service, State, and local cooperators have

conducted survey, control, and eradication activities. Efforts included imposing quarantines, conducting surveys, delimiting areas around confirmed infested sites, removing ash trees, and developing information which will support management efforts. Lack of effective survey and control technology made containment efforts challenging.

Intensive visual survey efforts in 2003 expanded this area by 12 additional counties in Michigan. After intensive survey efforts in northern Ohio, EAB was discovered in three counties. Additionally, due to a 2002 Michigan quarantine violation involving nursery stock, control actions were implemented in Maryland and Virginia in 2003.

Survey for emerald ash borer (EAB) has undergone an evolution of tactics, scope, and application since its discovery in 2002. Survey was originally based on visually detectable symptoms (exit holes, bark cracks, epicormic branching, woodpecker feeding sites, etc.) to determine presence or absence of EAB. Visual survey was applied at various levels of intensity and with various techniques (*e.g.*, ground surveys, ladders, climbing devices, bucket trucks). Overall results were poor and newly infested areas were often left undiscovered. It soon became apparent that destructive sampling of suspect trees was necessary.

Artificially stressed (girdled) trap trees offered an alternative to visual survey and were adopted program-wide in 2005. This technique was an improvement for defining or delimiting the extent of an EAB infestation and was used to evaluate areas treated for EAB (eradication cuts). Trap trees, however, are expensive to establish and evaluate, and offer liability problems for workers and the public. Uniformity of survey is also an issue because of difference in size, species, and locations of trees as well as methodology and timing of stressing prior to adult flight.

Continued developments in trap and lure design enabled the EAB Program to implement a survey based on attractant-baited traps in 2008. Traps offer several advantages over trap trees including lower cost, uniformity of sampling unit, greater safety, fewer logistical problems, and more precision in sampling. Based on the positive results and feedback from the trap-based 2008 through 2012 surveys, APHIS's 2013 EAB survey will again use the purple prism traps.

Beginning in 2012, trap placement was based on a survey sampling design developed in collaboration between the APHIS EAB Program and the U.S. Forest Service's Forest Health Technology Enterprise Team (FHTET). Beginning with the 2015 survey, the Center for Plant Health Science and Technology constructed an improved risk-based sampling design which employs several different models to achieve a

greater likelihood of detecting EAB. This computer-generated EAB survey sampling design product combines a scientific model of the likelihood of detecting EAB with historical program data and regulatory knowledge. Very simply stated, the survey sampling design model will pre-select geographic locations (cells) to deploy EAB traps resulting in the highest probability of pest detection.

As of February 2015, EAB infestations have been detected in 25 states; Arkansas, Colorado, Connecticut, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin. Strategies to manage the pest currently focus on survey activities using a detection tool, a trap, along with regulatory activities and public awareness campaigns to prevent human-assisted movement. Outreach efforts have emphasized "Don't Move Firewood", as firewood movement is a primary method of human-assisted spread for this pest. APHIS continues to identify effective tools to manage and control EAB populations and works to develop a biological control program.

Economic Impact

The eastern United States produces nearly 114 million board feet of ash saw timber with a value of $25.1 billion (McPartlan et al. 2006). White, black, and green ash make up over 7 percent of all hardwood species and 5.5 percent of all tree species in the northeastern United States and eastern Canada. The wood is used for a variety of applications including tool handles, baseball bats, furniture, cabinetry, solid wood packing materials, pulp, and paper. The continued spread of this pest threatens these resources and may permanently alter landscape ecosystems of the Midwest, which consists of up to 20 to 40 percent ash in some areas.

There is potential for extensive negative economic effects if this wood-borer were to become widespread in the United States. If left unchecked, EAB will continue to infest and destroy ash trees, resulting in the losses of millions of dollars to the lumber and nursery industries as well as urban communities. Preliminary findings by U.S. Forest Service estimate that EAB's potential impact to the national urban landscape is a potential loss of between 0.5 to 2 percent of the total leaf area (30-90 million trees) and a value loss of between $20-60 billion (McPartlan et al. 2006).

Infested States may experience significant economic losses in forest products if EAB spreads from the currently quarantined area. Quarantines imposed by State and Federal agencies have negative impacts on the nursery, landscaping, timber, recreation, and tourism industries which are economically important to the region.

In addition to its value to the timber industry and the forest ecosystem, ash is one of the most popular landscape trees because of its wide ecological amplitude and resistance to other pests. It is the most commonly planted tree in new residential and commercial developments.

In an economic analysis of EAB, Kovacs et. al. (2009) estimated that EAB could cause approximately $10.7 billion in additional costs to State and local governments and landowners to remove and replace dead and dying ash trees in urban and suburban areas over the next 10 years. This damage also causes intangible economic losses through higher residential cooling costs, diminished aesthetics, and a negative effect on property values.

Host Range

In North America, EAB is capable of infesting all ash trees in the genus *Fraxinus,* including green ash (*F. pennsylvanica*), white ash (*F. americana*), black ash (*F. nigra*), pumpkin ash, (*F. profunda*), blue ash (*F. quadrangulata*), and other native species in this same genus (MacFarlane and Meyer, 2005). An approximate natural range map of all ash species in North America can be found in Appendix D.

Chinese reports indicate that the species *F. chinensis* var. *chinensis, F. chinensis* var.*rhynchophylla,* and *F. mandshurica.* (Chinese Academy of Science 1986, Yu 1992) are native hosts in Asia.

In Japan, the reported host range includes Manchurian ash, (*Fraxinus mandshurica* var. *japonica*), Manchurian walnut (*Juglans mandshurica* var. *sieboldiana,* and var. *sachalinensis*), Japanese wingnut (*Pterocarya rhoifolia*) and Japanese elm (*Ulmus davidiana* var. *japonica*), (Akiyama and Ohmomo 1997, Sugiura 1999).

In 2014, EAB adult and larval specimens were collected from white fringetree (*Chionanthus virginicus)* in southern Ohio (Cipollini 2015). Further study is underway to determine the extent to which white fringetree is a suitable host for EAB.

There is an isolated reference to privet (*Ligustrum* spp.) being suitable for 1st stage larval development in a laboratory setting (Cappaert et al. 2005).

Geographic Distribution

Native distribution of EAB in Asia includes several provinces of China (Liaoning, Jilin, Heilingjiang, Inner Mongolia, Hebei, and Shandong), Korea, Japan, Taiwan, and a small area in adjacent Russia and Mongolia (US Forest Service 2008).

EAB is now considered established in portions of the United States and Canada. The most current map depicting the emerald ash borer infestation can be found at: http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/multistateeab.jpg

Biology

Current research suggests that EAB can complete either a one or two year life cycle. It has been observed that low density populations on vigorous ash trees tend to support a two year life cycle while stressed trees with higher larval population densities tend to support a one year life cycle (Cappaert et al. 2005). Effects on life cycle due to latitudinal and altitudinal variation are unknown at this time.

Life Cycle

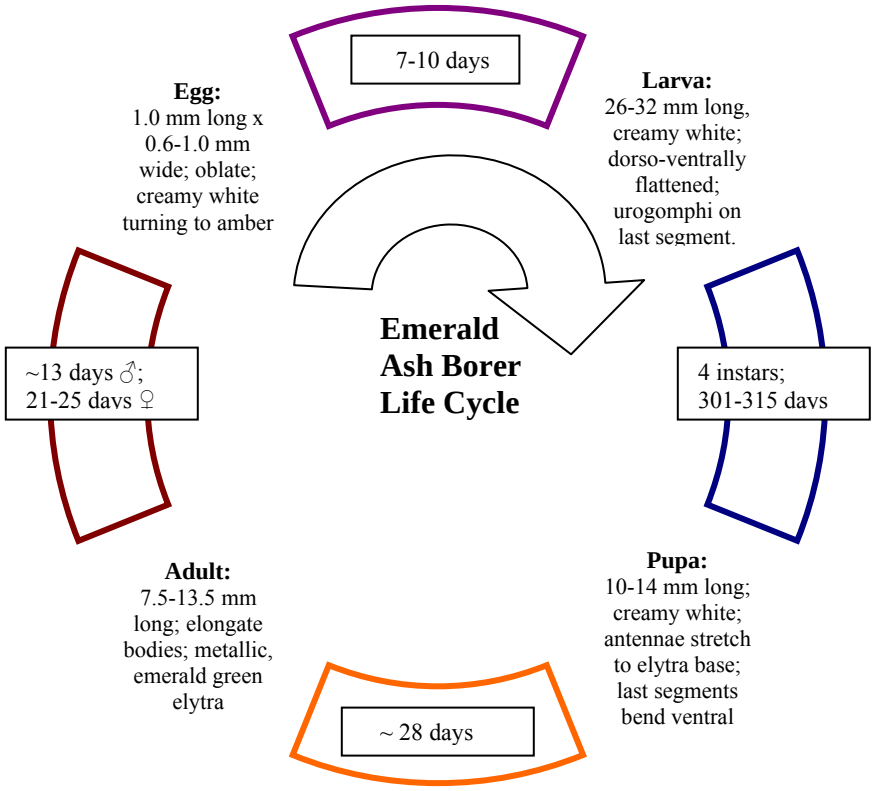


Figure 2.1 Emerald ash borer life cycle.

Eggs: This life stage is extremely difficult to visually detect during survey. Oviposition sites are likely to be correlated with the direction of sunlight, with the most eggs being laid on the southwestern side of the tree (Timms et al. 2006). Recent research indicates that females may prefer to lay eggs in areas where the bark is rough, cracked, or rippled, as may be found near branch crotches. The female may lay 1-23 eggs at a time, with one being the norm. Each female can lay 60-90 eggs in their lifetime, depositing them individually on the bark along the trunk and portions of the major branches. The eggs typically hatch in 7-10

days (Yu 1992).

Larva: Minute larvae bore through the bark and into the cambium where they feed on the phloem from late spring to early autumn. There are four stages to larval development (Cappaert et al. 2005). As they feed, the larvae create long serpentine galleries filled with frass, which enlarge in width as they grow. Larvae continue development into fall. Facultative diapause occurs after fourth instar larvae enter the sapwood or outer bark and excavate a pupal chamber where they overwinter as prepupae. Larvae too immature to prepupate spend the winter in the larval gallery and complete development the following spring. Larval galleries are typically 20-30 cm long.

Pupa: Pupal development is variable according to humidity and temperature. Pupation may begin upon the accumulation of 100-150 growing degree days and, in ideal laboratory conditions, pupal development typically takes approximately 4 weeks. After pupae transform into adults, the beetle takes 1 to 2 weeks before it emerges through D-shaped exit holes 3-4 mm wide. More research is necessary to fully understand pupal development.

Adult: Newly formed adults typically remain in the pupal chamber for 1-2 weeks after pupation is complete. Initial adult emergence predictively occurs when an accumulation of 400-500 growing degree days is achieved. Evidence of adult emergence appears in the form of a D-shaped exit hole 3-4 mm in diameter. Peak activity for adults is predicted to occur at approximately 1,000 growing degree days (McCullough and Siegert 2006). Adults are capable of immediate flight and, in laboratory conditions, adults mate shortly after emergence. An approximate 3 week period of maturation feeding occurs before oviposition. The adults feed on ash foliage, causing minimal damage. Adults may feign death when frightened or disturbed. They are phototactic and thermotactic and most active on warm, cloudless, windless days. Oviposition begins 7-9 days after the initial mating (Yu 1992). Average longevity for adult males is 13 days; average longevity for females is 22 days (Bauer et al. 2004, Lyons et al. 2004, Poland and McCullough 2006). *Agrilus planipennis* beetles are strong fliers, with females flying twice as far as males and mated females flying twice as far as unmated females. Tethered flight in laboratory conditions suggests that a mated female may fly more than 20 km (Taylor et al. 2006). Females may mate as many as 3 times with mating lasting 20-90 minutes (average of 60 min.).

Development

Many environmental factors can influence the development of insects, the timing of their biological events, and the dynamics of their populations. Among these factors are host availability, population

densities, photoperiod, and weather. Temperature and moisture, because they are so critical to biochemical reactions, are universal influences on egg, larval, pupal, and adult development in insects. Current research suggests initial adult emergence occurs when cumulative growing degree days reach 400-500 degree days with peak activity occurring at approximately 1,000 growing degree days. Temporal variation for these occurrences may exceed one month when considering latitudinal differences in the quarantine area.

Research is continuing in an effort to further understand EAB biology, including developmental thresholds on its life cycle.

Importance

Accurate identification of the pest is pivotal to assessing its potential risk, developing a survey strategy, and deciding the level and manner of control and/or management.

Authorities

For new detections in a State or county, the USDA APHIS PPQ National Identification Service must positively identify the suspect pest as *Agrilus planipennis* before consideration of any containment, control, or regulatory activities.

Identification

Some pre-identification and screening can be performed by field personnel assigned to the program if training is provided. A description of EAB, *Agrilus planipennis*, including distinctive features that separate it from native species that resemble it, with pictures, occurs below.

Description of the species, *Agrilus planipennis*

Eggs

Eggs are 1.0 mm long x 0.6 mm wide and oblate. They are creamy white turning to amber before hatching with a reductus extending radially toward the edges. Extremely difficult to observe with the naked eye.

Figure 3.1 *Agrilus planipennis* egg on bark. Photo: Houping Liu, www.forestryimages.org

Figure 3.2 *A. planipennis* egg cluster. Photo: David Cappaert, Michigan State University

Figure 3.3 Unhatched *Agrilus planipennis* neonate on bark. Photo: Houping Liu, www.forestryimages.org

Larvae

Larvae are creamy white, and dorso-ventrally flattened. They are 26-32 mm long when fully mature in the fourth instar. The small, brown head is mostly retracted into the prothorax with only the mouthparts remaining visibly externally. The prothorax is enlarged with the mesothorax and metathorax more narrow. The mesothorax and each of the first eight abdominal segments have a pair of spiracles.

Figure 3.4 Three instars of *A. planipennis* larvae. Photo: David Cappaert, Michigan State University

There are ten abdominal segments. The first abdominal segment shape varies considerably but can be distinctly rectangular to trapezoidal shaped. Segments A2 through A6 are somewhat trapezoidal with protruding flattened

Figure 3.5 Anterior abdominal segments. Photo: James Zablotny, USDA APHIS PPQ

lobes. A7 is strongly bell shaped and A8 is somewhat trapezoidal in shape. The last abdominal segment (A10) contains a pair of urogomphi. Emerald ash borer prepupae are more difficult to identify, being subtly different than less mature larvae, but A8 is still bell shaped.

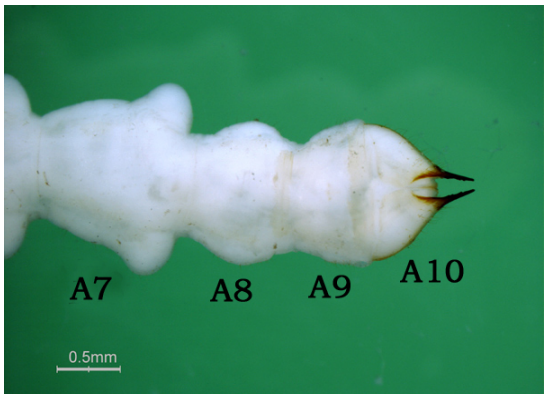


Figure 3.6 Posterior abdominal segments. Photo: James Zablotny, USDA APHIS PPQ

A larval screening guide comparing *Agrilus planipennis* to *A. anxius* may be found in Appendix L.

Pupae

Pupae are creamy white and 10-14 mm long. The antennae extend dorsally to the base of the wing buds. The posterior abdominal segments are slightly curved ventrally.

Fig 3.7 *Agrilus planipennis* prepupal stage

Figure 3.8 Pupal ventral and dorsal views Photo: Deborah Miller, USFS (NC)

Adults

Figure 3.9 *Agrilus planipennis* adult. Photo: David Cappaert, Michigan State University

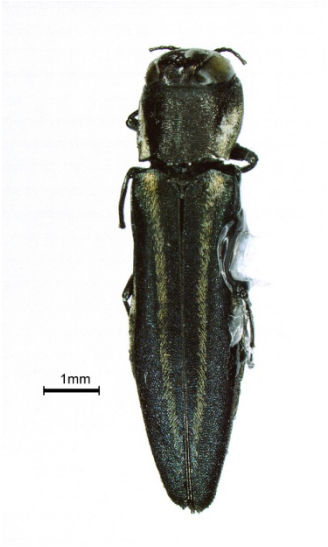
Adults have metallic (brassy or golden) green pronotum, with darker, metallic emerald green elytra and abdominal sternites. They may reach a length of 8.5-13.5 mm long and 3.1-3.4 mm wide. The cuneiform body is narrow and elongate. The abdominal tergites are metallic coppery red. The head is flat with the vertex shield shaped. The compound eyes are obscure-aeneous and kidney shaped. The rectangular prothorax is slightly wider than the head, but the same width as the elytra. The anterior margin of the elytra is raised, forming a transverse ridge; the surface is covered with punctures. The elytra's posterior margins are round and obtuse with small denticles on the edge. There is an emarginate pygidial spine.

Similar Species

Agrilus is one of the largest genera in the world with almost 3,000 described species. Species in this genus are difficult to identify because of structural coloration (*i.e.*, *Agrilus bilneatus* in Fig. 3.10 and Fig. 3.11) and subtle morphological differences.

In North America *Agrilus* also is a very diverse genus with 171 known species on this continent. North American species most similar to *Agrilus planipennis* are *A. anxius* (Weber) (Fig. 3.10), *A. bilineatus* (Weber) (Fig. 3.10 and Fig. 3.11), *Agrilus cyanescens* Ratzeburg (Fig. 3.11), *A. masculinus* Horn (3.12), *A. obsoletoguttatus* Gory, *A. subcinctus* Gory, and *A. vittaticollis* (Randall) (Fig. 3.12).

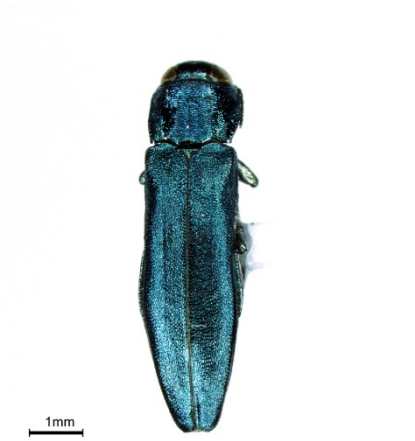
Agrilus anxius (Weber)



Agrilus bilineatus (Weber)

Figure 3.10 *Agrilus anxius* and *A. bilineatus* adults

Agrilus bilineatus (Weber)



Agrilus cyanescens Ratzeburg

Figure 3.11 *Agrilus bilineatus* and *A. cyanescens* adults

Agrilus masculinus Horn

Agrilus vittaticollis (Randall)

Figure 3.12 *Agrilus masculinus* and *A. vittaticollis* adults

The only other *Agrilus* species besides *Agrilus planipennis* known to occur on *Fraxinus* spp. in eastern North America is *Agrilus subcinctus*. The fact that *A. subcinctus* is a twig borer and prefers smaller branches for oviposition is a major behavioral difference between *A. subcinctus* and *A. planipennis*.

Collection and Preparation of Specimens

Collect as many specimens as possible of the pest for identification. Do not mix samples. Be sure to separate larvae into vials by tree or location. Use of entomological forceps is recommended in order to minimize damage to the specimen. Collect additional information as noted:

- Fill out PPQ 391.
- Gather the following information about the tree:
  - State
  - County
  - Date
  - GPS Coordinates
  - Tree Diameter at Breast Height (DBH)

Prepare specimens according to the following protocols.

- Any suspect Buprestidae adult or suspect adult EAB specimen collected from a trap in a **non-quarantined** county should be placed in a dry vial. Using Tanglefoot from the trap, stick the specimen to the side of the vial and/or gently pad with soft tissue placed into the vial on top of the specimen(s) to prevent damage during shipping.
- Suspect larvae/pupae from the same tree should be placed together into a vial separate from adult specimens. Do not insert larvae into alcohol at this time.
- Label the vial with the naming protocol: Year-collector initials-Month-Date (for example: 06-PDB-10-29)
- Larvae should be killed in boiling water, allowed to cool, and placed in 70% ethyl alcohol prior to shipping. (If guidance is needed on proper packaging to ship larvae in ethanol, please contact your local PPQ Safety Coordinator.)
- If there are too many larvae/pupae, extras may be placed in alcohol in larger container (labeled completely)
- Ship vials in a well-padded box (be aware of possible restrictions on shipping alcohol by air carriers).

Large specimens or small specimens that have been crowded into one vial should be transferred to fresh alcohol within a day or two to reduce the danger of diluting the alcohol with insect body fluids. If the alcohol becomes too diluted, the specimens may begin to decompose. It is recommended to place vials in a vapor lock bag to prevent leakage.

Screening for Suspect Buprestidae and Specimen Submission

Any suspect Buprestidae adult or suspect adult EAB specimen collected from a trap in a **non-quarantined** county should be placed in a dry vial. Using Tanglefoot from the trap, stick the specimen to the side of the vial and/or gently pad with soft tissue placed into the vial on top of the specimen(s) to prevent damage during shipping. Larval samples need to be shipped in a vial containing 70% ethanol. (If guidance is needed on proper packaging to ship larvae in ethanol, please contact your local PPQ Safety Coordinator.) All suspect specimens should be delivered to the State Plant Health Director or APHIS representative to be packaged and shipped to Dr. James Zablotny along with a completed "Specimens for Determination" PPQ form 391. Be sure to include any survey record number and/or GPS coordinates on the PPQ form 391 so identified specimens can be linked to survey records.

Dr. James Zablotny
USDA, APHIS, PPQ
11200 Metro Airport Center Drive, Suite 140
Romulus, MI 48174
Phone: 734-942-9005
E-mail: james.e.zablotny@aphis.usda.gov

Dr. Zablotny will make a determination and send specimens to the Systematic Entomology Laboratory (SEL), if necessary, for initial State detection confirmation.

Any suspect Buprestidae adult or suspect EAB specimen collected from a trap in a **quarantined** county should be placed in a dry vial. Using Tanglefoot from the trap, stick the specimen to the side of the vial and/or gently pad with soft tissue placed into the vial on top of the specimen(s) to prevent damage during shipping. Larval samples need to be shipped in a vial containing 70% ethanol. (If guidance is needed on proper packaging to ship larvae in ethanol, please contact your local PPQ Safety Coordinator.) All suspect specimens should be delivered to the State Plant Health Director or APHIS representative to be packaged and shipped to Mr. Bobby Brown along with a completed "Specimens for Determination" PPQ form 391. Be sure to include any survey record number and/or GPS coordinates on the PPQ form 391 so identified specimens can be linked to survey records.

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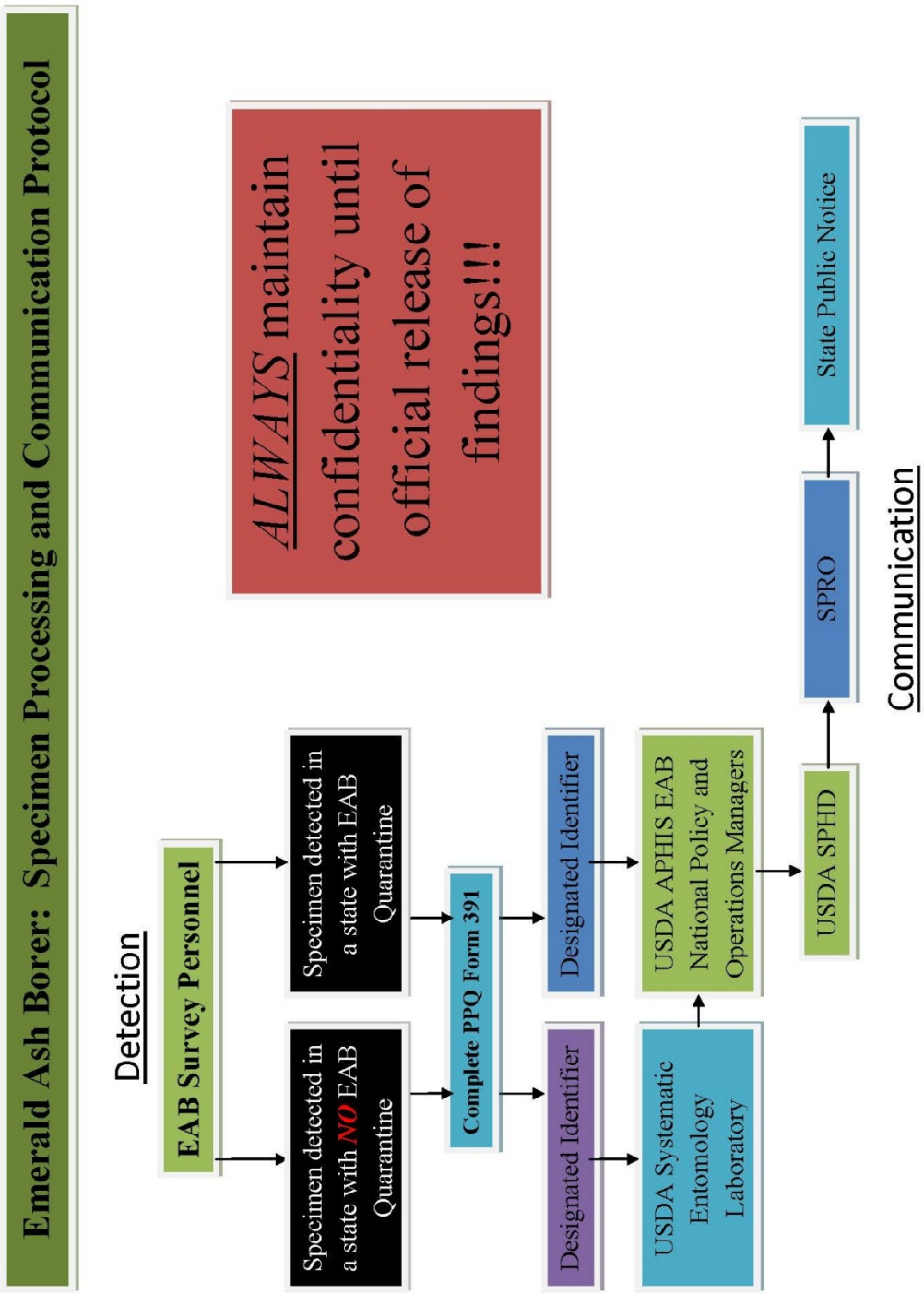


Figure 3.13 Emerald Ash Borer: Specimen Processing and Communication Protocol.

Introduction

Emerald ash borer (EAB) is a difficult pest to detect during early stages of infestation. Following introduction, visual signs or symptoms of infestation are often not observed for 3-5 years. When obvious visual signs of infestation (e.g., D-shaped holes, bark splits, crown dieback) are observed the possibility of eradication is remote. The EAB Decision Framework is an overview of what to expect and procedures to generally follow when a state's initial infestation is detected.

Consultation

It is imperative for the State Plant Regulatory Official (SPRO), State Plant Health Director (SPHD), and local officials to understand the initial steps to be taken when a new state detection is confirmed. Early in the identification and confirmation cycle discussions regarding possible regulatory actions and operational activities should be held with the National Operations Manager in order to coordinate all involved parties on these issues.

New State Detection

Development of lure-baited traps has provided a method of detecting the presence of EAB. In addition, outreach efforts have educated the general public on the identification of signs and symptoms of EAB infestation. New state detections may be identified in a variety of ways:

a. Caught in a baited trap
b. Reported by local government official, arborists, industry, general public, etc.

Identification by APHIS Identifier

Collected suspect is submitted to the APHIS Identifier along with PPQ Form 391 (See Fig. 3.13). A suspect identified as EAB is then forwarded to the USDA Systematic Entomology Laboratory (SEL) for confirmation. Negative findings will be communicated to the submitter.

Confirmation by SEL

Notification of SEL confirmation of EAB is forwarded to Domestic Diagnostics Coordinator with USDA APHIS PPQ National Identification Service (NIS). NIS then notifies Emergency and Domestic Programs Staff who in turn notify the respective SPRO and SPHD and other involved parties.

Public Declaration and SPRO Memo

Making the first public announcement of the new find is an option available to the affected State. A discussion is held with the National Policy Manager, National Operations Manager, and the SPHD and SPRO in the affected State to determine if the State would like to provide first notice and to discuss the timing of State and Federal notices of the new detection. PPQ's Deputy Administrator confers with the senior State agriculture official prior to release of the SPRO memo.

Radial Delimiting Survey

An initial visual delimiting survey of infestations accompanied by close inspection and/or destructive sampling of trees exhibiting obvious signs (*e.g.*, D-shaped exit holes, epicormic sprouting, crown dieback, serpentine galleries, bark splits, woodpecker damage) should be conducted. This initial survey is intended to provide a preliminary sense of the size and scope of the infestation. A more intensive follow-up survey strategy will be developed in consultation with EAB Program Management.

Survey Data

Compilation of the number of infested trees, larvae, prepupae, and adults and plotting the location where each was found on a map will aid in indicating epicenter and extent of the new infestation. This data should be input to the Survey Data Sheet for IPHIS. Inspecting in and near high risk facilities such as campgrounds, sawmills, new construction (nursery stock) may aid in determining the origin of the infestation.

Community Management Plan

Since cost effective control options to eradicate or prevent dispersal are not available at this time, it is recommended that authorities plan and prepare for an infestation of emerald ash borer.

Examples of preparedness or response plans for states may be found at:

http://www.emeraldashborer.info/communityplan.cfm

Biological Control

An EAB rearing facility for biological control agents has been established at the APHIS facility in Brighton, Michigan. Tools and techniques for rearing and releasing natural enemies of EAB are refined at this location with the goal of distribution of parasitoids to other states.

Stingless parasitoid wasps are currently under evaluation by APHIS. These parasitoids are known to attack EAB in its native range in China.

Small-scale trial releases were performed in 2007, 2008 and, 2009. Program releases and more research releases of larger numbers were conducted in 2010-2014. Release sites are monitored for establishment of the natural enemies and evaluated for their potential to control and slow the dispersal of EAB to other states.

Eradication

The Emerald Ash Borer Program has transitioned from an eradication program to an integrated pest management (IPM) program. Effective and cost efficient control and eradication technologies are not currently available. In the future, additional tools and strategies may become available to suppress the dispersal of this pest. Program partners are conducting extensive research to provide additional IPM tools and methodologies.

Currently

The National EAB Program conducts a detection survey which utilizes baited traps in 36 states. Beginning in 2015, trap placement was based on a survey sampling design developed in collaboration between the APHIS EAB Program and the Center for Plant Health Science and Technology with support from the U.S. Forest Service. This risk-based computer-generated EAB survey sampling design product combines a scientific model of the likelihood of detecting EAB with historical program data and regulatory knowledge. Work is currently underway to assess data from past surveys in order to improve and enhance detection survey work in upcoming years.

Long Range Management Options

Continued regulation and outreach are currently the most effective tools to prevent the dispersal of EAB. In the near future, biological control agents should begin to reduce and manage EAB populations. Ongoing research into promising new tools will help to prevent dispersal through development of more effective traps, a more attractive lure, and one or more effective pesticides.

Introduction

Surveys support the program by providing information on the location, distribution, and movement of EAB. Surveys also function as a delimiting tool to estimate the scope and extent of current EAB infestations. Survey information provides the basis for management decisions and provides continuous assessment of the effectiveness of the quarantine and control activities.

Trace Back and Trace Forward Investigations

Surveys are conducted to find new infestations and determine the extent of a known infestation. In the course of conducting surveys or carrying out regulatory activities, investigations of the movement of potentially infested articles can also be considered a survey activity. Trace back investigations are conducted to try to determine the source of an infestation and trace forward investigations help determine if further spread occurred due to movement of infested host material or means of conveyance.

Activities that may require investigations in the EAB program include the movement of nursery stock, logs, lumber, wood chips, pallets or firewood.

General Detection Surveys

The purpose of a general detection survey is to determine if a pest exists in an area. Positive results indicate that a pest is present. Lack of a positive result is valuable for providing clues to dispersal, temporal, or spatial activity patterns of pests particularly when considered with positive results from similar areas or proximities.

The current program survey method for *Agrilus planipennis* is the selection of locations for the placement of panel traps using the CPHST's risk-based model. Attractant-baited traps offer several advantages over previous detection methods including lower cost, uniformity of sampling unit, safety, fewer logistical problems, and more precision in sampling.

Destructive sampling may be used to recover increment cores or cross-sections from suspect trees identified from visual surveys for purposes of a dendrochronology study.

Attractant-baited traps have been determined to be the most effective and operationally efficient method of survey (Marshall et al. 2009, Francese et al. 2006, Francese et al. 2013). Aerial survey and remote sensing have not proven to be an efficient method of survey for EAB at this time.

Activities for conducting general surveys include:

- Planning, prioritizing, and procuring equipment and supplies for survey activities
- Developing or adapting existing protocols to meet new or unusual site-specific program needs
- Assisting scientists with the development and evaluation of new or improved survey protocols
- Following procedures for reporting new infestations and prompt specimen identification
- Maintaining survey records and maps
- Reporting survey results to management officials in a timely fashion

Many EAB infestations have been found by the public. As such, a strong outreach program is crucial for survey to be utilized efficiently. For current information on survey protocol, please consult the USDA Survey Guidelines located at: http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/survey_guidelines.pdf

Visual Survey

Although visual survey is not recommended as a primary survey tool for early detection, it can be helpful in locating older infestations. The EAB Program uses visual survey to rapidly assess new infestations. Visible symptoms are difficult to identify in early infestation stages with no visible symptoms in the first year of infestation. Visual survey will generally only detect trees that have been infested for three or more years. Early stages, which show few signs of infestation, will not be detected by visual survey alone. Traps are most effective in detecting earlier stage infestations (Marshall, 2009). On larger trees, symptoms may be present only in the upper canopy in the early stages of infestation.

Trees in a state of decline or with a combination of other symptoms should be examined more closely utilizing a destructive sampling technique. If no life stages, exit holes, or serpentine galleries under bark are found, the tree will be considered negative for data recording purposes.

Symptoms of EAB Infestations

Symptoms of *Agrilus planipennis* infestation to be alert for when conducting visual surveys include:

- Canopy stress/dieback


- Epicormic shoots/suckering


- Bark splits with larval galleries underneath


Figure 5.1 Symptoms of EAB on *Fraxinus* spp.

- Woodpecker Damage


- D-shaped exit holes (3-4 mm diameter)


- Serpentine larval galleries

Figure 5.2 Symptoms of EAB on *Fraxinus spp.*

Delimiting Survey

Delimiting surveys should be designed in consultation with program managers and other relevant experts. Factors to be considered include time of year and the availability of manpower, traps, and other necessary resources

The purpose of a delimiting survey is to gather population density and dispersal information that will assist in planning a strategy for management.

1) After detecting adult EAB(s) in traps or finding an infested tree, conduct a visual survey until symptomatic trees are no longer found. Continue visual survey for a distance of two miles beyond the initial trap capture or infested tree detection.

2) Determine the age of the infestation through utilization of the APHIS PPQ Dendrochronology Laboratory in Brighton, MI.

After completion of the visual survey, measure the distance between the two infested trees with the greatest separation. This distance will serve as the buffer zone measurement to create an exclusionary zone void of traps surrounding the infestation. A systematic grid of traps starting at the outside boundary of the exclusionary zone and extending for one mile in radius for every year that the infestation was determined to have existed and then add one additional mile.

> Example: Aging of the infestation indicates that it is three years old. From the last infested tree determined from visual survey, draw a band four miles wide (3 years + 1 mile) around the infestation and survey the area with program traps.

It is recommended trap deployment should be conducted with eight traps placed per square mile where ash trees are accessible. If a candidate area is devoid of ash, the area should be omitted. Exceptions to setting traps in only ash trees include areas where volumes of potentially infested logs and/or firewood were introduced to the site.

If additional personnel are to be used, a training session for all participants should be organized. Information covered should include recognition of EAB life stages, damage symptoms, ash tree identification, description of infested sites, survey methods, data collection protocols, and safety considerations.

Destructive Sampling	Destructive sampling of standing trees should be limited to specific trees displaying two or more symptoms of EAB in an uninfested county.
Monitoring Survey	The purpose of a monitoring survey is to evaluate the effectiveness of an action to contain or suppress EAB. Use the same survey tools specified for delimiting surveys.
Survey Sample Collection	Please refer to instructions provided in Section 3. Identification.
Quality Control for Survey Activities	Survey activities will be subjected to quality control monitoring. Quality control techniques will include resurvey of a percentage of the sites, analysis of survey data, and by direct observation. Other methods to assure sensitivity and selectivity, as well as the quality of the techniques employed, should be developed.

Instructions To Officers

Officers must monitor and certify regulatory treatments or other procedures when authorizing the movement of regulated articles. Only authorized treatments may be used in accordance with agency manuals and/or labeling restrictions.

Authorities

The Plant Protection Act of 2000 (Statute 7 USC 7701-7758) provides authority for implementation of emergency quarantine action. This provision is for interstate regulatory action only; intrastate regulatory action is provided under state authority. State departments of agriculture normally work in conjunction with federal actions by issuing their own parallel hold orders and quarantines for intrastate movement.

Emerald ash borer is not considered an extraordinary emergency as defined by the Plant Protection Act. However, if the U.S. Secretary of Agriculture determines that an extraordinary emergency exists and that the measures taken by the state are inadequate, USDA can take intrastate regulatory action provided that the governor of the state has been consulted and a notice has been published in the *Federal Register*. If intrastate action cannot or will not be taken by a state, then PPQ may find it necessary to quarantine an entire state.

The Federal Emerald Ash Borer (EAB) regulations (7CFR 301.53) provide the authority to establish quarantines and conduct regulatory activities. In addition to the Federal Quarantine(s), individual states have established state quarantines regulating intrastate movement of regulated material in accordance with federal regulations.

PPQ works in conjunction with states' department of agriculture to conduct surveys, enforce regulations, and implement control actions. PPQ employees must have permission of the property owner before entering private property. Under certain situations during a declared extraordinary emergency or if a warrant is obtained, PPQ can enter private property in the absence of owner permission. PPQ prefers to work with the state to facilitate land access. However, each state government has varying authorities regarding entering private property. A general Memorandum of Understanding (MOU) developed between PPQ and each cooperating state refers to how cooperative program activities are conducted. For clarification, check with your USDA Operations Manager, State Plant Health Director (SPHD) or State Plant Regulatory Official (SPRO) in the affected state.

Regulating the Spread of EAB

The rate of natural dispersal by adult flight of *Agrilus planipennis* is estimated to range from as little as 800 meters (Taylor et al, 2004) to as much as 9.84 km per year (Taylor et al, 2006). However, unpublished data also suggests that this rate may be much higher and variable due to

environmental factors and insect population density. Tethered flight in laboratory conditions suggests that a mated female may fly more than 20 km (Taylor et al. 2006). Human-assisted dispersal of EAB can be much greater and is the primary reason for establishment of satellite populations. Regulatory measures are necessary to prevent human-assisted spread through the transportation of EAB in firewood, logs, timber, and other host materials. Quarantine regulations typically prohibit the movement of potentially infested host material out of the infested area or require treatments, inspections, or other mitigating measures.

Regulated Articles

Regulated articles for *Agrilus planipennis* include:

1. The emerald ash borer (all life stages)
2. Firewood: all non-coniferous species
3. Nursery stock, green lumber, and other material living, dead, cut or fallen including logs, stumps, roots, branches, and composted and uncomposted chips of the genus *Fraxinus.*
4. Any article, product, or means of conveyance not listed above if an inspector determines that it presents a risk of spreading emerald ash borer and notifies the person in possession of the article, product, or means of conveyance that it is subject to the restrictions of the regulations.

Approved Regulatory Treatments

Approved regulatory treatments are determined by program management and/or a Technical Advisory Committee.

Table 6.1. Interstate movement of regulated articles from quarantined areas.

Regulated Article	Mitigation and Treatment Measures
Firewood of all hardwood species	• Remove bark and an additional ½ inch of wood[1] or • Kiln sterilization treatment (T404-b-4) or • Heat treatment (T314-a) in a heat treatment facility approved by APHIS or • Fumigate according to treatment schedule T404-b-1-1 (Methyl bromide fumigation at NAP-tarpaulin or chamber) or • Apply an APHIS approved method[2].
Chips and Mulch of all hardwood species	• Chip or mulch to less than one inch in at least two dimensions or • Follow an APHIS approved mulching or composting protocol or • Apply an APHIS approved method[2].
Nursery Stock of *Fraxinus* spp. Itself	No treatment available. No compliance agreements. No certification. This article is not being moved at this time.
Green lumber of *Fraxinus* spp. itself	• Remove bark and an additional ½ inch of wood[1] or

	• Kiln sterilization treatment (T404-b-4) or • Fumigate according to treatment schedule (404-b-1-1 (Methyl bromide fumigation at NAP-tarpaulin or chamber) or • Apply an APHIS approved method[2].
Logs of *Fraxinus* spp. itself	• Remove bark and an additional ½ inch of wood[1] or • Kiln drying treatment for logs <3" dia.(T404-b-4) or • Heat treatment (T314-a) in a heat treatment facility approved by APHIS or • Fumigate according to treatment schedule T404-b-1-1 (Methyl bromide fumigation at NAP-tarpaulin or chamber) or • Apply an APHIS approved method[2].
Other material including wood waste, living, dead, cut or falling including stumps, roots, branches of *Fraxinus* spp.	• Chip or mulch to less than one inch in at least two dimensions or • Apply an APHIS approved method[2].
WPM **containing regulated green lumber, including but not limited to,** dunnage, crating, pallets, packing blocks, drums, cases, and skids.	• ISPM accredited treatments or • Treatment/mitigations for green lumber of *Fraxinus* spp. itself as listed above or • Apply an APHIS approved method[2].

[1] The bark and wood removed will be regulated separately. If intended for interstate movement the removed bark and wood must be treated as described in Table 1 for chips and mulch. If produced at a mill located outside the quarantine area but approved to handle green ash logs or lumber from within the quarantine area, wood waste must be treated or destroyed prior to adult flight season.

[2] Consult Local USDA APHIS Official or State Plant Health Director.

Detailed specifications for treatments can be found in the current edition of the PPQ Treatment Manual online at:
http://www.aphis.usda.gov/import_export/plants/manuals/ports/treatment.shtml

Quarantine Boundaries

Quarantine boundaries will be determined in consultation with state authorities based on the following factors:

- Human-assisted (passive) dispersal
- Natural (active) dispersal
- Ease of enforcement due to geopolitical boundaries
- Historical and existing quarantine practices

Regulatory Management of Outlying Infestations

Isolated infestations outside of the quarantined boundary are common occurrences in pest management programs. These isolated infestations generally represent anthropogenic (human-assisted) dispersal of *Agrilus planipennis* created by movement of infested articles.

Regulatory management of outlying infestations will be handled using the following procedures:

1. Upon confirmation by a USDA EAB identifier and with consensus from the cooperating regulatory agencies, a quarantine will immediately be established. The quarantined area may be adjusted based on additional survey information.
2. A delimiting survey will be initiated as soon as possible to establish the area of impact.
3. Provisions of the temporary quarantine will be the same as those established in the formal quarantine. Newspapers and direct mailings will be used to notify inhabitants within the established area that a temporary quarantine is in effect.
4. If the cause of the outlying infestation is not readily determined, trace back inspections and interviews with local business and home owners will be conducted to determine the source. These inspections will begin at the epicenter of the infestation and work outward. Trace forward inspections will be conducted to determine if infested host material has been moved out of the area. These inspections should include all establishments located in and/or conducting business within the regulated area.

Regulated Establishments

Field personnel will attempt to detect the pest within the regulated area at all establishments where regulated articles are sold, grown, handled, moved, or processed. Involved establishments might include, but are not limited to:

- Campgrounds
- Firewood dealers
- Nurseries
- Logging/lumber companies
- Pallet manufacturing companies
- Landscapers and garden centers
- Utilities companies
- Tree removal companies
- Municipality forestry services
- Waste removal companies

Please refer to Appendix F for additional sources to identify regulatory concerns.

Principle Regulatory Activities

Regulatory activities are directed at implementing and enforcing quarantine provisions governing movement of regulated articles which could result in human-assisted dispersal of *Agrilus planipennis.* Typical activities include:

1. Identifying persons and establishments whose business or personal activities could result in the further dispersal of *Agrilus planipennis.* (See Regulated Establishments, above, and Appendix F.)
2. Contacting by regulatory visit, mail, email, and/or telephone those identified persons or establishments to explain quarantine provisions.
3. Determining if provisions of the quarantine (e.g., treatment or processing) may be applied to permit the person or establishment to move regulated articles out of the quarantined area.
4. Conducting inspections of regulated articles and monitoring procedures to mitigate pest risk on a shipment by shipment basis.
5. Issuing Limited Permits (PPQ form 530) to allow movement of regulated articles out of the quarantine area to a specific destination for further processing or treatment.
6. Issuing Certificates (PPQ form 540) to allow movement of regulated articles out of the quarantined area when they have been treated or processed in such a manner that they no longer present a risk for further dispersal of *Agrilus planipennis.*
7. Entering into a Compliance Agreement at the discretion of the inspector with a person or establishment that can demonstrate their ability to meet the provisions of the quarantine.
8. Conducting periodic physical site visits to monitor the activities of those persons or establishments placed under a Compliance Agreement to observe and assess treatments or other processes and activities. Periodicity of monitoring is based on risk assessment of the product and the business or individual under compliance.
9. Conducting and/or assisting with investigations of suspected violations of the quarantine as necessary and appropriate.
10. Recording information about contacts, visits, and compliance agreements and maintaining data on persons or establishments affected by the quarantine in the Integrated Plant Health Information System (IPHIS) database.
11. Reporting results of regulatory activities to management officials on a weekly basis.
12. Conducting special regulatory operations.
13. Researching local and interstate trade movement to determine pathway risk.

Investigations and Violations

When regulated material is suspected to have been moved out of the regulated area in violation of the quarantine, regulatory personnel will conduct initial preliminary investigations to determine if a violation of the quarantine has occurred and safeguard any regulated material. These investigations will also attempt to identify and to trace the source and destination of any other related shipments of regulated materials that have occurred.

Preliminary investigations by regulatory personnel will allow management to determine whether the situation warrants additional formal investigation by USDA APHIS Investigative and Enforcement Services (IES) personnel.

Regulatory Records

All data related to regulatory activities will be maintained in the IPHIS database. Regulatory personnel will record information such as:

1. Date of visit
2. Purpose of visit (routine, investigation, monitoring) and actions taken/needed
3. GPS coordinates of the site
4. Name and address of contact
5. Phone, fax, and/or e-mail of contact
6. Communication method
7. Type of contact
8. Compliance agreement number (if applicable)

Weekly status reports will be made by regulatory personnel to EAB management officials summarizing their activities and highlighting immediate and developing problems.

Quality Control

Management officials will review the results of visits, contacts, and compliance agreements maintained by regulatory personnel to ensure that program standards are followed. A percentage of establishments operating with or without a compliance agreement will be selected for a paper audit on a regular basis. This is important to reinforce the effectiveness of a compliance agreement.

Outreach

Outreach is a vital component of every aspect of the EAB program. Without public support and cooperation, the efficacy of the program is very limited. Regulatory personnel should utilize opportunities during general regulatory activities and special regulatory operations to inform the public about the EAB program and enlist their cooperation.

Special Regulatory Operations

Another aspect of regulatory activity is to identify and conduct special operations to serve as deterrents and quality control for movement of regulated articles. These operations also give unique opportunities to

inform the public of the pest and related regulations. The operations may be conducted with state cooperators. Special regulatory operations may include:

- Highway operations in cooperation with local law enforcement which stop traffic to inspect for movement of regulated articles by private citizens and commercial dealers and to increase public awareness.
- Rest stop and weigh station operations to monitor quality control.
- Ride along operations with law enforcement to regulate and ensure commercial enterprise compliance.
- Campground operations to regulate the movement of firewood from quarantined areas.
- Ferry operations to monitor the movement of regulated articles.
- Special focus operations to concentrate regulatory activities in a smaller area of interest.

Any special regulatory operation should be coordinated with Tribal governments and Federal, State, and local authorities including, but not limited to: Tribal, State, and local police departments, states' department of agriculture, states' department of transportation, states' department of natural resources, and local wood disposal and utilization entities.

Issuing an Emergency Action Notification

After an initial suspect positive detection in a new area outside a quarantined area, an Emergency Action Notification (PPQ form 523) may be issued to place a hold on regulated material or facilities where regulated material may be found pending positive identification by a USDA APHIS PPQ recognized authority.

An Emergency Action Notification (EAN) may also be issued within the quarantine area to order a hold, treatment, destruction, or other safeguarding action for a regulated material due to a potential pest risk. The EAN may be completed by hand in the field, but must be transferred into the EAN database within 14 days. Authority for EAN issuance is to be determined by each state's command structure.

Regulatory Forms

A sample compliance agreement template can be found in IPHIS and at the following link:

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/compliance_agreement/EAB_CA_Template_1.6.pdf

Other sample regulatory forms and useful documents are located in the appendices and include:

- Info Packets
- Regulatory operation forms
- Sources to find regulatory concerns
- PPQ 518 form (Report of Violation)
- PPQ 530 form (Limited Permit)
- PPQ 540 form (Certificate)
- PPQ 523 form (Emergency Action Notification)

Overview

The Emerald Ash Borer Program has transitioned from an eradication program to a management program. Effective and cost efficient control technologies are not currently available to apply area-wide to effect pest eradication. In the future additional tools may become available to suppress the dispersal of the pest. Program partners are conducting extensive research to develop additional tools and methodologies.

This section provides the program policy on management of isolated infestations and currently available information on control and management tactics. This will assist states, local communities, and the public in mitigating the effects of this destructive pest.

As research is ongoing in this area, management procedures will be subject to frequent changes. Please contact EAB Program Management to ensure that procedures are up to date before implementing management measures. Further guidance may be found in the APHIS Emergency Programs Manual at:

http://www.aphis.usda.gov/import_export/plants/manuals/emergency/downloads/epm.pdf

Community Preparedness Planning

Since control options to eradicate or prevent dispersal are not effective at this time, it is recommended that communities take action to prepare for an infestation of emerald ash borer.

It is prudent to have a response plan prior to an EAB infestation. Examples of preparedness/response plans for states may be found at:

http://www.emeraldashborer.info/communityplan.cfm

Examples of individual city response plans may be found at the following URLs:

http://www.mariettaoh.net/site_pages/government/commissions/EAB_man_plan.pdf

http://nfs.unl.edu/documents/foresthealth/EABCommunityReadinessFullSheet.pdf

http://www.mda.state.mn.us/plants/pestmanagement/eab/eabmanual.aspx

Urban forest management experts suggest taking preventive measures such as diversifying landscape plantings using the 30:20:10 rule: The urban forest should be composed of no more than 30% of the same

family, 20% of the same genus, and 10% of the same species. Choosing native species over non-native species is recommended in order to reduce costs associated with maintenance (watering and fertilizers). Ash (*Fraxinus* spp.) should be avoided as landscape plantings. Models exist for ash phloem reduction in managed forests/woodlots. One such model can be found at: http://www.ashmodel.org/
Reduction of ash populations should be considered in consultation with forest management experts.

Biological Control

In order to be a successful biological control agent, the following traits are desired:

1. Parasitoid (organism that lives on or in another organism)
2. Multivoltine (producing more than one generation per year)

Three parasitoids that meet the above criteria continue to be evaluated by APHIS. Research on EAB biological control began in 2002 when this destructive beetle was first found in Michigan. Since EAB is native to southeastern Asia, much of the early biological control research was conducted in China. The three non-native biological control agents include one larval ectoparasitoid, *Spathius agrili* (Hymenoptera: Braconidae) (Yang et al. 2005), one species of egg parasitoid, *Oobius agrili* (Hymenoptera: Encyrtidae) (Zhang et al. 2005), and one species of larval endoparasitoid, *Tetrastichus planipennisi* (Hymenoptera: Eulophidae) (Liu et al. 2003; Yang et al. 2006). These parasitoids are known to attack EAB consistently in its native range in China.

These natural enemies are tiny stingless wasps that seek and kill EAB eggs and larvae. Five years of research in China and quarantine laboratories led to an environmental assessment of field release of these natural enemies. After a 60-day public comment period and a "Finding of No Significant Impact", APHIS and the State of Michigan approved release of these wasps for control of EAB. Small-scale inoculative releases were performed in Michigan in 2007 and 2008. Releases have occurred in 19 States since 2008. The sites will continue to be monitored for establishment of the natural enemies and evaluated for their potential to control and slow the dispersal of EAB in the United States. Early results indicate that two species are capable of overwintering and reproducing in North America. The third species, *Spathius agrili*, is expected to perform well at locations south of the Maryland-Pennsylvania and Kansas-Nebraska state lines but there is insufficient data from releases in these more southerly locations at this time.

An EAB biological control rearing facility has been established in Brighton, Michigan. Tools and techniques for rearing natural enemies will be further developed at this location. Starting in 2010, specific release sites were designated for research and tracked to collect data to

determine:
- successful establishment of natural enemies
- numbers of natural enemies needed for establishment
- site conditions required for establishing natural enemy populations
- interactions among the three exotic natural enemies and native natural enemies
- natural enemy dispersal rates
- impacts on EAB populations and ash survival or recovery
- effects on non-target species

While the focus in the first several years of the biological control program was centered on how to maintain and mass-produce the parasitoids, release them into the field, and monitor for their ability to overwinter across the EAB-infested areas of the US, the program is now focusing on the impact of the parasitoids. Specifically, the program is now maximizing efforts to understand the dynamic relationship of the host EAB population to the parasitoids, and the impacts of releasing parasitoids on ash stand health and longevity.

Advances in rearing technology in the early stages of the biological control program have allowed average annual production of female parasitoids to increase rapidly from a few tens of thousands annually in 2009 to more than 750,000 per year in 2014. Future increases in annual parasitoid production are expected in 2015 as continued improvements are made, and these improvements, in turn, have facilitated additional investments into the parasitoid-impact questions that are now our focus.

The program has increased the suggested base numbers of insects released at a site as production increases have been made. We have also made parasitoids available to research cooperators to examine key questions that support program initiatives. These questions include: how far and how quickly the parasitoids are able to spread naturally (dispersal ability); how well-suited individual parasitoid species may be for given ecological and climatological regions of the US as EAB spreads, and how the parasitoids are influencing ash stand health as we evaluate recovery and establishment at parasitoid release sites over several years following the initial release.

The rearing facility is responsible for rearing these three natural enemies for scheduled releases. Release sites will be determined by APHIS in consultation with program partners. Limited by availability, releases will depend upon program needs, regulatory approval, and production capabilities.

For more information please visit the following web site:
http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/

downloads/EAB-FieldRelease-Guidelines.pdf

Initial releases and post-release monitoring, including impacts on EAB and non-target wood-boring beetles, and dispersal and establishment of each parasitoid species, will be conducted. The 2007 environmental assessment prepared in advance of the release of the three parasitoids mentioned here can be found at the following web address: http://www.aphis.usda.gov/plant_health/ea/downloads/eab-ea07-07.pdf

Other parasitoids are under evaluation and may be permitted in the near future to complement the three parasitoids currently in production.

Chemical Control

At this time available chemical treatments are not cost effective for large scale implementation. Therefore, the EAB program can not recommend chemical control on a large scale. However, depending on beetle population densities, research suggests individual trees may be effectively treated (Herms et al. 2009). Consult your county or university extension agent for information on approved treatments for your specific area.

Eradication Criteria

Eradication Criteria Guidelines outside the current leading edge:

All new detections outside the leading edge will be evaluated individually and any management action supported by APHIS will be considered only after all the following criteria are met:

1. The outlier must be a single, clearly identifiable regulatory incident. This may include nursery stock, firewood, or other regulated material transported beyond the current buffer.
2. The population, using dendrochronology and a delimiting survey, must be demonstrated to be less than two years old or to have no more than one population release from the original host material.
3. The population, using current technologies and methodologies, must be identified as eradicable by the EAB Management Team (i.e., the point of introduction clearly identified and age of infestation as delineated in item 2).

The EAB Management Team may consider control actions for EAB populations older than two years if circumstances indicate eradication may be achieved or the control action is determined to be strategically important for slowing the spread.

Overview

Environmental Services (ES) is a unit of APHIS' Policy and Program Development Staff (PPD). ES manages the preparation of environmental documentation, such as environmental impact statements and environmental assessments, to aid in program operational decisions. ES also coordinates pesticide registration and approvals for APHIS pest control and eradication programs, ensuring that registrations and approvals meet program use needs and conform to pesticide use requirements.

Disclaimer

All uses of pesticides must be registered or approved by appropriate Federal, State, and/or Tribal agencies before they can be applied. The information provided on pesticide labels may not reflect all of the actual information, including precautions and instructions for use, which you are required to follow in your specific State or locality. It is the responsibility of persons intending to use a pesticide to read and abide by the label, including labeling that has been approved for the particular State or locality in which the chemical is to be used, and to comply with all Federal, State, Tribal, and local laws and regulations relating to the use of the pesticide. APHIS program staffs are responsible for their compliance with applicable environmental regulations.

Protected Species

To ensure that protected species are not impacted negatively during survey and control activities, contact the Emerald Ash Borer (EAB) National Operations Manager.

To date, program activities have significantly interfaced with several protected species. Specific protocols have been implemented to mitigate negative impacts on the Indiana gray bat, the bald eagle, the copperbelly water snake, and other species in consultation with Fish and Wildlife Services.

For further details, see the biological assessment and contact the EAB National Operations Manager.

Environmental Assessment

All program control activities require review by Headquarters Environmental Services staff before any work may begin. Control activities include eradication and containment actions that require cutting and/or destruction of trees. An environmental assessment is mandatory before APHIS-supported control or containment activities may begin.

Introduction

EAB outreach and education have been sustained and dynamic program objectives since the pest was first detected in 2002. Collectively, Federal and State program partners work to increase awareness, facilitate understanding, and garner support and program compliance. Education and outreach efforts include the use of various vehicles and initiatives (outdoor advertising, radio & television, web, written materials, public presentations, etc.) to accomplish its goals and reach its audiences. EAB outreach and education have various material available free of charge. An electronic ordering system is available at: http://www.aphis.usda.gov/publications/ or contact the EAB program's Legislative and Public Affairs (LPA) specialist.

Regarding the development of new communication tools (publications, videos, posters, news releases, etc.), Federal and State cooperators are encouraged to work with LPA to prevent duplication of efforts and to ensure consistency. When USDA is mentioned or identified, and/or federal dollars are used, communication tools must be reviewed by the LPA program specialists prior to publication/release.

It is never too early to begin the education and outreach process, especially firewood messaging. "Do not move firewood" and "Burn it (firewood) where you buy it" speaks to firewood as a vector for pests and pathogens and supports proactive environmental stewardship. To that end, the EAB Communication Committee welcomes your participation. Contact the USDA's public affairs specialist for additional information.

Outreach Objectives for State Partners

1. Coordinate outreach efforts among your cooperators to ensure the program has a consistent message.
    A. Establish a small, core committee, to manage and direct program communication; membership should include local, state, and federal partners, cooperative extension, and other partners deemed relevant. This group will develop standard program messages in accordance with Federal and State regulations and the EAB Program Cooperative Agreement.
        - Identify roles and responsibility for individuals and as a whole
        - Identify policies and procedures for releasing information to the public and stakeholders
        - Address financial responsibilities
        - Develop a two-way reporting mechanism with Cooperative Agreement Staff
        - Establish a Communications Advisory Committee and identify roles and responsibilities. Membership could include industry groups such as professional landscapers and arborists, lumber

and wood industry, nursery owners, environmental organizers, and other economically impacted groups. This group will be an invaluable network for the dissemination of standard program messages and information.

2. Develop outreach materials to meet State program needs and reach multiple audiences. Outreach personnel will work with EAB program managers to identify areas or activities where outreach materials are needed and do not currently exist. Priorities will be as follows:
   - Identify target audiences and leadership
   - Identify key messages for all program initiatives; survey, public meetings, control activities, etc.
   - Identify key messages to support regulatory activities: "Don't move firewood", examine your trees, know Federal and State regulations, etc.

3. Deliver outreach materials through a variety of outlets to ensure widest exposure.
   - Create a marketing mix using mainstream/alternative/grassroots media to reach targeted audience. (Television, radio, outdoor, newspaper, internet, industry publications, civic groups, newsletters, etc.)
   - Reach out to specialized target audiences through their industry newsletters, web site links, and association meetings. Develop "champions" for the program.
   - Seek out opportunities for communication: Country fairs, home and garden shows, regional association meetings, Chamber of Commerce events, etc.
   - Establish a speakers' bureau and create canned PowerPoint presentations.

General Outreach Activities and Initiatives

Listed below are some common outreach and education initiatives to support an agency's EAB program:

1. Develop and maintain an EAB website to provide access to current information on EAB, quarantines, survey areas, etc.
2. Develop and staff a toll-free EAB hotline to address State-specific regulations and messages.
3. Catalogue and review existing informational materials to prevent duplication of effort and ensure consistency.
4. Develop your own public service announcements (PSA's) or use USDA-provided PSA's and arrange for broadcast.
5. Keep the media informed regarding program activities.
6. Keep local officials, local government, community leaders, Tribal

leaders, etc. informed about the program

7. When necessary, craft easy to read letters regarding time, date, location, and purpose of public meetings and execute mailing
    - Use tax rolls for names and addresses (Note: Tax rolls apply to owners not necessarily residents.)
    - Allow substantial lead time.
    - In resort areas, allow for absentee homeowner issues.
8. Arrange, moderate, and provide presentations and support at public meetings
9. Periodically meet with program staff for program feedback, problems, concerns, etc. Engage and encourage open dialogue.
10. Create specialized communication vehicles when needed or order USDA-provided items (magnets, tattoos, stickers, etc.) to support EAB awareness.
11. Continually refine and develop communication vehicles (brochures, posters, newsletters, etc.) to ensure accuracy and current program information.
12. Develop and arrange for publication of news releases for mainstream, electronic, and alternative media

Outreach Material

Program materials are available free of charge to support public education. To prevent duplication of effort and to ensure consistency, before implementing outreach activities contact the EAB LPA specialist to review existing outreach materials.

Telephone Hotline

The toll-free telephone National EAB hotline is 1-866-322-4512. The hotline is staffed by trained and knowledgeable personnel who can answer questions about the EAB program and direct callers to appropriate program personnel.

Web Site

WWW.emeraldashborer.info is the national website developed by the Cooperative EAB Program and funded by the U.S. Forest Service as a resource and link to Federal and State information. It contains current program information including quarantine information, maps, EAB signs and symptoms, ash tree identification, treatment options, tree replacement options, community preparedness plans, and on-going research.

WWW.HungryPests.com

Hungry Pests is the U.S. Department of Agriculture's signature outreach initiative to raise public awareness about the invasive pest threat. The pests targeted by the Hungry Pests initiative are federally regulated invasive species whose introduction into the United States and spread within the country is assisted by the activities of the general public. These pests have the ability to cause significant harm to U.S. agricultural and environmental resources. Through the Hungry Pests website and outreach materials, the public can learn how to Leave Hungry Pests Behind.

Public Meetings or Informational Open Houses

Public meetings or informational open houses take place when deemed necessary and/or appropriate. These meetings address public concerns, communicate the program strategy and actions, and help to garner community support and compliance.

Outreach personnel work collectively to coordinate scheduling, secure suitable facilities, ensure the delivery of adequate notification, and provide collateral materials (handouts, fact sheets, informational posters, etc.) for the meeting.

Public venues may include additional participation from:

1. Political representatives and community leaders who are familiar with local concerns and recognized by the local community.
2. State and Federal program representatives who can respond to questions about EAB, quarantine restrictions, control measures, and its impact.
3. Representatives from cooperating state universities who can answer questions about biology of EAB, its host range, and potential impact in the United States.
4. County, city, and local cooperators who can respond to questions about their roles.

Media Relations

The APHIS PPQ and LPA staff should be notified when a new EAB detection is confirmed. In addition, staff should also be notified of media requests. National media calls (from high profile media outlets) must be coordinated with APHIS LPA. To avoid conflicting and confusing statements, all outgoing information should be processed through the designated spokesperson. It is recommended that one primary media spokesperson be designated by the State cooperator to work with the EAB LPA spokesperson. Spokespersons should thoroughly understand particular aspects of the program, such as survey, regulatory, and management activities. EAB program spokespersons will develop and maintain close contacts with each other and reporters and community group leaders to provide accurate and consistent information. If no personnel at the local level exist or he/she does not have adequate media experience, the EAB LPA specialist should be notified so he/she can provide experienced media representation to the program.

Literature cited:

Akiyama K. and S. Ohmomo. 1997. A checklist of the Japanese Buprestidae. Gekkan-Mushi (Supplement 1).

Bauer, L. S., R. A. Haack, D. L. Miller, T. R. Petrice, and H. Liu. 2004. Emerald ash borer life cycle. In: *Emerald ash borer research and technology development meeting*, Compiled by: V. Mastro and R. Reardon.

Cappaert, D., D. G. McCullough, T. M. Poland, and N.W. Siegert. 2005. Emerald ash borer in North America: A research and regulatory challenge. *American Entomologist*, 51:152-165.

Chinese Academy of Science, Institute of Zoology. 1986. *Agrilus marcopoli* Obenberger. Agriculture Insects of China (part I), China Agriculture Press, Beijing, China.

Cipollini, D. 2015. White fringetree as a novel larval host for emerald ash borer. Journal of Economic Entomology, DOI: http://dx.doi.org/10.1093/jee/tou026.

Francese, J. A., I. Fraser, D. R. Lance, and V. C. Mastro. 2006. Developing survey techniques for emerald ash borer: The role of trap height and design. In: *Emerald ash borer and Asian long-horned beetle research and technology development meeting*, Compiled by: V. Mastro, D. Lance, R. Reardon, and G. Parra.

Herms, D. A., D. G. McCullough, D. R. Smitley, C. S. Sadof, R. C. Williamson, and P. L. Nixon. 2009. Insecticide options for protecting ash trees from emerald ash borer. North Central IPM Center Bulletin. 12pp.

Kovacs, K. F.,, R. G. Haight, D. G. McCullough, R. J. Mercader, N. W. Siegert, and A. M. Liebhold. 2010. Cost of potential emerald ash borer damage in U.S. communities, 2009-2019. Ecological Economics, 69:569-578.

Liu, H-P, L.S. Bauer, R-T Gao, T-H Zhao, T.R. Petrice, and R.A. Haack. 2003. Exploratory survey for the emerald ash borer, *Agrilus planipennis* (Coleoptera: Buprestidae), and its natural enemies in China. *Great Lakes Entomologist*. 36:191-204.

Lyons, D. B. G. C. Jones, and K. Wainio-Keizer. 2004. The biology and phenology of the emerald ash borer. In: *Emerald ash borer research and technology development meeting*, Compiled by: V. Mastro and R. Reardon.

MacFarlane, D. W. and S. P. Meyer. 2005. Characteristics and distribution of potential ash tree hosts for emerald ash borer. Forest Ecology and Management, 213:15-24.

Marshall, J. M., A. J. Storer, I. Fraser, and V. C. Mastro. 2009. Efficacy of trap and lure types for detection of Agrilus planipennis (Col., Buprestidae) at low density. Journal of Applied Entomology, In press.

McCullough, D. M. and N. W. Siegert. 2006. Using girdled trap trees effectively for emerald ash borer detection, delimitation, and survey. http://www.emeraldashborer.info/files/handoutforpdf.pdf Last accessed January 18, 2008.

McPartlan, D., P. D. Bell, C. Kellogg. 2006. Eradication of emerald ash borer in Michigan, Ohio, and Indiana – Implementation of the strategic plan. January 11, 2006 revision. http://www.aphis.usda.gov/plant_health/ea/downloads/eab-ea4-07.pdf Last accessed January 18, 2008.

Nomura, S. 2002. *Agrilus planipennis*. Canadian Food Inspection Agency Science Branch. Last accessed November 30, 2004.

Poland T. M. and D. G. McCullough. 2006. Emerald ash borer: Invasion of the urban forest and the threat to North America's ash resource. *Journal of Forestry*, 118-124.

Sugiura N. 1999. The family Buprestidae in Fukushima Prefecture: The genus *Agrilus*. http://www1.linkclub.or.jp/~sugirin/fukusima/nagatama/nagatama2.html Last accessed August 2002.

Taylor, R. A. J., T. M. Poland,, L. S. Bauer, K. N. Windell, and J. L. Kautz. 2006. Emerald ash borer flight estimates revised. In: *Emerald ash borer research and technology development meeting*, Compiled by: V. Mastro, D. Lance, R. Reardon, and G. Parra.

Taylor, R. A. J., L. S. Bauer, D. L. Miller, and R. A. Haack. 2004. Emerald ash borer flight potential. In: *Emerald ash borer research and technology development meeting*, Ed. V. Mastro and R. Reardon.

Timms, L. L., S. M. Smith, and P. de Groot. 2006. Patterns in the within-tree distribution of the emerald ash borer *Agrilus planipennis* (Fairmaire) in young green-ash plantations of south-western Ontario, Canada. *Agricultural and Forest Entomology*, 8:313-321.

US Forest Service. 2008. Emerald ash borer maps. http://www.ncrs.fs.fed.us/4501/eab/maps/ Last accessed: 01/17/08.

Yang, Z-Q., J.S. Strazanac, Y-X Yao, and X-Y Wang. 2006. A new species of emerald ash borer parasitoid from China belonging to the genus *Tetrastichus* Haliday (Hymenoptera: Eulophidae) parasitizing emerald ash borer from China. *Proceedings of the Entomological Society of America*. 108:550-558.

Yang, Z-Q, J. S. Strazanac, P. M. Marsh, C. van Achterberg, and W-Y, Choi. 2005. First recorded parasitoid from China of *Agrilus planipennis:* A new species of *Spathius* (Hymenoptera: Braconidae, Doryctinae). *Annals of the Entomological Society of America.* 98(5):636-642.

Yu, C. 1992. *Agrilus marcopoli* Obenberger (Coleoptera: Buprestidae), pp. 400-401. In: *Forest Insects of China* (2nd edition) Ed. G. Xiao, China Forestry Publishing House, Beijing, China.

Zhang, Y-Z., D-W Huang, T-H Zhao, H-P Liu, and L.S. Bauer. 2005. Two new egg parasitoids (Hymenoptera: Encyrtidae) of economic importance from China. *Phytoparasitica*. 33:253-260.

anthropogenic	Human-caused
APHIS	Animal and Plant Health Inspection Service
cambium	The meristematic tissue in woody plants that exists between the wood (xylem) and the inner most bark (phloem)
CFR	Code of Federal Regulations
CPHST	Center for Plant Health Science and Technology
cuneiform	Triangular or wedge-shaped
DBH	Diameter at breast height
delimiting survey	A sampling method to determine extent of an infestation of an exotic species in an area
destructive sampling	Method of observing signs and symptoms of the presence or absence of a pest by destruction of the living sample unit; *i.e.*, removal of bark to look for larvae
detection survey	A sampling technique to determine the presence or absence of a non-native species in an area
developmental thresholds	The minimum and/or maximum temperatures that support physiological development of a species
diapause, facultative	The cessation of growth and reduction of metabolic activity in a species which occurs seasonally or when environmental conditions are unfavorable
diapause, obligatory	A period of quiescence genetically controlled and affecting every individual of every generation within a species regardless of environmental conditions
dispersal, active	The spread of an organism by its own method of locomotion (*e.g.*, walking, flight, etc.)
dispersal, passive	The spread of an organism aided by other than it own method of locomotion (*e.g.*, wind, water, man, etc.)
EAB	emerald ash borer
EAN	Emergency Action Notification

ectoparasitoid	A parasitoid that develops inside the host
endoparasitoid	A parasitoid that develops outside the host and is attached or embedded in host tissue
epicormic shoots	Fast growing, relatively soft stems arising from the main trunk below the crown or root collar of a dying or stressed tree. Sometimes referred to as "water sprouts" or "suckering"
ES	Environmental Services
exotic species	An organism or pest species not native to nor historically resident in North America, also referred to as alien, non-native, or invasive species
F	Fahrenheit
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FY	Fiscal year
generally infested area	All areas within a line extending from the peripheral positive EAB finds
generation	One complete life cycle
GPS	Global positioning system
growing degree day	A measure of the number of thermal units (degrees) that accumulate above a specified base temperature over a 24 hour period
host	A species that provides food, shelter, or reproductive requirements for another organism
IES	Investigative and Enforcement Services
IPHIS	Integrated Plant Health Information System
ISPM	International Standard for Phytosaniatry Measures
km	kilometer
leading edge	The boundary defined by the line delineating the generally infested area
LPA	Legislative and Public Affairs
mg	milligram

mm	millimeter
monophagous	Feeding on only one type of food
MOU	Memorandum of understanding
multivoltine	Producing more than one generation per year
NC	North Central Forest Service Station
obscure-aeneous	Dark coppery color
parasitoid	An organism that lives on or in another organism, usually referred to as its host, and from which it obtains nourishment
PDA	Personal digital assistant
phloem	Nutrient conducting tissue of the inner bark
phototactic	Movement of an organism toward or away from a light source
PPD	Policy and Program Development
PPQ	Plant Protection and Quarantine
regulated articles	All known or suspected hosts of a confirmed infestation of a non-native species, including soil and any other suspected product or article
SEL	Systematics Entomology Laboratory
semio-chemicals	Chemicals emitted by plants, animals and other organisms and synthetic analogues of such substances, that evoke a behavioral or physiological response in individuals of the same or other species
SLN	Special local needs
SPHD	State Plant Health Director
SPRO	State Plant Regulatory Official
thanatosis	Feigning death in order to avoid predation
thermotactic	Movement of an organism toward or away from a heat source
USDA	United States Department of Agriculture

visual survey	Simple examination of areas for eggs, larvae, pupae, or other evidence to determine if a particular insect species is present
VPN	Virtual private network
WPM	Wood packing material
xylem	Water conducting tissue that comprises the bulk of most woody plants; wood

Agrilus planipennis Fairmaire Screening Aid

J. E. Zablotny, USDA APHIS PPQ

Figure 1. *Agrilus planipennis* Fairmaire.

Members of the genus *Agrilus* are challenging to identify due to structural coloration and subtle morphological differences between species. Furthermore, the presence of newly discovered exotic *Agrilus* species in the Midwest and Ontario complicates identification issues and demands a renewed interest in applied taxonomy of *Agrilus* beetles.

The emerald ash borer (EAB) is an invasive buprestid beetle native to Northeast China, Korea, Japan, and Russia (Figure 1). In Michigan, and Ontario, this pest is established and has devastated stands of native ash trees. The following characteristics can be used for discriminating EAB from other native *Agrilus* species:

- No patches of pubescence
- Pronotum copper/green
- Elytra and abdominal sternites emerald green
- Abdominal tergites purplish copper in color
- Length 13 mm
- Emarginate pygidial spine (Figure 2).
- **EXOTIC**

Figure 2. Pygidium of *A. planipennis*.

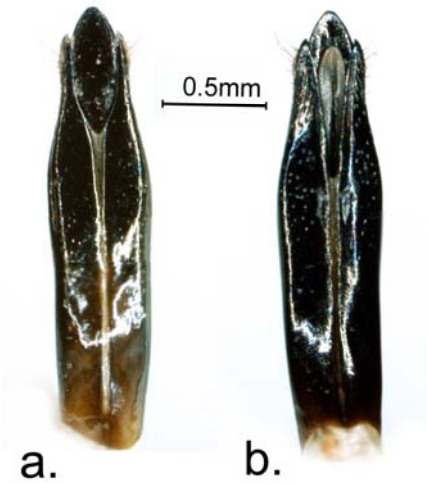


Figure 3. Aedeagus of *A. planipennis* (a. tergal, b sternal views).

Some commonly intercepted native and exotic species are illustrated and briefly described on the following pages.

***Agrilus bilineatus* (Weber):**

Figure 4**. *Agrilus bilineatus* (Weber)**

- Pubescent line on pronotum extending down each elytron.
- Bronze-black to dark blue.
- Length 11 mm
- Host *Quercus* spp.

***Agrilus cyanescens* Ratzeburg**

Figure 5 ***Agrilus cyanescens* Ratzeburg**

- No patches of pubescence.
- Metallic blue in color, darker below.
- Length 8 mm
- Host: *Lonicera* spp.
- **EXOTIC**

***Agrilus anxius* (Weber)**

Figure 6**. *Agrilus anxius* (Weber)**

- No patches of pubescence.
- Bronze-black
- Length 12-13 mm
- Host: Betula spp.***Agrilus vittaticollis* (Randall)**

Figure 7**. *Agrilus vittaticollis* (Randall)**

- Pubescent line on pronotum.
- Pronotum copper colored with dark elytra, darker below with violet highlights.
- Length 10-12mm
- Hosts: *Crataegus*, *Malus*,
- Amelenchier spp.

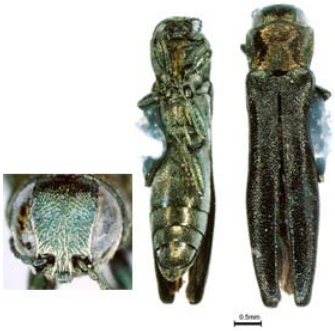
Agrilus obsoletoguttatus

Gory

Figure 8**.** ***Agrilus obsoletoguttatus*** **Gory**

- Pubescent spots on elytra.
- Copper color with violet elytral apices, darker below.
- Length 9-10 mm
- Hosts: Hardwood spp.

Agrilus masculinus



Horn

Figure 9**.** ***Agrilus masculinus*** **Horn**

- No distinct patches of pubescence
- Bronze-black, green face on males
- Length 6-7 mm
- Hindleg tarsi longer than tibia
- Host: Acer negundo

In addition to *Agrilus planipennis*, *A. subcinctus* Gory is the only other Agrilus species known to occur on *Fraxinus* in the Midwest. *A. subcinctus* differs behaviorally from *A. planipennis* in that it is a twig borer and prefers smaller banches for oviposition. In the field, A. subcinctus can be sweep-netted from ash leaves. *A. subcinctus* is small in size (>4.0 mm) and features a distinct subbassal and subapical spots of scale-like pubescence on the elytra (Figure 10).

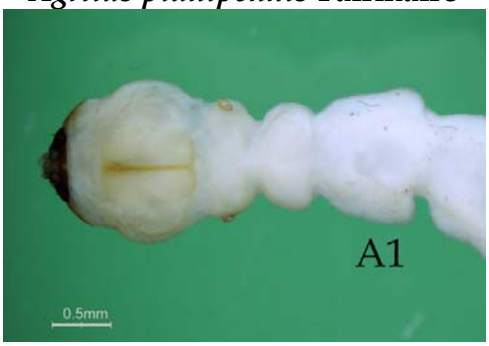
Figure 10**.** ***Agrilus subcinctus*** **Gory**

All of these Agrilus are often found on sticky and in funnel trap samples. With close to 50 Agrilus species known from the Midwest, I expect other species to be added to this preliminary guide in the near future.

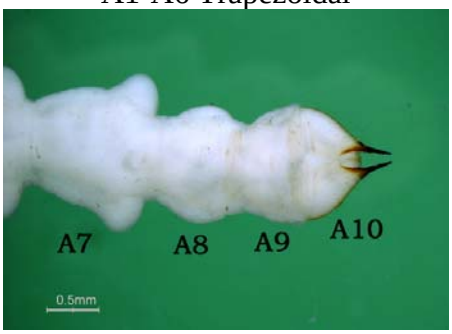
Emerald Ash Borer Larval Screening Guide

J. E. Zablotny

***Agrilus planipennis* Fairmaire**

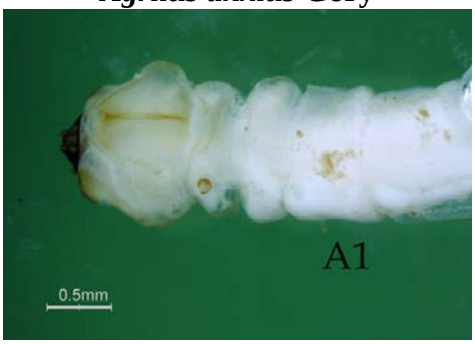


A1-A6 Trapezoidal

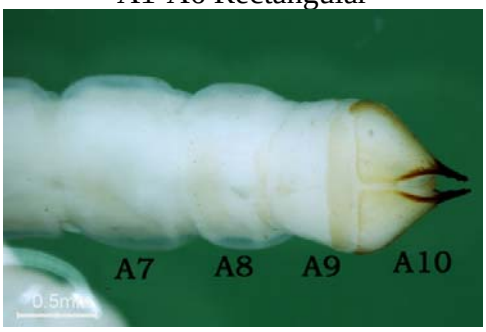


A7 Bell-shaped

***Agrilus anxius* Gory**



A1-A6 Rectangular



A7 Rectangular

The shape of the abdominal segments as well as host is useful for discriminating EAB (*Agrilus planipennis* Fairmaire) larvae from other native *Agrilus* species such as the bronze birch borer (*Agrilus anxius* Gory). I chose *A. anxius* to serve as a reference for comparison with EAB as its larval morphology is more typical for the genus.

The first abdominal segment shape varies considerably but can be distinctly rectangular to trapezoidal in *A. planipennis* while more rectangular and cylindrical in *A. anxius.* In EAB, A2 through A6 are somewhat trapezoidal with protruding flattened lobes. A7 is strongly bell shaped and A8 is somewhat trapezoidal in shape. In *A. anxius*, the abdominal segments do not have protruding flattened lobes and are rectangular in profile. A7 is not bell-shaped in bronze birch borer larvae.

These apparent differences in segment shapes are obvious in all instars of EAB examined so far. However, segment shape differences between species can be more subtle in prepupae and in poorly preserved larvae. In EAB prepupae, abdominal segment seven is still bell-shaped and rectangular in *A. anxius*.

In Michigan, EAB is the most common *Agrilus* species associated with F*raxinus*. North American populations of EAB are known only to oviposit in *Fraxinus*.

Appendix C

CONTACTS

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MSU Extension Bulletin E-2892, New May 2003

Distinguishing Ash from other Common Trees

Diane Brown-Rytlewski and Rebecca Thompson
Michigan State University IPM Program

Identifying ash trees

Due to the recent discovery of the emerald ash borer (EAB) in Michigan, it is important to be able to recognize and identify ash trees. To date, emerald ash borer has only been found on ash trees (see page 4). Not sure if your tree is an ash? This simple key is intended to help you distinguish between some common deciduous landscape trees frequently confused with ash, including: elm, boxelder, mountainash, walnut and hickory.

Using the identification key

Begin at number 1 on the key and choose (a) or (b). Then proceed to the number listed in italics at the end of your choice. This number will give you a new set of choices. Continue this way through the key. We have listed enough characteristics to help you determine whether or not your tree is an ash. If it doesn't match the characteristics in the key, relax; it most likely isn't an ash. If you don't want to use the key, tree ID photos are on pages 2-4.

If you are still curious about what kind of trees you have, consult Extension Bulletin E-2332, "Identifying Trees of Michigan," or a good field guide such as: "The Tree Identification Book," by George W.D. Symonds; "Tree Finder: A Manual for the Identification of Trees by Their Leaves," by May T. Watts; or "A Field Guide to Trees and Shrubs" by George A. Petrides. There are many other good guides available; these are mentioned only as examples.

Identification key

1. a) Branches alternate (Fig. 1) – *go to 2*
b) Branches opposite (Fig. 2) – *go to 4*

2. a) Simple leaves, with irregular leaf base and toothed edge (Fig. 3). See **elm**, page 2.
b) Compound leaves (Fig. 4), with 9 to 15 leaflets, finely toothed around edge of leaf – *go to 3*
c) Compound leaves, 5 to 7 leaflets – *go to 3c*

3. a) Cut open twig lengthwise.
Chambered pith (Fig. 6). See **black walnut**, page 3.
b) If pith is not chambered, but has white flowers in May, orange or red berries in fall. See **mountainash**, page 3.
c) If pith is not chambered, but has three leaflets at end of leaf larger than the rest. See **hickory**, page 2.

4. a) Compound leaves, 5 to 9 leaflets, smooth or finely toothed around outer edge. See **ash**, page 4.
b) Compound leaves, 3 to 5 leaflets, few coarse teeth or none, end leaflet pointed (Fig. 5). See **boxelder**, page 4.

Fig. 1- Alternate branching

Fig. 2- Opposite branching

Fig. 3- Simple leaf (American elm)

Fig. 4- Compound leaf, 7 leaflets (White ash)

Fig. 5- Compound leaf, 3 leaflets (Boxelder)

Fig. 6- Chambered pith (Black walnut)

Line drawings: Steven Brown

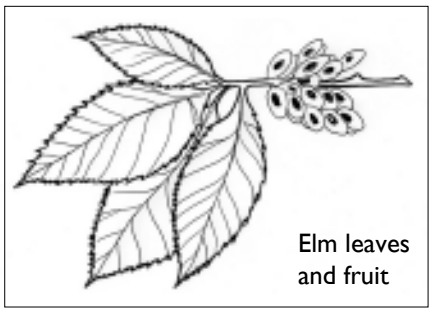
Definitions

- Alternate – leaves/branches that are staggered or not directly across from each other, Fig 1.
- Opposite – leaves/branches that are directly across from each other, Fig. 2.
- Simple – a single leaf blade joined by its stalk to a woody stem, Fig 3.
- Compound – a leaf with more than one leaflet. All leaflets attached to a single leafstem, Fig. 4-5.

MICHIGAN STATE UNIVERSITY EXTENSION

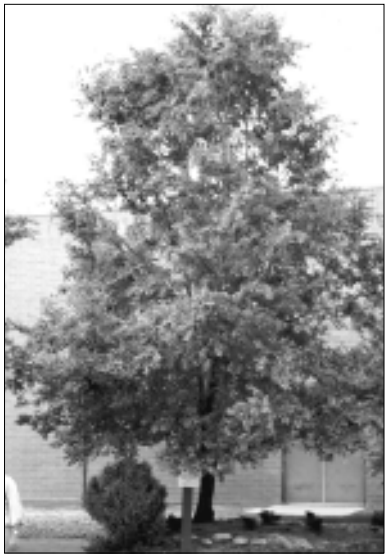
Elm, Ulmus spp.

Branches and buds are alternate and leaf bases are unequal. The leaves are simple, serrate (toothed) and 3 to 6 inches long and 1 to 3 inches wide (American elm) or 3/4 to 3 inches long and 1/3 to 1 inch wide (Siberian elm). The fruit is a winged seed.



Sandy Perry

Sandy Perry



Unequal leaf base

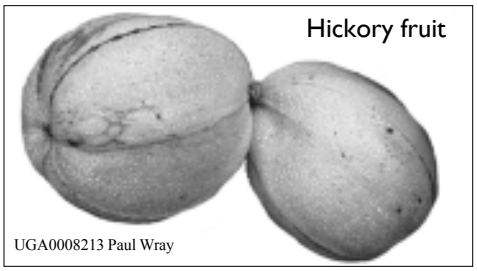
Alternate branching

Mary Wilson

Left: American elm has a vase-shaped growth habit. Right: Siberian elms are fast-growing, brittle trees that break easily. Other elms will have similar leaves and seeds, although leaf size and growth habit will vary.

Hickory, Carya spp.

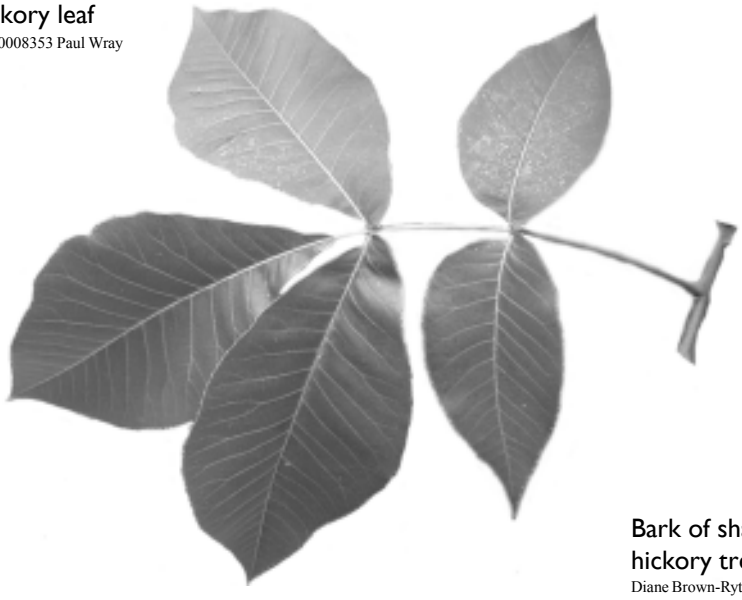
Shagbark hickory has distinctive bark – long, loose, shaggy strips. Leaves are compound, 8 to 14 inches long with 5 to 7 leaflets. The three terminal leaflets are larger than the other leaflets. Other similar species (not shown) include bitternut, pignut and mockernut, which have similar leaves and fruits although leaf size will vary. They do not have distinctive shaggy bark. These trees are seldom planted in landscapes, but are native, and may be found growing in woods. Fruits are hard-shelled light brown nuts, in a green husk that splits into four parts.



UGA0008213 Paul Wray

Hickory leaf

UGA0008353 Paul Wray



Bark of shagbark hickory tree

Diane Brown-Rytlewski

Black walnut, Juglans nigra

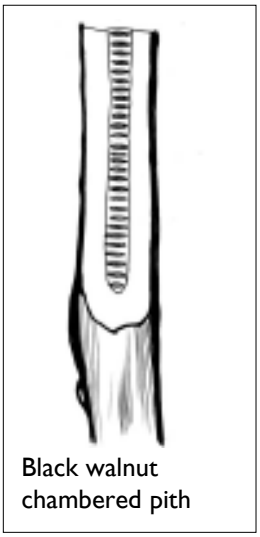
Branches and buds are alternate. Leaves are compound, 15 to 24 inches long, with 9 to 15 leaflets/leaf. Crushed leaflets and stems have a distinct odor – similar to turpentine. Twigs, split lengthwise, have chambered pith. Fruit is a large dark brown nut inside a green husk.

Black walnut fruit

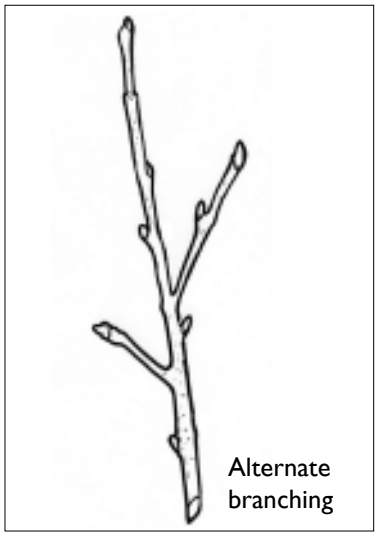
UGA0008279 Paul Wray

Black walnut leaf

UGA0008448 Paul Wray



Black walnut chambered pith



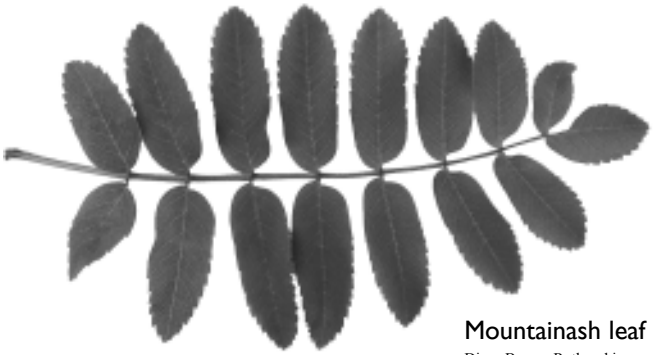
Alternate branching

Mountainash — alternate branching

Diane Brown-Rytlewski

European mountainash, Sorbus aucuparia

Leaves are compound, 5 to 9 inches long with 9 to 15 leaflets per leaf. Leaflets are a toothed, rounded oval shape. Flowers are five-petaled, white and similar to cherry or apple blossoms but in clusters. Fruits are fleshy, red-orange berries in clusters – they are found in the fall.



Mountainash leaf

Diane Brown-Rytlewski

Mountainash flowers

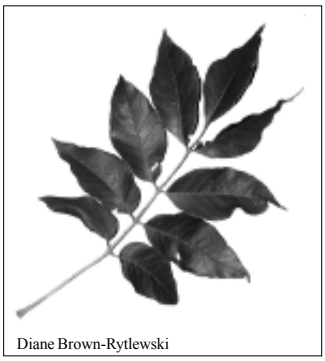
Diane Brown-Rytlewski

Ash, Fraxinus spp.

Branches and buds are opposite with a single bud at the end of the branch (terminal bud). Twigs are gray to brown and do not have a waxy coating. Leaves are compound, 8 to 12 inches long, 5 to 9 leaflets/leaf. Leaves may be finely toothed or have smooth edges. The most common ash trees planted in the landscape are **white ash** (*Fraxinus americana*) and **green ash** (*Fraxinus pennsylvanica*). Other native ash trees less commonly found include **black ash** (*Fraxinus nigra*) and **blue ash** (*Fraxinus quadangulata*) (not shown). **Black ash** has 7 to 11 leaflets and is found in wet woods; **blue ash** has 7 to 11 leaflets and distinctive 4-angled corky wings on the stem. **White ash** buds are paired with a leaf scar beneath the bud that looks like the letter "C" turned on its side. **Green ash** buds are paired with a leaf scar beneath the bud that looks like the letter "D" turned on its side (like a smile). Individual fruits are shaped like single wings and occur in clusters; many ash cultivars are seedless.

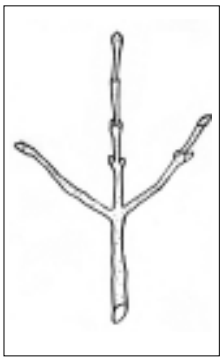
UGA0008289 Paul Wray

Green ash leaf



Diane Brown-Rytlewski

White ash leaf

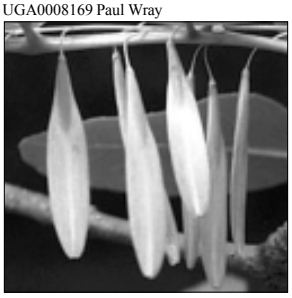


Opposite branching

Dave Cappaert

Left: green ash leaf scar. Right: white ash leaf scar.

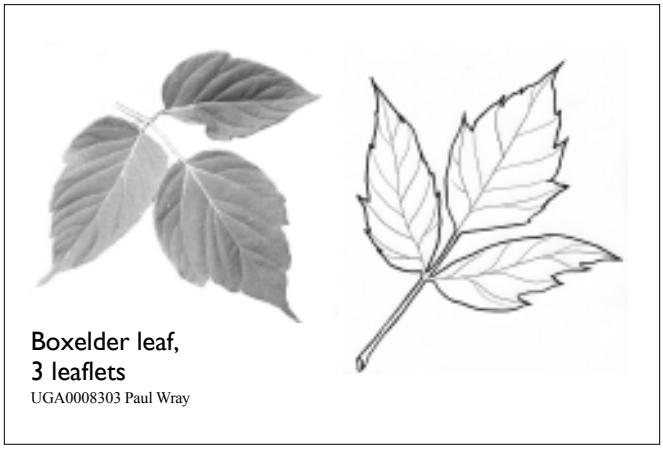
UGA0008169 Paul Wray



Ash seeds

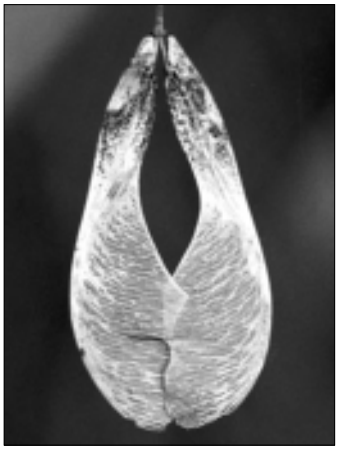
Boxelder, Acer negundo

Boxelder is sometimes called ash-leafed maple. The twigs and buds are opposite; with a single bud on the end of the twig (terminal bud). Twigs are green to purplish brown, and often have a waxy white coating that can be rubbed off the stem. Leaf scars beneath the buds are narrow, and join in a point. Leaves are compound, 4 to 10 inches long, with 3 to 5 leaflets/leaf. Leaves may have a few coarse teeth, or none. The end leaflet is sharply pointed. Fruit is a paired winged seed, occurring in clusters.



Boxelder leaf, 3 leaflets
UGA0008303 Paul Wray

Boxelder branches
UGA1219006 Bill Cook

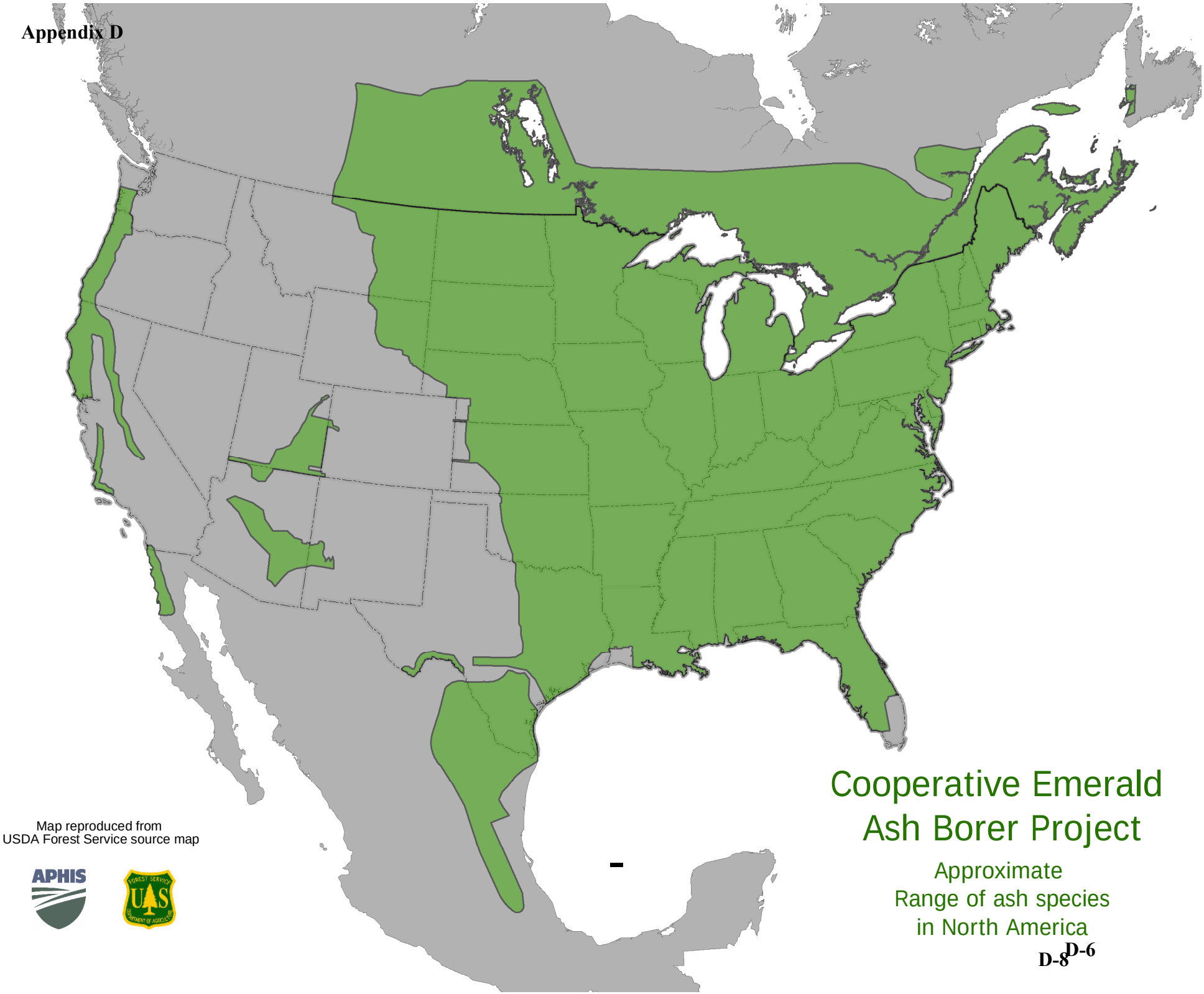


Boxelder fruit
UGA1219003 Bill Cook

Photo credits:
Bill Cook, Michigan State University, www.forestryimages.org/
Paul Wray, Iowa State University, www.forestryimages.org/

MICHIGAN STATE UNIVERSITY EXTENSION

Emerald Ash Borer Symptoms

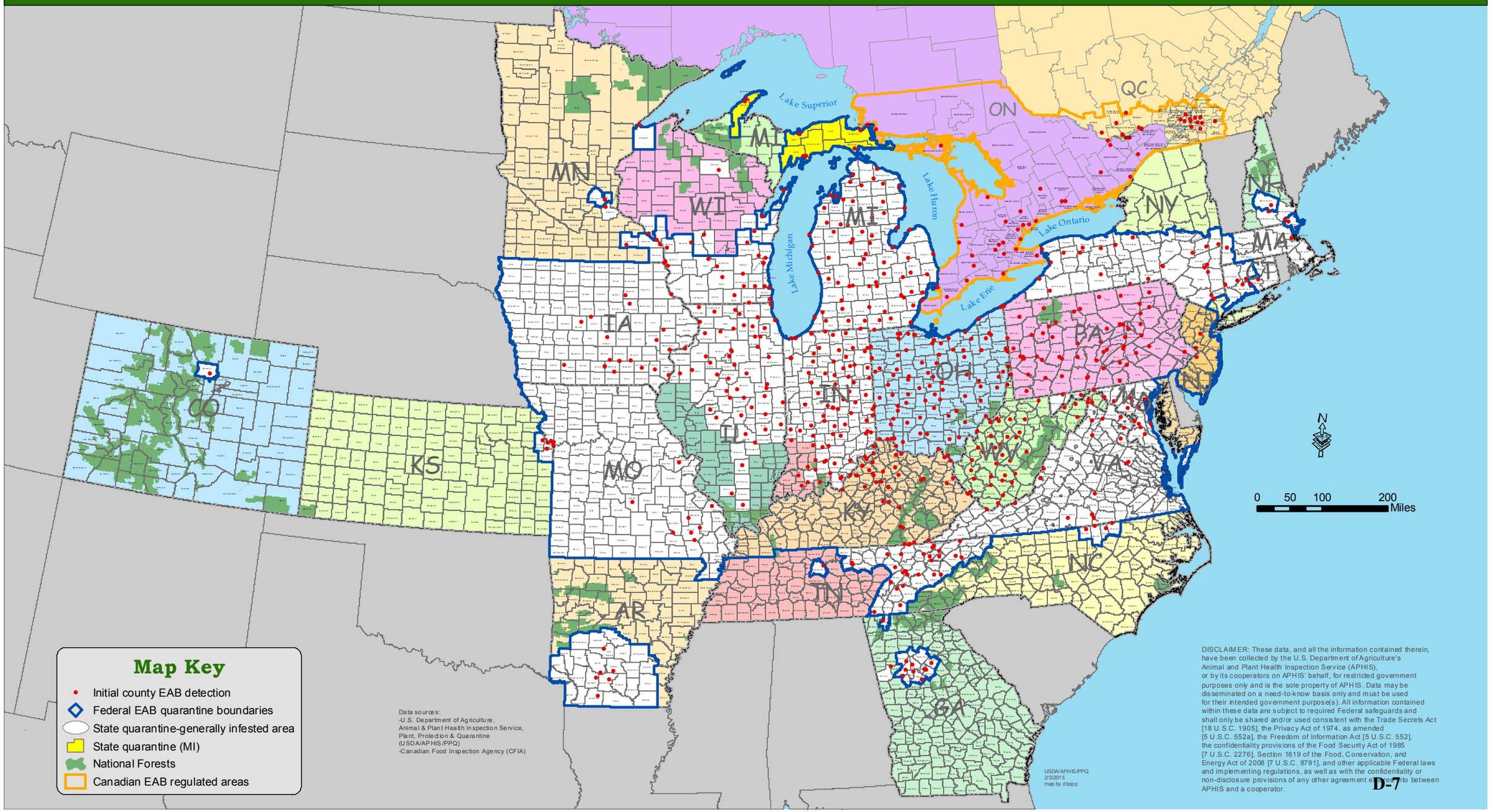

Cooperative Emerald
Ash Borer Project
Approximate
Range of ash species
in North America
Map reproduced from
USDA Forest Service source map
APHIS
USDA/APHIS/PPQ
July 2004
map by dboopp

USDA United States Department of Agriculture

Cooperative Emerald Ash Borer Project

Initial county EAB detections in North America

February 3, 2015



Inspector Name:_____Date:_____

Regulatory Contact
Concern or Business Name:_____
Contact Name:_____
Street Address:_____ City:_____
State:_____ Zip Code _____
County:_____
GPS Lat_____ Long_____
Phone:_____

Concern Type (circle up to three)
Nursery / Garden Center / Firewood Dealer / Public Campground / Private Campground / Milling & Manufacturing / Landscaper / Research / Municipality / Tree Removal Service / Landscaper / Logging Company / Misc. / Pallets / Pallet Stock / Mulch

Aware of EAB Quarantine Y or N If yes, how?_____

Interstate Movement Y or N
What/Commodity?

Frequency of shipments?

Quantity per shipment?

Final Destination of shipments?

From area near EAB positives?

Shipping Documents Available?

Signature below confirms representative(s) of the Cooperative Emerald Ash Borer Project contacted the signatory individual and gave them an information packet about Emerald Ash Borer.

Printed Name: _____

Signature: _____

Date: _____

Survey of Ash

Ash Product	Present? Y or N	Origin	Quantity	Inspected? Y or N	How long has the material been on site?
Firewood					
Nursery Stock					
Estab. Ash					
Ash Chips/Mulch					
Saw Logs					
Other					

Campground Survey

	Ash firewood Present? Y or N	% OH plates	% MI plates	% IN plates	Local Firewood Available	Permanent Campsites Present
Private Campground						
Public Campground						

EAB symptoms or specimens present Y or N,
If yes record ash product and X all indicators that apply.
Ash Product: _____

Crown Dieback	Life Stage	D-shaped holes	Bark splits	Epicormic shoots	Serpentine Gallery	Die-Back	Woodpecker Damage

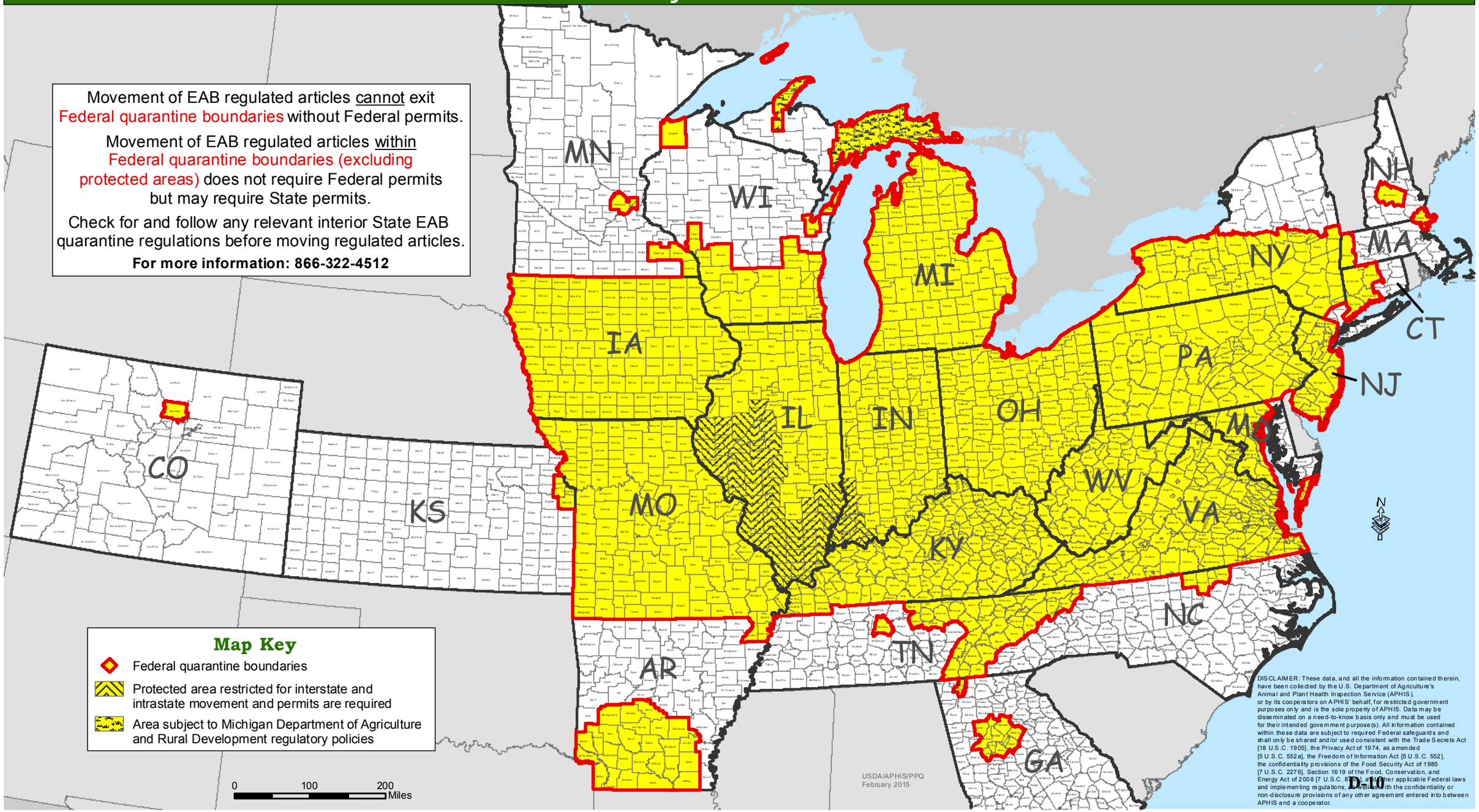
Remarks:

United States Department of Agriculture

Cooperative Emerald Ash Borer Project

Federal EAB Quarantine & Authorized Transit

February 3, 2015



Guidance on Conducting Select Regulatory Activities in the Emerald Ash Borer Program

INTRODUCTION

Initiation of the 1st National Emerald Ash Borer (EAB) Survey in 2008 involved numerous additional states in Program activities, including regulatory activities. This document is intended to provide some guidance on conducting a sampling of regulatory activities in the EAB Program, with an emphasis on those aspects of regulatory work that are unique to the Program. It is not intended to be inclusive or to serve as a manual for setting up and running a regulatory section in support of the EAB Program.

REGULATORY AUTHORITES

In October 2003 APHIS issued a Domestic Quarantine Notice, 7 CFR 301.53 (1)-(9), establishing the emerald ash borer Quarantine. This quarantine defines the regulated area and provides the authority to conduct regulatory activities. The focus of USDA APHIS PPQ regulatory activities fall under 7 CFR.301.53 (4)-(9) which set the conditions governing interstate movement of regulated articles. Several revisions to this quarantine have been published as interim rules or Deputy Administrator issued letters to the State Plant Regulatory Officers. Broad-reaching Federal authority for invasive pests and plant protection also resides in The Plant Protection Act of 2000.

REGULATED ARTICLES

7 CFR 301.53-2(a) classifies the following as **regulated articles**:

- The emerald ash borer in any stage of development
- Firewood of all non-coniferous (hardwood) species
- If in the genus *Fraxinus*
    - nursery stock,
    - green lumber,
    - and other material living, dead, cut, or fallen, including logs, stumps, roots, branches, composted and uncomposted chips of the genus *Fraxinus.*

Any other article, product, or means of conveyance not listed in 301.53-2(a) may also be designated as a regulated article if determined by the EAB Program that it presents a risk of spreading EAB in accordance with 301.53-2(b). In 301.53-1 an infestation is defined as the presence of EAB or the existence of circumstances that make it reasonable to believe that EAB is present. This definition, in conjunction with 301.53-2(b), will allow the EAB Program to take certain actions as required to regulate interstate movement of articles not otherwise covered, or in circumstances not covered by the quarantine. Intrastate movement of regulated articles is addressed under state authorities.

REGULATED AREAS

Federal Quarantines

A map of the areas under federal quarantine is available at the following website:

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/eab_quarantine_map.pdf

State Quarantines

Several states have also established intrastate quarantines for EAB. These are usually on a county-by-county basis. Please consult the office of the State Plant Regulatory Official with specific questions on state quarantines and regulations. Contact information for State Plant Regulatory Officials can be found at the following web site:

http://nationalplantboard.org/membership/

COMPLIANCE AGREEMENTS

Entering into compliance agreements with establishments engaged in regulated activities allows the program to make efficient use of regulatory personnel. The EAB Program currently enters into compliance agreements with establishments engaged in the following activities:

- Firewood producers
- Firewood distributors
- Sawmills that handle non-coniferous wood
- Transporting of non-coniferous timber and/or green lumber
- Production of mulch and/or ash chips
- Treatment of wood products or packing materials that contain ash

A sample of the compliance agreement used by the program can be found at the following website:

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/compliance_agreement/EAB_CA_Template_1.6.pdf

Prior to entering into a compliance agreement with an establishment or business, a site visit to determine ability to meet the terms of the compliance agreement must be made by an authorized inspector. Those requirements must be explained to the establishment, along with the consequences for non-compliance. Signing of the compliance agreement should occur only after all parties are satisfied that the terms of the compliance agreement can and will be met.

Compliance Agreement Monitoring

After a compliance agreement is entered into, periodic visits to monitor continued adherence to requirements must occur. The frequency of these visits is dependent upon a number of factors. The risk assessment matrix below is an example of a tool developed to quantify the risk level created by a regulated establishment, and the consequent minimum period that should elapse between compliance monitoring visits.

Risk Assessment Matrix for EAB

Below are descriptions of risk factors used in the risk assessment matrix to calculate the frequency of compliance monitoring visits to establishments operating under federal compliance agreements. An inspector's judgment is an important tool in determining risk, and other factors not listed below also may be considered.

Risk Factors:

- Ease of Establishment of EAB - Determine potential risk of establishment of EAB given proximity of pest and condition of host (nursery stock would be highest risk)
- Traceability – (inverse risk) if the business operation has easily followed paper trails then the risk is low
- Profile of the Concern – (inverse risk) high profile = low risk. Degree to which concern moves regulated material in large marked vehicles and operates in the public arena.
- Location of Activity –use following zones for risk assignment:
    - High = Within 50 miles of the quarantine boundary
    - Medium = buffer zone within quarantine boundary (50 to 100 miles from boundary)
    - Low = within quarantine area more than 100 miles from boundary
- Mobility of the Regulated Article – The more mobile the higher the risk

Calculating Risk Level: *assign level to each risk factor and multiply times the given factor for total*

Add Total column to arrive at quantified risk level

Example 1: Big nursery operation 55 miles from quarantine boundary
Risk Level = **9**

RISK LEVEL	Ease of Establishment of EAB	Traceability	Profile of Concern	Location of Activity	Mobility of Regulated Articles	**Total**
LOW (x1)		X	X			2
MEDIUM (x2)				X	X	4
HIGH (x3)	X					3

Example 2: Low profile firewood dealer in northern gateway
Risk Level = **14**

RISK LEVEL	Ease of Establishment of EAB	Traceability	Profile of Concern	Location of Activity	Mobility of Regulated Articles	**Total**
LOW (x1)						0
MEDIUM (x2)	X					2
HIGH (x3)		X	X	X	X	12

Example 3: USFS Campground 60 miles from quarantine boundary
Risk level = **11**

RISK LEVEL	Ease of Establishment	Availability of Records	Profile of Concern	Location of Activity	Mobility of Regulated Articles	**Total**
LOW (x1)						0
MEDIUM (x2)	X	X	X	X		8
HIGH (x3)					X	3

Use the following levels to assign a priority for the regulatory check data base
Risk Level 5-6 = Priority 4 – visit as needed
Risk Level 7-9 = Priority 3 – visit semi-annually
Risk Level10-12 = Priority 2 – visit bi-monthly on a minimum
Risk Level 13 – 15 = Priority 1 – visit monthly on a minimum

Firewood Quality Assurance Plan

The firewood quality assurance plan below provides specific guidance on the types and frequency of compliance monitoring activities used for firewood production and distribution.

Purpose: To increase firewood producer accountability and monitor alignment with compliance agreement parameters beyond initial point of production.

Firewood Compliance Agreement Monitoring

Base Line Periodicity

Firewood Treatment	Monitoring Guidance
Debarking and 1/2" of wood removed	Weekly during firewood season
Heat Treatment, Fumigation, Kiln Sterilization	Weekly during firewood season
Safeguarding (i.e. Distribution Facilities)	Monthly

Monitoring Production Facilities

1. Monitoring includes site visits, product inspection, and equipment data review.
2. Random visits should be conducted during non-production season to verify status.
3. The following information should be reviewed/collected periodically as a paper audit and to provide a basis for monitoring distribution facilities.
    a. Customer List
    b. Invoiced quantities
    c. Shipment dates
    d. Production dates
4. Discussions should be held with staff to determine their degree of knowledge regarding EAB regulated items and their handling.

Monitoring Distribution Facilities

1. Monitoring should occur at first transportation event and a minimum of monthly thereafter.
2. A minimum of 10% of the product should be inspected to assure labeling and/or mitigation/treatment requirements are met.
3. The following information should be reviewed/collected periodically as a paper audit.
    a. Customer List
    b. Invoiced quantities
    c. Shipment dates
    d. Production/supplier information

4. If a shipment has an interstate destination, it is recommended to randomly notify the destination state SPHD and request them to do a quality assurance follow-up check at product destination.
5. Discussions should be held with staff to determine their degree of knowledge regarding EAB regulated items and their handling.

Monitoring Firewood in the Marketplace

1. It is recommended that PPQ regulatory officers in each state make it a routine practice to monitor firewood in retail establishments to determine if the product is regulated.
2. If the firewood is regulated it should be inspected to determine compliance with federal regulations regarding that product's movement.
3. It is suggested that at least 5 of these checks are conducted per month.
4. These quality assurance monitoring events should be used as an opportunity to provide outreach and education materials to the retail establishment for potential posting in facility retail or employee areas.

Mulch Sampling Protocol

Size Requirements and Screening Procedure for Hardwood Mulch and Chips in the Emerald Ash Borer Quarantine Area

The following procedure should be followed to determine if hardwood and bark chips, nuggets, and mulch materials can be considered safe for movement from the emerald ash borer quarantine area:

Step 1. Using a 12 inch diameter 3.25 inch deep sieve with 1.25 inch steel mesh openings (Fisher Scientific #04-884-1J) take 10 samples from random locations in the chip or mulch pile - - do not take all samples from the same location. If any chips are found that are greater than 2.5 inches in two dimensions the pile is rejected. If there are no chips found greater than 2.5 inches in two dimensions then proceed to Step 2.

Step 2. If four or more chips from the 10 samples do not pass through the sieve proceed to Step 3. If three or fewer chips from the 10 samples do not pass through the sieve, then the pile passes and can be moved.

Step 3. Resample. Take 10 additional samples from random locations in the chip pile. If any chips are found that are greater than 2.5 inches in two dimensions the pile is rejected. If there are no chips found greater than 2.5 inches then proceed to Step 4.

Step 4. If four or more chips from the 10 samples do not pass through/put through the sieve the pile is rejected. If three or fewer chips fail to pass through the sieve then the pile passes and can be moved.

Note: Mulch chips that do not meet the specified requirements as outlined above may be reground to meet the specification of less than one inch in two dimensions or alternatively composted as outlined on the following pages.

Appendix E

Composting Requirements for Hardwood Mulch and Chips in the Emerald Ash Borer Quarantine Area

GENERAL:

Grinding - The bark/wood chips may be staged at the approved regulated composting bark site until a sufficient quantity is available to produce appropriately sized windrows. Once the windrows are assembled and the treatment has started, no additional material may be added to the windrows. All chip material surrounding the windrows must be cleaned up and added to the windrows at the beginning of the treatment to ensure that there is not untreated material being added to treated material. All equipment used in the transfer of untreated or partially treated material must be cleaned and the debris included in the composting process prior to using the equipment on finished certified material.

Probe type – Temperature recording devices may be 1.) a long probe inserted a minimum of 18" into the piles at the time of recording with temperature measurements recorded in a log book or 2.) a thermocouple with data logger. The probes inserted at the time of recording must be in place for sufficient time to allow the temperature to equilibrate prior to recording. The continuous recording system must have some way to note the current temperatures to gauge when the treatment has been completed prior to disturbing the piles.

Calibration - Every temperature measuring device should be checked and calibrated to be within ±1.0° F once a year at the beginning of the season. It takes about 5 minutes for a thermometer/thermocouple to equilibrate. A lab thermometer can be used to obtain the temperature for the hot tap water in order to know what the reading should show on the thermocouple.

> To calibrate, fill a 5 gallon pail with hot tap water (water temperature for calibrating should be close to the desired target temperature, i.e., 140°F), insert lab thermometer and thermocouple leads. Leads can be taped to be near the thermometer bulb. Stir water for 5 minutes. Thermocouples and composting temperature measuring devices should read ±1.0°F of the thermometer. If not, the thermocouple or compost pile thermometers(s) may be bad. A correction factor can be written on a tape tag at the thermocouple plug.
>
> Hot tap water is closest to the desired target calibration temperature of 140°F (60°C). Do not use ice water or boiling water for conducting this calibration!
>
> After the annual calibration, the thermocouple readings can be checked based on room or outside temperature before taking the readings. If abnormal or unusual readings are experienced at any time, the temperature reading devices/ thermocouples should be recalibrated to ensure they are working properly.

Composting Option For Mulch in Parallel Windrows

1-CONSTRUCTING PHASE 1 COMPOST PILE

1A. Build two parallel windrows of green chips separated at their base by a space of about five to six feet in a preferred North/South lengthwise orientation as space allows. The approximate dimensions of each windrow will be as follows: length, no less than 30 ft.; width at base, 15 ft.; height, 12 ft. (see Figures 1A and 1B).

1B. Measure and record temperatures every 24 hours in the windrows as follows:

1) An initial temperature recording should be made as soon as the windrows have been completed for the given treatment cycle.

2) Mark temperature probe locations across the face of each windrow as shown in Figure 1B. This line of probes will be placed no closer than 15 ft. from the end of the pile.

   Probe locations may be marked by a stake to which a card or plastic ribbon bearing the probe number that has been attached.

3) Record temperatures every morning, to a depth of 18 in, at each probe location as shown in Figure 1A.

   (a) Probes A and F are inserted horizontally 18" above ground level.
   (b) Probes B and E are inserted horizontally 6 ft. above ground level.
   (c) Probes C and D are inserted vertically at top center of the windrow.

4) Continue temperature recordings daily until 140°F (60°C) has been reached and maintained at all probe locations. Windrows will then be ready for turning per USDA PPQ requirements.

2 - CONSTRUCTING PHASE 2 COMPOST PILE

2A. Turn the windrows which have met temperature/time requirements within 3-4 days or before the temperature subsides to form the Phase 2 finished pile (see Figure 2). The turning will be done with a front end loader or other suitable equipment. Great care will be taken to insure that all bark from the unheated mantle of the windrows is buried in the finish pile to a depth of 3 ft. or more. Procedures for turning are as follows:

1) Place Probe G at 18" above ground level in the space between windrows before turning bark into the center space. See instructions Items 2B- 3(d).

2) Shear off the top 3 ft. of each windrow (Figure 2: sections 1 & 2). Push this material into the space between the windrows.

3) Scoop the outer 3 ft. of bark from each windrow turning it into the space between windrows (Figure 2: sections 3 & 4). Also scoop this layer from the end(s) of the windrow and turn it into the center.

4) Cover the top of the finish pile to a 3 ft. depth with the remaining material from the windrow sides (Figure 2: sections 5 & 6). This was the internal material (core) from the windrows that has been composted for at least 4 days at 140°F.

2B. Record temperatures daily in the finish pile as follows:

1) Temperature recording should start as soon as the windrows have been turned to form the finish pile.

2) Mark temperature probe locations (see Figure 3) across the surface of the pile. This line of probes should cross the pile in the same general location where probes were placed across the windrows. This line will be placed no closer than 15 ft. from the end of the pile.

   Mark probe locations with labeled stakes as was done in the windrows.

3) Take and record temperatures every morning as follows (see Figure 3):

   (a) Set Probes A and F horizontally 18" above ground level to a depth of 3 ft. and 18 in.

   (b) Set Probes B and E horizontally 6 ft above ground level to a depth of 3 ft. and 18 in.

   (c) Set Probes C and D vertically on opposite sides of the top center of the pile to a depth of 3 ft. and 18 in.

   (d) Set Probe G 18" above ground level near the center of the space between the windrows. <u>This probe must be set before the windrows are turned in.</u> Bury a bare-tip thermocouple with long, Teflon covered lead extending out of the finish pile.

4) Daily recording of temperatures may be discontinued when temperatures at all probe locations have reached and maintained a minimum 140°F (60°C) for 4 days or longer.

5) The bark/wood chip mulch in the finished pile would now be USDA, PPQ certified as eligible for movement to markets outside of the area regulated by the EAB Quarantine and the appropriate compliance agreement.

Fig. 1A – Windrows

A cross-sectional view of the windrow showing placement dimensions, a 3 ft. mantle, & location of probes for monitoring temperatures.

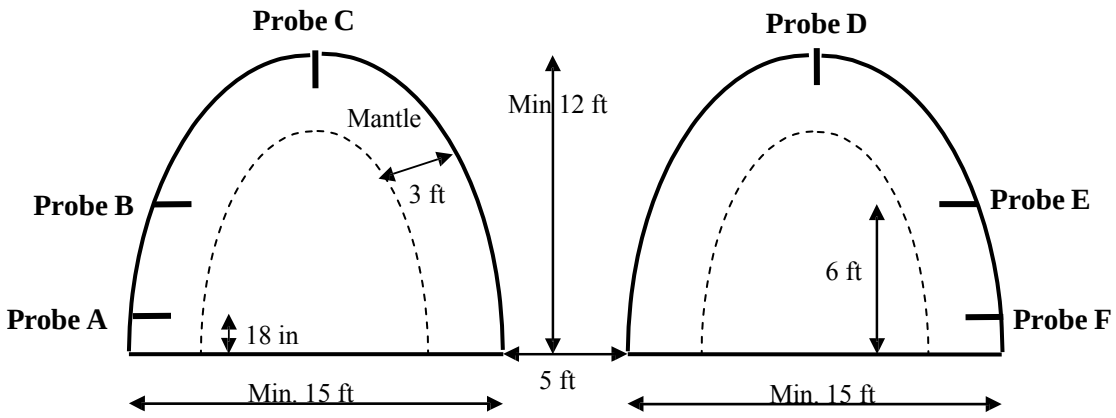


Fig. 1B – Windrows

An overhead view of the windrow showing preferred north-south placement & location of the probes.

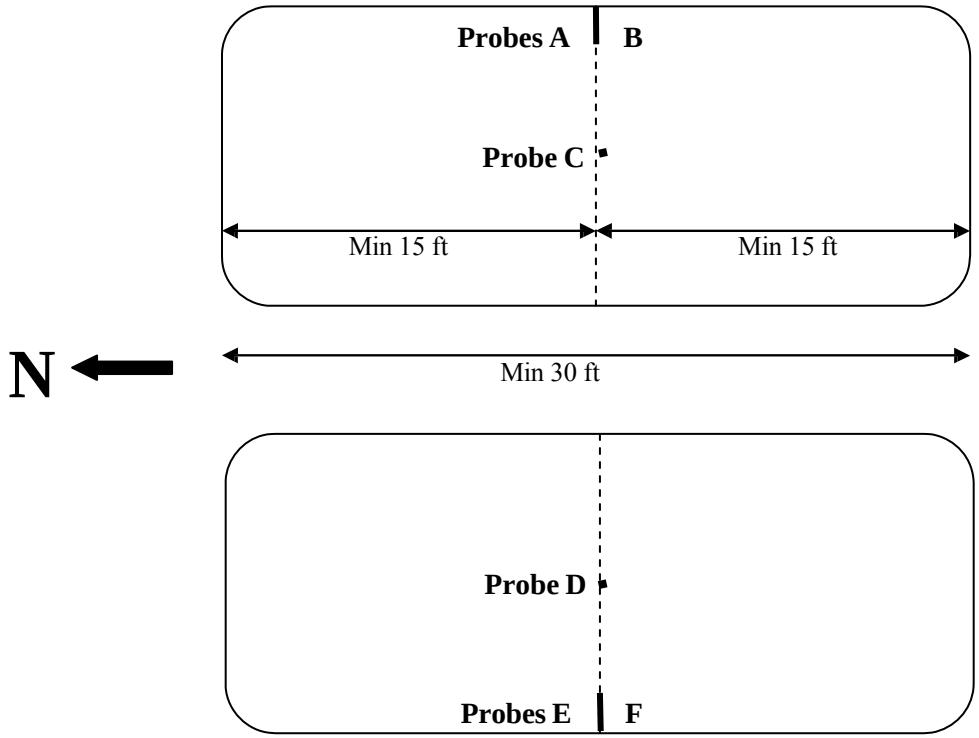


Figure 2 – Windrows to Finish Pile

A cross-sectional view of the windrows showing how the 3 ft. mantle will be turned inward & the inner core brought up to create the finish pile.

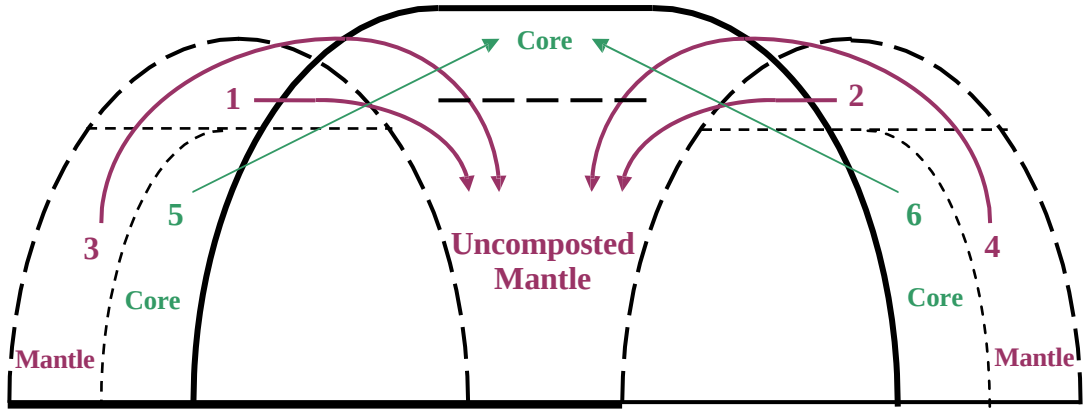
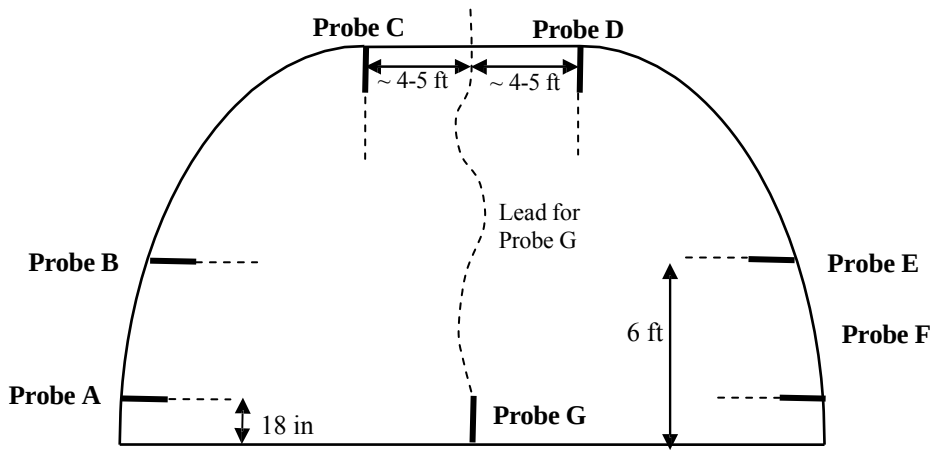


Figure 3 – Finish Pile

A cross-sectional view of finish pile showing location of probes for temperature monitoring. NOTE: Probe G must be placed prior to finish pile creation.



Appendix E

Composting Option For Mulch in a Single Windrow with Straddle-Type Compost Turner

1-CONSTRUCTING PHASE 1 COMPOST PILE

1A. Build one windrow of green chips in a preferred North/South lengthwise orientation as space allows. The approximate dimensions of a windrow will be as follows: length, no less than 30 ft.; width at base, no wider than the maximum capacity of the straddle-type compost turner; height, maximum operating height of straddle-type compost turner utilized. (see Figure 1A and 1B).

1B. Record temperatures every 24 hours in the windrow as follows:

1) Temperature recording should start as soon as the windrow has been completed for the given treatment cycle.

2) Mark temperature probe locations across the face of the windrow as shown in Figure 1B. This line of probes will be placed no closer than 15 ft. from the end of the pile.

   Probe locations may be marked by a stake to which a card or plastic ribbon bearing the probe number that has been attached.

3) Record temperatures every morning, to a depth of 18 in., at each probe location as shown in Figure 1A.

   (a) Probes A and F are inserted horizontally 18" above ground level.
   (b) Probes B and E are inserted horizontally at half the height of the windrow.
   (c) Probes C and D are inserted vertically at top center of the windrow.

4) Continue temperature recordings daily until 140°F (60°C) has been reached and maintained at all probe locations. Windrow will then be ready for turning per USDA PPQ requirements.

2 - CONSTRUCTING PHASE 2 COMPOST PILE

2A. Turn the windrow which has met temperature/time requirements within 3-4 days or before the temperature subsides. The turning will be done with a straddle-type compost turner only. Ensure that all bark/wood from the unheated mantle of the windrow is buried in the turned pile to a depth of 3 ft. or more. The straddle-type compost turner shall make only one pass turning the entire windrow of bark/wood.

2B. Record temperatures daily in the turned pile as follows:

1) Temperature recording should start as soon as the windrow has been turned to form the finish pile.

2) Mark temperature probe locations (see Figures 1A and 1B) across the surface of the pile. This line of probes should cross the pile in the same general location where probes were placed across the windrow. This line will be placed no closer than 15 ft. from the end of the pile.

Mark probe locations with labeled stakes as was done in the initial windrow.

3) Record temperatures every morning as follows:

   (a) Set Probes A and E horizontally 18" above ground level to a depth of 3 ft. (see Figures 1A and 1B)

   (b) Set Probes B and D horizontally half the height of the maximum vertical capacity of the straddle-type composter used in this operation to a depth of 3 ft. (see Figures 1A and 1B)

   (c) Set Probe C vertically on the top center of the pile to a depth of 3 ft. (see Figures 1A and 1B)

4) Daily recording of temperatures may be discontinued when temperatures at all probe locations have reached and maintained a minimum 140˚F (60˚C) for 4 days or longer.

5) The bark/wood chip mulch in the finished pile would now be USDA PPQ certified as eligible for movement to markets outside of the area regulated by the EAB Quarantine and the appropriate compliance agreement.

Fig. 1A – Windrow

A cross-sectional view of the windrow showing placement dimensions, a 3 ft. mantle, and location of probes for monitoring temperatures.

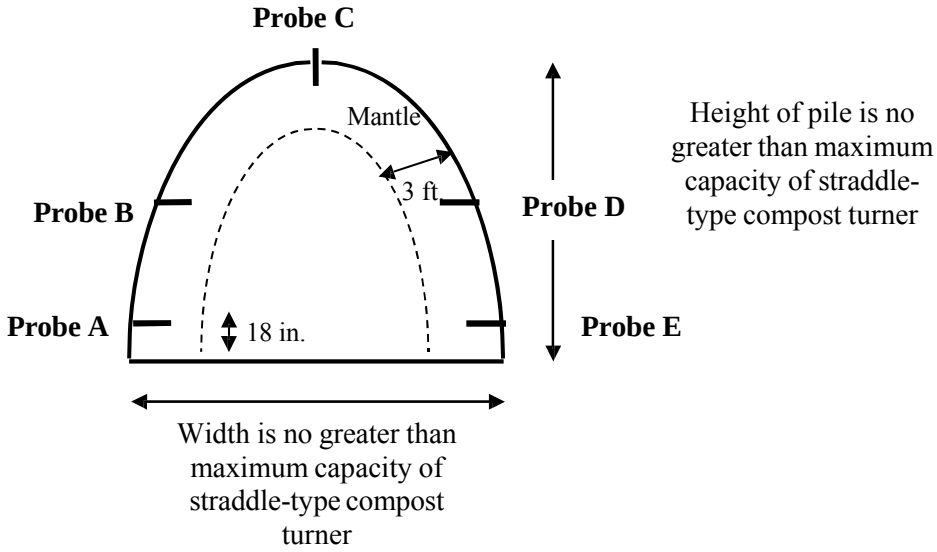
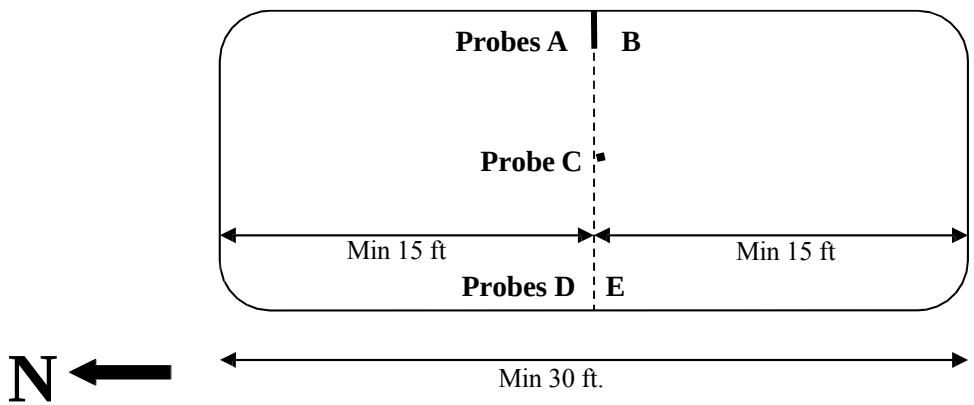


Fig. 1B –Windrow

An overhead view of the windrow showing preferred north-south placement & location of the probes.



LIMITED PERMITS AND FEDERAL CERTIFICATES

Limited Permits and Federal Certificates are instruments used to allow the movement of regulated articles out of quarantined areas. Limited Permits allow for movement to a restricted set of locations, often a single location. Restrictions on movement are detailed on the limited permit issued to the article in question. Federal Certificates allow regulated articles to move to any destination in the United States. Both instruments will contain additional details on the mode of transport and the type and quantity of the article being moved.

Common forms of the Limited Permit include PPQ Form 530, PPQ Form 537 (self-adhesive labels), pre-printed labeling on packaged goods and electronic stamps. In all cases, the Limited Permit remains the property of USDA APHIS. In the EAB Program, PPQ Forms 530 and 537 are used and application of the Limited Permit is restricted to ash logs, lumber, stumps, branches and chips being transported to an approved treatment facility located outside the quarantined area. Both the transporter and the treatment facility must operate under a compliance agreement with the program. Specific conditions governing this movement are contained in the compliance agreement. Limited permits are also issued to non-compliant commodities being returned to the state of origin during the course of regulatory actions taken in response to quarantine violations.

Federal Certificates can be issued in several forms as well, including PPQ Form 540, pre-printed packaging materials and electronic stamps. The EAB Program uses PPQ Form 540 as well as rubber and electronic stamps. Regulated articles eligible for interstate movement when accompanied by a Federal Certificate include ash lumber and logs, stumps and branches, or chips and firewood after they have been processed or treated at a facility operating under a compliance agreement. Specific conditions governing movement of these articles are contained in the compliance agreement relating to the article in question.

Prior to issuance of a Limited permit or Federal Certificate, eligibility of the article for interstate movement must be assured. This assurance is accomplished by entering into a compliance agreement with the person or establishment moving the article, or by the on-site presence of an authorized inspector. If the latter situation occurs, the inspector is responsible for ensuring that all necessary conditions have been met, and for signing and issuing the Limited Permit or Federal Certificate.

SPECIAL OPERATIONS

The EAB Program conducts special operations (sometimes referred to as blitzes) to serve as deterrents and quality control checks for movement of regulated articles. These operations are conducted in concert with state cooperators or less frequently as stand alone federal operations. Violations are issued and investigatory procedures are invoked when it is appropriate to do so for any individuals found moving regulated articles in violation of the federal quarantines. Violations of intra-state quarantines are referred to appropriate state regulatory officials.

Procedural details for planning and conducting a roadside firewood operation are given below as an example:

Roadside Firewood Operations

Early Planning Guidelines

1. **Cooperators:** Define the cooperators to participate in the operation and meet with them well in advance of the operations. Clearly define each others roles and authorities especially as it applies to stops, searches, seizures and what to do with individuals who do not cooperate. Set up a contact point person for each cooperator in the operation. Cooperators to consider are:
   a. State Dept. of Agriculture- This is the primary cooperator and operations should be staffed with both federal and state regulators. Identify those people who can document the federal safeguarding action/violation either on EAN (PPQ523) or ROV (PPQ 518) forms (validity of cooperator cards as authority to issue violations appears to be in question by OGC). Identify who can issue paperwork for state violations. Working in (state/federal) pairs at the pull-off can help the operation run more smoothly and get violators back on the road quickly.
   b. Law Enforcement – Law enforcement cooperators typically include state police for major routes, sheriffs for secondary roads, and municipal police within city/town limits. Motor carrier enforcement is not typically involved in firewood operations; they are more often cooperators when monitoring log movement. Law enforcement generally provides a squad car parked with flashing lights just prior to the stop and a uniformed officer for support. We have found that this is a beneficial arrangement as law enforcement often will find violations of their own or the officers themselves become engaged and participate in the outreach. Also pay attention to jurisdiction—whether the law enforcement branch you go with has the right to exercise the law at your particular site. For example, a county sheriff's deputy in one state related that State Highway Patrol can catch violations on state highways, but once the person is on private property (i.e. the pull off) their jurisdiction ends. A potential benefit for State Departments of Agriculture you may want to explore is determining if the salary/costs of the officer qualify as part of cost sharing towards a federal dollars match in an EAB cooperative agreement. *Note: County sheriffs (and a squad car) are generally less expensive and more available during high-traffic weekends like Memorial/Labor Day. If the*

squad car with flashing lights is parked on the side of the road, have the uniformed officer up at the pull-off to provide security for workers. Violators are much less likely to react aggressively with an (armed) officer close by.

c. State DOT- DOT should be contacted to discuss the operation site and provide traffic control equipment to maximize public and officer safety. Equipment usually includes a flashing marquee about ½ mile before the stop, traffic cones, and barrels. It's a good idea to put "Road Work Ahead" signs for the oncoming lanes so that drivers headed opposite the road block aren't surprised and have a chance to slow down.

d. Public Information Staff – Publicizing these events is critical to continued public education and outreach, but when and how is state driven. In some states they must publicize a roadside stop prior to conducting it. In those states a generic notification has been sent out saying firewood operations would occur over the weekend, but not detailing exactly when or where. Several operations have also invited media to the event itself where they are allowed to shoot footage and usually the PIO meets them there to answer questions and provide outreach. One operation was even published in USA Today.

e. APHIS-IES- It is beneficial to involve IES in the early planning. They may opt not to be present for the operation but as they will be receiving the Notifications of Violation, they should participate in set-up.

f. Native Americans - Any state conducting operations with federally recognized Native American groups may want to outreach to them to let them know and have a voice as appropriate.

g. Misc. – Other state agencies may want to participate such as the DNR. Incorporate these groups as you see fit. If the operation is done close to a state line, the adjoining state should be notified.

2. **Site Selection:** Careful attention should be made to site selection addressing all of the following factors at a minimum. Always secure permission from the landowner (public or private) before choosing a site and be sure to send them a thank-you note after the operation has concluded especially if you'd like to use the site again in the future. If you are not familiar with an area you'd like to blitz, call local law enforcement and DOT garages for suggestions. Sometimes the "perfect" site is not safe for an operation and these professionals can help make that call.

   a. Potential Firewood Movement – Evaluate the route on which the operation is proposed. Does the route provide relatively direct access to recreational areas where camping will occur or is it an artery into the state for vacationers? Will travelers likely be coming from an infested/regulated area? Is it near posted signs that warn motorists they are crossing a quarantine line? Are there firewood dealers nearby inside the quarantine that are selling wood (legally) without informing customers of quarantine laws?

   b. Traffic Volume – At this point, no mandatory stop operations have been conducted on interstate highways for valid reasons. Volume of traffic is high, vehicle speeds are high, and stop logistics untenable for law enforcement. Roadside rest areas can be used for "voluntary" firewood checkpoints. Provide an electronic sign so that drivers exit the freeway and conduct the operation in the

parking lot. The best options thus far have come from secondary US routes and state routes that are two lane roads. It is extremely useful to place the stop at an area where the road widens into 3 lanes for a short time. Officers can generally work safely in the middle lane. On these secondary routes traffic volume is sufficient to make operations effective but, not such a great volume that officers are creating back-ups. One consideration we have agreed to with law enforcement is to stop operations if the back-up becomes too great and allow a period of free movement. You may also opt to wave commercial/municipal vehicles through the block to keep traffic flowing at a reasonable rate.

c. Physical Conditions – The site must provide regulators the ability to stop cars safely, provide an inspection area, route vehicles back into traffic, and provide staff parking. Examples of sites used have included: two lane road near church with church's permission to use parking lot for inspections and church bathroom for officers; three lane route with temporary storage yard permission to use parking lot for inspections, gas stations nearby; two lane route with extensive shoulder/parking area in front of residence/business with owner permission; two lane route with historic marker pullout for inspection; town street with Elks Lodge permission to use parking lot for inspection and lodge for bathrooms (although they were not too happy with us when they realized the town cop would be with us all day watching who came in to drink and how long they were there).

d. Amenities – Operations vary in length from 6 to 12 hours typically and needs of the regulatory staff must be considered. Restroom facilities must be provided within a reasonable distance. If no eating facilities are near-by staff needs to be informed so they can prepare for that. The program has several shade tents and usually sets one up to give officers a break from the sun and/or rain. It can be very hot standing on the tarmac in the sun. The program has provided ice chests and management has provided bottled water and ice (from our own pockets-not govt. approved). Chairs and a folding table are also a real benefit to allow people breaks. This is no place to work on a suntan—sun block and appropriate clothing is essential, even on cloudy days.

e. Firewood Disposal – This is a critical component. If the operations are conducted outside a quarantined area (usual circumstance) then the material collected must be safeguarded or treated immediately. To date the program has utilized enclosed vehicles to store wood and transport it back into the quarantined area or burned it expeditiously on site or near-by. Another option would be to have a chipper on site and chip the material to less than 1" in 2 dimensions. Some state run operations have routinely allowed the individuals to burn the material within 48 hours. The EAB program does not support that disposition option. *Note: When disposal issues can not be resolved, an alternative approach is to set up a road block just inside the quarantine boundary and warn motorists that they are about to break the law. This is particularly useful in areas where the quarantine has just been expanded/imposed and serves as more of an outreach than regulatory activity*

3. **Operation Date:** The most effective dates for operations are those that precede some event in the area that draws the camping public. This can be as obvious as traditional

holiday weekends including Memorial Day, Labor Day, and 4th of July. There are many other events that may occur in your area that draw large crowds that camp. Check state park event listings for other ideas. Remember, camping season isn't just between Memorial and Labor Days—people tend to bring more firewood for the chilly fall nights. Some we have run across are:

- Bluegrass music festivals
- NASCAR races
- Coon dog trials
- Native American pow-wows
- Fall color tourism
- Hunting season
- Halloween (a large camping draw in Ohio)
- Horse camping events
- Fishing tournaments
- Morel season
- College rivalry sporting events

4. **Equipment:** What follows is a list of equipment the program has found useful at operations.
   a. Shade tent
   b. Folding table
   c. Folding chairs
   d. Orange pylons
   e. Cooler
   f. Enclosed vehicle for firewood transportation
   g. Operations Box (OpsBox) – plastic tubs w/lid kept in readiness
      1. Work gloves
      2. Vials with alcohol & larval forceps
      3. Chisels
      4. Outreach material – pamphlets, tattoos, EAB ID guides, etc. Bring hundreds of brochures—this may be your only chance to get EAB materials directly into the hands of these people.
      5. Accordion folders with: operation protocol, current quarantine maps, current quarantine language, EANs, PPQ 518s, maps to closest hospital/urgent care facility, PPQ 391s, directions to disposal site if applicable, lists of participants and contact numbers, operation log, survey forms, and written documentation of your agency's authority to conduct this operation and seize private property
      6. Hand held STOP/SLOW signs
      7. Safety vests – reflective mesh with pocket
      8. Orange flags
      9. First aid kit
      10. Flashlight
      11. Digital camera
      12. Outreach folder—violators are often angry and complain that they've never even heard of EAB or firewood movement. Compile a binder/booklet/file of

local newspaper articles, TV station transcripts, pictures, posters, etc. to avoid unpleasant phone calls to government offices made by those inconvenienced people.

Firewood Operation Staffing Duties

Roadway

Law Enforcement: Slow traffic flow ahead of the blitz

Vehicle Profiler (2):
- Tallies vehicle numbers
- Assesses vehicle for secondary referral
- Marks referred vehicle with flagging tape or radios ahead
- Provides EAB literature to drivers waved through

Flagger (1):
- Directs cars into inspection area and out of inspection area

Inspection Area

Interviewer/Inspector (4 – two teams):
- Greet and present identification
- Ask drivers if they are carrying firewood
- Ask about carrying firewood and ask to inspect the vehicle
- If no firewood found thank the driver, provide EAB pamphlet, remove flagging, and direct back into traffic
- If illegal hardwood firewood present seize and safeguard, explain why firewood is illegal, complete seizure record and a PPQ 523 EAN, take pictures of firewood with an identifier in the picture
- Inform the driver about penalty procedures

Other
Staff to alternate with other positions (1-2)
Supervisor (minimum 1)

Conducting Roadside Firewood Operations

- Personnel should be properly dressed according to their agency guidelines but at least wearing or carrying an item that identifies them as regulatory officials. This is for safety and program identification.
- It is recommended that each inspector have a flashlight for inspection after dark and a pair of gloves for unloading seized firewood.
- Law enforcement involvement is mandatory. In most scenarios law enforcement should be present and participating. If on site law enforcement is not possible it is

still mandatory to contact local law enforcement and inform them about the operation and solicit their support. A list of appropriate law enforcement contact numbers must be on site as well as a map to the nearest trauma facility. Traffic management should be handled by law enforcement and the use of safety aids should be maximized; electronic signs, reflective cones, reflective vests, etc.

- Traffic will be slowed, preferable by law enforcement, and regulatory personnel will visually inspect vehicles for evidence of regulated materials. If no regulated materials are present, thank the motorist for their cooperation, provide an educational pamphlet, and waive these vehicles on. When regulated materials are present, or there is an indication that regulated materials may be present as evidenced by related materials, the vehicles will be directed to the designated secondary inspection areas. All secondary inspections need to take place out of the flow of traffic in an area safe for travelers to enter/exit vehicles and for thorough inspection to take place. Cones should be used to mark of inspection areas and promote safe traffic flow.
- Contact with vehicles and travelers referred for secondary inspection should be conducted safely and with the following points in mind:
- Do not approach a vehicle alone, work in pairs
- Do not enter a vehicle or trailer unless another inspector is aware of your intent and is monitoring the situation
- If approaching a vehicle at night, use a flashlight
- Visually check the car and occupants for weapon or hazardous situations before focusing on the survey interview
- Be aware of vehicle occupants as you talk with them
- Never stand directly in front of a vehicle
- If violence is encountered, retreat to a safe place if possible, contact and wait for law enforcement
- In a polite and professional manner, identify yourself, present badge/identification and explain the reason for your contact, explain the program and its purpose, and the programs impact and threat to the nation's resources. Describe the quarantines (have copies available) and explain the ban on movement of regulated materials from the regulated areas.
- When a motorist is found transporting regulated materials, conduct an interview gathering information expeditiously.
- If regulated material is found moved in violation of the quarantine, regulatory action will be taken. Seizure of all of non-compliant regulated materials is required. Explain the enforcement activity and quarantine. e Plant Protection Act of 2000 and appropriate state legislations
- A PPQ 523 (Emergency Action Notification) shall be completed for each regulatory seizure.
- For all commercial violations contact a supervisor.
- Confiscated regulated materials should be seized and safeguarded in a safe and efficient manner.
- Should a motorist become belligerent and refuse to give up their fire wood or attempt to "run" the checkpoint remove yourself to a safe place and contact law enforcement. Do not attempt to detain travelers for non-compliance. Despite their non-compliance,

gather as much information as possible and enter it into the survey data, especially the license plate number. Further regulatory follow up will be required.

- Enclosed vehicles or containers must be on hand to safeguard confiscated items for the duration of the operation. The operation site may not be vacated until all confiscated materials are safeguarded or removed for destruction.

Remember, you are representing the United States Departments of Agriculture. Many citizens will be transiting through the operation area. Present a professional and informed presence. Use good common sense and, most importantly: WORK SAFE!!!!

Other special operations conducted by the EAB Program include weigh station and highway rest area operations and campground operations. Weigh station operations typically target logging trucks moving logs out of quarantine. Rest area operations focus on motorists moving firewood and also provide excellent outreach opportunities. Campground operations target campers moving firewood and also provide outreach opportunities.

VIOLATIONS/INVESTIGATIVE AND ENFORCEMENT SERVICES

When individuals or companies violate federal regulations their actions may result in the case being turned over to Investigative and Enforcement Services (IES). EAB Program officers will issue Limited Permits to non-compliant commodities when necessary and fill out required paperwork, Emergency Action Notification and Notices of Violation, as described in the Manual for Agricultural Clearance. Officers will also provide statements that are complete and accurate and suitable for an affidavit. EAB officers are responsible to identify and secure for the investigator all the documents, items or photographs that may be used as evidence. Chains of custody will be initiated by program officers for items of evidence such as EAB specimens, ash firewood or shipment paperwork if necessary.

Non-Commercial Violations

The movement of firewood presents a significant risk for artificial spread of EAB. This movement has a commercial component but a large percentage of it is done by individuals who are moving it for personal use to go camping, supply vacation homes, or provide fuel for winter heating. The EAB Program has made a concerted effort to educate this segment of the population about EAB and the risks in moving firewood. This is particularly difficult in areas where woodlots abound and camping and hunting are major recreation activities. The program soon realized that an EAB educated but non-compliant portion of the public continues to move firewood. It has been the past practice of IES and PPQ to not penalize non-commercial violations of domestic quarantines. This past practice gave the program no appropriate deterrent for these violations. EAB program officials worked with IES and CPAT to create a stronger regulatory platform for the program. It was agreed that the non-commercial violations would be reviewed by IES field investigators, but not investigated, and then referred to headquarters. IES staff in headquarters assesses a penalty using a table of penalties. In general, stipulations begin at $250.00 per non-commercial violation but may be higher depending on aggravating factors.

Commercial Violations

Commercial violations of the EAB regulations are processed through IES as in the past. Notices of Violation, associated paperwork and evidence is forwarded to IES field staff for further investigation, then submission to headquarters.

Cooperation with State Regulatory Enforcement

When less than an entire state is quarantined program officers may encounter violations of the state quarantine that do not involve interstate movement. 301.53-1 defines an infestation to be the presence of EAB or the existence or circumstances that make it reasonable to believe that EAB is present. This stipulation, along with 7 CFR 301.53-2(b) stating that any other article, product, or means of conveyance not listed in 301.53-2(a) may also be designated as a regulated article if determined by the EAB Program that it presents a risk of spreading EAB, will allow officers to take appropriate safeguarding action in this situation. The program officer should immediately make contact with a state regulatory official and fill out a PPQ 523 (EAN) if necessary. The officer should prepare a statement for use by state officials.

Appendix E

Inspection Log

Date:_____ Location:_____

Time (use hour intervals)	# of Inspections	Positive for Regulated Material	Seizure	Aware of EAB Quarantine
Totals:				

Remarks:

Firewood Operation Staffing Duties

Roadway

Law Enforcement: Slow traffic flow ahead of the operation

Vehicle Profiler (2):
- Tallies vehicle numbers onto log sheet
- Assesses vehicle for secondary referral
- Marks referred vehicle with flagging tape or radios ahead
- Provides EAB literature to drivers waved through

Flagger (1):
- Directs cars into inspection area and out of inspection area

Inspection Area

Interviewer/Inspector (4 – two teams):
- Greet and present identification
- Ask drivers where they are coming from and if they are carrying firewood
- Ask to inspect the vehicle
- If no firewood found thank the driver, provide EAB pamphlet, remove flagging, and direct back into traffic
- If illegal hardwood firewood is present seize and safeguard, explain why firewood is illegal, complete survey record and a PPQ 523 EAN, take pictures of firewood with an identifier in the picture
- Inform the driver about penalty procedures

Other

Staff to relieve other positions (1-2)
Supervisor (minimum 1)

Total Staffing = 10 (numbers may be reduced if low volume roadway is selected)

#1 Priority – Safety
#1 Priority -- Courtesy

Appendix E

Vehicle Log

State **Department of Agriculture** **Firewood Stop**

United States Dept. of Agriculture **Location:**

Time (use hour intervals)	# of Commercial Vehicles	# of Cars (sedans)	# of RVs	# of Trucks (SUVs, Vans)	# of Referrals	# Inspections Conducted
Totals:						

Remarks:

Cooperative Emerald Ash Borer Project **Regulatory Special Operation**

(Fill out for each traveler carrying regulated articles)

Inspector Name: _____ Agency:_____Date:_____

Operation Stop Location:_____Time:_____

IDENTIFICATION AND ORIGIN OF INDIVIDUAL **LICENSE PLATE # IS MANDATORY**	NAME: _____ ADDRESS: _____ _____ CITY:_____STATE: ____ZIP: _____ PHONE:_____ LICENSE PLATE (INCLUDING STATE):
Individual/Regulated Item Destination (Campground, Business, etc.) **COUNTY IS MANDATORY**	Enter Destination Information here: **COUNTY**
Regulated Item Origin	Inside quarantine?_____Yes_____No Origin if different than traveler (county, address, etc.):
Traveler aware of EAB Quarantine/Regulations?	_____No _____Yes (if yes, how?) How? _____
Regulated Item Type: ____Nursery stock_____Logs/Lumber ____Firewood _____Other	If firewood mark blanks as appropriate: _____Commercial Package_____Non-commercial Ash present_____Yes_____Unknown
Amount of Regulated Item	_____ Piece Count _____ Estimated Weight
Regulatory Action	Seizure?_____Yes _____No If no why not? _____
Evidence of EAB –check those that apply→ EAB Inspection not conducted:	_____D shaped exit holes _____Bark splits _____ Serpentine galleries_____EAB life stage
Comments:	

Inspector Name:_____Date:_____

Regulatory Contact
Concern or Business Name:_____Contact Name:_____
Street Address:_____City:_____
State:_____ Zip Code _____
County:_____ GPS
Lat_____Long_____
Phone:_____

Concern Type (circle up to three)
Nursery / Garden Center / Firewood Dealer / Public Campground / Private Campground / Milling & Manufacturing / Landscaper / Research / Municipality / Tree Removal Service / Landscaper / Logging Company / Misc. / Pallets / Pallet Stock / Mulch

Aware of EAB Quarantine Y or N If yes, how?_____

Interstate Movement Y or N
What/Commodity?

Frequency of shipments?

Quantity per shipment?

Final Destination of shipments?

From area near EAB positives?

Shipping Documents Available?

Signature below confirms representative(s) of the Cooperative Emerald Ash Borer Project contacted the signatory individual and gave them an information packet about Emerald Ash Borer.

Printed Name: _____

Signature: _____

Date: _____

Survey of Ash

Ash Product	Present? Y or N	Origin	Quantity	Inspected? Y or N	How long has the material been on site?
Firewood					
Nursery Stock					
Estab. Ash					
Ash Chips/Mulch					
Saw Logs					
Other					

Campground Survey

	Ash firewood Present? Y or N	Local Firewood Available	Permanent Campsites Present
Private Campground			
Public Campground			

EAB symptoms or specimens present Y or N,
If yes record ash product and X all indicators that apply.
Ash Product: _____

Crown Dieback	Life Stage	D-shaped holes	Bark splits	Epicormic shoots	Serpentine Gallery	Die-Back	Woodpecker Damage

Remarks:

Useful Sources to Identify Regulatory Concerns

A variety of methods are used by EAB regulatory staff to locate individuals/businesses that present a risk of spreading EAB. Below is a list of some of those that have been most effective along with some examples.

1. Physical Reconnaissance
2. Phone Directory Yellow Pages
    a. Sources
        - Superpages.com
        - Switchboard.com
        - Yellowbook.com
        - Google.com
    b. Keywords
        - Firewood
        - Lumber Wholesale
        - Sawmills & Planing mills
        - Campgrounds
        - Logging
3. Internet Auctions
    a. Ebay
4. Trade magazines
    a. Physical magazines
    b. Internet newsletters
        http://www.timberlinemag.com/aboutTL.asp
        http://www.timberpa.com/index2.htm
        http://www.timberbuyer.net/forum.shtml
        http://www.logsplitters.com/ArborAssociations.html
5. Internet Chats/Blogs
    a. Firewoodcenter.com
    b. Firewood.com
6. Internet Search Engine
    a. Google
    b. Yahoo
    c. MSN
7. State records
    a. LLC/Inc. registrations
8. County records
    a. DBA (Doing Business As) Licenses

9. Forest Industry Directories
    a. State Dept. Natural Resource
    http://www.michigandnr.com/wood/
    b. Forest Service
    http://www.srs.fs.usda.gov/econ/econhome.htm
10. County Health Departments
    Public Health - many states test private campground water sources
11. Personal Referrals
12. Targeted Operations

The information requested is voluntary, and is needed to record your knowledge of possible irregularities under the USDA Plant Protection and Quarantine Program.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE

REPORT OF VIOLATION

SERIAL NO. A 229511

1. DATE VIOLATION DISCOVERED

2. VIOLATED - REG/COMPL. AGREEMENT

3. WHERE INTERCEPTED *(City or Port, and State; also county if domestic)*

4. ORIGIN OF ARTICLE *(Include county if domestic)*

5. ARTICLE MOVED IN VIOLATION OF REGULATIONS

6. IDENTITY OF ARTICLE *(Serial No., Waybill No., description, etc.)*

7. NAME AND BUSINESS ADDRESS OF VIOLATOR *(Shipper, caterer, cleaner, garbage handler, servicing agent, broker, ship's agent, etc. Identify which)*

8. VIOLATOR HAD Compliance agreement? ☐ Yes ☐ No Permit? ☐ Yes ☐ No

9. IF NO, VIOLATOR WAS AWARE OF REGULATION? ☐ Yes ☐ No ☐ Unknown

If "Yes," how informed and when?

10. NAME AND BUSINESS ADDRESS OF CARRIER

11. CARRIER WAS AWARE OF REGULATION? ☐ Yes ☐ No ☐ Unknown

If "Yes," how informed and when?

12. IDENTITY OF CARRIER

PLANE Acft. No. Flight No.

SHIP Flag Name

ROAD VEHICLE License No.

13. NAME AND BUSINESS ADDRESS OF CONSIGNEE

14. DISPOSITION OF PEST RISK *(i.e., articles named in Item 5 were fumigated, destroyed, etc.)*

15. REMARKS *(Attach additional sheet, if needed)*

16. VIOLATOR OR CARRIER'S STATEMENT OF VIOLATION *(Attach additional sheet, if needed. Identify who gave statement.)*

17. OFFICER'S STATEMENT: Must attach a detailed, signed, and dated statement. State how the action violated the regulations or compliance agreement cited in Item 2. Describe fully the facts of the violation from discovery through disposition of pest risk including when, who, what, and where.

18. SIGNATURE OF INITIATING OFFICER

19. PRINTED NAME OF OFFICER AND WORK UNIT

20. DATE REPORT COMPLETED

21. OFFICER IN CHARGE COMMENTS *(Attach additional sheet, if needed)*

List Previous Violations

Recommendations

22. SIGNATURE OF OFFICER IN CHARGE

23. PRINTED NAME OF OFFICER IN CHARGE AND WORK UNIT

24. DATE SIGNED

PPQ FORM 518
AUG 2002

Previous editions are obsolete.

Appendix H

FORM APPROVED - OMB NO. 0579-0102

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE

EMERGENCY ACTION NOTIFICATION

SERIAL NO.

1. PPQ LOCATION

2. DATE ISSUED

3. NAME AND QUANTITY OF ARTICLE(S)

4. LOCATION OF ARTICLES

5. DESTINATION OF ARTICLES

6. SHIPPER

7. NAME OF CARRIER

8. SHIPMENT ID NO.(S)

9. OWNER/CONSIGNEE OF ARTICLES

Name:

Address:

PHONE NO.

FAX NO.

SS NO.

TAX ID NO.

10. PORT OF LADING

11. DATE OF ARRIVAL

12. ID OF PEST(S), NOXIOUS WEEDS, OR ARTICLE(S)

12a. PEST ID NO.

12b. DATE INTERCEPTED

13. COUNTRY OF ORIGIN

14. GROWER NO.

15. FOREIGN CERTIFICATE NO.

15a. PLACE ISSUED

15b. DATE

Under Sections 411, 412, and 414 of the Plant Protection Act (7 USC 7711, 7712, and 7714) and Sections 10404 through 10407 of the Animal Health Protection Act (7 USC 8303 through 8306), you are hereby notified, as owner or agent of the owner of said carrier, premises, and/or articles, to apply remedial measures for the pest(s), noxious weeds, and or article(s) specified in Item 12, in a manner satisfactory to and under the supervision of an Agriculture Officer. Remedial measures shall be in accordance with the action specified in Item 16 and shall be completed within the time specified in Item 17.

AFTER RECEIPT OF THIS NOTIFICATION, ARTICLES AND/OR CARRIERS HEREIN DESIGNATED MUST NOT BE MOVED EXCEPT AS DIRECTED BY AN AGRICULTURE OFFICER. THE LOCAL OFFICER MAY BE CONTACTED AT:

16. ACTION REQUIRED

☐ TREATMENT:

☐ RE-EXPORTATION:

☐ DESTRUCTION:

☐ OTHER:

Should the owner or owner's agent fail to comply with this order within the time specified below, USDA is authorized to recover from the owner or agent cost of any care, handling, application of remedial measures, disposal, or other action incurred in connection with the remedial action, destruction, or removal.

17. AFTER RECEIPT OF THIS NOTIFICATION COMPLETE SPECIFIED ACTION WITHIN (Specify No. Hours or No. Days):

18. SIGNATURE OF OFFICER:

ACKNOWLEDGMENT OF RECEIPT OF EMERGENCY ACTION NOTIFICATION

I hereby acknowledge receipt of the foregoing notification.

SIGNATURE AND TITLE:

DATE AND TIME:

19. REVOCATION OF NOTIFICATION

ACTION TAKEN:

SIGNATURE OF OFFICER:

DATE:

PPQ FORM 523 (JULY 2002) Previous editions are obsolete.

Clear Form

Appendix I

PPQ Form 530 – (Limited Permit)

No. C-325575

Information requested is needed to determine if a permit can be issued (7 CFR 301).
FORM APPROVED: OMB NOS. 0579-0068 & 0579-0123
See reverse side for additional information.

U.S. DEPARTMENT OF AGRICULTURE
ANIMAL AND PLANT HEALTH INSPECTION SERVICE
PLANT PROTECTION AND QUARANTINE

LIMITED PERMIT

This permit authorizes the movement of the NONCERTIFIED articles described below to a specified destination for limited handling, utilization, or processing, or for treatment. The movement of such articles is regulated by Federal or State cooperative domestic plant quarantines.

1. DATE ISSUED	2. VOID AFTER

3. NAME OF CONSIGNOR

4. SHIPPING POINT

5. NAME AND ADDRESS OF CONSIGNEE

6. VEHICLE LICENSE NO. & STATE	7. R.R. CAR INITIALS

8. DESCRIPTION

A. Quantity	B. Article	C. Remarks

9. SIGNATURE OF ISSUING OFFICER

ENDORSEMENT

The above described shipment was received by the designated consignee, and was handled in the manner approved under the provisions of all applicable Federal or State cooperative domestic plant quarantines.

10. DATE RECEIVED

11. SIGNATURE OF DESTINATION OFFICER

PENALTY FOR MISUSE OR ALTERATION (7 USC 163)

PPQ FORM 530 (FEB 2002)
Previous edition dated APR 88 may be used.

PART 1 - CONSIGNEE'S COPY

☆ U.S. GOVERNMENT PRINTING OFFICE: 2002–722-410

PPQ Form 540 – (Certificate)

FORM APPROVED
OMB NO. 0579-0088

Information requested is needed to determine if a permit can be issued (7 CFR 301). See reverse side for additional information.

E 089704

U.S. DEPARTMENT OF AGRICULTURE
Animal and Plant Health Inspection Service
Plant Protection and Quarantine

CERTIFICATE

This certificate must be surrendered to the consignee at destination of shipment.

The articles described below are certified under all applicable Federal or State cooperative domestic plant quarantines.

1. DATE ISSUED
2. VOID AFTER
3. NAME OF CONSIGNOR
4. SHIPPING POINT
5. NAME & ADDRESS OF CONSIGNEE
6. VEHICLE LICENSE NO. & STATE
7. R.R. CAR INITIALS & NO.
8. DESCRIPTION

A. Quantity	B. Article	C. Remarks

9. SIGNATURE OF ISSUING INSPECTOR

PENALTY FOR MISUSE OR ALTERATION
(7 USC 163)

PPQ FORM 540
(APR 89)

Previous edition obsolete.

PART 1—CONSIGNEE

Passive dispersal pathways of emerald ash borer, *Agrilus planipennis* (Fairmaire), (Coleoptera: Buprestidae) identified by USDA APHIS PPQ EAB Program

Item: *Firewood*

Type: Packaged/bundled or bulk (split, unsplit, or slab)

Pathway:
- "Big box" store
- Firewood producer/distributor
- Firewood broker
- Sawmill slab wood
- Campground
- Online sale and auction
- Local auction
- Roadside sale
- Small business sale
- Homeowner collection

Method of transport:
- Long-distance hauling company
- Domestic parcel delivery service
- Private vehicle

Item: *Solid Wood Packing Material*

Type:
- Dunnage
- New and recycled pallet
- Pallet stock/cant
- Crating
- Case
- Skid
- Block

Pathway:
- Pallet manufacturer
- Sawmill
- Distribution center

Method of transport:
- Railway
- Freighter
- Long-distance hauling company
- Domestic parcel delivery service
- Air cargo service

Item: *Lumber*

Type: Sawn timber
- Green lumber
- Air-dried rough lumber
- Air-dried dimensioned lumber
- Miscellaneous products
  - Railroad ties
  - Crane mats
  - Stakes
  - Trailer beds and sides

Pathway: Sawmill
- Portable sawmill operator

Method of transport: Railway
- Long-distance hauling company
- Domestic parcel delivery service
- Local delivery service

Item: *Logs*

Type: Saw log
- Pulp log
- Veneer log

Pathway: Logger
- Log hauling company
- Sawmill
- Portable sawmill operator
- Tree service company
- Veneer mill
- Paper mill
- Pulp mill

Method of transport: Freighter/barge
- Railway
- Long-distance hauling company
- Local hauling service

Item: *Chips*

Type: Biofuel
Animal bedding
Engineered wood panel material

Pathway: Wood-fired utility company
Panel manufacturer
Zoo
Tree service company
Sawmill

Method of transport: Long-distance hauling company
Railway
Local delivery service
Private vehicle

Item: *Mulch (Composted and uncomposted)*

Pathway: Landscape company

Method of transport: Long-distance hauling company
Local delivery service
Private vehicle

Item: *Nursery Stock (Fraxinus spp.)*

Pathway: Nursery
Online sales and auction

Method of transport: Long-distance hauling company
Local delivery service
Private vehicle

Standard Operating Procedure (SOP) for Domestic Transport of Emerald Ash Borer (EAB) Host Logs to Ports of Export

This document specifies procedures for domestic movement of eligible EAB host logs (*Fraxinus* spp.) to a port of export outside of EAB quarantine zone for shipment to an importing country that does not require fumigation or other treatment. Movement must comply with regulations in 7 CFR 301.53, to ensure all risk factors are mitigated and safeguarding requirements are met. This process will allow for domestic movement of *Fraxinus* spp. logs by exporters, such that industry and trade are not impeded, but safeguarding measures are effectively implemented in protecting U.S. agriculture and the environment.

Regulated eligible EAB host logs (*Fraxinus* spp.) may be moved from a quarantined area for export to a foreign country, if free of signs of active EAB infestation and moved with a Limited Permit. Eligible *Fraxinus* spp. logs are inspected at the log yard/mill or initial point of departure by an Authorized Certification Official (ACO). An ACO can issue a Limited Permit for domestic movement of *Fraxinus* spp. logs, where it is determined the logs are apparently free of EAB based on inspection. In addition, proper safeguarding practices must be maintained, the logs placed into a fully enclosed shipping container with all openings safeguarded and the doors sealed for transport to the port of export, thus mitigating risk of EAB escape.

The shipping container is sealed at the log yard/mill or initial point of departure with intent for international export, as verified by the waybill(s). The container shall remain sealed throughout domestic transport and through the port of export until arriving at the intended foreign port of import. The container must not be opened or the seal broken by unauthorized personnel at the port of export, including for the purpose of fumigation or treatment. The carrier must keep the limited permit, issued for domestic movement of the regulated *Fraxinus* spp. logs, with the sealed containerized logs during transport to the port of export. The destination officer's copy of the Limited Permit should be faxed or emailed to the Officer in Charge at the port of export to provide notification of shipment.

Prior to issuance of a Limited Permit, eligibility of the *Fraxinus* spp. logs for domestic movement in accordance with all applicable Federal quarantines must be assured. The ACO is responsible for ensuring all necessary conditions specified above have been met, and for signing and issuing the Limited Permit. The waybill documents, including booking numbers, must accompany the container, and identify the points of origin and port of export. The ACO is also responsible for informing the exporter that any deviation in the planned movement of the shipment is to be communicated to the local PPQ office at the port of export.

This SOP is currently valid for shipments exported from ports in the following states: Georgia, Maine, New Hampshire, Rhode Island, and South Carolina.

Dated November 16, 2015