July, 12, 2013

Emerald Ash Borer Management Plan for Pennsylvania Communities

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1. Introduction

The emerald ash borer (EAB), *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae), an exotic woodborer from northeast Asia, was first discovered attacking ash trees in Michigan in 2002 (USDA Pest Alert). Since then, it has been found in 19 additional U. S. states and two Canadian provinces across the Great Lakes region and beyond (Regional Map of EAB Infestation). Larval feeding in the cambial region disrupts water and nutrient transportation inside the tree, resulting in 99% tree mortality within 4-5 years. An estimated 20 to 55 million ash trees have been killed by this pest in the infested areas. The potential economic damage may exceed $10 billion in 25 states expected to be affected within in the next 10 years (Kovacs et al. 2010).

Managing this pest in North America has been confounded by difficulties in early detection, limitations in control options, and scarcity in available resources. Tree removal works for small outlier infestations, whereas chemical control is effective on high-value ash trees. However, long-term EAB management in various landscapes will ultimately depend on biological control.

In Pennsylvania, EAB was first detected in Butler County in 2007. A total of 38 counties are currently infested and the entire state is under federal quarantine (PA Counties with EAB Present). Ash is an integral part of the forest biodiversity, wildlife habitat, riparian areas, and the urban landscape, with more than 300 million trees. There are 67 counties, 56 cities, 958 boroughs, 1 incorporated town, and 1,547 townships in Pennsylvania. A management plan is urgently needed to mitigate the potential damage caused by this pest across the state in the coming years.

2. Purpose

The purpose of this document is to provide information and guidelines for local communities (counties, cities, boroughs and towns/townships) in Pennsylvania to prepare for the negative economic, social and environmental impact of emerald ash borer on urban forests. While proper procedures and actions are recommended in general terms, each community should customize the template plan by selecting applicable options to address its own management goals. A template plan for the imaginary city of Ashville is included to illustrate the utilization of these guidelines and principles. Being proactive against this invasion will serve the community better and more efficiently.

3. Applicability

This plan is suitable for any community with ash (white, green, black, and pumpkin) trees on its streets and in parks and nature areas. Communities currently infested by EAB should have a management plan now before most of its ash trees disappear from the landscape. For those not yet infested but within 20 miles of known infestations, a management plan will need to be implemented within a year to have a

chance to save their ash resources, whereas those further away from the current infestations may have two to three years to develop such a plan giving the current distribution in the state.

4. Management Options

Trees are valuable natural resources in urban communities (Dwyer et al. 1992, Nowak et al. 2002), with compensatory values on shade, air quality, storm water discharge, heating/cooling costs, and aesthetic or property value (http://www.treebenefits.com/calculator/). With the arrival of EAB, all communities will be forced to respond to the infestations in some degree, regardless of the strategies they choose to adopt. Dead trees on streets and in community parks present real threats to public safety. Removing ash from the local ecosystem will permanently alter the natural habitats for related species. Sudden changes in urban canopy cover may result in negative impacts to local communities. Addressing some or all of these concerns requires a well conceived management plan with specific goals and implementable mechanisms.

There are four management options a community can choose from, each with its own pros and cons:

Option A. No Action. In this option, ash trees will be treated and maintain the same as other species in the community. No survey will be conducted to detect and monitor the spread of EAB, and no control actions will be undertaken even when EAB becomes established in the community. No tree replacement plan for affected areas is in place. As a result, most ash trees will be killed by the end of the infestation. It may cost nothing up front. However, the community is still responsible for the removal of hazard trees along roadways and woodland trails. Significant changes in neighborhoods and local landscapes can also be expected.

Option B. Selective Management. In this option, high-value ash trees in selected areas (streets, landmarks, historic sites, popular parks, important ecological sites, etc.) within the community will be managed actively, whereas those in other areas (e.g. woodlots) will be left alone. Ash trees will be monitored for their health and levels of EAB infestation. Chemical control and tree removal will be applied wherever appropriate in a cost-effective manner. Tree replacement will be prioritized towards community needs. As a result, most ash trees in the natural areas will be killed by the end of the infestation, whereas a great portion of high-value ash trees are protected for future generations to enjoy. In addition, dead or dying ash trees in streets and parks will be replaced with non-host species to prevent major canopy gaps in neighborhoods. Annual cost for this option is moderate to the community, with minimal disturbance to the urban forests. Habitat change in untreated natural areas is expected.

Option C. Preemptive Management. In this option, ash trees in urban areas (streets, parks, golf courses etc.) will be removed preemptively and replaced with non-host species, whereas those in natural areas (e.g. woodlands) will be left alone. No EAB survey activity will be conducted. As a result, treatment areas will contain no ash trees, with no concerns over EAB in the future either. The initial cost of this option could be very high because of expenses associated with tree removal and replacement. Neighborhoods also need to deal with major canopy gaps temporarily at the beginning before replacement trees become well established. However, no annual cost will be incurred after the completion of the project. Habitat change in untreated natural areas is still expected.

Option D. Aggressive Management. In this option, all ash trees in the community will be managed actively with all available management tools. EAB survey activities will be carried out on both roadways and woodlands. Information from the surveys will be used to determine proper management actions

across different landscapes. Chemical control will be actively pursued to protect the maximum portion of ash trees and their canopy. Only dead or dying ash trees will be replaced with non-host species. Biological control is also considered for ash resources in the natural areas. As a result, most high value ash trees in the streets and parks will be saved from EAB damage, whereas a small portion will be replaced with non-host species. In addition, ash resources in natural areas may have a chance to survive in the long term when effects of introduced natural enemies are realized. Community suffers the least socially and environmentally from the infestation, with less risk of losing urban canopy cover. However, annual cost to the community is the highest among all options.

5. Major Components

A community EAB management plan is a written document specifically drafted to deal with current or anticipated EAB infestations in its urban forests. It contains clear objectives and viable approaches in the management of EAB at the community level. When adopted, it becomes the official action plan for the community to use in its battle against EAB for the protection of its ash resources. A typical EAB management plan for a community should include the following major components:

Title: Identify the plan and incorporate it with other related community policies and tree management plans.

Administration: List municipal agencies and persons-in-charge responsible for the implementation of the plan. Large communities may need several technical teams to deal with project management, fiscal management, information, communication, public and media relations, training, contracting, debris removal and disposal, and community forestry.

Executive Summary: Outline strategies, goals and actions that the community is going to take to manage its ash trees against EAB infestation (existing or potential) and associated damages.

Authority: Define authority of the community over the ash resources and their management within its boundary. Trees in community streets, parks, and natural areas are generally covered by the plan, whereas trees on private lands are the responsibility of landowners. However, communities with available resources should encourage property owners to join the plan by offering incentives.

Tree Inventory: A detail ash tree inventory is needed to make sound management decisions. Different types of inventory methodologies can be used base on conditions in the community (The Community Forest Inventory Decision Model). The I-tree tool (http://www.itreetools.org/) (A Software Tool for Assessment- iTree) is the preferred methodology in Pennsylvania. For the management of ash against EAB, inventory data should at least include location (GPS if possible), species (white, green, black, pumpkin), habitat (street, park, natural area, private), size (diameter-at-breast-height), health conditions (crown dieback ratio) and other important information (e.g. tree value) for every single tree on the streets and day use area within the parks. Trees in the natural areas should be estimated using standard forestry inventory methods that contain stocking information, species composition, and basal areas. An ash distribution map should be included for strategic planning of all management activities.

EAB Monitoring: EAB infestation in the community should be monitored if selective management, aggressive management, or a combination of different management options is adopted. EAB usually initiates its attack in the mid-crown of the tree and works its way downward along the trunk. Detecting early infestation is still very difficult with current survey and monitoring tools. However, established

infestations can readily be detected through branch sampling (Ryall et al. 2011) or ground surveys using damage and symptom patterns caused by EAB (Signs and Symptoms of EAB). Woodpecker damage along tree trunks are excellent indicators of moderate to heavy infestations, especially in the winter when ash trees shed their leaves. It's worth noting that most initial infestations lasted at least a couple of years before they were detected. Incorporating EAB monitoring protocols to routine maintenance and sanitation operations on community trees will help this effort.

Management Tools: Available management tools and their advantages and disadvantages should be explored before some or all of them are selected for the plan. Tree removal is 100% effective against immature stages of EAB when infested wood is treated and disposed properly. The high cost may prohibit its use on a large scale especially in urban settings; chemical control is moderate to highly effective depending on the insecticides chosen (Insecticide Options, Potential Side Effects of EAB Insecticides), however, it requires a long term commitment that will escalate the total cost over time. The efficacy of biological control is still being evaluated in several states (Gould et al. 2010). In addition, gaining access to the introduced parasitoids could be difficult for any community as they are currently limited to state partners for introduction and evaluating purposes.

Wood Utilization: Ash trees designated for removal may have residual values as lumber, pulpwood, firewood, biomass, or mulch (http://www.na.fs.fed.us/werc/). These values should be actively pursued through bidding or public auctions to recoup a portion of the lost value from the removed trees (Urban Wood Utilization Planning). Inter- and intra-state movement of ash materials needs to follow quarantine regulations governing the program areas (http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml).

Material Disposal: Ash materials generated from tree removal should be disposed according to guidelines established by USDA Animal and Plant Health Inspection Service (APHIS) (http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/quarantine.shtml) and Pennsylvania Department of Agriculture (http://www.agriculture.state.pa.us/portal/server.pt/gateway/PTARGS_0_2_24476_10297_0_43/AgWebsite/ProgramDetail.aspx?palid=68&). A properly managed community marshalling yard could provide assistance to the disposal process.

Replanting / Canopy Replacement: Removed ash trees need to be replaced with other non-host species to prevent canopy loss in the urban areas. Follow general guidelines when choosing tree species for replanting (http://treevitalize.net/TreeCare/SelectingTrees.aspx). Consult your local arborists for specific replacement choices.

Cost/Benefit Analysis: A cost/benefit analysis is required to make decisions for any management actions. An EAB cost calculator (http://extension.entm.purdue.edu/treecomputer/index.php) developed by Purdue University can help with the decision making process (Sadof et al. 2011). However, no value for existing trees was assigned in the calculation. To address this, an EAB planning simulator was recently developed by scientists from the University of Wisconsin at Stevens Point and is being tested with different data sets (Vannatta et al. 2012). Individual tree value can be appraised using the landscape tree valuation formula developed by Council of Tree & Landscape Appraisers (CTLA) (Watson 2002, Landscape Tree Appraisal). In the end, potential benefits must outweigh management costs before they can be considered for implementation.

Fiscal Planning: A community with limited resources should plan ahead when adopting an EAB

management plan. A multi-year plan is usually adopted in many communities to spread the cost over a period of time. Budget properly each year to support management actions.

Time Table: A time table should be set for all activities each year, e.g. tree inventory, EAB monitoring, tree removal, chemical treatment and efficacy evaluation, parasitoid release and establishment confirmation, replanting and canopy replacement. Follow the time table in the planning of all management actions.

Data Collection and Reporting: Field data should be collected according to established guidelines and stored electronically in a centralized database. Progress reports should be created monthly or even weekly to make sure things are going as planned. A comprehensive annual report by the end of each year would help document accomplishments. Necessary adjustments based on changing circumstances should be applied at the beginning of each year.

6. Case Studies

Many infested and threatened communities in the U. S. and Canada have developed EAB management plans for their ash trees based on management goals, pest conditions, available resources, and public support. Below are the brief descriptions of a few EAB management plans from various communities that might shed some light on what to expect when different management options were adopted under different circumstances.

Option A. No Action

a. **City of Windsor, Ontario, CANADA (2002)**
   EAB was first discovered in July 2002. Unable to take any proactive action at the time due to the lack of knowledge on EAB and its management strategies and faced with a rapid spread of the infestation, the City chose a reactionary removal of dead and dying trees as its sole course of action. A total of 6,000 hazard public ash trees, representing 9% of the city's urban tree canopy, were removed and replaced at the cost of $4 million. No attempt was made to remove thousands more dead ash trees in woodland areas. Trees on private property were left to the property owner's discretion. By 2010, only an estimated 5% of ash trees were still alive, with most infested with EAB. Over one million ash trees are estimated to have died in Windsor and surrounding Essex County, including most of the endangered pumpkin ash (*Fraxinus profunda*).

b. **City of Ann Arbor, Michigan, USA (2003)**
   EAB was first discovered in Ann Arbor in 2003. At that point, ash compromised 17% of the city's tree population. No proactive action was taken in the following couple of years except some concerted tree removal. By 2005, the City had about 10,000 dead or dying ash trees in its parks and right-of-ways. A failed millage ballot worth $4.2 million was proposed in 2005 to fund the tree removal activities. The management approach since then has been focused on tree removal and wood utilization. As a result, the Traverwood library in the City was able to use some EAB-impacted ash trees to create flooring and other wood features in its new facility. The infestation has now spread through the City, with few surviving ash trees within its boundary. The city

forestry crew has spent the last three years doing nothing but removing ash trees. An estimated 7,000 dead ash trees have been removed from city streets so far, with 3,000 more in parks and natural areas waiting to be removed in the coming years. The total cost is expected to exceed $2 million.

Option B. Selective Management

a. **City of Fort Wayne, Indiana, USA (2009)**
EAB was first discovered in Fort Wayne in 2006. The City of Fort Wayne has approximately 13,500 ash trees along the city streets. Ash trees on both public and private properties provide 25% of the urban canopy. An EAB management plan was developed in 2009 to save about 1,000 ash trees through chemical treatment of imidacloprid through soil (tree with a diameter < 41 cm) and trunk (tree with a diameter > 41 cm) injection. The city anticipates treating ash trees for the next 15 years with an annual budget of $900,000 that includes tree removal, chemical treatment, and replanting.

b. **Village of Northbrook, Cook County, Illinois, USA (2010)**
EAB was first confirmed in the Village in May 2010. Ash trees represent about 20% of the village's 15,130 parkway trees. The Village developed a proactive, multi-faceted management plan in 2010 that includes surveying village owned ash trees, treating a portion with insecticide, and removing and replacing dead or dying trees. About 730 declining ash trees will be removed and replaced, and 268 ash trees will be treated with the insecticide Tree-äge (emamectin benzoate) for the next four years (2011-2014), with a total projected cost of $426,500. See link below for details.
(http://www.northbrook.il.us/Modules/ShowDocument.aspx?documentid=2351)

Option C. Preemptive Management

a. **City of Toledo, Ohio, USA (2004)**
Low levels of EAB infestation was first discovered in Toledo in 2004. The City of Toledo had an estimated 9,100 ash trees, accounting for 9% of its urban canopy. Since eradication was the official management strategy for the State of Ohio at the time, the City removed 1,100 trees using federal money in order to create a buffer zone. By 2005, new infestations were found outside the buffer zone and other parts of the state. As a consequence, eradication was officially abandoned as a realistic goal. By 2009, an estimated 2,600 dead or dying ash trees were still standing. No chemical treatment was carried out due to fiscal constraints and high pest populations within the City. Cost for dead tree removal is expected in the coming years.

b. **City of Grand Rapids, Michigan, USA (2007)**
Ash accounted for 15% of the public tree population (approximately 10,000 trees) in Grand Rapids in 2007 when the City made "proactive tree removal on a rotating basis" the primary management action. The ten-year budget for removal and replacement was estimated at $7-12

million. However, the arrival of EAB in a high profile area in 2009 shifted the city's focus to a reactive model until the infestation could be slowed down. About $600,000 have been spent by the City so far to remove and replace ash trees, and to save some of the 6,600 ash trees with several new treatments in city parks and right-of-ways.

Option D. Aggressive Management

a. **City of Milwaukee, Wisconsin, USA (2009)**
EAB was first detected in the State of Wisconsin in summer 2008. New infestations found in other communities within the state in the following year prompted the City to adopt a preemptively chemical treatment approach for the management of this pest. All of its 33,000 urban ash trees were to be treated with Tree-äge through the trunk within two years at the cost of $1.6 million. However, saving ash in the long term was considered a lost cause by the City. Therefore, all 33,000 ash trees will eventually be removed and replaced at an annual rate of 5% for the next 20 years. The goal is not to save the ash trees, but rather to maintain a relative percentage of ash in the urban canopy. It is considered as a cost-effective approach by the City when compared to the estimated cost of $25 million to remove and replace all the ash trees.

b. **City of London, Ontario, CANADA (2011)**
EAB was first discovered in London in 2006. Ash accounted for 5.7% of public tree population (9,938 trees) along streets and in manicured areas of parks. A 15-year EAB management plan was developed in 2011 to treat, remove, and replant affected ash trees through active monitoring and coordination. A total of 384 ash trees were chemically treated with TreeAzin (Azadirachtin) in 2011. Treated trees were selected using the matrix developed to determine the best candidates. Those trees will be treated every two years for the next 15 years, or after the threat of EAB has passed. The rest (9,554 trees) will be removed and replaced over the next 10 years. In addition, approximately 14,450 ash trees from wooded areas within public parks and greenways will also need to be removed to reduce hazard and liability. The total cost of this plan is estimated at $14.3 million over 15 years. See link below for details.
(http://www.london.ca/trees_lawns_and_gardens/pdfs/london_eab_final_090711.pdf)

7. Contacts and Information

Pennsylvania Department of Conservation and Natural Resources
(www.dcnr.state.pa.us/forestry/fpm_invasives_EAB.aspx)

Pennsylvania Department of Agriculture EAB hotline: 1-866-253-7189 or Badbug@state.pa.us

Pennsylvania State University Extension
(http://ento.psu.edu/extension/trees-shrubs/emerald-ash-borer)

Emerald Ash Borer (www.emeraldashborer.info)

USDA APHIS
(http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/regulatory.shtml)

USDA Forest Service (http://na.fs.fed.us/fhp/eab/)

i-Tree - Tools for Assessing and Managing Community Forests (http://www.itreetools.org/)

TreeVitalize - A partnership to restore tree cover in Pa. communities
(http://treevitalize.net/TreeCare/SelectingTrees.aspx)

EAB Cost Calculator (http://extension.entm.purdue.edu/treecomputer/index.php)

National Tree Benefit Calculator (http://extension.entm.purdue.edu/treecomputer/index.php)

USDA Forest Service Wood Education and Resource Center (http://www.na.fs.fed.us/werc/)

Ash Utilization Options Project (http://semircd.org/ash/news/news.php)

8. References

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