Spring 2010

A Potential Plan of Action for Emerald Ash Borer in Nebraska

Lee Wheeler
University of Nebraska at Lincoln

A Potential Plan of Action for Emerald Ash Borer in Nebraska

by

Lee Wheeler

AN UNDERGRADUATE THESIS

Presented to the Faculty of
The Environmental Studies Program at the University of Nebraska-Lincoln
In Partial Fulfillment of Requirements
For the Degree of Bachelor of Science

Major: Environmental Studies
With the Emphasis of: Biology

Under the Supervision of Dr. Scott Josiah

Lincoln, Nebraska

April, 2010

Abstract

Emerald Ash Borer (*Agrilus planipennis)* (EAB) is an invasive insect pest. It feeds on the cambium tissues of ash tree species. It was first discovered in the United States in 2002 in Detroit, Michigan. Their effects on ash trees are deadly, and it is quickly spreading across the Midwest. Nebraska has not yet been invaded, but confirmed findings continue getting closer and closer. The major problem facing Nebraskans, with regards to EAB, is how to begin preparations to prevent a dramatic economic loss when an infestation does occur. So, to address this problem, I have conducted street and park tree inventories, to determine the amount of ash trees that are contained in Nebraska's community forests; and with that data I have attempted to create a possible EAB action plan for Nebraska communities. Based on inventory findings, I have calculated that 6% of Nebraska's community trees are ash, which is a large percentage. Then, I proposed a plan of action for communities that involve planting a diverse landscape, and a combination of ash replacement programs, and treatment for ash that are less valuable or damaged.

Table of Contents:

Introduction:

For my senior thesis project, I am going to look at the spread of the Emerald Ash Borer (EAB) (*Agrilus planipennis*) throughout the United States. Then, I am going to look at Nebraska specifically. I have collected data on the total count of all public ash (*Fraxinus spp.*) trees in 75 communities throughout the state, as well as a total tree count. Public trees constitute all trees lying within public property, including along streets, within parks, and other public right of way areas. With this data I plan to create a damage assessment plan that will help communities prepare for the future potential infestation of EAB, and also give them an idea of how much it will cost them to treat or remove their ash.

When discussing the affects of EAB on other States, I will focus on the social, environmental, and economic impacts of the pest. These factors are important because a community's trees are not only beautiful to look at; they serve other purposes as well. For example, trees sequester carbon from the atmosphere, and they provide economic benefits by lowering utilities bills, and they add aesthetic values to homes.

It is important to know the effect that EAB could potentially have on Nebraska in the future, given the severe damage it has caused in other areas of the United States. EAB feeds on the cambium located between the bark and wood of the tree. This is the tissue the tree uses to conduct nutrients throughout its systems, and when the cambium is damaged it is unable to transmit nutrients throughout the tree. This leads to the eventual death of the tree within generally two to three years. All ash trees with the exceptions of Mountain Ash (*Sorbus aucuparia*) are

susceptible. Mountain Ash does not belong to the genus *Fraxinus*, so it is not a true ash.

Experiments have also been conducted on the host selection of EAB. In one study by Deepa Pureswaran, she concluded that EAB prefers to feed on green, black, and white ash, which are all native to the United States. Research demonstrated that EAB even preferred these trees over the Manchurian ash that they naturally feed on in China. This preference is likely due to the lower relative volatiles in the American ash species, which is suspected to make them more attractive and less resistant to EAB.

EAB has caused the death of an estimated 50+ million ash trees in Michigan, Ohio, Indiana and Ontario since its discovery in 2002 in Michigan. Since then it has spread and been detected in Illinois, Kentucky, Maryland, Minnesota, Virginia, West Virginia, and Wisconsin. At the rate that EAB is spreading, it is only a matter of time before it is found in Nebraska. With the inevitably of an EAB infestation, it is important to develop a plan of action to deal with the problem (NFS Pamphlet).

According to John Ball, "Exotic Stressors such as emerald ash borer are an increasing concern to many communities across North America." One way for a community to be properly prepared for a stressor that affects its tree resources is to perform inventories. A tree inventory gathers information on the health and diversity of community forests. An inventory can answer questions such as how many street trees are there? What species? What condition are the trees in? It is impossible to manage a communities tree resource if you do not know how many, what type, and what condition your trees are in (uconn.edu).

Once you have an idea of the extent of your tree resource, you can begin to analyze the economic benefits that it produces. According to T. Davis Syndor, there are three main fiscal impacts that are associated with an EAB infestation; loss of the landscape, ecosystem service, values of existing trees, the cost to remove dead or declining trees, and the cost of replacement. This is why it is important to look at tree loss from social, economic, and environmental points of view.

Thesis Objective:

First, I will discuss the social, environmental, and economic impacts that EAB has had on other states in the Midwest. By doing this, I will be able to better understand what kind of affects an EAB infestation will have on Nebraska. Then, I will use the data collected from Nebraska's ash tree resource to develop a plan of action for the potential EAB infestation in Nebraska.

Materials and Methods:

1. Research Design and Approach

First, I will conduct a street and park tree inventory for 75 communities across the state of Nebraska. Next, I will count the total number of ash trees, and then a total tree count of all species. In the parks, all trees within the park boundaries will be counted. For this research project, a street tree will be defined as any tree that is located between the sidewalk and the street. If there is no sidewalk, then a street tree will be defined as any tree between the streets and any city property such as light poles, power lines, or fire hydrants, which are typically defined as the right-of-way.

2. Sampling Methodology and Data Collection

The communities were selected prior to the inventories. It is necessary to get an even geographic distribution across the state. The communities that were selected, for the most part, are located along major U.S. highways, so there is a slight bias in that respect. Also, for training purposes, several communities were selected based on their relative proximity to Lincoln, resulting in a large grouping of communities in Lancaster County.

Table 1 (appendix 1) shows the data collection method. The ash trees will be separated into 4 different diameter classes. With the trees separated into diameter classes, the inventory process will be much more efficient. Also, there will be a total count of all public trees, park and street. This allows for calculations of ash percentage.

3. Data Analysis

Once the data is collected, I will enter it into an excel spreadsheet. The spreadsheet will include the number of ash trees in each diameter class, the total tally of trees, and the percentage of ash trees for each community. Also, with the help from Nebraska Department of Roads, I will use the total street miles in each community to determine stocking rates.

I will also enter the data into two powerful online tools. I will enter it into the Davey Tree Benefit Calculator to determine the overall value of the ash tree resource. I will also be using the EAB Calculator provided by Purdue University. The EAB Calculator will help me to determine the costs of treatment, removal, and replacement of ash trees.

4. Technology Transfer

After the inventories are complete and the research project is finished, I would like to distribute my findings to Nebraska communities. Distribution can be accomplished by emailing the project to city planners or tree boards. Hopefully my work can be used as a reference in the decision making process as communities prepare for EAB.

Results:

Data Totals:

After all of the data was collected, and entered into spreadsheets, I was able to calculate the average number of ash trees in a Nebraska community, and also the average percentage of ash in relation to the total tree population. I also broke the tree counts into street trees and park trees.

Table 2 (appendix 2) shows the total number of ash trees in the 75 communities inventoried in Nebraska for each diameter class for both street and park trees. The data show that ash trees constitute 7.5 percent of Nebraska street trees, and 6.1 percent of Nebraska park trees. The table also shows that the highest percentage of ash street trees are in the 12-24" diameter class, and the highest percentage of ash park trees are in the 4-12".

Table 3 (appendix 2) shows the data when street and park trees are integrated. When the data from street trees and park trees were combined, the statistics were very similar. The average number of public ash trees for the entire community was 6.9 percent, and the largest number of ash fell into the 12-24" range, while the 4-12" was slightly less.

EAB Calculator:

When using the EAB Calculator, I entered the average values of street and park trees combined from *Table 3*. I did this so that I can get a cost analysis for an "average Nebraska community." I set the Calculator up to analyze three different management options. The first was to remove all ash trees, and replant no trees in their place. The second option was to replace all ash trees. This option involves removing all ash, then replacing them with other species. The final alternative that I analyzed was the treatment of all ash trees. I also set up the calculator to allow for 5 years to complete the implementation process for each management option.

When you look at *Chart 1* (appendix 3), you can see that the replace all option has the highest initial cost, because it involves removing all ash and then planting replacement species in the same spot. The remove all option has still has a high initial cost, but lower than the first option because it does not involve any replanting. Even though the initial cost of the first two options is high, *Chart 1* shows the after the implementation of the management option is complete, the annual cost drops to zero. If you look at the annual cost of the treat all option, you will see that the initial cost is very low, but every year the cost increases as the total diameter of the tree resource grows. This is because the cost of treatment is calculated by the diameter of the tree.

Chart 2 (appendix 3) compares the cumulative cost of each treatment option. The chart shows that even though the initial cost of treating ash trees for EAB is low, the costs add up in the long run, because it has to be done repeatedly to be effective. According to *Chart 2*, after 25 years implementing the management options, treating

all of the ash trees will end up costing around $50,000 more than the replace all option, and around $60,000 more than the remove all option.

Davey Tree Benefit Calculator:

Using the Davey Tree Benefit Calculator, I was able to find the average annual value of an ash tree for each diameter class. Davey uses multiple variables determining the value of a tree. They take into account the amount of shade the tree produces, which lowers utility bills, also, the amount of carbon that it sequesters, and the amount of wind that it can block from hitting a home. Aesthetic values are also added into the mix, because trees add value to property. *Chart 3* (appendix 4) shows how the value of a tree is affected by diameter size. An ash with a one-inch diameter is starts out at around 25 dollars of value. The value of the tree increases greatly to about 255 dollars when it reaches 21 inches. After that point, the tree may be defined as a potential hazard or liability, and the value begins to decline.

Summary and Conclusions:

Examples From Other States:

In a study preformed in Toledo, Ohio, Joseph Heimlich surveyed residents and asked them how important trees are to them, and what they enjoyed most about trees. The results were showed that trees are an important factor in whether or not someone "likes" their neighborhood. People enjoyed the shade that they provide, and added home value, and the appearance of streets lined with trees. Residents also preferred trees that provide abundant amounts of shade, like ash trees.

Heimlich also describes some of the policies being adopted by aggressive and forward thinking Ohio communities. The most popular is an ash replacement program. This program was put in place before the pest has even been identified in many instances. The program involves planting a wide variety of tree species near ash trees, and when the new trees grow larger and then remove the ash. I believe that this is a very pro-active approach that could be very feasible in Nebraska. Because EAB has not yet been identified here, this plan could be implemented over the course of several years, allowing to costs to be spread out over a longer time period.

In an inventory of Wisconsin's community tree resource, Anne Cumming discovered some startling results. She discovered that *Fraxinus spp.* made up 12.5% of the Wisconsin community tree resource. She said that the potential risk to EAB is $2.4 billion in structural and environmental damages. EAB could be a cause for dramatic monetary loss in the state. One way to prevent such huge losses is by planting a more diverse landscape. Cumming also suggests that long term monitoring and inventory of tree resources is key to developing effective management plans. Knowing what kind of trees you have and how many allows planners to estimate costs of potential outbreaks.

Many states in the Midwestern and Eastern states have already put plans into action as a result of EAB. In the last ten years, EAB has been introduced in the U.S. and has spread over great distances. According to Michael Raupp, who surveyed the street trees in several Eastern cities, nearly 50% of the trees could be lost from EAB and other exotic insect stressors. This is because the majority of the street trees in

the areas he surveyed consisted of only a few species, mainly *Fraxinus* and *Acer* species. Raupp also describes ways that Eastern Cities have tried to lessen the impact exotic stressors. Mainly, city and state governments are promoting biodiversity of trees. This is an option available to Nebraskans, and biodiversity is an idea being preached by organizations such as the Nebraska Forest Service through initiatives like ReTree Nebraska.

My Plan For Nebraska:

Nebraska has many options available to help prepare for EAB. I believe that the right plan for Nebraska would involve a combination of treatment and replacement. I do not think that removal without replacement is a good option. Trees have too much value, and empty spaces along streets are not aesthetically pleasing. Also, biodiversity is key to a good plan, because a diverse collection of street trees will be more tolerant to exotic stressors.

With treatment of trees having a low initial cost, and a relatively low yearly cost, I think that would be very cost effective to treat some ash trees. Trees that have the most social and environmental value should be the focal point of treatment efforts. Examples would include trees near important building, like around the state capital. Ash trees in arboretums and in parks could also be candidates for treatment. Trees that exhibit high monetary values should also be treated. Ash trees between 10 and 21 inches in diameter produce a yearly value that is greater than the cost of treatment, so it would be economically feasible to treat them. The approximate values can be determined using the Davey Tree Benefit Calculator.

Replacement of existing ash trees is an integral part of a good EAB action plan. The most important aspect of the replacement plan is making sure that a monoculture is not replanted. It is necessary to plant I wide variety of species. It is also a good idea to plant trees that are native, and can handle the weather extremes of Nebraska and the Great Plains.

Finding the right combination of replacement and treatment is the key to an effective EAB action plan. In an average Nebraska community, there are 25 (6.08%) street ash trees, and 11 (5.81) park ash trees. According to the EAB calculator, the cost of treatment is roughly $4 per inch of diameter. Also, the majority of trees are within the 4-24" range.

With all of the Data that I have collected, and the research I have done on the impact of EAB in other states, I have developed a plan that I think could be effective and economically feasible for communities in the state of Nebraska:

1. Replace all trees that are smaller than 4" and larger than 24", because the environmental and social benefits that they provide are less than the cost of treatment.
2. Any trees within the 4-24" range that are unhealthy or damaged should also be replaced
3. Healthy trees between 4" and 24" can be treated, because trees in that range are worth more than the cost of treatment.
4. Plant Diversity! A diverse landscape is the key to a beautiful and more stress resistant community landscape.

I believe that these rules are a good combination of replacement and treatment. It will cost the community money, but by planting new trees they will gain in aesthetic and environmental value. And, if the communities make sure to plant a wide variety of species, they will lessen the impact of future exotic stressors.

Appendix 1

Data Collection Table

	Diameter Classes - STREET TREES				
	0 - 4"	4 - 12"	12 - 24"	> 24"	TOTAL
Ash					
TOTAL					
TOTAL Count ALL Street Trees (tally)					

	Diameter Classes - CITY PARK & NATURAL AREAS				
	0 - 4"	4 - 12"	12 - 24"	> 24"	TOTAL
Ash					
TOTAL					
TOTAL Count ALL Park Trees (tally)					
TOTAL Count ALL STREET and PARK Trees (tally)					

Table 1.

Appendix 2

Total Number of Ash By Diameter Class

	Total Number of Ash Street Trees*					Total Street Trees
Diameter Class	0-4"	4-12"	12-24"	>24"	Total	(all species)
Total Count	127	585	679	460	1851	24821
Percentage	0.512	2.357	2.735	1.853	7.457	

	Total Number of Ash Park Trees*					Total Park Trees
Diameter Class	0-4"	4-12"	12-24"	>24"	Total	(all species)
Total Count	59	352	274	128	813	13355
Percentage	0.442	2.636	2.052	0.958	6.088	

Table 2.

	Total Number of Ash Street and Park Trees*					Total Trees
Diameter Class	0-4"	4-12"	12-24"	>24"	Total	(all species)
Total Count	186	937	953	588	2664	38176
Percentage	0.4872	2.454	2.496	1.540	6.978	

Table 3.

*Total number of all 75 communities combined.

Appendix 3

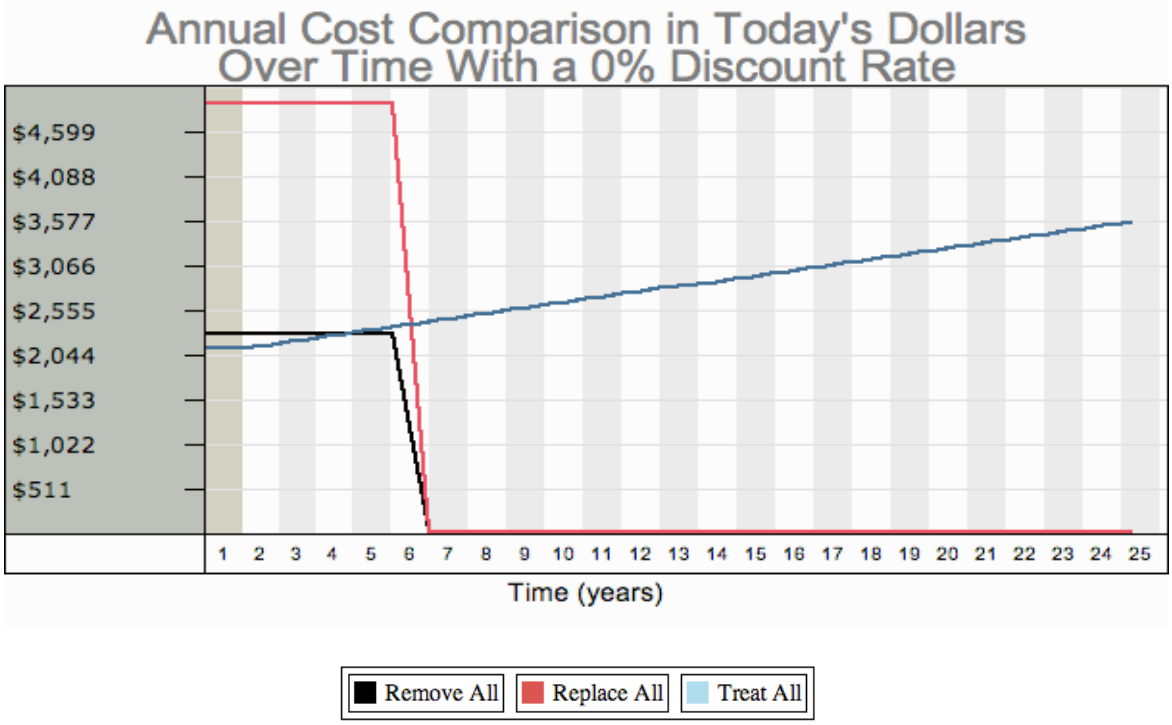

Chart 1.

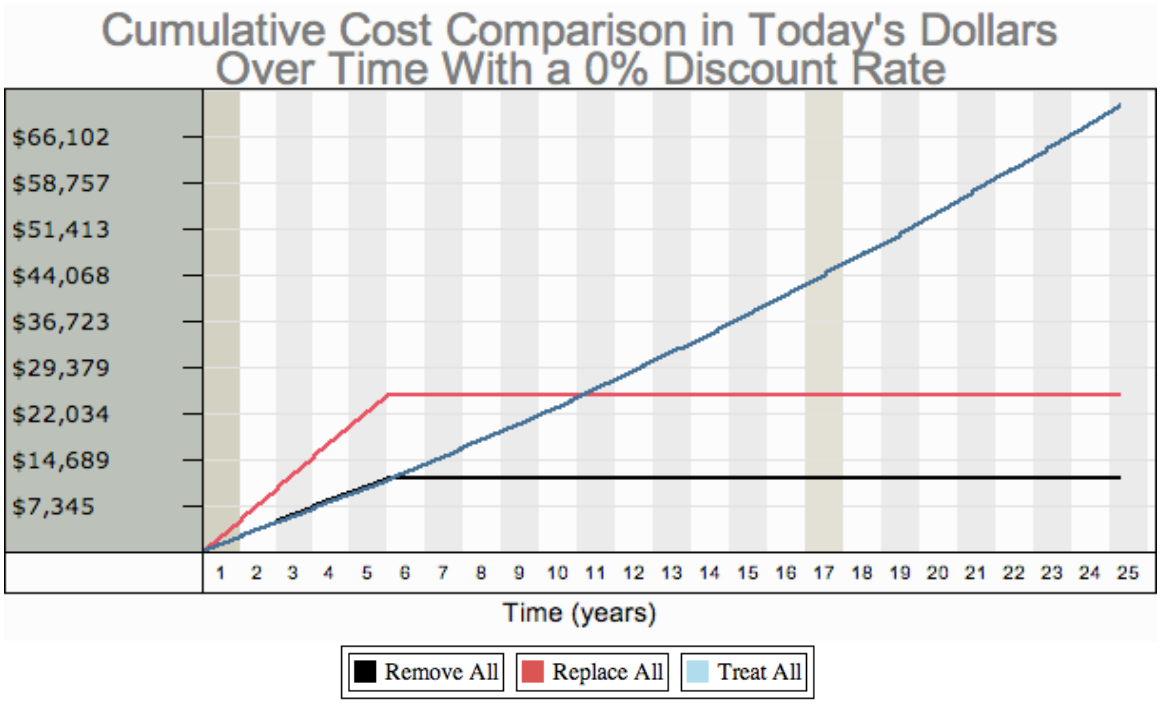

Chart 2.

Appendix 4

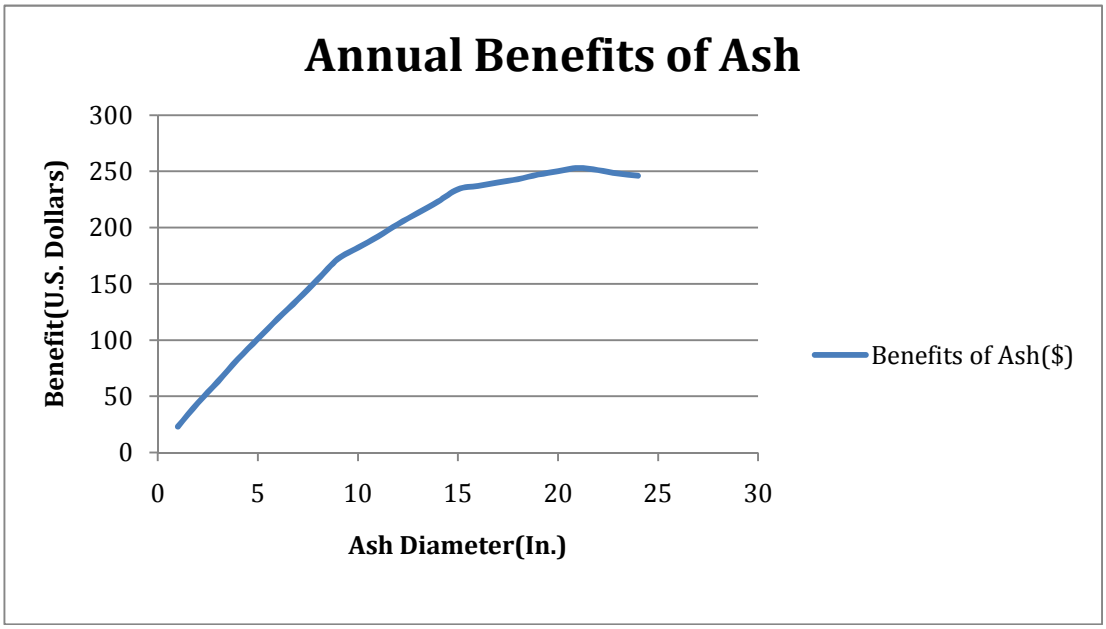

Chart 3.

References

Ball, John, Sarah Mason, Aaron Kiesz, Dan McCormick, and Craig Brown. "Assessing The Hazard of Emerald Ash Borer and Other Exotic Stressors to Community Forests." Arboriculture & Urban Forestry. Sep. 2007: 350-359.

Cumming, Anne Buckelew, Daniel B. Twardus, and David J. Nowak. "Urban Forest Health Monitoring: Large-Scale Assessments in the United States." Arboriculture & Urban Forestry. Nov. 2008: 341-346.

Heimlich, Joseph, T. Davis Sydnor, Mathew Bumgardner, and Patrick O'Brien. "Attitudes of Residents Toward Street Trees on Four Streets in Toledo, Ohio, U.S. Before Removal of Ash Trees (Fraxinux spp.) from Emerald Ash Borer (Agrilus planipennis)." Arboriculture & Urban Forestry. Jan. 2008: 47-53.

Lindell, Catherine A., Deborah G. McCullough, David Cappaert, Natalya M. Apostolou And Melinda B. Roth. "Factors Influencing Woodpecker Predation on Emerald Ash Borer." The American Midland Naturalist. 159.2 (2008): 434-444.

Marshall, Jordan M., Andrew J. Storer, Ivich Fraser, Jessica A. Beachy, and Victor C. Mastro. "Effectiveness of Differing Trap Types for the Detection of Emerald Ash Borer (Coleoptera: Buprestidae)." Environmental Entomology. 38.4 (2009): 1226-1234.

Pureswaran, Deepa S., and Therese M. Poland. "Host Selection and Feeding Preference of Agrilus planipennis (Coleoptera: Buprestidae) on Ash (Fraxinus spp.)." Environmental Entomology. 38.3 (2009): 757-765.

Raupp, Michael J., Anne Buckelew Cumming, and Erin C. Raupp. "Street Tree Diversity in Eastern North America and Potential for Tree Loss to Exotic Borers." Arboriculture & Urban Forestry. Nov. 2006: 297-304.

Ricard, Robert M. "The Tree Inventory." UConn Extension Forestry. 12 Oct. 2009. < http://www.canr.uconn.edu/ces/forest/fact8.htm>

Sydnor, T. Davis, Matthew Bumgardner, and Andrew Todd. "The Potential Economic Impacts of Emerald Ash Borer (Agrilus planipennis) on Ohio, U.S., Communities." Arboriculture & Urban Forestry. Jan. 2007: 48-54.

United States Department of Agriculture. Emerald Ash Borer The Green Menace. Pamphlet

Nebraska Forest Service. Wanted: Dead – Emerald Ash Borer. Pamphlet

Online Tools

Davey Tree Benefit Calculator:

http://www.davey.com/ask-the-expert/tree-calculator/national-tree-benefit-calculator.aspx

Emerald Ash Borer Cost Calculator:

http://extension.entm.purdue.edu/treecomputer/index.php