

PUTTING THE PIECES TOGETHER: CAN WE SOLVE THE EMERALD ASH BORER MANAGEMENT PUZZLE?

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ABSTRACT

Emerald ash borer (*Agrilus planipennis* Fairmaire), a phloem-feeding buprestid native to Asia, has become one of the most devastating forest pests in the U.S. More than 25 million ash trees (*Fraxinus* spp.) have been killed by emerald ash borer (EAB) in southeast Michigan alone. Well-established populations are present across much of lower Michigan and areas of Ohio, Indiana, and Ontario. Localized outlier populations, most of which were established at least 4 to 6 years before they were detected, have been found in four other states. Data collected from more than 30 forested sites show that virtually all ash trees > 1 inch in diameter are killed once EAB moves into a stand. At least 15 native ash species across the U.S. are threatened by this invasive pest. Efforts to eradicate EAB in localized outlier populations are expensive and unpopular, and most have not been successful. As populations of EAB expand and more outliers are discovered, it is becoming clear that alternative strategies for EAB management are needed.

The Slow the Spread of Gypsy Moth Project (STS) has demonstrated that many economic and ecological benefits can be accrued by slowing the rate at which gypsy moth populations build and spread. Presumably, a similar approach applied to EAB could yield even greater benefits. Gypsy moth, however, has been studied and managed in the U.S. for almost 150 years; EAB was not discovered until 2002. Nevertheless, in the past 5 years, scientists have learned much about EAB. A multi-year, integrated effort to slow the spread and delay the onset of widespread ash mortality may now be feasible for EAB.

Many of the components of an integrated EAB management program would likely parallel similar components of the STS project. For example, host range and preference of EAB have been evaluated in several studies (Anulewicz et al. 2007, 2008a, 2008b; Eyles et

al. 2007; Rebek et al. 2008). In general, these studies have shown that EAB appears to successfully develop only in *Fraxinus* species. EAB host preference or host susceptibility differs among North American ash species. Green ash and black ash, for example, appear to be highly preferred and very susceptible to EAB. Asian ash species are generally more resistant or less preferred hosts when compared with North American ash species.

Much research has been directed at finding effective methods to detect relatively new or low-density EAB outlier populations. Detection of EAB is especially difficult because newly infested trees have virtually no external symptoms. Many larvae in healthy trees with low EAB densities will require 2 years for development (Tluczek et al. 2008). This means that a tree can be infested for at least 2 years before even a D-shaped exit hole is present. Detection trees—girdled ash trees that are debarked in winter to find larval galleries—remain the most effective method to detect low-density EAB infestations. Establishing girdled trees, however, is expensive and labor-intensive, and it can be difficult to locate suitable trees. Research on traps and lures for EAB is progressing. In 2008, USDA APHIS plans to establish a 2- to 3-mile-wide band of traps set on a 1.5 by 1.5 mile grid. The traps will consist of purple panels that use EAB beetles' response to color. Traps will be baited with Manuka oil lures. Manuka oil is chemically similar to volatiles associated with ash wood and bark. Research will also continue to determine if additional colors, variations in trap design, or improved lures can increase the effectiveness and efficiency of the traps.

Biological control for EAB is another option that has been aggressively pursued by scientists. Researchers from the U.S. Forest Service and APHIS, along with Chinese scientists, have conducted a substantial amount

of research on EAB parasitoids native to China (Bauer et al. 2005). Two larval parasitoids and one egg parasitoid appear to hold promise for biological control of EAB. Work included determining the biology of each species, developing rearing methods, and conducting studies with potential non-target species. In 2007, the three Asian parasitoids were released in sites in southeast Michigan (USDA 2007). Followup studies to evaluate establishment and impacts of the parasitoids on EAB populations are planned. In addition, we found a braconid parasitoid, identified as *Atanycolus* sp., associated with late instar EAB larvae in at least two sites near Fenton, MI (Cappaert and McCullough 2008). Subsequent surveys indicated that parasitism rates at the primary site reached 70 to 80 percent in some trees. Further studies to identify this parasitoid and assess its potential for augmentative biocontrol are planned.

Substantial progress has been made in developing methods for using insecticides to protect valuable landscape ash trees. Systemic neo-nicotinoid products, applied to the soil, injected into the trunk, or applied as non-invasive trunk sprays, are often successful, especially if treatments are initiated before EAB larvae damage the vascular tissue. Efficacy can vary, however, depending on the size and vigor of the tree, the beetle pressure (e.g., density of EAB in the area), and the application methods and products. In 2007, we evaluated a new product, emamectin benzoate. Results were striking. Overall, the emamectin benzoate provided > 99 percent control of EAB when the treated trees were compared to untreated trees (McCullough et al. 2008). We have never observed this level of control with any of the other systemic products we have tested. A special registration for emamectin benzoate will be requested in Michigan and probably other affected states.

Additional research efforts that are underway will provide information that can be incorporated into an integrated EAB management strategy. We developed models that can be used to predict the phloem area and the potential number of EAB adults that can be produced based on the d.b.h. of a tree (McCullough and Siegert 2007). If ash inventory data are available for a site, therefore, it is relatively simple to estimate how many EAB can be produced in the site if no action

is taken. Using ash inventory data collected from two outlier sites, for example, we determined that roughly 80 percent of the ash trees at both sites were less than 4 inches in diameter. Only 5 to 6 percent of the ash at the sites were merchantable—e.g., > 9 inches in diameter. The merchantable trees, however, would have eventually produced 55 to 65 percent of the EAB at each site. Therefore, harvesting only those large ash trees could considerably reduce the overall EAB density in the sites.

An extensive dendrochronological reconstruction of the progression of ash mortality across southeast Michigan was recently completed (Siegert et al. 2007) and has provided us with insight into the rate and patterns of EAB spread. A model of EAB population growth and spread is currently being developed, using empirical data from this and other EAB studies. We are also determining whether girdled ash trees can be used to suppress EAB population growth. Data from pairs of girdled and control trees at an outlier site showed that at low EAB densities, girdled trees were highly attractive to ovipositing EAB females (McCullough et al. 2007). Removing these “sink” trees before larvae complete development eliminates a portion of the EAB population. As EAB density builds, however, all trees become stressed and girdled trees will no longer function as sinks. Whether sink trees can be used operationally to slow EAB growth and spread will be determined in a large-scale experiment initiated in 2007.

The research summarized here, as well as other studies that are underway, is providing tools and options for EAB detection, survey, and control. Other components of an EAB-STS type program are, however, still lacking. A thorough economic evaluation is needed to assess the costs of EAB impacts in urban and forested settings and to compare costs and benefits of alternative management options. A consistent, transparent, and accessible database is still needed to support EAB survey and mitigation efforts. A more formal link between Federal regulatory agencies and the scientists working on EAB research would facilitate the transfer of new technology and research to operational programs. Funding, particularly for a multi-year, integrated approach to EAB management, remains problematic. If these issues, which are largely administrative, can be addressed, we can make considerable progress in slowing EAB and ash mortality.

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