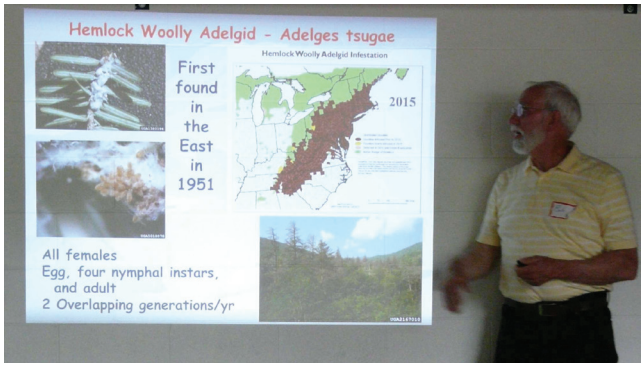

Exotic Forest Pests in Michigan: Current and Potential Invaders

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Exotic (= alien, non-native) forest insects are moved between countries in many ways, but primarily through wood packaging material (WPM; e.g., pallets and crating) and live plants. Other means include international trade in logs, firewood, processed wood items, passenger baggage, mail, as well as hitchhiking on such items as shipping containers, ships, aircraft, and machinery (Meurisse et al. 2018). Historically, WPM has commonly contained bark- and wood-infesting insects because it was often made from recently cut trees with some bark retained, which is attractive to many borers that infest dying and recently cut trees (Eyre and Haack 2017, Haack 2006). Travel times between countries is usually very short, being a matter of hours (air travel) to days (ocean vessels), and thus has little impact on insect survival.

Every country is dealing with exotic insects. In the continental US, there are over 2000 exotic insects of all types, of which over 500 feed on woody plants, including more than 100 bark- and wood-infesting insects. In Michigan, the three most destructive exotic forest insects currently active are the emerald ash borer (*Agrilus planipennis*), beech scale/beech bark disease complex (*Cryptococcus fagisuga* + *Neonectria* fungi), and hemlock woolly adelgid (*Adelges tsugae*).

The emerald ash borer (EAB), an Asian buprestid, was discovered in the USA in 2002 in the Detroit area and later that same year in nearby Windsor, Canada (Haack et al. 2002, Poland and McCullough 2006). As of June 2018, EAB has been found in 35 US states and 4 Canadian provinces, and is present in all Michigan counties now. EAB is primarily a pest of ash trees (*Fraxinus*), but has occasionally been found infesting fringe tree (*Chionanthus*), which is in the same plant family (Oleaceae). EAB has already killed millions of ash trees in North America, and will kill many millions more as it expands its range. EAB can spread naturally through adult flight, as well as hitchhiking in vehicles as well as through inadvertent movement of infested firewood, nursery stock,

and logs. To date, four EAB parasitoids from Asia (3 from China and 1 from Russia) have been approved for release in the USA, of which three attack EAB larvae (*Spathius agrili*, *Spathius galinae*, and *Tetrastichus planipennisi*), and one attacks EAB eggs (*Oobius agrili*) (Bauer et al. 2015). EAB has also been introduced to European Russia, in Moscow, and is spreading westward towards Belarus and Ukraine (Haack et al. 2015). European ash are just as susceptible to EAB as are North American ash. In addition to biocontrol, there are also efforts to identify native ash trees that show immunity to EAB as well as breeding programs that cross North American ash species with highly resistant Asian ash (Herms and McCullough 2014).

Beech bark disease (BBD) results from infection by fungi in the genus *Neonectria* of the feeding wounds caused by beech scale (*Cryptococcus fagisuga*), a European insect, on the bark of branches and trunks of beech trees (*Fagus*). BBD was first discovered in North America in 1890 in Nova Scotia, and has slowly spread westward and southward throughout much of the natural range of American beech. Beech scale insects are all females, with the newly hatched crawlers being the main dispersal stage (mostly by wind). Beech scales can also be spread by moving infested firewood, and by wildlife such as birds as they fly from tree to tree. BBD was first found in Michigan in 2000, in two parks (Ludington State Park in Lower Michigan and Bass Lake Campground in the UP), suggesting that it was introduced on firewood (Wieferich and McCullough 2013). BBD has now spread throughout much of Michigan and it was first detected in Wisconsin in 2009. Some native beech trees show signs of immunity to BBD, and these trees are now the focus of breeding programs (Koch and Heyd 2013).

The hemlock woolly adelgid (HWA) was first discovered in the eastern US in 1951, where it has spread primarily through the Appalachian states. HWA infests the twigs of hemlock trees (*Tsuga*) and can cause branch and tree death after years of feeding. Since 2002, Michigan has had an external quarantine that prohibits importation of hemlock trees, such as nursery stock, from any state known to be infested with HWA. Nevertheless, several small HWA infestations have been discovered in Michigan, starting in 2006 in Emmet County. In each case, an aggressive eradication program was initiated that included destruction of all known infested trees followed by multiple years of insecticide injection of all hemlocks within a buffer zone around the original infestation. More recently, starting in 2015, a relatively large HWA infestation was found in Ottawa County, MI, near the Lake Michigan shoreline. Since then, HWA has been found in three neighboring counties (Allegan to the south, and Muskegon and Oceana to the north). Currently, intensive surveys are being conducted along the Lake Michigan shoreline from the Michigan-Indiana border to the top of Michigan's Lower Peninsula. Once the northernmost infestation of HWA has been identified in Michigan, control efforts will focus on that area and then move southward in future years. Elsewhere in the USA where HWA has been present for several years, biological control efforts have been initiated as well as breeding for resistance (Havill et al. 2014).

Another recent invader in Michigan is the Asian chestnut gall wasp (*Dryocosumus kuriphilus*), which was first found at several sites in southwestern Michigan in 2015. Surveys are being conducted to learn the extent of the infestation. This insect lays its eggs in buds of chestnut trees (*Castanea*), which initiate gall formation the following year when the buds open. The galls result in twig distortion and eventual death, and lower nut production (Haack et al. 2011, Battisti et al. 2014).

There are many other exotic forest insects in nearby states that could eventually reach Michigan. For example, the Asian longhorned beetle (*Anoplophora glabripennis*; ALB) is a tree-killing Asian cerambycid first found in the USA in 1996 in New York. ALB can infest and

kill healthy hardwood trees in several genera such as *Acer*, *Aesculus*, *Betula*, *Populus*, *Salix*, and *Ulmus* (Haack et al. 2010). In the USA, there are still active ALB infestations in Massachusetts (near Worchester), New York (near NYC), and Ohio (near Cincinnati). Eradication has been the goal of all ALB infestations found in the USA, Canada, and Europe. Several populations have been eradicated in both North America and Europe, but many still persist (Eyre and Haack 2017). The current US eradication plan calls for cutting and chipping all infested trees and also most nearby potential host trees. For example, in Ohio where ALB was first found in 2011, over 19,000 infested trees have been cut as well as over 80,000 additional high-risk trees as of March 2018.

Thousand canker disease (TCD) is a lethal disease of walnut trees (*Juglans*) caused by a native western bark beetle, the walnut twig beetle (*Pityophthorus juglandis*), and a fungus of unknown origin, *Geosmithia morbida*. TCD first appeared in several western US states in the 1990s and early 2000s (Newton and Fowler 2009). Then, starting in 2010, TCD appeared in the eastern US, first in Tennessee and later in North Carolina, Ohio, Pennsylvania, and Virginia. The name TCD refers to the patch of dead inner bark and sapwood that surround each gallery system of the walnut twig beetle, which number in the thousands on infested trees. TCD has now appeared in Europe, being first detected in Italy in 2013 (Faccoli et al. 2016).

The spotted lanternfly (*Lycorma delicatula*), an Asian insect, was first found in Pennsylvania in 2014 (PDA 2018). This insect feeds on the smooth bark surfaces of many hardwood trees and shrubs, but prefers tree of heaven (*Ailanthus*). Sooty mold develops on the exudate from the insects and feeding wounds. This insect can easily be moved by humans given that egg masses are laid on smooth surfaces, including the bark of host plants but also, lawn furniture, vehicles, and other structures.

There are many other tree-killing pests in the US now. For example, the redbay ambrosia beetle (*Xyleborus glabratus*) was first discovered in the Southeast in 2002 (Haack 2006). This beetle vectors the fungus *Raffaelea laurelensis*, which can be lethal to several members of the laurel family (Lauraceae), including redbay (*Persea*), pondspice (*Litsea*), spicebush (*Lindera*), and sassafras (*Sassafras*) (Fraedrich et al. 2007). This disease complex is often called *laurel wilt*. The avocado industry is very concerned about laurel wilt given that avocado is also a member of the genus *Persea*. Another example is the soapberry borer (*Agrilus prionurus*), which is native to Mexico, but is now killing western soapberry trees (*Sapindus*) in Texas (, Billings et al. 2014, Haack 2006). A third example is the goldspotted oak borer, *Agrilus auroguttatus*, which is native to Arizona and adjacent Mexico, but is now killing several species of oak (*Quercus*) in southern California, where it was introduced (Coleman et al. 2017). Firewood was the likely means of introduction for both *A. auroguttatus* and *A. prionurus*.

Several international phytosanitary standards have been developed in recent years to help reduce the incidence of live insects in traded products or their conveyances (Meurisse et al. 2018). These global standards are known as International Standards for Phytosanitary Measures (ISPMs) and are developed by the International Plant Protection Convention (www.ippc.int/en/core-activities/standards-setting/ispms/). The ISPMs most closely related to reducing movement of forest insects are ISPM Number 15 (wood packaging materials; first adopted in 2002), ISPM-36 (plants for planting; 2012), ISPM 38 (seeds; 2017), ISPM 39 (wood; 2017); ISPM 40 (growing media; 2017), and ISPM 41 (used vehicles, machinery and equipment; 2017).

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MES Website: http://michentsoc.org Facebook: https://www.facebook.com/michentsoc/

Upcoming MES Events

2019 Breaking Diapause – Saturday, March 23rd at the Dow Gardens, Midland, MI. The Pines historical home will host the event. (1038 W. Main St. Midland MI) Butterflies will be displayed in the conservatory so we can visit them. Self-guided tours or walks in the garden are welcome. 10 am- 3 pm.

65th Annual Meeting – **Saturday, 22 June 2019** at the Rockwell Lake Lodge. (https://rockwelllakelodge.hillsdale.edu/). More information to follow! The Rockwell lake Lodge has been a great place for several of our annual meetings, with posh accommodations and lots of habitat to explore!

The 2015 Annual Meeting at Rockwell Lake

A New Logo for the Michigan Entomological Society

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Our logo has remained unchanged since our society adopted its first logo in 1965. The familiar circle of the whimsical blue butterfly, inside a neatly lettered blue ring, was designed by member Hollace "Bud" Gordininer. His design won the MES emblem contest, and has been in play ever since (Mich.Entomol.Soc. Newsletter 11(1) : 1. p. 1).