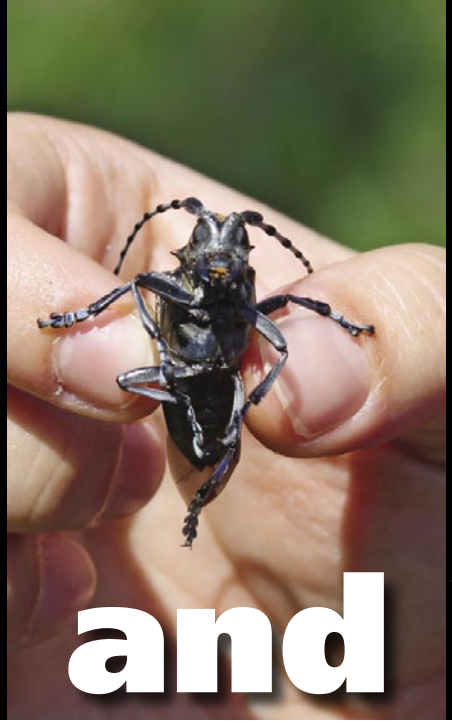

Busted! The Asian longhorned beetle now is confirmed to have a foothold in five U.S. states, and the most effective eradication approach has been the removal and destruction of high-risk trees.

A Killer in Black and White

With a proven ability to hitchhike across the globe, Asian longhorned beetle has been found in five U.S. states. Unlike its fellow pest, emerald ash borer, ALB is known to kill a wide range of trees. So how do we rid our trees of this menace?

By Joe Boggs, Amy Stone and Dan Herms

On Friday, June 17, 2011, the United States Department of Agriculture, Animal and Plant Health Inspection Service (USDA APHIS) and the Ohio Department of Agriculture (ODA) jointly announced that an Asian longhorned beetle (ALB) (*Anoplophora glabripennis*) infestation had been found near the Village of Bethel, a small Ohio town in Tate Township, Clermont County, located about 25 miles east of Cincinnati. On that black (and white) Friday, Ohio had the dubious distinction of joining four other states (New York, Illinois, Massachusetts and New Jersey) and Toronto, Canada, in the fight to eradicate ALB in North America. Some battles have been won; ALB has been eradicated in Illinois and in some locations in New York and New Jersey.

Much is at stake. ALB has a very wide host range and the beetle is a tree killer; infested trees do not recover, and they are continually re-infested until dead. Unlike other devastating pests and diseases of non-native origins, such as emerald ash borer (*Agrilus planipennis*; EAB), Dutch elm disease and chestnut blight that kill trees in one genus, ALB kills trees belonging to 13 plant genera. This nonnative tree-killer has the potential to cause an unprecedented catastrophic loss of trees in North America.

Photos by Joe Boggs

Adult Asian longhorned beetles are approximately 1 to 1½ inches long; antennae have alternating bluish-black and white bands and are longer than the length of the beetle's body.

ALB's host range includes all species of *Acer* (all maple species); *Aesculus* (horsechestnut and buckeye); *Ulmus* (elm); *Salix* (willow); *Betula* (birch); *Platanus* (sycamore; planetree); *Populus* (poplar); *Albizia* (mimosa); *Cercidiphyllum* (katsura); *Fraxinus* (ash); *Koelreuteria* (goldenraintree); *Sorbus* (mountainash); and *Celtis* (hackberry).

While the first six in this list of genera are generally considered the trees most commonly attacked by ALB, *all* of the trees in this list can be attacked and killed by ALB. Trees in the first group are like steak to ALB while trees in the second group are like hamburger. All are food for ALB; all are considered hosts!

There are no known natural enemies of ALB in North America. Some of the same predators and parasitoids that target native longhorned beetles may attack ALB; however, there has been no indication that bio-allies have had a substantial impact on ALB populations found thus far in North America.

A brief history of ALB in North America

ALB is native to China and the Koreas. It is now well-known that the beetle is capable of hitchhiking across the globe as larvae, pupae and newly developed adults inside the wood of packing materials. Genetic testing has revealed that the infestations in the five states and Toronto, Canada, were started by a few beetles arriving directly from Asia; the beetles did not come from other North American infestations. Of

course, some human-assisted spread has occurred in North America. There is a general repeating pattern of multiple related ALB infestations being found in a region; the beetle gets moved around in infested wood before it's discovered.

The beetle was first discovered in North America in Brooklyn, N.Y., in 1996. It was later discovered in three other New York City boroughs: Queens, Manhattan and Staten Island, as well as in Nassau and Suffolk (Islip) counties on Long Island. It was also found in two counties in New Jersey: Hudson (Jersey City) and Union. All of these infestations are related through an original point of introduction from Asia and then a subsequent movement of infested materials.

The general pattern of multiple ALB infestations being found in a region was repeated in Chicago in 1998, where five related infestations were discovered. ALB was also found in 1998 in Toronto, Ontario. In 2008, the largest infestation in North America was discovered in Worcester, Mass.

ALB in Ohio has followed the same pattern of localized spread that has been seen elsewhere. Since its discovery near Bethel in Tate Township, there have been two smaller satellite infestations found nearby. Both infestations have been traced back to infested wood being moved from Bethel prior to the discovery of the beetle in Ohio.

However, the Ohio infestation also represents several "firsts." It was the first time the beetle had been found in a rural area dominated by farmland and it is the southern-most ALB infestation to be found in North America. The Ohio infestations illustrate how this beetle may pop up where it's least expected: Bethel is a rural community located far from major transportation hubs.

The take-home message is to never assume ALB is "somewhere else."

Ohio also represents the first time the beetle has been found in an area where EAB is known to be wreaking havoc on ash in landscapes and forests. EAB actually overlapped ALB in Chicago; however, it was not known in 1998 that EAB had established beachheads in North America.

EAB was first detected in North America in a Detroit suburb in 2002. Unfortunately, the beetle had already become widespread in a number of states prior to its discovery. The EAB story provides a cautionary tale: By the time the beetle was found, it was already too late for eradication. ALB remains confined to relatively small and distinct infestations compared to EAB, so eradication remains a viable strategy. However, the successful eradication of ALB depends upon early detection.

ALB produces a single generation per season.

ALB detection

Following are some of the key identification and diagnostic features for ALB.

• The beetle: ALB is a large, striking looking beetle—adults measure 1 to 1½ inches in length. The beetle belongs to the family Cerambycidae; beetles in this family are commonly called "longhorned" because of their extremely long antennae. The antennae of ALB have alternating bluish-black and white bands and are longer than the length of the beetle's body. The bullet-shaped, shiny black beetles are covered with numerous, irregularly shaped and sized white spots; the spots look like someone has tried to dab white paint onto the beetle using a frayed paint brush.

There are very few native longhorned beetles that are look-alikes to ALB. Indeed, many of the North American infestations, including the Worcester, Mass., infestation, were discovered by people finding beetles rather than diagnosing the tree mortality caused by the beetles.

ALB produces a single generation per season. Adults have been reported to be active from April through December with peak activity during May to July. Newly emerged adults spend some time feeding on the phloem tissue of small twigs and on tree leaf veins. This is known as "maturation feeding." While distinct symptoms are produced, the damage is not on the same scale and as apparent as the symptoms produced by other twig and leaf-feeding insects simply because of the number of beetles feeding at a given time. The beetle can successfully spend the winter in all stages (egg, larva and pupa) except the adult stage; adults are killed with the first substantial freeze.

• Oviposition pits: Although the beetles are capable of flying several hundred yards in search of a suitable host, they prefer to remain close to the tree in which they developed in order to reinfest if the tree is healthy enough to support another generation. After mating, ALB females chew oblong-shaped, three-eighths-inch-wide "oviposition pits" through the bark and phloem. A single egg is deposited into each pit on the outer surface of the exposed xylem; a female lays an average of 35 eggs during her lifetime. The oviposition pits and adult exit holes, if found on living branches and stems, are strong diagnostic indicators for an ALB infestation.

• The larva: It is the larval stage of ALB that kills trees. The immature stages are found inside infested trees, which is why it is important to avoid moving wood (for example, firewood, logs and so on) outside

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Newly emerged adults spend some time feeding on the phloem tissue of small twigs and on tree leaf veins.

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ALB quarantine zones—moving infested wood moves the beetle! Cerembycid larvae are commonly referred to as "roundheaded borers," and ALB larvae look like typical cerembycid larvae. The segments toward the front of the fleshy, thin-skinned, yellowish-white larvae are larger in diameter than the rest of the larval segments. This makes the larvae look like they have round heads and tapering bodies.

ALB larvae usually develop through five instar stages. First and second instar larvae commonly tunnel through and feed on phloem tissue. Their feeding activity may produce weeping, canker-like symptoms on the bark. Third, fourth and fifth instar larvae bore deep into the white wood. Occasionally, this turn into the xylem starts with second instar larvae.

IdentifyingCerembycid larvae is a risky endeavor because they share so many features. However, finding roundheaded borers in the live stems and branches of a preferred ALB host, particularly *Acer* spp., should signal concern and further investigation.

Coarse white frass is a sign that ALB has infested a tree. Another telltale marker is the emergence hole, which is large enough to insert a No. 2 pencil. Remember that ALB infests healthy, living trunks and branches, whereas a number of native longhorned beetles infest dead or dying stems.

• Coarse frass and wood shavings: The larval wood boring activity produces coarse white frass that is exuded from the infested stems. The frass looks like "wood wool" or Excelsior packing material. Adult female beetles also produce similar looking wood shavings as they chew their oviposition pits. Both the larval frass and beetle wood shavings collect in branch forks and on the ground beneath infested trees.

• Big emergence holes; the "pencil test": Adult emergence holes are three-eighths- to one-half-inch in diameter, and the holes extend deep into the xylem because the larvae tunnel through the xylem. The holes are large enough to easily insert a No. 2 pencil, and this "pencil test" is effective in separating phloem feeding borers from ALB—emergence holes of phloem feeders are much shallower. Of course, ALB holes are on *living, healthy* branches and trunks; there are a number of native longhorned beetles that infest dead or dying stems.

• Heavy woodpecker damage: ALB larvae bore into the white wood (xylem); woodpeckers must excavate deeply to extract these larval meat morsels.

• Branch breakage: The damage to the white wood (xylem) produced by late instar larval feeding activity causes substantial structural weakening of infested branches leading to branch breakage. In fact, one of the Worcester infestations was discovered by USDA APHIS personnel examining the ends of branches broken after an ice storm. One of the Ohio satellite infestations was detected by an alert landowner who noticed an unusual amount of branch breakage on a maple tree on his property.

• Tree dieback and death: ALB infestations eventually kill trees; however, death comes very slowly. While infested trees will show canopy thinning, this symptom on maple sometimes does not occur until the main stem is riddled with emergence holes. Canopy decline is not a reliable indicator of an ALB infestation.

ALB management—with an eye on EAB

Given the overlap between EAB and ALB in Ohio, when people think of ALB, they may also be thinking of EAB, which is now widely distributed in the state. This confusion will probably be repeated in other states as EAB spreads into areas where ALB has been discovered. The two beetles are like apples to oranges in almost all aspects including their host range, tree-killing behavior and management options in North America.

The much smaller EAB adults are very good flyers, and they easily disperse. While ALB adults are relatively good flyers, they take flight much less frequently compared to EAB perhaps because their large bodies require much more energy to launch and remain airborne. Thus, ALB tends to stay and continually re-infest trees until the trees die and are no longer able to support

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a new generation. As a result, ALB does not spread very fast from tree to tree compared to EAB.

EAB is now found in multiple locations in very large populations in a number of states; the beetle represents a clear and present danger to ash trees throughout a large area of North America. ALB was first found in North America in 1996 and even now, populations remain small and isolated compared to EAB. The management strategy for ALB is eradication with the overarching goal to eliminate ALB from North America. Eradication of ALB has been successful elsewhere: It has been eradicated from Chicago, from Hudson County (Jersey City), N.J., and from Suffolk (Islip) County, N.Y., and eradication is nearly complete in some of the New York City boroughs. However, there is no hope for eradicating EAB.

Although EAB is not targeted for eradication, ash trees can be successfully protected against EAB through treatments with systemic insecticides. Treatment success is measured by the health of the canopies and not by the number of beetles killed. EAB larvae feed exclusively on the phloem, where they are highly vulnerable to systemic insecticides. Adult EAB beetles are also killed when they feed on the leaves of systemically treated trees. Systemic insecticide treatments are highly effective in EAB suppression; however, the overarching management goal is very different from that for ALB. Maintaining a full canopy does not require 100 percent efficacy—every EAB beetle does not need to be killed!

Eradication using insecticides means the treatments must be 100 percent effective, or very nearly so. While ALB larvae start out feeding on the phloem, they quickly bore into the xylem. Unfortunately, this places the larvae out of the reach of systemic insecticides that do not translocate effectively within the xylem. If a tree already has ALB larvae in the xylem, those larvae will successfully complete their development and new adults will emerge and disperse even if the tree is treated.

Insecticides do not make trees "immune" from ALB. Field experiments conducted in China under highly controlled condition using small (2- to 4-inch-diameter), uniform trees found that ALB density was reduced by 71 to 90 percent. While this level of control may be sufficient for protecting trees, it is not adequate when the goal is eradication. The effectiveness of insecticides for controlling wood borers declines as the size of the tree increases.

Ultimately, the way to eradicate Asian longhorned beetle is to remove infested and high-risk trees.

Insecticides have been used in ALB eradication programs in North America, but it's the adult beetles, not the larvae, that are targeted. The adult beetles feed on twig and leaf tissue during their maturation feeding period. Unfortunately, while some ALB adults are killed by systemic insecticides during maturation feeding, the number of adults killed will not meet the standards required for eradication. Achieving high adult mortality is challenged by the extended period of time that adults are active during the season, limitations associated with product label restrictions, and the fact that size matters: Efficacy is uncertain on large trees. This is why insecticides have always been used in a support role in conjunction with other eradication tools and primarily outside of the core infested zones. The most effective eradication approach has been the removal and destruction of high-risk trees.

Let's listen to science

As with any new discovery that finds its way into the news media, science sometimes takes a back seat to opinions formed out of rampant speculation. The discovery and management of ALB in North America is no exception. Regrettably, myths and misconceptions spawned from conjecture sometimes outpace the progress of science. Science is an ever-advancing enterprise based on new discoveries made through research; what we think is true today may be proved untrue tomorrow. Pruning paint is a perfect example; once a common recommendation, research revealed that the paint is actually counterproductive to wound closure.

Some myths and misconceptions about ALB stem from well-intended efforts by non professionals to understand sometimes-complex arboricultural and pest-host concepts. Others that have arisen in Ohio are directly related to the occurrence of EAB in the state. Understandably, non-professionals may believe all tree borers are equal, a perspective that horticulture professionals know is not true. Unfortunately, these misconceptions have gained some traction based on appearing in multiple venues. As William James said, "There's nothing so absurd that if you repeat it often enough, people will believe it."

How do we avoid falling into the trap of believing ALB myths and misconceptions? First, keep yourself informed and updated—never miss attending training programs on ALB. Second, always consider the source of your information: Does your source have an alternate agenda? Finally, always separate facts that are based on research from opinions that are based on speculation.

Daniel Patrick Moynihan said it best: "Everyone is entitled to their own opinions, but not their own facts."

Joe Boggs is an assistant professor with The Ohio State University Extension and OSU Department of Entomology. He works as a commercial horticulture educator for OSU Extension, Hamilton County (Cincinnati). Joe can be reached at: boggs.47@cfaes.osu.edu. *Amy Stone is a horticulture educator and county director with OSU Extension, Lucas County (Toledo). She is the statewide coordinator for the OSU Extension, EAB/ALB Team. Amy can be reached at* stone.91@osu.edu. *Dan Herms is Professor and Interim Chairperson of the OSU Department of Entomology. Dan can be reached at* herms.2@osu.edu.