Asian Longhorned Beetle (ALB) and Emerald Ash Borer (EAB): The Tale of Two Beetles

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Boggs and Stone draw upon years of practical experience in providing educational outreach on EAB and ALB to compare and contrast the two beetles so participants are prepared to handle questions from clientele and the public regarding the impact and management of these destructive tree pests.

Extended abstract:

Emerald ash borer (EAB) and Asian longhorned beetle (ALB) are found in the same location in Ohio. The discovery of ALB in Ohio in 2011 was the first time that the beetle was found in an area where EAB is known to be infesting ash (*Fraxinus* spp.) in landscapes and forests. EAB actually overlapped ALB in Chicago; however, it was not known at the time (1998) that EAB had established beachheads in North America.

The convergence of these non-native tree killers in Ohio has created considerable confusion; when people hear ALB they often think EAB and vice versa. Of course, the two beetles are like apples-to-oranges in all aspects including biology, behavior, spread, distribution in North America, and management options. This geographical overlap between the two beetles will no doubt occur elsewhere as EAB spreads across North America.

Both beetles are tree killers and exhibit no real preferences for stressed versus healthy trees. However, EAB only infests and kills trees in one genus (*Fraxinus*) while ALB infests and kills trees

in 13 genera. Trees that are considered "very good hosts" of ALB include: *Acer* (all maple species); *Aesculus* (horsechestnuts and buckeyes); *Ulmus* (elms); and *Salix* (willows). Trees that are considered "other hosts" include: *Betula* (birches); *Platanus* (Sycamore / Planetrees); *Populus* (Poplars); *Albizia* (Mimosa); *Cercidiphyllum* (Katsura); *Fraxinus* (ashes); *Koelreuteria* (goldenraintree); *Sorbus* (mountainash); and *Celtis* (Hackberry). While the "very good hosts" 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 considered hosts!

Both beetles are native to Asia with ALB being confined to China and the Koreas. Indeed, ALB is a serious pest in China causing widespread mortality to poplars, willows, elms, and maples. Much of the damage in China occurs on street trees, trees in windbreaks and hedgerows, and trees in man-made forests and plantations. EAB has never been observed to cause significant injury to its *Fraxinus* hosts in Asia. This difference in pest status between the two beetles in Asia is partially responsible for why there was a greater amount of scientific data on ALB compared to EAB when both beetles were discovered in North America.

Both beetles have been accidently introduced into North America; however, EAB appears to have had a single point of introduction in a suburb of Detroit (MI, U.S.) whereas ALB has been introduced from China to multiple sites in the U.S. as well as to a site in Toronto, Canada. Thus far, no new ALB infestations have been traced back to other infestations in North America; all of the beetles that started new infestations arrived directly from China. However, there has been a repeating pattern with a single point of introduction from China being followed by multiple infestations in a region; the result of movement of infested wood or other materials.

Although ALB was discovered much earlier in North America (1996) compared to EAB (2002), EAB has become much more widely distributed in North America even though ALB has been introduced to multiple locations. Explanations for this disparity in the current distribution of the two beetles include differences in symptomology and thus detection as well as beetle behavior. The much smaller EAB adults are very good fliers and they easily disperse. While ALB adults are relatively good fliers, 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 a new generation. As a result, ALB does not spread very fast from tree to tree compared to EAB.

While both beetles are tree killers, their tree-killing behavior is heavily dependent upon differences in larval feeding behavior coupled with morphological differences in their host trees. EAB only attacks ash trees and all ash species are "ring porous;" water and nutrients are only transported through the outermost xylem ring. EAB is a phloem feeder; however, as the larvae gain size, they start etching the outermost xylem ring. Consequently, trees may die quickly as EAB larvae girdle trees by consuming the phloem and etching the single functioning xylem ring.

ALB infests some ring porous trees; however, maples are most commonly attacked and maples are "diffuse porous;" water and nutrients are carried by 4-5 of the outermost xylem rings. Although ALB larvae bore into the xylem, their tunneling causes less disruption of the xylem vascular flow compared to damage caused by EAB in a ring porous tree. In the end, the ALB larval damage does kill trees, but infested trees may linger for many years giving the false impression that they are not being killed. Of course, as they linger, the trees are a constant source of new beetles. While canopy thinning is a key symptom used to detect EAB, it is not a dependable symptom for detecting ALB infestations. Indeed, this is usually the most startling revelation for individuals who first observe an ALB infestation; heavily infested trees just don't look infested!

EAB is now found in multiple locations in a number of states with very large populations occurring in many of those 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, IL, from two locations in New Jersey, from Suffolk (Islip) County, NY, and from Toronto, Canada. 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 ALB. Maintaining a full canopy does not require 100% efficacy; every EAB beetle does not need to be killed!

Eradication using insecticides means the treatments must be 100% 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. Field experiments conducted in China under highly controlled condition using small (2-4" diameter) uniform trees found that ALB density was reduced by 71-90%. 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.

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.

Following is a table comparing EAB and ALB. In this presentation, these key differences will be discussed in further detail.

	Emerald Ash Borer		Asian Longhorned Beetle
1)	Infests and kills tree belonging to a single plant genus: *Fraxinus*	**1)**	Infests and kills trees belonging to 13 plant genera representing multiple plant families
2)	Widespread; large areas infested	**2)**	Isolated infestations
3)	Beetles easily disperse; good fliers, quick to fly!	**3)**	Beetles tend to stay with trees; slow to take flight
4)	Can kill ring porous (Ash) trees quickly: thinning canopies often appear early in the infestation process	**4)**	Diffuse porous trees (Maples) die slowly: canopy thinning occurs very late in the infestation process
5)	Multiple management options	**5)**	Management options center on eradication
6)	Insecticides are highly effective in protecting trees	**6)**	Insecticides are not sufficiently effective to be used as a primary eradication tool
7)	No chance for eradication from U.S.	**7)**	Eradication has been successful in multiple locations

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