

Ash continues to regenerate in forests invaded by emerald ash borer for 20 years.

Emerald ash borer (EAB) is one of the most damaging invasive species to have arrived in North America. Since its invasion in the late 90's, and its detection in 2002, millions of ash trees have died due to EAB infestation (see photo 1).

EAB larvae hatch from eggs laid by adult beetles in the summer. The larvae then chew their way into the phloem of trees and they will feed on the wood and create serpentine galleries all summer. This feeding damage affects the ability of trees to transport water and nutrients. The canopy of infested trees will slowly dieback until the entire tree is dead which can occur in a few years after trees are colonized by EAB.

When EAB first swept through North America scientists were worried about the extent to which ash would survive in North American forests. For example, an early study found up to 99% of ash were dead in forests in Michigan and Ohio following EAB invasion (see photo 2).



Photo 1: EAB larvae kill trees by creating serpentine tunnels in the phloem as they feed. This impacts the ability of trees to transport nutrients which eventually leads to tree death. Photo by Caleb J. Wilson, Ph.D.



Photo 2: Ash in varying stages of canopy dieback as a result of EAB infestation. When trees surpass 30 % dieback, insecticide treatments typically fail to improve tree health. Photo from Sadof et al. 2023 – Journal of Integrated Pest Management.

It has now been over 30 years since EAB has invaded North America and thankfully ash is still present within most post-invasion forests. What remains to be seen is if ash will continue to persist and regenerate in forests following EAB invasion, or if ash populations will eventually crash as a result of EAB.

To determine the extent to which ash is regenerating in post-invasion forests, we conducted surveys of four ash strata within four forests in south-central Michigan in 2022 and 2023. At these sites EAB has been present for approximately 20 years. Our results were published in *Forest Ecology and Management* (see photo 3).

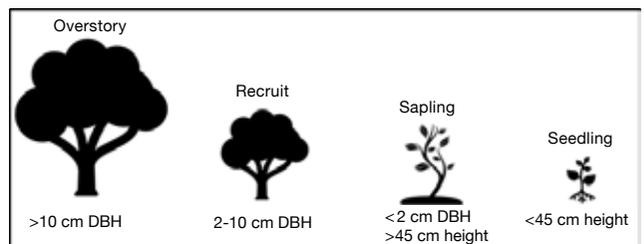


Photo 3: The four ash strata we surveyed in this study. DBH stands for diameter at breast height. Graphics are provided by Microsoft PowerPoint and Flaticon.

We created a 50 x 50 m grid over the extent of each forest we surveyed, and within each cell of that grid we assessed the canopy condition of four ash that were at least 3 cm or larger in diameter. In each cell we recorded the density of overstory ash (larger than 10 cm in diameter), ash recruits (2 – 10

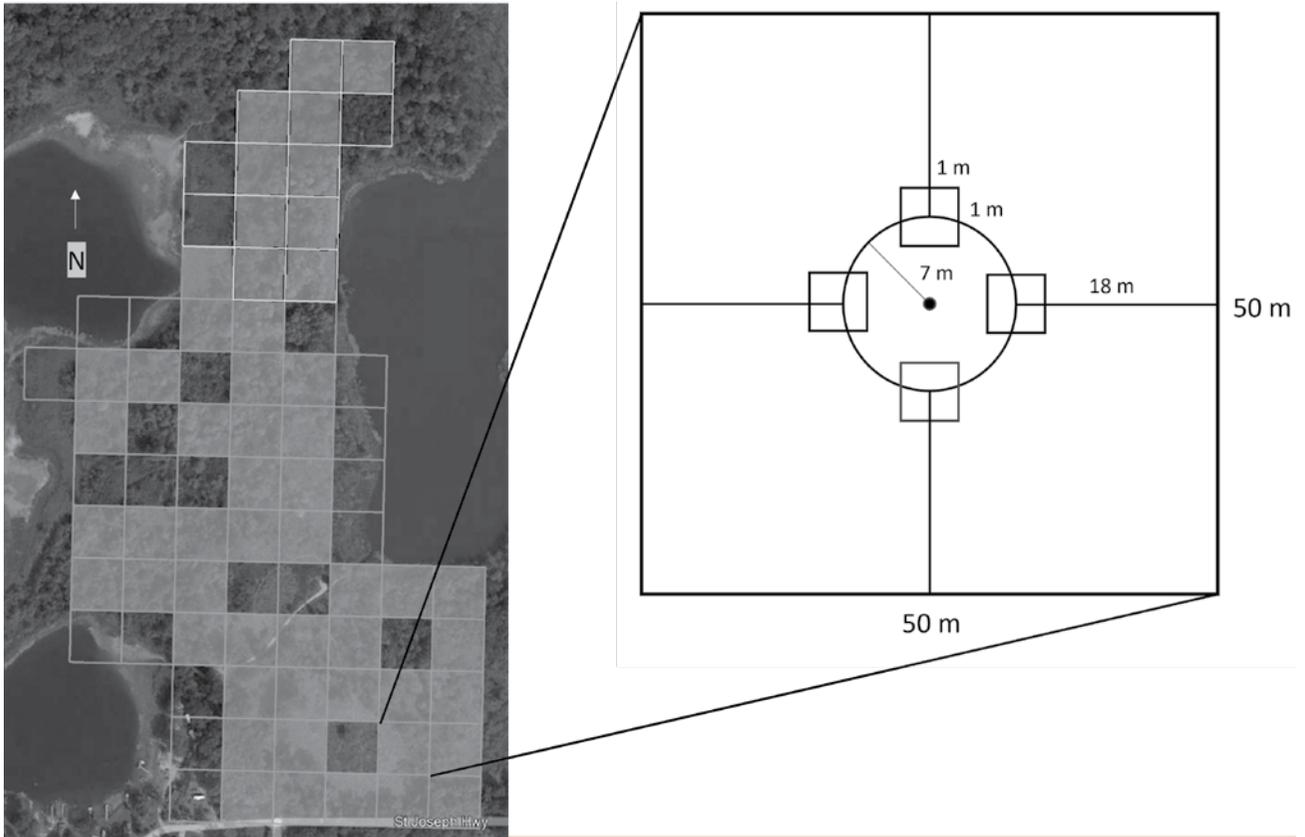


Photo 4: We surveyed ash in 50 x 50 m grid cells at four different forests in south central Michigan. Left: A field site with all grid cells shown. We conducted surveys within highlighted cells. Empty cells did not have at least four living ash larger than 3 cm in diameter within the cell. Right: Survey protocol for each cell. Overstory ash, and recruits were surveyed within a 7 m fixed radius plot and four, 18 m transects in each cell. Seedlings were surveyed within four 1 m² microplots within each cell. Image credit: Caleb J. Wilson, Ph.D.

cm diameter), ash saplings (< 2 cm diameter, > 45 cm height), and ash seedlings (< 45 cm height). We also recorded the extent to which recruit-sized ash were infested within a 7 meter radius situated at the center of each cell of the grid (see photo 4).

Overall, we documented substantial ash regeneration in all the tree strata we surveyed and 54% of overstory ash and 43% of ash recruits had less than 30% dieback. Thus, approximately half of the two largest tree strata were in good condition. However, 47% of overstory ash, 17% of recruits, and 7% of saplings that we surveyed were dead. We also found that 33% of ash recruits had external signs of EAB infestation while 45% were uninfested and 21% were dead. Finally, 22% of the trees that we surveyed had seeds within their canopy (see ash regeneration graph page 50).

White ash was the dominant ash species at our sites and green ash represented about 1/3rd of all trees. Of the common ash species in eastern North America, blue ash is most resistant to EAB, white ash is intermediate, green ash is susceptible, and black ash is highly susceptible to EAB. Surveys like

ours in white ash or blue ash dominated stands tend to find high rates of regeneration and that most standing ash are alive. However, in green and black ash stands, mortality rates are much higher and it is unclear if these species will be able to continue to regenerate in the face of EAB invasion (see photo 6).

As the amount of live ash declines in post-invasion forests, EAB densities tend to decline somewhat due to a reduction in resources available to support EAB. However, as ash regenerates in these stands, EAB populations may once again rise and produce a second wave of widespread ash decline. It's unclear if ash and EAB will ever reach a state of equilibrium or if certain ash species will decline to extinction (black and green ash) while more resistant species (white and blue ash) maintain some level of regeneration within post-invasion forests in spite of EAB infestation pressure.

However our study documents that while about half of ash larger than 10 cm in diameter are dead in these post-invasion forests, there is still substantial regeneration of smaller diameter trees. Although EAB has been a devastating invasive pest, ash are still an important part of our forests and it is worth taking

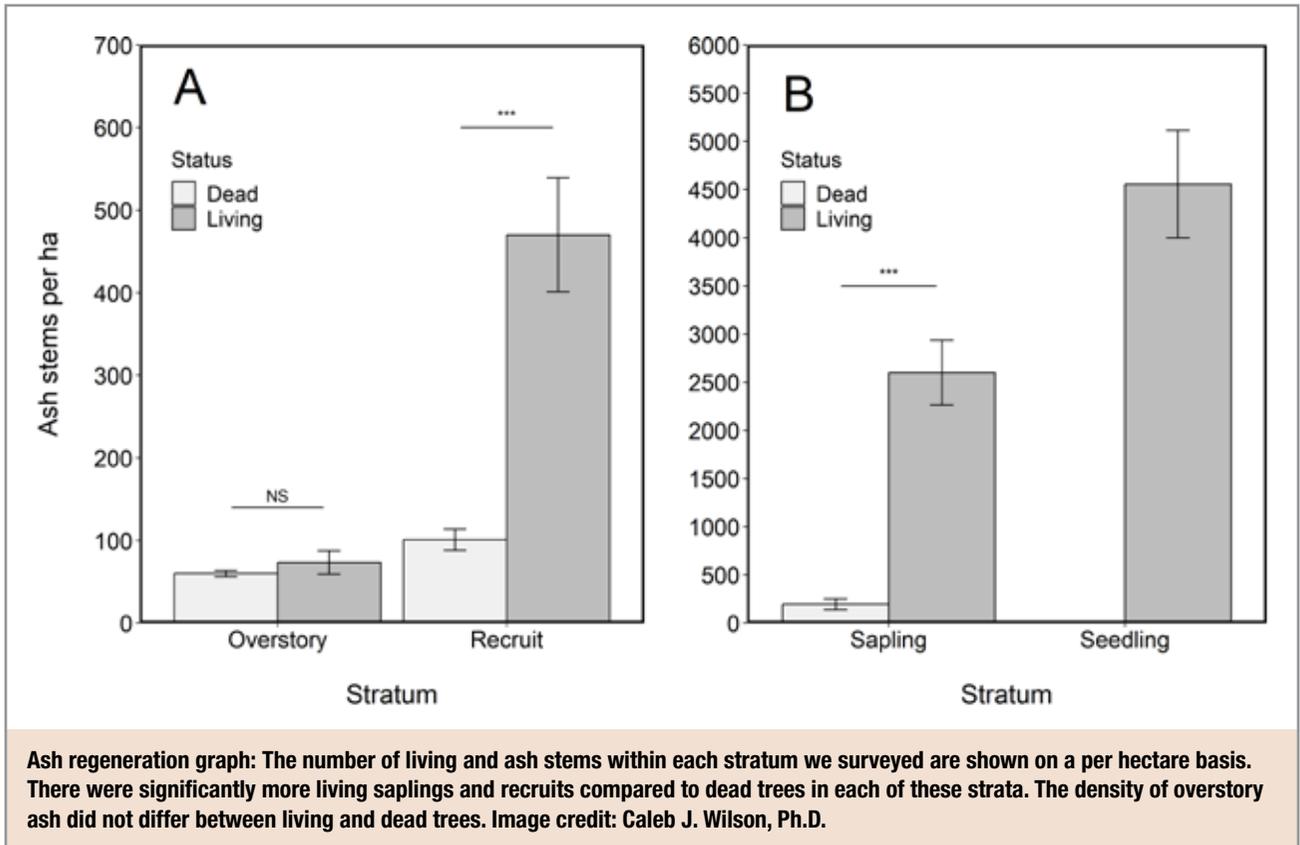


Photo 6: Left: Black ash is highly susceptible to EAB. Photo: Samuel Brinker. Right: Blue ash is one of the more resistant ash species in North America. Photo: T. Davis Sydnor, The Ohio State University, Bugwood.org.

whatever steps we can to manage EAB or slow the spread of new introductions. USDA APHIS continues to release EAB parasitoids throughout North America and trunk injections of systemic insecticides like Emamectin Benzoate will effectively protect trees from EAB for up to three years. Over time as parasitoids become more established in North America the hope is that EAB will become a less serious pest and mortality of larger ash trees will begin to slow.

About the Author



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