FOREGROUND / **PLANTS**

THE LAST ASH STANDING

BLUE ASH HOLDS CLUES TO EMERALD ASH BORER RESILIENCE.

BY JEFF LINK

CHRISTOPHER ASARO, VIRGINIA DEPARTMENT OF FORESTRY, BUGWOOD.ORG

ABOVE
Emerald ash borer *(Agrilus planipennis)* larvae galleries in white ash *(Fraxinus americana)*.

Jeffrey Carstens and Nickolis Ouellette left Ames, Iowa, in July 2017, in a Dodge minivan packed with pole pruners, pocket chain saws, brown paper and green mesh bags, and a Garmin GPS unit. They were setting out on a weeklong U.S. Department of Agriculture (USDA) trip to sample and collect blue ash *(Fraxinus quadrangulata)* seeds from fruiting trees, some 350 years old and likely to succumb to emerald ash borer *(Agrilus planipennis)* within one to three years.

Carstens, who grew up at odds with his nature on a tree-barren tract of Nebraska farmland, is a horticulturist with an entomology background who works out of the USDA Agricultural Research Service's North Central Regional Plant Introduction Station in Ames, Iowa. His colleague, Ouellette, is an agricultural science researcher at the same facility who has owned his own landscape construction business and been among plants his whole life.

With a shotgun approach aimed at collecting seeds of diverse geographic origin, they cut across the rugged open forests and alkaline cliffsides of Ohio, Kentucky, and Tennessee, where blue ash survives in thinning stands. Every 50 miles or so, they veered off at a highway exit to collect seed, cutting down 20- to 100-foot-high branches with pocket chain saws (using pole pruners for lower branches) before sifting through the fallen samara to assess seed viability, documenting latitude and longitude coordinates, and labeling and bagging the accessions.

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JEFFREY CARSTENS HOLDS OUT HOPE THAT NATURE WILL FIND ITS WAY EVENTUALLY.

ABOVE
White ash *(Fraxinus americana)* samaras containing seeds.

RIGHT
Jeffrey Carstens and Nickolis Ouellette stand before a blue ash *(Fraxinus quadrangulata)* in Griffith Woods near Broadwell, Kentucky, where ash specimens have been dated to some 350 years old.

To anyone who has been following the seemingly irrepressible death march, or flight, as it were, of the iridescent green Asian borer, a kind of beetle, across the central and eastern United States woodlands, much of what they saw is not particularly surprising. Alongside healthy outcroppings of blue ash were thin-canopied specimens of the same species, likely hosting emerald ash borer and at risk of dying in a matter of years. Close by were the skeletal leafless crowns of mature white ash *(Fraxinus americana)*, the majority of which, at least in Ohio and parts of northern Kentucky, were dead, pocked with woodpecker holes and showing the signature D-shaped exit holes of the borer.

But the seeds Carstens and Ouellette sampled from 87 single mother blue ash trees at 16 sites—at an average 2,844 seeds per tree—could hold promise for the regeneration of ash woodlands hundreds of years, or just decades, from now. The bulk of the accessions are stored in freezers, at –18 degrees Celsius, at the USDA-ARS North Central Regional Plant Introduction Station and backed up at the National Center for Genetic Resources Preservation in Fort Collins, Colorado. Germplasm from 13 sites is available for ash conservation research and education efforts at universities, government agencies, and botanic gardens and arboreta.

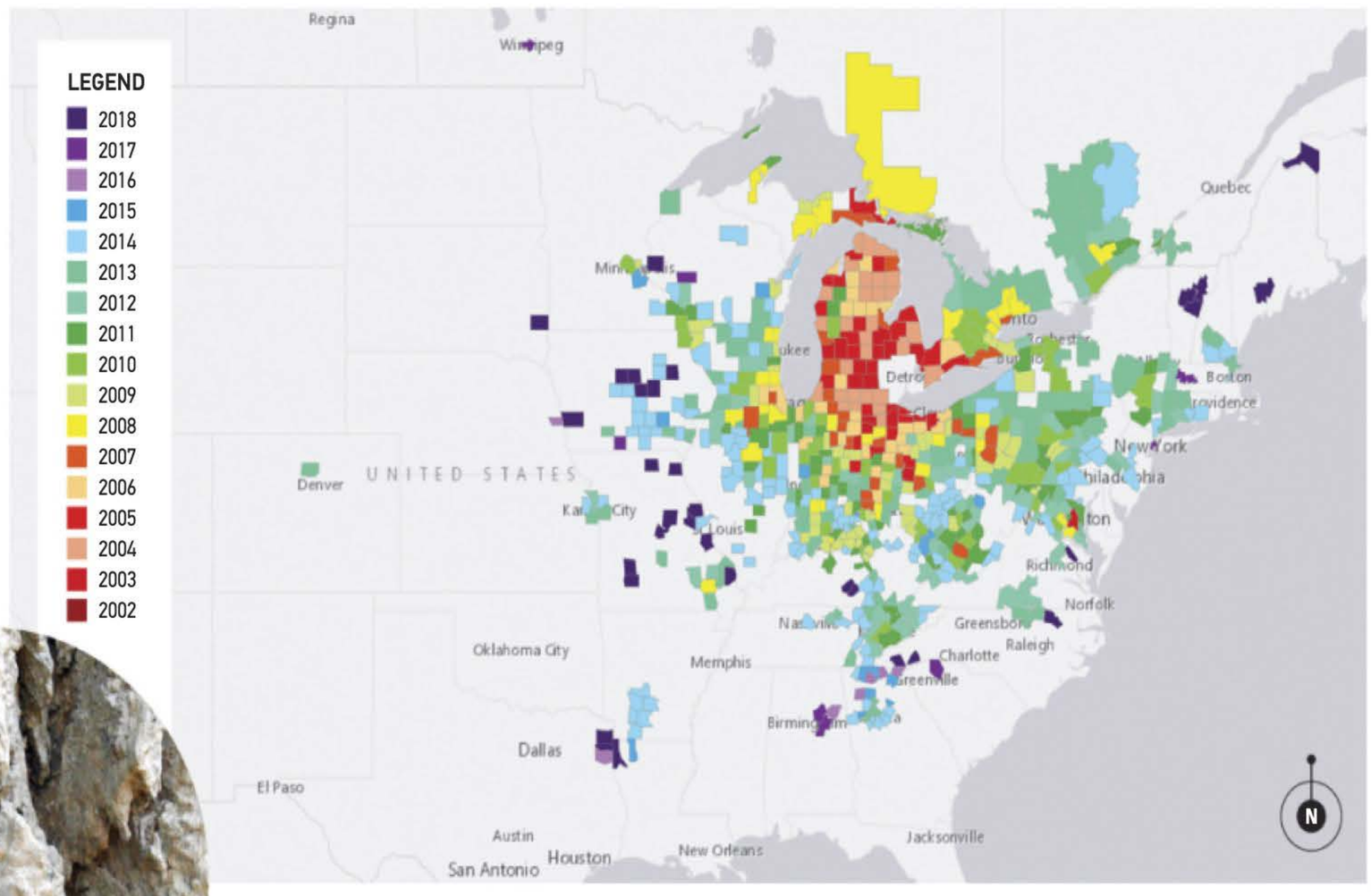
"The whole goal of the project is to conserve the genetic diversity of ash. We want to try to capture genetics and bank them before ash is lost and gone, so that in the future we can reintroduce the species with known-sourced genes," Carstens says.

Since its arrival in southeastern Michigan in 2002, where it is believed to have arrived in infested wood packing crates, the emerald ash borer has destroyed tens of millions of ash trees; the Asian beetle is now found in 35 U.S. states and

KEITH KANOTI, MAINE FOREST SERVICE, BUGWOOD.ORG, LEFT; JEFFREY CARSTENS, RIGHT

FOREGROUND / **PLANTS**

EMERALD ASH BORER DETECTIONS BY COUNTY AND YEAR



ABOVE
D-shaped entry hole from the emerald ash borer *(Agrilus planipennis).*

Washington, D.C., from as far north as Minnesota to as far south as Louisiana, from Colorado to the Eastern Seaboard, according to the most recent USDA Animal and Plant Health Inspection Service report updated in September. Five of the six most prominent ash tree species in North America are listed in the International Union for Conservation of Nature's Red List as Critically Endangered—only one step from going extinct.

The commercial effect of the loss of ash is being deeply felt at two Hillerich & Bradsby Company timber mills in Pennsylvania that produce Louisville Slugger bats. Rick Redman, the vice president of corporate communications at the company, says that ash was the wood of choice among major league baseball players for decades, revered for its whip. Mickey Mantle, Ted Williams, and Joe DiMaggio all swung ash.

Brian Boltz, who heads up the company's timber division, says only about 13 percent of Major League Baseball players now use ash bats, preferring the heft and pop of maple, but Little League bats, souvenir bats, high-end amateur bats, and college bats likely will be converted to poplar, yellow birch, soft maple, and other woods. Within two years, Boltz says, the company plans to phase out ash bats entirely. That means finding a new type of wood for roughly 400,000 of the 700,000 bats Louisville Slugger produces annually, from 1.2 to 1.4 million board feet of ash. "It won't get every tree, but there won't be enough to manage 400,000 bats. Maybe 200,000, 100,000 in five years. Slowly but surely it will all die out," Boltz says.

Carstens, however, is optimistic about ash's surviving in North American woodlands long into the future, and one reason for his hopefulness is the apparent resilience of blue ash to the emerald ash borer. "We do know that blue ash has a different chemical profile than the other ash species, and we also know that blue ash in nature—it's difficult to say—is either less preferred or more tolerant of insects," he says.

Thousands of newly germinated blue ash seedlings, fighting for sunlight on the forest floors of several of the 16 sites where Carstens and Ouellette traveled, add to a list of auspicious signs that genetic adaptation, steered by assertive land management practices, insecticide treatments, biocontrol wasps, and breeding efforts, may help ash outlast the rapid onslaught of the beetle.

"It's kind of similar to Dutch elm disease, which killed mature specimens. The emerald ash borer only attacks large trees, generally at least six-inch diameter at breast height. Right now, there are not good resistant lines of ash because the trees adapted in the absence of the insect. But as emerald ash borer eats its way through trees

RS & GIS, MICHIGAN STATE UNIVERSITY, TOP; DAVID MARINO, DAHLKEMPER LANDSCAPE ARCHITECTS & CONTRACTORS, INSET

FOREGROUND / **PLANTS**

and loses its food source, there will be declining pressure. Over time, a few specimens will likely have some resistance. They'll grow and produce seeds, cross with other species, and build resistance," Carstens says.

Don Cipollini, a professor of plant physiology at Wright State University in Dayton, Ohio, says blue ash is found in the alkaline limestone bedrock of the Midwest, covering a range that loosely follows U.S. Route 23, from southern Michigan to Tennessee and as far west as Missouri.

He was journeying out to assess 30 marked white and blue ash trees in a wild area at Glen Helen Nature Preserve near Yellow Springs, Ohio, when he spoke to me by phone. Identified for study six years ago, the trees are just starting to be visited by the beetle. "I can tell you what I'm going to see. The blue ash will be completely healthy, a small amount of dieback, a little bit of mortality, not perfect, but in very good health. Most white ash will be completely dead," Cipollini said.

He describes blue ash as lighter colored than its more commonly occurring and borer-susceptible relatives—white, green, and black ash—with a flakier, channeled bark and square twigs. The tree is rarely planted in ornamental landscapes, he says, perhaps because it is slow-growing and harder to raise in nurseries.

But the tree and its genetic material may deserve a closer look. Several peer-reviewed studies support the conclusion that blue ash is not a preferred host for the borer. One possible explanation for the species' resilience, Cipollini says, relates to attractiveness: Blue ash is not a preferred food source of adult beetles. "When you put a beetle on blue ash and force it to eat it, the larvae do pretty well. They eat and kill the tree. But it appears adults don't feed as well; they don't like the leaves as well, and because they have to complete maturation before laying eggs, they probably don't lay eggs as much. They're simply not as attracted to the tree for reasons still unknown," Cipollini said.

Another explanation could be that blue ash, compared with other North American natives, has a better built-in resistance system—chemicals released from the bark that kill larvae. It is the larvae, Cipollini says, that do the most damage to the tree. Hatched in the spring, they tunnel into the ash tree's phloem and form serpentine galleries, which kill the tree by cutting off nutrients to the crown.

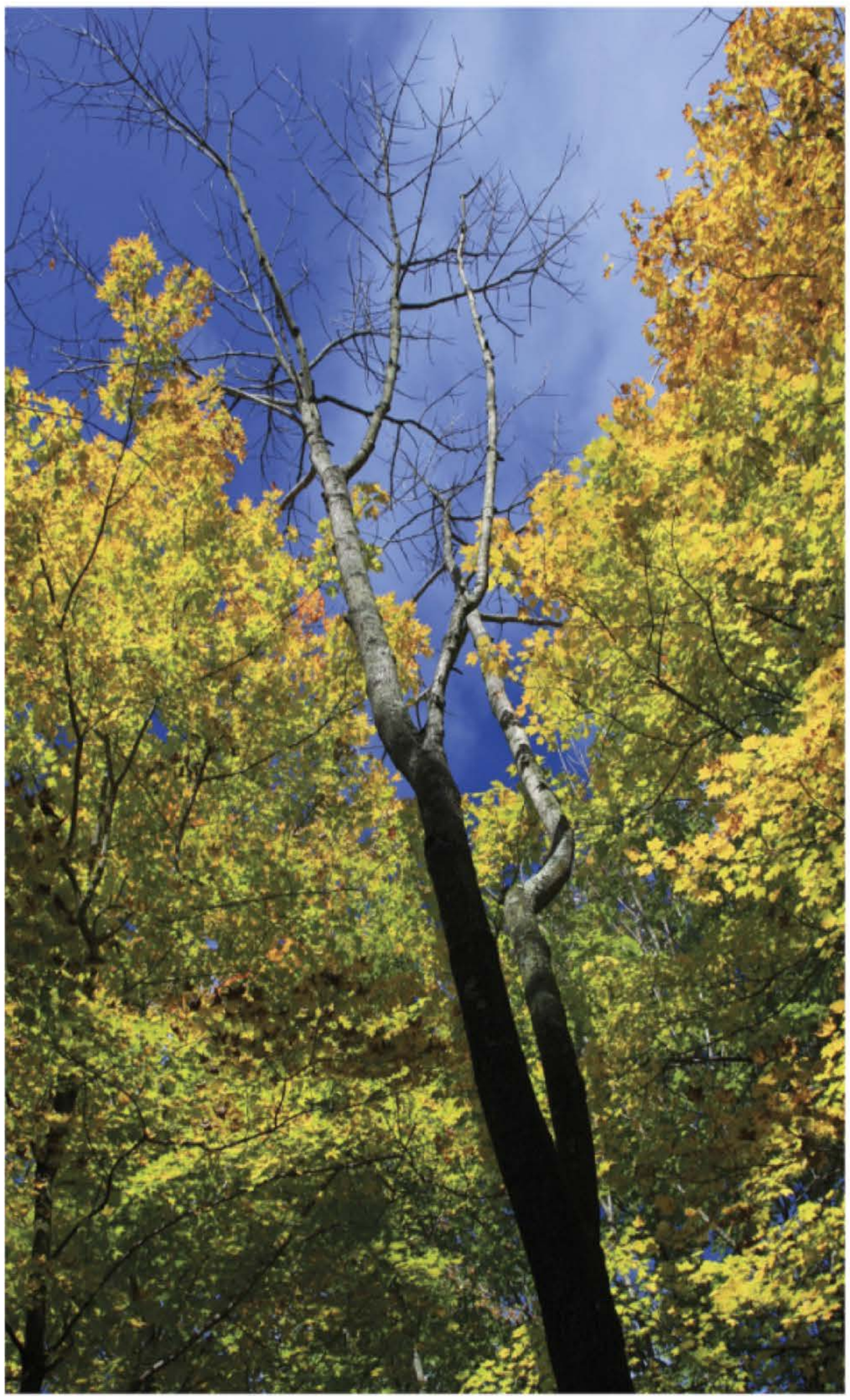
Manchurian ash and other species that coevolved with the insect native to northeastern Asia have developed strong biochemical defense systems and are typically attacked only when girdled or drought damaged, Cipollini says. But, in a kind of evolutionary feedback loop, the borers have evolved to recognize and avoid these trees. "The best hypothetical is, 'Mom knows best where to place her eggs.' But the trees are also more resistant to larvae. It's both sides of the coin."

A better understanding of the basis for blue ash's resilience, supported by seed collection, may also help guide breeding efforts, such as one led by Jennifer Koch, a research biologist who works out of the U.S. Forest Service's Northern Research Station in Dayton. Working with 25 ash species, Koch says, scientists there have begun breeding trees selected for their genetic resilience, with the aim of developing orchards to produce improved seed for restoration. "The goal here is forest restoration—so retaining genetic

ABOVE
Milled ash is prepared for bat production at the Louisville Slugger Museum & Factory in Louisville, Kentucky.

COURTESY LOUISVILLE SLUGGER

FOREGROUND / **PLANTS**



RIGHT
A mature ash (*Fraxinus* spp.) killed by emerald ash borers in a mixed hardwood stand in central Ohio.

STEVEN KATOVICH, USDA FOREST SERVICE, BUGWOOD.ORG

diversity and adaptive capacity is key. We want to prove the concept that this breeding approach will produce seed with improved defense against emerald ash borer, and then determine if our approach can be applied in different areas and regions, with regional seed orchards producing seed for restoration in those areas."

Carstens holds out hope that nature will find its way eventually. "My approach takes you back to basic biology, simple prey and predator. Populations of your host will increase, followed by an increase in predators. As opposed to coyotes and rabbits, you have tree and insect. Eventually, there will be a balance."

Until then, Megan and Clay Aronson, of Aronson Woodworks, who live and work on an acreage 15 minutes south of Des Moines, Iowa, will continue to pay a small fee to have the foreman of a local tree company drive a truck stacked with salvaged ash to their property, surrounded by fencerows and fields of corn. Clay Aronson, a master craftsman, who kiln-dries the wood off-site, will craft the wood into dining room tables, benches, doors, and cabinets, finishing it with a process that preserves the wood's field and grain beneath high-gloss paint, glaze, or stain.

The company, Megan Aronson says, has taken orders from the HGTV designer Vern Yip, Buckingham Interiors + Design, and other Chicago interior design firms. The wood is tracked back to its location of origin, often where an ash tree succumbed to the beetle.

Does she ever worry that her family's livelihood relies on a resource at risk of extinction? "I think of that nearly every day. I wish I was a millionaire and could collect every single log taken down. But I'm not a millionaire, and we don't have enough acreage to bring every log home and utilize it. The rate they are taking them down, we'll have a three-year supply, and then that will go down to a trickle. When we make these things out of ash, we try to remind people that this is a keepsake, and in 20 years you may not be able to find it." ●

JEFF LINK IS A CHICAGO-BASED JOURNALIST AND GRADUATE OF THE IOWA WRITERS' WORKSHOP. HIS WORK HAS APPEARED IN *FAST COMPANY*, *ARCHITECT*, AND *ARCHITECTURAL RECORD*, AMONG OTHER PUBLICATIONS.