Photos courtesy: Mark Wiedewitsch

American Chestnut: A Kentucky Update

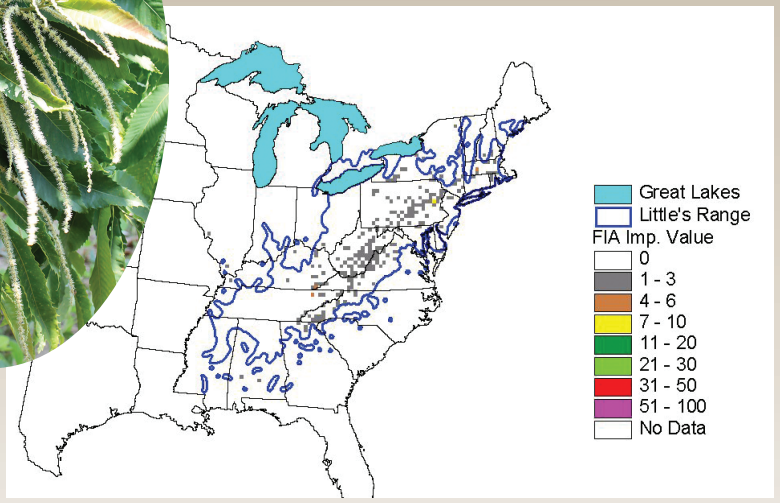
by Lynn Garrison and Jared Westbrook

Prior to the introduction of the exotic pathogens root rot (*Phytophthora cinnamomic*) and chestnut blight fungus *(Cryphonectria parasitica)*, American chestnut *(Castanea dentata)* was a widespread canopy species in the Eastern deciduous forest. It was a large, fast-growing tree that could exploit openings in the canopy by rapidly reaching the canopy before the canopy closed. Due to its control of population and community dynamics as well as ecosystem process it functioned as a foundation species. It was an integral component of forest ecosystems that provided habitat and abundant food for wildlife and people. A late-flowering tree unaffected by seasonal frosts, it produced fruit annually with little variation from year to year. Chestnuts were a reliable food source for birds such as wild turkey and blue jays and for mammals such as squirrels, deer, chipmunks, and bears.

The American chestnut was also valuable for people. The nuts were prized as food and were an important cash crop for rural families. Nuts were sent to major cities to be roasted and sold by street vendors. The wood was straight-grained, easy to work, and rot-resistant. Some of its uses included utility poles, railroad ties, shingles, paneling, building material, fencing, ship masts, coffins, furniture, musical instruments, pulp, plywood, and firewood. It was high in tannin, which was used in the leather industry for tanning.

Two exotic fungi greatly impacted the ecological function of the American chestnut. As early as 1824, chestnut trees were reported to be dying from root rot fungus. Root rot nearly eliminated chestnut from some of the southern part of its native range from 1824 to 1870, especially from low-lying areas and poorly drained areas. An even greater impact was first noticed in 1904 when a forester reported an unknown fungus killing chestnuts at the New York Zoological Park. This fungus was chestnut blight. It rapidly spread throughout the native range of the American chestnut and by 1950 most American chestnut trees had perished. Some estimate that 4 billion trees perished. Possibly the greatest ecological disaster of all time had occurred. Many trees that are not impacted by root rot continue to sprout from the root collar of dead trees. The magnificent American chestnut has been reduced to a subcanopy species and no longer performs it historic ecological role as a dominant canopy species.

The American Chestnut Foundation (TACF) is committed to restoring the American chestnut tree to our eastern woodlands to benefit our environment, our wildlife, and our society. This will involve the interaction of ecology, technology, and society. Restoration of the American chestnut is more than restoring a single species, it is restoring the ecosystems of which it was a part. It will increase our knowledge of how to restore other species. Restoration of the American chestnut will not happen as quickly as we had originally hoped. The backcross breeding program was based on the premise that blight tolerance from Chinese chestnut is controlled by a few genes with major effect. Thus, it should be possible to dilute out all genes from Chinese chestnut except for those involved in blight tolerance and through repeated backcrossing of Chinese x American chestnut hybrids to American chestnut. The American Chestnut Foundation recently tested this premise by genotyping many advanced generation backcross hybrids. They found that there is a tradeoff between blight tolerance the proportion of hybrid genomes inherited from American chestnut. In other words, hybrid trees that more closely resembled American chestnut, were less blight tolerant. This result suggests that genetic control of blight tolerance is more complex than previously assumed. The American Chestnut Foundation plans to complete selection of the most blight-tolerant trees in the current backcross seed orchards. Selected trees are expected to



The American chestnut (upper left) was once a dominant tree in the eastern U.S. The blue outline on the map shows the historic range of the American chestnut. The dots within the range reflect the importance value of the tree in an area. The importance value is based on the number of stems and basal area of understory and overstory trees using forest inventory data from more than 100,000 plots in the eastern United States. The importance value ranges from 0 to 100 and gives a measure of the abundance of the species.

Scott Freidhof, Kentucky Department of Fish and Wildlife Resources, clips male flowers away from the female flower (upper left) while Kenny Pyles, Kentucky Division of Forestry, bags female flowers after they have been pollinated.

have intermediate blight tolerance and will be planted in restoration trials to determine if this level of resistance is enough for the trees to reproduce on their own in the forest. In addition, TACF is pursuing multiple alternative strategies to develop blight-tolerant populations. First, they are advancing additional backcross lines from additional Chinese chestnut parents through fewer backcross generations to American chestnut. These new backcross lines will be less "American" on average but will have greater blight tolerance. They aim to find the optimal balance between blight tolerance and American chestnut traits. Second, they plan to outcross transgenic American chestnuts containing a wheat gene to a diverse collection of wild American chestnut trees. These transgenic trees were developed by professors William Powell and Charles Maynard at the State University of New York. Federal review of transgenic American chestnut is ongoing and a decision about whether these trees may be distributed to the public is expected in the next few years. Trees from early outcross generations would be available almost immediately after federal approval; however, they estimate that three additional outcross generations will be required to dilute out the transgenic founder genome and incorporate enough genetic diversity for regional adaptation. Third, TACF is pursuing genomics research to identify genetic variants that underlie blight tolerance in Chinese chestnut. This work may enable future work to edit the genome of American chestnut to enhance blight tolerance. With all these approaches applied in parallel and possibly in combination, TACF remains optimistic about the prospect for large-scale restoration with blight-tolerant American chestnuts.

The Kentucky Chapter of TACF (KYTACF) continues to work with TACF on its breeding program with tremendous assistance from volunteers. We plan to expand our effort to help preserve the regional diversity of the American chestnut throughout its original range. Each tree has a genetic makeup that evolved to enhance its survival. From flowering early in the South to cold-weather resistance in the North, each region is unique. Preserving the genetic material of the American chestnut is crucial to TACF's effort to breed a blight-resistant tree and to increase the "adaptive capacity" of the American chestnut so it will someday have the "ecological resilience" to once again return to its historic ecological role in Kentucky's forest.

The Kentucky Chapter of TACF is looking for surviving American chestnuts across the state. The American chestnut tree in this image was recently found on a farm in central Kentucky. If you think you have an American chestnut on your property contact Lynn Garrison at 502.655.5038 or lynn.garrison@earthlink.net.

In furtherance of the TACF mission, KYTACF will continue to assist with the TACF breeding program, is increasing outreach, and is increasing its effort to establish in situ and/or ex situ Genetic Conservation Orchards (GCOs) in each of the four ecoregions in Kentucky where chestnuts were common prior to the blight. GCOs will help conserve the genetic diversity of Kentucky chestnuts, increase capacity to provide pure American chestnut seeds for constituents, provide pure American seeds for silvicultural research, and enhance breeding to incorporate Kentucky genotypes into genetically resistant trees.

How can you help? You can become a KYTACF volunteer. Examples of ways volunteers help include but are not limited to orchard maintenance, pollination, outreach, and helping locate wild American chestnut trees. We need a lot of help in locating surviving pure American chestnut trees for in situ and ex situ conservation orchards and for mapping surviving trees. If you would like to help with this effort, we can teach you how to identify American chestnuts and how to use Tree Snap to record data. If you want to be involved in searching for trees you may contact Rex Mann at 859.771.3477 or rexbmann@gmail.com. If you think you have found an American chestnut, you can send a close-up picture of a leaf to Lynn.Garrison@earthlink.net or text to Lynn Garrison at 502.655.0538. If you want to be involved in other volunteer work, you may contact Ricky Caldwell at 502.807.2257 or rcaldwell@bernheim.org.

We are hopeful that someday the American chestnut will once again be a major part of Kentucky's forest landscape.

About the Authors:

Lynn Garrison *is past-President of the Kentucky Chapter of TACF. He can help you determine if you found an American chestnut tree. 502.655.5038; lynn.garrison@earthlink.net.*

Jared Westbrook, *Ph.D., is the TACF Director of Science TACF. He is working to take TACF's breeding program to the next level. 828.281.0047 x1106; jared.westbrook@acf.org.*