THE
Journal
OF THE AMERICAN CHESTNUT FOUNDATION

JULY / AUGUST 2013 | ISSUE 4 VOL. 27

TACF CELEBRATES 30 YEARS 1983 -2013

Game Changers for the Appalachian Forest over the Past 100 Years

Biological Control Efforts in the West Salem Stand

Register Now for TACF's 30th Annual Meeting in Herndon, VA

Enter to Win!

TACF's 2013 Chestnut Photo Contest

Submit your photos to win great prizes and see your images in print!

Send your best chestnut-related photos to TACF. The top entries will be featured at TACF's 30th Annual Meeting, this fall in Herndon, VA. Meeting attendees will vote for the winning photo, which will be featured on an upcoming cover of *The Journal of The American Chestnut Foundation*. The winner will receive a TACF T-shirt, a copy of *Mighty Giants, An American Chestnut Anthology*, and a complimentary one-year TACF membership.

How to Enter and Contest Terms

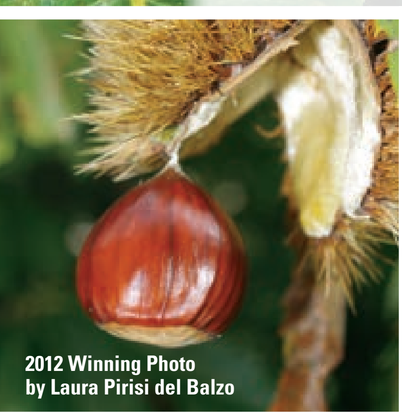
- Photos should be sent digitally (submitted on disk or flash drive, or via e-mail or Drop Box) by September 30, 2013.
- Include your name, address, and telephone number with your submission, as well as the words: "Entry for TACF Photo Contest."
- All photos must have been taken by you and not previously published or submitted to any other contest.
- All entries must be submitted with caption information including names of subjects, locations, etc.
- All photos must in some way relate to the American chestnut.
- Entries must be at least 1920 x 1080 pixels and in a .jpeg or a .tiff format.
- If a person in the photo is recognizable, you must secure a model release from the subject or, in the case of a minor, a parent or guardian and enclose it with your entry.

Send Entries to:

The American Chestnut Foundation, 160 Zillicoa Street, Asheville, NC 28801
Attn: Mila Kirkland (e-mail: mila@acf.org)

All photos on this page are by 2012 TACF Photo Contest entrants

Photo by Jack LaMonica



2012 Winning Photo by Laura Pirisi del Balzo

Photo by Abby Chesnut

Photo by Randy Nonemacher

Photo by Andy Newhouse

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THE AMERICAN CHESTNUT FOUNDATION®

The Mission of The American Chestnut Foundation

Restore the American chestnut tree to our eastern woodlands to benefit our environment, our wildlife, and our society.

We harvested our first potentially blight-resistant nuts in 2005, and the Foundation is beginning reforestation trials with potentially blight-resistant American-type trees. The return of the American chestnut to its former range in the Appalachian hardwood forest ecosystem is a major restoration project that requires a multi-faceted effort involving 6,000 members and volunteers, research, sustained funding, and most important, a sense of the past and a hope for the future.

About Our Cover Image On our cover this month is an American chestnut tree in West Salem, Wisconsin, taken by Jim Savarino. Chestnut blight has had an impact on trees at this stand since the disease was first discovered there in 1986. Yet, many large trees, like this one, continue to survive as hypovirulence has provided a level of biological control for the perpetuation and regeneration of the stand. A 20-year study has been conducted in the stand and is discussed in the article beginning on page 19.

THE Journal OF THE AMERICAN CHESTNUT FOUNDATION

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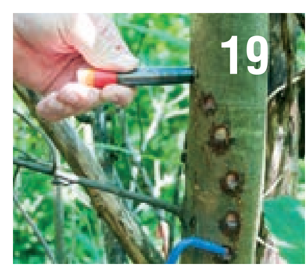


Background photo: Female chestnut flowers at about two weeks of age. Photo by Mark Double

Gypsy moth defoliation of hardwood trees along the Allegheny Front near Snow Shoe, Pennsylvania in 2007.
Photo courtesy of http://commons.wikimedia.org/wiki/File:Gypsy_Moth_Defoliation_Snow_Shoe_PA.jpg

Restoring the American Chestnut—What Will It Mean 100 Years After the Blight?

By Dr. Kim Steiner, TACF Chairman, and Bryan Burhans, TACF President & CEO

Our forests today are different from when the chestnut blight swept through the eastern US. During the first half of the 20th century most eastern forests were young, having been recently harvested to build our growing nation. Nowadays, these forests are typically older, and the trees larger than was the case almost a century ago. There are other differences as well: our forests contain more deer and turkeys, more of some tree species such as red maple and less of oak, and more non-native trees, vines and shrubs such as tree-of-heaven, Oriental bittersweet, and several honeysuckles.

Our forests have always been changing. Research on the ebb and flow of forest species distributions during the last ice age, as deduced from pollen sequences in lake beds and other evidence, reveals that forest community "types" were mutable as trees became neighbors in novel combinations. Eastern hemlock almost vanished 4,800 years ago, presumably because of a disease epidemic, only to reemerge as a common species 1,000 years later. In more recent centuries, extended dry periods and more frequent wild fires favored oak and chestnut, while wetter periods and fewer disturbances favored red maple and eastern white pine.

Fire, or the absence of fire under modern fire-control regimes, is a major force shaping forest composition and structure in both eastern and western parts of the country. One of the most striking examples of this can be seen in apparently pristine western landscapes whose 19th century photographs clearly show fewer trees and more meadow and prairie than are present now, particularly in the fire-prone ponderosa pine zone.

We have contemporary examples of how rapidly our forests can change. The advancing frontier of the gypsy moth invasion is always followed by heavy mortality to oaks, which are among the insect's favored foods. Eastern hemlocks are universally declining and dying where the woolly adelgid has taken hold. Green ash, white ash, and black ash are literally disappearing as the emerald ash borer spreads from its scarily recent foothold in southern Michigan. And many of us can recall a time before dogwood anthracnose when the blossoms of this species were much more abundant in the forest understory. However, as disturbing as these events are, it is worth remembering the holes left by dying trees are soon filled with something else. Change means nothing to the forest; "different" is a human notion.

Yes, our forests are different from what they were in the early 1900s, and they will be different in other ways 100 years from now. The role that the reintroduction of American chestnut will play in those changes over the next century remains to be chronicled. But one thing can be predicted: We will ensure that the American chestnut will once again have a chance to play a part in the natural ebb and flow of our eastern forests.

Brad Stanback, Paul Sisco, and Bryan Burhans plant the first of three Restoration Chestnut 1.0 trees during OM Sanctuary's ribbon-cutting.
Photo by Taylor Taz Johnson, www.TazDigital.com

Restoration Chestnuts 1.0 Planted at Newly Opened OM Sanctuary

In June, TACF was honored to participate in the ribbon-cutting ceremony of OM Sanctuary, a non-profit holistic education retreat center located in Asheville, NC. The center offers classes, demonstrations, lectures, training, and daylong and extended-stay programs on topics such as life enrichment, stress reduction, cooking for health, yoga, and meditation.

Nearly 300 people gathered to celebrate OM Sanctuary's opening and tour the facilities. After the ribbon cutting, visitors walked through vibrantly colored gardens to the site of a chestnut memorial planting for Jake Michel, the former owner of the property. The Restoration Chestnut 1.0 seedlings were made possible through a donation by Jonathan and Susan Nilsson to Buncombe County Treasured Trees and Asheville Greenworks Program.

Those present at the planting were moved by the sweet voice of Asheville singer/songwriter Sarah Tucker, who performed "O Chestnut Tree," a song written by Dolly Parton and her uncle Bill Owen, a longtime TACF cooperator. Following the song, Bryan Burhans, TACF President & CEO, along with TACF board members Dr. Paul Sisco and Brad Stanback and other guests, planted three chestnut seedlings on the grassy hillside. In time they will grow into tall and beautiful trees that can be admired from the entrance to the property.

PA-TACF interns Aryk Strunk and Tyler Kulfan examine materials collected for the Archive Project housed at Penn State. Photo by Sara Fitzsimmons

Pennsylvania Chapter Volunteers Launch TACF Archive Project

By Deb Ridgeway, Secretary, Raystown Restoration Branch, PA-TACF

A call for volunteers went out this spring to help Bill Lord, one of our longtime PA-TACF members, put together an official archive for TACF that will be housed at Pennsylvania State University (PSU). Responding to the call were PA-TACF volunteers Rebecca Hirsch, Vicki Brownell and Deb Ridgeway, each bringing experience in writing, publishing, and library or archive administration.

The initial goal of the Archive Project is to establish a permanent location and methodology for preserving the records of TACF and PA-TACF. These materials have continuing value to researchers looking for information about the organization and the science behind the important work done by the foundation.

The project is in the beginning stages and creating this repository requires extensive planning. Over the next months, the volunteers will review and organize all the materials, define the scope and mission of the collection, assist in determining the role of the PSU Library, consider budget requirements if any, and recommend a system to categorize the

TACF Archive Project continued

collection and provide access to users. It is hoped that the development of this project will encourage other members and non-members of TACF to share materials they might have.

Some of the materials the group is archiving include nearly 25 years of board and meeting minutes, newsletters, newspaper and magazine articles, technical briefs, personal correspondence, photographs and slides from TACF Annual Meetings and PA-TACF activities, videos, and scientific articles.

Readers are encouraged to contact Sara Fitzsimmons with questions and to contribute any historical items that they might like to add to the archives. Sara can be reached at PA-TACF, 206 Forest Resources Lab, University Park, PA 16802; 814-863-7192; or by email at mail@patacf.org.

Co-author Nicole Rodriguez poses with one of the first chestnuts she planted in the demonstration orchard in Poolesville, Maryland. Photo by Steve Haggblade

Maryland High School Students Aim to Make a Change for the American Chestnut Tree

With rapid advancements in chapter and national education programs each year, more students are learning the story of the American chestnut. One such development is taking place in Poolesville, Maryland: a collaboration in which Alex Pike, a former senior in the Global Ecology Science Program at Poolesville High School; Alex's project sponsor, Tom Kettle; the Maryland Chapter of TACF; and the Town of Poolesville created the Elgin Park Chestnut Demonstration Orchard for public educational purposes.

After Alex graduated, Kirby Carmack and Nicole Rodriguez, both students in Poolesville High School Class of 2013, took on the maintenance of the orchard for their senior project. Additionally, they wrote a children's book titled "The Legend of the American Chestnut," with illustrations by their classmate Michael Torres. They donated a hard copy of the book to Poolesville Elementary School to be introduced into the third grade curriculum as part of their unit on "making a change."

"Our book displays how simple making a change can be," said co-author Kirby Carmack. "Many youth believe that a change has to be something huge that has an impact on thousands of people. This book shows that a small project that impacts a small community can be just as powerful."

The authors made their book available to TACF; it can be downloaded at http://www.acf.org/educational_programs.php.

TACF Approved Charity for 2013 Combined Federal Campaign

CFC Combined Federal Campaign Approved Charity

Thank you to all the federal employees and military personnel who made donations to TACF through the 2012 Combined Federal Campaign (CFC). You helped make our first year in the program a great success! We have just been informed that TACF will again be listed on the 2013 CFC charity list. If you are a federal employee or member of the military, please consider designating The American Chestnut Foundation (donor code 95986) as your beneficiary this year.

In the June e-newsletter, TACF member Jon Taylor wrote an article about his experiences last summer collecting data on American chestnuts on the Appalachian Trail. He documented his trip with beautiful photographs, like this one of a red eft, the terrestrial juvenile stage of the eastern newt. Photo by Jon Taylor

Stay in Touch with TACF by E-mail

It's never too late to sign up for TACF's monthly e-newsletter! Each issue features interesting tidbits from the chestnut world: the latest updates from field staff and their regions, a monthly photo contest, recent videos and news articles from around the range, and inspiring human interest stories from members like yourself. Plus, it's all free! All you have to do is sign up on our website at www.acf.org, then sit back and wait for it to arrive in your inbox.

West Virginia Chestnut Festival Will Bring Excitement to Columbus Day Weekend

By Dr. Joe Nassif, WV Chestnut Festival Director

The Rowlesburg Revitalization Committee invites the public to join them on Sunday, October 13, 2013, from 10:30 am to 7:30 pm, for the 6th Annual West Virginia Chestnut Festival in Rowlesburg, WV, a quaint village nestled on the scenic bend of the Cheat River, 35 miles from Morgantown. The festivities will take place in Rowlesburg Park and culminate at The Szilagyi Center for the Visual and Performing Arts, where the Gala Chestnut Dinner Banquet will be held.

Bryan Burhans crowns Mindy Double at 2012 West Virginia Chestnut Festival. Mark and Mindy Double received the honor of Mr. and Mrs. Chestnut at last year's festival. Photo by Erin Double

The day will begin with a continental breakfast from 10:30 am to 12 noon where attendees will have an opportunity to meet distinguished guests. The afternoon park festivities include vendors with jarred chestnuts in honey, chestnuts roasting on an open fire, various chestnut saplings available for sale, chestnut furniture and crafts on display, and for the children, a game of "throwing chestnuts in the well."

The WV Chapter of TACF will hold a meeting from 12 noon – 2:00 pm and the public is welcome to attend.

From 4:00 – 5:00 pm is the Scientific Session featuring Charles "Rick" Sypolt, Professor of Forestry at Glenville State College, and Matt Brinckman, Mid-Atlantic Regional Science Coordinator for TACF. Dinner will begin at 5:30 pm and includes the crowning of 2013 Mr. and Mrs. Chestnut, followed by a presentation by Dr. Greg Miller, President of Empire Chestnut Company.

For information and to reserve dinner tickets or vendor space contact Shirley Hartley, (304) 329-1240, or shartley812@frontier.com or visit www.rowlesburg.info.

In Memory of and In Honor of Our TACF Members May/June 2013

In Memory of

Wayne Carpenter
Beverly Oeltjen
Natalie Tennant

William Gooch
Kirsten Gibbons

Vincent Joseph LaMonica
Kathleen and Rob Marmet

Katherine Tilson Murray
Gail Kinney and John Murray

E.L. Nicholson
Shirley Nicholson

In Honor of

G. Alexander Bernhardt
Janet Wilson

Bryan Burhans
John and Ann Chalk

TACF's 30th Annual Meeting

October 18-20, 2013

Join Us this Fall at the Hyatt Dulles in Herndon, VA

30th Annual Meeting Registration Fees

Full Registration: $324 per person *(Lodging not included)*

Includes:

- Friday Welcome Dinner and Awards Program
- Saturday Opening Session
- Saturday/Sunday Workshops/Presentations
- Breakfast, Lunch and Snacks for both days
- Saturday 30th Anniversary Gala Dinner

Other Registration Options:
per person, includes Workshops/Presentations, Breakfast, Lunch and Snacks
DOES NOT INCLUDE FRIDAY AND SATURDAY DINNERS

- Saturday/Sunday Pass: $199
- Saturday Only Pass: $149
- Sunday Only Pass: $50
- Student Saturday Only: $50 (must show Student ID)
- Student Sunday Only: $35 (must show Student ID)

Friday and Saturday Dinners

- Friday Welcome Dinner and Awards Program: $50 per person
- Saturday 30th Anniversary Gala Dinner: $75 per person

Register online at www.acf.org/annualmeeting.php or call The American Chestnut Foundation at (828)281-0047

Accommodations

Reserve rooms now by calling Hyatt Dulles at 1-800-233-1234 or visit https://resweb.passkey.com/go/Chestnut2013. Special room rates start at $129 per night. To receive these rates, let them know that you are attending TACF's 30th Annual Meeting.

Hyatt Dulles • 2300 Dulles Corner Blvd • Herndon, Virginia 20171

TACF's 30th Annual Meeting Schedule
October 18-20, 2013

Friday ▪ October 18, 2013

4:00 PM-6:00 PM Registration Open
5:00 PM-6:00 PM Welcome Reception
6:00 PM-8:30 PM Dinner and Awards Program

Saturday ▪ October 19, 2013

7:30 AM-5:00 PM Registration Open
8:00 AM-9:00 AM Breakfast

GENERAL SESSION

9:15 AM-11:45 AM **Official Welcome**
Dr. Kim Steiner, Chairman of the Board, The American Chestnut Foundation

Different Tools, One Goal: A Transgenic Approach to Blight Resistance
Dr. William Powell, Council on Biotechnology in Forestry, SUNY College of Environmental Science and Forestry (ESF) and Co-Director of the American Chestnut Research and Restoration Program

Keynote Address - Landscapes Give Back
Holly Shimizu, Executive Director, United States Botanic Garden

The Next 30 Years
Bryan Burhans, President & CEO, The American Chestnut Foundation

12:00 PM-1:00 PM **Lunch**

CONCURRENT PRESENTATIONS/WORKSHOPS

1:00 PM–1:45 PM **Restoration of the American Chestnut**
Dr. Steven H. Rogstad, Biological Sciences, University of Cincinnati

1:00 PM-2:25 PM **West Salem Update/Hypovirulence in Wisconsin**
Dr. William L. MacDonald, Professor of Forest Pathology, WV University
Dr. Anita Baines, Assistant Professor of Biology, University of WI, LaCrosse

1:00 PM-3:45 PM **Workshop: Monitoring and Control of Ambrosia Beetles in Chestnut Orchards**
Dr. Martin Cipollini, Department of Biology, Berry College, GA

1:00 PM-3:45 PM **Workshop: Chestnut Leaf Inoculations** *Limited seating, pre-register by calling 828-281-0047*
Dr. William Powell, Council on Biotechnology in Forestry, SUNY College of Environmental Science and Forestry (ESF) and Co-Director of the American Chestnut Research and Restoration Program
Andy Newhouse, Senior Research Support Specialist, SUNY-ESF

2:00 PM-2:45 PM **Next Generation of American Chestnut Advocates**
Betty Gatewood, Interpretive and Education Park Guide, Shenandoah National Park

3:00 PM–3:45 PM **Topic - TBD**
Dr. Christopher Topik, Director of Restoring America's Forests, The Nature Conservancy

3:00 PM-3:45 PM **Chestnut Research at the Connecticut Agricultural Experiment Station**
Dr. Sandra L. Anagnostakis, Plant Pathology and Ecology, Connecticut Agricultural Experiment Station

4:00 PM-5:00 PM **Student Research Presentations**

5:00 PM-6:30 PM **Poster Session Reception**

6:30 PM-9:30 PM **30th Anniversary Dinner/Program**

Sunday ▪ October 20, 2013

7:30 AM-12:00 PM Registration Open
8:00 AM-9:00 AM Breakfast

CONCURRENT PRESENTATIONS/WORKSHOPS

9:00 AM-9:45 AM **How do Landowners and the Public Benefit from Breeding Programs in Forest Trees?**
Dr. Steven McKeand, Director, Cooperative Tree Improvement Program, NC State University, Raleigh, NC

9:00 AM-9:45 AM **The Cultivated Varieties of Chestnut**
Dr. J. Hill Craddock, Robert M. Davenport Professor in Biology at the University of Tennessee at Chattnooga

9:45 AM-10:30 AM **Fungal Interactions and Their Influence on Establishing American Chestnut Seedlings in Ohio Coal Mine Reclamation**
Dr. Jenise M. Bauman, Miami University, Oxford, OH

Schedule continued on page 10

Sunday ▪ October 20 *Schedule continued from page 9*

9:45 AM–10:30 AM	**Chestnut as a Global Food Source** Dr. Dennis W. Fulbright, Dept. of Plant Pathology, Michigan State University
11:00 AM–11:45 AM	**American Chestnut and Nut Production** Dr. Brian C. McCarthy, Dept. of Environmental and Plant Biology, Ohio University
11:00 AM–11:45 AM	**Hypovirulence in Michigan Hybrid Chestnut Orchards** Joshua Springer, Biology Department, Michigan State University
12:00 PM-1:00 PM	**Lunch**
	End of Annual Meeting

Schedule subject to change

TACF's 30th Annual Meeting October 18-20, 2013
Workshop and Program Descriptions

Saturday, October 19th

Keynote Address: Landscapes Give Back

Holly H. Shimizu, Executive Director, United States Botanic Garden

This program will focus on the transformation of landscapes using the Sustainable Sites Initiative and the Landscape for Life programs that the U.S. Botanic Garden has been a part of developing. With a focus on good plant choices, soil, water, materials, as well as human health and well-being, outdoor spaces can provide many benefits to the natural world that help restore quality of air, water, and life.

Holly H. Shimizu has been the Executive Director of the United States Botanic Garden since 2000. The U.S. Botanic Garden, located adjacent to the U.S. Capitol on the National Mall, is the oldest botanic garden in North America as well as the most visited public garden. She has degrees in horticulture from Temple University, Ambler Campus; Pennsylvania State University; and the University of Maryland. In 2009, Holly received the honorary degree of Doctor of Science from Washington College, Chestertown, Maryland.

Restoration of the American Chestnut

Dr. Steven H. Rogstad, Biological Sciences, University of Cincinnati

The return of the American chestnut to its keystone position in the eastern forests will involve planting thousands of seeds at each of thousands of locations. In harvest year 2012, TACF distributed 60,479 Restoration Chestnuts 1.0 seeds. Planting and nurturing such valuable seeds to generate new populations will be costly, so new methodologies to improve restoration project outcomes are needed. Researchers at the University of Cincinnati have been investigating whether different geometric patterns of founder planting can substantially alter the natural growth rate of restoration populations, and the degree to which such populations maintain their founding genetic diversity. We have developed the computer program NEWGARDEN, which allows modeling and statistically comparing the growth of computer populations initiated from user-designated input. Through examples in which equivalent numbers of founders are planted, we show that some geometric planting patterns greatly outperform others in population growth and genetic diversity retention.

West Salem Update/Hypovirulence in Wisconsin

Dr. William L. MacDonald, Professor of Forest Pathology, West Virginia University

Dr. Anita Baines, Assistant Professor of Biology, University of Wisconsin, LaCrosse

A stand of American chestnut growing near West Salem, Wisconsin, has presented a unique opportunity to study the progress of chestnut blight disease as it must have occurred in eastern North America a century ago. The potential for utilizing hypovirulence emerged when chestnut blight was discovered at the site in the late 1980s. Since then, artificial introductions of hypoviruses have been made in an effort to establish a level of biological control comparable to areas in Michigan where the blight no longer causes significant damage. A history of the disease and its development at the West Salem site will be presented including discussion of the effects of hypovirus introduction. An assessment of the longer-term prospects for the stand will be included.

Workshop: Monitoring and Control of Ambrosia Beetles in Chestnut Orchards

Dr. Martin Cipollini, Department of Biology, Berry College, GA

Some TACF orchards have recently experienced attacks of ambrosia beetles (Scotylidae). Attacked stems either die back or show delayed shoot development, and in many cases trees survive via basal re-sprouting. Even if trees survive, infestations affect their size and condition, potentially compromising subsequent tests of blight resistance. Dr. Cipollini will present monitoring and management techniques specifically addressing ambrosia beetles in chestnut orchards.

Workshop: Chestnut Leaf Inoculations

Limited seating, pre-register by calling 828-281-0047

Dr. William Powell, Council on Biotechnology in Forestry, SUNY College of Environmental Science and Forestry (ESF)

Andy Newhouse, Senior Research Support Specialist, SUNY-ESF

This workshop describes a screening technique used to estimate chestnut blight susceptibility on trees of any age with minimal damage to the tree. Briefly, leaves are collected, exposed to the blight fungus, and incubated for five days, at which point resulting lesions are measured and compared. Attendees will hear background about the technique, see demonstrations, and get to practice inoculations and measurements. A paper describing this technique was accepted for publication in *Plant Disease*: see http://dx.doi.org/10.1094/PDIS-01-13-0047-RE.

Next Generation of American Chestnut Advocates

Betty Gatewood, Interpretive and Education Park Guide, Shenandoah National Park

Just as TACF is striving to produce the next generation of chestnut trees, many teachers up and down the Appalachians are striving to educate the next generation of chestnut tree researchers and stewards of this remarkable resource. Through the American Chestnut Learning Box activities, the on-line Charlie Chestnut curriculum, outreach programs for teachers, and in-the-field transects, students are learning the history, lore, culture, and science of the American chestnut. For the past two summers, students from Valley Ridge Governor School in Rockingham and Augusta Counties in Virginia have delved into the history and science of the American chestnut through readings, electrophoresis genetic lab research, and fieldwork in which they conducted a symbolic American chestnut transect using the protocol for the Appalachian Trail MEGA-Transect Chestnut Program.

Chestnut Research at the Connecticut Agricultural Experiment Station

Dr. Sandra L. Anagnostakis, Department of Plant Pathology and Ecology, Connecticut Agricultural Experiment Station

The Connecticut Agricultural Experiment Station began studying chestnut growth and timber use in the late 1800s. Staff has included P. J. Anderson who named the blight fungus; tree breeders A. H. Graves, D. F. Jones, and R. A. Jaynes; and mycologists who studied the fungus and imported hypovirus for biocontrol. Breeding for improved timber and orchard trees has continued, as well as studies of the interactions of host and pathogens. This talk will give an overview of the Experiment Station people and their contributions.

Sunday, October 20th

How do Landowners and the Public Benefit from Breeding Programs in Forest Trees?

Dr. Steven McKeand, Director, Cooperative Tree Improvement Program, NC State University, Raleigh, NC

Foresters in the southern US are responsible for over 75% of the nation's tree planting, and over 95% of these seedlings are genetically improved loblolly and slash pines. Deployment practices such as planting only the best open-pollinated families, full-sib crosses, and clonal varieties to the best sites are resulting in dramatic increases in productivity and timber quality. Dr. McKeand will discuss how forest tree breeding programs offer exciting opportunities for private forest landowners and the general public.

The Cultivated Varieties of Chestnut

Dr. J. Hill Craddock, Robert M. Davenport Professor in Biology at the University of Tennessee at Chattanooga

The cultivated varieties of chestnut have their origins in the species of Castanea that occur naturally in eastern Asia, Europe, and eastern North America. Many of our modern cultivars are derived from selections of wild types that had characteristics favorable to domestication. Recent attempts to improve chestnuts have included techniques like interspecific hybridization, which allows for the combination of the best traits from diverse types through classical plant-breeding methods; and genetic engineering, which permits direct manipulation of the plant's DNA. A major challenge to successful chestnut growing is the proper choice of cultivars well adapted to local conditions. Replicated cultivar trials in the United States provide information about which types will grow best and produce the best chestnuts in the different regions of North America.

Fungal Interactions and Their Influence on Establishing American Chestnut Seedlings in Ohio Coal Mine Reclamation

Dr. Jenise M. Bauman, Miami University, Oxford, OH

Experimental planting methods such as deep ripping and plowing were applied to a reclaimed surface coal mine in Ohio. Coupling these methods with plantings of pure American chestnut and two types of blight-resistant backcrossed chestnuts (*BC2* and *BC3*) have resulted in high seedling survival and healthy root colonization by beneficial mycorrhizal fungi after the first growing season. Dr. Bauman will discuss seedling survival, growth, and mycorrhizal associations of chestnuts after five field seasons. Chestnut blight cankers caused by *Cryphonectria parasitica* have been recorded to assess the disease-resistance potential of the backcrossed seedling lines.

Chestnut as a Global Food Source

Dr. Dennis W. Fulbright, Dept. of Plant Pathology, Michigan State University

This presentation will discuss the opportunity to initiate chestnut farms in North American based on our current knowledge and observations from farms in other countries. Chestnut blight and other limiting factors for growth need to be considered, but may be overcome with germplasm and management strategies.

American Chestnut and Nut Production

Dr. Brian C. McCarthy, Dept. of Environmental and Plant Biology, Ohio University

As blight-resistant American chestnut becomes available for restoration efforts, conservation groups are interested in reintroducing the species as a wildlife food resource. Dr. McCarthy will discuss seed production of mature forest-grown trees in a disjunct population of American chestnut in Wisconsin. This exciting project offers insight into the American chestnut as an important wildlife food resource in stands where the species was dominant.

Hypovirulence in Michigan Chestnut Orchards

Joshua Springer, Biology Department, Michigan State University

This talk will discuss hypovirulence work that has been carried out in Michigan hybrid chestnut orchards. Lessons learned will be applied to the potential use of hypovirulence in future restoration plantings using TACF's Restoration Chestnuts 1.0.

TACF Honors Its Volunteers

John Scrivani

John Scrivani and Taylor Cochran pollinating trees in a VDOF bucket truck at Lesesne State Forest. Taylor is an undergraduate summer scholar from Miami University of Ohio working on the AT-MEGA Transect Chestnut Project. Photo by Ansel Bubel

As a past president of the Virginia Chapter and a current board member, John Scrivani of Earlysville, Virginia, has furthered the chapter's work immensely since becoming involved with TACF in 2008. John earned his PhD in Forestry from Oregon State University, then taught and conducted research at Virginia Tech University and with the Virginia Department of Forestry (VDOF).

In 1991, John starting working on chestnut breeding at the Lesesne State Forest in Nelson County, VA. There, he strove to enhance the relationship between the VA Chapter and the VDOF, creating cooperation on pollinating and growing trees. Currently, he works with the Virginia Information Technologies Agency on Geographic Information Systems (GIS) projects, such as aerial photography and topographic modeling.

One of John's favorite TACF projects is the Appalachian Trail (AT) MEGA-Transect Chestnut Project, which engages the public in citizen-science efforts to collect data on American chestnuts growing along the AT. In addition to leading trainings on how to collect data, John and his students have subdivided the trail into analysis units and created useful maps for citizen scientists.

"John's extensive knowledge of GIS and mapping technologies has enabled the chapter to locate mother trees, to make our databases more precise, and to create visuals to communicate where trees are located," said Cathy Marmet of the VA Chapter. "He also helped to develop a science strategy for the next seven years as part of the chapter's strategic planning initiative."

With a pole pruner in hand, Woods Sinclair is always game for a hike in the woods to identify American chestnuts that might be useful for the local breeding program. Photo by Leila Pinchot

Ellery "Woods" Sinclair

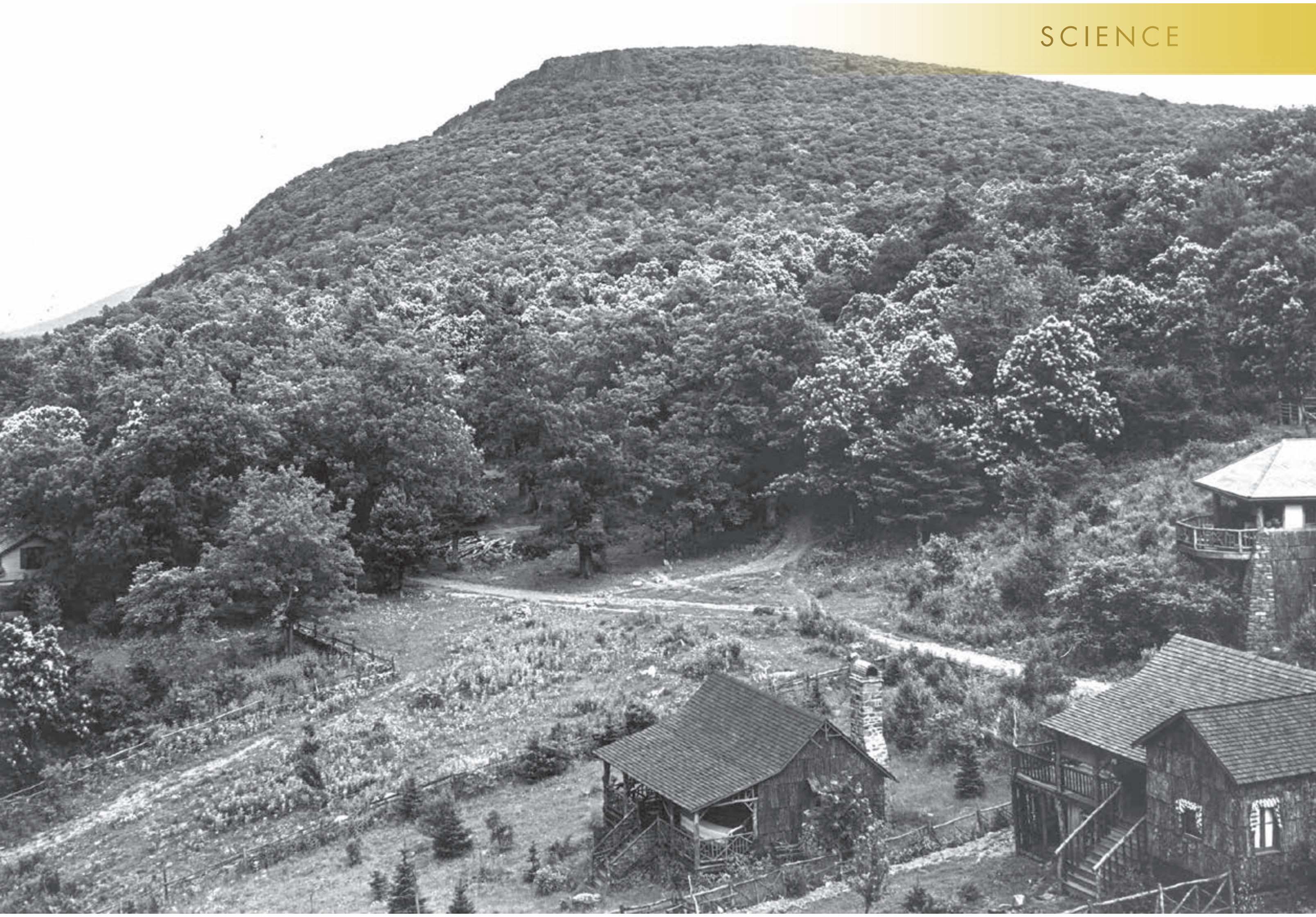
Ellery "Woods" Sinclair lives in Falls Village, Connecticut, the second smallest town in the state. With all the positions he takes on to help run his community, TACF is fortunate for his dedication as a board member of the Connecticut Chapter of TACF and manager the chapter's Great Mountain Forest Orchard.

Woods has deep roots in the Falls Village area. He lives on the property where he grew up, which is dotted with remnants of the American chestnut giants that once thrived there. One fixed landmark that's been there all his life is a chestnut log cabin, built by Swiss Italians during the depression years.

Woods graduated from Housatonic Valley Regional High School, and went on to earn a BA in Philosophy at Colorado College. After marrying his wife, Mary Lu, and a stint in the US Army, he earned his teaching credentials and joined the English Department at his high school alma mater, where he eventually became department chairman.

Now retired, he works with the high school's Agricultural Education students, who help plant chestnuts at the Great Mountain Forest Orchard and assist with inventory and maintenance. His students even built an informational kiosk at the orchard from lumber donated by a local sawyer.

"Woods does a great deal of outreach, spreading the work of TACF to his community and the surrounding area," says Regional Science Coordinator Kendra Gurney. "He is a true chestnut champion in Northwest CT."



Mountainsides white with chestnut blooms near Skyland Cabins, Shenandoah National Park, 1912. Courtesy of Shenandoah National Park, National Park Service, Skyland Glass Slide Photograph Collection, Item #205

Game Changers for the Appalachian Forest over the Past 100 Years

By Katie L. Burke

Change is inevitable; in and of itself, this is not a very interesting or informative statement. Some changes are small and have little overarching impact in the grand scheme of things. Others are seemingly big, but everything returns to normal over time. Then there are game changers, events that transform the grand scheme. The loss of American chestnut in the canopies of eastern forests was a game changer. But it certainly was not the only change. European settlement in North America induced many profound changes—new species, new land uses—and this period was followed by the industrial revolution as well as an increasingly globalized economy. Bringing back the chestnut to eastern forests will create a new forest, not restore a previous one. Certainly, there will be similarities between the old and the new, but there will also be differences.

Each forest is a product of its context in history, and a restoration forest is no different. Take a hike through a mixed oak forest in the Appalachians today, and it's likely you will see telltale signs of its history: perhaps some flattened stumps indicating past logging; or rusted tangles of barbed wire suggesting the presence of pasture; or the overgrown bed of a logging road that still traces a line through the trees; or rocks piled into cairns that show previous tilling; or charcoal inside the catface of a tree, indicating that the forest burned sometime during that tree's lifetime. Understanding the

Devastation caused by logging and fires, Mt. Mitchell, North Carolina, 1923. Courtesy of the National Archives, Still Records Branch, College Park, Maryland, NA: 95G-176379

Forest clearing for farming on the Southern Appalachian Mountains around 1905. Courtesy of US Geological Survey, Department of the Interior/USGS

forest of days gone by, and studying how the chestnut forest once responded to such changes helps to inform the management of forests with reintroduced chestnut in their contemporary context.

"Understanding the forest of days gone by, and studying how the chestnut forest once responded to such changes helps to inform the management of forests with reintroduced chestnut in their contemporary context."

Although many forests in the Appalachians had been cut selectively for local lumber use, the slopes were not clear-cut until the turn of the 20th century. By the late 1800s, as more accessible timber resources were depleted, railroad lines into the interior Appalachians were built. The post-Civil War recession enabled timber barons to buy large tracts of land in the Appalachian Mountains, because many people moved to urban areas where there were more jobs. This amalgamation of small pieces of land into the hands of a powerful few allowed for large-scale logging operations. Timber production in the Appalachians reached its apogee in 1909 at four billion board feet of sawtimber.[1] The widespread logging brought with it more intense and frequent fires; soon after in the 1940s Smokey the Bear came to the forest front lines,[2] spawning an era of outspoken forest fire suppression. Incidentally, during this time period, the chestnut blight pandemic was sweeping across eastern deciduous forests. To boot, over the past century, the severity and frequency of droughts have declined in eastern North America,

Hemlock woolly adelgid has caused widespread hemlock decline in Appalachian forests. Photo by Connecticut Agricultural Experiment Station Archive, Connecticut Agricultural Experiment Station

compared to the past five centuries.[3] This confluence of game-changing events established the context for the eastern deciduous forests we see today.

Cryphonectria parasitica, which causes chestnut blight, was not the first invasive species to cause widespread dieback for American chestnut. Many low elevation and Piedmont chestnuts died in the mid- to late 1800s due to the introduction of *Phytophthora cinnamomi,* which causes root rot. However, this pathogen did not infect chestnuts on ridgelines and high elevations in the mountains, and so the forests where chestnut dominated the canopy remained unaffected. Chestnut blight also was not the last invasive species to affect American chestnut. Chestnut gall wasp (*Dryocosumus kuriphilus*) was first observed in 1974 on imported chestnuts and is a problematic pest in chestnut breeding orchards.[4] Other invasive pests have also impacted Appalachian forests. Gypsy moth (*Lymantria dispar*) eats chestnut among many other hardwoods, and outbreaks have caused canopy hardwoods to die off en masse in some areas, including areas where chestnut is in the understory. Hemlock woolly adelgid has caused widespread hemlock decline as well.

I never really thought about how stirring these changes were until I experienced them. In the summers of 2008 and 2009, I worked in some areas in Jefferson National Forest in southwestern Virginia that were infested with gypsy moths. The trees were devoid of leaves; I had to teach my field assistants winter tree identification—during the summer. They learned to tell the species apart by bark, bud, and twig features, because the canopy trees did not appear to have a single leaf intact. It sounded like it was raining in the forest, but it was not rain that was falling from the trees—it was "frass," a nice word for a mixture of caterpillar droppings and leaf pieces. The trunks of the trees were literally covered with caterpillars, and their itchy stings were unavoidable as we put our arms around the trees to measure their diameters. The insects squished beneath our tape measures, and the brown goo that oozed out got all over our equipment, clothing, arms, and datasheets.

My experience observing the hemlock woolly adelgid pandemic was also striking, although not quite so disgusting and dramatic. When I was working at Highlands Biological Station in the southwestern tip of North Carolina in the summer of 2001, the adelgid had just come to the area. The trees at the field station were not infected, but some trees down the street were. Two years later, I returned for another summer job. The trees down the street were gone, and the hemlocks at the field station were losing needles. When I started work at Mountain Lake Biological Station in Giles County, Virginia, the U.S. Forest Service had recently removed all the dead and dying hemlocks along the creek sides on the trail to the beautiful Cascades, because the standing dead trunks were a hazard to hikers. Piles of hemlock logs lay crisscrossed across the watershed.

Chestnut blight canker on an American chestnut tree.

These scenes have given me some idea of what the loss of chestnut must have felt like to a bystander. Surrounded by a landscape of huge trees which are ill, deformed, or dead… all I can say is that it feels deeply wrong. There are breathtaking pictures from Shenandoah National Park of mountainsides white with chestnut blooms. It's easy to wax poetic and sound nostalgic or melancholy when we talk about chestnut. But if you were there watching the trees die, it must have been overwhelming, ugly, strange, and disturbing. Given the increasing rate of species introductions over the last century as world travel and trade have increased, the list of invasive forest game changers is only going to get longer.

When anyone walks in the woods today, he or she often walks unaware of what was once there. Whole forests have grown up and been cleared or transformed in one dramatic way or another. Trees used to grow in eastern forests that aren't there anymore. Animals used to walk there that no longer walk there. The sands of time have a way of obscuring the past; forest history becomes overgrown with opportunistic vines and brush.

The situation for wildlife that shared habitat with chestnut has been equally as tumultuous as it was for the trees. Many current Appalachian residents are unaware that bison and elk roamed the Appalachians in the 1600s and 1700s. White-tailed deer, beaver, and wild turkeys were almost extinct by the beginning of the 20th century because of unregulated harvest for the fur trade. The estimated deer kill in the 18th century by Cherokee hunters in the southern mountains is between one and five million. And this number is only for one tribe; the Creek and Shawnee were also trading deerskins with Europeans for export across the Atlantic.[5] Only through massive restoration efforts do these animals still exist today. However, because our top predators (cougar and red wolves) were not equally fortunate, deer populations have no predator to keep their numbers in check except for hunters, and deer populations in some regions have soared out of control during the last half century. An animal that was once on the brink of extinction is now a common nuisance in gardens, on highways, and yes, in chestnut orchards.

It was also during and following this period of intense forest change in eastern deciduous forests that oaks stopped regenerating. We have a whole baby boomer generation of oaks without enough seedlings to grow up in their places when they die. Because of the myriad changes eastern deciduous forests have experienced over the past century, the lack of regeneration cannot be attributed to any one reason. But deer overpopulation and fire suppression, combined with a varied list of invasive species, are thought to play major roles.[6] A recent analysis showed that all of the "game changers" mentioned so far—changes in land use and fire patterns, decreases in top predators and concomitant increases in deer populations, and massive changes in forest composition with the loss of chestnut—combined with the decline in severity and frequency of droughts over the past century, are the major drivers behind the decreased oak regeneration.[7]

There are three major harbingers of premature death in today's chestnut populations: (1) blight, (2) deer, and (3) shade. The loss of chestnut initially opened up the canopy so that the next cohort of saplings could grow up and fill in the gaps. But over time, forest succession has led to a closed canopy in many former oak-chestnut forests, and the chestnuts left in the understory may not have enough light to survive, especially when also faced with blight infection or serving as deer fodder. Areas that are exposed to more light, such as fire-prone southwestern facing slopes, tend to have the most abundance of chestnut in the southern Appalachians.[8]

Fortunately, these three harbingers of chestnut mortality are all preventable. Forest and orchard managers will be able to plant blight-resistant chestnuts in areas that have plenty of light, while protecting saplings from deer until they are tall enough to avoid their hungry jaws. There is, however, a fourth harbinger, a looming game changer for chestnut: climate change. The warming trends that are predicted by climate scientists also forecast higher numbers of pest insects and widespread range shifts for climate-sensitive species (that is to say… most species). Anantha Prasad and Louis Iverson, both ecologists at the U.S. Forest Service's Northern Research Station, have used U.S. Forest Service Forest Inventory Analysis data and climate models to predict the future distribution of all eastern North American trees by 2100. They predict that American chestnut's range would narrow as populations decline at lower elevations but remain at high elevations.[9] Such predictions will be important for developing a 100-year plan for restoration of American chestnut.

Developing blight-resistant chestnuts has been an ambitious task, and TACF and collaborators have shown that hard work, a positive outlook, and a strong community can accomplish this gargantuan task. Restoration, the next step, is equally ambitious. TACF and collaborators want to change the game yet again and restore chestnut to the eastern deciduous forest. To do so, we need to understand past game changers, predict future ones, and plan for the inevitability of unpredictable change. The traits most important to resisting and surviving paradigm-shifting changes are high genetic variation and occupying a wide niche. The latter is already true of chestnut—it is a generalist and can grow in a wide variety of climates and on a wide variety of soils. Thus, promoting genetic variation within backcrossed restoration chestnuts will be essential to a successful reintroduction strategy. If there's one thing humans have demonstrated over the past century, it's that we are game changers. I like to think we can change the game as a force for good, rather than a force for unwitting and thoughtless transformation.

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Katie Burke is associate editor at *American Scientist* magazine and blogs about ecology at www.the-understory.com. She finished her PhD in 2011 studying chestnut conservation biology at the University of Virginia.

Recapping Twenty Years of Biological Control Efforts in a Stand of American Chestnut in Western Wisconsin

Mark Double,[1] William MacDonald,[1] Andrew Jarosz,[2] Dennis Fulbright,[2] Jane Cummings Carlson,[3] Sally Dahir,[3] and Anita Davelos Baines[4]

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Figure 1. Application of hypovirus-containing inoculum into holes made around the margin of a canker. Photo by Mark Double

Background

American chestnut in eastern North American forests has been relegated to the status of an understory tree by chestnut blight, a fungal disease. Today, some trees may grow to a height of twenty to forty feet before they succumb to the blight fungus; occasionally, a few trees grow large enough to flower and produce nuts. In the mid-1980s, people who were aware of the plight of American chestnut were excited to learn about a large stand of them in North America, with tree diameters measured in feet rather than inches. Visitors from across the United States and Canada were attracted to this mixed hardwood stand in western Wisconsin, near West Salem. Today, the stand is comprised of approximately 4,000 chestnut trees, the offspring of 8-10 trees that were planted in the mid-1880s. The stand includes the Wisconsin state champion chestnut—a tree that takes five people, hand in hand, to encircle. People who wanted to see these trees ventured to the "coulee," or hilly, dairy farming region of the state, to see the magnificent chestnuts on this 50-acre stand.

The owners of the property, Ron Bockenhauer and Delores Rhyme, a brother and sister, welcomed interested botanists and nature enthusiasts to their stand of impressive trees. There was no chestnut blight in this stand in the mid-1980s, and people who had seen the devastation of chestnut blight in the eastern United States marveled at the sight of towering, healthy chestnuts. Some of these travelers to the stand may have unintentionally carried spores of the blight fungus, *Cryphonectria parasitica*, on their boots or clothing and introduced it to these remarkable, but susceptible trees. Another possible source of blight may have been birds, carrying the fungus from neighboring states as they migrated through the stand. Regardless of how the fungus arrived, in 1987 Ron Bockenhauer noticed flagging, or yellowing, of leaves on the branches of a few of the trees, a tell-tale sign of blight. Ron called on experts who verified that the chestnut blight fungus was infecting trees in the stand. He and his sister were unsure what action to take. Three solutions to their problem were offered. The first, an ecological approach, was to allow nature to take its course and do nothing; this presumably would have duplicated what had occurred decades earlier in eastern North America. The second solution was eradication, the removal of infected trees. The third option was the use of a biological control agent, using one organism to control another. Ron and Delores were advised that introducing a biological control agent might actually be more detrimental if additional strains of the fungus were introduced. Believing that there was a chance to eliminate the disease, the eradication approach was chosen; the infected trees were felled and buried. Other infected trees were sprayed with fire-retardant in an effort to cover the cankers and reduce spore production, and thus eradicate the chestnut blight fungus. Ron and Delores carefully watched their stand of chestnut, hoping for the best. Unfortunately, the number of infected trees continued to increase. Clearly, the progress of the disease was not going to be halted by burying infected trees or covering them with fire retardant. As a consequence, in 1991, the landowners agreed to option three, the biological control approach.

Figure 2. Isolates of C. parasitica from the West Salem stand: (top) West Salem virulent (killing) isolate, no virus; (bottom left) West Salem isolate with Michigan hypovirus; (bottom right) West Salem isolate with Euro 7 hypovirus. Photo by Mark Double

This method involves utilizing a virus of *C. parasitica* to control the blight. To accomplish this, it was necessary to infect the killing (virulent) strain of the West Salem fungus with a virus. The term that has been given to these sorts of viruses is 'hypovirus' as 'hypo' implies less than, indicating that when the virulent strain is hypovirus infected, its ability to cause disease is reduced. The hypovirus does not kill the fungus but reduces its ability to grow in bark, allowing the trees' natural defenses to produce callus tissue and wall off the infection. A human analogy is that of a runner who can run a 4-minute mile when healthy. However, if the runner is infected with a flu virus, it may take longer to finish the same one-mile course. The runner can still usually run when infected, but much more slowly.

The West Salem stand appeared to offer an ideal setting for biological control as, at that time, all isolates of *C. parasitica* from different cankers were genetically identical. It was believed that this condition should allow the hypovirus to be transmitted readily among the virulent strains.

Treating history and results

After Ron and Delores agreed to the biological control approach, there were discussions about which hypovirus to deploy in the stand. A number of different hypoviruses in *C. parasitica* exist, each with its own unique effect on the fungus. We decided to use a hypovirus from an isolated chestnut stand in Michigan where biological control was active. When the Michigan hypovirus was transmitted successfully to the virulent West Salem fungus in the laboratory, it caused severe debilitation, the condition we hoped to achieve. In the spring of 1992, the first hypovirus-containing (hypovirulent) isolate was introduced in the stand. To do this, holes were punched around the margin of cankers as treatment introduction sites. The inoculum used to fill the holes consisted of a mixture of the hypovirus-infected West Salem strain and the agar medium upon which it was grown, blended to the consistency of applesauce (Figure 1). Tape was used to cover the holes to retard drying. Thirty-nine cankers on 14 trees were treated with the hypovirulent mixture. For the next eight years, the Wisconsin Department of Natural Resources (DNR), led by Jane Cummings Carlson and Sally Dahir, scouted the stand in the winter to discover newly infected trees. Each year, during May and June, a group of 20-25 individuals from Cornell University, Michigan State University, the University of Wisconsin-LaCrosse, USDA-Forest Service, West Virginia University, and the Wisconsin DNR gathered to assess trees and treat cankers in the stand.

In 1993, 42 more cankers on seven new trees were treated. In 1994, the third year of treatment, 25 additional cankers on six newly infected trees were added. After the third year of treatment, we began to sample cankers by removing small 2-mm bark pieces from treated cankers as well as from new, untreated cankers that had been newly discovered. By sampling previously untreated cankers, the movement of the hypovirus among the strains of *C. parasitica* could be assessed.

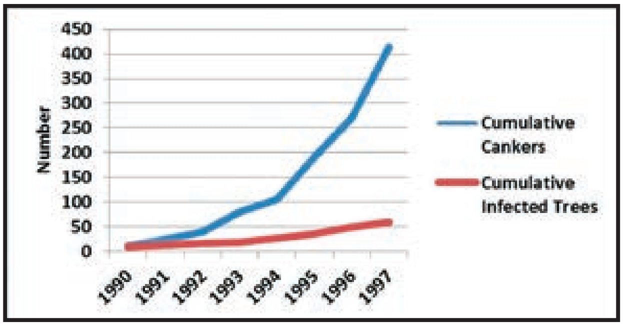


Figure 3. Early disease progress from 1990 to1997.

Bark plugs from each canker were transported to West Virginia University and cultured to determine whether recovered strains were virulent or hypovirulent. The hypovirus-infected strains are distinct in appearance when grown in culture (Figure 2). The initial results of those isolations were disappointing, as hypovirus was recovered from only half the isolations made from cankers that had been treated. Even worse, the hypovirus was not spreading within the stand as it was associated with only 30% of new cankers on trees with previously treated cankers and 15% of cankers on newly infected trees. We expected spores produced by the hypovirulent strain to spread hypovirus rapidly to existing and new cankers and initiate biological control. During this period of treatment, we learned that only 3% of the

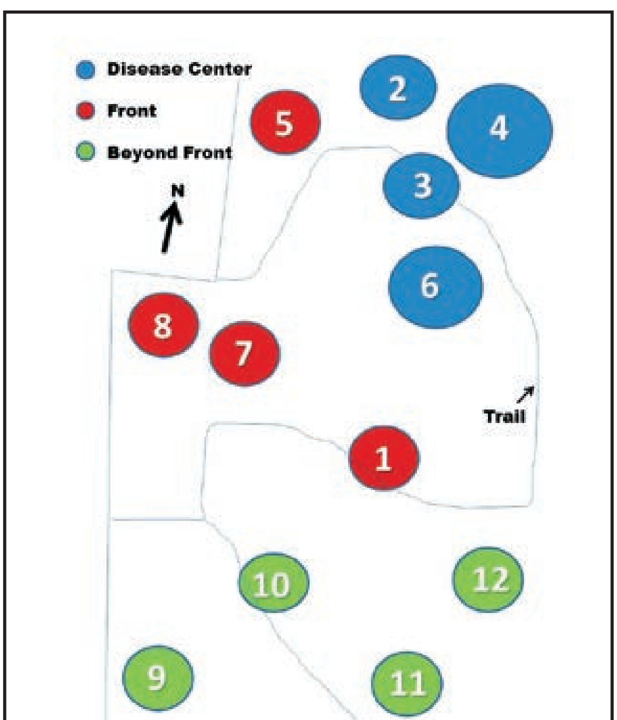


Figure 4. Diagram of twelve permanent plots.

spores produced by the West Salem strain we were using for treatment carried the Michigan hypovirus. These early data unfortunately indicated that the Michigan hypovirus might not spread effectively enough to control the blight epidemic. We evaluated whether to continue use of the Michigan hypovirus or introduce a second hypovirus. The decision was made to change to a second hypovirus, one that had been associated with a *C. parasitica* isolate recovered from a hypovirulent canker near Florence, Italy, where biological control was active. This hypovirus, termed Euro 7, was not as debilitating to the fungus. When the West Salem strain was infected by this hypovirus, 95% of the spores that were produced carried the Euro 7 hypovirus, theoretically enhancing the opportunity for hypovirus spread. The strain containing the Euro 7 hypovirus was used to treat cankers from 1995 to1997. During that three-year span, 312 new cankers on an additional 38 infected trees were treated.

The bark samples taken in 1997 showed that far more of the treated cankers harbored the Euro 7 hypovirus (about 78%) than the Michigan hypovirus that had been used previously. Also, movement to new cankers that arose on trees with treated cankers was significantly better (55%). However, after six years of treatment with the two hypoviruses, their spread to non-treated trees remained disappointingly low; only 10% of new infections yielded hypovirus on trees that had never been infected and thus never treated.

During the first six years of hypovirus treatment, 1992-1997, we attempted to treat cankers on all infected trees in the stand. The task became increasingly difficult as the blight epidemic continued. After the 1997 season, there were more than 400 cankers on 62 trees (Figure 3). The epidemic probably was similar to that which occurred in the eastern forests during the early to mid-twentieth century. We simply could not continue to maintain the treatment and sampling efforts. Therefore in 1998, we decided to discontinue hypovirus treatment but to continue assessing hypovirus spread that resulted from our six prior years of treatment. We wanted to see if the hypoviruses we introduced would spread without further introductions. Trees were still monitored for infections and cankers were sampled annually, but no hypovirus inoculum was applied to cankers from 1998 to 2003.

Recent treatment protocols and results

By the end of the 2000 growing season, disease progress was so great that our approach was modified further. Because we could no longer sample every canker on

Figure 5. Devin Rhyme (son of Carl and Debbie Rhyme) and William MacDonald of West Virginia University applying treatment to an American chestnut tree in the West Salem stand. Photo by Mike Marshall

every tree, the decision was made in 2001 to establish permanent plots in three areas of the stand representing different levels of disease incidence. Twelve permanent plots were established; each plot contained 30-80 chestnut trees (Figure 4). Four plots each were established in: (1) the area with the greatest incidence of infection ("disease center," where about 95% of the trees already were infected); (2) an area with 30% incidence, identified as the "disease front"; and, (3) an area with only 10% infected trees, termed "beyond the disease front." We continued to monitor all cankers annually within these twelve plots from 2001 to 2003. Following the 2003 season, the movement of hypovirus to cankered trees that had never received treatment was still poor, ranging from 14% in the disease center plots to 0% in the beyond the disease front plots. This prompted us, in 2004, to reinstate hypovirus treatment using the West Salem isolate that harbored the Euro 7 hypovirus (Figure 5). We have continued this treatment protocol within the permanent plots through 2013.

During the 2008-2009 treatment and assessment period, we began to notice that there were numerous trees in the disease center that previously exhibited dieback but had begun to form new growth, 20-50 feet off the ground. Even though the tops of the trees were dead, the middle portions of the trees were producing significant new branch and leaf growth. Callus tissue on most cankers in the disease center was very prominent, indicating that trees had sufficient vigor to wall off the invading fungus. Bark samples taken from the disease center trees in 2011 revealed that 78% of the cankers on trees that had never been treated had acquired hypovirus. When compared to our findings from the mid-1990s when hypovirus spread was poor, the change was remarkable. The disease center findings suggest that, given adequate time, hypovirus spread was sufficient enough for the West Salem trees to show the formation of callus tissue around canker margins, a visible sign of recovery.

Currently, trees in the disease front and beyond the disease front areas continue to lag behind those in the disease center in terms of hypovirus establishment and visible tree response, but hypovirus deployment in these areas has been much more recent. As of 2011, cankers on trees that were never treated in the disease front and beyond the disease front have acquired hypovirus at a lower rate, 43% and 28%, respectively, compared to 78% for the disease center. The question remains whether additional years of treating infections in the disease front and beyond the disease font plots will result in hypovirus acquisition at rates similar to those in the disease center. Likewise, will the level of control observed in the disease center occur throughout the entire stand, beyond the treatment plots?

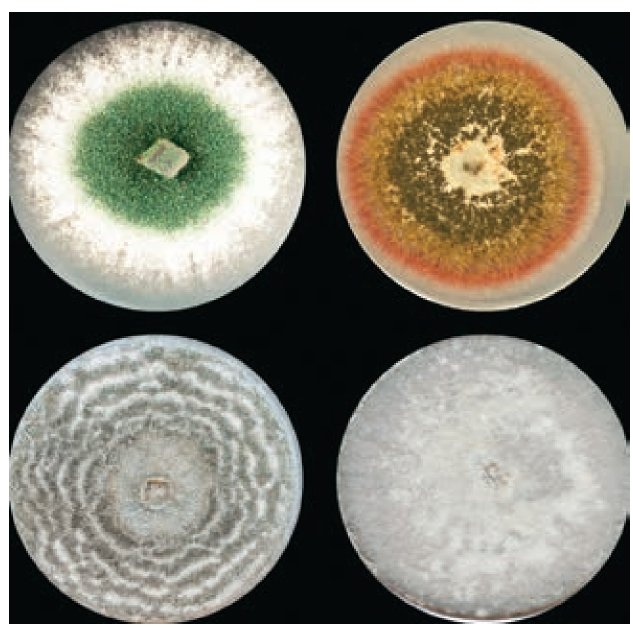


Figure 6. Fungi commonly recovered from older chestnut blight cankers: *Trichoderma* (top left), *Epicoccum* (top right), *Didymostilbe* (lower left), *Botryosphaeria* (lower right). Photo by Mark Double

Figure 7. Current landowners of the West Salem stand property: (front row) Cassie Bockenhauer, Devin and Debbie Rhyme, (back row) Scott and Shari Bockenhauer, and Carl Rhyme. Photo by Mark Double

Over the twenty-year period of the study, we have sampled approximately 3,200 cankers; some of the cankers were treated, others were not. Most cankers have been sampled multiple times, as long as trees remain alive. One major trend we have observed is that, as cankers age, there is a change in the number of different fungi that are recovered from bark samples. Typically, young (newer) cankers yield high numbers of virulent *C. parasitica* isolates. Following treatment, hypovirulent isolates commonly are recovered from most infections. As significant, over time, is the increase in the number of other fungi that are isolated from cankers, including species of *Trichoderma, Epicoccum, Didymostilbe* and *Botryosphaeria* (Figure 6). Some of these fungi colonize bark and become major components of the cankers, especially species of *Trichoderma,* a known parasite of other fungi. These organisms may be antagonists to *C. parasitica*, thereby further contributing to the biological control we are observing. Our research group has begun to study the role other fungi may play in the recovery of the chestnut trees in the West Salem stand.

Summary

In the disease center portion of the stand, hypovirus has spread to almost every tree, whether or not hypovirus inoculum was applied. Most cankers have abundant callus and most of the trees are recovering from chestnut blight. Hypovirus spread and stand recovery in the disease front and beyond the disease front plots have been slower but presumably will occur given the additional component of time.

Acknowledgements

The study would not have been possible without the significant financial support of The American Chestnut Foundation. Their continued funding through the years is deeply appreciated. The cooperation and support of former landowners, Delores Rhyme and the late Ron Bockenhauer, and the current landowners, Carl and Debbie Rhyme and Scott and Shari Bockenhauer, made this work possible and enjoyable (Figure 7). Their interest in saving the stand has provided motivation to succeed in our efforts.

To find out more about the biological control study at the West Salem stand, check out a presentation by William MacDonald and Anita Baines during the **30th Annual Meeting in Herndon, Virginia**. The two researchers will host a special extended session on Saturday, October 19.

Register for TACF's 30th Annnual Meeting at www.acf.org/annualmeeting.php

Restoring the American Chestnut Tree in the Atomic Age

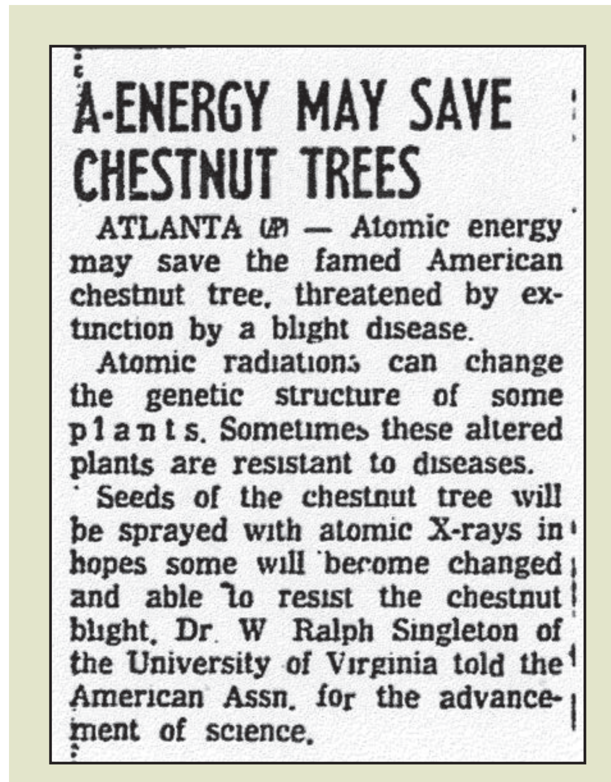
By Helen Anne Curry

In December 1955, at a meeting of the American Academy for the Advancement of Science (AAAS), a group of scientists gathered to present research related to the uses of atomic energy in agriculture. Encouraged by growing international interest in the applications of atomic energy in the mid-1950s, these scholars described the use of radioisotopes and other nuclear technologies in studies ranging from plant and animal nutrition to fertilizer application and food irradiation.

One of the participants, Willard Ralph Singleton, a professor of genetics at the University of Virginia, spoke at length about the use of radiation for yet another purpose: plant breeding. Among the many species he thought could benefit from this application of atomic energy was the American chestnut.

It was well known by that time that exposure to radiation could cause mutations, inheritable changes in the genes of living organisms. Why not use radiation to deliberately produce mutations in important crop plants? Although most would prove to be harmful, or useless, a point Singleton readily conceded, it was possible that every so often a beneficial change would occur.

Singleton summarized the research that had already been done, some of which had been conducted under his own supervision, in hopes of proving that this idea would work. From 1948 until the summer of 1955, Singleton had worked at the Brookhaven National Laboratory, a nuclear research facility. Together with his colleagues in the biology department he founded a program to study the potential of radiation-induced mutations in plant breeding. The research had not produced much in the way of convincing evidence, but Singleton remained undaunted. He called attention to a tentative success, a variety of oats that showed resistance to a fungal disease common in oats. It had been bred from seeds exposed to radiation by a Brookhaven biologist, and this apparent success (later recanted) encouraged Singleton and others to hope that disease resistance could be produced in many important agricultural species.


A-ENERGY MAY SAVE CHESTNUT TREES

ATLANTA (AP) — Atomic energy may save the famed American chestnut tree, threatened by extinction by a blight disease.

Atomic radiations can change the genetic structure of some plants. Sometimes these altered plants are resistant to diseases.

Seeds of the chestnut tree will be sprayed with atomic X-rays in hopes some will become changed and able to resist the chestnut blight, Dr. W Ralph Singleton of the University of Virginia told the American Assn. for the advancement of science.

This Associated Press story was published in the *Sarasota Journal* on December 29, 1955.

In his talk at the AAAS meeting, Singleton carried this ambition one step further. "We have become intrigued with the possibility of producing resistant types among some of our forest trees," he explained, to "help preserve species that once flourished but now are on their way to almost certain extinction."[1] He envisioned that it might be possible to use radiation to produce an American elm that could escape Dutch elm disease or an oak resistant to the oak wilt—and of course an American chestnut that could survive the chestnut blight.

Singleton's unusual proposal made the national news, circulating in an Associated Press story under headlines such as "A-Energy May Save Chestnut Trees."

Bill Lambert, who worked with the experimental chestnut trees at Sugarloaf Mountain, points to blight on a young chestnut tree. This photo was taken in February 1989 and published in the Montgomery Journal. Photo courtesy of Stronghold, Inc.

Not long after, Singleton received a phone call from a chestnut lover eager to help with the project. Albert "Ab" Dietz, an industrial chemist, had been collecting chestnuts for many years along the Blue Ridge Parkway in Virginia. These he planted on his own land, hoping that from such plantings a blight-resistant tree might spontaneously emerge. Encouraged by Singleton to think that exposure to radiation might speed up the process, he sent along two quarts of chestnuts to be irradiated. Singleton sent them to his old laboratory at Brookhaven, where they were given radiation treatment—either bombarded with neutrons in the nuclear reactor or exposed to gamma radiation from a radioisotope such as Cobalt-60—and then sent them back to Dietz to be cultivated. The next season the two went searching together for chestnuts in Deitz's usual haunts, an effort that produced another 2,000 or so seeds ready for irradiation.

For several years the project extended no further than this. Dietz cultivated his stock of trees from irradiated seed while Singleton kept his attention mostly on his other genetic research.

A decade later, however, growing interest in the American chestnut breathed new life into the project. When the philanthropists Anne and Arthur Valk decided to donate land and money to promote chestnut restoration in the late 1960s, they sought out approaches that offered an alternative to the hybridization programs that had dominated efforts in chestnut breeding to that time. Faith in the approach of crossing American trees with individuals from the related Chinese and Japanese was at a low ebb, creating an opportunity for Singleton's atypical approach to attract new interest.

In 1968 the Valks donated funds to support Singleton in establishing a grove of chestnuts grown from irradiated seeds at the National Colonial Farm in Accokeek, Maryland, and the land and funds for a much larger chestnut restoration project—incorporating both irradiated stock and hybrid trees—at what would soon be christened the Lesesne State Forest in Virginia.

A third initiative centered on irradiated trees began at nearly the same time, at Sugarloaf Mountain, a private forest reserve in Maryland maintained by Stronghold, Inc. The Stronghold board had decided to make saving the American chestnut part of their organization's mission, and they were captivated by Singleton's mutation theory and especially the speed at which it promised to produce a blight-resistant tree. Singleton thought it could be done in as few as three generations, and his faith in this idea gave others hope. As one

Stronghold administrator described, breeding a blight-resistant chestnut "could take several hundred years, but we believe the process can be cut to thirty years by irradiating the nuts."[2]

By 1969, then, it was full steam ahead for mutation breeding of the American chestnut. The three sites were planted with sapling trees that Dietz had cultivated on his property from the original batches of irradiated seed. Efforts were made to irradiate still more chestnuts, to establish still larger groves of trees potentially carrying mutations, and to raise these to maturity so that second-generation trees from these populations could be created. By 1972 there were some 9,000 living chestnut seedlings and young trees grown from irradiated seed growing at the sites in Virginia and Maryland and on Dietz's land. Six years later, the tally stood at 8,200 first-generation trees and 10,600 second-generation trees, scattered across some 14 sites.

Maryland Chapter of TACF still harvests seed from Stronghold's Sugarloaf Mountain orchards. Pictured is East Field, the healthier of the two orchards, where two or three dozen trees are still providing ample seed. Photo by Gary Carver

Despite this flurry of activity and rapid expansion, and despite the efforts of Dietz in particular to keep the projects running, the radiation-induced mutation program struggled to survive—not unlike the chestnuts grown from the irradiated seed. By the 1980s these trees were clearly demonstrating the effects of blight. What's more, the attention of chestnut restorers had turned to more promising, and also more scientifically plausible, methods. These included finding hypovirulent strains of the blight and, in the area of breeding, the backcross method proposed by Charles Burnham. The mutation programs were gradually abandoned in favor of new approaches.

It is tempting to dismiss the chestnut irradiation effort as an atomic-age oddity, but a glance at its history suggests that it flourished during a brief window of time in which the future of chestnut tree restoration seemed bleak. By the mid-1960s, the early hybridization programs had not produced resistant trees that conformed to the desired type, and selecting for resistance from among American trees was acknowledged to take many, many generations, if it were to work at all. Breeding by induced mutation, by comparison, would not involve the introduction of unwanted traits and could take place within a human lifetime.

At least, that is what Singleton hoped and preached. "It is anticipated that the 20th Century, which witnessed the devastation caused by one of the most serious plant diseases, may also see the conquering of this disease by another 20th Century phenomenon, the harnessing of the atomic energy," Singleton told one audience.[3] Although it is likely that this vision was never tenable, it clearly held appeal for many chestnut enthusiasts in the 1960s and 70s.

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1 Singleton, ms. "The Use of Radiation in Plant Breeding" (paper delivered at AAAS symposium in Atlanta, Georgia, 28 December 1955), Papers of W. Ralph Singleton, Special Collections, University of Virginia, Box 18.

2 Quotation in Essie Burnworth, "A Brief History of the Efforts by Stronghold, Inc. to Restore the American Chestnut, 1969 to the Present" (Dickerson, Maryland: Stronghold, Inc, 2002), 9.

3 Singleton, ms. "The Use of Radiation to Produce Blight Resistant Strains of the American Chestnut, *Castanea dentata*" (no date), Papers of W. Ralph Singleton, Special Collections, University of Virginia, Box 20.

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The remaining trees in Sugarloaf West Field are now reduced to big multi-stemmed bushes, and the Maryland Chapter expects to harvest a few hundred seed this year. Photo by Gary Carver

An Update on Chestnuts at Sugarloaf Mountain, Maryland

By Gary Carver, MD Chapter President

About 1,600 seedlings from irradiated nuts were planted at Sugarloaf Mountain. One thousand were planted at the Sugarloaf Mountain American Chestnut Research Area—East Field in April 1970. The following April, almost 600 second-generation irradiated-nut seedlings were planted at West Field.

In 1972, Dr. Deitz sent seeds to Stronghold to have them neutron-irradiated by Jack Ransohoff, owner of Neutron Products, Inc., in nearby Dickerson, Maryland. We do not know how many of these neutron-irradiated nut seedlings may also have been planted at Sugarloaf.

Today, fewer than two hundred trees survive at Sugarloaf. They are all in serious decline and only a few possibly original stems remain.

In recent years, Maryland Chapter volunteers have harvested many thousands of seeds from the Sugarloaf trees. This year, because most of the remaining trees are now reduced to big multi-stemmed bushes, the harvest promises only a few hundred seeds from West Field. The two or three dozen surviving trees at East Field are doing better and should continue to provide thousands of seeds.

I have 15-year-old third-generation trees from West Field seeds growing at my 60-acre home, which is protected by a conservation easement. I also have grown, and given away, many fourth-generation trees from seeds these trees produced. I have seen no mutations and no obvious increase in blight resistance.

Recently, Jack Ransohoff's son, Bill, told me that his father remains interested in the trees at Sugarloaf and would like a few of their seeds to plant. I am looking forward to meeting him and giving him the seeds. After 41 years, this would bring the Sugarloaf Mountain American chestnut project full circle.

To read a brief history of the efforts to restore the American chestnut at Sugarloaf Mountain written by the late Essie Burnworth, past president of the Maryland Chapter and TACF secretary, visit www.acf.org/pdfs/Stronghold_History.pdf.

Chestnut-Flavored Savory Cake with Prosciutto and Sun-Dried Tomatoes

Recipe and photo from David Santori at Frenchie and the Yankee. Find more at http://frenchieandtheyankee.com.

Ingredients

3 eggs
1/2 cup olive oil
1/4 cup whole milk
1/4 cup white wine
1/2 cup shredded Parmesan
1/2 cup grated Pecorino Romano
1/2 cup chestnut flour
1/3 cup white rice flour
5 tbsp amaranth flour
3 tbsp millet flour
2 tsp baking powder
1.5 tbsp xanthan gum
1 garlic clove – minced
1.5-2 oz prosciutto – roughly cut and chopped
12 green olives – sliced
6 tbsp pine nuts – toasted
7 sun-dried tomatoes – roughly chopped
2 tbsp sage – chopped
2 tbsp basil – chopped

Made with chestnut flour, this gluten-free cake awakens the taste buds with hints of prosciutto and sun-dried tomatoes, and brings great texture thanks to a combination of millet and amaranth flours and a crunchy finish with toasted pine nuts.

Directions

Preheat the oven to 350°F. Butter an 8.5" x 4.5" loaf cake pan and set aside. In a small pan, toast the pine nuts over high heat until they become fragrant (about two minutes). Let them cool.

In a big bowl, combine the eggs and the olive oil using a hand mixer until light and smooth. It should have doubled in volume. Add the milk and wine. Continue mixing for 1 minute. Add both cheeses to the bowl and mix delicately with a spatula.

In a smaller bowl, sift the flours together with the baking powder and xanthan gum. Mix them together. Add the flours to the wet ingredients and stir until well combined. Add the rest of the ingredients to the batter: garlic, prosciutto, olives, toasted pine nuts, sun-dried tomatoes, sage and basil. Mix gently.

Pour and spread the dough in the cake pan and bake for 45 minutes or until a toothpick inserted in the middle comes out dry.

Chestnut Moments

"A chestnut tree in full bloom is a fine sight. It blossoms about the first of July, in clusters of long, yellowish white filaments, like a tuft of coarse wool rolls. The whole top of the tree is silvered over. We have never seen them so finely in blossom as this year, and we foresee a grand harvest for the boys."

Henry Ward Beecher of Litchfield, Connecticut, 1870

While in full bloom, the 95-foot-tall American chestnut tree in Hebron, Maine, stands out in a sea of green.
Photo by Ann Siekman

http://www.fs.fed.us/r8/chestnut/