THE Journal OF THE AMERICAN CHESTNUT FOUNDATION

JULY/AUGUST 2012 | ISSUE 4 VOL. 26

Special Issue: The Ecology of Chestnuts

How and where they grow, how they reproduce, respond to light and shade, and adapt to a changing environment.

Register Now for the 2012 American Chestnut Summit in Asheville, NC

Enter to Win!
TACF's
2012
Photo Contest

Submit your photos NOW 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 the 2012 American Chestnut Summit in Asheville, NC, this fall. 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, 2012.
- 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: Paul Franklin (e-mail: pfranklin@acf.org)

All photos on this page are by 2011 TACF photo contest entrants

Photo by Vicky Soma


Photo by Gary Coeburn

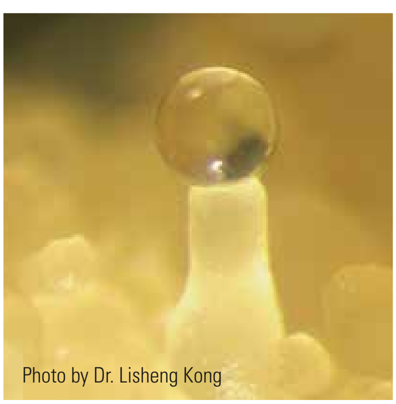
Photo by Dr. Lisheng Kong


Photo by Vicky Soma


Photo by Lawrence Johnson

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

This remarkable photo of a soldier beetle (Coleoptera: Cantharidae, possibly Chauliognathus pennsylvanicus) and a green metallic wasp (Hymenoptera) on an American chestnut catkin was taken by Mark Moore of Rimersburg, PA. The role of wind vs. insects in chestnut pollination is discussed in the article on chestnut reproduction beginning on page 15.

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INSIDE THIS ISSUE

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Background photo:
A spider weaves a lazy July web in a young chestnut tree at Meadowview Research Farms, Meadowview, VA.
Photo by Paul Franklin

This American chestnut tree in the West Salem, Wisconsin stand, was infected with chestnut blight and then inoculated with a hypovirus. These naturally occurring viruses weaken the chestnut blight and allow the tree more time to respond by forming a thick canker to better contain the spread of the chestnut blight.
Photo by Bryan Burhans

Using Research to Restore the American Chestnut

by Glen Rea, TACF Chairman of the Board, and Bryan Burhans, TACF President and CEO

Deep in Wisconsin's farm country, there is a small farm with thousands of American chestnuts growing on a small woodlot. Early settlers planted a handful of nuts in 1885 and within 100 years the population of chestnuts had expanded to well over 6,000 trees. And this number does not include the countless seedlings currently growing in the forest understory.

Because Wisconsin was beyond the historic range of the chestnut, these trees thrived in their blight-free environment, and one even became the state's champion chestnut tree. Then the blight hit the trees in the mid-1980s.

Beginning in 1992, researchers began examining the effects of a naturally occurring virus, called a hypovirus, which attenuates the chestnut blight. In some ways, it is like giving the chestnut blight the flu. The virus weakens the blight and gives the chestnut tree more time to fight back.

The American Chestnut Foundation (TACF) has continued this important and ground-breaking research. Some of the chestnuts treated with the hypovirus have responded to treatment. Today, you can find hypovirus-treated trees that are actually recovering from the blight. TACF is hopeful that the results of this work will play a role in reintroducing the chestnut to our forests.

This is just one example of the important research ongoing at TACF. This issue of *The Journal of The American Chestnut Foundation* focuses on the ecology of the American chestnut, which is truly fascinating and is sure to capture the imagination of our membership. A firm understanding of the chestnut's ecology is critical to allow us to eventually return this species to our eastern forests.

The stated mission of TACF is to restore the American chestnut to our eastern woodlands to benefit our environment, our wildlife, and our society. The rigorous scientific research that TACF supports provides the baseline information we need to further that mission.

Although TACF has invested the vast majority of our resources in programs that support the development of blight-resistant chestnut trees, we clearly understand that just having a blight-resistant tree is not enough. We must use the best available science to address a myriad of issues—from ecology, to pathology, to silviculture—and then apply the findings in our on-the-ground efforts.

Thanks to the financial support of our members and the commitment of our university and agency partners, TACF will continue to use the best available science to ensure that the American chestnut will once again reign as king of the forest.

2012 American Chestnut Summit

October 19-21, 2012

PRESENTED BY

THE AMERICAN CHESTNUT FOUNDATION®

AND THE U.S. FOREST SERVICE

Join Us This Fall at the Beautiful Crowne Plaza Resort in Asheville, NC

American Chestnut Summit Registration Fees:

Full Registration $99 per person

(Lodging not included)

Includes:

- Saturday Opening Session
- Saturday & Sunday Workshops/Presentations
- Bent Creek Research Forest Tour
- Breakfast, Lunch and Snacks for both days

Dinners Not Included in General Registration.
Tickets can be purchased separately:
Friday Welcome Dinner & Reception: $35 per person
Saturday Dinner Event: $50 single / $75 per couple

Day Passes

- **Saturday** $60 per person includes: Workshops/Demonstrations + Breakfast & Lunch
- **Sunday** $45 per person includes: Workshops/Demonstrations + Breakfast & Lunch

Student Day Passes (with Student ID)

- **Saturday** $35 per person (includes Lunch)
- **Sunday** $35 per person (includes Lunch)

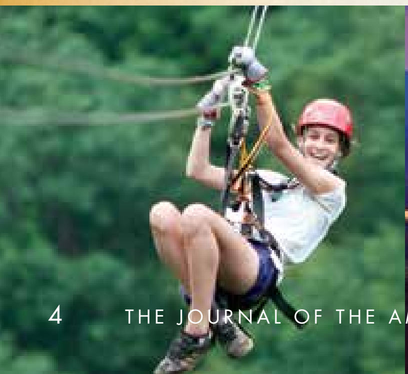
The Society of American Foresters (SAF) is offering Continuing Forestry Education credit for attendance at the Summit.

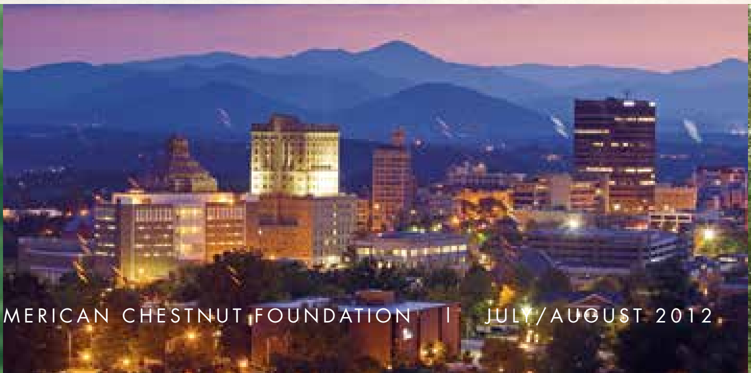
Tickets can be purchased separately for the following:

- Friday Welcome Dinner & Reception: $35 per person
- Saturday Lunch: $20 per person
- Saturday Dinner Event: $50 single / $75 couple
- Sunday Lunch: $20 per person
- Bent Creek Research Forest Tour (Box Lunch Provided): $15 per person
  (Space is limited. Pre-registration is required)

Accommodations

Reserve rooms now by calling Crowne Plaza Resort at 888-233-9527 or visit https://resweb.passkey.com/go/ACF2012OCT. Rooms start at $139.00 per night. To receive these special room rates, let them know that you are attending the American Chestnut Summit. If you are a Federal employee please contact The American Chestnut Foundation at 828-281-0047 for reservations.





2012 American Chestnut Summit

October 19-21, 2012 • Asheville, NC

SCHEDULE AT A GLANCE

Schedule may be subject to change

FRIDAY, OCTOBER 19TH

1:00 PM - 6:00 PM Registration Open
5:00 PM - 6:00 PM Welcome Reception
6:00 PM - 7:30 PM Dinner and Program

SATURDAY, OCTOBER 20TH

7:30 AM - 4:00 PM Registration Open
7:00 AM - 8:30 AM Continental Breakfast
8:15 AM - 10:00 AM **Opening General Session:**
The American Chestnut — Genetic, Ecological and Strategic Aspects of Resistance and Restoration
Dr. Rob Doudrick, Director, USDA Forest Service, Southern Research Station
Chestnut Breeding and Restoration: Elements of Success
Dr. Kim Steiner, Professor of Forest Biology, Penn State University
10:00 AM - 7:00 PM POSTER SESSION/EXHIBITS
10:00 AM 10:30 AM Refreshment Break
10:30 AM - 11:15 AM **Keynote Speaker:**
Nature on the Move — How Important Are We?
Dr. Patrick McMillan, Director, Campbell Museum of Natural History at Clemson University
11:15 AM - 12:00 NOON Panel Discussion
12:00 NOON - 1:00 PM Lunch

CONCURRENT SESSIONS

Track 1 - CHESTNUT GENETICS AND DISEASES

1:00 PM - 1:45 PM **Beyond Hybrid Backcross Breeding: The Intersecton of TACF´s Breeding Program with Conventional Forest Tree Improvement, Varietal Forestry and Transgenics**
Dr. Scott Merkle, Professor of Forest Biology, University of Georgia
1:45 PM - 2:30 PM **Hypovirulence of *Cryphonectria parasitica*, the Fungus that Causes Chestnut Blight Disease**
Dr. Bradley I. Hillman, Professor of Plant Biology and Pathology, Rutgers University
2:30 PM - 3:15 PM ***Phytophthora cinnamomi* and the American Chestnut: A Chance Encounter with Unfortunate Consequences!**
Dr. Steven N. Jeffers, Professor and Extension Specialist, Clemson University
3:15 PM - 3:30 PM Refreshment Break
3:30 PM - 4:30 PM Panel Discussion

Track 2 - CHESTNUT ECOLOGY AND RESTORATION

1:00 PM - 1:45 PM **Opportunities for Public-facing Institutions to Contribute Research and Engage People in Reviving our Lost Legacy**
Dr. Nicole Cavender, Vice President of Science and Conservation, The Morton Arboretum
1:45 PM - 2:30 PM **How Can We Restore Chestnut: Forest Management Approaches to Long-term Restoration**
Dr. Stacy Clark, Research Forester, USDA Forest Service, Southern Research Station
2:30 PM - 3:15 PM **American Chestnut and Eastern Forest Wildlife Communities**
Dr. Bill Healy, Wildlife Biologist, USDA Forest Service (retired)

Track 2 - CHESTNUT ECOLOGY AND RESTORATION continued

3:15 PM - 3:30 PM Refreshment Break
3:30 PM - 4:30 PM **Exploring the "Fit" Between Genes and the Environment**
Dr. Paul Schaberg, Plant Physiologist, USDA Forest Service

Track 3 - CULTURE AND HISTORY OF CHESTNUTS

1:00 PM - 1:45 PM **The Chestnut Trade in Southwestern Virginia**
Dr. Ralph Lutts, Faculty Member, Goddard College
1:45 PM - 2:30 PM **Finding Chestnuts in Northern American History**
Dr. Donald Davis, Governmental Affairs Representative, TACF
2:30 PM - 3:15 PM **Third Presentation - TBD**
3:15 PM - 3:30 PM Refreshment Break
3:30 PM - 4:30 PM Panel Discussion

5:00 PM - 6:00 PM Reception - Poster Exhibit
6:00 PM - 9:00 PM Saturday Night Special Event: Dinner, Entertainment, Auction

SUNDAY, OCTOBER 21ST

7:00 AM - 8:30 AM Continental Breakfast
7:30 AM - 12:00 NOON Registration Open
8:00 AM - 9:00 AM Business Meeting
8:00 AM - 12:00 NOON **Critical Needs Workshop:**
Identifying future critical needs that must be addressed to facilitate the reintroduction of the American chestnut to our eastern forests
Moderator: Nancy Walters, Organization Development Specialist, USDA Forest Service

Track 4 - PRACTICAL SKILLS

8:00 AM - 9:00 AM **Introduction to Planting and Growing Chestnuts**
Kendra Gurney, New England Regional Science Coordinator, TACF
9:00 AM - 10:00 AM **Introduction to Wood Identification**
Sara Fitzsimmons, Northern Central Regional Science Coordinator, TACF
10:00 AM - 10:30 AM Refreshment Break
10:30 AM - 11:30 AM **Introduction to Chestnut Pests and Diseases**
Tom Saielli, Southeast Regional Science Coordinator, TACF

OTHER ACTIVITIES

10:00 AM - 1:00 PM **(DEPARTS 9:45 AM)** **Field Trip: Bent Creek Chestnut Tour**
(Boxed lunches provided)
Return to Resort by 1:00 PM
12:00 NOON - 1:00 PM Lunch
1:00 PM **END OF SUMMIT**

For more information contact The American Chestnut Foundation at (828) 281-0047

WORKSHOP AND PROGRAM DESCRIPTIONS

SATURDAY KEYNOTE

Nature on the Move – How Important Are We?

Dr. Patrick McMillan, Director, Campbell Museum of Natural History at Clemson University

One of the most difficult lessons for a naturalist to learn is that change is a constant in nature. Man has always been an integral part of nature and change. The truth is we are the most significant force of change on the planet. The fate of the American chestnut is but one example of how our choices have resulted in profound impacts on our world. From the Piedmont forests to the mysterious shell rings of the Carolina coast our actions can be seen hundreds, indeed thousands of years later. Join Patrick for a tour across the continent and into the past for a look at how man's hand is visible across the globe and how simple choices we can all make can change the course of the world.

OPENING GENERAL SESSION

The American Chestnut – Genetic, Ecological and Strategic Aspects of Resistance and Restoration

Dr. Robert L. Doudrick, Director, USDA Forest Service, Southern Research Station

This talk will address the genetics and strategy of building resistance into an iconic tree species. Dr. Doudrick will address the ecological aspects of establishing a native in a "non-native" environment including thriving in an occupied niche, invasive plants, pests and pathogens and climate change. He will touch on the strategic and logistical aspects of restoration including the outlook for funding of restoration efforts and will discuss the critical research and restoration needs of the future and socioeconomic factors that affect our ability to restore and manage the American chestnut tree.

Chestnut Breeding and Restoration: Elements of Success

Dr. Kim Steiner, Professor of Forest Biology, Director of The Arboretum at Penn State, Penn State University

Drawing on four decades of experience in the field of forest tree breeding, and on the history of nearly a century of work battling chestnut blight, Dr. Steiner will discuss the pitfalls of grand projects like ours and the opportunities for our success.

TRACK 1 - CHESTNUT GENETICS AND DISEASES

Beyond Hybrid Backcross Breeding: The Intersection of TACF's Breeding Program with Conventional Forest Tree Improvement, Varietal Forestry, and Transgenics

Dr. Scott Merkle, Professor of Forest Biology, University of Georgia

Now that the TACF breeding program is at its B3F3 goal, it may be time to look at where some aspects of commercial tree improvement, varietal forestry and even transgenics can make substantial contributions to the goals of TACF. In particular, applying the varietal approach to TACF B3F3 chestnuts, either via rooted cuttings or in vitro techniques, such as micropropagation or somatic embryogenesis, could both enhance restoration efforts and induce interest in landowners in growing chestnuts, by making elite chestnut material available to them for commercial timber or nut production.

Hypovirulence of *Cryphonectria parasitica*, the Fungus that Causes Chestnut Blight Disease

Dr. Bradley I. Hillman, Professor of Plant Biology and Pathology, Rutgers University

In the 1950's, debilitated strains of *Cryphonectria parasitica* called "hypovirulent" were first used to help control the spread of the fungus in European chestnut. Attempts in the U.S. were less successful. This presentation will review the history of the use of hypovirulence as a biological control of the fungus, and will look at how the recently completed genome sequence of the fungus has opened the door to further comparative studies on fungal response to virus infection.

Phytophthora cinnamomi and the American Chestnut: A Chance Encounter with Unfortunate Consequences!

Dr. Steven N. Jeffers, Professor and Extension Specialist, Clemson University

The presentation will focus on the specific interaction between *Phytophthora cinnamomi* and the American chestnut here in the southeastern USA. Included will be an overview of the genus *Phytophthora*: its historical background, general biology and roles as a plant pathogen of worldwide importance.

TRACK 2: CHESTNUT ECOLOGY AND RESTORATION

Opportunities for Public-facing Institutions to Contribute Research and Engage People in Reviving our Lost Legacy

Dr. Nicole Cavender, Vice President of Science and Conservation, The Morton Arboretum

Today, the expanded mission of many botanic gardens, arboreta and zoological centers includes taking proactive roles in protection, conservation and restoration. These facilities can provide many services and resources that advance plant-based research and engage the public. This presentation will offer a closer look at these activities and opportunities as they relate to the plight of the American chestnut.

How Can We Restore Chestnut: Forest Management Approaches to Long-term Restoration

Dr. Stacy Clark, Research Forester, USDA Forest Service, Southern Research Station

Co-authors: Dr. Scott Schlarbaum, Dr. Brian McCarthy, Dr. Aaron Stottlemyer, and Dr. Fred Hebard

The USDA Forest Service and other partners have implemented several research plantings on the National Forests using potentially blight-resistant material available from The American Chestnut Foundation. Early results indicate these chestnuts are competitive with native plant species, and behave similarly to pure American chestnut in growth and survival. Successful restoration will require management or control of native fauna (deer, bear) and flora (seedling sprouts), and will also require attention to a host of non-native pests and pathogens other than blight (root rot disease, insects).

American Chestnut and Eastern Forest Wildlife Communities

Dr. William M. Healy, Certified Wildlife Biologist, USDA Forest Service (retired)

The eastern deciduous forest that developed after the last glaciation was characterized by widespread species, including oaks, maples, beech, basswood, hickories, ash, elm, birch, yellow poplar, and chestnut. The seeds and nuts from these trees provided the most abundant and nutritious food source and the forests supported a large and diverse wildlife community. American chestnut played a unique role because of its flowering characteristics, productivity, and lack of hard shell. During the last century, chestnut and other foundation tree species have been lost from this forest. Despite these changes, tree seeds and nuts are still the most important fall and winter food for forest wildlife whose populations rise and fall with the annual tree seed crop. The restoration of American chestnut is an important step in the ecological restoration of the eastern deciduous forest.

Exploring the "Fit" Between Genes and the Environment

Dr. Paul G. Schaberg, USDA Forest Service, Northern Research Station and the University of Vermont Rubenstein School of Environment and Natural Resources

There are multiple existing and emerging factors that could complicate the goal of robust restoration across the American chestnut's entire range. One way of assessing the interplay of genetics and management is in a "common garden" – where many genetic sources are planted together to see how they perform under similar environmental (and management) conditions. This talk will present data on the influence of genetics and silvicultural treatment on the performance of American chestnut grown in a common garden in Vermont. Emphasis will be placed on understanding the "fit" between genetic sources and the local environment now and in the face of changing climates.

TRACK 3 - CULTURE AND HISTORY OF CHESTNUTS

The Chestnut Trade in Southwestern Virginia

Dr. Ralph H. Lutts, Faculty Member, Goddard College

A close look at the brisk trade in American chestnuts in southwestern Virginia during the early decades of the twentieth century reveals some surprises. The size of local chestnut economies varied, often related to the size of the chestnut crop, the prosperity of county residents, and the extent of a county's transportation system. Although chestnuts were usually gathered as a wild crop, some people managed their trees as personal orchards. In rare instances, conflicts over chestnuts even led to murder.

Finding Chestnuts in North American History

Dr. Donald Edward Davis, Governmental Affairs Representative, TACF and Fulbright Scholar, Vasyl Stefanyk Precarpathian University, Ivano-Frankivsk, Ukraine

This presentation will examine the environmental history of the American chestnut over the past 20,000 years. By examining fossil pollen records, archaeological studies, and original archival documents, the author provides new–and perhaps groundbreaking–information about the role of the American chestnut in shaping North American history and culture.

TRACK 4 – PRACTICAL SKILLS

Introduction to Planting and Growing Chestnuts

Kendra Gurney, New England Regional Science Coordinator, The American Chestnut Foundation

Learn about site selection, planting, and common pitfalls for successfully growing American chestnuts.

Introduction to Wood Identification

Sara Fitzsimmons, Northern Central Regional Science Coordinator, The American Chestnut Foundation

This workshop covers the basics necessary to begin identifying wood samples, especially that of chestnut and those most often mistaken for chestnut. Presentation developed by Lee Stover, retired instructor of Wood Products from Penn State University.

Introduction to Chestnut Pests and Disease

Tom Saielli, Southeast Regional Science Coordinator, The American Chestnut Foundation

Learn about common greenhouse and field pests and diseases of chestnuts and how to treat them.

SPECIAL ACTIVITIES:

Critical Needs Workshop

Moderated by Nancy Walters, USDA Forest Service

The restoration of the American chestnut represents a historic conservation success story. However, the chestnut's century-long absence from our forests creates a challenge. The Chestnut Summit's Critical Needs workshop will gather information from participants to provide strategic processes needed to reintroduce this American icon to our forests. Topics of discussion will range from the role of diverse partnerships, opportunities and challenges to restore the chestnut to private and public lands, and future research needs.

Field Trip: Bent Creek Chestnut Tour with Presentation

Managed by the USDA Forest Service under the leadership of the Southern Research Station, the Bent Creek Experimental Forest encompasses nearly 6,000 acres within the Pisgah National Forest near Asheville, North Carolina. Scientists at the Bent Creek Experimental Forest currently study oak ecosystem restoration, hardwood regeneration, fire ecology, growth and yield, forest stand dynamics, acorn and native forest fruit production, invasive plant species, American chestnut restoration, wildlife response to forest management practices, and ecosystem classification.

Visit the Bent Creek Experimental Forest website to learn more about their research at www.srs.fs.usda.gov/uplandhardwood.

The American Chestnut Summit is presented in partnership with:

Southern Group of State Foresters, National Resources Conservation Service, Georgia Pacific, North East Area State Foresters, North Carolina Forest Service, Southern Research Station, Carolinas Chapter of TACF®

Sheri Shambor pauses on a hike with her dogs Maya and Kokomo.

Two TACF Chapters Welcome New Employees

In February 2012, Sheri Shambor was hired as the Virginia Chapter's first Volunteer and Event Coordinator. Sheri works out of the state chapter office in Marshall, VA, and her role is to coordinate volunteer activities and provide the training and tools volunteers need to make their experience fun and successful. As an outdoor enthusiast and avid hiker, she has enjoyed exploring the region since moving to Virginia in 2008. Wherever you find Sheri, her two chocolate labs are not far behind.

Stephanie Bailey was hired as PA-TACF Chapter Administrator in June 2012. Based out of the North Central Office at Penn State University, her duties involve the day-to-day operations of the chapter, such as managing a portion of the office finances, member correspondence and coordination, and answering phones and other general secretarial duties. She has a bachelor's degree in biology from Appalachian State University. Prior to coming to PA-TACF, Stephanie worked at various research labs and non-profit organizations. She and her fiancé, Mark, are getting married in September in Eastern TN.

Stephanie Bailey with an American chestnut seedling in the greenhouse at Penn State
Photo by Sara Fitzsimmons

Cathy Mayes was recently recognized by *Garden & Gun* magazine, for her work in helping to restore the American chestnut.
Photo by Michael JN Bowles

TACF's Cathy Mayes Recognized as a *Garden & Gun* Visionary, Saving the South's Wild Places

We all know Cathy Mayes of Hume, Virginia, to be a tireless and spirited TACF leader who works vigilantly to restore American chestnuts to our eastern forests. Several weeks ago we learned that she is one of ten people in the South to be celebrated by *Garden & Gun* magazine as "champions of Dixie's natural beauty."

In her interview for the April/May issue of *Garden & Gun*, Cathy said "I will never know if this work is successful, but each generation has to turn the ball a bit to keep it rolling." Last year, VA-TACF completed the first large-scale test planting of chestnuts in Virginia. "What we're doing," she added, "is truly astonishing—restoring a species on a magnitude beyond the scope of anything ecologists have ever attempted."

Congratulations to Cathy for this great honor! To read the article, visit http://gardenandgun.com/article/cathy-mayes-marshall-virginia.

The Remediation of the Palmerton Superfund site serves as a model of innovative environmental technology for the EPA.
Photo Credit: Sara Fitzsimmons

News From the North Central Region

The North Central region of the chestnut range has been humming with activity this year. Here are a few highlights from the numerous plantings and orchards volunteers have installed:

The Ohio Chapter planted a demonstration orchard at Highlands Nature Sanctuary in southern Ohio. The Highlands Nature Sanctuary is 2000-acre hiking and nature education destination in the heart of the scenic Rocky Fork Gorge.

The New York Chapter and SUNY-ESF planted 200 of their first transgenic seedlings on a test site near Syracuse, New York. These transgenic seedlings are the result of controlled crosses between transgenic chestnut pollen and wild-type American chestnuts. This demonstrates that transgenic trees can flower normally and produce viable offspring, potentially allowing researchers to combine the benefits of traditional breeding with transgenic research.

The Pennsylvania/New Jersey Chapter planted 2000 B2F3s and 75 B3F3s at the Palmerton Superfund site in Palmerton, PA, as part of a project to remediate a zinc superfund site. This thousand-acre plot of forest in Carbon County, PA, is the largest re-vegetation project ever undertaken by the U.S. Environmental Protection Agency's Superfund program. This is the second year that TACF has planted chestnuts on the site.

A host of Pennsylvania collaborators teamed up for a TACF progeny test planting of 300 B3F3s and controls with Sewickley Heights Borough Park in Sewickley Heights, PA. Several organizations and clubs took part to help fund and establish this orchard, including the Sewickley Heights Restoration Branch, Garden Club of Allegheny County, Sewickley Civic Garden Council, Village Garden Club, Little Garden Club, and a local private donor.

5th Annual West Virginia Chestnut Festival Offers Entertaining Activities and Programs on Columbus Day Weekend

Mark your calendars for West Virginia's 5th Annual Chestnut Festival on Sunday, October 7, 2012, from 10:30a.m. to 7:30p.m. in Rowlesburg, WV. The festival will be held in scenic Rowlesburg Park, located along the big bend of the Cheat River, and in the nearby Szilagyi Creative Arts Center.

The festivities begin with a continental breakfast served from 10:30a.m. to noon in the River City Café. From noon to 5:00p.m., vendors will set up in Rowlesburg Park with various chestnut fare and crafts. The public is encouraged to attend the West Virginia Chapter meeting of The American Chestnut Foundation (TACF) from 12:00 noon to 2:00p.m. and a scientific program from 4:00 to 5:00p.m. with speakers Dr. Dennis Fulbright, plant pathologist from Michigan State University, and Mark Double, associate researcher at West Virginia University. The Gala Chestnut Dinner Banquet begins at 5:30p.m. in the auditorium of the Szilagyi Center.

For more information and/or to reserve banquet dinner tickets or vendor space, contact Shirley Hartley, (304) 329-1240, Shartley812@frontier.com or visit http://www.rowlesburg.info/chestnut_festival.php.

Roasting chestnuts at the West Virginia Chestnut Festival
Photo by Bryan Burhans

Participants gather around a blooming American chestnut found by Bert Crabtree and Kevin Kimbrough.
Photo Credit: Hill Craddock

Volunteers Link Their Interest in the American Chestnut and the Appalachian Trail

Since 2008, chestnut enthusiasts have combined their love for American chestnuts and the Appalachian Trail (AT) through the AT MEGA-Transect Chestnut Project. Volunteers receive training enabling them to locate surviving American chestnut trees and collect vital data on the trail. Scientists use the data collected to determine the status of surviving remnants of American chestnuts and better understand the preferred site requirements for American chestnut.

The first AT MEGA-Transect training workshop in 2012 was led by Dr. Hill Craddock of University of Tennessee at Chattanooga and took place at the Nantahala Outdoor Center in Wesser, NC on June 9th. After conducting the theoretical component of the training, participants hiked one mile of the AT for the practicum component and counted all American chestnuts greater than 3 feet tall, located less than 15 feet from trail edge. "I was interested to find that an overwhelming percentage of surviving American chestnuts are found in our home turf," said participant Darlene Hills of Young Harris, GA. "This gave us hope that we will be able to bring them back in our area."

Seeking Reclaimed Mine Land Sites for Reforestation

Michael French, TACF's forester working on the Conservation Innovation Grant (CIG), is currently seeking reclaimed mine land sites for reforestation in 2013 and 2014. The purpose of the CIG is to establish 12 demonstration plantings across 5 states (KY, VA, WV, OH, and PA) of a mixed hardwood/ American chestnut forest on reclaimed mine lands over a 3-year period. These plantings will be approximately 30 acres in size and will include a fenced-in 1 acre progeny test of our Restoration Chestnuts 1.0. If you own mined land, or know of a landowner with mined land in need of reforestation, please contact Michael at (812) 447-3285 or michael@acf.org.

In Memory of and In Honor of our TACF Members May 1-June 30, 2012

In Memory of

Essie Burnworth
Barbara and Mervin Muller

John R. Ellis
James Donowick

James W. Lorenzini
Nicki Dangleis
Beth and Dyrk Keyser

William M. Palmer
Kirk Trost
Peter Watt

Richard K. Balinger
Susan Browning
Sarah Douglass
John and Peggy Kimbirl
Margaret Legard
Letty Mallery
Claudia Ralston
Betty Taylor
Hugh and Betty Voreess
Terrance Wharton

In Honor of

Jan K. Herman
Audrey Lipes

Dr. Gregory Weaver and Paula Phelps-Weaver
Kittie Perryman

Alan Tumblin and Zhuxuan You (PA-TACF intern) complete pollination at the Reineman orchard in central PA.
Photo Credit: Sara Fitzsimmons

TACF Honors Its Volunteers

Alan Tumblin

When Alan Tumblin read about TACF in his Electric Cooperative member magazine in 2002, he decided to attend the PA-TACF spring meeting in Hershey, PA. He volunteered to help pollinate trees that summer and before he knew it, he was planting a PA-TACF Cytoplasmic Male Sterility (CMS) orchard on his property. In addition to managing the CMS orchard, Alan helps maintain the Reineman Wildlife Preserve chestnut orchard in Perry County, PA and this spring planted a BC1 orchard on his family farm in Coshocton County, OH. He serves on the PA-TACF board and helps coordinate supplies for the PA Farm Show and volunteers at various chapter events such as inoculations or canker measuring.

Born and raised on a farm in Southeastern Ohio, Alan earned a Bachelor's Degree in Agricultural Economics from The Ohio State University and a Master's Degree in Agricultural Economics from the University of Illinois. Currently, he resides in Newville, PA and works as a materials manager for Ames True Temper, a manufacturer of lawn and garden tools.

In addition to participating in American chestnut restoration, Alan enjoys restoring his 5.5 acre property. Portions of the property are natural wetlands, so he enrolled in the Wetland Reserve Program with the USDA NRCS and certified it as a Monarch Waystation, to create habitat for monarch butterflies.

"I like to call Alan the chestnut ninja," says Sara Fitzsimmons, TACF Northern Appalachian Regional Science Coordinator. "You never know he's coming, and then he's there, ready to lend a hand. Alan is a well-rounded volunteer with a lot of valuable experience."

Steve Haggblade

Steve Haggblade of Poolesville, MD, first became interested in chestnuts several years ago, when his daughter, Marlene, did her Global Ecology Senior High School project on chestnut blight. For her project, Steve drove Marlene around Maryland to sample bark from large surviving chestnut trees. In the process, he met many of the key MD-TACF leaders such as Essie Burnworth, Gary Carver, and Ron Kuipers. The more connections Steve made, the more intrigued he became with American chestnuts.

Alex Pike and Steve Haggblade at the Brightwell Crossing Demonstration Orchard in Poolesville. Steve assisted Alex with the design, preparation and planting of this orchard for Alex's senior project with the Global Ecology Program.
Credit: Kirby Carmack

Fast forward two years, Steve now serves on the MD-TACF board and heads up the MD-TACF education committee, working with teachers to get students interested in American chestnuts. When asked about his experience working with students, Steve says, "I enjoy the energy and initiative the students show. Their questions make me think about old issues in new ways. They keep me thinking and moving, which helps to keep me young."

After earning his Ph.D. in Economics from Michigan State University (MSU), Steve spent 22 years overseas in Cameroon, Botswana, Burkina Faso, Madagascar and Zambia studying African farming technologies and marketing systems to identify ways of raising productivity in African agriculture. In 2006 he moved his family to Poolesville, MD where he continues to work for MSU, working and traveling from his base in MD.

"Steve is ensuring the future of chestnut restoration in Maryland by mentoring and inspiring students and teachers," said Gary Carver, Maryland Chapter past president. "He works on individual student chestnut projects, school chestnut orchards, and data collection and analysis in chapter breeding orchards."

Ecology of the Chestnut:

How and Where They Grow

by Dr. Brian C. McCarthy

Fig. 1. Our understanding of how and where chestnuts grow is often based on limited, post-blight data. Stand-level distribution and abundance data suggest that the species may have grown in habitats ranging from moist to xeric, upland to lowland, often on northwest-facing aspects, and in almost any well-drained, non-calcareous soil type.
Photo by Paul Franklin

With each passing year, there are fewer and fewer of us who remember the American chestnut growing in its wild state. The timing of the blight in eastern North America was rather unfortunate, as the science of ecology and its application to forests (i.e., forestry) were relatively young in their development as disciplines. Thus, most early studies were largely descriptive in nature, typically confined to a single site, and often based on a weak experimental design with inadequate power for strong inference. Nonetheless, a plethora of good descriptive data remains that provides much insight. Combined with recent studies using modern methodologies, we have captured a reasonable understanding of the ecology of the American chestnut—recognizing the caveat that there will always be some aspects that we will never fully understand outside of its original habitat.

Most of us walking in the woods throughout the Appalachians encounter chestnut on a rather routine basis. We see occasional small- to modest-sized stems, 4-8 inches in diameter, often blighted, and copious numbers of stump sprouts. So we feel rather comfortable about the chestnut's association with mixed oak or oak-hickory forests. But what we see now is not necessarily what the past was like. In fact, if we roll back the clock 11,000 years or so to the period of the Wisconsin glaciation, we see the chestnut's closest associate was most likely hemlock and that both had a largely southern distribution. As the climate moderated toward the latter part of the Holocene, tree species migrated northwards with many oaks, hickories, and chestnut arriving in their current-day range ca. 4,000 years ago. Palynological (study of pollen) and archaeological data suggest chestnut may have lagged behind the oaks and hickories, not attaining full dominance in New England until only 2,000 years ago. The main point is chestnut did not evolve in its recent historical habitat and may have always been only a minor component (2-10%) of at least parts of the mixed oak, oak-hickory, and oak-chestnut forest throughout much of the Holocene.

FYI

"Ecological amplitude": the ability of a species to adapt to changes in the environment.

"Phenotypic plasticity": the ability of an individual organism, such as a tree, to change its physical expression of genetically controlled traits based on changes in the environment.

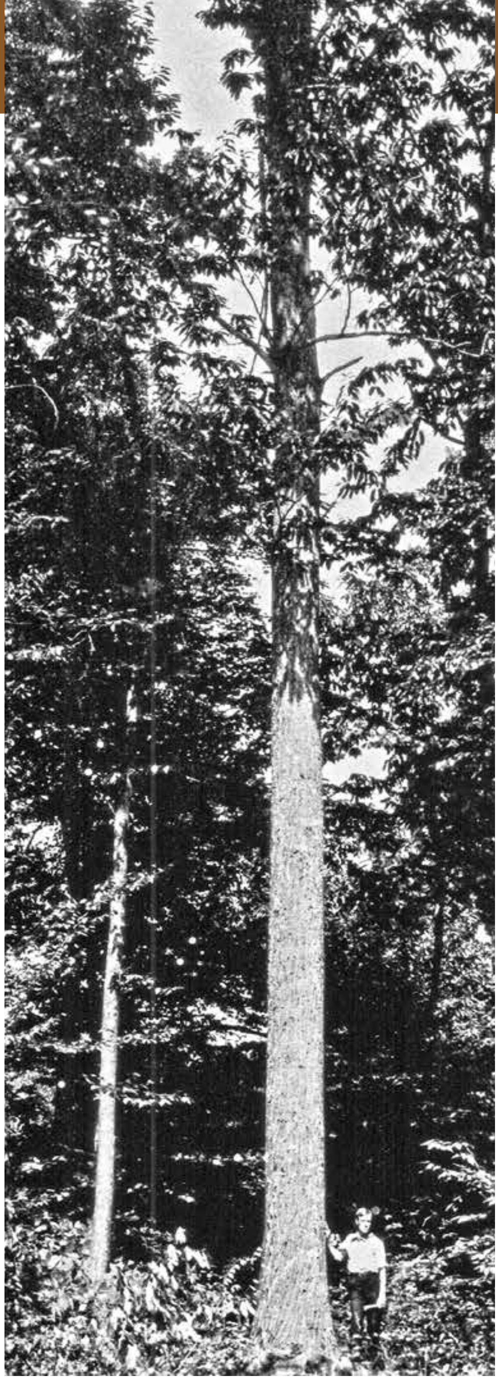


Fig. 2. This American chestnut in Scotland, CT, was 83 feet tall and 27” in diameter at breast height when it was photographed in 1905. Current wisdom suggests chestnuts grow best on moderately dry upper slopes and ridge tops. However, historical literature and witness trees from survey data suggest that chestnuts also grew well in lower slope, cove, and/or riparian areas, as long as the site was well drained.

Photo courtesy of Connecticut Agricultural Experiment Station

How then did chestnut come to dominate so many Appalachian forests? Although scientists still debate this issue, a major factor was human activities.

How then did chestnut come to dominate so many Appalachian forests? Although scientists still debate this issue, a major factor was human activities. Native Americans may have facilitated this process, but the data clearly show a rapid acceleration in post-Columbian times as Anglo settlers affected the woodlands. The rich timber resources of eastern North America were a significant reason why the region was so heavily colonized. Deforestation ensued (for agriculture, home sites, etc.), and chestnut would vigorously re-sprout from the root crown. Thus, the hardwood forests of the Appalachians increased in density and basal area of chestnut as a function of species biology and disturbance regime, yielding the high volume chestnut forests we encounter in the scientific literature from the mid-1800s onwards, until the blight struck. The point here is that the distribution and abundance of chestnut in Appalachian forests when blight struck is a rather recent phenomenon that has its roots in human disturbance of the forested landscape.

So, can we use data from the chestnut’s current pattern of distribution and abundance to make inference about the species’ ecology? Maybe yes, maybe no. Today, chestnut often seems to increase in abundance on relatively dry, well-drained upper slopes, with a southerly aspect and poorly developed understory. But this may simply reflect the light, moisture, or competition conditions that are necessary for the species to survive post-blight, and may not in any meaningful fashion reflect the full range of habitats the species likely grew in originally. Stand-level distribution and abundance data suggest the species may have grown in habitats ranging from moist to xeric, upland to lowland, often on northwest-facing aspects, and in almost any well-drained, non-calcareous soil type.

Some have argued that American chestnut has many of the functional light, moisture, and nutrient requirements as the oaks (about which we know considerably more). This is reasonable to a certain extent, but the ecological amplitude of chestnut seems broader. For example, like oak, chestnut is often classified as mid-tolerant with respect to light. However, unlike oak, chestnut seems able to adapt to low-light conditions and remain in the understory for long periods of time prior to release. Like oak, the species responds rapidly to disturbance, but enhanced light often leads to a growth rate that exceeds oak by as much as 2:1. These are distinct ecophysiological differences between chestnut and oak.

The nutritional requirements of American chestnut are less well understood. Increased growth rates have been observed on nutrient-rich soils; however, the species is also frequently found on nutrient-poor soils. Moisture requirements are also a bit vague. Current-day populations of sprouts are often found on upper slopes and ridge tops that tend to be moderately dry. However, historical literature and witness trees from survey data suggest it used to grow well in lower slope, cove, and/or riparian areas, as long as the site was well drained. Recent controlled experiments have shown that chestnut is very competitive, relative to other hardwood congeners, under a variety of light, water, and nutrient regimes.

In sum, American chestnut appears to have broad ecological amplitude relative to many other hardwood species. In the absence of formal testing, the species also seems to have considerable phenotypic plasticity (e.g., light tolerance). Soil pH and drainage may be the strongest controlling mechanisms in the soil, with survival and growth severely diminished above a pH of 6.0 or in soils where standing water is common. Thus, almost any site that is well drained (based upon texture, aspect, and slope position), with a pH below 6.0, and modest to high light availability will suffice for chestnut establishment. Recent data suggest chestnut restoration is quite compatible with most current forest management regimes (thinning, prescribed fire, etc.) and other restoration or reclamation efforts (e.g., mine land reclamation). In other words, it does well under a moderate disturbance regime and can tolerate fairly extreme environments.

As we saw from the blight, biotic factors may be the greatest impediment to chestnut establishment, survival, and growth. American chestnut is subject to a broad range of pests beyond *Cryphonectria parasitica*. The fungus *Phytophthora cinnamomi* (ink disease) often limits survival on sites with heavy, poorly drained, agricultural soils in the southern half of the tree's range (i.e., most of the Piedmont physiographic province). Recent studies suggest that mycorrhizae (symbiotic fungal associations with the roots) may be necessary for adequate survival and growth. The gall wasp, *Dryocosmus kuriphilus*, may in certain areas severely curtail shoot growth, fruiting, and ultimately survival. White-tailed deer, *Odocoileus virginianus*, have been shown to preferentially browse on chestnut in the presence of many other hardwood species, effectively selecting against chestnut in areas with high densities of deer. Voles (principally *Microtus* spp.) and the eastern cottontail rabbit (*Sylvilagus floridanus*) have long posed problems for establishment in old fields, pastures, and other areas of high ground cover.

In conclusion, we know quite a bit about the silvics and ecology of American chestnut and this will be of great benefit as we begin restoration efforts. Ongoing studies will serve to refine our understanding of the biology of the species as we begin the long process of returning it to the forests of the Appalachians.

Dr. Brian C. McCarthy is Professor of Forest Ecology and Chair of the Department of Environmental and Plant Biology at Ohio University. He is a certified Senior Ecologist and is currently President of the Ohio Chapter of The American Chestnut Foundation.

Fig. 3 Chestnuts grow well in nutrient-rich soils with good drainage, but they will also grow well in poor soils. Here, chestnuts are being planted as part of a project to reforest damaged mine lands.
Photo courtesy of ARRI

Figure 4. Volunteer Kieu Manes measures a large surviving American chestnut near the Appalachian Trail as part of the AT Mega-Transect project. Continued research will increase our understanding of the ecology of the chestnut and how best to restore it to the eastern forests.
Photo by Mike Manes

Pistillate flower. The green bracts comprise the involucre, which will develop into a bur. The white spiky structures are styles
Photo by Kendra Gurney

Reproduction in the American Chestnut: An Overview

by Dr. Leila Pinchot

In its heyday, the American chestnut was so abundant, with blossoms so prolific, that blooming chestnut forests appeared to be covered in snow – a sight that forecast a generous crop of nuts to ripen in autumn. Today, blight keeps American chestnut stunted in a pre-adolescent state, in which it seldom produces fertile seed and persists only by reason of its superior sprouting ability. The untiring efforts of chestnut researchers, scientists and volunteers, however, may grant the species a second life. In doing so, we will not only restore American chestnut as we know it but, more importantly, revive the tree's ability to reproduce in nature and therefore evolve and adapt to a potentially changing habitat.

American chestnut reproduction has been shaped over millions of years and many thousands of generations. Although most species in the *Fagaceae* family flower by early spring, the American chestnut patiently bides its time, first unfurling its distinctive, toothed leaves before developing flowers in early summer. This strategy allows chestnut to flower despite late spring frosts, enabling them to produce relatively regular and abundant nut crops compared to their earlier-flowering cousins.

Chestnut trees are monoecious, a term derived from the Latin "one house," meaning that each individual tree produces both male, or staminate, and female, or pistillate, flowers. The chestnut first develops catkins beginning in late April in the south and continuing through June in the species' northern range. Catkins are long (5–9") inflorescences on which staminate flowers develop in clusters of 4-9, spirally arranged along the catkin axis. Come early summer, stamens, short thin structures that bear pollen, emerge from the myriad cream-colored catkins adorning the branches of mature chestnut trees.

The American chestnut patiently bides its time, first unfurling its distinctive, toothed leaves before developing flowers in early summer. This strategy allows chestnut to flower despite late spring frosts.

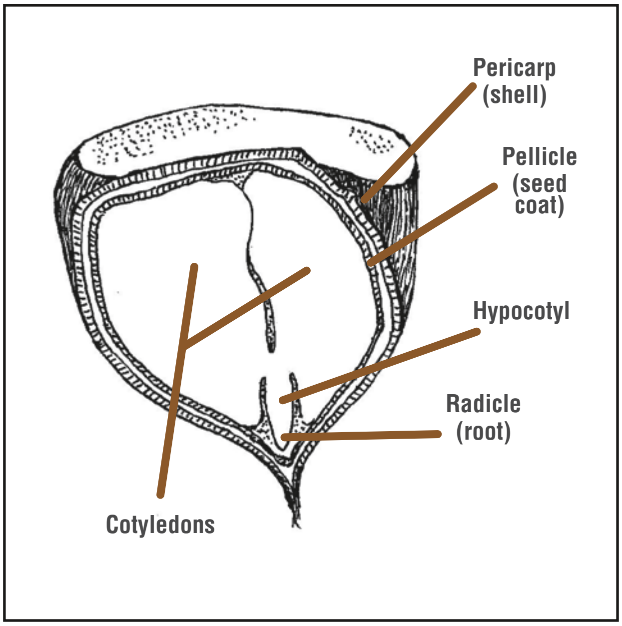
Although most catkins bear only male flower parts, bisexual catkins, which develop near the ends of branches receiving full light, produce both pistillate and staminate flowers. Pistillate flowers are inconspicuous compared to their showy male counterparts. Borne at the proximal end of bisexual catkins, they are small (~1/3") green spheres covered in spikey bracts, collectively called the involucre. Within each involucre are three flowers that each contain an ovary with numerous eggs, or ovules. About the same time that stamens develop on staminate flowers, three sets of 6-8 styles emerge from each ovary and poke through the spiky involucre. The flowers become receptive to pollen when the styles spread outwards and turn a straw-yellow color, 5 to 16 days after emergence. The pollen grains that are fortunate enough to land on the tip, or stigma, of a style, produce a pollen tube that grows down the

Staminate inflorescence. The long catkin is covered with many clusters of male flowers. The thin spiky structures are stamens.
Photo by Paul Franklin

hollow styles, guiding two sperms to each ovule stored in the ovary. Pollen landing on styles from the same tree may germinate, however the pollen tube will not develop normally, thereby preventing self-pollination. After fertilization, a process known as double fertilization occurs within an ovule. One sperm cell fuses with the female egg cell and produces a zygote that, over the course of the summer, develops into a chestnut seed, while the other sperm cell fuses with two polar cells, developed in the ovaries, to form a triploid (having three sets of chromosomes) endosperm. The endosperm provides nutrients to the developing cotyledons, the fleshy part of chestnuts. Between pollination in early summer and nut maturation in early autumn, the fertilized embryo rapidly develops, preparing for dormancy over the winter and ultimately germination the following spring.

The principal mode of dissemination of chestnut pollen has become a debated issue. Several key characteristics, including the small size and light weight of the pollen (chestnut has the smallest pollen in the *Fagacea* family), suggest that chestnut pollen is primarily wind-disseminated. Additionally, the female flowers of insect-pollinated species tend to be showy and fragrant while the female flowers of the chestnut are modest. But chestnut enthusiasts also agree that chestnut flowers are routinely visited by numerous insects, attracted by the strong odor produced by male flowers. Insects such as leatherwings, bees, and flies feed on chestnut anthers, inadvertently transporting pollen among trees as they fly from chestnut to chestnut. Regardless of the relative importance of each vector – wind or insect – chestnuts can thank both for facilitating their pollination, thereby ensuring the continuation of the species.

The mahogany brown shell, or pericarp, of a chestnut fruit (each fruit usually contains one seed) protects the fragile embryo growing within. The embryo consists of a radicle, which develops into the root, the epicotyl, which develops into the stem, and two cotyledons that provide carbohydrates and nutrients for the developing seedling. A thin seed coat, called a pellicle, provides an additional barrier between the cotyledons and shell. The spiky chestnut bur provides further protection for the encased chestnuts until they reach maturity in the fall, at which point the bur breaks open, revealing one to three chestnuts within.



American chestnut seed.
Drawing by Dr. Fred Paillet

A strong wind or shaking by a wandering squirrel will knock the chestnuts out of their protective burs onto the forest floor. Only a very few of the fallen chestnuts will germinate and grow into seedlings. Most chestnuts will provide a nutritious meal for rodents, birds, bear, deer, etc. The high sugar and low tannin content of chestnuts compared to acorns and other mast crops

Chestnut's Importance for Wildlife

American chestnut is known for producing reliable and abundant nut crops that supported various wildlife species, including black bear, deer, and numerous birds. This assertion is based primarily on historical observation and very little scientific evidence. A paper published in the year 2000 by Diamond et al.,[1] however, aims to substantiate this claim by estimating pre-blight and post-blight hard mast production of chestnut-oak forests in the southern Appalachians. Using chestnut production data from orchards, surviving large American chestnut trees, and estimates from interviews with people who collected chestnuts prior to the blight, the authors estimate that chestnut-oak forests in the southern Appalachians produced an average annual hard mast of 423.7 kg/ha^2, with some years of heavier and some years of lower production. American chestnut produced 64% of the mast, followed by northern red oak (*Quercus rubra*), various other oak species, and finally hickory species (*Carya spp.*). Post-blight oak-hickory forests of the southern Appalachians were estimated to produce an average of 279.8 kg/m^2 of hard mast (34% reduction), with much greater variation in annual production compared to forests with a large chestnut component. Although only indirectly based on scientific data, this study strongly suggests that claims of chestnut's critical importance for wildlife are not simply romanticized stories of a former forest king.

Green metallic wasp on American chestnut catkin. Insects regularly visit chestnut catkins and female flowers, playing a role in pollinating chestnuts.
Photo by Mark Moore

make them sweeter and therefore preferred by wildlife. Some of the chestnuts will be carried by birds and squirrels miles from their mother tree, and a lucky few may be dropped or cached and forgotten about. These and other surviving chestnuts will lie dormant during the cold winter months, patiently waiting for warmer and longer days to signal the beginning of spring.

With the onset of spring comes a flurry of metabolic activity within each surviving chestnut. Once the ground warms to 40° F, carbohydrates, fats, and nutrients stored in the cotyledons start to feed first the radicle and later the shoot. The radicle emerges first, growing down into the soil in search of moisture and nutrients. After the root is well established, the shoot is pushed out through the top of the nut and grows upward, in search of light. Given access to adequate moisture, nutrients, and light, the chestnut will continue growth – both upward, producing leaves to capture energy from the sun, and downward, producing roots and root hairs to provide the stem and leaves with water and nutrients. Throughout its life each chestnut will face many challenges: competition by other seedlings and trees, predation by rodents and deer, desiccation when rain is sparse, and damage from late spring frosts. Many will not survive. Those that do will succeed due to a combination of beneficial genetic traits and good fortune. And a lucky few will benefit from the loving care of chestnut enthusiasts who are passionately devoted to resurrecting this majestic tree.

Leila Pinchot is a Research Fellow at the Pinchot Institute for Conservation, based out of Grey Towers National Historic Site in Milford, PA. Before earning her Ph.D in Natural Resources from The University of Tennessee, Leila worked for two years as TACF's New England Regional Science Coordinator. Her current research focuses on upland hardwood restoration.

[1] Diamond, S.J.; R.H. Giles; R.L. Kirkpatrick; and G.J. Griffin. 2000. Hard mast production before and after the chestnut blight. Southern Journal of Applied Forestry 24(2):196 – 201

Fig. 1. Chestnut seedlings have the ability to manage resources allowing them to survive in adverse conditions of low light and heavy competition so as to be ready to take advantage of improved conditions. This example shows a chestnut sprout that may have originated as a seedling before 1910, and has survived competition from a sugar maple (visible trunk) remaining alive but essentially unchanged due to lack of light required to grow into a dominant forest tree. Photo by Dr. Fred Paillet

Chestnut Ecology and Shade Tolerance

by Dr. Fred Paillet

All trees require light, and chestnuts are no exception. A tree's leaf surfaces are photosynthetic energy sources that enable the tree to grow and prosper in the wild. When referring to light requirements, trees are known as "tolerant," "intermediate," or "intolerant." Tolerant trees are designed to operate best under low light conditions so that they can "tolerate" the shade cast by the forest around them. Intolerant trees do best in full sunlight so as to take maximum advantage of favorable light conditions, but are at a distinct disadvantage when overtopped by competing trees.

So how tolerant is chestnut? Almost all modern sources credit chestnut with intermediate tolerance. The tree is considered to have a tolerance class similar to that of many of our oaks, such as white and northern red oak, and other familiar trees, such as white ash or American elm. Examples of highly tolerant trees include beech, sugar maple, and basswood. Intolerant trees include big-tooth aspen, paper birch, and tulip poplar. An insight into the life history of a typical mid-tolerant tree is given by northern red oak. Studies at the Harvard Forest show red oaks seed into regenerating forests rather early and manage to survive in the understory wherever there is a reasonable amount of light penetrating from above. Young oaks are poised to take advantage of events that provide a brief improvement in light conditions, producing a series of growth spurts until they can achieve a position in the overstory. Thus, an intermediate level of tolerance allows such trees to make an effective compromise concerning the efficiency of energy utilization. They are equipped to slowly accumulate resources in less than optimum lighting and are poised to put those resources to good use when an opportunity arises.

My studies of American chestnut in the few places where it can be seen in the wild suggest our chestnut trees (and probably European chestnut in its Russian homeland) use an intermediate level of tolerance to very effectively infiltrate an established forest. Chestnut does this by using a number of strategies to significantly enhance the natural advantages of the mid-tolerant tree package. This starts with tree architecture. Chestnut adopts a leaning and layered growth form in low light conditions so as to capture as much light as possible

Light utilization in leaves is measured by the amount of oxygen produced. The more oxygen that is measured, the more photosynthesis is taking place. At the low end of the scale is the **compensation level**: the minimum amount of light required to barely meet the leaf's metabolic needs, with nothing left over for growth. At the other end of the scale is the **saturation point**, where the leaf is producing its maximum level of photosynthesis and no additional photosynthesis will occur no matter how much more light falls on the leaf. Tolerant trees have lower compensation levels and lower saturation limits to enhance efficiency at low light levels.

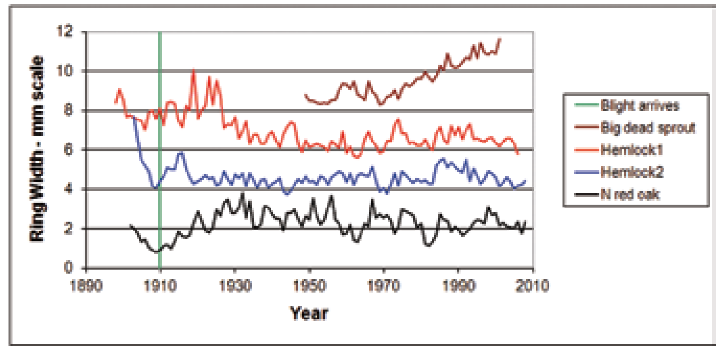


Fig. 2. Tree ring growth chart shows the accelerating growth history of an understory chestnut wending its way into the canopy after a period of suppression when its career was cut short by blight in Connecticut; tree ring series from other trees show spurts of growth produced by the original demise of chestnut trees in this forest. One suppressed stem originated before 1950 and got its chance in 1970 when gypsy moth defoliation opened the overstory. This tree was well on its way to a place in the canopy when felled by blight in 2001.

with the minimum expenditure of resources. Efficient allocation of resources enables chestnut to survive in surprisingly low light and otherwise competitive environments. At the same time, chestnut architecture enables the tree to respond very rapidly to a sudden improvement in light conditions.

A moderate improvement results in the reorganization of chestnut tree structure so that renewed growth occurs by formation of a new vertical leader from the most advantageously positioned branch on the existing trunk. If greatly improved lighting occurs, as in the case of clear-cutting or severe storm, the tree is equipped with pre-formed basal buds that can literally leap into growth capable of out-competing stump sprouts and suppressed seedlings of other species that may be present. In this way, American chestnut takes its status as a mid-tolerant tree species to a whole new level—just another in the long list of amazing attributes of this amazing tree.

Fig. 3. American chestnut has the ability to respond to sudden improvements in light conditions that seems to go beyond anything that other mid-tolerant trees can achieve. Heavily suppressed chestnut saplings adopt a layered and leaning form to maximize limited light. If light improves somewhat as in the removal of an overstory tree (here by road construction), the existing stem responds by developing a new leader that can grow rapidly upward (left). If a more severe disturbance (here logging) provides full lighting, the tree responds by generating entirely new stems from pre-formed buds at the base of the tree (right).

Drawing by Dr. Fred Paillet

References

Joesting, Heather M., Brian C. McCarthy, and Kim Brown. 2008. Determining the shade tolerance of American chestnut morphological and physiological parameters. Forest Ecology and Management, v. 257, no. 1, 260-268. (A 2012 study by Boyd and Craddock extends the findings of Joesting et al. We will feature their report in a future Journal - ed.)

Oliver, C. D. and E. P. Stephens. 1977. Reconstruction of a mixed-species forest in central New England. Ecology, v. 58, 562-572.

Paillet, F. L. 1984. Growth form and ecology of American chestnut sprout clones in northeastern Massachusetts. Torrey Bulletin, v. 111, 316-328.

Paillet, F. L. 2002. American chestnut: the history and ecology of a transformed species. Journal of Biogeography, v. 29, 1517-1530.

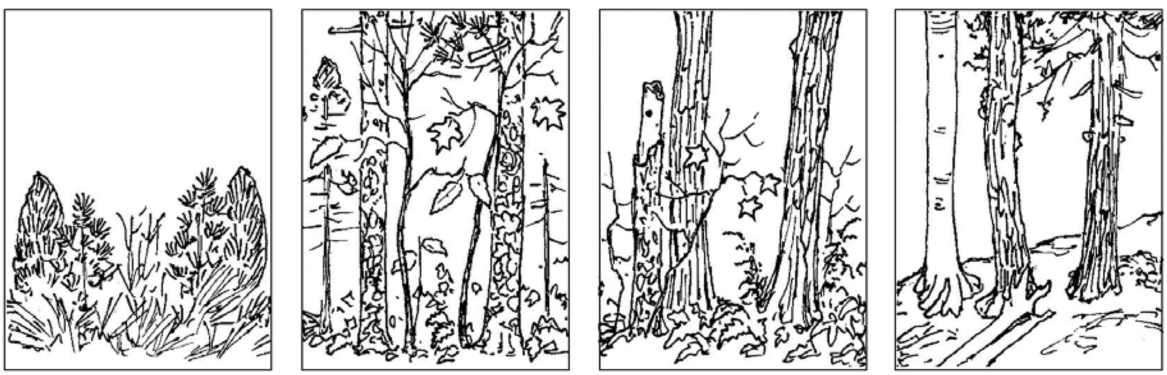
Chestnut and Succession

by Dr. Fred Paillet

The concept of ecological succession is one of the oldest and most established principles in biology. Forest ecologists have long noted there is a regular and predictable series of plant communities that develop on a landscape as it responds to severe disturbance. The traditional model of forest succession is based on observations made during land abandonment at a time when large areas of rural North American landscape were being taken out of agriculture and allowed to return to a natural forest cover. This model usually begins with topography such as abandoned agricultural land. First come grasses, then shrubs develop. Tree species adapted for seeding into former plowed fields or pastures were the next arrivals, and were followed by a series of other species adapted to grow into these early-succession forests. Then shade-tolerant late-succession species would eventually become established and develop into the final climax forest as mid-succession trees completed their life cycle.

Scientists usually consider chestnut a mid-succession tree, establishing itself after early succession trees such as cedar (juniper), pine and big-tooth aspen, but relatively early in the hardwood cycle. This is indicated by the chestnut's relatively large seed, which is more restricted in how far it can spread compared to windblown seeds (see sidebar on pg. 21). Also supporting the mid-succession theory is the tree's moderate shade tolerance, and its unique ability to store energy as an understory tree and put on impressive growth, beating out the competition when a disturbance opens a hole in the canopy.

However, the chestnut's role in forest succession is somewhat uncertain because chestnut disappeared from our forests before the science of forest ecology and the concept of successions were established. We have to glean further insights into chestnut ecology wherever we can, as in the journals of early observers such as Bartram and Thoreau, and from reconstructions of forest history based on fossil pollen.



A B C D

Fig. 1. Forest succession in central Connecticut starting from an abandoned field with red cedar and pitch pine seedlings (A), to mature pitch pine forest with overtopped cedars, thickening understory, and established chestnut and oak saplings (B), to mature chestnut and oak forest as pine deteriorates and a lush ground cover of ferns, herbs, and tolerant tree seedlings develops (C); to death of chestnut and oak by windstorm, and maturity of tolerant trees like beech, maple, and hemlock where dense shade inhibits growth on the forest floor (D). Drawings by Dr. Fred Paillet

More recent ecological thinking has come to recognize that forest ecology is not just simple, unidirectional succession, and this has important implications for chestnut restoration efforts. At any given time, disturbances such as disease, fire, windstorm and human manipulation of the landscape can impact a local section of forest and produce an ever-changing tapestry of opportunities for specific tree species. These events all combine in a statistical sense to determine the composition of both natural and managed forests. Many forest tree species have evolved to fit specific roles in the disturbance cycle. Rather than being a departure from the forest primeval, disturbance events are increasingly being seen as natural agents of forest ecology. The response to disturbance can sometimes be long and complicated. Studies on the evolution of the New England landscape show forests are still responding to the original land clearing events of European settlement and land abandonment in the late 1800s.

Chestnut as an Opportunist: Fire and Secondary Succession

When any ecosystem is significantly disturbed by an event such as fire, windstorm or flood, a secondary succession process begins (Fig. 2).

As an efficient root collar sprouter, suppressed chestnut in the forest understory responds favorably to the elimination of competing overstory trees by a moderate fire. One instructive example of chestnut response to fire disturbance and over-all forest structure is given by

> Scientists usually consider chestnut a mid-succession tree, establishing itself after early succession trees such as cedar (juniper), pine and big-tooth aspen, but relatively early in the hardwood cycle.

study in central Massachusetts. Pollen cores were used to infer the character of chestnut at this location near its northern range limit over the past 10,000 years. The data showed on average, chestnut was about 5% of the

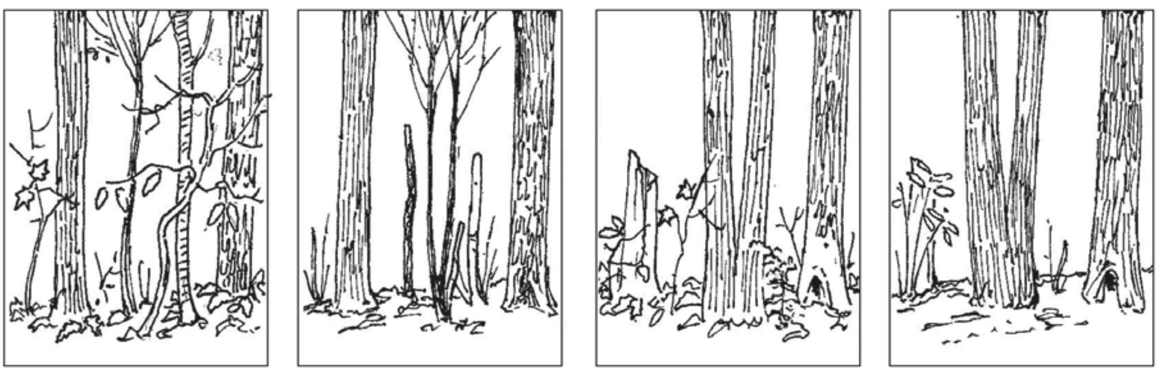


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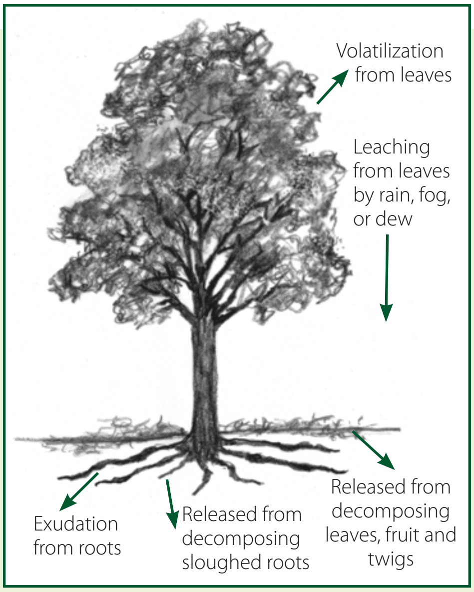
Fig. 2. Effect of repeated fire in amplifying chestnut in Virginia: Chestnut sapling grows under tulip poplar and oak competing with maple and sweet birch (A); fire has killed smaller trees and sprouts from chestnut overtop other sprouts two years later (B); after a century the chestnut sprouts have become large trees and other tree seedlings become established (C); another fire kills tolerant tree seedlings and allows a second generation of chestnut sprouts to become established (D). Drawings by Dr. Fred Paillet

R and K: Two Paths to Species Survival

One insight into succession is the distinction between R and K reproductive strategies. R trees produce multitudes of lightweight seeds that are widely spread by wind, as in the case of cottonwoods and aspen. K trees concentrate seed resources into a few carefully prepared packages. Each such seed is designed to find a specific environment, and often comes with resources that give the new seedling a head start while serving as reward for rodents and birds to carry them to favorable habitats. This idea defines a dichotomy in the tree world between small seeded, widely dispersing trees that seek out disturbed habitats in the early stages of succession, and the large-fruited species that have a found mechanism to get their seeds to a specific niche in an old-growth forest. Chestnut seems to engage in the ultimate K strategy by producing especially desirable seeds with lots of reserve energy for the new seedling, which is then equipped to survive in the understory for an extended period after that.



Allelopathy in Black Walnut

Allelopathy: Does American Chestnut Kill the Competition?

Forest succession can be influenced by allelopathy where leaf litter from a tree discourages the seedlings of potential competitors. Biologists have surmised that trees rarely exhibit their full-growth capacity because they are equipped to divert resources to defenses in a constant state of chemical warfare with their insect and fungal enemies. But trees also use chemistry to influence succession by altering the soil around them. Some trees such as maple simply add nutrients to the leaf litter to tip the scale in favor of their nutrient-demanding seedlings. Others add noxious substances to their falling leaves to discourage competing tree species. Allelopathy has long been identified for two prominent tree species, black walnut and black cherry, and is suspected in a number of others. American chestnut is known for its valuable tannins and at least one study shows that extracts from chestnut leaves can inhibit the germination and growth of some trees and shrubs, which may postpone the invasion of chestnut stands by competing species such as maple and hemlock.

forest, and steadily present in this proportion for the past 3,000 years. However, local soil pollen representing deposition from trees immediately overhead showed a great bulge just above a distinct charcoal horizon, followed by a sharp decline as late succession trees such as hemlock and beech returned to the local scene.

Additional pollen data from this site, dating to pre-chestnut times, indicate the relationship between chestnut and disturbance is complicated, depending on subtle differences in the nature of disturbances such as fire and windstorm, as well as the circumstances that immediately preceded those disturbances.

The whole subject of forest regeneration in eastern North America and its relation to disturbance has come under intense scrutiny because forest ecologists observe that oak-dominated forests are failing to regenerate themselves. In some cases this is called "mesiphication" because stands of oaks are developing understories dominated by the reproduction of mesic (moisture and shade demanding) species such as maple and beech. It also has been seen in older literature as the final stage of forest succession. Various mechanisms have been cited to account for this, such as fire suppression, deer browse, and changing climate. Some trees may even condition the soil beneath them as a way to influence regeneration in their vicinity (see sidebar allelopathy discussion). Chestnut, as yet another nut-producing, mid-succession tree species, will fall into this ecological puzzle. So there may be a lot more to chestnut restoration than just planting blight-resistant trees in the forest – such as anticipating how light conditions, competition, and the natural disturbance regime will influence the ability of chestnut to expand into the surrounding landscape.

Dr. Fred Paillet is semi-retired as Adjunct Professor of Geosciences at the University of Arkansas. He has published several investigations of chestnut ecology as related to the prehistoric forests and climate of New England. His highly detailed sketches of chestnuts have graced many editions of *The Journal*.

References

Foster, David R. and John D. Aber. 2004. Forests in Time – The Environmental Consequences of 1,000 Years of Change in New England. Yale University Press, New Haven.

Foster, David R. and T. M. Zebryk. 1993. Long-term vegetation dynamics and disturbance history in a Tsuga-dominated forest in New England. Ecology, v. 74, 982-998.

Spetich, Martin A., Editor. 2004. Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. U. S. Forest Service General Technical Report SRS-73, 311 p.

Chestnut Ecology and Adaptation

How The Tree Interacts with Its Environment

by Dr. Paul Sisco and Dr. Kim Steiner

Fig. 1. Pure American (left), BC_4 (center), and Chinese (right) chestnut trees in an orchard at Black Mountain, NC. The Chinese chestnut tree leafed out first and was frozen back by a late frost in early April of this year. The American and BC_4 trees leafed out after the frost event and thus were undamaged. This photo was taken in early May before the secondary buds had leafed out on the Chinese chestnut tree.
Photo by Paul Franklin

Years ago, a common magazine advertisement featured body-builder Charles Atlas, who promised that by following his exercise program a skinny boy could develop into a muscular dynamo, thereby impressing all the girls. Muscular development in humans is a great example of **phenotypic plasticity**. With enough hard work in the gym, a person can noticeably change in muscular development and strength.

But if that same muscular dynamo were only 5' 4" tall at maturity, he would have little chance of being a player in the National Basketball Association, no matter how hard he worked. Height at maturity is a great example of **genetic determinism**. Although height at maturity can be somewhat influenced by diet and hormone supplements, for the most part it is set by one's genes at birth.

In the same way, some adaptive traits of chestnut trees are under strong genetic control, determined at the embryo stage, while others are more plastic, capable of change during the life cycle of the tree as its micro and macro environments change. Phenotypic plasticity is especially important in long-lived plants like chestnut trees, because they literally have to sit in one spot and take whatever nature dishes out for hundreds of years. They do not have the option of moving to a new location as conditions change.

We have a good example of genetic determinism in the timing of bud break in TACF's breeding program. The Chinese chestnut trees commonly found in the United States have a bud break date as much as two weeks earlier than that of American chestnut trees, although there are also differences among American chestnut trees from different latitudes and altitudes (provenances). Genetic studies done in the 1990s on four different backcross and F_2 mapping populations from TACF's breeding program revealed that a single locus (single gene, perhaps?) on Chromosome L* resulted in the early bud break seen in the Chinese species, and that this single gene was dominant, causing early bud break in the F_1 trees as well. In subsequent F_2 and BC_1 generations the early bud break segregated as a single, dominant

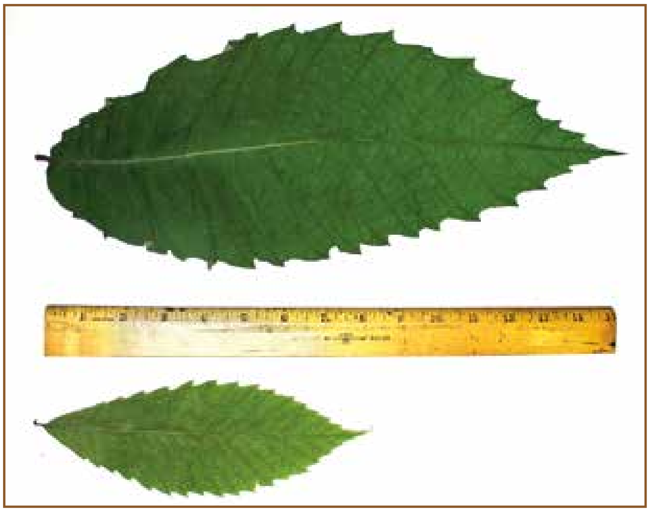


Fig. 2 This extreme example of a shade leaf (top) compared to a sun leaf (bottom) from an American chestnut tree near Asheville, NC, is an excellent example of phenotypic plasticity. The wooden ruler is 15 inches long. Photo by Paul Sisco

gene (Hebard and Sisco, 1999). In years when there is no late frost, the trees with the Chinese gene for early bud break have a longer growing season, but in years when there is a late frost, trees with this particular Chinese gene are at a disadvantage because their leaves get frozen back and they have to wait for a second flush of leaves before resuming growth (Fig. 1).

So how do researchers sort out the effects of genetics vs. the environment on the expression of plant characteristics? This is done by experimentally and statistically comparing the characteristics of multiple "genotypes" when grown together in common gardens across multiple environments. In this context, a genotype is a collection of plants expected to be genetically identical or closely related and different from other, similar collections. The genotypes may be different clones, the offspring of different seed parents, or plants from seeds collected in different natural populations. Natural populations separated by some distance can differ genetically because they likely occupy somewhat different environments and natural selection regimes, and because they consist of individuals that are related through interbreeding and a common ancestry back, typically, for several thousand years. Everyone is familiar with this phenomenon in the human species, whose distantly scattered, indigenous populations can differ strikingly in appearance.

Common garden experiments in which natural populations are compared are called provenance tests. In provenance tests, specimens from different populations of a single tree species from a wide range of environments are planted together, sometimes at more than one site, and a set of adaptive traits is measured over the trees' life span. Provenance tests, especially if repeated in multiple environments, can tell us a great deal about the importance of genetic adaptations to local environments. We would have difficulty doing such a study on American chestnut because of the impact of blight. In Europe, where the blight is less severe, the early results of a common garden study of European chestnut (*Castanea sativa*) were published by Fernández-López et al. (2005). Seeds collected from native** chestnut trees in six contrasting environments in Greece, Italy, and Spain were collected in 2000 and planted in pots in 2001, then transplanted in 2002. Six separate test plots were established, one in each of the six environments, and open-pollinated progenies of 26 trees from each of the six environments were planted at each site in a randomized complete block design, with one tree per plot and 20 blocks. Measurements were taken in 2001, 2002, and 2003 of growth in height during the year, time of bud break in the spring and time of final bud set in the late summer. Growth was related to the timing of bud break and bud set, because trees that budded out earlier and set final buds later had a longer growing season, unless a late frost killed the first flush of leaves.

The most consistent trait across sites was the time of bud break in the spring. Time of bud break in trees is known to be under strong genetic control. In this study, leaves of the trees from the northern populations consistently emerged or "flushed" later in the spring than the leaves of trees from the southern populations, although the exact date of flushing depended on the accumulated degree-days in the spring. In warmer springs the northern populations flushed earlier, but so did the southern populations. The relative timing of bud break between the northern and southern populations was the same in all years regardless of the accumulated degree-days in the spring.

In the European study, as in TACF's breeding program, the time of bud ***break*** in the spring was consistent between any two populations at all sites. However, the six European chestnut populations varied in timing of final bud ***set***, depending on where they were planted. This is an example of **genotype by environment (GxE) interaction** (see sidebar). The authors of the

European study speculated the timing of final bud set was influenced by day length as well as by ambient temperature, and the day length varied from site to site, because the sites were at different latitudes.

An example of phenotypic plasticity in chestnut is the difference between shade and sun leaves on a single chestnut tree (Fig. 2). The sun and shade leaves vary in many ways, not only in size and shape but in chemical composition, physical structure, and degree of hairiness. Both sun and shade leaves on a single tree have exactly the same DNA sequences in their chromosomes. But the expression of the DNA – whether and how the protein products of the DNA are made and utilized in a cell – can vary greatly between different tissues of the same plant. That's why one cell forms a flower and another cell, with exactly the same DNA composition, forms a root. It's also why a shade leaf differs from a sun leaf.

An interesting genetic phenomenon that has become a popular subject in the last 10 years is **epigenetics**, the study of how environment can influence gene expression (Carey, 2012). This has revived a 150-year-old controversy in genetics about whether an acquired trait can be inherited. If a giraffe stretches its neck to reach tall leaves throughout its lifetime, will the giraffe's offspring inherit longer necks? Genetic orthodoxy says "No." The generally accepted theory is that some giraffes are born with longer necks by a chance combination

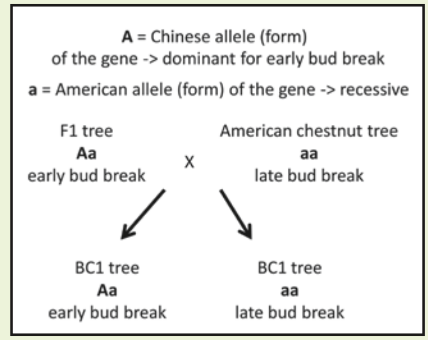
Fig. 3. Five-year-old Chinese chestnut seedlings planted at 1-foot spacing in Rosemont, NJ. This picture was taken one year after inoculation with chestnut blight. The trees' small average diameter (1.3" at 5 years) and unusually high susceptibility to blight have created speculation that stress caused by close planting may have affected the ability to adapt to their environment.
Photo by Sara Fitzsimmons

of genes, and they are the ones most likely to survive to produce offspring. However, some recent studies have shown that although the basic DNA sequence cannot be changed by the environment, the sequence can be chemically modified in certain ways that can be heritable. A common form of chemical modification is cytosine methylation. Cytosine is the "C" in the AGTC alphabet soup that forms the DNA backbone, and its chemical structure can be altered by the addition of a methyl group (CH_3). This can permanently shut down expression of the methylated gene in a particular

Genotype by Environment (GxE) Interaction:
"Race Horses" vs. "Work Horses" in Corn Hybrids

One of the clearest examples of genotype by environment (GxE) interaction comes from the world of corn breeding. Corn hybrids that produce higher-than-average grain yields in optimal environments but lower-than-average yields in stressful environments are nicknamed "race horses." Corn hybrids that are dependable but unspectacular grain producers in either environment are called "work horses." If a farmer fertilizes heavily and uses irrigation, a race horse hybrid should be planted. But a work horse horse may be more dependable in average environments, where the farmer is at the mercy of the weather. The race horse hybrid has a high GxE interaction, whereas the work horse hybrid has a lower GxE interaction. The higher the interaction, the more the environment affects the trait, in this case, grain yield.

Genetic Segregation definition: The words "segregate" and "segregation" have a specialized meaning in genetics. Chestnut trees, like humans, have two copies of each chromosome, so there are two possible forms of each gene. These two forms of a particular gene are called "alleles", such as "A" and "a". When pollen and egg cells form, only one allele is present in each pollen grain or egg. Otherwise, the number of alleles would double each generation. So the two types of alleles "segregate" in the next generation, with the offspring getting one or the other allele. If the Chinese allele for early bud break is "A" and the American allele for late bud break is "a", an F1 tree backcrossed to an American chestnut tree would be Aa x aa. The "A" allele for early bud break would segregate in the BC1 generation, with about half the offspring getting the "A" allele and half the "a" allele from the F1 parent.



organism (tree, person), and sometimes this methylation state can be passed on to the next generation.

How might epigenetics affect TACF's chestnut breeding efforts? We have some preliminary evidence that changes in blight resistance can be caused by stress in a tree's early development. Sara Fitzsimmons, TACF's Northern Appalachian Regional Science Coordinator, planted Chinese chestnut seedlings at very close spacing (1 foot apart) and found that their susceptibility to the blight appeared to increase (Fig. 3). Did the stress of close planting cause a change in the expression of the blight resistance genes, and is this change permanent? Sara is setting up experiments to try to answer these questions.

Genetic determinism, phenotypic plasticity, genotype by environment interaction, and epigenetic changes all are part of the chestnut tree's interaction with the world around it. As a long-lived species, individual chestnut trees need to be somewhat plastic – able to change as the environment changes. But there are limits to phenotypic plasticity, and ultimately it is important that wild trees be genetically well-adapted to the environments in which they grow. Perhaps we can eventually set up common garden studies of American chestnut trees to better understand these things.

Dr. Paul Sisco, a 26-year member of TACF, received his Ph.D. in Plant Breeding and Genetics from Cornell University. Since retiring as TACF's Staff Geneticist and Southern Regional Science Coordinator, he has served as President of the Carolinas Chapter of TACF and a member of TACF's Board of Directors.

Dr. Kim Steiner is Professor of Forest Biology at the School of Forest Resources, Penn State University. He is the Director of the Arboretum at Penn State and Vice Chair of TACF' Science Cabinet.

* Chestnut has 12 chromosome pairs, which were labeled "A" through "L" in a paper by Kubisiak et al. (1997).

**There is controversy about the original range of European chestnut before the Romans started planting chestnuts throughout their Empire as far north as Great Britain. The six populations in this study were considered "native" in that they were wild and had been in place hundreds of years.

References:

Carey, Nessa. 2012. The epigenetics revolution: how modern biology is rewriting our understanding of genetics, disease and inheritance. Columbia University Press, New York. http://www.guardian.co.uk/books/2011/aug/19/epigenetics-revolution-nessa-carey-review

Fernández-López, J., R. Zas, R. Diaz, F. Villani, M. Cherubini, F.A. Aravanopoulos, P.G. Alizoti, G. Eriksson, R. Botta, and M.G. Mellano. 2005. Geographic variability among extreme European wild chestnut populations. Acta Hort. (ISHS) 693:181-186. http://www.actahort.org/books/693/693_21.htm

Hebard, F.V. and P. Sisco. 1999. Meadowview Notes 1998-1999. J. Amer. Chestnut Found. 13(1):7-15. http://www.acf.org/pdfs/resources/journal/journ_vol13-1_99.pdf

Kubisiak, T.L., F.V. Hebard, C.D. Nelson, J. Zhang, R. Bernatzky, H. Huang, S.L. Anagnostakis, and R.L. Doudrick. 1997. Molecular mapping of resistance to blight in an interspecific cross in the genus *Castanea*. Phytopathology 87:751-759. http://www.acffarms.org/papers/reprints/Inheritance%20-%20Molecular%20Mapping%20of%20Resistance%20to%20Chestnut%20Blight,%201997.pdf

The Reintroduction of the American Chestnut

Understanding Chestnut Ecology Will Aid Restoration Efforts

by Dr. Stacy Clark

Successful reintroduction of the American chestnut will require far more than blight resistance. The greatest challenge will be the ability of blight-resistant seedlings to survive and reproduce in a forest that presents both native and non-native threats.

In 2007, the United States Department of Agriculture, Forest Service (USFS), The American Chestnut Foundation (TACF), and The University of Tennessee (UT) began collaborating on chestnut restoration research on national forest land. Over the ensuing years TACF provided material to the USFS for the establishment of eleven field plantings that included 4,596 trees, 2,022 of which were the first potentially blight-resistant seedlings (B_3F_3 generation, Restoration Chestnuts 1.0). (*This represents only one segment of the total forest and progeny testing undertaken by TACF that currently numbers over 10,000 B_3-F_3 seedlings. – Ed*).

We predicted that the most important factors for reforestation success would be the ability of the seedling to: (1) compete with natural rivals like tulip poplar (*Liriodendron tulipifera*), (2) overcome deer browse pressure, and (3) have enough resistance to survive the blight.

At four of the planting sites, chestnuts have had high survival (75 percent) and are growing one foot in height per year. It is still too early to test for blight resistance, but after three growing seasons, we have determined that initial seedling quality is of utmost importance to establishment success. The tallest trees planted are staying above competition and deer browse. These results indicate that the future of restoration will require high-quality seedlings at the time of planting. Competition control using herbicides will also be essential on the sites with dense natural vegetation that can crowd out the planted chestnuts.

At seven planting sites, we discovered other factors that are hampering restoration success. Survival is relatively low (59 percent) in these plantings due to root rot caused by an exotic fungus, *Phytophthora* spp. The future of chestnut restoration in the southern United States, where this pathogen is present, will require that seedlings for planting be grown using soil and water free of the disease fungus (e.g., containers), and planting on sites that do not have the disease (e.g., previously uncultivated land). Other exotic pests affecting seedlings included the Asiatic oak weevil (*Cyrtepistomus castaneus*) and the Asian gall wasp (*Dryocosmus kuriphilus*). These species could have negative impacts on chestnut restoration, and there are currently no adequate control methods for them. Native pests may also take their toll, including cicadas, which severely damaged one planting.

University of Tennessee technician, John Johnson, measures a three year old chestnut in a national forest planting. The chestnut is the same height as the pole.
Photo by Dr. Stacy Clark

In planning for the future of chestnut restoration, an integrated approach will be essential. Success will require a balance among good seedling quality, follow-up competition control, testing for resistance, and forest management practices to control native and non-native pests and pathogens, including blight.

Stacy Clark is a Research Forester with the Southern Research Station in Knoxville, TN. She received her Ph.D. in Plant Science from Oklahoma State University. Her primary research interests are American chestnut restoration, artificial regeneration of oak, and forest succession.

Banana Chestnut Cake

by Alejandra Ramos
From her blog www.alwaysorderdessert.com

Ingredients

1 cup chestnut flour

1/3 cup all-purpose flour

1/2 cup ground walnuts, pecans, or macadamia nuts

1/2 teaspoon baking soda

1 teaspoon kosher salt

1/2 teaspoon freshly ground cardamom

1/2 teaspoon ground allspice

1/3 cup + 1 tablespoon of coconut oil or olive oil

1/2 cup brown sugar

1 large egg, room temperature

1 teaspoon pure vanilla extract

1 tablespoon dark rum (optional)

2 over-ripe bananas, smashed and whisked until smooth and creamy

1/4 cup coconut milk or buttermilk

Confectioner's sugar, for serving

Recipe makes 1 single-layer 9" cake

Directions

Butter and flour a 9" springform pan.

Preheat the oven to 350 degrees.

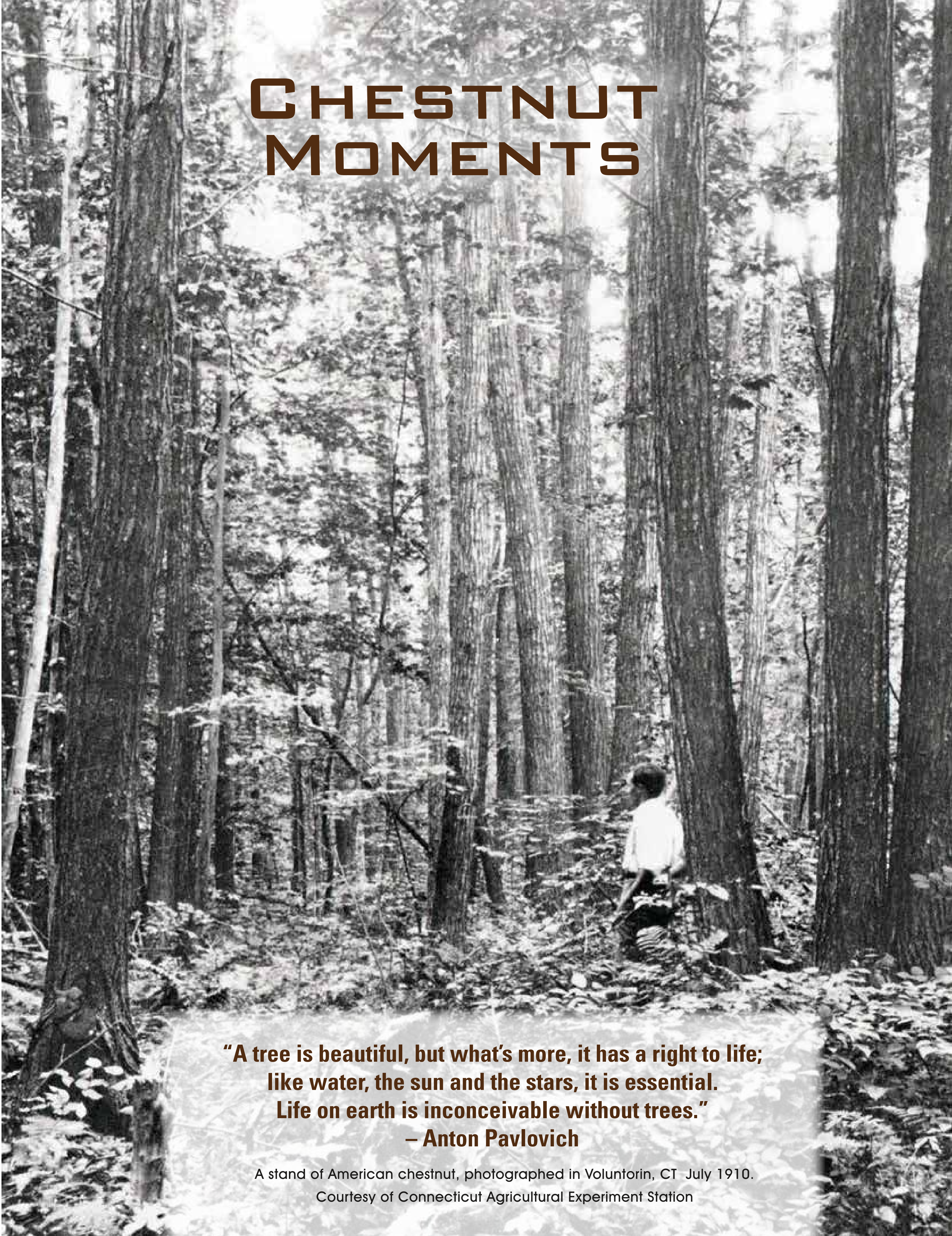
Combine the chestnut flour, all-purpose flour, ground nuts, baking soda, salt, cardamom, and allspice in a large bowl. Whisk until everything is evenly combined. Set aside.

In a separate large bowl, combine the oil and sugar and whisk until well combined. Add the egg, mixing until it is well incorporated. Add the rum, vanilla extract, bananas, and coconut milk until everything is mixed well.

Gently add the flour mixture to the wet ingredients and mix in by hand until it is all incorporated and no dry spots remain. Pour the batter into your prepared pan and bake at 350 degrees for approximately 30 - 40 minutes or until a tester inserted in the center of your cake comes out clean. Let cool in the pan for 5 minutes, then remove the sides and slide cake onto a cooling rack. Let cool completely.

Dust with confectioner's sugar before serving, if desired.

Chestnut Moments



"A tree is beautiful, but what's more, it has a right to life; like water, the sun and the stars, it is essential. Life on earth is inconceivable without trees."
– Anton Pavlovich

A stand of American chestnut, photographed in Voluntorin, CT July 1910.
Courtesy of Connecticut Agricultural Experiment Station

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

A Restoration Chestnut 1.0 growing in a National Forest. The USDA Forest Service and TACF are partnering to restore the American chestnut on public lands.