CONTENTS

FROM THE EDITOR

In this issue of *The Journal* our continuing series *From Then to Now* examines the chestnut's role as a commodity in the marketplace. We're told it was a "cash crop," and research from our contributors shows us quite clearly what that meant.

Ralph Lutts, a member of the faculty at Goddard College, in Plainfield, VT, illustrates in real dollars the value of chestnuts harvested and sold in the Blue Ridge counties of southwestern Virginia between 1900 and 1930. Lutts cites historic records showing millions of pounds of chestnuts marketed in a single year in Virginia, supporting every economic sector along the way, including mountain-dwelling families, shopkeepers, hauling and shipping enterprises, the railroad industry and of course, city street vendors selling the delicious roasted nuts in Philadelphia and New York. Lutts brings the people who thrived, and then suffered so greatly, into the picture for us.

Andrew Owen, a recent graduate of Georgetown University, points out the substantial increase in profitability of chestnut wood subsequent to 1912, when a chemical engineer at the Champion Paper and Fibre Company revolutionized the acid wood industry. The entrepreneurial engineer modified the method of extracting tannin, allowing the chestnut wood to be resold afterward as a by-product for paper pulp production. "What this new method meant to industries and the pulp mill towns was twice the profit," Owen concludes.

Owen's contribution to this issue of *The Journal* is adapted from his senior thesis on the historical complexities of the American chestnut, the blight, and the modernization of North Carolina mountain communities. The level of interest and enthusiasm expressed by this young man is requisite to our goal to restore the American chestnut.

In *Science and Natural History*, Fred Paillet examines archeological indicators of the chestnut's ancestry as a native species, and evidence that it had survived several periods of "biological crisis" prior to the blight. This interesting chronicle of the tree's natural history is exhilarating to those who champion its restoration. Paillet wisely concludes that *Castanea dentata* has already proven itself well worth saving is effortless to accept.

Bill Lord reaffirms that as the single most abundant tree in its native range, the reliable chestnut crop provided more nourishment to forest animals than any other plant. Lord tells us how the tree's near-devastation from blight led to hunger and malnourishment among the creatures of the forest.

Joe Schibig, Clint Neel, Michael Hill, Mark Vance and Jack Torkelson report to us on their development of a database. This research was partly funded by a grant from the National Forest Foundation through The American Chestnut Foundation to Volunteer State Community College.

Marcus Selig, John Seifert, and Doug Jacobs report the results of their research to determine the best means of weed control for chestnut plantations. Controlling competition from weeds will be an important factor in the success of blight-resistant chestnut plantations, they say, and their study has evaluated weed control protocols using pure American chestnuts. Their research was partly funded by TACF's External Grants Program and by our Indiana Chapter.

This issue's offering to *Chestnut Memories* comes from William Banks, of North Carolina, who recalls working at his dad's sawmill as a youth, prior to World War II. He describes his first job at age 13: "...10 cents per day plus room and board, doodling sawdust from dad's mill, which was cutting large chestnut logs." The chestnut was beginning to die from the blight, he says, but was still the major species of production at the sawmill.

And in *Notes*, we offer our newly-revised *TACF Writing Guide* for research papers and narrative articles contributed to TACF for possible publication in *The Journal*. Paul Sisco and Doug Jacobs contributed a great deal of time and expertise helping me develop our new guidelines. My goal is set to high standards for clear and concise writing, to broaden *The Journal*'s appeal to the largest possible audience.

Dale

Dale Kolenberg, Editor
Journal of the American Foundation

from then to now

THE AMERICAN CHESTNUT TRADE IN THE BLUE RIDGE OF SOUTHWESTERN VIRGINIA

Millions of pounds of delicious chestnuts yielded shoes, clothing, schoolbooks and hard cash for Appalachian families.

Adapted from Ralph H. Lutts. 2004. Manna from God: The American Chestnut Trade in Southwestern Virginia. Environmental History 9(3):497-525.

This article focuses on the trade in American chestnuts during the period of 1900-1930 in the five Virginia Blue Ridge counties located southwest of Roanoke: Franklin, Floyd, Patrick, Carroll, and Grayson. Floyd, Carroll, and Grayson counties are part of the core region of Appalachia as defined by John Alexander Williams. (1) The Blue Ridge portions of Franklin and Patrick counties are topographically and culturally similar to the other three. During that time, the economy of this region was based largely on agriculture, although Grayson County also was involved in a timber boom in the first decades of the century.

The Virginia Department of Agriculture estimated in 1914 that 2 million pounds of American chestnuts were harvested statewide. A share of that harvest was shipped by train to Baltimore, Philadelphia and New York, where street vendors roasted and sold the warm, tasty nuts.

For mountain folk, chestnuts were more than a source of food for themselves. The nuts also fattened their hogs, which foraged freely throughout the local forest. In addition, the chestnuts were a source of income. They were sold at the local general store, or exchanged for merchandise or store credit. Each autumn, many children exchanged nuts for shoes, clothes, and schoolbooks.

What did the storekeeper do with all these the nuts? Trying to sell them to local customers was like bringing coals to New Castle. Chestnuts were abundant and free for the taking, so why would anyone pay money for them? Herein lies a tale.

In the southern Appalachian mountains, chestnuts had little or no cash value until it was possible to ship them to areas outside the chestnut's range. The nuts acquired cash value as the transportation system improved.

Southwestern Virginia's Blue Ridge counties depended largely on the railroad to ship theirs, although some surely were shipped by wagons before the railroad arrived. With improvements in transportation, the trade in chestnuts grew

The price that people received for nuts was high when the season began and declined later in the autumn as nuts flooded the market. One Patrick County resident recalled that the stores initially paid 10 cents a pound and the price decreased to two cents as the market filled with nuts. Another recalled the price began as five or six cents, declining to two or three cents. Still another recalled that chestnuts were worth as much by the bushel as corn. A 1909 store accounts book shows that customers received two or three cents per pound at the beginning of October. (2)

Not all people traded their nuts at the local store. Some acted as dealers, hauling their nuts to a railroad station and shipping them to a wholesale house on their own. Others dealt with hucksters, peddlers who accepted chestnuts and other goods in exchange for merchandise.

In southwestern Virginia and elsewhere, when people brought nuts to a store, they had three options for compensation. They could receive cash, exchange them for merchandise, or have the value of the nuts credited to their store account to pay off past or future debts. If they received cash, they were usually paid in cardboard or metal tokens called "due bills," or the amount received was written on a slip of paper called "scrip." These were good only for exchange at the issuing store, so customers actually received store credit, rather than cash. If a store owner has a good reputation for trustworthiness, the store's due bills and scrip might be exchanged in transactions among local people before they were eventually cashed in at the store. In effect, each country store minted its own money. (3)

Once merchants received chestnuts, they had to ship them to a market outside their region. They bagged the nuts in cloth sacks and hauled them to the railroad station. This was not an easy trip. Although roads in the region had improved by the early twentieth century, they were still dirt roads and travel often was difficult. Most Blue Ridge communities did not see a paved road until the arrival of the Blue Ridge Parkway in the 1930s, after the chestnut trade had died. James D. Hopkins, a Patrick County storeowner, would haul two thousand pounds of nuts at a time to the railroad station in his horse-drawn wagon. Alternatively, if a sup-

Not all people traded their nuts at the local store. Some acted as dealers, hauling their nuts to a railroad station and shipping them to a wholesale house on their own. Others dealt with hucksters, peddlers who accepted chestnuts and other goods in exchange for merchandise.

plier brought goods to a store, the merchant might ship the nuts back to town in the supplier's otherwise empty wagon.

The scale of the chestnut trade is difficult to determine. Published accounts differ. The 1914 Virginia Department of Agriculture publication placed the statewide annual value of the nut crop at $200,000. At a return of 10 cents a pound, this amounted to 2,000,000 pounds of nuts. (4) On the other hand, a Virginia Writers Project history of Floyd County placed the value of that county's annual nut harvest alone at $100,000 (1,000,000 pounds). A 1937 University of Virginia economic study of Patrick County stated that "Patrick's chestnut crop, at one time, was a greater source of revenue than cattle." The author did not mention a dollar value, but he did note that after a 20-year decline in the size of the herd, the "7,143 cattle reported in 1930 were valued at $336,260. Dairy products sold totaled $52,164." That was the equivalent of over 520,000 pounds of nuts. (5) The 1914 figure of $200,000 for the annual statewide value of the chestnut harvest may be an underestimate, or more likely the trade grew significantly in the years following 1914.

Country store record books provide much more accurate information, but they are difficult to find, especially day books. Records of hucksters' business and personal shipments are virtually nonexistent. There are, though, other clues. A set of Mayberry General Store shipping receipts from the Southern Express Company provide revealing details of the trade of one business. The store, which is located in the Patrick County Blue Ridge community of Mayberry, near the border of Floyd and Carroll counties, shipped its nuts through Stuart. As Table 1 shows, the store shipped at least 9,156 pounds of nuts in 1914, and another 6,560 pounds in 1915, with a total estimated wholesale value of $872, or about six cents per pound. This store sometimes actually realized nine to eleven cents per pound. (6) Although some nuts went to wholesalers in Richmond and Norfolk, Virginia, most went to Baltimore, Philadelphia, and New York City. The local trade in chestnuts linked even the poorest folks, who seldom if ever used cash, to the national economy despite the often-encountered myth that these mountain people lived in isolation. The roasted chestnuts sold by vendors on the streets of New York, or stuffed into turkeys in urban and suburban areas throughout the northeast, may have been gathered by poor children and adults in the Blue Ridge of southwestern Virginia.

TABLE 1

CHESTNUTS SHIPPED, MAYBERRY GENERAL STORE, PATRICK COUNTY, VIRGINIA

Year	Bags	Pounds	Estimated Value	Destination (Number of Shipments)
1914	229	9,156	$451.00	New York City (7) Baltimore (2) Richmond (2) Norfolk, VA (1)
1915	138	6,560	$421.00	New York City (4) Baltimore (3) Philadelphia (1)
TOTAL	**367**	**15,716**	**$872.00**	

Shipments from Stuart moved on the Danville & Western (D&W) railroad, which reached Patrick County, Virginia, in 1884. The narrow-gauge track began in Danville and extended westward to its terminus in Stuart, the county seat. Affectionately called the "Dick & Willie" by county residents, the D&W was upgraded to standard gauge by 1903. The arrival of the D&W expanded economic opportunities for the county and especially for the chestnut trade. The son of a stationmaster recalled that the best money his father made was from shipping chestnuts. He also was an express agent and earned commissions on the shipments. The nuts were shipped at the higher rate for perishables. "His express commissions," his son recalled, "were just fantastic." His father told him that, "during the harvest time of chestnuts you could hardly find a place to put the bags of chestnuts down, because everyone was a chestnut dealer, just about. They harvested the chestnuts and brought them and shipped them to the big cities." (7)

The chestnut trade was not necessarily small; in some areas it was a large industry. The U.S. Agriculture Census figures for 1910 show that Grayson, Carroll, Patrick, Floyd, and Franklin counties produced 360,384 pounds of nuts (Table 2). This amounted to 43 percent of the entire production of all nuts in Virginia that year. It is quite likely that the trade grew rapidly between 1910 and 1920 to something approaching 500,000 to 1,000,000 pounds a year in Patrick, the most productive of these five counties. It was a boom-and-bust trade that accelerated sharply with the arrival of the railroad and ended just as suddenly with the death of the trees.

TABLE 2

NUT PRODUCTION

	Grayson Co.	Carroll Co.	Patrick Co.	Floyd Co.	Franklin Co.
1900 Misc. Nuts					
Trees	64	310	164	21	333
Bushels	224	305	153	16	216
1910 All Nuts					
Trees	128	5,578	15,423	2,061	13,032
Pounds	5,550	64,931	159,852	48,791	81,260
1930 Nuts					
Bearing Age Trees	Pecans 6	Pecans 3 Walnuts 1	Pecans 8	Chestnuts 35 Other Nuts 15	Pecans 11
Pounds		314	30	260*	

* Includes 170 pounds of chestnuts

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References

1. Williams, J.A. 2002. Appalachia: A History. University of North Carolina Press, Chapel Hill.

2. Josie G. Thomas interview, Patrick County Project, Special Collection, Newman Library, Virginia Polytechnical Institute and State University, Blacksburg, VA. (hereafter cited as "PCP"), Tape 1, Side 2, 154 / 91; Helms interview, PCP, - / 175; Robert Samuel and Sally Slate interview, PCP, Tape 3, Side 1, 200 / 166. (Tape locator numbers on the left indicate location noted in PCP index. The numbers on the right indicate where I found it on my recorder.) Cockram Store Accounts Book: 30 lbs accepted for $0.90 credit, Sept. 30, 1909; 64 lbs accepted for $1.28 credit, 2 October 1909, Patrick County Historical Society, Stuart, VA.

3. See Joseph E. Morse, Virginia's Country Stores: A Quiet Passing (Manassas, VA: E. M. Press, 1996), 13-25, photo of due bills on 14. See Eliot Wigginton and Margie Bennett, eds., "The General Store," Foxfire 9 (New York: Doubleday / Anchor, 1986), 83-206.

4. Ten cents per pound is a rough estimate of the resale value of the nuts to the general store owner before the costs of shipping and the wholesaler's commission are deducted. (See note 6 for the source of this figure.) My intention is to use a somewhat high resale value to generate a conservative estimate of the quantity of nuts traded.

5. Gravatt, "The Chestnut Blight in Virginia" (Virginia Department of Agriculture and Immigration: January 1, 1914), 13; Gertrude Blair, "Brief History of Floyd County," Virginia Writer's Project, typescript, Montgomery-Floyd Regional Library, Floyd, VA, 5 ; Maynard Calvin Conner and William K. Bing, An Economic and Social Survey of Patrick County, University of Virginia Record Extension Series, 11 (January 1937): 69, 66. Butter accounted for most of the dairy products sold.

6. Southern Express Company shipping receipts (bills of lading) for chestnuts from Mayberry General Store, courtesy of Coy Lee Yeatts and Dale Yeatts, Meadows of Dan, VA. These records recently were transferred to the Albert and Shirley Small Special Collections Library, University of Virginia, Charlottesville, Va. The Yeatts operate the Mayberry Trading Post, Patrick County, VA, successor of Mayberry General Store. Note that these are loose receipts found in a drawer and the gaps in shipping dates suggest that this may be an incomplete record of shipments. The value shown on the receipts represent the estimated resale income to the store. Statements from a New York wholesaler, Parker & Allison, indicate that eight bags sold for a total of $36.16 and nine bags for $34.50. With an average weight per

A 1937 University of Virginia economic study of Patrick County stated that "Patrick's chestnut crop, at one time, was a greater source of revenue than cattle."

bag in 1914 and 1915 (see Table 1) of 42.8 lbs., the merchant received about $0.11 and $0.09 per pound, respectively. (After the expense of shipping and commissions were deducted, Mayberry General Store received $27.92 and $21.83, or.$0.08 and $0.06 per lb. for these shipments.) Statements from Park & Allison Wholesale Commission Merchants dated 9 October and 28 October, Mayberry General Store, courtesy of Coy Lee and Dale Yeatts, Meadows of Dan, VA. No year was noted, but these lots correspond with the store's shipments of 20 September and 21 October 1915. A 1907 letter from a Philadelphia wholesaler to a resident of Pennick, VA, complained of the failing crop in the northeast and promises $11.00- $15.00 per bushel of chestnuts. E. R. Redfield & Co. to J. S. Elliott, 30 September 1907, Bedford County Historical Society Museum, Bedford, VA.

7. History of Patrick County, Virginia (Stuart, VA: Patrick County Historical Society, 1999), 359 (note the photo of the wagons at the railroad station on the same page); "Railroads in Patrick County," in Patrick County, Virginia, Heritage Book, Vol. 1: 1791- 1999 (Patrick County Heritage Book Committee, n.d.), 4-6. Store customer accounts books from the late nineteenth century, including one from Mayberry General Store, do not indicate the presence of a trade in chestnuts. W. Curtis Carter interview, PCP, Tape 1, Side 1, 436 / 329; Carter, statement made at Reynolds Homestead Continuing Education Center, Patrick Co., 13 May 2003.

AMERICAN CHESTNUT: WASTE NOTHING — SELL THE SAME WOOD TWICE

by Andrew Owen, adapted from a senior thesis, *Blight on the Blue Ridge: Western North Carolina and the Myths of the Chestnut Blight*, Georgetown Univ., May 15, 2004

To extract tannin from acid wood, prior to 1912, the wood was ground almost into a powder to maximize the extraction process, and then discarded. A chemical engineer at the Champion Paper and Fibre Company plant in Haywood County, NC, however, revolutionized the acid wood industry when he devised an improved chipping method that instead thinly shaved the wood, so that the chips could be used first for…acid extraction and then, as a by-product for paper pulp production. What this new method meant to industries and the pulp mill towns was twice the profit.

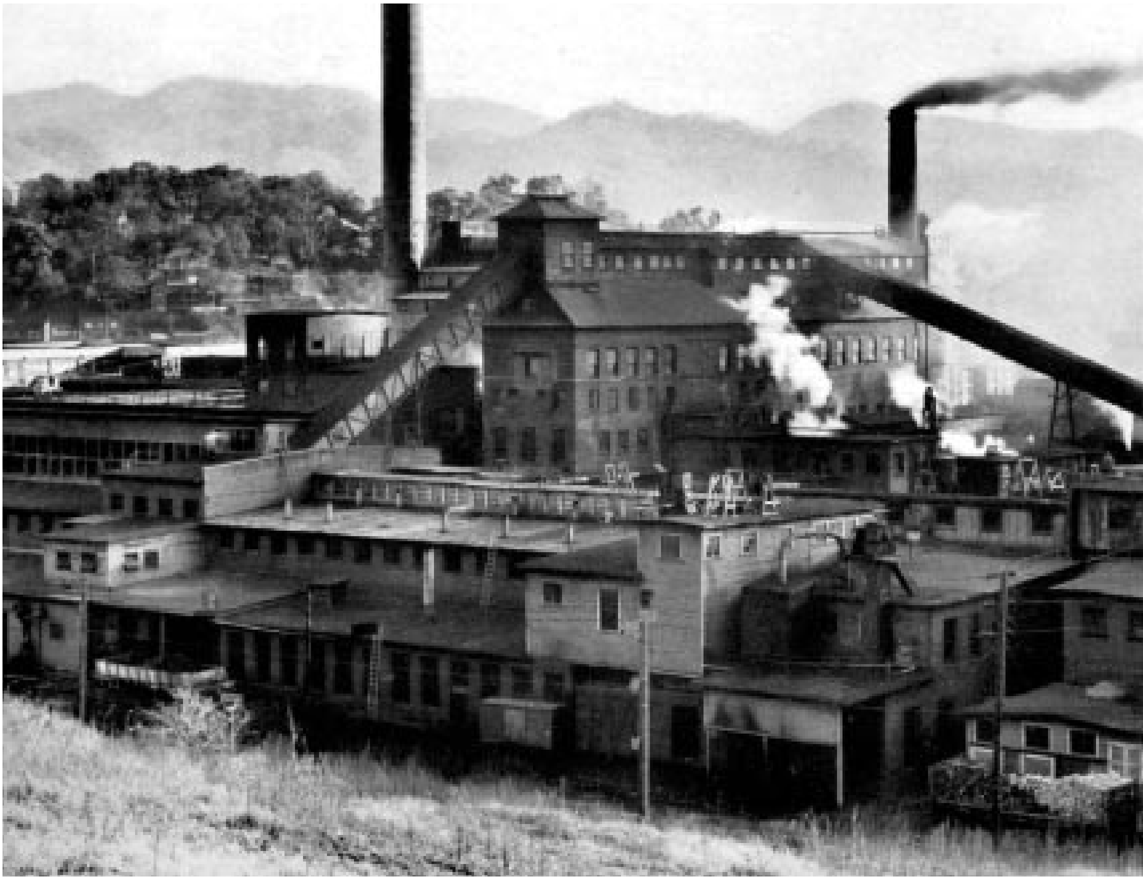
Employees at the Champion Paper and Fibre Company called it "double dipping."(1) Double dipping meant not only that the wood was used twice but that industries equipped with extract and pulp facilities, like Champion, were making twice the profit. The cost of harvesting the chestnut tannin paid for itself when the acid extract left the plants in either liquid or powder form. But when chestnut went into paper supply, industries were able to waste nothing and sell the same wood twice.

When a new paperboard factory opened up in 1928 in Jackson County, NC, the pulp supply didn't come from a lumber company but from the extract plant, where chestnut chips were shipped by train to the new paper mill. *The Jackson County Journal* knew what the development of a paperboard factory meant for chestnut timber owners in 1928: "…in addition it will furnish continuous market to the farmers for their chestnut wood, throughout this section of North Carolina as the new mill will utilize as a valuable byproduct, the chestnut chips from the extract plant, that have heretofore been burned after the tannic acid had been extracted from them." (2) In this instance, where the extract plant and the pulp mill were separately owned, two different companies and two different sets of

"What this new method meant to industries and the pulp mill towns was twice the profit."

"…when chestnut went into paper supply, industries were able to waste nothing and sell the same wood twice."

PHOTO: FROM THE STORY OF CHESTNUT EXTRACT, COPYRIGHT 1937, THE CHAMPION PAPER AND FIBRE COMPANY



Part of the Champion Paper and Fibre Company complex in Canton, Haywood County, NC, circa 1936. The chestnut extract plant, the low building in the foreground, was torn down in the 1950's. A chute from the extract plant (at left in the photo) transported American chestnut wood chips, from which the tannic acid had been extracted, up to the tall, slender digester building at center. The chestnut chips were combined with softwood chips carried up the chute on the right, to create the proper mixture of pulp for paper-making. The digester building and smokestack are still standing. From The Story of Chestnut Extract, copyright 1937, The Champion Paper and Fibre Company.

employees made profit on one item. Doubling up on the chestnut spread community wealth over a larger population.

Although chestnut was too soft to be a choice wood for lumber, its acid content made it highly rot-resistant and therefore a durable wood for fence rails, fence posts, roof shingles, cabin siding, or anything outside exposed to rotting. And because chestnut trees grew tall and straight, chestnut timber was the premier wood used for telephone poles, providing an additional market for the chestnut.

The Ruralite from 1926 reported the growth of the chestnut pole industry as one of nearly no consequence a few decades earlier, to an industry shipping roughly 70,000 poles, principally from Jackson, Swain, Macon, and Haywood counties, annually. One purchaser of chestnut poles claimed in the article that in the past 30 years his company alone had bought near a million poles, many from landowners, at an average price of one dollar and a half.

Full grown chestnuts exceeded the proper dimensions needed for poles, but younger trees less than three feet in diameter worked perfectly. These poles in turn were sold to big electric and telephone companies. Jack Grist, in an interview from 1980 with the Foxfire Group, remembered the summer of 1924, when the Georgia Power Company put in a request at his father's mountain store for 1,500 poles, all 25 feet in length, paying a dollar each. In order to get the job done as quickly as possible, Grist's father "put everybody he could find with a crosscut saw to work" numbering somewhere around "a hundredsome." (3)

If mountain farmers were ever concerned about how to turn their labor into cash, working for wages on timber operations or for local manufacturers was a strong answer. But employment was often sporadic, especially with timber companies, and so most mountain residents typically didn't give up their farms. Working for an hourly wage during the slack farming seasons became a part of the seasonal cycle for many farmers. Manufacturers tried to account for this cyclical flux of labor by setting up benefits and incentives for employees who stayed on year round.

At the Champion Paper Company in Haywood, consistent employees received the "old age bonus" of a pay increase of five percent every five years, up to 25 years. Commenting on the tactic, president of the company Reuben Robertson said, "it added quite a few dollars to the payroll, but it gave us a stability of employment that was extremely valuable to us…and we were spared the expense of re-educating skilled workers every few months." (4)

"Doubling up on the chestnut spread community wealth over a larger population."

Workers at pulp mills were more fortunate than many manufacturing employees during the Depression because demand for paper and pulp products remained constant. In fact, in Haywood County at the Champion Fibre Company in 1932, the company constructed a $1,500,000 addition to its paper plant, which raised the employment level and assured a future market for farmer's pulpwood.

Commenting on the relationship between the farmer and Champion, Robertson said in a news interview from 1932, "Our present plan is to buy our main pulpwood supply from farmers who have small holdings. It gives them a good market, not only for their trees but for the labor of felling them and hauling them to our plant." (5)

1. Wayne Carson, personal interview, 10 January 2004.
2. "Wheels At Paperboard Plant Will Begin To turn July 2nd ," *Jackson County Journal* [Sylva, NC] 28 June 1928.
3. Rice, G., A. McCoy, T. Webb, C. Bond, and V. Speed. 1980. Memories of the American chestnut. pp 397–421 In E. Wigginton (ed). Foxfire 6. Garden City, NY: Anchor Press / Doubleday.
4. Reuben Robertson, interview with Elwood Maunder, *Forest History Society*, 15 February 1959.
5. "Noted Raleigh Editor Praises Fibre Company," *The Ruralite* [Sylva, NC] 20 September 1932.

Andrew Owen was born, raised, and currently lives in Albemarle County, Virginia, just outside of Charlottesville. He attended Georgetown University on a lacrosse scholarship and graduated with a bachelors degree in American Studies.

"The turning point of my studies was reading Changes in the Land *by William Cronon, where I was introduced to a new dimension of historical scholarship: environmental/ecological history. Following Cronon, I chose to write my undergraduate thesis in a similar vein, but about a more familiar region: the Blue Ridge Mountains. The historical complexities of the American Chestnut, the blight, and the modernization of North Carolina mountain communities proved to be a dynamic and fascinating topic. I am very thankful to TACF for all of their help and cooperation in my research, especially Dr. Paul Sisco, of TACF."*

m e m o r i e s

MY LIFE WITH THE CHESTNUT

By William A. Banks

Dedicated to my grandchildren, Michael Watson II, Lyndsay Watson, and Mitchell Banks. Their lives, like ours, have been somewhat affected by the chestnut.

When I was born, in 1924, the mountain tops, ridges and valleys of the Appalachian Range from Maine to northern Alabama were adorned with the chestnut. These magnificent trees grew on the slopes of every point of the compass. In the early spring, they led the forests in the surge of brilliant green to confirm the demise of winter. My home in Burnsville, NC is near midpoint north and south of the Appalachians and is very mountainous; so it provided us this display year after year.

In late spring, their fuzzy bloom added a tinge of color to the green background that reminded one a bit of fall. But in the fall — *oh, in the fall* — the whole area burst forth in blazing golden color, with tan burs opening wide to reveal those delicious brown nuts that began to drop to the ground.

My first memories of the chestnut emerge in my pre-grade schooldays. My parents, William Kerl and Julia Allen Banks, bought their flour and meal for family food in 25-pound cloth sacks. In the fall, after chestnuts had fallen to the ground and "sweetened" for a while, we would go up the ridge behind the house and gather the nuts in these sacks. It was not uncommon to come home with more than one sack full each time we made a trip.

My dad was in the lumber business during my early youth, operating small sawmills, known as "ground mills" in our local area. The mills would be moved from cove to cove and the logs cut in the woods and skidded to the mill with horses. Always the predominant species he manufactured was chestnut, so it became involved in my first job. At about age 13, dad had a mill in the valley that is now the watershed for the town of Mars Hill, NC near Asheville. This valley had the most prolific growth of chestnut I have ever seen. In the fall people would come into the valley pulling a sled with a single horse and take out sled loads of sacks filled with chestnuts for personal use and to sell on the commercial market.

Mom loved to have a garden and always wanted me to help her with it in summer, when school was out. I hated gardening. So I went with dad to the sawmill that summer and took my first job, at 10 cents per day plus room and board, doodling sawdust from dad's mill, which was cutting large chestnut logs. "Doodling" was a term used for shoveling the sawdust from beneath the saw into a wheelbarrow, rolling it away from the mill and dumping it into a pile on the ground. Hard work, but it was better than gardening.

Ensuing years previous to World War II found me mostly working with dad at the sawmill. The chestnut was beginning to die from the blight in our area, but it was still the major specie of production.

Dad had a mill near the top of the mountain immediately west of our present family-owned Mountain Aire Country Club, near Burnsville, NC. There was no truck road to the mill, so a "flume line" (much like a bobsled run) was built from the mill about a mile down the mountain to move the lumber down to load on trucks. The flume line was then filled with water from a nearby stream and the lumber floated down the line to the end. Raymond Robinson, a dear friend, worked at that mill along with myself and several others. Raymond and I were the only ones crazy enough to do so, but frequently at the end on the day, we would each pick out a wide chestnut board and ride it sled-like down the flume line. It was a wild ride and when you came off at the lower end, you had better be running hard or you ended up turning somersaults across the landing area.

William Banks worked in his dad's lumber business. "Ensuing years previous to World War II found me mostly working with dad at the sawmill. The chestnut was beginning to die from the blight in our area, but it was still the major species of production."

By the time I volunteered in the Army Air Corps in the early 1940's, the chestnut blight had really taken its toll in our area. Hillsides that had hosted chestnut in the green of spring and the gold of fall were now covered with huge gray skeletons, bleakly outlined against the slopes. Quite often, as we sat on our porch in the cool of the evening, we could hear a heart rendering "thud" and know that another giant had severed its final root connection to Mother Earth and assumed a prone position. This process continued until there were no skeletons left standing.

I followed my father's footsteps after I returned from World War II and entered the hardwood lumber manufacturing business, primarily serving the furniture industry. It is a competitive business with up and down markets, but also very gratifying and harbors a fine group of individuals. I felt the need to not just be a "run of the mill" mill and embarked upon a plan to set us apart from the ordinary.

The dead chestnut skeletons on the southern and western slopes could not defy the tendency of wood to deteriorate if it goes frequently from wet to dry; they were rapidly rotting away. As I entered the lumber business, these chestnuts were being removed and used as "acid wood" in the leather tanning process. It was a labor-intensive process and created very little net return to those who did the work. The chestnuts lying on the northern and eastern slopes had become covered with moss. They maintained a constant moisture content and many of them still contained sound wood. With this knowledge, we thus embarked on our plan to introduce wormy chestnut as a specialty wood to once again produce fine cabinetry, picture frames, mill work, and wall paneling. We immediately doubled the raw price of the wood and sent crews through the mountains searching for chestnuts "sogs" as we called them. It was much like prospecting for minerals, but produced many years of activity for our people and helped jump start our own career. During those years, we were among the top three wormy chestnut producers in the world. In addition to bringing chestnut to many who might have never known it, the upbringing and education of our children were anchored on this activity.

Because of its versatility, the loss of chestnut was the greatest tragedy that ever occurred in the Appalachian Range. It grew rapidly on all slopes, fed animals and people, was strong enough for wagon axles or personal homes and barns, durable enough for fence rails, soft and colorful enough for the finest cabinetry, paneling, molding and furniture — the list goes on and on. As I watched its demise with dismay in my early life, it created a mental image of the delicacy of our forests that has never faded. That image is as bright today as it was in my youth. And it grows year by year, as I see sprouts of chestnut spring from an old stump, only to grow a few years and then die.

Hillsides that had hosted chestnut in the green of spring and the gold of fall were now covered with huge gray skeletons, bleakly outlined against the slopes. Quite often, as we sat on our porch in the cool of the evening, we could hear a heart rendering "thud" and know that another giant had severed its final root connection to Mother Earth and assumed a prone position.

science and natural history

CHESTNUT IN TIME — THE *REALLY* LONG VIEW

How old is the chestnut, and what has it previously survived?

By Frederick L. Paillet

While focusing on the current problem of restoring American chestnut to modern forests, it is easy to forget that this species has a long history, much of which is completely hidden from our knowledge. In particular, changes in climate are a continuing process acting all over the globe and at virtually all time scales, and these must have affected the fate of all plant species including chestnut. In the classic landmark book *The Eastern Deciduous Forest*, Lucy Braun (1950) expressed the former consensus that the Ice Age glaciers had minimal effect on most forests. This idea stressed that the ice sheets expanded a few times at high latitudes. But these "isolated" events of unknown cause only affected the polar regions. Things went on as usual everywhere more than a few miles south of the ice front. We now know that this theory was about as wrong as a theory can be.

Braun's theory unraveled in dramatic fashion when ocean floor drilling provided samples of the sediments that have been slowly settling to the bottom of ocean basins for millions of years. For the first time earth scientists had a continuous and complete record of the earth's environment at their disposal. The cycles in these sediments showed for certain that the Ice Ages exactly followed the rhythmic changes in the shape of the earth's solar orbit (degree of ellipticity and angle of tilt of the axis of rotation). These "orbital parameters" vary continuously over 20,000 to 100,000 year cycles corresponding to a regular and repeating oscillation of climate. The significance of this observation is hard to over-emphasize. The results showed that global climate has been changing continuously, and that there were at least 20 (and possibly hundreds) of separate glacial-interglacial cycles superimposed on an over-all cooling trend. According to Lucy Braun, the great diversity in our Appalachian deciduous forests was derived from the long-term stability of those forests over immense time periods – a theory similar to the old theories of tropical diversity. The new theory (Levin, 2000) suggests that diversity is caused by climate change forcing species to move around on the landscape, pro-

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viding frequent opportunities for pockets of disjunct populations to diversify into new species (allopatric speciation). So the slow progress of botanical science has quietly been turned on its head by the latest advances in geoscience.

Exactly how old is chestnut? The oldest records of chestnut go back to 87 million years ago (Willis and McElwain, 2002), and chestnut becomes frequent in the fossil record after 55 million years ago (Graham, 1999). So chestnut appears to have originated at or soon after the time when the flowering plants (angiosperms) began to dominate the world, but well after the first appearance of flowering plants at least 100 million years earlier. There are several periods of "biological crisis" where major episodes of extinction are noted. The last of these (65 million years ago) involves the demise of the dinosaurs and is attributed to a giant, high-speed meteor impact in Yucatan. Chestnut and many other broad-leaved trees made it through the crisis – but it may not have been easy. Studies of that event as recorded in coal deposits in New Mexico show that there was a period of about 10 thousand years over which nothing but ferns grew in the area (Wolfe and Upchurch, 1986). After that, trees began to return. In no time at all, (maybe a few million years) a new diverse forest took control of the landscape.

The other major environmental change affecting ancestral chestnut is the slight increase, and then drastic decrease, in global average temperature over the past 100 million years. Geologists cite climate reconstructions to develop the concept of the *Arcto-Tertiary Forest* (Wolfe, 1987). In a warmer world where all the continents (Asia, Europe, and North America) were connected, the far northern parts of these lands may have had a single uniform forest. When the earth cooled and dried, these northern forests were forced south to mid latitudes. This explains the similarity of forests in certain core refuge areas of cool climate and abundant rainfall — such as the Appalachians, western Caucasus, and southeastern China. We now believe that the uniformity of that ancient forest is an artifact of our limited data. There were probably several different varieties of chestnut then as there are now. But the migration of all ecological environments under the influence of climate must have been a significant factor in the evolution of all deciduous tree species.

The last two million years of earth history are known as the Ice Age because of the repeated advance and retreat of the great Pleistocene glac-

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iers. The trend in cooling climate has allowed great ice sheets to develop in the northern hemisphere whenever radiation conditions (the earth orbit business) are suitable. The best information comes from oxygen isotopes in ocean sediments. Evaporation is biased towards light oxygen, so that ice sheets "lock up" these light isotopes. In the long past, the isotope signal depends on chemistry, temperature, and ice volume in a complicated way. But for the past million years the isotope record can be calibrated in global ice volume (Shakelton, 1987). The data show unambiguously that there have been about 20 major periods of continental ice sheets since the "official" start of the Pleistocene era about 2 million years ago.

The high ice volume points on Shakelton's isotope curve represent times when Connecticut was a frozen wasteland covered with more than a mile of ice. Compare this image to the modern Constitution state with its diverse deciduous forest and ideal climate for chestnut. Or consider Florida. At the height of the last glaciation, southern Florida was a land of sparse scrub oak and sand dunes in comparison with the modern cypress swamps and semi-tropical hardwoods —explaining the disjunct occurrence of desert tortoises and scrub jays in the Sunshine State today. Such mental exercises give a rough idea of the extremes of climate change and the extent of range migration that trees like chestnut must be prepared to cope with.

One direct product of Pleistocene glacial periods is the extinction of many familiar tree species in northwest Europe (Germany and France). Because the Alps form a great barrier to tree migration, the periodic transformation of this area to arctic steppe during cold times exterminated native trees, and the alpine barrier prevented their return when climate became warm. We can get a glimpse of the ancient European forests at fossil sites in France (Leroy and Roiron, 1996) and Italy (Magri, 1999). Ongoing volcanic activity dammed gorges and created deep crater lakes, trapping leaves and pollen at the start of the Pleistocene, about two million years ago. These fossil data show a flora that would be familiar to any Appalachian resident: oak, chestnut, hemlock, black gum, hickory, sweetgum, and bald cypress. Some species, such as bald cypress and hemlock, disappeared fairly quickly, while a few, like hackberry, held on for some time. Chestnut seems to have gone out with most of the other major extinctions somewhere around 1.5 million years ago — at least on the north side of the Alps. There are still those who think that "European"

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chestnut held out in refugia in Spain and the Balkans, while others are convinced that chestnut was re-introduced to Europe from the Caucasus area by the early Greeks or Romans.

Thus we have dramatic indications that our constantly fluctuating global climate can have a real effect on the survival of tree species. In the case of American chestnut, this is an interesting question because the species is adapted for well-drained, “light” (sandy) soils on mountainous terrain. During the height of the last glacial period most of chestnut’s historic habitat in America was unavailable. Potential habitat was probably restricted to a thin strip along the lower Atlantic and Gulf coasts. Considering the generally drier climate of the glacial periods and the scarcity of suitable soils within the restricted range, it may have been a close thing that we now have chestnut at all. My best guess is that real chestnut habitat during these times was restricted to ravines in the bluffs along major drainages such as the Apalachicola in the Florida Panhandle. Who knows what effect this has on the current genetic variability of the species. Theoretical models of the expansion of tree species out of such refugia show that long-distance seed transport to form outlying colonies facilitates migration. Modern genetic structure in tree populations seems to reflect this in that studies show a mosaic of genetic enclaves derived from these original outliers in tulip poplar in North America and durmast oak in Europe (Levin, 2000).

Most of the information we do have about prehistoric American chestnut comes from the very end of the Pleistocene. Chestnut began to migrate northward as climate warmed during the past 12,000 years. But the advance of chestnut into the northeastern quarter of its range was very slow. Chestnut was probably part of the Holocene forest of the southern Appalachians as soon as other species — oak, beech, maple, and hickory — became established. North of New Jersey, chestnut did not become a major part of the forest until after 3,000 years ago (Davis 1969; Whitehead, 1980). Although the presence of chestnut before then has been questioned, many of us (Foster and Aber, 2004) now accept that chestnut was actually present in New England as long as 8,000 years ago in small quantities. Then something happened to make chestnut come to prominence at a time too early to be related to aboriginal agriculture. The one consistent clue is that the pollen production of spruce begins to rise at exactly the same time that chestnut pollen literally explodes. The late-Holocene increase in spruce is routinely credited to “climatic deterioration” — in other words, slightly cooler and slightly wetter (Davis et al, 1980). I am guessing that the cooler and wetter climate allowed chestnut to “climb down” from enclaves in mountain valleys to inhabit the much more extensive coastal plains in Connecticut and Massachusetts. But that’s just my opinion. Whatever the cause, ecologists note that the presence of chestnut as a major actor in the landscape completely altered the trajectory of stand development following disturbance (Foster and Zybryk, 1993). That leaves two other prominent markers in the chestnut record: an abrupt increase in chestnut pollen soon after settlement related to early land use practices, and the abrupt disappearance of chestnut pollen after the introduction of blight (Brugham, 1978).

“ I am guessing that the cooler and wetter climate allowed chestnut to “climb down” from enclaves in mountain valleys to inhabit the much more extensive coastal plains in Connecticut and Massachusetts. But that’s just my opinion.”

One of the unfortunate facts of American geology is that there are almost no pollen or macrofossil data from earlier interglacial periods. One suspects that chestnut was slow to migrate after all previous glacial episodes. It would be nice to know for sure that this happened for a real reason and was not just a fluke. Studies such as those of (Combourieu-Nebout, 1993) show that European forests sometimes follow very repeatable cycles every time that climate changes. The pollen series from each climate cycle are remarkably consistent, showing a repeatable succession from pine to oak to hornbeam to fir to spruce and then back to pine. This repeatability is driven by a cyclic climate, going from cool and dry as the glaciers retreat through a warm and wet “optimum” and then into a wet and cool phase as glaciers begin to advance again. Unfortunately, no such set of data exists for this side of the Atlantic. When and if we do find such a data set for eastern North America, we will know how many of the details we see in pollen profiles are just the luck of the draw, and which are the faithful response of tree species to climate-forcing events it has “learned” to accommodate. And we will know for certain which parts of the cycle are artifacts of the effects of aboriginal people on the landscape.

My working hypothesis is that chestnut is naturally adapted for moist climates and well-leached soils, and finds the last third of the interglacial period most congenial. The only problem is finding a way to survive the rest of the cycle! I am betting that there are certain as-yet-unidentified chestnut traits honed to deal with that part of the climate regime. Thus, it would certainly be a shame to write *Castanea dentata* off now, after that species has survived so many previous life-threatening crises.

Fred Paillet is a frequent contributor to The Journal. He has offred us his perspective on many aspects of chestnut science, history and ecology, and has written about his own research on European chestnuts growing in the Caucasus region of Russia. He is retired from the US Department of Interior Geological Survey, and now teaches at the University of Maine.

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WILDLIFE FOOD

The pre-blight chestnut and the post-blight acorn

By William Lord

By two paramount standards the American chestnut, prior to the blight, was the most important wildlife food source throughout its range in the forests of eastern America. It was the single most abundant tree and its plentiful, reliable nut crop provided more nourishment than any other member of the plant kingdom.

The trees that replaced the chestnut varied north to south; in New England, the sugar maple, and the northern red and the chestnut oak; in Pennsylvania the red maple, black cherry, chestnut oak and hickories. Oaks and hickories dominated in the south (Johnson, 1995). Of these trees only oak acorns provide nourishment to sustain wildlife through the food scarcity of winter.

Wildlife biology did not become a university-trained profession until the 1930's. Therefore our knowledge of how wildlife fared in pre-blight times lacks the organized data of our present day. However, we have the

The American chestnut was an important wildlife food source throughout its natural range.

acute observations of writers like Henry David Thoreau. He described "chestnutting in mid winter," finding "thirty or forty nuts in a pile left in its gallery just under the leaves by the common wood mouse," and, "…one February, as much as a peck of chestnuts in different parcels within a short distance of one another, under the leaves, placed there….by the striped squirrel…" (Thoreau, 1993).

Moist and protected beneath a cover of dead leaves, chestnuts remained "fresh" and viable until they germinated in spring. As such they provided winter sustenance for deer, rabbit, bear, raccoon, wild boar, squirrels, mice, wood rat, turkey, grouse, crow and jay.

How well has the acorn crop sustained wildlife since the demise of the chestnut? Obviously not as well. The chestnut was noted for the abundance and reliability of its fall harvest. Oaks flower in spring and killing frosts frequently null an acorn crop. The chestnut flowers in June to early July when killing frosts seldom occur.

Oaks of the white oak group [including post and chestnut oaks] produce acorns annually. Oaks of the red oak group [including black, pin, and scarlet oaks] produce acorns biennially. A killing frost in one year would deplete the white oak crop; a killing frost in two successive years could eliminate the entire acorn crop.

But even in the absence of killing frosts, acorn production is much less reliable than the well-recorded bounty of the chestnut. Recent studies indicate that, "… periodicity (cycles) in production ... occurs at 2-, 3-, and 4-year intervals for black, white, and northern red oaks, respectively" (Morgan and Schweitzer, 2000). Thus, frost or no frost, acorn production is difficult to predict.

Wildlife biologists use the term "mast" to describe foods produced by plants in their natural habitat. Soft mast includes berries, grapes and apples. Hard mast consists primarily of nuts like the acorn, chestnut, hickory, beech and walnut. It is obvious that only hard mast provides food during winter. I believe that acorns are the principle component of present day hard mast. As evidenced by their impact on black bear, hard mast failures are lethal to wildlife.

"In Minnesota, radio telemetry studies have shown bears to be quite vulnerable following years of mast failure. One radioed sow with three yearlings was followed through the spring and early summer months after poor food conditions the previous fall. When approached by researchers, the yearlings were too weak to climb trees.… In West Virginia, wildlife personnel have observed starving bears that have been literally 'skin and bones' in spring months following mast failures. In 1983, following the mast failure in 1982, reports were common of weakened bears unable to walk along streams and roadside ditches." (Igo, 2001)

How did bear and other wildlife fare in the pre-blight forest? Folklore tales expand the bounty described by Thoreau. Even with an allowance for exuberant exaggeration, doubt is not possible. "The chestnut mast is knee-deep… A man fell waist deep in the mast and had to be pulled out… Did game fatten on the chestnut? Lord have mercy, yes. Rabbits were so fat and lazy a child could fetch one in with a chucking stone" (Cameron, 2002). "Reports of chestnuts four inches deep on the forest floor were not uncommon in the southern mountains." (Davis, 1999)

I am currently trying to verify the location of a Chestnut Ridge reputedly named by George Washington, circa 1754-58. While traversing a slope covered with fallen chestnuts, the footing was so slippery Washington had to dismount and guide his steed on foot. The most abundant acorn crop seen today is seldom more than a sprinkle among the fallen leaves. Both the acorn and the chestnut provide good wildlife nourishment in terms of fat, protein and carbohydrate requirements, but the chestnut, overall, is more palatable. (Johnson, 1995; Wright and Kirkland, 2000). It must be granted that cold, rainy weather during chestnut bloom can depress the nut crop, but such events have less effect than killing frosts have on acorns. The return of a chestnut-blended forest will result in more wildlife maneuvering amid its branches and foraging beneath its shade.

"While traversing a slope covered with fallen chestnuts, the footing was so slippery [George] Washington had to dismount and guide his steed on foot."

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RESPONSE OF AMERICAN CHESTNUT TO WEED CONTROL TREATMENTS AT PLANTATION ESTABLISHMENT

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INTRODUCTION

As the introduction of a blight-resistant American chestnut (*Castanea dentata*) hybrid comes closer to reality, it becomes increasingly important to understand aspects of silvicutural management for the species. American chestnut afforestation[1] plantings will likely involve interplantings of multiple hardwood species. While the competitiveness of American chestnut in mixed hardwood plantations is understood (Jacobs and Severeid, 2004), little is known of the effects of weed competition upon establishment in plantations. Afforestation plantations are commonly established on field sites with an existing seed bed and root stock of undesired plants that may vigorously compete with planted seedlings. Effective control or elimination of this weed competition for up to three years is an essential component of hardwood plantation establishment (Bey and Williams, 1976; Jacobs et al., 2004). While the importance of weed control in plantation establishment is clear, few herbicides are specifically developed for forestry applications. Results from past studies (Ezell and Hodges, 2002; Groninger et al., 2002; McGill and Brenneman, 2002; Seifert and Woeste, 2002) and operational experience have identified effective her-

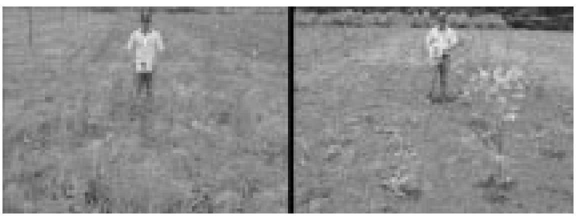
Established American chestnut seed, soon after germination

[1] Afforestation = Forest crops established by planting on land previously not used for tree crops. In contrast, reforestation is the replanting of trees on previously forested lands.

bicides in plantation establishment of some hardwood species. However, no known studies have evaluated weed control protocols for plantation establishment of American chestnut. Thus, the purpose of this study was to examine the effects of weed control on establishment and growth of pure American chestnut seeds and seedlings in a mixed species plantation.

Methods

This study was established in spring of 2003 at the Southeast Purdue Agricultural Center, in southeastern Indiana (N 39° 02', W 85° 30'). The soil at the study site is a Parke series (fine-silty, mixed, active, mesic, Ultic Hapludalf) with <1% organic matter and 6.5 pH. The field was previously planted in soybeans.



Obvious ground cover differences between control treatment (left) and tilled treatment (right)

Nineteen herbicide treatments, along with a tilled and untreated control treatment were used in the study (Tables 1 and 2). The study was designed as a randomized complete block design with three replications. Within each of three blocks, the 21 treatments were randomly assigned to individual plots. To mimic operational mixed-species plantations, seed and seedlings of American chestnut as well as four additional hardwood species (*Prunus serotina*, *Quercus rubra*, *Fraxinus americana*, and *Liriodendron tulipifera*) were planted together. Ten bareroot seedlings of each species, and 10 chestnut seeds, were planted or sown 2.5 cm (0.98 in) deep at 1m (3.28 ft) x 1m spacing within each plot.

American chestnut seed and seedlings (2+0 bareroot) were obtained from Cascade Nursery (Cascade, IA), both originating from a central Wisconsin seed source. Half of all chestnut seeds were germinated prior to sowing and germinated and ungerminated seeds were evenly dispersed among treatment plots. All other species were planted as 1+0 bareroot stock from Vallonia State Nursery (Vallonia, IN).

Herbicide treatments were applied once each year prior to the growing season. All herbicide treatments were applied using a carrier of 95 L (25.10 gallons US) of water with a CO_2 backpack applicator. Herbicide spray was directed approximately 25 cm (9.84 in) from the base of the trees to prevent overspray damage. The second year herbicide application was supplemented with 1.68 kg (3.70 lbs.) ai / ha of the isopropylamine salt of glyphosate

[N-(phosphonomethyl) glycine] to kill perennial weeds that established since the prior year. To reduce possible damage to germinating seed, herbicide treatment rates applied to seeds were half that applied to seedlings.

The tillage treatment was conducted once prior to each growing season and repeated monthly throughout the entire growing season. Plots were tilled to a depth of 5 cm (1.97 in) with a rotor tiller between rows and weeds were removed between trees with a hoe.

Heights and basal diameters of planted seedlings were measured immediately following planting. Following leaf abscission in fall 2003, planted seedlings were re-measured and survival recorded. Sown seeds were monitored for seedling establishment (i.e. presence of live, measurable seedling) after the first growing season and heights and diameters were measured. A seedling was classified as having top dieback if a negative difference was identified for height growth. All seedlings were re-measured in fall 2004.

Planted chestnut seedlings and sown chestnut seeds were analyzed separately as randomized complete block designs. Treatment and block effects were tested with analysis of variance (ANOVA) using JMP IN® statistical software (SAS Institute, Cary, NC). When weed control treatment was significant ($P \leq 0.05$) in the ANOVA, Tukey's highly significant difference (HSD) test was used to separate treatment differences.

Results and Discussion

Seedling establishment from direct seeding is dependent upon numerous variables including germination, predation, herbicide damage, and weed competition (Dey, 1995). Forty-five percent of all sown seeds successfully established themselves as discernible seedlings with a mean height (± standard error of the mean) of 13.2 ± 6.1cm (5.20 ± 2.40 in) and diameter of 2.7 ± 1.0 mm (0.11 ± 0.04 in) after one season (Figure 1). Establishment failures were likely due to germination failure, predation, or unfavorable environmental conditions, as weed control treatments had no statistically significant effect upon seedling establishment. Direct seeding studies of oaks (*Quercus spp.*) have demonstrated establishment rates as high as 85% (Bowersox, 1993; Zacek et al., 1993), yet operational success is commonly closer to 35% after the first growing season (Johnson and Krinard, 1985).

Seedling mortality was negligible for both planted seedlings and those established from seed. Weed control treatment did not significantly affect

TABLE 1

Common, trade, and chemical names of herbicides used.

Common name	Trade name	Chemical name
Azafenidin	Milestone	2-[2-4-dichloro-5-(2-propynyloxy)phenyl]-5,6,7,8-tetrahydro- 1,2,4-triazolo[4,3-A]pyridin-3 (2H)-one
Isoxaben	Gallery	N-[3-(1-ethyl-1-methylpropyl-5-isoxazolyl]-2,6-dimethoxybenzamide
Oryzalin	Surflan	3,5-Dinitro-N4,N4-dipropylsulfanilamide
Oxyfluorfen	Goal	2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl) benzene
Pendimethalin	Pendulum	(N-(1-ethylpropyl)-3,4-dimethyl)1-2-6-dinitro-benzenamine
Simazine	Princep	2-chloro-4,6-bis(ethylamino)-s-triazine
Prodiamine	Endurance	2,4-Dinitro-N3,N3-dipropyl-6-(trifluoromethyl)-1,3-benzenediamine
Sulfometuron	Oust	{Methyl2-[[[(4,6dimethyl-2-pyrimidinyl)amino]carbonyl]sulfonyl]benzoate}

first or second year mortality. Ezell and Shankle (2004) also found that the use of sulfometuron and oxyfluorfen did not significantly affect first year mortality of planted oaks and green ash (*Fraxinus pennsylvanica*).

Seedling dieback (negative height growth between consecutive measurement periods) is an indicator of non-lethal physiological stress caused by a number of factors singly or in combination. Twenty-two percent of planted chestnut seedlings exhibited dieback during the first growing season, while second season dieback was negligible for both stocktypes. First year dieback of planted American chestnut seedlings was greater than that incurred by any other species planted. While no attempt was made to discern the cause of dieback, it is suspected that a late season frost inflicted heavy damage upon the chestnut seedlings, which we suspect were more adversely affected and less able to recover than associated species.

While there were no significant differences in dieback between weed control treatments for direct-seeded or planted chestnuts, this does not guarantee seedling resistance to the phytotoxic effects of the herbicides used. Herbicide applications were applied in a manner that was intended to reduce any seedling damage.

Total mean height growth across all treatments for direct-seeded chestnut was significantly greater (P=0.0097) than that of the planted chestnut in year one, with a mean height growth of 13.1 ± 1.0 cm (5.16 in ± 0.39 in) and 3.5 ± 1.4 cm (1.38 ± 0.55 in), respectively. However, this effect reversed (P=0.0216) during the second season, as the sown

TABLE 2

Weed control treatments ranked by seedling height

Treatment	Rate		Seed Chestnut			Planted Chestnut		
	Seed	Planted	Yr 1	Yr 2	Total	Yr 1	Yr 2	Total
---------(amount of product / ha)----------			-----------------------Rank (best to worst)-----------------------------------					
Control	n/a	n/a	6 a b c	21 a	20 a	11 a	21 c	20 b
Tilled	n/a	n/a	15 a b c	1 a	1 a	3 a	2 a	2 a
Simazine	2.3 L	4.7 L	5 a b c	16 a	12 a	8 a	16 a b c	13 a b
Simazine	4.7 L	9.4 L	7 a b c	20 a	17 a	6 a	18 b c	15 a b
Pendimethalin	2.3 L	4.7 L	13 a b c	10 a	9 a	15 a	17 a b c	16 a b
Pendimethalin	4.7 L	9.4 L	11 a b c	13 a	15 a	18 a	20 b c	19 b
Sulfometuron	0.035 kg	0.053 kg	19 a b c	8 a	16 a	1 a	1 a	1 a
Sulfometuron	0.053 kg	0.070 kg	21 c	19 a	21 a	9 a	5 a b	3 a b
Oxyfluorfen	2.3 L	4.7 L	2 a	14 a	10 a	5 a	11 a b c	10 a b
Oxyfluorfen	4.7 L	9.4 L	8 a b c	15 a	14 a	7 a	9 a b c	9 a b
Isoxaben	0.370 kg	0.740 kg	17 a b c	18 a	18 a	21 a	19 b c	21 b
Isoxaben	0.740 kg	1.491 kg	9 a b c	7 a	7 a	4 a	7 a b c	6 a b
Oryzalin	2.3 L	4.7 L	4 a b c	6 a	4 a	12 a	12 a b c	12 a b
Oryzalin	4.7 L	9.4 L	14 a b c	11 a	11 a	19 a	14 a b c	17 a b
Prodiamine	0.897 kg	1.793 kg	10 a b c	9 a	8 a	2 a	10 a b c	5 a b
Prodiamine	1.793 kg	2.578 kg	3 a b c	3 a	2 a	16 a	3 a b	4 a b
Simazine + Pendimethalin	2.3 + 2.3 L	4.7 L	12 a b c	4 a	5 a	14 a	13 a b c	14 a b
Simazine + Sulfometuron	2.3 l + 0.035 kg	4.7 l + 0.053 kg	20 b c	2 a	6 a	17 a	4 a b	8 a b
Oxyfluorfen + Pendimethalin	2.3 + 2.3 L	4.7 L	16 a b c	12 a	13 a	13 a	8 a b c	11 a b
Simazine + Oxyfluorfen	2.3 + 2.3 L	4.7 L	1 a b	5 a	3 a	10 a	6 a b	7 a b
Oryzalin + Simazine	2.3 + 2.3 L	4.7 L	18 a b c	17 a	19 a	20 a	15 a b c	18 a b

*Means with the same letter are not significantly different ($P \leq 0.05$)
1 liters equal 0.26 gallons or 4.23 cups (US, liquid) 1 kilograms is equal to 2.20 pounds (avoirdupois)

chestnut grew 14.4 ± 2.0 cm (5.67 ± 0.79 in) while the planted chestnut grew 36.1 ± 3.7 cm (14.21 ± 1.46 in) in height. Height growth increases between years one and two were most evident for planted chestnut. Due to the poor performance of planted chestnut during the first growing season, and consistent growth of direct-seeded chestnut through both seasons, there was no significant difference in total height growth between the two stocktypes at the end of the second growing season.

Weed control produced a noticeable yet statistically non-significant effect on first-year height growth of planted seedlings, while direct-seeded chestnut exhibited mixed results (Table 2). The lack of a statistically significant effect of weed control during the first year suggests that other stresses incurred by the seed and seedlings were more prominent than those resulting from competing vegetation. While the first year benefits of weed control are not readily apparent, the second season and total growth more clearly illustrate the advantages of weed control over the unmanaged control (Table 2). The control treatment yielded the least height growth for both direct-seeded and planted seedlings during the second growing season and ranked second lowest for total height growth of both stocktypes (Table 2). During the second growing season, six weed control methods provided significantly ($P \leq 0.05$) greater height growth to planted seedlings than the unmanaged control (Table 2). There were no significant differences between any treatments for the direct-seeded

TABLE 3

Two years of diameter and height growth for best and worst treatments compared with control.

	Height*			Diameter		
Species	Control	Best treatment	Worst treatment	Control	Best treatment	Worst treatment
	cm			mm		
Seed chestnut	16.4 ± 4.8	38.4 ± 13.2	12.5 ± 12.0	2.7 ± 0.6	5.7 ± 2.5	2.6 ± 0.7
Planted chestnut	12.4 ± 0.8	75.8 ± 39.2	6.6 ± 14.8	3.0 ± 1.0	15.3 ± 5.2	3.8 ± 2.1

*Mean growth ± standard deviation
**Best and worst treatment based on total height growth of seedling.
1 centimeter is equal to 0.39 inches. 1 millimeters is equal to 0.04 inches.

chestnuts during the second growing season or for total height growth, yet trends among means continue to show evidence of the importance of weed control.

These data clearly indicate the benefits of weed control, yet treatment efficacy varied and differences between treatments were somewhat difficult to discern. No single weed control treatment was consistently best for both stocktypes in the study, and not all treatments differed significantly from one another (Table 2). The practical importance of the statistical differences among treatments can be evaluated by comparing the height growth of the best and worst treatments with that of the control (Table 3). The most appropriate weed control treatment will depend upon specific site conditions and management goals. For the purpose of this study the “best” and “worst” weed control treatments were identified as those which promoted the greatest and lowest total height growth over two growing seasons, respectively.

The greatest growth of direct-seeded chestnut was in the tilled treatment, while the least was in the high-rate sulfometuron treatment. The best treatment for the planted chestnut was the lowest rate of sulfometuron, while the worst treatment was the lowest rate of isoxaben (Table 2). Interestingly, the worst treatment for the direct-seeded chestnut was identified as the best treatment for the planted chestnut. The poor performance of direct-seeded chestnut to the highest rate of sulfometuron may be associated with herbicide damage to germinating seed, as Timmons et al. (1993) demonstrated that the use of the herbicide glyphosate reduced the direct seeding success of oaks. The effectiveness of sulfometuron for increasing growth of other established hardwood seedlings has been noted by others (McGill and Brenneman, 2002; Groninger et al., 2002).

The tillage treatment used in this study was designed to mimic nearly 100% weed control through intensive, monthly applications (Figure 2). While effective, this treatment is impractical at an operational scale due to costs. This demonstrates the importance of weighing costs associated with various weed control methods to growth gains. The growth associated with the best and worst treatments (Table 3), as well as the related rankings of various treatments (Table 2), provide a preliminary basis to help determine optimal weed control strategies for chestnut restoration.

Conclusion

This study examined 21 different weed control options over two growing seasons for plantation establishment of American chestnut using direct-seeding and 2+0 bareroot seedlings. Direct-seeding resulted in a 45% success rate for establishing a discernable seedling, suggesting that this technique holds promise for chestnut plantation establishment. Weed control treatments did not affect mortality or top dieback of direct-seeded or planted seedlings. A late frost during the first growing season caused significant dieback of planted chestnut seedlings (22%). This study reaffirms the importance of weed control for establishing hardwood plantations. While statistically significant differences were not identified between all selected weed control treatments, a relative ranking system, and gains achieved by best and worst treatments, provides information to help develop a protocol for use in selecting weed control treatments suitable for chestnut restoration.

Marcus F. Selig is a Research Associate, John R. Seifert is an Extension Forester and Douglass F. Jacobs is an Assistant Professor in the Department of Forestry and Natural Resources at Purdue University.

Acknowledgements

This research was funded by The American Chestnut Foundation (TACF) and the Indiana Chapter of TACF.

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ECOLOGY OF AMERICAN CHESTNUT IN KENTUCKY AND TENNESSEE

By Joe Schibig, Clint Neel, Michael Hill,
Mark Vance and Jack Torkelson

INTRODUCTION

The American chestnut (*Castanea dentata*) was a dominant tree in many of the forests of Kentucky and Tennessee prior to the blight which swept westward through the region from the late 1920s to the early 1940s; by the late 1940s nearly all the large chestnut trees were dead.

Rhoades and Park (2001) reviewed the historical information on the pre-blight distribution and abundance of American chestnut in Kentucky and concluded that it was most abundant in the Cumberland Mountains of southeastern Kentucky. Ashe (1911) stated that, in Tennessee, chestnut was most abundant in the Unaka Mountains. Figure 1 shows the major physiographic regions of Kentucky and Tennessee and the general pre-blight abundance of chestnut in these regions.

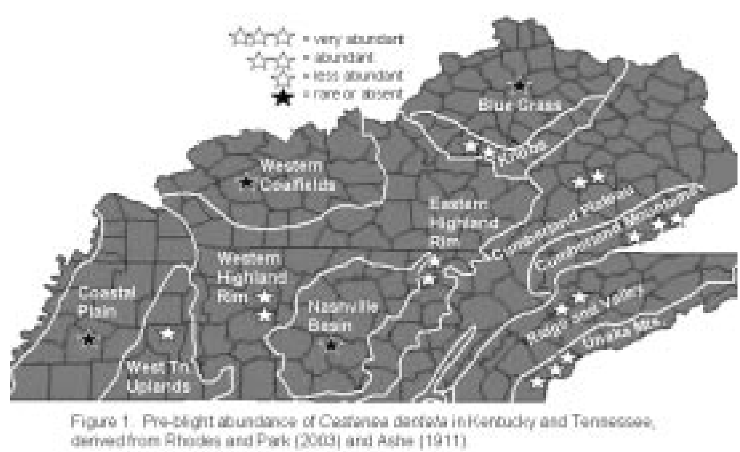

Fig. 1. Pre-blight abundance of *Castanea dentata* in Kentucky and Tennessee, derived from Rhoades and Park (2003) and Ashe (1911).

Primary objectives of this study

(1) Begin construction of a database of American chestnut trees in Kentucky and Tennessee, including data on location, size, health, fruiting, site conditions, and associated tree species
(2) From the database of live specimens, determine geographic distribution, preferred habitat conditions, size class distribution, incidence of blight, ratio of fruiting to non-fruiting trees, and seedling production
(3) From the dead stem database, determine average growth rates, diameters, and longevity.

Methods

From 2001 to 2004, we recorded data on native chestnut trees from the Highland Rim eastward to the Cumberland Plateau and westward to the Coastal Plain. Global Positioning Satellite coordinates for each tree were recorded and then mapped with ArcView® mapping software. A handheld compass was used to determine slope aspect. Notes on signs of blight, flowering, soil conditions, and associated tree and shrub species were made. Stem diameter at 1.4 m (4.5 ft) above ground (dbh) and estimated height for live specimens were recorded; data for dead chestnut stems ≥ 2.5 cm (1 in) dbh also were recorded, and a small section of each dead stem was cut at dbh level for tree ring examination. If stems were in a cluster (clone), only the largest stem was measured. All data were entered into a computer database.

Results and Discussion

We recorded data on 2,068 chestnut trees in 42 counties of Kentucky and Tennessee. At Mammoth Cave National Park (MCNP), 1,201 chestnut specimens were recorded in two counties. On the Highland Rim, 441 trees were recorded in 33 counties. On the Cumberland Plateau, 389 specimens were found in four counties, and on the Coastal Plain of Kentucky and Tennessee, 37 chestnut trees were recorded in three counties.

Our results were compared to those of Wood (2003) who provided ecological data on 288 chestnut trees in the Great Smoky Mountains National Park (GSMNP). Figure 2 shows a map of the chestnut sites.

Chestnut sprouts were found at elevations exceeding 1,770 m (5,800 ft) in the GSMNP (Wood, 2003) to elevations under 115 m (377 ft) in southwestern Kentucky.

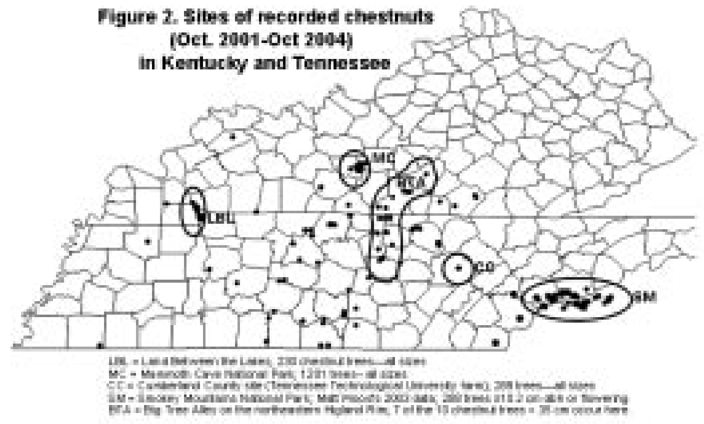

Fig. 2. Sites of American chestnut trees recorded in KY and TN Oct. 2001 - Oct. 2004. LBL = Land Between the Lakes; MC = Mammoth Cave National Park; BTA = Big Tree Alley on the northeastern Highland Rim; CC = Cumberland County site on Tenn. Tech. Univ. agricultural farm; SM = Great Smoky Mountains National Park (Data of Matthew Wood).

Eight percent of the chestnut trees on the Highland Rim were flowering. Elsewhere, the percent which flowered were: Coastal Plain, 6%; Cumberland Plateau, 1%; and MCNP, 0.08%. Overall, of the 2,068 specimens we examined, only 2% were flowering.

We observed only four recent chestnut seedlings on three sites which had obviously resulted from natural cross pollination. Paillet (1984) found no recent seedlings in his study of 353 chestnut trees (sprout clones) in northeastern Massachusetts. Post-blight reproduction of chestnut has been almost 100% asexual — sprouting from the root collar.

The percent of blighted chestnut trees in the various regions was Highland Rim (17%), Coastal Plain (25%), MCNP (1%), and Cumberland Plateau (1%). Overall, 5% of the chestnut trees in Kentucky and Tennessee were blighted. Of the 67 larger (≥ 10.2 cm [≥ 4 in] dbh) trees, 63% were blighted, while 83% of the 42 flowering trees had the blight. Wood (2003) reported that 51% of the 288 chestnut trees (≥ 10.2 cm [≥ 4 in] dbh or flowering) he recorded in the GSMNP were blighted. Of the 19 chestnut "mother" trees used in TACF's breeding program in Kentucky and Tennessee, 17 had the blight.

The percentages of chestnut trees with a dbh ≥ 10.2 cm [≥ 4 in] in the different regions were: MCNP, 0.6%; Cumberland Plateau, 1%; Coastal Plain, 5.6%; and Highland Rim, 12.7%. Most of the chestnut trees at MCNP were quite small and slow growing--85.8% were < 2.5 cm [< 1 in] dbh. This was probably due to greater shade suppression in the park where there has been no logging in 70 years. Of the 10 chestnut trees with a dbh > 35 cm (14 in), seven were clustered on the northeastern Highland Rim. Surprisingly, the largest chestnut recorded in the GSMNP by Wood (2003) had a dbh of only 31 cm (12 in).

The two largest and oldest chestnut trees recorded in Kentucky and Tennessee have swollen cankers. Their survival may be due to a combination of these factors: (1) the attacking blight pathogens are hypovirulent; (2) the trees have some resistance to the blight; and (3) the trees are growing on sites conducive to chestnut growth. Griffin (1986) believed such factors explained the survival of the large American chestnut in Amherst County, Virginia.

On the Highland Rim, 74% of the chestnut trees were found on dry sites (ridges and mostly south to west-facing slopes), while 26% were on relatively mesic sites (ravines and mostly north to east-facing slopes). At LBL, a U. S. Forest Service National Recreation Area, chestnut trees were found primarily on the dry west-facing bluffs overlooking Kentucky Lake. On the Cumberland Plateau, only 9% were on drier sites while 91% occurred on more mesic sites. Hinkle (1989) reported that, on the Cumberland Plateau, live chestnut sprouts were in 4.8% of his ravine plots, while 1.8% were on drier upland plots. At MCNP, 45% of the sprouts were on dry sites, and 55% were on mesic sites; many of these were in an old-growth forest called the "Big Woods", but some were on the rocky slopes of large sandstone-capped sinkholes. Overall, 83% of the 41 flowering chestnut trees were found on dry sites. In the GSMNP, Wood (2003) obtained similar results with 74% of his 157 flowering chestnut trees occurring on dry sites.

We found chestnut trees on a wide range of well-drained, acidic soils. On the Highland Rim, they usually occurred on cherty soils derived from Mississippian limestone of the Fort Payne Formation. On the Coastal Plain, they were usually on sandy soils. At MCNP, they were mostly on rocky, sandstone soils. On the Cumberland Plateau, they were on sandy soils derived from Pennsylvanian sandstone.

Using county soil survey maps, we determined the following soil series for sites occupied by chestnut at LBL: Baxter-Hammock soils derived from cherty limestone (28.3% of the chestnut sites); Bodine Cherty Silt Loam from cherty limestone (23.5%); Saffel and Brandon-Saffel mostly from Cretaceous gravel (32.2%); Brandon Silt Loam from loess and Cretaceous gravel (8.3%); Guin Gravelly Loam mostly from Cretaceous gravel (5.2%); Nixa Cherty Silt Loam from cherty limestone (1.7%); and Hammack-Baxter soil derived from cherty limestone (0.9%).

At MCNP, the soil series were: Bledsoe-Wallen Rock Outcrop (at 39% of the chestnut sites) —rocky sandstone soils; Riney Loam (28%) — loamy sandstone soils; Wellston Silt Loam (21%) — from loess and sandstone-siltstone residuum; Lily Loam (6%) — from sandstone, shale, and siltstone; Jefferson Lily Rock Outcrop (4 %) — rocky sandstone soils; Caneyville Rock Outcrop (1%) — soil with limestone outcrops; and Tiltsit Silt Loam (1%) — sandstone-based soils.

For most chestnut trees recorded, we noted the associated tree species within a 15 m (50 ft) radius (Table 1). Red maple was the chief chestnut associate; like chestnut, it is adapted to acidic, dry soils, but unlike chestnut, it is also found on poorly-drained soils.

A total of 112 dead chestnut stems ≥ 2.5 cm (≥ 1 in) were examined; their average longevity was 15.9 years, average diameter was 6.4 cm (2.5 in), and average growth rate was 0.5 cm (0.2 in) per year. Thirty-five of the 112 dead chestnut stems were MCNP specimens; these averaged 3.3 cm (1.3 in) in diameter, had and average growth rate of 0.2 cm (.08 in) per year, and their average longevity was 20 years.

We believe this baseline data will be useful in monitoring future changes in native chestnut populations. Knowing the habitat preferences of chestnut will be helpful in determining the best sites for restoration when regionally adapted, blight-resistant American chestnut trees become available.

Joe Schibig is Professor of Biology at Volunteer State Community College (VSCC), Gallatin, Tennessee. Clint Neel is Vice President of TN-TACF. Michael Hill and Mark Vance are TACF student interns at VSCC. Jack Torkelson is a student at VSCC.

TABLE 1

The 20 tree species most often associated with 2,031 chestnut trees recorded in Mammoth Cave National Park (1,201 chestnut trees), on the Highland Rim (441 trees) and on the Cumberland Plateau (389 trees). Most of these trees were recorded in south central Kentucky and north central Tennesse.

Common Name	Scientific Name	No. of times found within 15 m (50 ft) of a chestnut tree	Percent of 2,031 possible associations
Red maple	*Acer rubrum*	1336	65.8
Tulip poplar	*Liriodendron tulipifera*	932	45.9
Sourwood	*Oxydendrum arboreum*	927	45.7
Blackgum	*Nyssa sylvatica*	854	42.1
Dogwood	Cornus florida	808	39.8
White oak	*Quercus alba*	617	30.4
Pignut hickory	*Carya glabra*	585	28.8
Sassafras	*Sassafras albidum*	555	27.3
Black oak	*Quercus velutina*	552	27.2
Chestnut oak	*Quercus prinus*	442	21.8
American beech	*Fagus grandifolia*	418	20.6
Serviceberry	*Amelanchier arborea*	313	15.4
Scarlet oak	*Quercus coccinea*	296	14.6
Mockernut hickory	*Carya* tomentosa	235	11.6
Virginia pine	*Pinus virginiana*	163	8.0
Post oak	*Quercus* stellata	144	7.1
Sugar maple	*Acer saccharum*	121	6.0
Red hickory	*Carya ovalis*	104	5.1
Northern red oak	Quercus *rubra*	85	4.2
Shagbark hickory	*Carya ovata*	64	3.2

Acknowledgements

We thank TACF and the National Park Service for their support and the many people who assisted us; Edward W. Chester, Paul Sisco, Mark DePoy, Nancy Morris, Rex Barber, Jeannie Katzenmiller, Greg Weaver, and Bill Turner were especially helpful.

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SILVICULTURE AND AMERICAN CHESTNUT GROWTH

Brian C. McCarthy, Professor of Forest Ecology at Ohio University, and his graduate student, Corie L. McCament, have been conducting experiments to evaluate how well American chestnut will survive and grow in the managed forest landscape of southeastern Ohio. Highly blight-resistant American chestnut seed will soon be publicly available. This means that we may begin to shift our emphasis from the breeding of blight resistance to the ecological restoration of this once mighty species.

However, American chestnut is unlikely to be explanted into unmanaged old-growth forests, ecological preserves, or used in plantation systems. Rather, it will more likely be returned to small, private, woodland environments and larger tracts of public and private land that are being managed for other purposes (e.g., timber, wildlife, etc.).

McCarthy and McCament decided to use a large experimental design (Fire and Fire Surrogate Study) already available for use and provided by the US Forest Service. For the last five years the USFS has been studying the role of fire and thinning as silvicultural tools in regional Ohio State forests (Zaleski & Tar Hollow) and in Vinton Furnace Experimental Forest. Seedlings of American chestnut were planted into stands that had just been burned, just been thinned, or thinned and then burned, and were then compared to control stands receiving no treatment.

Seedlings planted into the treated stands responded very positively, especially to those stands that received some form of thinning. This suggests that chestnut responds favorably to increased light microenvironments in the forest understory and this may help direct future plantings. Seedlings did their absolute best in terms of survival and growth in stands that had been both thinned and burned. Burning likely reduces competition with neighboring herbs and thinning then increases light availability. All treatments responded better than controls, suggesting that intact, undisturbed forest will not be a good place to try and reintroduce chestnut seedlings. Most undisturbed mixed-oak forest understories have inadequate light and increased competition by other plants for American chestnut to do well.

McCarthy and McCament's work will soon appear in the scientific literature via the Canadian Journal of Forest Research.

Brian C. McCarthy, Ph.D. is Professor of Forest Ecology, Dept. of Environmental and Plant Biology, Ohio University, Athens, OH

Useful links for more information:

Brian C. McCarthy Lab: http://www.plantbio.ohiou.edu/epb/faculty/faculty/bcm.htm

US Forest Service, Delaware, OH: http://www.fs.fed.us/ne/delaware/

Fire and Fire Surrogate Research: http://www.fs.fed.us/ffs/

notes

THE AMERICAN CHESTNUT FOUNDATION WRITING GUIDELINES

Revised February 2005

Authors are invited to submit manuscripts of historic or scientific interest relating to the American chestnut. Submissions must conform to the following guidelines and formats.

Manuscripts and papers must be clear, concise, accurate and interesting. First-person, active voice is preferable. Submissions to *The Journal* are limited to 1,500 words of text plus tables, figures, and references, and to *The Bark*, 500 words of text, plus tables, figures, and references. All submissions are reviewed by TACF Editorial Review Board, are subject to editing, and are published at the discretion of TACF.

Please submit manuscripts and images electronically via e-mail, or on a 3x5 floppy disk formatted for PC, or burned to a CD, using either MS Word or WordPerfect. TACF is not responsible for errors in transmission. E-mail to journal@acf.org.

Please format photos, original art and drawings as ".jpg" files, at least 300 dpi (dots-per-inch), and send electronically to journal@acf.org.

GENERAL FORMAT

Unfamiliar or new terms, as well as abbreviations, acronyms, and symbols, should be defined at first mention.

RESEARCH ARTICLES — Please divide and subtitle as follows:

- *Title Page* — Include the title of the article, the author's name(s) and affiliation(s) with complete mailing addresses, phone / fax numbers, and E-mail addresses.
- *Introduction* — What was studied
- *Methods* — How the study was conducted
- *Results* — The findings of the study
- *Discussion* — What the study and the findings mean
- *Conclusion* — Summary of the study, implications for future use of findings and further studies

RESEARCH DATA — Present research data only once, either within the text, in a table, or in a figure.

FIGURES: PHOTOS, IMAGES, ORIGINAL ART AND DRAWINGS
Please format as ".jpg" files, 300 dpi, and send electronically. (see instructions above). Figures should be referenced in the text with successive numbers (Fig. 1, Fig. 2, etc.). Put a place-holder for figures on a separate line within the manuscript, with a caption typed below it.

Example 1 — Place holder can be a small version of the image pasted into the text.

Fig. 2. Pollination of uninfected American chestnuts remaining in forests is important of TACF's regional breeding program.

OR

Example 2 — Place holder can be text only, with figure submitted as a separate document.

PLACE FIGURE 2 HERE
Fig. 2. University of Kentucky students on a field trip in western Kentucky.

TABLES
Cite tables in text by successive numbers (Table 1, Table 2, etc.). Use Arabic numerals within tables. Mark explanatory material within table as footnotes labeled alphabetically in order of appearance as the table is read horizontally. Place footnotes immediately below the table. Insert tables on separate pages in your document using either single line entries with tabbed text for columns, or MS Word or WordPerfect tables. MS Excel tables may be submitted as a separate document, with a note in the text indicating placement and name of table.

Example 1 — Inserted tabled into document, on a separate page, using tabbed text to format columns.

Table 3. Two years of diameter and height growth for best and worst treatments compared with control.

	Height*			Diameter		
	Control	Best treatment	Worst treatment	Control	Best treatment	Worst treatment
Species	---------- cm ----------			---------- mm ----------		
Seed chestnut	16.4 ± 4.8	38.4 ± 13.2	12.5 ± 12.0	2.7 ± 0.6	5.7 ± 2.5	.6 ± 0.7
Planted chestnut	12.4 ± 0.8	75.8 ± 39.2	6.6 ± 14.8	3.0 ± 1.0	15.3 ± 5.2	3.8 ± 2.1

*Mean growth ± standard deviation
**Best and worst treatment based on total height growth of seedling.

Example 2 — Indicate a place holder for table within text, and submit table as a separate document.

PLACE TABLE 3 HERE

NOMENCLATURE

Use standard scientific nomenclature according to Council of Biology Editors Style Manual

SCIENTIFIC NAMES — should follow the first mention of each common name in the manuscript and be set off by parentheses. The genus, species, and variety names should be in italics. Common names or scientific names can be used subsequently.

AUTHOR'S FULL NAMES — Place author's name(s) below the paper's title. For academic degrees, use a suffix (M.D., LL.D., DVM, Ph.D., etc.)

Example —

Study Locates Sources of Disease

By Joseph P. Brown, Ph.D.

Put additional professional information about author(s) at end of paper.

Example —

Joseph P. Brown, Ph.D, is Professor of Forest Ecology, Ohio University, Athens, OH

OTHER NAMES — When notation of an academic degree is necessary to establish credentials within the text of a paper, use a suffix (M.D., LLD, and Ph.D, etc.) only with first mention of the individual's full name. When appropriate, use a prefix with the last name for subsequent reference. For other names within the text, use complete name for first reference, last name only for subsequent reference.

Example —

According to research by James R. Green, M.D., the sample was unsuitable. Dr. Green said he was later able to locate another sample. However, Robert G. Brown, Ph.D., of East University, noted a problem. Dr. Brown's research showed a lack of similar characteristics in the second sample. Jane F. Brown, a doctoral candidate in the program, will conduct the seminar. Brown said she is thoroughly prepared.

STATES — Spell out the names of all states when they stand alone in a sentence. Use official US Postal Service abbreviations, without periods, when the name of a state is used in conjunction with the name of a village, town or city. USPS state abbreviations are available on their website: http://www.usps.com/ncsc/lookups/usps_abbreviations.html.

Example —

The map indicated that my destination in Kentucky was 550 miles from Philadelphia, PA.

COUNTRIES — Spell out the names of all countries. United States may be abbreviated as US, without periods.

Example —

The research on that disease was begun in China, but in the US it was expanded to include the subspecies previously mentioned.

SEASONS — Winter, spring, summer and fall, and derivatives such as springtime: all lower case unless part of a formal name, Winter Olympics. No comma after season with year, The event began in spring 2005.

NUMERICALS

MEASUREMENTS CITED — If metric measurements are used, follow with English common style in parentheses.

DECIMAL PLACES — Use a consistent number of decimal places appropriate to research presented.

WHOLE NUMBERS — Spell out whole numbers below 10, use figures for number 10 and above. Avoid beginning a sentence with a number. If such use is unavoidable, spell the number out at the beginning of a sentence. One exception is a numeral that identifies a year.

Example —

Last year only seven students completed the program, although 14 were registered. 1995 was a better year, with five percent of the student body participating and 90% successfully completing it.

ORDINAL NUMBERS — For ordinal numbers, spell out first through ninth. Starting with 10th, use numerals. Use numerals below 10 (1st, 2nd, 3rd, etc.) only to indicate an assigned sequence: 4th district, 2nd edition.

Example —

His third failed attempt led his professor to recommend seeking a 12th person to participate. The elected representative of the 3rd Congressional District agreed that the solution was to find another participant.

DATES — For dates, use numerals only, not ordinals. Months may be abbreviated when used in a complete date. For seasons, see above, nomenclature.

Example —

Please submit all requests by February 10 to ensure proper processing. The last message will be mailed on Jan. 3, 2006.

PERCENTAGES — Use numerals only. The exception is at the beginning of a sentence. Use decimals, not fractions: Forty percent of the students passed the exam, but 15 percent were absent; 3.5 percent failed.

ACKNOWLEDGEMENTS, REFERENCES, FOOTNOTES

ACKNOWLEDGEMENTS — Place acknowledgements at the end of paper, before References section.

Example —

Joe J. Ready, MD, Administrator of Support Research Center, edited this manuscript . Robert T. Friendly, DVM, provided the images of raccoons.

REFERENCES — List all references in alphabetical order in a References section at the end of text. Check text against *References* to ensure all references are cited properly and all citations appear in the text, tables or figures.

FORMATTING REFERENCES FOR SCIENTIFIC ARTICLES

WITHIN THE TEXT — Format references in text as (last name(s) of the author(s) and the year of publication) e.g. (Francis, 1978). Citations with two authors should be formatted as (Hacskaylo and Gerdemann, 1971). Use the first author's name and "et al." when there are more than two authors as (Vance et al., 1992). The order for references within parentheses in the text should be by year of publication. For works by the same author(s) in the same year, append a lowercase a, b, c, etc., to the year of publication.

WITHIN THE REFERENCES SECTION —

Journal article (two authors)

Shi, Y. and F.V. Hebard. 1997. Male sterility in the progeny derived from hybridization between *Castanea dentata* and *C. mollissima*. J. Amer. Chestnut Found. 11(1):38-47.

Journal article (three or more authors)

Burnham, C.R., P.A. Rutter, and D.W. French. 1986. Breeding blight-resistant American chestnuts. Plant Breeding Reviews 4:347-397.

Paper in conference proceedings

Payne, J.A. 1978. Oriental chestnut gall wasp: new nut pest in North America. pp. 86-88. In W.L. MacDonald, F.C. Cech, J. Luchok, and C. Smith (eds). Proceedings of the American Chestnut Symposium. Morgantown, WV.

Book

Mayr, E. 1970. Populations, species, and evolution. Cambridge, MA: The Belknap Press of Harvard University Press.

Thesis or Dissertation

Carey, W.A. 1985. The virulence of *Endothia parasitica* (Murr.) And. & And. associated with large American chestnuts in North Carolina. Ph.D. Dissertation. Duke University, Durham, NC, 168 p.

FORMATTING REFERENCES FOR HISTORICAL OR NARRATIVE ARTICLES

WITHIN THE TEXT — Format as described above for scientific references. References containing multifaceted information from numerous historical or narrative sources may be cited in the text as sequential numbers within parentheses, and listed in the References section in the same numerical order.

Example — A 1909 store accounts book shows that customers received two or three cents per pound at the beginning of October (1,2).

WITHIN THE REFERENCES SECTION —

1. Josie G. Thomas interview with Ralph Lutts, PCP, Tape 1, Side 2, 154 / 91; Helms interview, / 175; Robert Samuel and Sally Slate interview, PCP, Tape 3, Side 1, 200 / 166.
2. Cockram Store Accounts Book: 30 lbs accepted for $0.90 credit, Sept. 30, 1909; 64 lbs accepted for $1.28 credit, 2 October 1909.

FOOTNOTES — Use superscript numbers within text to designate footnotes that reference information other than literature cited. List complete footnote in italics at the end of paper.

Example —

Details about raccoon eating habits within this range are largely unknown.[1]

[1] For more information about raccoon eating habits, contact Grange Botanical Orchards, 333 North Road, Sometown, South Carolina. Phone: (555) 111-4545.

WRITING ABOUT THE AMERICAN CHESTNUT FOUNDATION

Style guide for reference to The American Chestnut Foundation and related science

The American Chestnut Foundation — The first letter of each word is capitalized, including "The," to conform with our legal name. Use TACF as the acronym. ACF is trademarked by The Association of Consulting Foresters and should not be used.

American chestnut — "A" is capitalized, "c" is lower case

Blight-resistant — is hyphenated, as in "blight-resistant chestnut" or "the tree will be highly blight-resistant"

Blight resistance — is not hyphenated, as in "The tree will have sufficient blight resistance."

Bur — is preferred rather than burr

Backcross (single word) **breeding** — The process used by TACF. Selected offspring of the first cross between Chinese and American chestnut are crossed with, or "back to" American chestnut only in subsequent generations.

Cross breeding — should be avoided because it implies multi-generation crosses between species, varieties or breeds. In cross breeding, selected offspring of the first cross may again be crossed with other species, varieties or breeds in subsequent generations.

Breeding — may be used, as it refers more generally to crossing within species, varieties or breeds.

Escaped infection — preferred usage for uninfected wild-growth trees, rather than "survived" infection.

Seed Distribution — TACF *expects* to have limited quantities of a highly blight-resistant hybrid available by 2006, with wide-scale planting expected in the next 5 to 15 years. Seed quantities will be limited at first, growing in number in each subsequent year. Initial seed production will be dedicated to forest testing and research, prior to wider distribution.

Tree Population — The American Chestnut comprised an average of 25% of the hardwood tree population within the heart of it range. In a few areas, pure stands of American chestnut could be found.

SCIENTIFIC NAMES

Cryphonectria parasitica — The scientific name of the blight fungus. "C" is capitalized, the "p" of the second word is not. Both words are italicized.

Phytophthora cinnamomi and *Phytophthora cambivora* — both incite *Phytophthora* root rot (known as ink disease in Europe); the former is seen more often in the southeastern U.S., while both species are found in Europe.

Castanea dentata — American chestnut

Castanea pumila — Allegheny chinkapin (or chinquapin) sometimes *C. pumila var. pumila*

Castanea ozarkensis — Ozark chinkapin (or chinquapin) sometimes *C. pumila var. ozarkensis*

Castanea sativa — European chestnut

Castanea mollissima — Chinese chestnut

Castanea crenata — Japanese chestnut