PRE-BLIGHT ABUNDANCE OF AMERICAN CHESTNUT IN KENTUCKY

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INTRODUCTION

The Commonwealth of Kentucky extends west from the Appalachian Mountains to the Mississippi River, spanning a variety of physiographic regions (Fenneman, 1938) and forest types (Braun, 1950; Smalley, 1986). American chestnut (*Castanea dentata*) was a major component of both mixed mesophytic and western mesophytic forests, the two dominant forest types in Kentucky (Braun, 1950). With the exception of the limestone-dominated Bluegrass Region in central Kentucky and portions of the western extreme of the state, chestnut was found throughout Kentucky (Saucier, 1973; Russell, 1987).

The chestnut blight fungus (*Cryphonectria parasitica*) spread across the southern Appalachians and Kentucky during the 1920's and 1930's (Cochran, 1990). By the mid- to late- 1930's, the blight had spread throughout the state; by the mid-1950's, the American chestnut as an overstory tree was virtually extinct. Forest pathologists and geneticists from various institutions currently predict that blight-resistant seedlings will be available for distribution and outplanting within five to fifteen years (Hebard, et al. 2000; S. Anagnostakis, Conn. Ag. Expt. Station, pers comm.). These predictions have spawned public interest in reintroduction of American chestnut to eastern forest ecosystems. In Kentucky, where production of hardwood lumber is a major source of financial gain, return of the chestnut combines nostalgia for the forests of the Appalachian forebearers, the restoration of original forest species composition and forest dynamics, and the potential of regional economic development.

Pollen analysis has confirmed the existence of American chestnut in Kentucky's forests for the past several millennia and has linked increased chestnut density with Native American burning and clearing practices (Delcourt and Delcourt, 1997 & 1998). While range maps detail the pre-blight distribution of American chestnut (Saucier, 1973; Russell, 1987),

very little quantitative information exists regarding the tree's abundance within Kentucky forests (Braun, 1935). Such information will help focus and prioritize Kentucky's chestnut reintroduction activities.

The objective of this project was to survey information regarding the historic distribution and abundance of chestnut across Kentucky. We reviewed independent sources of historic information that each provided county-level estimates of chestnut canopy cover, relative stem density, or timber volume. The sources included land deeds, USDA chestnut blight survey notes, and a statewide inventory of standing timber. The data sources corresponded to the 30-year period leading up to the onset of chestnut blight disease in Kentucky. Taken separately, the inherent biases of historic data may weaken their ability to describe past conditions (Whitney and DeCant, 2001). Comparison between several independent sources, however, should strengthen their predictive value.

SOURCES OF HISTORIC INFORMATION

The statewide distribution and abundance of American chestnut was estimated from an inventory of standing timber resources produced in 1919 by the USDA, Forest Service, and the Kentucky Department of Geology and Forestry (Barton, 1919). This inventory ranked the board footage of the dominant forest species for the 119 Kentucky counties established at that time. One county (McCreary) was established following the data collection phase of the project. Between 7 and 18 tree species were recorded for each county. County area, forested area, and the average stand volume were also estimated. While we have been unable to locate details regarding the data collection protocol, this record provides a unique "snap-shot" of the historic importance of chestnut as a timber species at the time of the arrival of blight in Kentucky.

In Kentucky, land deed surveys were historically delineated by corner trees or distinct topographic features (i.e. streambanks, exposed rock outcrops). Individual land deeds provide a species tally based on the corner trees, along with the ownership, size, and location of the plot (Whitney and DeCant, 2001). Individual deeds were registered and archived at county land offices across the Commonwealth from the time of statehood in 1792, through the early part of the 20th century. Although some of these records have been destroyed by fire, most are still available. Each land survey provides a unique sample of tree species composition within a specific county

and time period. For parcels deeded around the turn of the 20th century (1890-1910), we tallied the corner tree species on a minimum of five deeds per county for about half the counties in Kentucky (n = 54).

As the chestnut blight disease radiated south and west from its point of introduction in New York City through the eastern deciduous forest, plant pathologists from the US Department of Agriculture tracked its progress. Between 1924 and 1931 USDA field agents traveled through Kentucky surveying the abundance and health of chestnut stands. Their systematic assessment noted local topography and overall forest cover. These county-by-county notes provide a third unique record of Kentucky's forest resources, one focused specifically at the presence and abundance of chestnut. Information is available for 51 Kentucky counties, mostly located in the eastern part of the state. During the eight year survey period, nearly 300 stand assessments were recorded, 250 of which were located in the eastern mountains and Knobs region and the rest in the Bluegrass, western Knobs and south-central portions of the state.

The use of historic records as a tool for reconstructing previous forest species composition must be approached with caution and their biases recognized. The reliability of land deed records, for example, may be hampered by species misidentification or selection bias (Whitney, 1994). Surveyors often

Table 1

American chestnut and forest cover estimated during county surveys conducted by USDA forest pathologists between 1924 and 1931. Means followed by the same letter are not significantly different as determined by Tukey's means separation test (a = 0.05).

		Chestnut Cover			Forest Cover			Topography
Physiographic Region	n =	Mean		Max	Mean		Max	Median
		%			%			
Cumberland Mountains	50	20.3	a	50	82.9	a	100	Mountainous
Cumberland Plateau	164	6.7	b	50	65.0	b	100	Low Mountains
Eastern Knobs	41	5.4	b	20	41.2	c	90	Hilly
Western Knobs	9	2.6	bc	20	14.6	d	50	Rolling
Mississippian Plateau	8	2.0	bc	10	19.0	d	80	Rolling to Hilly
Bluegrass	20	0.5	c	2	14.5	d	45	Rolling
Total	**292**	**8.2**		**50**	**58.4**		**100**	

selected trees based on lifespan, timber value, ease in identification, and size. Land settlement patterns present an additional source of bias, which may alter the interpretation of both the land deed and chestnut blight surveys. Early land settlement was most often concentrated on the lower portions of the landscape with property boundaries corresponding to streamcourses. Chestnut, on the other hand, occurs most commonly on steep slopes and ridges. In spite of these and other shortcomings, few other alternatives exist for estimating the pre-blight abundance of chestnut. Physical evidence of chestnut abundance based on the density of stumps, logs and sprouts are becoming less reliable with time. The rate of log or stump decomposition and of chestnut sprout mortality vary across the landscape and bias abundance estimates that are based on the density of residual material.

RESULTS

Based on a 1919 timber inventory, chestnut was listed as a significant portion of the board footage in 75 of Kentucky's 119 counties (Fig. 1). Statewide, chestnut represented 8.5% of the 24,000,000 MBF tallied. Chestnut was distributed throughout the Cumberland Mountains and Plateau, the Knobs Region surrounding the Bluegrass Region, and was scattered throughout the western portion of the state. In 4 counties chestnut was the top-ranked species, representing >20% of the 1919 timber inventory. More than 80% of Kentucky's chestnut stumpage occurred in the 27 counties comprising the Cumberland Mountain and Plateau regions.

In over half the counties of the eastern mountainous counties and in about one-third of the central counties the standing volume of chestnut timber ranked among the top five species. West of Louisville, chestnut ranked among the top 5 species in only 2 counties and was top-ranked in none. Chestnut occurred in only 2 of 27 Bluegrass counties and in 3 of 8 Mississippi Embayment counties in extreme western Kentucky. Statewide, white oak (*Quercus alba*) was the most dominant timber species. It was ranked among the upper five species in 97, 98, and 85% of the counties in the eastern, central and western sections of the state, respectively. Similar to American chestnut, the abundance of chestnut oak (*Q. prinus*) reached its maximum within the Cumberland Mountains and Plateaus and declined westword. Black oak (*Q. velutina*) and hickory (*Carya* spp.) both increased west of the Cumberlands while sugar maple (Acer saccharum) and American beech (*Fagus grandifolia*) reached their highest abundance in the central portion of the state.

American chestnut averaged 8% of the forest cover in the eastern third of Kentucky according to USDA forest pathologists (Table 1). The greatest abundance of chestnut occurred in the Cumberland Mountain region where chestnut averaged 20% and reached 50% of the forest canopy. Chestnut was significantly scarcer in the less mountainous regions and was nearly absent from the Bluegrass, according to blight survey notes. Counties with the greatest chestnut cover also supported the greatest forest cover; the five counties with the most chestnut were all more than 80% forested.

Chestnut corner markers were found on 90% of the land deeds surveyed in the Cumberland Mountain region; they represented 19% of the stems (Table 2). Chestnut stems did not exceed 44% within any region. Land deeds in the Bluegrass and western regions did not mention chestnut, confirming evidence from the other sources of data.

DISCUSSION

The three historic sources estimated the abundance of chestnut with surprising consistency considering that each source quantified different stand variables (Table 2).

The sources each partitioned Kentucky into three zones based chestnut

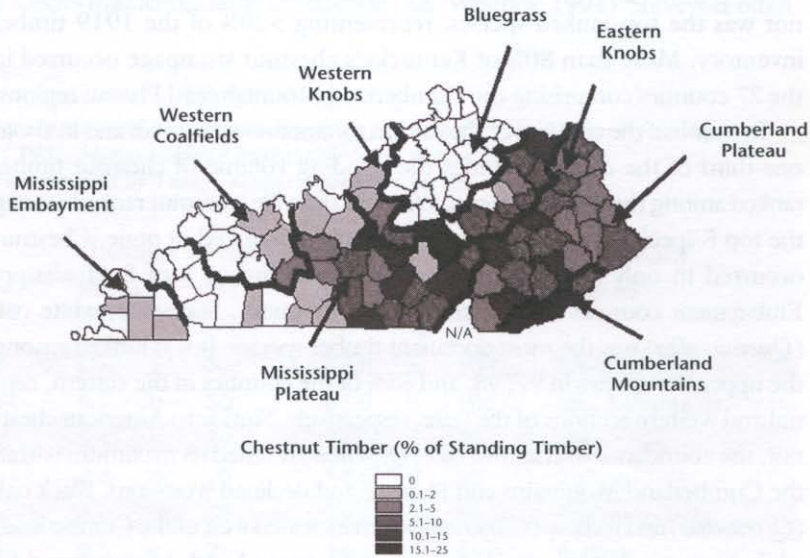

Figure 1 American chestnut as a percent of the volume of total standing timber stocks in 1919

Table 2

The pre-blight abundance of American chestnut in Kentucky estimated from independent information sources.

Physiographic Region	Deeds Records 1890-1910 Stems		Timber Inventory 1919 Standing Volume		Blight Survey 1924-1931 Canopy Cover	
	Mean	Max	Mean	Max	Mean	Max
	%					
Cumberland Mountains	19	44	17	22	20	50
Cumberland Plateau	6	43	7	15	7	50
Eastern Knobs	6	44	7	13	5	20
Western Knobs	2	36	7	19	3	20
Mississippian Plateau	7	40	5	24	2	10
Bluegrass	0	0	0	1	1	2
Western Coalfields	0	0	1	3	nd	nd
Mississippi Embayment	0	0	0	1	nd	nd

abundance. The Cumberland Mountains of extreme southeastern Kentucky contained the greatest density of chestnut. The Cumberland Plateau, Knobs and Mississippian Plateau supported intermediate chestnut abundance. Chestnut was relatively rare in the Bluegrass and western extremity of the state.

The vast majority of Kentucky's chestnut timber and the highest cover and stem densities were confined to a three-county area in the extreme southeastern corner of the state. Early writings noted the great abundance of chestnut in the Cumberland Mountains (deFreise, 1884; Braun, 1935 & 1950). The Cumberlands form the western boundary of Braun's Oak-Chestnut forest region which follows the Blue Ridge and Ridge and Valley physiographic provinces (Fenneman, 1938) and extends northwest from the Tennessee-North Carolina border to central Connecticut (Braun, 1950).

This region includes Pine and Cumberland Mountains, Kentucky's only thrust-fault mountains, where chestnut grows under a wide variety of soil, topographic and abiotic conditions. On xeric sites with shallow, rocky soils on Pine, Cumberland and Brush Mountains, chestnut was associated with a "stunted growth of hardy trees" including "mountain" chestnut oak, red oak, and various pines (deFreise, 1884). Conversely, on richer sites and deeper soils of Black Mountain, chestnut co-occurred with "yel-

low poplar, black walnut, white and blue ash, birch, linden (basswood), and white hickory (butternut)." A survey of Pine Mountain Braun (1935) reported that chestnut was the only overstory species present in all 21 communities situated on both the north- and south-facing slopes on soils formed from shale, sandstone, and limestone parent material. Chestnut was most abundant in Cumberland Mountain oak-chestnut forest (mean: 25% of forest canopy), but was also common in xeric pine-oak stands, mesic mixed mesophytic cove forest, and sugar maple- hemlock- and beech-dominated stands (Braun 1935, & 1950).

Chestnut abundance was intermediate for the majority of Kentucky's eastern and central counties. This region which includes 71 of Kentucky's 120 present-day counties corresponds to the mixed mesophytic forest and oak-hickory forest of the central hardwood region (Bryant, et al. 1993; Hinkle, et al. 1993). The Cumberland Plateau and Knobs of eastern Kentucky contained only about one-third as much chestnut on average as the Cumberland Mountain region; the mean combined across data types was 6% compared to 19% (Table 2). The Mississipian Plateau and western Knobs regions that cover the central third of Kentucky contained similar or only slightly less chestnut than the Cumberland Plateau area. Each data source, however, noted similar maximum values of chestnut canopy cover, standing volume, and stem density between the second-tier regions and the Cumberland Mountains. It is interesting to note that while the blight surveyors mentioned occasional clumps of pure chestnut, at the stand level, chestnut did not surpass half the canopy cover. Statewide, chestnut represented the highest percent of the standing timber stock (24%) in Larue County, directly south of Louisville on the Mississipian Plateau.

Chestnut comprised less than 1% of the forest resources in the remainder of Kentucky: the Bluegrass Region and the western-most portion of the state. Our findings agree with original distribution maps regarding the lack of chestnut from the Bluegrass Region (Saucier, 1973; Russell, 1987). Blight survey notes indicated that chestnut's occurrence within the Bluegrass corresponded to topographic anomalies such as the rocky ledges along the Kentucky River, rather than the rolling Inner Bluegrass plain. While the paucity of chestnut in the Bluegrass is often attributed to the underlying limestone parent material, limestone is also the dominant substrate beneath the Mississipian Plateau and is common with the Knobs region (Karathanasis, 1992 & 1993). It is unclear if chestnut's absence

from the Bluegrass relates to soil chemical differences between the Ordovician limestone of the Bluegrass and the Mississipian limestone sediments found elsewhere or to some other factor (i.e. high plant competition, low fire frequency or intensity). Chestnut was found as far west as Carlisle County, bordering the Mississippi River where it represented 0.1 % of the timber inventory. Deeds surveyed around 1900 noted chestnut as a corner tree no farther west than Edmonson and Barren counties near Bowling Green and Mammoth Cave National Park.

Our review of historic records verifies that American chestnut was an important part of Kentucky's pre-blight forests and helps to delimit priority regions for reintroduction. It remains uncertain how soil and climatic conditions interacted with disturbance processes such as fire, insects, or disease to generate the pattern of chestnut abundance that the early European settlers encountered in Kentucky's forests. As the challenge of reintroducing chestnut to the southern Appalachian region progresses it will be crucial to consider how environmental factors and disturbance events may have changed since the time when chestnut was a dominant part of the forest overstory.

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