United States Department of Agriculture

Forest Service

Northern Research Station

Research Note NRS-144

Historical (1899) Age and Structural Characteristics of an Old-Growth Northern Hardwood Stand in New York State

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Abstract

Based on records taken during a harvest operation in 1899 on more than 400 trees in a northern hardwood stand in upper New York State, age and structural characteristics, including growth patterns, were developed and summarized. Age and size characteristics indicate that this was an exemplary old-growth stand similar in character to current old-growth examples in the northeastern United States. The purpose of this paper is to add to the available information on old-growth stand characteristics in the Northeast.

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INTRODUCTION

Old-growth forests in the eastern United States have received special concern and attention over the last several decades, partly because of their relative scarcity and partly because of their special and enlightening characteristics. By "old growth," we mean stands that have never been harvested but that may have experienced moderate natural disturbances from wind, native insects/diseases, or fire. These stands are of particular ecological interest because they serve as benchmarks for maximum sizes, ages, deadwood, and soil development.

The characteristics and concerns over eastern old-growth forests were well summarized at the Sixth Eastern Old Growth Conference, held in 2004 in New Hampshire (Bennett 2005). This conference addressed the elusive definitions of old growth (Cogbill 2005), strategies for locating this scarce resource (Ingraham 2005, Kane 2005, Leverett 2005, Stoddard 2005), structural and areal characteristics (Chandler 2005, Hagan and Whitman 2005, Snyder 2005, Teeling-Adams 2005, Van de Poll

2005), disturbance history (White et al. 2005), nutrient relationships (Goodale 2005), wildlife habitat (Hagan 2005, Yamasaki 2005), implications for sustainable forest management (Frost 2005, Keeton 2005a), watershed impacts (Keeton 2005b) and threats including development (Niebling 2005, Smith 2005), and biotics (Frelich 2005). Additional research has documented long-term changes (Martin and Bailey 1999), age structures (Leak 1975, 1985), and additional threats such as invasive species (Knapp and Canham 2000).

Recently, a series of tabulations (Form U.S. 558a) were found in Northern Research Station files, Durham, New Hampshire, that provided data taken from felled trees on a cutover old-growth stand described as St. Regis Tract, Township 14, New York State (quite possibly, the area known as Macombs Great Tract #1 of 1792) (Personal communication from J. Jenkins, Adirondack Wildlife Conservation Society). Form 558a (revised 1928) was commonly used to record tree measurements for volume table construction. However, the data on these forms had been copied from earlier forms dated 1899 (U.S. Department of Agriculture, Division of Forestry), which included age and 10-year diameter growth at stump height (about 2.5 feet), age and diameter growth at the top of the first log (about 15 feet), as well as the upper logs, total height, and some additional tree/site characteristics. According to Spurr (1952), the growth records were probably taken along a radius equal to one-half tree diameter to provide consistency and avoid bias. (See Appendix for an example of the 1899 USDA Division of Forestry form). The forms used in this analysis were bound in the same folder and presumably came from the same stand.

The stand was harvested in 1899, apparently by the diameter-limit method, common in that period, removing all merchantable trees of about 14 to 15 inches d.b.h. and larger as well as a few smaller ones. So the record includes entire stand characteristics above about 14 to 15 inches d.b.h. There were no notes indicating that this was considered an old-growth stand. However, the size and age characteristics described below speak for themselves. Data from dominant trees in another similar stand, located in the same region, were previously used for a detailed analysis of long-term growth trends (Leak 2011). The present paper concentrates on old-growth stand characteristics.

METHODS

The entire sample consisted of 241 sugar maple (*Acer saccharum*), 95 beech (*Fagus grandifolia*), 77 yellow birch (*Betula alleghaniensis*), 12 basswood (*Tilia americana*), and 7 soft (red) maple (*Acer rubrum*); trees with excess rot that hampered age/growth determinations were not used (primarily yellow birch with 31 rejected samples). The species mix with high proportions of sugar maple and the presence of basswood indicates an excellent site. Data from the forms were simply tabulated, graphed, and described as follows. There are no records of the acreage of the stand that was sampled; probably it was large. However, a sample of 463 sawtimber trees likely would represent at least 10 acres. Due to the harvesting protocol (few trees harvested below about 14 inches d.b.h), the sizes and ages are truncated to some degree at the lower end, which limits a strict, numerical analysis of distribution characteristics.

AGE AND SIZE

Tree age at stump level (2.5 feet) ranged up to about 300 years for sugar maple and beech, up to more than 350 years (368 years maximum) for yellow birch, and a little less than 200 years for basswood and soft (red) maple (Fig. 1, A-E). These ages generally exceed the ages found in well-known New England old-growth areas such as The Bowl Research Natural Area (Leak 1985) where maximum recorded ages for sugar maple, beech, and yellow birch were 175 (n=47), 258 (n=46), and 267 (n=24), respectively (Leak 1985). However, keep in mind that the numbers of samples in The Bowl were less than in the New York stand, which would limit estimates of maximum ages. Maximum ages of sugar maple and beech in the East Tionesta old-growth forest in Pennsylvania (Hough and Forbes 1943) were 420 and 366 years, respectively, while yellow birch also attained a maximum age of 366 years.

The relationship of age over d.b.h. was poorly correlated for sugar maple and beech (r^2 = 0.27 and 0.09,

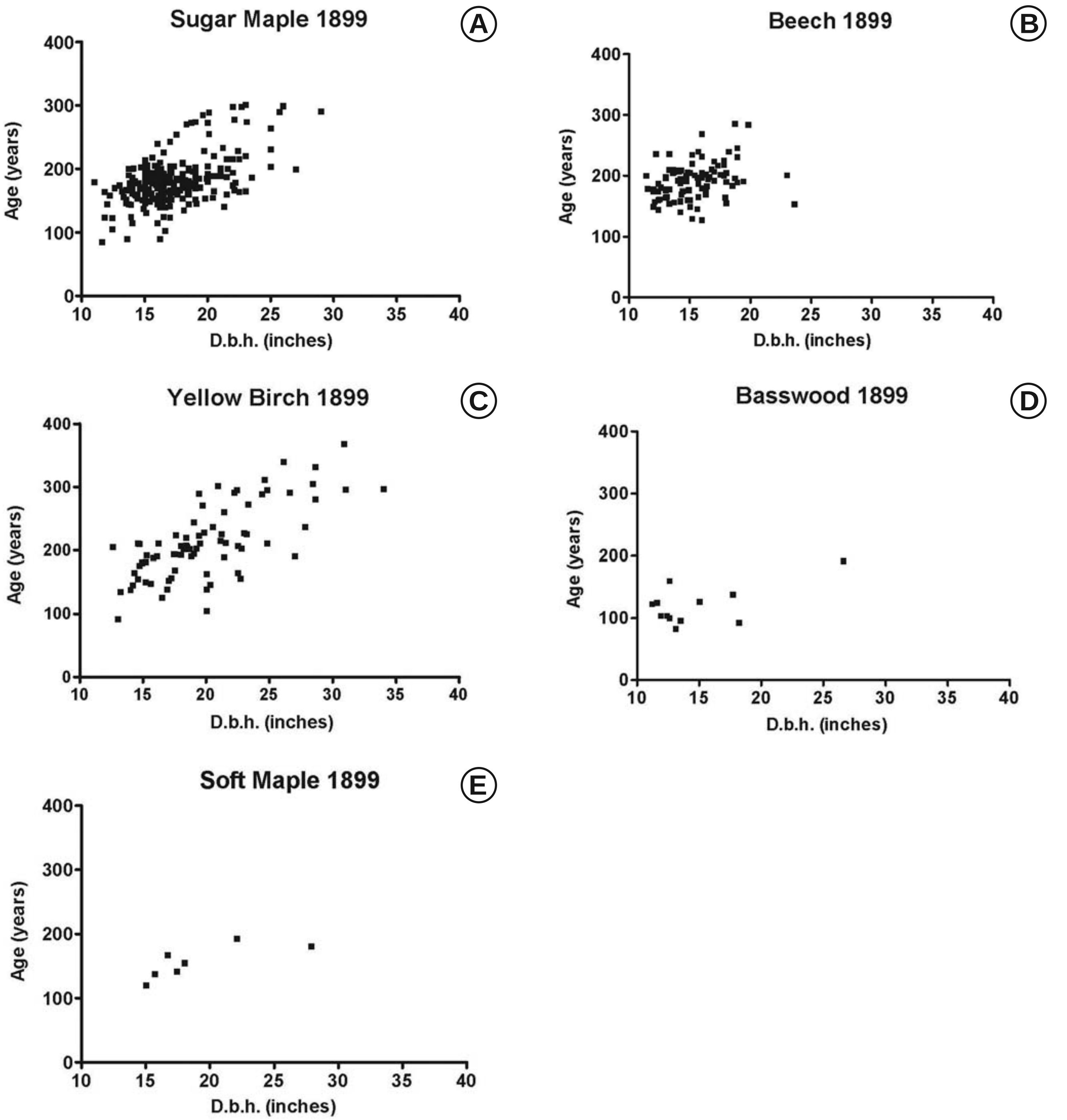

Figure 1.—Age at stump height over d.b.h. for A. sugar maple, B. beech, C. yellow birch, D. basswood, and E. soft (red) maple.

respectively), but considerably better correlated for yellow birch ($r^2 = 0.51$). This reflects the intermediate shade tolerance of yellow birch, a species that does not survive and grow well under a closed canopy.

Sizes ranged up to 34 inches d.b.h. for yellow birch, a little less than 25 inches for beech, and between 25 and 30 inches for the other species.

Table 1.—Mean and standard error (in parentheses) of 10-year (1889-1899) inside bark diameter growth at stump height and top of first log by species

Species	Stump Height (in.)	Top First Log (in.)	N
Sugar Maple	1.52 (0.04)	1.13 (0.03)	241
Beech	1.25 (0.05)	0.97 (0.04)	95
Yellow Birch	1.12 (0.06)	0.88 (0.04)	77

TOTAL HEIGHT

Total heights were not unusual: up to about 100 feet for all species, with a few taller individuals of sugar and soft maple. There was a slight and variable positive relationship between height and tree d.b.h. (Fig. 2, A-E).

SIZE/AGE CLASS DISTRIBUTION

The size-class distribution (number of trees over 2-inch d.b.h. classes) for sugar maple, beech, and yellow birch shows some evidence (above 15 inches d.b.h.) of the typical declining, somewhat J-shaped, trend typical of most older northern hardwood stands (Fig. 3, A-C). Below 15 inches d.b.h., the distribution would be skewed due to the limited harvesting of smaller trees.

The age-class distributions (Fig. 4, A-C) centered on trees of about 200 years of age or a little less; again, the lower portions of these graphs would be affected by the harvesting regime. The shapes of these graphs are fairly similar for all three species, showing a broad range in tree age. Sugar maple and beech regenerate consistently under a closed canopy, perhaps with small-scale disturbances. Due to its intermediate shade tolerance, yellow birch regenerates and survives only under moderate to heavy canopy disturbances. The wide range in age of this species indicates that such levels of disturbance were quite common in the study area. Detailed age distributions from The Bowl Research Natural Area (Leak 1975) in New Hampshire show that sugar maple and beech in old-growth forests typically have well-developed, inverse-J-shaped distributions down to the youngest age class, while yellow birch tends to have a skewed normal distribution. This reflects the tendency for yellow birch to regenerate and survive poorly under a closed canopy and to depend on natural disturbances to become established (Peterson 2000).

DIAMETER GROWTH

Diameter growth records showed that 10-year d.i.b. growth at both the stump height (Fig. 5, A-C) and top of first log (Fig. 6, A-C) were extremely variable. There are some indications, with yellow birch especially, of a decline with increased d.b.h., but not a very distinct relationship. Average values (Table 1) show rates of about 0.9 to 1.5 inches over a 10-year period. Values at stump height are variable and inflated somewhat by the root swell. Growth rates at d.b.h, the typical measurement point for diameter growth, would be somewhere between the stump and first log values. These rates have been shown to be reasonably similar to current rates of growth (Leak 2011, Long et al. 2009).

CONCLUSIONS

Based on ages and diameters of about 300 to 350 years and up to 34 inches d.b.h, this New York stand apparently qualifies as an excellent example of a northern hardwood old-growth stand. The high proportion of sugar maple and the presence of basswood indicate that the site was excellent. Maximum ages of 366 years have been reported for beech and yellow birch, while ages of up to 420 years have been reported for sugar maple in Pennsylvania (Hough and Forbes 1943). However, well-documented old-growth stands in New England (e.g., The Bowl) exhibit some lower ages for these species, somewhere within the 200- to 300-year range (Leak 1985). It is uncertain why maximum tree ages by species vary from place to place.

Average diameter growth at stump height over a 10-year period ranged from 1.52 inches (sugar maple) to 1.12 inches (yellow birch), while rates at the top of the first log ranged from 1.13 to 0.88 inches. These rates are comparable to present-day growth rates, especially considering the excellence of the New York site.

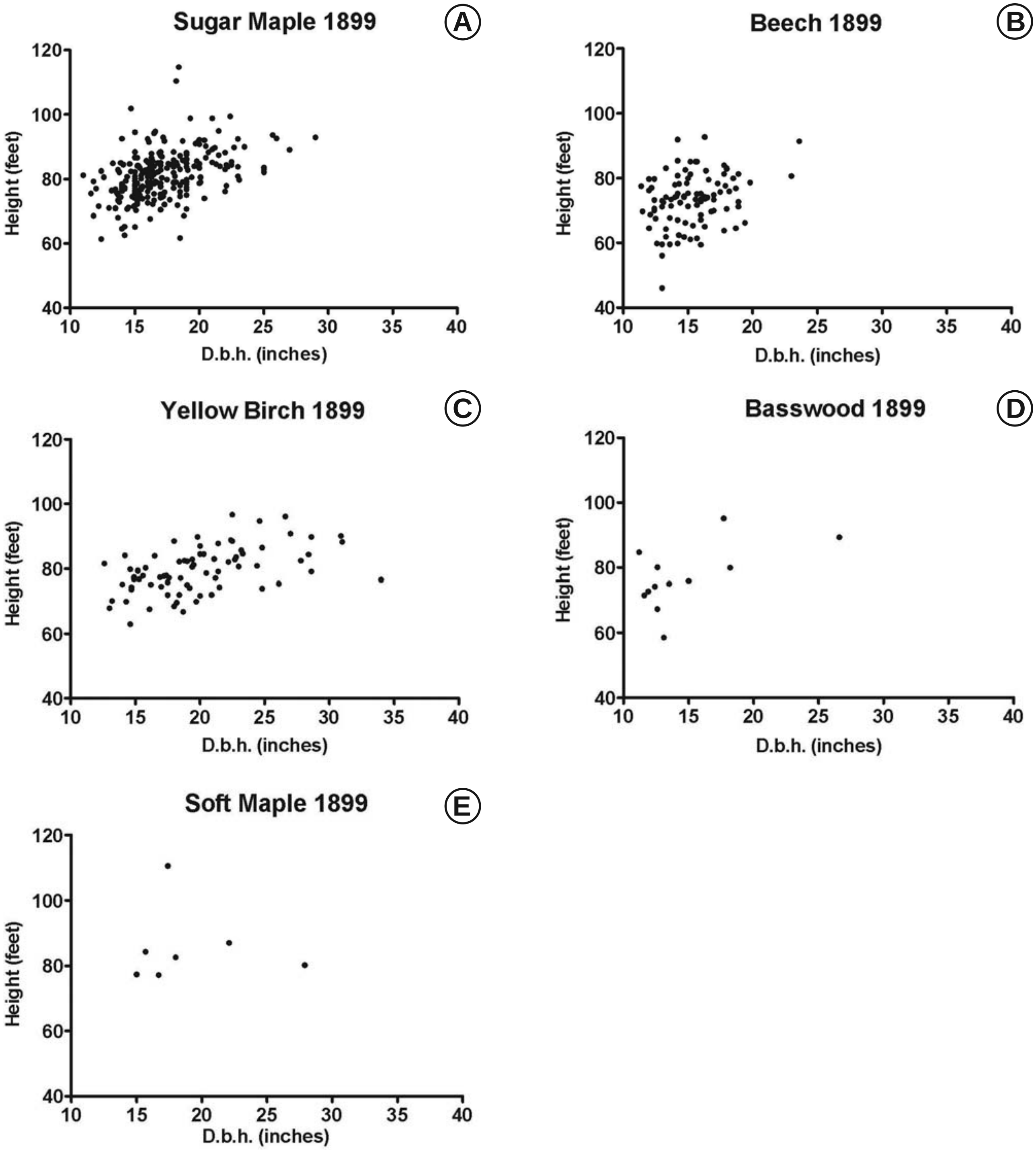

Figure 2.—Total height over d.b.h. for A. sugar maple, B. beech, C. yellow birch, D. basswood, and E. soft (red) maple.

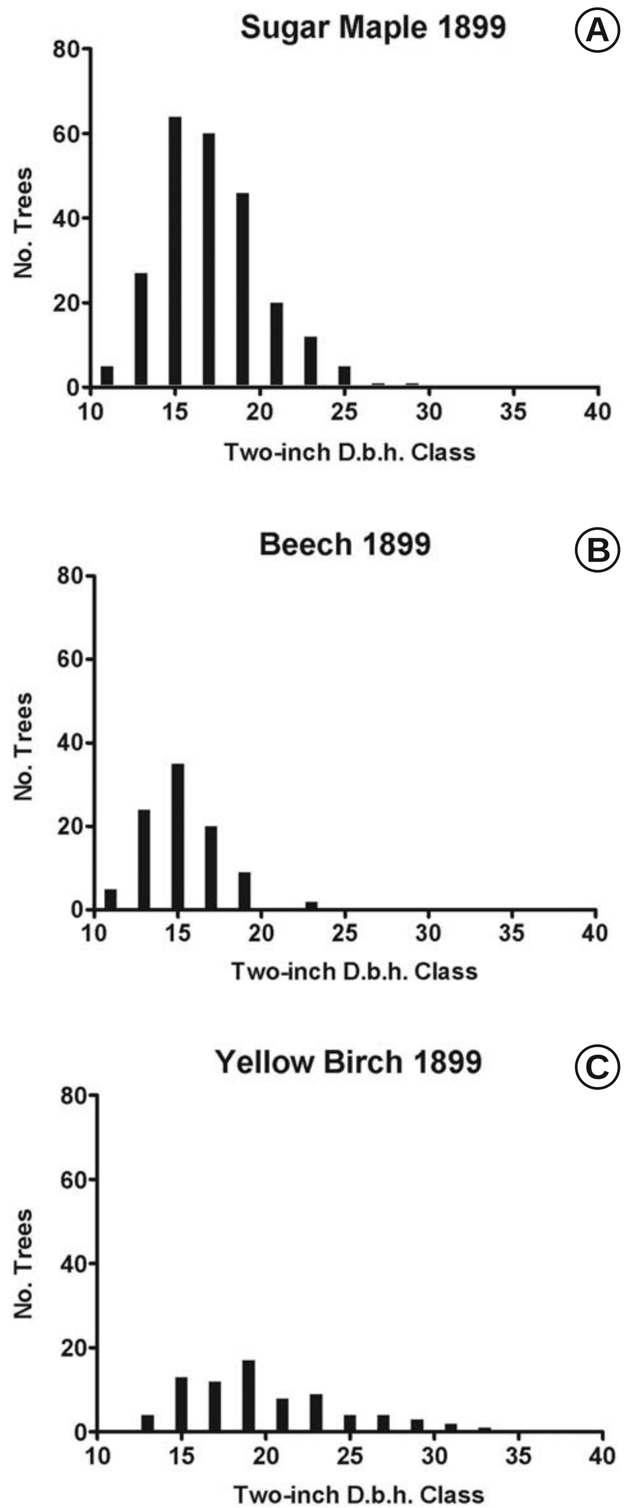

Figure 3.—Number of trees by 2-inch d.b.h. classes for A. sugar maple, B. beech, and C. yellow birch.

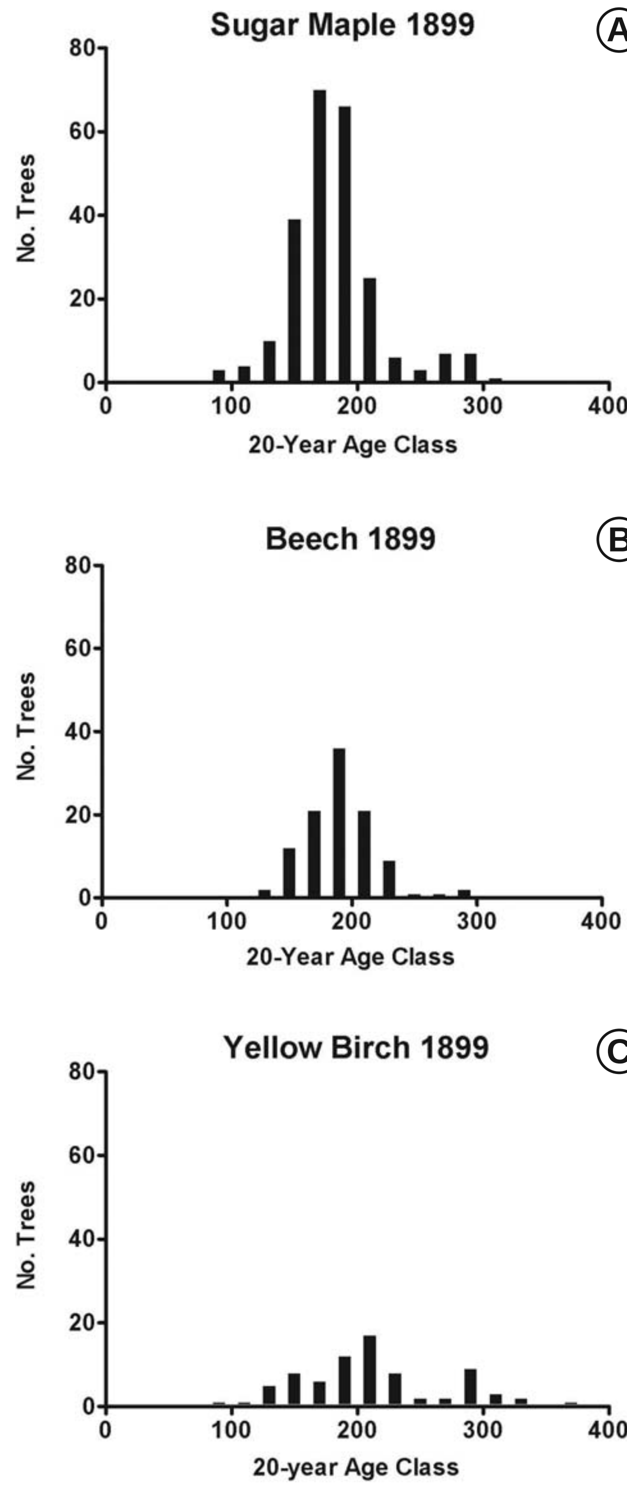

Figure 4.—Number of trees by 20-year age class for A. sugar maple, B. beech, and C. yellow birch.

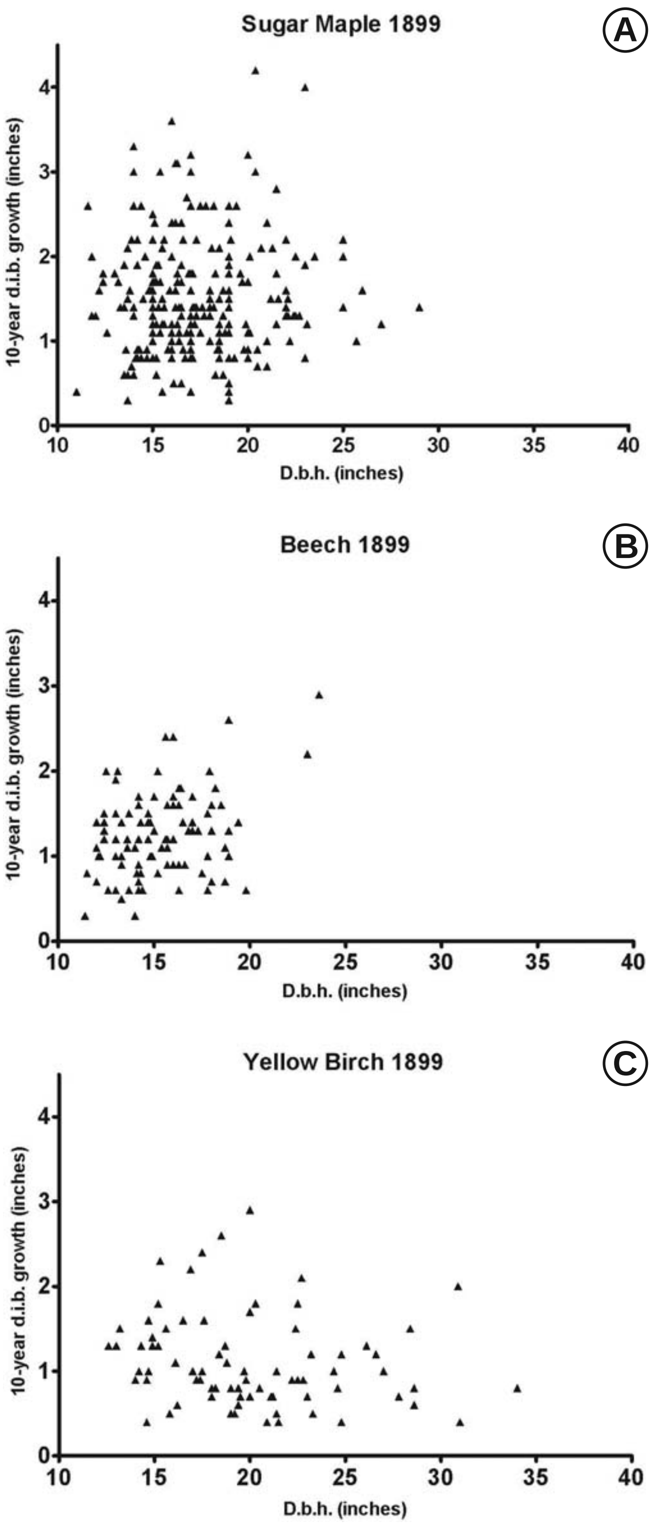

Figure 5.—Ten-year inside bark diameter growth at stump height by d.b.h. for A. sugar maple, B. beech, and C. yellow birch.

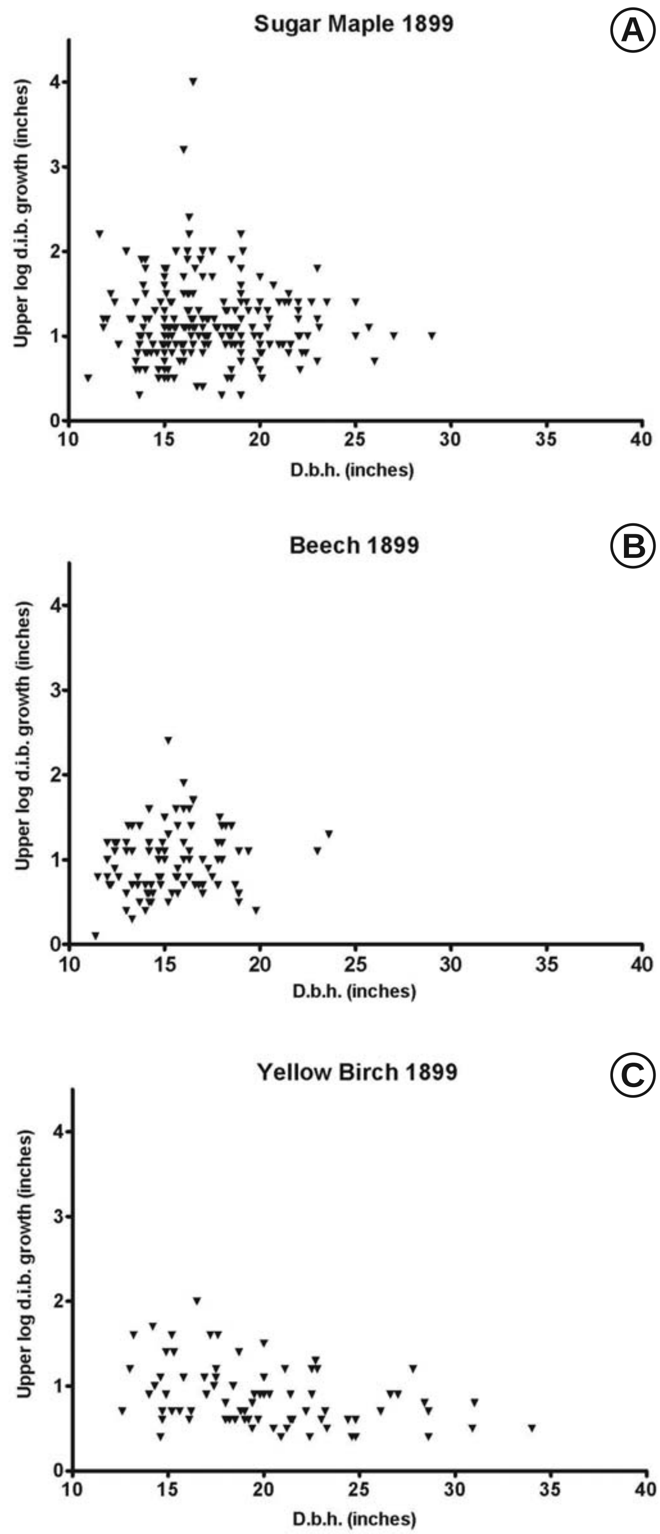

Figure 6.—Ten-year inside bark diameter growth at top of first log by d.b.h. for A. sugar maple, B. beech, and C. yellow birch.

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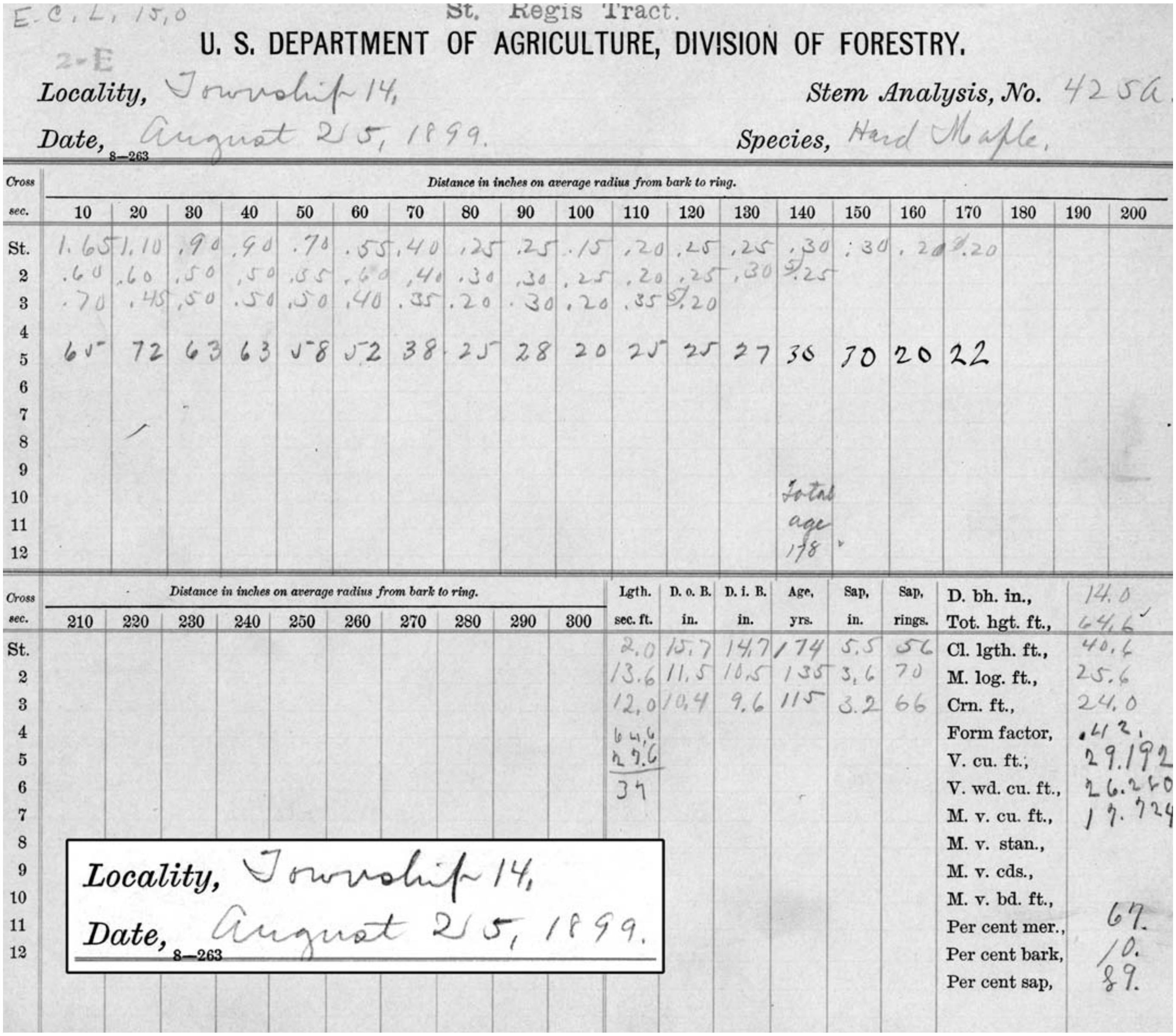
APPENDIX



E. C. L. 15.0

St. Regis Tract.

2-E

U. S. DEPARTMENT OF AGRICULTURE, DIVISION OF FORESTRY.

Locality, Township 14, *Stem Analysis, No.* 425a.

Date, August 25, 1899. *Species,* Hard Maple.

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Cross sec.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
St.	1.65	1.10	.90	.90	.70	.55	.40	.25	.25	.15	.20	.25	.25	.30	.30	.20	.20			
2	.60	.60	.50	.50	.55	.60	.40	.30	.30	.25	.20	.25	.30	.25						
3	.70	.45	.50	.50	.50	.40	.35	.20	.30	.20	.35	.20								
4																				
5	65	72	63	63	58	52	38	25	28	20	25	25	27	36	70	20	22			
6																				
7																				
8																				
9																				
10														Total						
11														age						
12														178						

Distance in inches on average radius from bark to ring.

Cross sec.	210	220	230	240	250	260	270	280	290	300	Lgth. sec. ft.	D. o. B. in.	D. i. B. in.	Age, yrs.	Sap, in.	Sap, rings.
St.											2.0	15.7	14.7	174	5.5	56
2											13.6	11.5	10.5	135	3.6	70
3											12.0	10.4	9.6	115	3.2	66
4											64.6					
5											27.6					
6											37					
7																
8																
9																
10																
11																
12																

D. bh. in.,	14.0
Tot. hgt. ft.,	64.6
Cl. lgth. ft.,	40.6
M. log. ft.,	25.6
Crn. ft.,	24.0
Form factor,	.412
V. cu. ft.,	29.192
V. wd. cu. ft.,	26.260
M. v. cu. ft.,	17.724
M. v. stan.,	
M. v. cds.,	
M. v. bd. ft.,	
Per cent mer.,	67.
Per cent bark,	10.
Per cent sap,	89.

Locality, Township 14,

Date, August 25, 1899.

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Example of an original USDA Division of Forestry tally sheet dated 1899.

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