

1 **Dendroarchaeological analysis of the Terminal Warehouse in New York City reveals a**
2 **history of long-distance timber transport during the Gilded Age**

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4 Caroline Leland^{a,*†}, Mukund Palat Rao^{a,b,c,*†}, Edward R. Cook^a, Benjamin I. Cook^{d,e}, Bryan M.
5 Lapidus^f, Andrew B. Staniforth^f, Alan Solomon^g, Marguerite Y. Holloway^h, Milagros Rodriguez-
6 Caton^a

7

8 ^aTree Ring Laboratory, Lamont-Doherty Earth Observatory of Columbia University, Palisades,
9 NY 10964, US

10 ^bCooperative Programs for the Advancement of Earth System Science, University Corporation
11 for Atmospheric Research, Boulder, CO 80301, US

12 ^cDepartment of Plant Science, University of California, Davis, CA 95616, US

13 ^dNASA Goddard Institute for Space Studies, New York, NY 10025, US

14 ^eOcean & Climate Physics, Lamont-Doherty Earth Observatory of Columbia University,
15 Palisades, NY 10964, US

16 ^fL&L Holding Company, LLC, NY 10019, US

17 ^gSawkill Lumber, LLC, Brooklyn, NY 11238, US

18 ^hSchool of Journalism, Columbia University, New York, NY 10027, US

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20 *The authors contributed equally to this manuscript

21 †Corresponding authors:

22 Caroline Leland; email: cleland@ldeo.columbia.edu

23 Mukund Palat Rao; email: mukund@ldeo.columbia.edu

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25 **Abstract**

26 The Gilded Age of the late 19th century marked a period of rapid development and urbanization
27 in New York City, U.S. To accommodate the high demand in wood products during that time,
28 the timbers used for development of the city were increasingly sourced from locations distant
29 from the northeastern United States. The Terminal Warehouse in the Chelsea neighborhood of
30 New York City was one of many large buildings erected during this period of city expansion,
31 and is an important symbol of New York City commerce during the late 1800s. To determine the
32 history and provenance of timbers used in the construction of the Terminal Warehouse, we used
33 tree-ring analysis on longleaf pine (*Pinus palustris* Mill.) joists that were original to the building.
34 The ring-width patterns on the joists crossdated well internally, suggesting a common origin of
35 the sampled lumber. Further, our Terminal Warehouse tree-ring chronology (1512-1891 C.E.)
36 correlated strongly with existing tree-ring chronologies from western/central Georgia and eastern
37 Alabama, indicating that the timbers were extracted from this region of the southeastern United
38 States. The provenancing and dating of the Terminal Warehouse timbers underscores the
39 important role that southern pines played in the expansion and development of New York City
40 during the Gilded Age.

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46 **Keywords**

47 Dendroprovenance, longleaf pine, yellow pine, *Pinus palustris*, southeast US

48

49 **1. Introduction**

50 The Terminal Warehouse building is located between 11th and 12th Avenue and 27th and 28th
51 streets in the West Chelsea Historic District of lower Manhattan, New York City (NYC), New
52 York, U.S. (Fig. 1). The warehouse was built by William W. Rossiter in the early 1890s [King,
53 1893], a time of rapid industrialization of the New York City region, and is comprised of 25 sub-
54 buildings [Burrows and Wallace, 1999]. A large majority of these units were originally used to
55 store wines, liquors, rubber, fur, rugs, robes, and Broadway theatre sets, while four units
56 functioned as United States bonded warehouses [King, 1893; Miller, 2012]. At the time of its
57 construction during the late 19th century, private refrigeration was uncommon and the building
58 was one of few that offered cold storage facilities. The signage advertising its cold storage
59 facilities is still visible on the facade of the building (Fig. 1). The tracks of the New-York Central
60 Railroad and the Hudson River Railroad ran directly into the building, and its western end
61 included a pier into the Hudson River facilitating the easy loading and unloading of goods into
62 the Warehouses' storage units [Fig. 1; King, 1893; See Plate 14 in *Lionel Pincus and Princess*
63 *Firyal Map Division*, 1885; Miller, 2012]. The immense scale of the building with close to 0.1
64 km² (1 million sq. ft.) of real estate space, along with its easy accessibility to shipping, rail
65 transportation, warehousing, and packing, made the Terminal Warehouse a key symbol of the
66 development of New York City in the late 19th and early 20th centuries.

67

68 The expansion of urban centers like New York City in the late 19th century, the so-called Gilded
69 Age in the U.S. [Stiglitz, 2015], depended on vast amounts of wood for construction, fuel,
70 charcoal, railroad ties, and ship building. Many buildings in New York City erected during that
71 period were constructed using lumber from old-growth forests; these timbers were valuable

72 construction materials due to their high density, hardness, and strength [Bergsagel and Lynch,
73 2019]. White pine (*Pinus strobus* L.) along with other northern conifers (e.g., spruce, hemlock,
74 and fir), and southern longleaf pine (*Pinus palustris* Mill.) were commonly used. This demand
75 for timber led to the widespread deforestation of the eastern United States [Pfaff, 2000], and a
76 notable loss of old-growth forests. By the end of the nineteenth century, the northeastern U.S.
77 had lost nearly 70% of its original stands of forest [Kellogg, 1909]. Consequently, the wooden
78 construction materials for many of the buildings constructed during this era were sourced from
79 regions distant from New York such as Maine, Florida, Pennsylvania and other locations across
80 the eastern U.S. and Great Lake States.

81

A)



B)



C)



82

83 **Figure 1:** *Historic and modern photographs of the Terminal Warehouse in Chelsea, New York*
84 *City, NY, U.S. Panel A) shows an artistic rendering of the west-facing view of the Terminal*
85 *Warehouse from the year 1912 along the Hudson River [New York (N.Y.). Department of Docks*
86 *and Ferries, 1906]. Close observation of image A) shows the presence of railroad tracks*
87 *connecting the pier in the Hudson River to the interior of the Warehouse. Panels B) and C) show*
88 *the eastern face of the Terminal Warehouse from 1892 [King, 1893] and 2019 (credit: Terminal*
89 *Fee Owner, LP), respectively. Close observation of image B) shows a freight train in the process*
90 *of exiting the Terminal Warehouse onto 28th St. and 11th Avenue in New York City.*

91
92 In the case where the source of timber from a building is of interest, but written records are not
93 available, tree-ring analysis can be performed to reveal the specific history of construction. The
94 use of tree-ring records to determine the geographic origin, age, and general history of woody
95 material from various structures has been practiced since the early 20th century [e.g., *Douglass,*
96 *1929; Hawley, 1934*], and is broadly referred to as dendroarchaeology [*Speer, 2010*].
97 Specifically, dendroprovenancing refers to the use of dendrochronological methods to locate the
98 region of origin of wooden material [*Bridge, 2012; Eckstein and Wrobel, 2007*]. Once the tree
99 species utilized for construction has been identified, standard methods of dendroprovenancing
100 typically rely on i.) the presence of unique micro-climatic fluctuations at the source location that
101 facilitates the development of a crossdated chronology, and ii.) an established network of
102 chronologies that aid in exactly dating the timbers and determining the proximate provenance
103 location [*Domínguez-Delmás, 2020; Pearl et al., 2020*]. To name a few modern examples,
104 dendroprovenancing has been used to successfully locate the source of wooden material found in
105 shipwrecks on the Iberian Peninsula [*Domínguez-Delmás et al., 2013*] and of a buried shipwreck

106 under the former World Trade Center building of New York City [*Martin-Benito et al.*, 2014], as
107 well as to understand timber procurement by Ancestral Puebloan people at Chaco Canyon
108 [*Guiterman et al.*, 2016], and to decipher the construction history of colonial era buildings in the
109 northeastern U.S. [*Krusic et al.*, 2004].

110

111 Historical records of timber procurement are not available for many notable late 19th and early
112 20th century structures in New York City. To better understand the history of the Terminal
113 Warehouse, here we use dendrochronology to provenance and date the timber material used in
114 the construction of the building. This analysis will shed light on the specific sourcing of timbers
115 for the Terminal Warehouse, an archetypal example of New York City construction during this
116 era. In doing so, we will provide a perspective on timber transport and the logging industry that
117 facilitated the rapid development of New York City in the late 19th century.

118

119 **2. Material and Methods**

120 Tree-ring samples were collected from the Terminal Warehouse in the Chelsea neighborhood of
121 New York City in June and July of 2019. We collected cross-sections from several remnant joists
122 from the original construction that had been disassembled and were being stored in the cellar of
123 the Terminal Warehouse (Fig. 2). We selectively sampled 22 joists that i) were considered to
124 have a sufficient number of rings for dendrochronological analysis (at least ~150 visible rings);
125 ii) preferably contained bark or sapwood for a better estimate of felling dates; and iii) were
126 accessible for safe cutting with the chainsaw. All of the sampled joists were likely installed
127 around the same time, soon after the building permit was issued in June of 1890. That said, there

128 were certain areas of the Terminal Warehouse that were reconstructed after damage from fires in
129 1902 and 1912 [*New York Times*, 1902; 1912].

130



131

132 **Figure 2:** A) Remnant longleaf pine joists stored in the basement of the Terminal Warehouse in
133 Chelsea, New York City; B) Four joist timbers (TWB04, TWB05, TWB06, and TWB12) after
134 being cut, sanded, and prepared for dendrochronological analysis.

135

136 The tree-ring samples were taken to Columbia University’s Lamont-Doherty Earth Observatory
137 Tree Ring Laboratory in Palisades, New York, for standard dendrochronological processing
138 [*Stokes and Smiley*, 1968]. We determined that the timbers collected from the Terminal
139 Warehouse were longleaf pine (*Pinus palustris* Mill.) due to the high resin content, pronounced
140 latewood banding with varying widths, and pencil-sized pith of the samples [*Wahlenberg*, 1946],
141 (Fig. 2). The samples were dried and sanded with progressively finer sandpaper so that the rings
142 were clearly visible for visual inspection under a stereoscope. The rings on each cross-section
143 were initially counted along two radii and visually cross-referenced to ensure all rings were

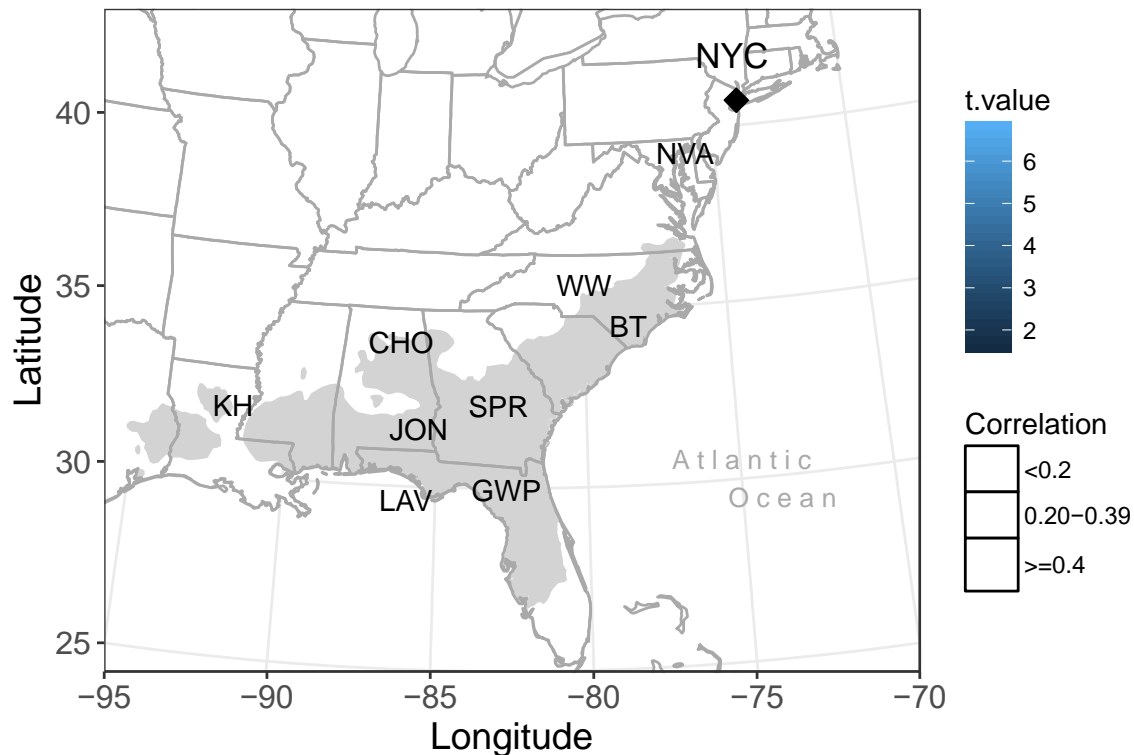
144 counted. A single radius on each cross-section was measured as undated (i.e., arbitrary pseudo-
145 dates were assigned) to a precision of ± 0.001 mm using a sliding measuring stage and the
146 program Measure J2X. The undated tree-ring series were then collated and internally cross-dated
147 against one another both visually and using the program COFECHA [Holmes, 1983]. Based on
148 this analysis, measured series were temporally shifted to produce an undated chronology. Each
149 series was detrended using a cubic smoothing spline with a 50% wavelength cutoff at 32 years to
150 obtain tree-ring indices [Cook and Peters, 1981] and we calculated the bi-weight robust mean of
151 the indices to develop the undated Terminal Warehouse master chronology.

152

153 To provenance the Terminal Warehouse samples, the undated chronology was compared against
154 several existing longleaf pine tree-ring chronologies. The native range of longleaf pine is in the
155 southeastern United States (Fig. 3), therefore we hypothesized that the timbers were likely
156 harvested from this region soon before being transported to New York City. To determine where
157 within this region the timbers likely originated, we compared the undated Terminal Warehouse
158 master chronology with nine reference longleaf pine chronologies from five states: Alabama
159 (n=1), Georgia (n=4), Louisiana (n=1), North Carolina (n=2 adjacent sites), and Virginia (n=1)
160 (Fig. 3). Chronology comparisons between the Terminal Warehouse chronology and the
161 reference chronologies were performed by calculating the nonparametric Spearman's rank
162 correlation coefficient for 50-year periods with 25-year overlaps in the program COFECHA
163 [Holmes, 1983], and we assessed the highest correlations across all site comparisons and
164 overlapping periods to date the Terminal Warehouse chronology.

165

166 As an additional analysis for provenancing the timbers, we compared the master Terminal
167 Warehouse chronology against the North American Drought Atlas [NADA - Cook *et al.*, 2004;
168 Cook *et al.*, 2010] using nonparametric Spearman's rank correlation coefficients to identify the
169 general region that most strongly correlated with the warehouse timbers. These correlations were
170 calculated on a grid-cell-by-grid-cell basis between the final dated Terminal Warehouse
171 chronology and the NADA using their common period of overlap (1670-1891, see results).



172
173 **Figure 3:** Locations of longleaf pine (*Pinus palustris*) chronologies compared against the
174 Terminal Warehouse master chronology located in New York City (NYC; black diamond). The
175 size of the circles corresponds to the Spearman's rank correlation coefficient between the
176 Terminal Warehouse chronology and each site, and the shade of blue represents the t-value for

177 *the same comparisons (see Table 2 for site codes, correlations, and t-values). The distribution*
178 *range of longleaf pine based on Little [1971] is shown in light gray.*

179

180 **3. Results**

181 Of the 22 longleaf pine joists that were sampled from the Terminal Warehouse, 16 samples could
182 be internally crossdated (Table 1). The crossdated series ranged in length from 114 to 268 rings
183 and yielded a Spearman's intercorrelation of $r = 0.42$ ($p < 0.01$) (Table 1). The strong
184 intercorrelation between samples suggests that the joist timbers were likely sourced from a
185 similar region, and thus could be combined into a single master chronology. The final
186 chronology was derived as the bi-weight robust mean of the detrended, internally cross-matched
187 series. Seven of these samples contained sapwood on the outer portion of the joist (Table 1), and
188 one sample (TWB12) appeared to have a waney edge (Fig. 2), allowing us to better estimate the
189 felling date/period of the timbers used in construction.

Seq	ID	# Years	Sapwood	CORREL	Dating
1	TWB01	172	Yes	0.410	1664-1835
2	TWB02	149	No	0.401	1670-1818
3	TWB03	190	No	0.444	1613-1802
4	TWB04	207	Yes	0.382	1652-1858
5	TWB06	150	Yes	0.515	1703-1852
6	TWB07	127	Yes	0.462	1731-1857
7	TWB08	151	No	0.370	1650-1800
8	TWB09	182	Yes	0.447	1709-1890
9	TWB10	203	No	0.281	1623-1825
10	TWB11	196	Yes	0.436	1694-1889

11	TWB12	168	Yes	0.386	1724-1891
12	TWB14	166	No	0.529	1669-1834
13	TWB16	144	No	0.473	1669-1812
14	TWB19	114	No	0.436	1749-1862
15	TWB20	167	No	0.479	1639-1805
16	TWB21	268	No	0.327	1512-1779

190

191 **Table 1:** Joist samples collected from the Terminal Warehouse during the summer of 2019. The
 192 presence of sapwood for each series is indicated. The CORREL column refers to correlation of
 193 each series against the master chronology based on all dated series from the Terminal
 194 Warehouse. The number of crossdated years (# Years) and the matching period (Dating)
 195 corresponding to tree-ring data from Georgia and Alabama (Choccolocco Mountain and
 196 Spreewell Bluff sites) are shown. TWB05, 13, 15, 17-18, and 22 remain undated and are
 197 excluded from the table.

198

199 In comparing the undated Terminal Warehouse chronology with the longleaf pine reference
 200 chronologies the Terminal Warehouse chronology most strongly correlated with Choccolocco
 201 Mountain, Alabama (CHO) from 1690-1891 C.E. (Spearman's rank-order correlation (r_s) = 0.44,
 202 $p < 0.01$, $t = 6.9$, $n = 202$), followed closely by Spreewell Bluff, Georgia (SPR) from 1754-1891
 203 C.E. ($r_s = 0.40$, $p < 0.01$, $t = 5.1$, $n = 138$; Table 2, Fig. 3). In both cases, the strongest statistical
 204 matches yielded an outermost date of 1891 for the Terminal Warehouse chronology. The
 205 Choccolocco Mountain and Spreewell Bluff sites are located near one another along the border
 206 between Georgia and Alabama (Fig. 3), and when we averaged their chronologies, the

207 correlation with the Terminal Warehouse chronology increased ($r_s = 0.54$, $p < 0.01$, 1690-1891
 208 C.E., $t = 9.1$, $n = 202$; Table 2, Fig. 4).

209

210 The full Terminal Warehouse chronology extends back to 1512 with an outermost date of 1891,
 211 and the years 1612-1890 consist of two or more series (Fig. 4a-b). The common signal of the
 212 detrended series as measured by the Expressed Population Signal [*EPS: Wigley et al., 1984*] is
 213 strongest (>0.70) from around 1670-1815, but weakens slightly before and after those dates due
 214 to a decline in sample size (Fig. 4b). Therefore, for the correlation analyses with all sites, we
 215 truncated the Terminal Warehouse chronology at 1670, when the sample depth drops below ten
 216 series.

217

218 The dates of individual series based on an outermost chronology date of 1891 are shown in Table
 219 1. Only one series reached an outermost date of 1891 (TWB12), though two other samples had
 220 an outer ring close to this date (1889 and 1890 for TWB11 and TWB09, respectively). These
 221 three samples had a considerable proportion of sapwood and TWB12 appeared to have a waney
 222 edge.

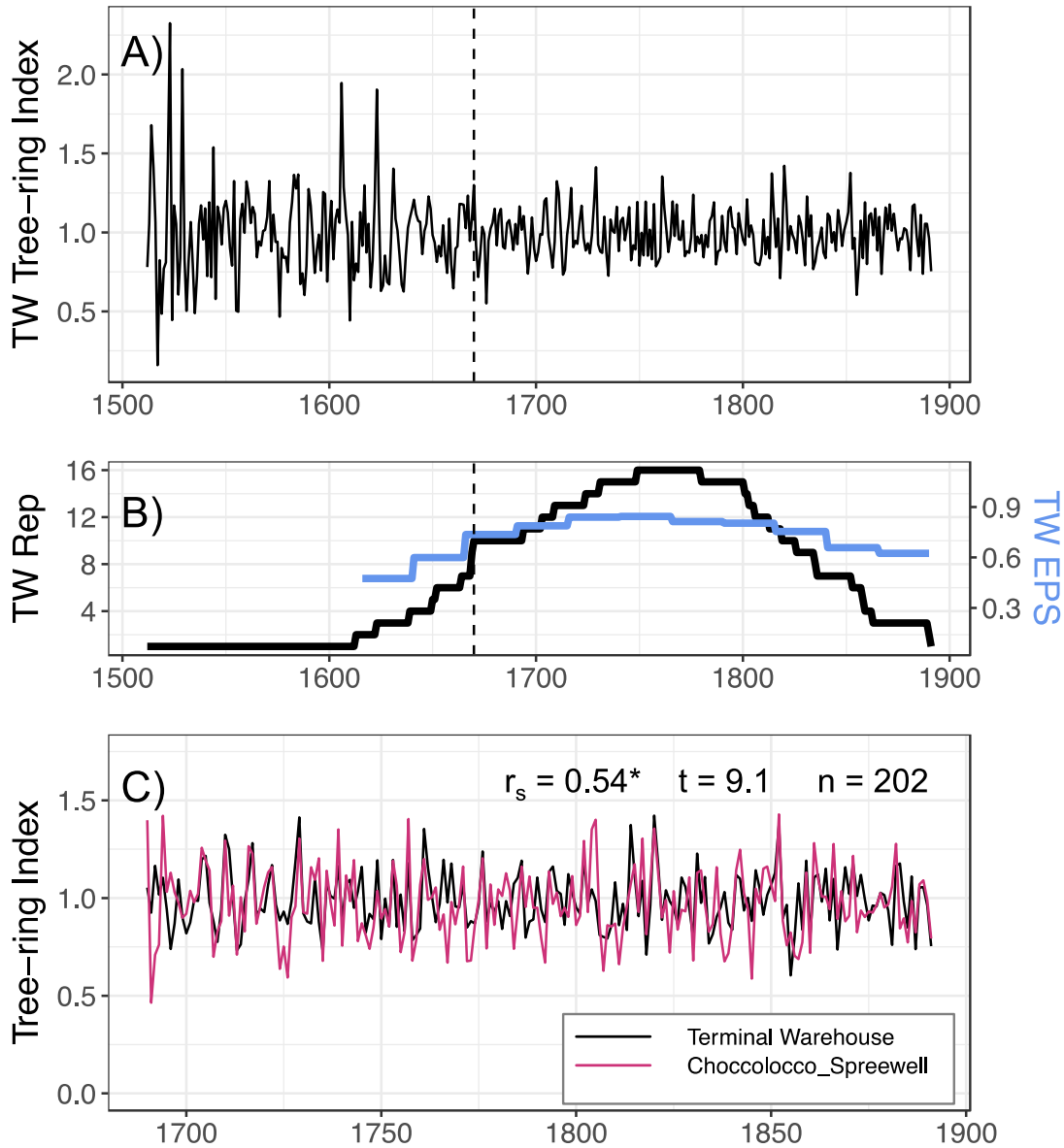
223

<i>P. palustris</i> Chronology (U.S. State)	Code	FY	LY	N	r_s (*sig)	t	Reference
Choccolocco Mountain (AL)	CHO	1690	1891	202	0.44*	6.9	[<i>Guyette et al., 2012</i>]
Greenwood Plantation (GA)	GWP	1739	1891	153	0.34*	4.5	[<i>Pederson et al., 2012</i>]
Jones Ecological Research Center (GA)	JON	1844	1891	48	0.23	1.6	[<i>Pederson et al., 2012</i>]
Lavender Mountain (GA)	LAV	1820	1891	72	0.37*	3.4	[<i>Pederson et al., 2012</i>]

Spreewell Bluff (GA)	SPR	1754	1891	138	0.40*	5.1	[Pederson et al., 2012]
Kisatchie Hills (LA)	KH	1670	1891	222	0.25*	3.8	[Guyette et al., 2012]
Boyd Tract (NC)	BT	1711	1891	181	0.22*	3.0	[Cook and St. George, 2013]
Weymouth Woods (NC)	WW	1690	1891	202	0.23*	3.3	[Barefoot, 1997]
Northern Virginia Combined (VA)	NVA	1670	1849	180	0.16	2.2	[Cook et al., 2010]
Choccolocco Mountain and Spreewell Bluff Combined (AL & GA)	--	1690	1891	202	0.54*	9.1	-

224

225 **Table 2:** Comparisons between the Terminal Warehouse chronology and nine longleaf pine
226 chronologies (and one combined chronology) from the eastern United States. The sites are
227 organized alphabetically by the state in which each site is located (AL=Alabama; GA= Georgia;
228 LA=Louisiana; NC=North Carolina; VA=Virginia). “FY” and “LY” indicate the first and last
229 year of the chronology comparison, respectively, and “N” refers to the number of years
230 compared. The first compared year was contingent on at least 5 trees and a strong signal
231 strength for both sites. The Spearman’s rank correlation coefficient (r_s ; $*p \leq 0.01$) and t-value (t)
232 for each chronology comparison are shown.



233

234

235 **Figure 4:** A) The Terminal Warehouse master chronology from 1512-1891. B) The number of

236 samples comprising the Terminal Warehouse (TW) chronology through time (black), and the

237 Expressed Population Signal (EPS) for 50-year periods with a 25-year overlap (blue). The

238 dashed line on panels A and B represents the year 1670, when the Terminal Warehouse sample

239 size drops below 10 and the EPS weakens. C) A comparison of the Terminal Warehouse master

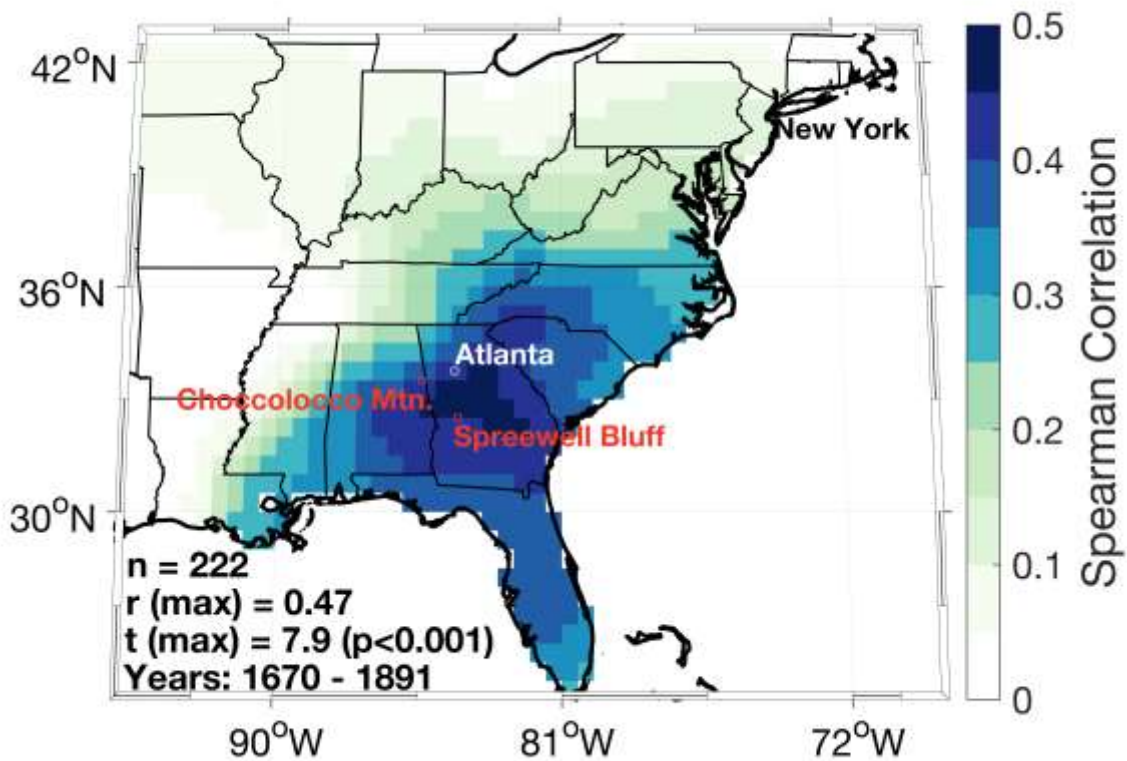
240 *chronology (black) and a master reference chronology (magenta) combining sites Choccolocco*
241 *Mountain (eastern Alabama) and Spreewell Bluff (western Georgia) from 1690-1891. $r_s =$*
242 *Spearman's correlation; * = $p < 0.01$; $t = t\text{-value}$; $n = \text{number of years for comparison}$.*

243

244 A spatial correlation analysis of the Terminal Warehouse chronology with the NADA from
245 1670-1891 further shows that the ring-width patterns on the joist samples most strongly correlate
246 with tree-ring data from central and western Georgia, near Atlanta, as well as the border of
247 Alabama (Fig. 5). The Spearman's rank correlation coefficients steadily decrease in strength
248 when progressing away from this region. When calculating correlations between the Terminal
249 Warehouse chronology and the NADA from 1670-1825, when the sample depth remains at
250 $n=10$, the same spatial correlation patterns emerge, but the correlations are slightly higher (see
251 Fig. 5 caption). The NADA does not include either of the two reference chronologies used to
252 date the Terminal Warehouse timbers (Choccolocco Mountain nor Spreewell Bluff) and
253 therefore represents a comparison with an independent dataset. The NADA also consists of a
254 network of many tree-ring chronologies developed from other tree species and thus confirms our
255 provenancing results from individual site comparisons.

256

257



258

259 **Figure 5:** Spearman's rank correlations between the Terminal Warehouse master chronology
 260 and the North American Drought Atlas (NADA) from 1670-1891. The location of the two
 261 chronologies that correlated most strongly with the Terminal Warehouse chronology are shown
 262 in red. *r* (max): maximum Spearman's rank correlation, *t* (max): *t*-value for *r* (max), *n* = number
 263 of years of overlap. These spatial correlations strengthen further to an *r* (max) of 0.5 and *t* (max)
 264 of 7.1 (*p* < 0.001) if the Terminal Warehouse chronology is truncated between 1670-1825, the
 265 section with a sample depth of at least 10 samples.

266

267 **4. Discussion**

268 The results of this study suggest that at least some of the timbers used for construction of the
 269 Terminal Warehouse were felled in the late 1800s from the western/central Georgia and eastern

270 Alabama region. This is a relatively inland portion of the natural range of the longleaf pine (Fig.
271 3), where these trees tend to grow on dry, mountainous slopes [*Finch et al.*, 2012; *Outcalt*,
272 2000]. Many of the joist samples (i.e., at least 16 of the 22 that could be crossdated) had a high
273 intercorrelation (mean series intercorrelation = 0.42), indicating that lumber from these joists
274 were harvested from the same or nearby site(s).

275

276 The building permit for the Terminal Warehouse was documented in June of 1890 and the
277 building was erected in 1891 [*King*, 1893]. Three of the 16 dated samples had an outer ring year,
278 close to this known construction period of the Terminal Warehouse and also had a large
279 proportion of preserved sapwood (TWB09: 1890; TWB11: 1889; TWB12: 1891). Thus, these
280 samples were likely harvested around the time of construction. TWB12 in particular appeared to
281 have a rounded/waney edge, suggesting that the outer portion of the tree on this sample was
282 preserved and no outer rings were lost. This provides evidence that the lumber used for that joist
283 was cut in 1891. The fact that TWB09, TWB11, and TWB12 have the most recent growth rings
284 of the entire collection, and their dates directly precede or coincide with the known construction
285 period of the Terminal Warehouse, further corroborates our dating results. Based on these
286 results, we speculate that the joists were installed in an early phase of construction, and that at
287 least some of the lumber used for other joists were also cut in 1891. However, we note that four
288 other samples also have sapwood, of which three have outer dates in the 1850s (TWB01: 1835;
289 TWB04: 1858; TWB6: 1852; TWB17: 1857). Since these samples predate the construction of
290 the Terminal Warehouse in 1891, we do not exclude the possibility that some of the joists were
291 sourced from stockpiled logs or reused timbers from the same or a nearby site.

292

293 The use of longleaf pine for construction of the Terminal Warehouse is not surprising. In fact,
294 southern longleaf pine surged as an important construction material after the Civil War [*Smith et*
295 *al.*, 2000; *Wahlenberg*, 1946]. Southern pine had a reputation of being sappy, hard, difficult to
296 paint, and likely to warp [*Fickle*, 2014; *Williams*, 1989]; however, the strength, scale, and
297 abundance of longleaf eventually overshadowed these concerns and it became a widespread
298 construction material. In New York City, longleaf pine was used for area warehouses and
299 factories, to frame high-end uptown residences, and to construct important landmarks and
300 structures, such as the iconic Brooklyn Bridge and the city’s large subway system [*Yee*, 2015].
301 The wood’s beauty and durability also grew in esteem for residences; narrow refined cuts of
302 pine, called ‘comb grade’ were prized for row house floors.

303

304 Due to growing demand during the late 19th and early 20th centuries, longleaf pine became the
305 most harvested tree species in the U.S. by a wide margin, and contributed nearly 30% of all
306 lumber logged each year in the country [*Finch et al.*, 2012; *Kellogg*, 1909; *Stambaugh et al.*,
307 2021]. By that point, much of the red and white pine of New England and the Lake States had
308 been heavily harvested, resulting in a migration of the logging industry to the pine forests of the
309 southern United States [*Croker*, 1987; *Smith et al.*, 2000]. The intensive period of longleaf pine
310 logging followed the expansion of steam technology used for logging railroads, steam skidders
311 and sawmills [*Frost*, 1993; *Smith et al.*, 2000; *Wahlenberg*, 1946]. From 1880-1890, isolated
312 railroads were connected and tracks were standardized, leading to a higher efficiency and cost-
313 effectiveness of timber transport, and these advances in technology and transportation resulted in
314 the near decimation of virgin longleaf timber in the Southeastern U.S. from 1870-1930 [*Frost*,
315 1993].

316

317 By the turn of the 20th century, the state of Georgia was the leading producer of yellow pine
318 (including longleaf) timber, and contributed twelve percent of the total output in the U.S.
319 [Kellogg, 1909]. The extensive extraction of longleaf pine in Georgia during this period led to
320 widespread deforestation in the state. Our 1891 procurement date therefore also coincides well
321 with large-scale extraction of this species from this particular region. Due to rapid deforestation,
322 by 1910 Georgia had already slipped to the ninth leading producer of longleaf pine as the
323 industry was forced to shift westward to Louisiana, Texas, and Mississippi [Kellogg, 1909;
324 Wahlenberg, 1946].

325

326 We currently cannot determine with certainty how the timber was transported from the
327 Georgia/Alabama region to New York City for the construction of the Terminal Warehouse. The
328 rail systems and shipping routes during this era were convoluted and rapidly evolving. One
329 hypothesis is that The Sample Lumber Company (later renamed the Kaul Lumber Company) in
330 Hollins, Alabama, near the Talladega National Forest, could have supplied some of the lumber
331 used for construction of the Terminal Warehouse. The Sample Lumber Company was a large
332 logging and sawmill operation in the region [East, 2013]. In this scenario, boards could have
333 been loaded onto the Columbus and Western Railroad, which was built through the town of
334 Hollins, AL in 1888. The route then connected with the Anniston and Atlantic Railroad (later
335 acquired by the Louisville and Nashville Railroad in 1890), and then the Georgia Pacific
336 Railroad, linked to the port of Savannah, GA. Savannah was the primary Atlantic seaport in the
337 state of Georgia and was home to an extensive lumber milling and long-distance shipping
338 industry through the 19th century [Eisterhold, 1973]. At that point, lumber would have been

339 unloaded by hand (each 3" X 12" X 22'/7.6 cm X 30.5 cm X 6.7 m joist, weighing close to 250
340 lbs/113 kg each), and reloaded onto schooner ships, with the boards fed into an opening in the
341 hull [*Detroit Publishing Co., 1900-1906*]. Another possibility is that the lumber was first
342 transported to Savannah via the Shenandoah Valley Route, which had multiple rail lines
343 connecting locations close to the inferred source region of the wood [*Matthews-Northrup*
344 *Company and Shenandoah Valley Railway Company, 1890*], and was then transported to New
345 York City via rail. Knowledge regarding the transport of timbers to New York City during the
346 late 19th century is currently limited, and we encourage more research on this topic to better
347 elucidate the workings of the timber industry during this notable period of rapid development.

348

349 Our research highlights the importance of preserving timbers from historic landmarks, as insights
350 gleaned from dendrochronological analysis of original timbers can provide a rich history of a
351 particular place in time. In addition, such tree-ring records can be used for other purposes beyond
352 archeology, such as for the reconstruction of past climate or ecological conditions in regions
353 where the wood was originally sourced. This potential use of archeological wood is clearly
354 illustrated by the strong correlation between the Terminal Warehouse and the NADA; this
355 indicates that the recovered timbers contain a strong southeastern US regional drought signal.

356 Outside of dendrochronological research, salvaging wood from old buildings is also important
357 for economic and sustainability reasons. Regarding longleaf pine specifically, New York City is
358 the country's largest repository of lumber from this species due to its extensive inventory of 19th
359 and early 20th century buildings. A portion of this wood is reclaimed from old buildings
360 undergoing demolition each year and is often re-purposed for millwork. The wood is sometimes
361 sent to the southern United States, where longleaf remains a cherished part of the region's

362 heritage. In New York City, salvaged and reclaimed longleaf pine is also deeply valued as it
363 represents a piece of the city's history. It is estimated that nearly 14,000 m³ of wood from old-
364 growth trees of various species is removed from demolished buildings in New York City every
365 year [*Bergsagel and Lynch* 2019]. The reusing of salvaged wood not only holds historical
366 significance, but also benefits the environment through reducing both waste and demand for new
367 lumber.

368

369 **5. Conclusions**

370 We successfully crossdated 16 of the 22 longleaf pine (*Pinus palustris*) joist samples collected at
371 the Terminal Warehouse in New York City, U.S. through comparing their annual ring-width
372 patterns. The Terminal Warehouse tree-ring chronology developed from these 16 samples
373 showed a strong positive match with two independent longleaf pine chronologies in eastern
374 Alabama and western Georgia when dated to an outer year of 1891, yielding a chronology
375 spanning 1512-1891 C.E. This was further supported by the high spatial correlations between the
376 Terminal Warehouse series and the North American Drought Atlas (NADA) in the same region.
377 The three timber samples with outer dates extending into the 1880s had a large proportion of
378 sapwood suggesting that the outer rings may approximate the cutting period of these timbers. In
379 conclusion, timbers to build the Terminal Warehouse were very likely sourced from the
380 southeastern U.S. in the region of central/western Georgia and eastern Alabama (i.e., near
381 Choccolocco Mountain, AL, Spreewell Bluff, GA, and Atlanta, GA) and cutting dates for
382 individual timbers occurred around 1891 or earlier. Our results provide insight on the
383 significance of lumber from distant locations, specifically longleaf pine, on the development of

384 an important New York City landmark, and highlight the value of preserving old timbers from
385 buildings that are being renovated or demolished.

386

387

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