A PHOTOGRAPHIC RECORD OF THE FIRST SILVICULTURAL RESEARCH BY THE SOUTHERN FOREST EXPERIMENT STATION

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ABSTRACT

On July 1, 1921, researchers from the new Southern Forest Experiment Station (SOFES) took over what would become the Station's first silvicultural research project in young, even-aged, old-field pine stands on Urania Lumber Company lands in central Louisiana. While few records of this pioneering thinning study remain, a collection of images, reports and plans, and some publications can help with its reconstruction. With this study, the SOFES sought to quantify the response of young overstocked stands to "German" and "French" thinning approaches at different levels of intensity ("grades"). The quarter-acre plots (which included unthinned "checks") established in 1915 were supplemented with others in the 1920s and maintained until the study closed in 1961. Installed before the widespread use of probabilistic statistics, hypothesis testing, and effective study design, this poorly replicated and inadequately controlled effort would today be considered more demonstration than research. Nevertheless, the Urania thinning study produced multiple publications that supported targeted density reductions in overstocked pine stands and helped train numerous SOFES silviculture researchers.

INTRODUCTION

When the U.S. Department of Agriculture (USDA) Forest Service established their Branch of Research under Earle Clapp in 1915, the Federal agency had no formal research program outside of a few small and isolated field stations in the Western United States and the Forest Products Laboratory in Madison, WI (Williams 2005). Otherwise, any Forest Service science conducted outside of those Government-owned locations was done on the lands of others. In 1915, the Forest Service found one of those "others" in Louisiana lumberman Henry Hardtner. That year, Hardtner approached the Forest Service for help with his nascent forest management efforts on the pineywoods of his Urania Lumber Company. In response, that same year the Forest Service sent Samuel Trask Dana and several others (fig. 1) from the Washington Office to establish a series of small plots in young, even-aged, naturally regenerated old-field stands of loblolly (*Pinus taeda*) and shortleaf pine (*P. echinata*) for a thinning study (Maunder and Fry 1966, Wyman 1922).

With openings of the Southern Forest Experiment Station (SOFES) and the Appalachian Forest Experiment Station on July 1, 1921, the Forest Service initiated a formal research program in the Southern United States. The SOFES took over the agency's thinning project and other studies at Urania (Dana and the others had also installed plots to consider the effects of fire and hogs on longleaf [*P. palustris*] and loblolly pine reproduction [Chapman and Bickford 1932, Maunder and Fry 1966]). Although poorly designed by today's standards, this first silvicultural research of the SOFES proved to be a useful research and demonstration tool to help foresters and landowners learn to effectively manage the even-aged, pine-dominated forests of the South.

Figure 1—Heavily thinned 20- to 22-year-old loblolly pine-dominated old-field stand in LaSalle Parish, LA, January 27, 1915. USDA Forest Service photo (image number 22419A) by Samuel Trask Dana.

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Such work was critical, as the studied condition—young, naturally regenerated old-field pine—was increasingly common and silviculturists had few management options for this type. As the old timber was cleared, even the mighty southern pine industry in Louisiana began to fail (Garrison 1952). However, a rapidly growing pulp and paper industry in Louisiana after 1920 provided a ready market for small-diameter trees, low-grade larger logs, and less commercially viable species, and thus provided new management options for landowners.

This paper does not present new research on or a new analysis of the original Urania thinning study. Rather, it presents a series of photographs taken between 1915 and 1951 as an encapsulation of some of the people, places, and projects that were involved in this first silviculture study of the SOFES.

MATERIALS AND METHODS

Original Thinning Study and Later Modifications

The Urania thinning study consisted of four sets of plots (called "Holly," "Maxwell," "Mayes," and "Castor"), with additional plots added during the next 10–15 years (Bull 1936, Chapman and Bickford 1932). All of the plots were relatively small (0.2–0.25 acres), unreplicated, and lacked a good experimental design. Unfortunately, when the Urania thinning study was originally installed and then expanded upon, the foundational work of R.A. Fisher on more robust statistical analyses and the factorial design of experiments was still years in the future (Fisher 1925, 1935). Such deficiencies were recognized almost immediately, but the SOFES considered the plots established at Urania as valuable nevertheless. According to Chapman and Bickford (1932: 28), "Although many of these experiments were begun without adequate planning and were carried on under the handicap of inexperienced and frequently changing personnel, it is felt that they have furnished a variety of miscellaneous information as well as serving to train the staff." Chapman and Bickford (1932) believed the first results of this Urania thinning study were inconclusive (in part because of the design flaws) but held out hope they would later demonstrate the influence of thinning in these young pine stands.

The thinning treatments used were consistent with the concepts and terminology of that time (Barrett and Righter 1929). When first installed, these were called "German" ("thinning from below") and "French" ("thinning from above"). In addition, different thinning intensities ("grades") were applied, ranging from light ("A") to heavy ("D") removals. Later researchers (for example, Bull [1935]) eschewed the German and French designs for a more "American" approach to managing these even-aged stands with stocking levels based on the number of residual (target) trees or basal area per acre.

Over the years, the plots were periodically remeasured, rephotographed, and thinned (when feasible). As these plots matured, a few were destroyed by fire, insects, wind, or inadvertent logging, and some had new studies implemented to consider other treatments. For instance, later researchers looked at pruning or growth and yield in some of these plots, while others changed the thinning approach (Bull 1935) or added pruning and timber stand improvement components. Not surprisingly, such changes to these small plots contributed to problems as the study aged, with some planned treatments not being possible in later years as too few pines remained. Ultimately, this prompted F.W. Whitmore, then the researcher in charge of the study, to formally close the last Urania thinning study plots in the early 1960s (Whitmore 1961a, 1961b).

Current Approach

A large collection of historical photographs, negatives, maps, and some documents from the Urania thinning study were stored at the Crossett Experimental Forest (CEF). As a part of the 100th anniversary of the founding of the Forest Service Southern Research Station (the successor to the SOFES), many of these old images have been digitized and permanently archived in the Forest Service Research Data Archive (RDA) as a part of the Southern Research Station Historical Documents and Images collection (Bragg 2020; digital versions of these public domain images and many others can be downloaded from https://doi.org/10.2737/RDS-2020-0047).

This paper is based on 15 of the 190 photographs currently in this collection, each chosen because they clearly demonstrated an objective or interesting facets of this study. All photographs were digitized with a flatbed scanner at a resolution of at least 300 dots per inch. Available metadata (for example, Forest Service negative number, date picture was originally taken, photographer, location, image content) for each scanned image was also recorded. Additional information on the Urania thinning study has been extracted from several published articles and information from a series of unpublished establishment, progress, and closing reports. This included material from the "Urania Bible," an unpublished account of the Forest Service work on the Urania Lumber Company lands up to 1932 (Chapman and Bickford 1932).

RESULTS AND DISCUSSION

Check Plots

In the Urania thinning study, a series of "check plots" served as the unmanaged (uncut) controls for the thinning

Figure 2—Loblolly pine-dominated unthinned old-field stand in LaSalle Parish, LA, March 1920. USDA Forest Service photo (image number 45632A).

Figure 4—Maxwell check plot number 3, LaSalle Parish, LA, April 1931. USDA Forest Service photo (image number 254794) by R.A. Chapman.

treatments, and at least one was established for each old-field set of plots. Figure 2 is a 1920 picture of a check plot, a clear example of an overstocked pine stand. Check plots were compared to other treatments to help evaluate their effectiveness. As mentioned earlier, the check plot comparison to unreplicated treatment plots failed to control for several relevant initial conditions. This provided inherent logical challenges with unsatisfactory outcomes; for example, see the work of Righter (1929) based in part on these Urania thinning studies and Mulloy's (1929) response. Such limitations affected the inferences and statistical power of the analysis (Gevorkiantz 1935). Based in part on their experiences with the Urania thinning study, a later treatment of a proposed experimental design offered by Barrett and Righter (1929: 786) suggested the replication of thinning treatments across a range of sites for a more robust evaluation. Barrett and Righter (1929) included uncut controls, but they also felt that check plots were needed only if time and money were available, and that a single check would suffice.

Although unreplicated for their paired treatment and therefore lacking the capacity to identify the contributions of site, initial stocking, and other factors, the check plots helped demonstrate to landowners some of the consequences of overstocked, even-aged southern pine stands. Figures 3 and 4, although not of the same plot shown in figure 2, reflected the high mortality and slow individual tree growth of these unthinned stands. The Urania thinning study also documented that more productive sites responded sooner to overstocking, consistent with the principles of self-thinning (Reineke 1933) and at the expense of considerable volumes of small (but often usable) wood lost to mortality (Bull 1935, Mann 1952).

Thinning Approaches

As mentioned earlier, the original study was intended to compare two different approaches to thinning at several levels of thinning intensity. Figure 5 shows a "light" (Grade A) German thinning. This approach, better known today as thinning from below (or sometimes "low thinning"), first targeted the removal of dead, dying, or suppressed trees. At the lightest (or Grade A) thinning intensity, these would be the only trees removed. With progressively higher degrees of removal (B, C, and D), a greater proportion of the smaller trees would be taken until at Grade D, when many codominant stems were cut (Barrett and Righter 1929, Hawley 1929).

The second thinning approach, French (now generally called "thinning from above" or "high thinning"), approached harvests differently. As can be seen in figure 6, French thinnings were designed to release the most prominent crop trees from the beginning, with increasing intensity (grades)

Figure 3—Maxwell check plot number 1, LaSalle Parish, LA, January 1925. USDA Forest Service photo (image number 194734) by E.N. Munns.

Figure 5—Recently thinned 20-year-old shortleaf and loblolly pine old-field stand in Winn Parish, LA, January 1915. USDA Forest Service photo (image number 22421A) by S.T. Dana.

Figure 6—Light French thinning plot U-65, Winn Parish, LA, December 1928. USDA Forest Service photo (image number 232355) by L.I. Barrett.

Figure 7—"Shortwood" (for pulp) stacked following a light French thinning, December 1928. USDA Forest Service photo (image #232350) by L.I. Barrett.

targeting a greater proportion of the remaining tree classes for removal (Barrett and Righter 1929, Hawley 1929). In practice, more intense German and French thinnings could be difficult to distinguish from each other. While their targeting approaches may have differed, the end results would not: under heavy thinnings of both, all but a few of the best crop trees would be removed.

Regardless of the system employed, the earliest thinnings in these even-aged southern pine stands were largely noncommercial because Louisiana lacked good markets for small-diameter pine. It would be the development of the pulp and paper industry that soon provided such a market. After 1920, a series of new pulp mills that used southern pine opened in Louisiana and immediately changed the dynamics of management practices (Garrison 1952). Now, the quantity of usable volume became the issue; figure 7 demonstrates the amount of pulpwood produced by a single light French thinning on this study plot. The mixture of bolt diameters is a good indicator of French thinning, with some larger stems from felled codominant trees.

Thinning Results

As the study progressed, the effectiveness of the different treatments became increasingly apparent. Most noticeably,

Figure 8—Loblolly pine-dominated unthinned old-field stand in LaSalle Parish, LA, November 1929. USDA Forest Service photo (image number 241513) by R.A. Chapman.

Figure 9—Light German thinning of shortleaf pine stand, Winn Parish, LA, April 1929. USDA Forest Service photo (image number 254806) by R.A. Chapman.

in the check plots (such as the one in fig. 8), individual tree diameter growth was noticeably less, there was a greater amount of mortality, and the closed canopy of these unthinned stands produced a sparse groundcover typical of the low-light understory environment (Bull 1935).

Light thinnings of either German or French styles released a few pines and started opening the canopy, allowing for increasing numbers of hardwoods in the understory (fig. 9). In German-style light thinnings, some of the pines that were of poor form, undesired species, unhealthy, or likely to

Figure 10—Heavy French thinning, LaSalle Parish, LA, December 1928. USDA Forest Service photo (image number 232351) by L.I. Barrett.

die from suppression were utilized for timber production, but only limited growth in the residual pines resulted from their removal. In a light French thinning, most of these subordinate or poor trees were retained (many of which would soon die or continue to decline or degrade), yet too few crop trees were sufficiently released to provide much of a response from the residual pines. Bull (1935) favored heavier thinnings that included competitors to crop trees at relatively early stages of these even-aged southern pine stands to provide a stronger growth response from the residual, thereby producing sawtimber sooner (fig. 10).

Other Lessons Learned

Bull (1935) also noted that if the market for pulpwood or other small-diameter products was a major driver for the thinning treatments, other recommendations could be justified. For example, sometimes thinnings could be made later in the rotation and would not need to be as intensive to improve outcomes. In areas where both pulpwood and sawtimber markets were viable (fig. 11), thinning should be tiered towards the most profitable product. Even modest thinnings in areas with good small-diameter markets were often profitable and offered landowners a chance to earn income while putting their crop trees in a better position to get to sawtimber size sooner. From the Urania thinning study, Mann (1952) concluded that stand-level cordwood production at 35 years was maximized by not thinning but at the cost of no early income. Light thinnings were best when both pulpwood and sawtimber were desired, and heavy thinnings favored faster sawtimber production at the expense of lower total volume yield.

The realization of other ecological consequences would influence silvicultural practices. For example, it became quickly apparent (fig. 12) that the moderate to heavy thinnings that opened the canopy to best release crop pines also triggered the greatest hardwood understory response, especially when fire was suppressed (Chapman 1953). Later research work elsewhere further documented the impacts of

Figure 11—Over three cords of pulpwood from a quarter-acre plot following a heavy French thinning in LaSalle Parish, LA, December 1928. USDA Forest Service photo (image number 232352) by L.I. Barrett.

Figure 12—Hardwood understory response after a heavy thinning in LaSalle Parish, LA, early 1940s. USDA Forest Service photo (image number 443391).

these hardwood competitors and the value of their control in improving pine volume production (Grano 1970, Korstian and Bilan 1957).

…And the Rest of the Story

The evolution of a robust system of experimental design, sampling, and statistical analysis in the late 1920s into the 1930s made it apparent how inadequate the original Urania thinning study was, but this does not mean that the effort was in vain. Rather, the utility of such a project to help train new agency researchers while still producing some reasonable, fact-based silvicultural recommendations was considerable. Other lessons were drawn from this original work. For instance, rather than focusing just on a relative assessment of heavily stocked, even-aged stands of a species such as loblolly pine, researchers learned that site conditions can play a major role in determining thinning responses and that site quality can vary remarkably from one stand to the next. Figure 13 provides an example of one of the Urania thinning plots on a former longleaf pine site that was inherently less productive than most of their other sites. In this photograph, the presence of the old longleaf pine stumps indicated that this location likely had not been row cropped (perhaps just grazed), making it even more different than plots on more productive sites that had been farmed.

Figure 13—Loblolly pine plot in the "Deer Pasture" site near Urania, LA, with original longleaf pine stumps remaining, April 1924. USDA Forest Service photo (image number 185985) by W.R. Hine.

Figure 14—View of branch stubs from pruned trees in 1951, 18 years post-thinning. USDA Forest Service photo by Wilbur F. Mattoon.

Such design considerations would be incorporated into future studies as suggested in Barrett and Righter (1929). As this study matured, investigators had other questions, leading to the layering of new research on the existing design. For example, young, heavily thinned stands had much less natural branch loss as the trees aged, producing knottier wood of lower value. This suggested that pruning may benefit such treated stands by removing the branches to improve the quality of the lower bole (fig. 14). However, some of the studies imposed upon the existing Urania thinning study reduced the ability of an already design-limited study to address the original objectives. Not all of these lessons learned were negative. Knowledge gained across a range of thinning intensities led to a better understanding of stand development and individual tree growth patterns, which were later adapted to develop other approaches to intermediate treatments such as timber stand improvement that targeted low-quality individual trees (fig. 15). Over the years, the SOFES researchers also produced multiple publications on this work (Bond and others 1937; Bull 1935, 1936; Mann 1952; Righter 1929; Wyman 1922).

CONCLUSIONS

This collection of historical photographs and documents covers an interesting period in the South where even limited studies by the SOFES helped shape a “new” timber industry and the practice of forestry. Once the industry was convinced that second-growth pine forests had the potential to produce adequate wood (and new pulp and paper markets developed), interest in these increasingly common old-field stands grew (Bragg 2021). Not surprisingly, then, a remarkable amount of useful silvicultural information arose from the Urania thinning study. Between 1915 and 1961, this effort also helped the SOFES develop new researchers and the forestry profession benefited from a suite of treatment recommendations for this often-undervalued forest type. Furthermore, future research projects learned from the mistakes and limitations of this initial effort. Though these stands have long since been cleared, the legacy of the Urania old-field thinning study continues to live on.

Figure 15—A crooked loblolly pine marked as a part of a timber stand improvement experiment in LaSalle Parish, LA, August 1937. USDA Forest Service photo (image number 352080) by C.A. Bickford and T.T. Kohara.

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