SILVICULTURAL RESEARCH IN THE SOUTH: ITS HISTORY AND THE ROLE OF THE BIENNIAL SOUTHERN SILVICULTURAL RESEARCH CONFERENCE

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Abstract—Through the application of silvicultural research, the forests of the South that were devastated by aggressive harvesting in the early 20th century have been restored to become the most productive and sustainable forests in the world. The development of this research capability and its application throughout the South is documented, and the role of the Biennial Southern Silvicultural Research Conference is discussed.

INTRODUCTION

The impact of silvicultural research of southern forest species on the restoration of the South's and the Nation's economy is remarkable. In less than 100 years, the forests of the South have been transformed from cutover "stumpscapes" to the some of the most productive and sustainable forests of the world. Why and how did this happen?

Early in the 20th century, forestry in the United States was in its infancy and depended upon foresters trained in Europe to implement management and provide forestry training. In this era, development of the lumbering industry following the Civil War brought jobs and businesses that began to restore the South's economy. The "golden age of lumbering" began and, in the first quarter of the 20th century, the harvest of much of the virgin pine forests in the South occurred in what has been described as "probably the most rapid and reckless destruction of forest known to history" (Cooper and Terrill 1991).

When the Southern Pine Association cosponsored a "Cut-Over Land Conference of the South" in New Orleans in 1917 to discuss the problem of cutover lands, the possibility of reforestation was scarcely considered because it seemed economically infeasible (Barnett and Carter 2017).

The magnitude of the cutover land was brought into focus when a survey was conducted by the Southern Pine Association in 1919—the South's cutover land equaled the combined areas of Alabama, Mississippi, and Louisiana! This survey reported that 92 million acres of land had most of the timber removed (Heyward 1958).

Thus, the seriousness of this situation began to be understood. During the first decade of the 20th century, President Theodore Roosevelt and the U.S. Forest Service's Chief Forester, Gifford Pinchot, predicted that the once-boundless resources of the country might be reduced to the state of some impoverished Mediterranean country (Williams 1988).

Not all of this land was barren stumpland since all sawmills did not practice the same degree of utilization, nor did all make use of steam skidders (fig. 1), a form of logging which caused great damage to any timber left standing. However, little of this acreage was capable of becoming productive again without help. Cutover lands were a man-made problem and warranted a man-made solution.

EARLY REFORESTATION EFFORTS

Slowly, lumbermen and the general public became interested in some kind of reforestation. The leader of this effort, Henry Hardtner, President of the Urania Lumber Company in the backwater town of Urania, LA, was one of the first to recognize that cutover lands were a serious problem. Although he had no formal forestry training, he read widely about forestry and crusaded for the forestry cause. Hardtner's ideas on reforestation were ahead of the professional knowledge of the time. At his request, in 1909, the Forest Service, U.S. Department of Agriculture, sent W.W. Ashe and, later, W.R. Mattoon and Austin Cary, to Urania (Burns 1978). While Hardtner's belief that a second crop of trees could be grown profitably after the virgin timber was cut was widely ridiculed, these Forest Service specialists, who published some of the earliest documents on the silvics

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Figure 1—This massive rail-mounted Clyde skidder could harvest 40 acres of timber at one setting. Four cables could pull timber from up to 1,000 feet.

of major southern species (Ashe 1915, Mattoon 1922), gave credibility to Hardtner's reforestation efforts.

Hardtner set out to develop methods to regenerate longleaf pine (*Pinus palustris*), even though he estimated that it would take 60 to 100 years to grow a merchantable-size tree (Carter and others 2015). By applying some basic forestry principles to his land—leaving seed trees, fencing to exclude hogs, and establishing a primitive fire protection system—Hardtner demonstrated the potential of growing another crop of pines. In 1917, Hardtner, who also believed in research and education, invited the annual Yale University School of Forestry spring field camp to be located at Urania. Professor H.H. Chapman, who supervised and trained the students, began to conduct research efforts to clarify the role of fire in longleaf pine management and established some early growth-and-yield guidelines (Barnett and Carter 2017).

Others quickly recognized the potential of reforestation. For example, in 1919 A.C. Goodyear (President) and W.H. Sullivan (General Manager) of the Great Southern Lumber Company visited Hardtner to learn how to modify their company's logging practices and begin a reforestation program. Great Southern Lumber Company started leaving seed trees, reduced the impact of skidding operations, fenced their longleaf regeneration to exclude hogs, and established a tree nursery program. By the following year, the Great Southern Lumber Company assigned the task of establishing its reforestation program to a 24-year-old named F.O. "Red" Bateman. Bateman was not trained in forestry, but he had worked in the forests since high school and possessed an intuition and perception that allowed him to become, in the words of Philip C. Wakeley, "one of the greatest silviculturists the South has known… For many years all the rest of us merely followed or wrote up what he developed and showed us" (Wakeley 1976). By 1922, Bateman succeeded in naturally regenerating longleaf pine, established a nursery, and developed methods for seed collection, seedling production, and planting (fig. 2). He also invented a planting tool, "the dibble," and a method of "slit" planting that became an enduring standard across the South (Carter and others 2015).

PROGRAMS FOR DEVELOPING FORESTRY EXPERTISE

At the turn of the century, it was apparent that there was a critical need for forestry training and education. In the late 1800s, Gifford Pinchot, who later became Chief of the Forest Service, established a forestry program at George Vanderbilt's Biltmore Estate near Asheville, NC. After Pinchot left the Biltmore Estate, a professionally trained forester from Germany named Carl A. Schenck was hired as his replacement. Schenck established the Biltmore Forest School in 1898; its curriculum focused on providing 1 year of practical forestry management

Figure 2—The Great Southern Lumber Company reforestation program gained international recognition—in 1925, this group toured the effort. From left kneeling: R.D. Forbes. Director of the Southern Forest Experiment Station; Roy Hogue, State Forester of Mississippi; W.R. "Billy" Hine, State Forester of Louisiana. Standing from the left: J.K. Johnson, Great Southern; Norman Gore, Louisiana State Ranger; Dr. Tor Jonson, leading professional Forester in Sweden; Harry Lee Baker of the Forest Service Washington Office; Mr. Johansson, Dr. Jonson's interpreter; F.O. "Red" Bateman, Great Southern; E.L. Demmon, who succeeded Forbes as Director of the Southern Forest Experiment Station.

training. It is considered the first forestry school in the United States, although Cornell University, University of Minnesota, Michigan State University, and Yale University created 4-year forestry schools shortly after the Biltmore experiment began.

Schenck's Biltmore Forest School closed after 15 years, but as unconventional as it was, it trained about 400 students, some of whom made notable contributions to forestry in the United States. Schenck and his students established a few plantations, but their focus was more on stand management. In the South, the University of Georgia (1906) and Louisiana State University (1926) led in establishing forestry programs. H.H. Chapman of Yale University brought many students down to the South as early as 1909 to give them additional field opportunities in forestry. It is fitting, perhaps, that it was forestry graduates from northern universities who began moving into the South to lead reforestation efforts resulting from the forest devastation caused largely by northern lumbermen.

Forestry expertise developed through other sources as well. About this same time period, the newly created U.S. Forest Service received requests for assistance and information on reforestation from lumber companies and individuals scattered across the South. To satisfy this demand, the Forest Service recruited individuals with practical experience related to the issues of concern. Although they had little forestry training, these individuals had exceptional ability to observe nature, draw tentative conclusions, and make practical recommendations. The most notable of these "transients" who traveled widely throughout the South were Austin Cary, W.W. Ashe, and W.R. Mattoon (Barnett 2011).

EARLY RESEARCH OF THE U.S. FOREST SERVICE EXPERIMENT STATIONS

In 1921, the U.S. Forest Service established the Southern Forest Experiment Station (headquartered in New Orleans, LA) and the Appalachian Forest Experiment Station (Asheville, NC). The Southern Forest Experiment Station was responsible for research in the southern pine types. This included all of the Coastal Plain areas in Georgia and South Carolina; all of Florida, Alabama, Mississippi, and Louisiana; Texas and Oklahoma as far as the pine type went; and Arkansas south of the Arkansas River. The Appalachian Forest Experiment Station emphasized the mountainous pine-hardwood types.

Carter and others (2015) attributed three U.S. Forest Service publications that highly influenced the development of forestry in the South. First, from the earliest days of interest in managing southern pine, industrialists, landowners, and foresters had been asking, "How fast do southern pines grow, how long does it take to grow a sawlog, and how much volume of second growth can I expect to grow on an acre?" Miscellaneous Publication 50 (USDA Forest Service 1929) or MP-50, as *Volume, Yield, and Stand Tables for Second-growth Southern Pines* was known, provided answers to these questions. The pocket-sized MP-50

became a constant companion to foresters and continued to be in such demand that it was reprinted in 1976, nearly 50 years after it was first published (Carter and others 2015) and it is still available as an electronic publication on the Forest Service's Treesearch website (https://www.fs.usda.gov/treesearch/pubs/24559).

The second milestone contribution from the Southern Forest Experiment Station was Philip C. Wakeley's development of the technology for establishing and managing southern pine plantations. When Wakeley was recruited to work for the Southern Forest Experiment Station in 1924, there were fewer than 20 professional foresters working in the entire South (Wakeley and Barnett 2011). Nearly a third of these were on the Southern Forest Experiment Station's staff, and almost as many were employed by the Appalachian Forest Experiment Station. When Wakeley arrived at the Station, he was assigned to work with the Great Southern Lumber Company's reforestation program underway at Bogalusa, LA. The Great Southern program ended in the 1930s when the company went into receivership. Wakeley moved his research effort to the Kisatchie National Forest's Stuart Nursery in central Louisiana in 1935. This effort culminated with the publication of Wakeley's (1954) monograph, *Planting the Southern Pines* (earlier versions appeared in 1929 and 1935). As the basis for most reforestation efforts across the South after World War II, this publication is probably the most frequently cited forestry publication in the South and is still well cited although it has been out of print for many decades.

The Southern Forest Experiment Station's third pioneering contribution was the first forest survey of the South following the passage of the McSweeney-McNary Forest Research Act of 1928, which authorized a nationwide forest inventory. The challenge of this effort was enormous—an inventory of over 200 million acres of forest stretching from the Carolinas to east Texas. The Southern Station began fieldwork in 1932 and remarkably completed this task by 1936. To conduct this first survey, compass lines were run 10 miles apart across each State from the Tennessee line southward to the tip of Florida. At every 660 feet along each line, a 0.25-acre plot was measured—all trees were counted and their size, species, and other information determined. A steady stream of information came from the analyses of these data, and releases on results were eagerly sought. The amount of data was so massive that it was about 1944 before all the results were published. Benefits of the survey have been summarized as astounding, as people had no idea of the amount and distribution of the timber, how fast it grew, or its stage of development—this knowledge would soon help bring the pulp and paper industry to the South (Barnett 2018, Maunder and Eldredge 1960). Although this effort is not pure silvicultural research, it provided the information needed for the expansion of industrial forestry in the South and the data required for the rapid development of forest management technology.

SILVICULTURAL RESEARCH IN THE POST-WORLD WAR II YEARS

During World War II, forestry research reached a low ebb—many employees served overseas in military services, and those remaining at home were given war-related responsibilities. Field studies could not be maintained, and data were lost. However, the postwar environment began to energize and expand the research program. Fortunately, forestry schools were now crowded with veterans going to school on the GI Bill. In the late 1940s, the war's end brought a great need for intensified research. Even as late as 1960, up to 29 million acres of forest land in the South were in need of reforestation and management technology (Wahlenberg 1960). With an increasing need for forestry-related research in the South, the Forest Service restructured for its greatly enhanced mission (at the time, there were no forest industry-sponsored research programs and university research was in its infancy).

Realignment of Experiment Stations

A major element of the Forest Service's restructuring was the realignment of the boundaries of the Southern and Appalachian Forest Experiment Stations. Officials of the Southern Forest Experiment Station had learned that the vastness of the Station—the entire southern Coastal Plain—made administration of the organization challenging. So, in 1946, the extent of the New Orleans-based Southern Forest Experiment Station was altered. Tennessee and all of Arkansas were added to the Southern Forest Experiment Station, and South Carolina, Georgia, and Florida were reassigned to the remainder of the Appalachian Forest Experiment Station, now called the Southeastern Forest Experiment Station (which was still headquartered in Asheville).

Creation of Research Centers

The Forest Service also changed how the forest experiment stations were organized. In the early version of the Southern Forest Experiment Station, individual scientists reported directly to the Station Director and usually only one or two scientists were assigned to an area of research. The new organization was patterned more like a military organization, with the Station Director having a staff of both administrative and program Assistant Directors. Leaders of field research centers reported to the Assistant Directors, and the research centers generally consisted of a number of scientists of differing disciplines. For example, modern, state-of-the art research facilities at the Alexandria Research Center in central Louisiana were created in 1946. Located in the Alexandria Forestry Center (which also housed units of the U.S. Forest Service's National Forest

System and State and Private Forestry), the Alexandria Research Center's mission was to develop technology for establishing and managing southern pine plantations in Louisiana and Texas. When the author was assigned to the Alexandria Research Center in the spring of 1961, it had a large scientific staff: W.F. "Bill" Mann was the Research Center Leader and worked wherever his interests lay; Gene Shoulders studied nursery and soil concerns; Vince Duvall worked in range research; Harold Derr researched direct seeding; Bob McLemore (and the author) studied seed problems; Bob Blair investigated wildlife relationships; John Moser worked with insects; Glen Hatchell researched growth and yield; Fred Peevy investigated woody plant control; Harold Grelen worked on botany and range issues; and Hans Enghardt (a scientist assigned by the Louisiana Forestry Commission) investigated plantation management.

Similar research centers were located in different geographic areas across the Southern Forest Experiment Station. Many of these developed very strong political alliances; centers were able to create "advisory committees" that included the foremost forestry leaders within the State. Most of these forestry leaders served in the military during World War II and knew how to organize supportive programs. The centers became very effective research organizations, and many of the research center leaders became so politically astute that Station Directors had difficulty managing them.

Statistical Training

In the 1950s and early 1960s, those hired as researchers brought a mixed bag of scientific credentials—some had a bachelor's degree (including the author, hired in 1957 with only a Bachelor of Science in Forestry), others had a master's degree, and only a few had doctorates. The stations were liberal in their support of scientists' needs for continuing education—time was provided and expenses were covered for those obtaining advanced degrees. During these years, however, few forestry students got college training in sampling, statistics, and other relevant courses needed to effectively conduct scientific research. As a result, the Southern Forest Experiment Station began to provide training in sampling and statistics. Workshops were held for new employees, and "cookbooks" were written to lead the scientists though common techniques that were needed to conduct statistical analyses. Probably more important was the availability of statisticians on the Station's staff for counseling and review of all study plans, final reports, and publications for proper use of statistics.

Establishment of Research Work Units

A major realignment of Forest Service research occurred in 1963 when research centers were broken up into smaller units, called "research work units" (RWUs), and the establishment of local advisory committees was banned. These were the Station Directors' efforts to reduce the political influence of the powerful Center Directors with their constituents, especially with respect to procuring budgets for center research programs from Congress, for which the Directors might not approve!

At the Alexandria Research Center, this resulted in center scientists being reassigned to one of five different RWUs: timber (later renamed forest), range, fire, insects, and wildlife. The Center Leader position was abolished, and Project Leaders assumed leadership role for RWUs. Typically, RWUs had a staff of three to five scientists and a good support staff of technicians and clerical positions.

Funding for Research

During the early 1960s, funding for scientific research blossomed, largely related to the successful aerospace program and support from forest industries. Up to this time, Forest Service Research and Development (R&D) was the primary provider of technical information for the rapidly developing forestry efforts across the South. Slowly, forest industry began to provide some funding for their more specific internal needs. In addition, Federal funding for forestry research by land-grant universities was provided by the McIntire-Stennis Act of 1962, which enabled universities to develop their research programs to support a broad array of regional forestry needs.

Maturation of the South's Research Programs

By the late 1970s, forestry research in the South had matured. The Southern and Southeastern Forest Experiment Stations were still the primary providers of forestry research, but industrial and university research efforts had also expanded the scope of their programs. During this period, collaborative efforts became prominent. Numerous cooperative programs were established to pool scientific capabilities among government, industry, and university specialists. These occurred in areas such as genetics and tree improvement, soil productivity, nursery production, biometrics, growth and yield, and herbicide application. Also, during this time the adequate dissemination of information became a concern and focus—frequently called for was the need for greater coordination and transfer of technology to user groups.

THE ROLE OF THE BIENNIAL SOUTHERN SILVICULTURAL RESEARCH CONFERENCE

Although the transfer of scientific information is an obvious justification for establishing the Biennial Southern Silvicultural Research Conference, there were some more pragmatic reasons as well. Within Forest Service R&D, the Southern and Southeastern Forest Experiment Stations were conducting research in the same region and on the same species, so there were

always some turf issues around who was primarily responsible for any particular topic. Initially, these issues were resolved by the program Assistant Directors of the two stations, but over time the number of Assistant Directors declined. There, too, was a level of frustration among silviculturists because their research was generally long term and there was a lack of outlets to publish preliminary data.

A venue where Forest Service silviculturists could meet, share information, and coordinate their programs' efforts was needed. Needed, too, was the involvement and inclusion of silviculturists from universities and forest industry. In 1978, long-term Project Leader Bill Mann at the Alexandria Research Center in Pineville proposed the conference, and the idea was supported by the Directors of the two stations. The administrative Assistant Directors of both stations were charged with making arrangements for hotels and providing other administrative support. The author was named to chair a committee selected to plan the biennial conference that would begin in the fall of 1980, and other committee members selected from the two stations' geographic regions included Tommy R. Dell, Southern Station; David L. Bramlett and William R. Harms, Southeastern Station; George L. Switzer, Mississippi State University; and Klaus Steinbeck, University of Georgia.

Conference Mission and Organizational Structure

The committee met and established some guidelines for the conference. The mission of the conference was to provide a forum for exchange among silviculturists, research coordination, continuing education for researchers, review of research in progress, and presentation of new approaches or techniques of general interest, as well as a published conference proceedings to help disseminate preliminary results of long-term studies.

Since a number of concurrent sessions were anticipated, the committee wanted to establish a structure that would ensure participants could move easily from one session to another. Hence, presentations were limited to 20 minutes, allowing 5 minutes for discussion and 5 minutes for movement to another session. Moderators were charged to keep sessions on schedule. This system worked well and has been used in all succeeding meetings.

The first Biennial Southern Silvicultural Research Conference proved to be a success and became the format for continuing conferences for the next 40 years. Subsequent meetings have had at least 100 presentations and an attendance of about 250 individuals. Optional field tours following the meeting were soon incorporated into the conference.

Publication of the Proceedings

Prompt publication of a proceedings was seen as important by the committee. Since this session was in the pre-computer word processing era, the authors were required to submit the documents in camera-ready form and were responsible for the content of their papers. To assure uniformity of the written material, large oversized sheets with blue outlines showing the needed format were sent to each author—this would allow the written material to be photocopied and reduced to normal page size for publication by the Southern Forest Experiment Station.

The job of the Conference Chair was to collect the documents from the authors, ensure they met the format criteria, organize the material for publication, and submit it to the Southern Forest Experiment Station's publication group. The documents were published without further review. Seventy-five papers were included in the first proceedings of the conference, and the proceedings was distributed within 6 months of the meeting. The computer age has added a number of complications for the Conference Chair. Papers now need to be submitted in an electronic format, and the agency has stricter guidelines for peer review and editorial standards. Because of these added layers, the Conference Chair and those involved in the publishing process must work diligently to ensure that users can still receive the published proceedings in a timely manner. Though the proceedings are now published online only (no hard copies), they are now available on demand for anyone in the world to read. Times have changed!

CURRENT STATUS OF SILVICULTURAL RESEARCH

Driving a few miles down almost any highway in the forested areas of the South, one can observe beautiful and productive forests that are the backbone of the region's economy. The restoration of forests on over 20 million acres of cutover land over the last 5 or 6 decades is a major accomplishment—one due to the development and application of silvicultural research.

This effort has been effective because silvicultural knowledge is now available to manage our major forest species. But that success has included an unintended outcome—the perception that there is a reduced need for the continued intensive silvicultural research found throughout the latter half of the 20th century. This is borne out by declining support within Forest Service R&D. The Southern and Southeastern Forest Experiment Stations merged in 1995, and appropriated funding levels for research continue to decrease. In addition, the number of active Forest Service-wide Research Forester positions has declined, from about 350 positions in 1985

to 94 in 2016. Forest industries are selling their forest land and minimizing forest management programs. Funding available to universities for silvicultural research is declining as well, and university forestry departments are merging with other departments on campus as enrollments decline. These trends affect the Biennial Southern Silvicultural Research Conference, with the numbers of presentations and attendees slowly dropping.

There will be, however, a continuing need for silviculturists and silvicultural research. Nature is never stagnant—our climate is changing and manufacturing technology continues to advance. If forestry in the South is to remain competitive in world markets, we must have updated silvicultural knowledge to adjust to changing conditions and markets. Coordination of these efforts through events such as the Biennial Southern Silvicultural Research Conference will continue to be needed.

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