The Escambia Experimental Forest

Kristina F. Connor[1], Dale G. Brockway[1], William D. Boyer[1] and Ronald K. Tucker[2]

[1]U.S. Forest Service, Southern Research Station, RWU-4158, Auburn, AL 36849;
[2]U.S. Forest Service, Southern Research Station, RWU-4158, Brewton, AL 36426

Background
In 1874, a sawmill was established on the Conecuh River, near the mouth of Lindsey Creek in Escambia County, AL. Some of the creek tributaries were ditched, and a dam for a storage pond was built. The harvesting of the adjacent stands of longleaf pine trees (Pinus palustris Mill.) began at a modest rate; then, around the turn of the century, railroads were extended into southern forests. From 1900 to 1919, all merchantable longleaf pine trees on land now occupied by the Escambia Experimental Forest (Escambia) were cut (Croker 1987). This was typical throughout the South when intensive and extensive harvest reduced the southern longleaf pine forests from 93 million acres to the fewer than 3 million fragmented acres they occupy today. Longleaf pine forests are now one of the most threatened ecosystems in the United States (Noss et al. 1995).

The U.S. Forest Service established research centers throughout the country in the early 20th century. Six of these were located within the native range of longleaf pine, including one at Brewton, AL. The Escambia was established near the Brewton unit of the East Gulf Coast Research Center, Southern Forest Experiment Station, on April 1, 1947, when the T.R. Miller Mill Company of Brewton, AL, represented by Tom Neal Sr., Ed Leigh McMillan, John Miller Sr., and John Richard Miller, provided land, at no cost, to the U.S. Forest Service through a 99-year lease. This 3000-acre tract in southwest Alabama, with trees then averaging 35-45 years of age, was selected because it typified the low density, second-growth longleaf pine forests that then covered about 6.2 million acres in southern Alabama and northwestern Florida (Croker 1987). The Escambia is centrally located in the longleaf pine belt and well situated for the study of the species.

Climate at the Escambia is temperate (humid, subtropical) with long, hot summers and a growing season exceeding 200 days. Winters are generally mild. Mean daily temperatures range from 34 to 90 °F. Annual precipitation of 68 inches arrives almost entirely as rain and is uniformly distributed throughout the year. Escambia soils are dominated by the Troup-Bibb-Benndale-Orangeburg association (Mattox 1975) and range from well-drained gently rolling sandy uplands to lesser areas of poorly drained stream bottoms. The understory plant community is dominated by bluestem (Andropogon spp. L.) and similar grasses; a variety of legumes, composites and other forbs; shrubs; and hardwood tree species which persistently sprout and expand unless periodically burned by prescribed fire.

The First Half-Century of Progress
Following establishment, the land was surveyed and divided into 40-acre compartments. Three 40-acre studies were immediately installed:

(1) The Management Systems Study was established in even-aged and uneven-aged compartments to examine the forest management and economic aspects of three rotations for longleaf pine forests: short (40 years), medium (60 years), and long (80 years).

(2) The Farm Forty Study demonstrated management of a 40-acre farm woodlot. It was managed for logs and poles on an 80-year rotation. An annual field day was held to showcase the products harvested from the woodlot in a typical year (for a 30-year summary see Boyer and Farrar 1981).

(3) The Investment Forest Study was set up to simulate forest management of a typical investor. Records were kept of all activities such as timber marking, maintenance of roads and boundary lines, and prescribed burning.

Three significant events occurred in 1947, the consequences of which still resonate today. One was a wildfire, the second was a bumper seed crop of longleaf pine, and the third was a decision to intentionally burn another 26,000 acres of land in and around the Escambia (Croker 1987). The resulting successful establishment of longleaf pine seedlings on burned areas was evidence of what could be achieved by applying reasoning, deduction, and scientific principles to the issue of longleaf pine regeneration. Fire, long considered the enemy of America's forests, was now viewed as necessary for successful longleaf pine stand establishment. Thomas Croker (1987) wrote about his astonishment that almost all of the prolific advanced regeneration in his seed-tree study area resulted from the 1947 naturally established seedlings and little if any from the seed trees. Many of the third growth forests at the Escambia were established from this one seed crop, and the seed-tree reproduction method for longleaf pine was abandoned on the Escambia. In addition to the resulting poor regeneration, the seed-tree method did not provide pine needles and other fine fuels in sufficient quantity to carry prescribed fire across the study sites.

In 1951, organizational changes in the research stations resulted in discontinuation of the management systems study at the forest. Other studies were put on a maintenance basis and efforts concentrated on the Farm 40 and Investment Forest studies. However, in 1955, with strong local support, young foresters were hired to assist with studies and research management data. One of these, William D. (Bill) Boyer later became the Project Leader of the research unit responsible for managing the Escambia. In 1956, Thomas Croker suggested that the shelterwood reproduction method be used to regenerate longleaf pine forests and published his article in the Journal of Forestry (Croker 1956; Boyer 1963; Croker and Boyer 1975).

In 1964, a region-wide longleaf pine growth study was initiated on the Escambia by Forest Service scientist Robert M. Farrar and later expanded to other locations in Alabama, Mississippi, Florida, Georgia, and North Carolina (Kush and Tomczak 2007). Nearly half of the 305 plots in this study are located on the Escambia. The objective at the time of initiation, and currently, was to quantify growth and yield of natural, thinned longleaf pine forests spanning a range of ages, site types, and residual stand densities across the Southern Region. Site quality was measured by site index (from 50-90 feet) and stand age determined (from 20-80 years). Study sites are thinned to maintain the target basal area for each stand (from 30 to 150 square feet), and new stands are added every 10 years for temporal replication. All plots are re-measured every 5 years, with the 45-year remeasurement scheduled to take place in 2009. In addition to the original objective of the study, scientists are now examining their data to determine whether recent increases in longleaf pine growth are a result of increasing levels of atmospheric CO2 and whether the carbon storage capacity of longleaf pine can serve as a potential mitigation factor for climate change.

The region-wide longleaf pine seed production study began in 1966 as part of the shelterwood test study entitled "Longleaf Regeneration Trials". Mature longleaf pine trees from Louisiana to North Carolina are annually monitored and the number of longleaf pine flowers, conelets, and cones are counted to assess seed production (Boyer 1974, 1987, 1998; Croker 1973). After many observations of cone production in stands at varying densities, stands are now thinned to maintain a maximum shelterwood density of about 30 square feet per acre. There are 10-15 seed-bearing longleaf pine trees per study site. At the Escambia, pollen counts are also conducted annually. A report containing estimates for the regional cone crop is sent to forest managers every June.

Fire studies have been conducted at the Escambia since 1973. In one continuing study, plots are either burned once every 2 years in spring, summer, or winter, or left unburned as a control. In conjunction with the season of burn, some plots received an initial herbicide treatment while on others vegetation was periodically cleared away by hand. Initially, all pine height and diameters were measured, fire behavior was documented, and crown scorch recorded every three years. Understory species were also measured and sampled. While still in progress, the study measurements are now taken every five years. A second study, established in 1985, examines both fire season and the length of time between burns (e.g., one fire every 2, 3, or 5 years) (Boyer 1990).

Following successful management of operations on the Farm 40 Study (which uses the group selection reproduction method) and Tom Croker's publication in the Journal of Forestry (emphasizing benefits of the shelterwood reproduction method), land managers began rethinking their approach to longleaf pine regeneration and stand management methods. As a result, an uneven-aged management study was initiated on the Escambia by Robert M. Farrrar. The objective of the study was to demonstrate and compare three uneven-aged management techniques with fixed basal area per acre stand regulation methods. Plot sizes range from 30 to 40 acres. Fire is applied every 3 years, and diameters of all trees on the study sites are measured every 5 years. The Methods study, or phase one, was established in 1977 and used the volume-guiding diameter limit method (V-GDL). The second phase of the study, installed in 1981, employed the Basal Area-Maximum Diameter Diminution Quotient method (BDq). The third phase, added in 1991, tested the Diameter Limit Cutting method (DLC).

Current and Future Directions

A little more than 80% of the Escambia is currently occupied by longleaf pine stands, with the remainder in slash pine and hardwood bottoms. Tree ages range from young seedlings to 160 years, with the second-growth timber approximately 95-years-old. Over 1200 acres of the forest have been naturally regenerated and more than half of this is in stands ranging from 35-50 years of age. Stand densities vary widely; some variations were artificially created for the growth and yield studies started in 1964. Site quality averages 70-75 feet at 50 years (range = 65-83 feet). Very few locations in the South can boast the combinations of stand ages, sites, and conditions that are found at the Escambia.

After Hurricane Ivan struck the Escambia in September 2004, some of the heavily damaged longleaf pine stands were salvage harvested by clearcutting. On these areas, scientists installed a study to examine the influence of intensive management practices on accelerating restoration of the longleaf pine forest. Study plots received herbicide treatments of either (a) 2.5 lbs of Velpar®, (b) 0.75 lb of Chopper®, (c) 6 lbs of Garlon® XRT, or (d) none as a control. Soon after tree planting, half of the plots were fertilized with superphosphate and potash and will receive 140 lbs of urea per acre at ages 15 and 30. The other half of the plots will remain unfertilized. Seedling survival will be monitored and growth will be measured at established intervals to track developmental progress.

The advantages of the long-term work in progress at the Escambia are exemplified by the discoveries that cannot be made by short-term experiments. For example, because of the long-term records, Bill Boyer noted significant growth differences between second-growth and third-growth stands (Boyer 2001). While trees from second-growth stands in 16 compartments averaged 66.5 feet in one study and 66.4 feet in a second, estimates of height growth in third-growth stands obtained from studies in 17 compartments averaged 81.3 feet. All of these stands are intermixed and cover a similar range of soil-site conditions. Additionally, less than 5% of second-growth trees in the study showed signs of early suppression followed by later release. In fact, based on early radial growth measurements of the first 25 rings, second-growth trees outgrew third-growth trees, suggesting that changes in growth aren't due to differences in site or early tree growth. The study may have significant implications for climate change researchers.

Another observation is that, in 33 years, natural longleaf pine regeneration catches and surpasses planted longleaf pine in height, even with understory control on the planted sites (Boyer 1997). For a landowner or forest manager with longleaf pine already in place, natural regeneration methods are both effective and economical, eliminating the large sums needed for planting and related costs. Carrying such costs over the years diminishes the economic benefit to the forest owner.

Lastly, cone crop information has been collected for 50 years on the Escambia and at many sites across the region. Because of this extensive long-term database, scientists have noted that cone production by longleaf pine trees on the Escambia has more than doubled during the period from 1986 to 2008 compared to the preceding 20 year average (Figure 1). At this time, researchers are uncertain as to the cause for this increasing frequency of good cone crops. It may be related to tree age or a result of climate change.

The importance of the preceding examples is that all were possible because of the long-term databases now available from experimental forests such as the Esambia, where studies can be actively maintained and protected for decades of information gathering. Because of research on the Escambia, we now know that the shelterwood reproduction method is a successful and cost-efficient means of regenerating longleaf pine forests; that fire is essential for longleaf pine regeneration; that height growth of naturally regenerated longleaf pine catches up to and surpasses planted seedlings after 33 years; and above all that longleaf pine ecosystems are an integral and vital part of the southern economy and culture.

The Escambia Experimental Forest is managed by the U.S. Forest Service, Southern Research Station, Unit SRS-4158, headquartered in Auburn, Alabama, with scientists also stationed at Clemson, South Carolina and Pineville, Louisiana.

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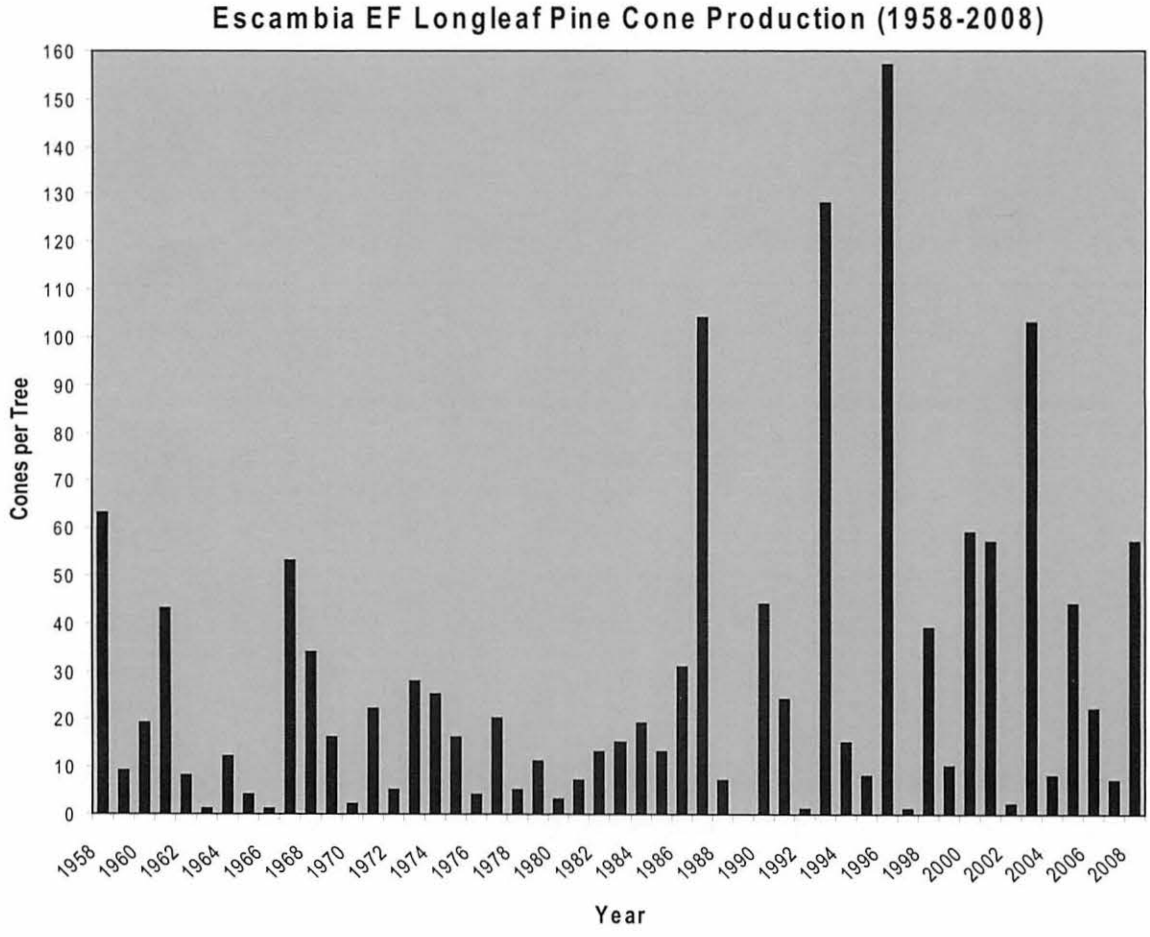

Figure 1. Escambia longleaf pine cone production, from 1958 through 2008. A strategy for transitioning loblolly pine stand to longleaf: implications for restoring native groundcover.