FIELD NOTE

J. For. 115(3):238-241
https://doi.org/10.5849/jof.15-145

silviculture

Longleaf Pine Cone Collection on the Sabine National Forest during October 2014

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Longleaf pine is known as an unpredictable seed producer, with adequate or better seed crops occurring once every 5 years or longer. However, in the spring before seed fall, good cone crops can be predicted by visually counting green cones in the canopy, which by then are large enough to be seen, especially when binoculars of suitable power are used. During the spring of 2014, cone surveys in eastern Texas suggested that the autumn longleaf pine cone crop there could be a bumper crop. As a result, staff of the National Forests and Grasslands in Texas, in cooperation with Southern Region Forest Management staff, planned and conducted a longleaf pine cone collection that was implemented during the fall of 2014. Results were a great success, with more than 1,000 bushels of cones collected, producing nearly 1,000 pounds of seed (equivalent to approximately 5 million seedlings, enough to plant roughly 8,000 acres at typical planting rates). This seed supply will meet the needs of the National Forest and Grasslands in Texas for the foreseeable future.

Keywords: longleaf pine, cone collection, Sabine National Forest

Longleaf pine (*Pinus palustris* Mill.) is known as an episodic producer of seed. Historically, good seed years were thought to occur only once every 5–7 years, with failures once every 5 years (Wahlenberg 1946). However, Boyer (1987) noted that there were some differences in the periodicity of seed production at different locations within the natural range of this species. Boyer (1998) also noted that the frequency of fair or better cone crops has increased since 1983, but the reasons for this trend were uncertain. Brockway and Boyer (2014) updated that observation, noting that fair or better cone crops have occurred during 51% of all years since 1966.

However, before the maturing of southern pine seed orchards, use of seed collected from national forest "seed production areas" was an accepted practice. These seed production areas were located in stands with phenotypically superior mature trees that showed evidence of past cone production. Such stands remain a practical alternative for augmenting seed supplies for longleaf pine, in which adequate or better seed crops are unpredictable.

Cone and seed production is important in longleaf pine silviculture for two reasons. The first relates to the potential for natural regeneration of longleaf pine using either even-aged or uneven-aged reproduction cutting methods. Croker and Boyer (1975) thoroughly discussed the natural regeneration of longleaf pine relative to the use of the shelterwood method. Much of the literature on longleaf pine cone production during the last three decades of the 20th century was conducted to provide a better understanding of cone and seed production in stands, which were naturally regenerated via even-aged methods (Boyer 1993, 1997, 1998). Cone production is also relevant to stands managed via selection systems, although such stands are less dependent on large seed crops and can naturally regenerate with more modest levels of seed rain available to them each year (Farrar and Boyer 1991).

In addition, seed crop predictability is fundamental to the management of seed orchards that provide seed for artificial regeneration (i.e., reforestation). Research on the development of male and female strobili, pollination, cone growth, and seed production, especially in loblolly pine (*Pinus taeda* L.)

Received December 20, 2015; accepted May 3, 2016; published online July 7, 2016.

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Acknowledgments: *We thank National Forests and Grasslands in Texas employees: Kimpton Cooper, Jeremiah Haddix, Shawn Jones, Murphy Semetko, Troy Toole, Phyllis Wolf, Marsha Cooper, John Amegin, Juanita Garcia, Ira (Ike) McWhorter, Tom Philipps, and Sherra Taylor. We also thank Robert Makowski, Region 8 Regional Silviculturist, for the support from the Regional Office in funding the cone collection. Additional support was provided by Bobby Ray, Stuart Seed Orchard Manager (Pollock, LA) and Michael McGregor, Ashe Seed Extractory Manager (Brooklyn, MS). Finally the excellent work of UFL, Inc. Foreman Juan Gomez and his crew and tree shaker operator John Delaney of the Louisiana Forest Seed Company, Inc., were key to the success of the project.*

and slash pine (*Pinus elliottii* Engelm.), was conducted in direct support of genetic and breeding efforts for southern pines (Wakeley 1954, Dorman and Barber 1956, Dorman 1976, Wakeley and Barnett 2011). The same environmental factors that govern cone and seed production in wild stands also influence cone and seed production in seed orchards. However, management practices in production seed orchards include controlled pollination, fertilization, and the use of insecticides to control seed and cone insects. As a result, cone production and seed yields in orchards are more consistent from year to year and with larger crops within any given year, especially during years when wild seed crops are average to poor (Barnett 1996).

The historical decline of longleaf pine is well documented. Before European colonization, longleaf pine-dominated forests occupied roughly 91 million acres, but by the mid-1990s, less than 4 million acres remained (Frost 1993, Oswalt et al. 2012). As a result, a major effort is now underway to recover this tree species through the efforts of the Longleaf Alliance (established 2008 by multiple partners[1]) as well as America's Longleaf Restoration Initiative (ALRI) (established 2009), with publication of the Rangewide Conservation Plan for Longleaf Pine (ALRI 2009), a collaboration of the US Departments of Agriculture, Interior, and Defense. The conservation plan describes a 15-year mission to restore longleaf pine on 8 million acres of longleaf pine forests on public and private lands by 2025.

There are two silvicultural approaches that have guided these early efforts to restore longleaf pine. The first is to establish new longleaf pine plantations on abandoned agricultural lands that had once supported cutover longleaf pine forests. The other is to harvest off-site species, such as mature stands of slash pine in the lower west Gulf Coastal Plain of Louisiana and Texas, and reforest those sites with planted stands of longleaf pine.

For many years, federal land managers have also been concerned about the decline of longleaf pine and have been working to recover this species on national forest lands within its native range. During the past several decades, the National Forests and Grasslands in Texas (NFGT) have been establishing new longleaf pine plantations using seed provided by the Stuart Seed Orchard, operated by the US Department of Agriculture (USDA) Forest Service near Pollock, Louisiana. However, with the increasing popularity of longleaf pine restoration via plantation establishment, demand for longleaf pine seed has risen markedly. Simply stated, the demand for seed from the seed orchard exceeds the supply, because of both the natural variability in longleaf pine seed production and the increased demand for seed to support the ALRI rangewide restoration plan (Crane and Barbour 2009). During the spring of 2014, visual observations indicated that mature longleaf pine stands on the NFGT were producing an excellent cone crop (Figure 1). Data collected from a long-term regional cone monitoring study indicated that this year would bring a bumper crop (Brockway and Boyer 2014), which in eastern Texas occurs only once every 15 years, on average. Given this "early alert" forecast, plans were made to take full advantage of this opportunity by conducting a cone collection on the Angelina and Sabine National Forests, to supplement the NFGT longleaf pine seed supply.

Figure 1. Abundant green cones of longleaf pine in the spring of 2014 foretell the possibility of a bumper cone crop in the fall of 2014. Stuart Seed Orchard, USDA Forest Service, Pollock, Louisiana. (Photo by James M. Guldin.)

Methods

The objective was to collect 1,000 bushels of mature longleaf pine cones from suitable National Forest sites in eastern Texas and deliver them to the Ashe Seed Extractory, operated by the USDA Forest Service near Brooklyn, Mississippi, for seed extraction, de-winging and storage. Tests for seed purity, germination, and viability would be performed at the National Tree Seed Laboratory, operated by the USDA Forest Service in Dry Branch, Georgia. Stored seed would eventually be used to produce seedlings for reforestation and restoration of longleaf pine stands, primarily on NFGT sites.

Site Selection

After preliminary work to identify the most suitable sites for collection, cone surveys were conducted during June 2014 at seven sites on the Angelina and Sabine National Forests. At these sites, average counts ranged from 45 to 78 cones per tree, which represented a good crop for all but one of the sites. Although all seven sites were included in the contract for cone collection, only sites on the Sabine National Forest and in Sabine and Newton Counties were used (Figure 2). Sites 1 through 3 are located on the Stark tract in Compartments 141 and 142 (Figure 3), and site 4 is located near Fox Hunter's Hill in Compartment 139 (Figure 4). The Forest Management Unit in the Southern Regional Office, located in Atlanta, Georgia, provided funding and support for preparing the contract, which was awarded to U.F.L., Inc., of Ackerman, Mississippi, in early September.

Management and Policy Implications

One important aspect of restoring longleaf pine forests is to reestablish this tree species at locations within its historical range where it is now absent or poorly represented. On lower west Gulf Coastal Plain sites in East Texas, the recovery process often involves the harvest of nonnative slash pine stands or other off-site species, followed by site preparation and planting with containerized longleaf pine seedlings. Because these seedlings must be grown from seed, the supply of longleaf pine seed has been a concern, especially in the past when methods for producing and/or obtaining such seed were less advanced. The primary source of seed for reforestation in the Western Gulf Region is a first-generation longleaf pine seed orchard at the Stuart Seed Orchard in Louisiana, which includes selections from Texas. However, prior to the maturing of southern pine seed orchards, use of seed collected from national forest 'seed production areas' was an accepted practice. These seed production areas were located in stands with phenotypically superior mature trees that showed evidence of past cone production. Such stands remain a practical alternative for augmenting seed supplies for longleaf pine, in which adequate or better seed crops are unpredictable.

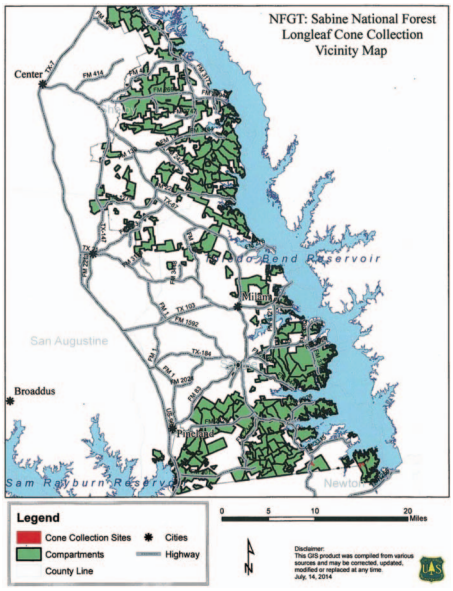

Figure 2. Sabine National Forest longleaf pine cone collection sites.

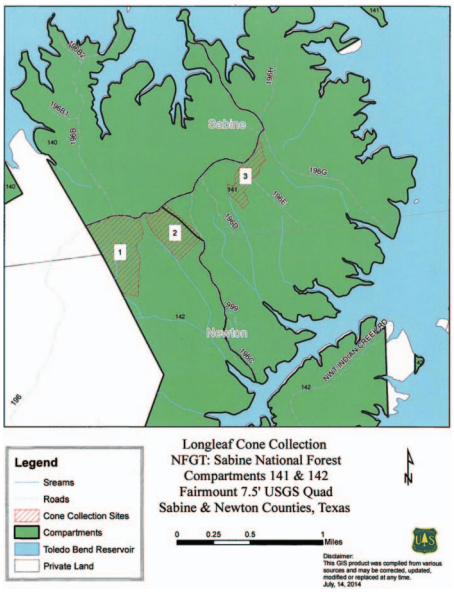

Figure 3. Longleaf pine cone collection sites, Compartments 141 and 142 (Stark Tract) on the Sabine National Forest.

Cone Collection

Protocols for determining the maturity of southern pine cones were established by Wakeley (1954), and data specific to longleaf pine are available from the National Tree Seed Laboratory (Barbour 1996). Cones are mature when their specific gravity falls below 0.89. Before cone collection, specific gravity testing required the use of firearms to shoot cones from the tree crowns. Shooting was performed by USDA Forest Service law enforcement officers of the NFGT.

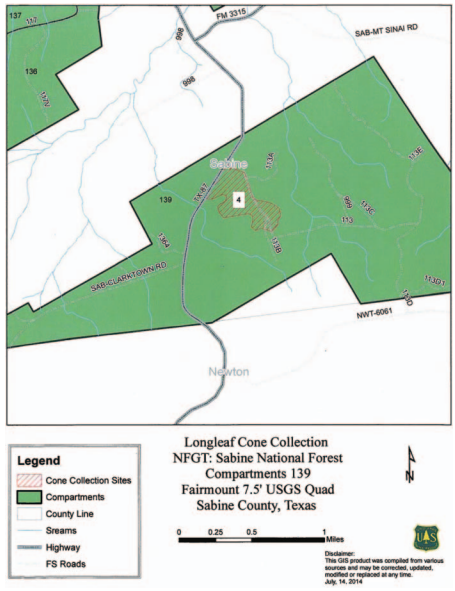

Figure 4. Longleaf pine cone collection site, Compartment 139 (Fox Hunters Hill) on the Sabine National Forest.

Figure 5. Tree shaker used to dislodge cones from Longleaf pine trees on the Sabine National Forest. (Photo by George F. Weick, Jr.)

Cone testing began on Sept. 17 and continued weekly, until specific gravity measurements in mid-October determined that the cones were sufficiently ripe. Cone collection began on Oct. 22. The contractor used a tree shaker (Figure 5), provided by the Louisiana Forest Seed Company, to shake the trees (Figure 6), causing cones to fall to the ground. A field crew then collected the cones by hand and delivered them to the Yellowpine Work Center on the Sabine National Forest.

Results

Within 4 days, the project collected 1,036 bushels of cones, all from the Stark tract and the Foxhunter's Hill site on the Sabine National Forest. Cones were shipped to the Ashe Seed Extractory on Oct. 26, where the two lots (Lot 1 from Foxhunter's Hill and Lot 2 from the Stark tract) were individually processed and stored to preserve their unique identities. The 1,036 bushels of cones yielded 990 pounds of seed, or approximately 0.95 pound of seed per bushel. Tests at the National Tree Seed Laboratory indicated that Lot 1 yielded 439.7 pounds of seed, with a 99% germination rate, and Lot 2 yielded 550.4 pounds of seed, with a 97% germination rate, both after 14 days of stratification.

Figure 6. Machine shaking trees to dislodge longleaf pine cones on the Sabine National Forest. (Photo by George F. Weick, Jr.)

Summary

Estimates are that this collection yielded about 4.85 million seeds to help meet longleaf pine forest restoration needs in the future. If planted at an average density of 600 seedlings per acre, more than 8,000 acres could be planted with seedlings produced from this collection. At the current pace of plantation establishment, this will meet the reforestation needs of the NFGT for the next 10 years, well within the acceptable storage life if seeds are properly processed and stored. Based on this experience, seed collection from appropriately chosen seed production areas in the forest may be an effective method for helping to meet the

growing demand for longleaf pine seed, as rangewide interest in longleaf pine restoration continues.

Endnote

1. For more information, see www.longleafalliance.org/.

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