PINE

Longleaf Pine: Natural Regeneration and Management

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Longleaf pine has long been recognized as a high-quality timber tree providing a number of valuable products. It is a versatile species with characteristics allowing the use of several silvicultural options. Both natural and artificial regeneration of longleaf pine are now practical management options. Natural regeneration is a low-cost alternative whenever sufficient seed trees are present. If not, then longleaf can be restored through planting. Risks of planting failure have been greatly reduced through use of container stock, especially on adverse sites. Longleaf's reputation as a slow grower may be more myth than reality. On many former longleaf sites, the growth of longleaf may equal or exceed that of loblolly or slash pine. This article reviews the important attributes of longleaf pine and options for management of this species.

The Tree

Longleaf pine is a long-lived tree, capable of reaching ages close to 500 years, although this is rarely attained due to the many natural hazards ranging from lightning strikes to tropical storms. Longleaf pine is a very intolerant pioneer species, but generally lacks the characteristics of such species. It is a poor seed producer. The seeding range is relatively short. Seedlings, once established, may remain in the stemless grass stage for years before beginning height growth. Despite these competitive drawbacks, longleaf pine has maintained itself in place for thousands of years. To do so, the species had to become naturally established in sufficient numbers and, despite its slow early growth, manage to overcome many aggressive competitors.

Longleaf pine has always been recognized as a high-quality timber tree providing a wide range of products: logs, poles, piling, posts, peelers for plywood, and pulpwood. It usually has a higher specific gravity than other southern pines and thus produces more dry weight per unit of volume. On average sites, 30 to 80 percent of the trees will make poles, which are more valuable than sawlogs.

Longleaf pine has many attributes that allow a variety of management options. In addition to its commercial quality and versatility, longleaf, once established, is a low risk species to manage. It is resistant to fire and the more serious diseases and insect pests that afflict other Southern pines, including fusiform rust, annosus root rot, phytophthora, pitch canker, southern pine beetle, and tipmoth. The species develops a massive taproot that, in mature trees, may reach a depth of 8 to I2 feet or more, reducing the risk of windthrow.

NaturalRegeneration

Successful natural regeneration of longleaf pine will depend on one of the occasional good seed years. Longleaf cone crops are highly variable from year-to-year, and from place-to-place. In most years, the cone crop will do little more than supply the many animals that feed on these large, nutritious seeds. In poor seed years there are not only fewer cones per *tree,* but also fewer sound seeds per cone. Given a receptive seedbed, 360 cones per acre are needed, on average, just to obtain the first seedling. A minimum of 750 cones per acre is usually needed to provide for acceptable regeneration. Given 25 residual seed trees per acre in a shelterwood stand, it takes an average of 30 cones per tree to reach this minimum. Cone crops of this size or larger are uncommon throughout much of the longleaf region, and are erratic in their occurrence. The large "masting events," indicated by an average of 150 or more cones per mature tree, are extremely rare. Two have occurred in the central Gulf Coast longleaf belt in the last 50 years: 1947 and 1996. In most years, cone crops will average less than 10 cones per mature seed tree.

Natural regeneration is a practical low-cost alternative given an adequate number and distribution of seed-bearing trees. It should not be difficult under these conditions, since nature has managed to do so over the millennia. Some of the observed examples of successful regeneration in nature seemed to resemble a shelterwood method and led to the hypothesis that this approach could be the most appropriate for longleaf pine. This has since proven to be the case. The shelterwood method of natural regeneration is highly flexible and can be adapted to a variety of site conditions and management objectives.

To ensure success, the manager needs to see that all biological requirements for natural regeneration are met in a timely manner. These include:

- An adequate seed supply.
- Pre-establishment competition control.
- A well-prepared seedbed.
- Post-establishment competition control.
- Control of brown-spot needle blight.

Except for seed supply, all these requirements can be met through timely use of prescribed fire.

Given a mature, managed stand of longleaf pine periodically thinned to medium densities, the regeneration process begins about five years before the planned harvest date. At that time, a seed cut creates a shelterwood stand with a residual density of 25 to 30 square feet

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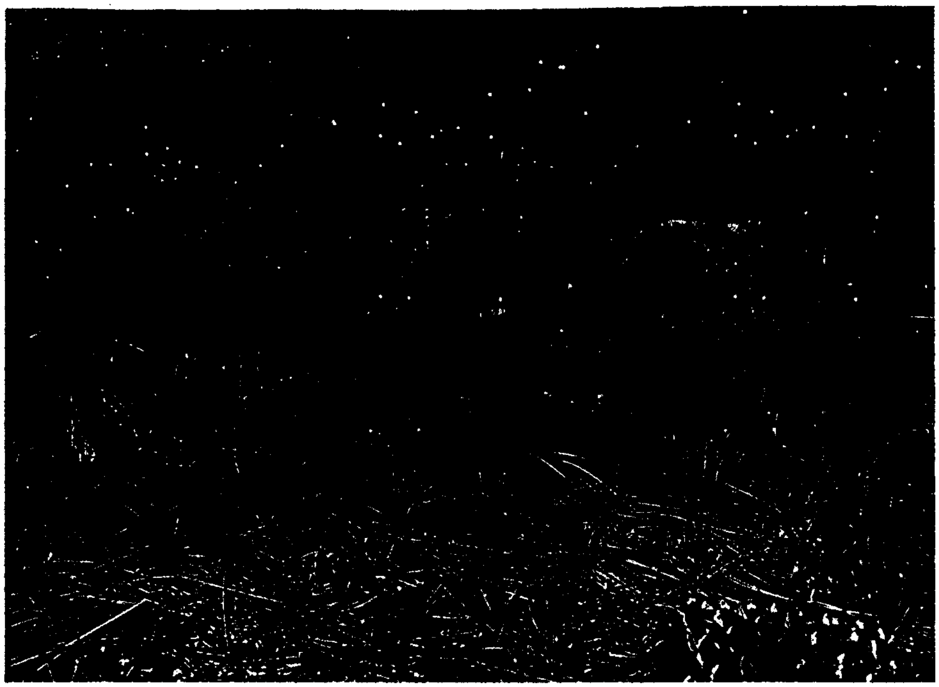

One-year-old seedlings following heavy seed crop.

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of basal area per acre of well-distributed, high-quality dominant trees, preferably those with a history of cone production. Cone production on a per-acre basis peaks at stand densities of 30 to 40 square feet, but the lower end is preferred because logging-related seedling mortality increases with increasing density of the overstory removed. At a stand density of 30 square feet or less, logging related seedling mortality should remain below 50 percent. In addition to maximizing seed supply, this density produces enough needle litter to fuel the fires that can limit hardwood encroachment and prepare an adequate seedbed when needed. During the wait for a good seed crop, high-quality volume growth is added to residual trees. Although the seed cut may reduce stand density by half, volume growth is reduced only about one-third as the dominant trees take advantage of released growing space.

Within a regeneration area, advance warning of an upcoming good cone crop is obtained through annual checks of flowers and conelets on sample trees. Binocular counts are made in the springtime, when both flowers and conelets are most visible. Flower counts are relatively unreliable predictors of cone crop size, due to uncertain and often heavy flower losses. These counts do reliably predict cone crop failures, and reveal any possibilities of a good cone crop. Counts of the green conelets are good predictors of cone crop size for the coming fall, although only a limited time remains to accomplish any needed competition control and seedbed preparation.

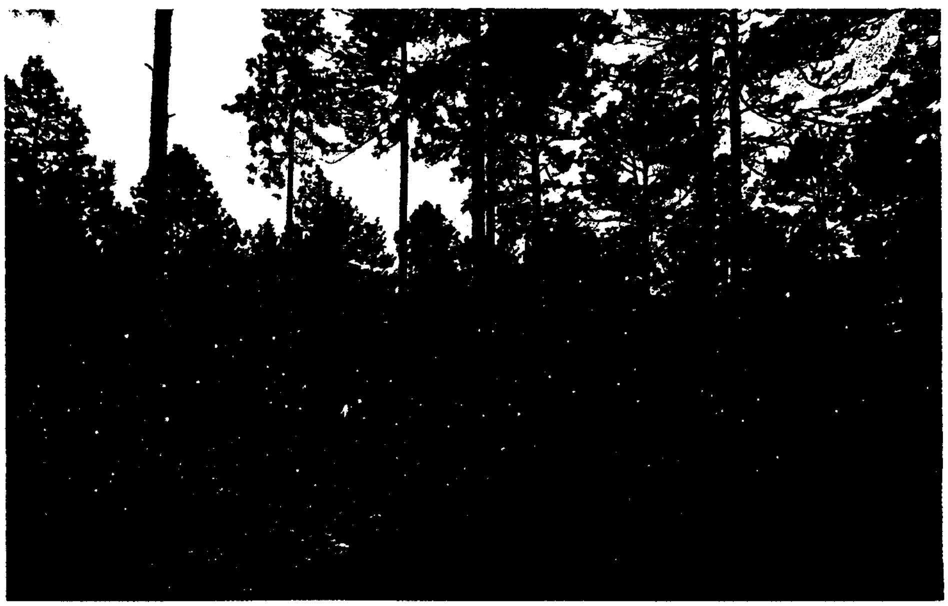
The regeneration goal is 6,000 or more seedlings per acre at least one year old before the parent overstory is removed. This number allows for logging losses of up to half the stand. It leaves enough survivors that the superior, fast-growing, brown-spot resistant fraction of the stand will provide 300 to 600 high quality trees per acre for the next generation. This number of one-year-old seedlings is flexible and may be adjusted to meet local conditions. A smaller number of established seedlings might suffice, especially if logging mortality can be reduced through careful supervision.

Once a regeneration survey indicates adequate seedling stocking, the overstory can be removed. Longleaf seedlings can survive for years under a parent overstory provided they are not burned before reaching a fire-resistant size. Thus, overstory removal can be scheduled to meet management needs or market conditions. However, the overstory should be cut before many of the best seedlings begin height growth. Stemless grass-stage seedlings are less likely to suffer serious damage from logging, but when they do. are more likely to sprout. Burning should be delayed until at least two years after overstory removal. This allows time for logging slash and accumulated litter to decay and for suppressed seedlings to respond to release.

A number of successful tests and applications of the shelterwood method described above indicate that longleaf pine stands can be regenerated naturally at low cost and with a high probability of success provided necessary cultural treatments are properly timed and executed.

Management

A principal management goal should be the use of silvicultural methods that



Development of multi-age longleaf pine stand under parent overstory can sustain longleaf pine ecosystems in perpetuity. They will incorporate natural regeneration and will likely simulate, in a systematic way, some of the events and processes that maintained longleaf ecosystems in nature. Management, however, can exercise positive control of the processes rather than merely responding to the impact of chance events.

Longleaf pine forests can be maintained with any one or more of three basic management systems or their variants. The three systems are: 1) even-aged management, 2) two-aged stand management (the irregular shelterwood), and 3) uneven-aged management. Each of these can simulate the processes that maintained longleaf pine in the past. While much is known about even-aged management of longleaf pine, relatively little is known about the long-term consequences of alternatives to traditional even-aged management or their adaptability to differing site conditions. Limited tests suggest that, at least on average sites, management of two-aged stands and selection management are both viable alternatives for longleaf pine.

Even-aged management-Even-aged stands are initiated by natural regeneration from one or several seed crops that occur within a short span of time. The parent overstory is removed only after an adequate seedling stand is established,

Variants include:

I. Rotation age

2. Thinning regimes.

This method represents the catastrophic stand replacement event that often led to the even-aged stands found in nature. Cutting replaces the blowdown that often followed severe tropical storms. Ultimately, most coastal plain forests will experience such an event. certainly within the potential lifespan of a longleaf forest. Risks from tropical storms increase with rotation length and proximity to the coast. Management hopes to ensure that the stand replacement event (overstory removal) occurs only after adequate regeneration is present. This may or may not occur in nature. and possibly not even under management.

Two-aged stand management-A mature stand is reduced to a shelterwood density after which seedlings from one or more good seed crops are established. All or part of the parent overstory is retained through all or part of the next rotation.

Principal variants are:

1. Maintain two-aged stand through rotation. Dominant ingrowth fills canopy gaps; thinning from below removes intermediate/suppressed trees, plus some dominant/codominant trees as needed to maintain desired stand density. At the selected rotation age, the process is repeated. Area control is preserved. Within the above, variants include:

a) Density of residuals retained.

b) Length of time residuals retained.

c) Rotation length.

d) Thinning regimes.

2. Maintain the reverse-J diameter class distribution (more small trees and fewer large trees) resulting from retention of overstory trees. This is a fast way to reach an uneven-aged stand structure. Selection management is imposed, leading ultimately to an uneven-aged condition which is maintained indefinitely.

Once the uneven-aged structure is established, variants will be the same as those listed below. Two-aged stand management represents the situation in which a partial stand is left after a catastrophic event and regeneration is present on the forest floor. It is most likely to occur where good seed crops are infrequent and regeneration from the first big crop preempts the site, maintaining essentially a two-aged stand.

Uneven-aged management-Forest stands are comprised of three or more age classes. Conditions are estabiished to promote periodic recruitment of regeneration in order to develop and retain a full range of age classes within the management unit. Once established, it can be maintained indefinitely in absence of a major catastrophic event.

Variants include:

1. Single tree selection.
2. Group selection. Group size and shape a variable.
3. Any one of several methods of regulation.

This method represents the condition that develops over time with normal attrition, mainly through lightning strikes, bug-kills, fire, and limited blowdowns. This is combined with regularly recurring recruitment and retention of regeneration in newly created gaps.

Summary

The management systems outlined above illustrate systematic ways to perpetuate longleaf pine forests, including their diverse associated fire-dependent communities, using processes that maintained these systems in nature. The adaptability of longleaf pine to so many management goals and methods should make it an attractive management option for many forest landowners in the longleaf region. Stewardship of diverse and productive longleaf pine forests, growing high-value products, will not only provide a good economic return to the landowner but can also preserve environmental values that have nearly vanished from the Southern landscape.

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