The Longleaf Pine Forests of the Southeast: REQUIEM OR RENAISSANCE?

Courtesy of USDA Forest Service

This naturally established second-growth longleaf pine forest, shown at age 45, arose following final harvest of the old-growth. Most second-growth longleaf has been cut, normally without replacement. The remnants generally range from 70 to 100 years in age.

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VAST FORESTS OF LONGLEAF PINE *(PINUS PALUSTRIS)* GREETED the first European settlers of the lower Atlantic Coastal Plain of the Carolinas and Georgia. At that time, this species may have dominated as much as 92 million acres throughout the southeastern United Srates (Frost 1933). Only about 20 million acres of longlraf pine forest were left by 1935 (Wahlenberg 1946). These forests declined to less than 5 million acres by 1975, and within the next decade to 3.8 million acres (Kelly and Bechtold 1990). A more recent update (USDA Forest Service, Forest Inventory and Analysis, unpubl. data) puts the total at about *3.2* million acres. Losses since rhen have likely reduced remaining longleaf forests to less than 3 million acres.

What once was one of the most extensive forest ecosystems in North America has nearly vanished without notice. But only recently has this loss begun to attract attention and concern (Means and Grow 1985; Noss 1989). The objectives of this paper are to describe the longlraf pine ecosystem and its ecological and economic values, document its continuing decline, and explore possibilities for retaining longleaf pine as an imporrant part of southern forests.

The Longleaf Pine Ecosystem

The natural range of longleaf pine covers most of the Atlantic and Gulf Coastal Plains, from southeastern Virginia to eastern Texas and south through the northern two-thirds of Florida, with extensions into the Piedmont and mountains of north Alabama and northwest Georgia *(fig. 1)*. The species occurs on a wide variety of sites, from wet, poorly drained flatwoods near rhe coast to dry, rocky mountain ridges (Boyer 1990).

Longleaf pint: is a long-lived tree, potentially reaching or excrcding an age of 500 years; however, longleaf pine forests

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Table 1. The distribution of longleaf pine, by state and ownership class.

	All ownerships	National forest	Misc. federal	State-owned	County/ municipal	Forest ind.	Farmer	Other corp.	individual
				thousands of acres					
Florida	950.7	178.5	118.6	118.4	2.3	149.9	66.4	118.7	197.9
Georgia	520.2	0.0	55.3	3.5	0.0	44.7	122.8	77.5	216.4
North Carolina	255.5	12.3	57.8	37.8	0.2	20.3	43.1	21.0	63.0
Texas	45.0	11.1	0.0	0.0	0.0	22.8	0.0	5.8	5.3
South Carolina	369.0	18.7	73.4	23.2	0.0	15.4	38.1	71.6	128.6
Alabama	535.1	81.8	5.8	5.7	10.7	190.3	73.7	59.1	108.0
Mississippi	270.3	91.5	0.0	9.9	0.0	37.3	23.2	6.6	101.8
Louisiana	232.9	61.6	12.0	0.0	0.0	75.5	0.0	36.3	47.5
Total	3,178.7	455.5	322.9	198.5	13.2	556.2	367.3	396.6	868.5

SOURCE: USDA Forest Service, Forest Inventory and Analysis data, 1994.

are often exposed to catastrophic hazards such as blowdown or fire and to continuing attrition from lightning. Most of the longleaf pine range is within 150 miles of the Atlantic or Gulf coasts, a region subject to damaging tropical storms. As a result, few longleaf pines are likely to reach their biological potential.

Longleaf pine is a very intolerant pioneer species; it is a poor seed producer, and its large seeds have a limited dispersal range. Once established, seedlings grow slowly and, where vigorous competition is present, may remain in the stemless grass stage for years.

The longleaf pine ecosystem is distinguished by open, park-like "pine barrens," which are composed of even-aged and multi-aged mosaics of forests, woodlands, and savannas, with a diverse groundcover dominated by bunch grasses and usually free of understory hardwoods and brush. Longleaf pine is the key tree species in a complex of fire-dependent forest ecosystems long native to the southeastern United States. Its existence was dependent on periodic fire, to which it is adapted while most of its potential competitors are not. An exception may be very dry sites where groundcover is too sparse to prevent seeds from reaching mineral soil or competing with established seedlings.

Pine barrens are known for remarkable persistence and diversity, yet they generally lack the fertile soils or layered canopies of mixed species that characterize many other diverse systems.

Elements of ecosystem persistence. The ecological persistence of pine barrens is a product of long-term interactions among climate, fire, and the traits of key plants. Regional dominance by southern pines began to redevelop about 10,000 years ago with a warming trend following retreat of the last continental ice sheet. The modern longleaf pine-turkey oak *(Quercus laevis)* forests were established in north Florida about 7,800 years ago (Watts et al. 1992), and over the next 4,000 years reinvaded the rest of the Southeast (Delcourt and Delcourt 1987). The forests of the southeastern United States, as found in historic times, were apparently in place about 5,000 years ago, with pollen records indicating 65% pine and 15% oak plus most other elements of the modern forest (Watts 1980). Undoubtedly, these forests included extensive longleaf pine stands much like those found by the first European travelers in the region. Thunderstorm systems with frequent lightning and rain have prevailed over this vast region, a complex of mostly sandy (quick-drying) sites that are well exposed to natural and anthropogenic disturbances.

Longleaf pine and bunch grasses (e.g., wiregrass and certain bluestems) possess traits that facilitate the ignition and spread of fire during humid growing seasons (Landers 1991). Frequent fire was largely responsible for the competitive success of longleaf pine and the grasses. These keystone species exhibit pronounced fire tolerance, longevity, and nutrient-water retention that reinforce their dominance and restrict the scale of vegetation change following disturbance.

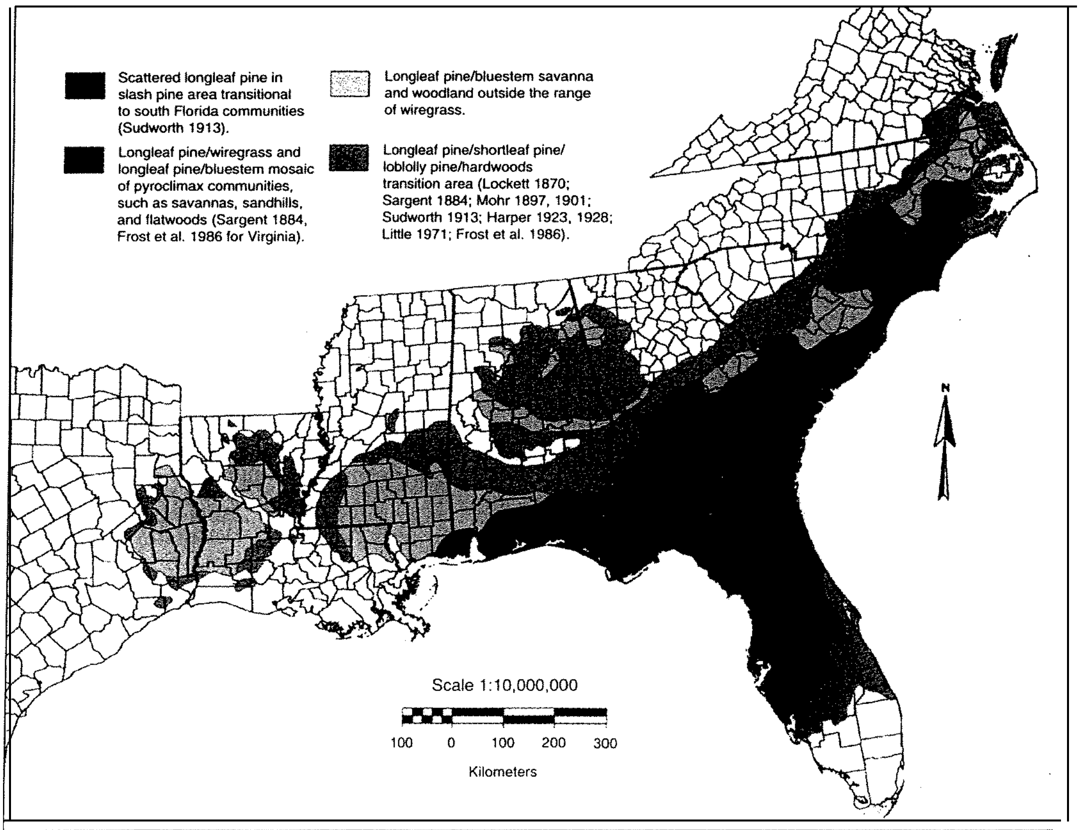

Figure. 1. Presettlement range of longleaf pine in the southeastern United States. Source: C. C. Frost 1993.

Frequent fires during the growing season largely prevent species native to other habitats from encroaching into pine barrens. The chronic fire regime also maintains soil structure and nutrient dynamics to which longleaf pine is adapted, while inhibiting the processes of soil weathering and building (McKee 1982). These fire effects tend to make longleaf pine sites more favorable to resident species than those indigenous to more nutrient-rich habitats.

*Elements of **ecosystem diversity.*** Combinations of disturbance and site factors play important roles in maintaining biological diversity. Variability is added to the disturbance regime by frequent lightning strikes, treefalls, and various animal influences that have local effects. More vast areas can be severely affected every few decades by tropical storms and hydrologic extremes. Disturbances acting across site gradients provide temporary habitat features (e.g., dead wood, hardwood thickets, bare mesic/wet patches) along with more stable features (e.g., living old pines, treeless spaces, swards, bare xeric patches). Thus, many organisms are adapted to this disturbance-prone but relatively stable environment. Among them are opportunists coexisting in habitat mosaics with longer lived species. Many birds and mammals use cavities made by the red-cockaded woodpecker, and at least 60 vertebrate and 302 invertebrate species use gopher tortoise burrows (Jackson 1989). Thus, spatial and temporal variations in habitat, coupled with commensal relationships, accommodate an unusual variety of species for a given area. The diversity of groundcover plants per unit area places longleaf pine ecosystems among the most species-rich plant communities outside the tropics (Peet and Allard 1993).

Yet longleaf pine ecosystems now occupy only a small part of their original area. Extreme habitat reduction is the main cause for the precarious state of at least 191 taxa of vascular plants (Hardin and White 1989; Walker 1993) and such key wildlife as the red-cockaded woodpecker, gopher tortoise, and southern fox squirrel. A concerted and committed effort to restore and manage longleaf pine ecosystems would help ensure a future for this important part of the nation's natural heritage.

Decline of the Longleaf Forest

Because of its many desirable attributes, longleaf pine has been intensively exploited ever since colonial times (Croker 1979). In early settlement days, trees were cut to build cabins and homes or to clear land for crops. Because waterways formed the major routes for transportation through most of the 19th century, timber, usually larger trees, was cut where it could be easily moved to water. The advent of railroad logging near the end of the 19th century provided access to the remaining longleaf timberland. Merchantable trees were cut, and much of the remainder damaged or destroyed.

Cutting generally proceeded from rhe Atlantic states west through the Gulf Coast region to Louisiana and Texas, with increasing intensity of use as time went on. Longleaf pine logging reached a peak in 1907, when an estimated 13 billion board feet were cut (Wahlenberg 1946). Logging came to a halt with the Great Depression and the near exhaustion of the timber resource.

Second-growth longleaf pine, to varying degrees, succeeded old-growth on millions of acres throughout the Southeast. Cutting in this natural second-growth forest began during World War II and continues today as this age class has matured. Over 90% of the longleaf pine remaining in 1985 was natural in origin (Kelly and Bechtold 1990). Annual removals exceeded growth by 43%. Declines were observed in every diameter class below 16 inches while increases were confined to the 16-inch and larger diameter classes, suggesting that most remaining forests are aging without replacement.

A combination of circumstances appears responsible for the long-term decline of the longleaf pine forest. Much of the land in the region was once cleared for cropland or pasture. Longleaf pine does not successfully invade open land in competition with more aggressive species. It has sometimes succeeded old-growth when periodic fires provided a seedbed and controlled woody competition, and when wild hogs did not reach a density high enough to destroy established seedlings. The disruption of natural fire regimes, resulting in part from forest fire protection policies implemented during the 1920s, however, allowed invasion of longleaf sites by hardwoods and more aggressive southern pines. Longleaf pine and its associated community cannot naturally succeed itself under these conditions.

Since the end of World War II, many large lumber companies that owned and generally favored longleaf pine for high quality logs and poles have slowly been ac-

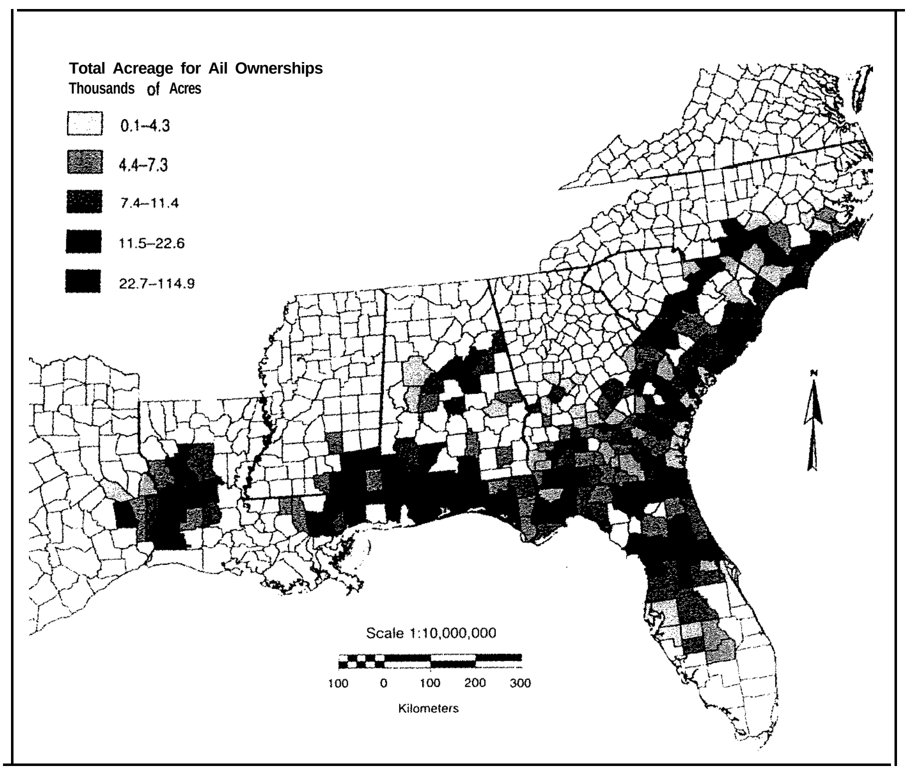

Figure 2. ***Current distribution of longleaf pine, by county, in the southeastern United States. Source: USDA Forest Service 1994. Map produced by Donald van Blaricom, Clemson University.***

quired by the pulp and paper industry. These companies' need to maximize volume yield over the shortest possible period of time led to intensive short-rotation plantation management using genetically improved loblolly (*Pinus taeda* L.) or slash pine *(P. elliotti).* Longleaf pine is often considered a slow-growing species that is difficult to regenerate and that cannot economically compete with the other pines. Loblolly and slash pine are thus the preferred species for planting and recently accounted for 95% of all southern pine seedling production.

Management Options

Longleaf pine has many attributes that allow a variety of management options. It 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 almost always has a higher specific gravity than the other southern pines and thus produces more dry weight per unit ofvolume. On average sites, 30 to 80% of rhe trees in a longleaf stand will make poles, which are more valuable than sawlogs (Boyer and White 1990).

In addition to its commercial quality and versatility, longleaf pine, 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, pitch canker, southern pine beetle, and tipmoth. Longleaf pine is more resistant than slash pine to breakage from ice storms (Van Lear and Saucier 1973). The species develops a massive taproot that, in mature trees, may reach a depth of 8 to 12 feet or more, helping reduce the risk of windthrow (Boyer 1990).

It is thus suited to a wide range of management goals and silvicultural methods. These include even-aged, two-aged, and, on many sites, a range of all-aged management methods (Farrar and Boyer 1991). Because of longleaf pine's natural tolerance of fire, uneven-aged stands can be regularly burned at 2- to 4-year intervals to control hardwoods and brush or prepare a seedbed without the need for any special measures to protect regeneration. The rapid early breakup of longleaf seedling stands into a range of size classes helps reduce the risk of excessive seedling mortality from untimely fire.

In addition, longleaf pine's reputarion as the slowest growing southern pine may be largely undeserved. On many former longleaf sites, based on side-by-side comparisons, the species grows as well as, or berter than, the other southern pines once it has emerged from the grass stage (Schmidtling 1987; Outcalt 1993). If desired, longleaf pine on average sites can produce poles and logs in 40- to 50-year rotations, possibly less in plantations. Most growth data for natural longleaf pine have been derived from forests that periodically burn. Both the diameter and height growth of young longleaf pines are reduced by regular burning (Boyer 1994). The reduction in height growth alone is equivalent to a loss of 5 feet in site index. The growth reduction associated with periodic fires has been regularly reported over the years, and the bias this introduces for site classification and yield table construction has long been recognized (Cary 1932). Many landowners, however, may be willing to accept lower yields in return for the natural beauty and enhanced biodiversity of open, regularly burned, longleaf forests.

Longleaf pine can be naturally or artificially regenerated at a reasonable cost and with a high probability of success if necessary cultural measures are properly timed and executed. Quality planting stock along with appropriate cultural treatments can reduce the grass stage to one or two years.

Longleaf pine straw is also becoming a major and valuable product in many areas. Pine-straw raking can be detrimental to legumes and other species in the herb layer, however, and should be avoided where species diversity is valued (Frost 1990). Permanently reserving some areas from raking may preserve species diversity by providing local refugia. Pine-straw production peaks at about the time that volume increment culminates, so a regulated forest will allow pine straw to be efficiently gathered on a continual basis, even if harvesting is confined to a single age class for a relatively short period of time. Fertilization can make up for the nutrients removed with the straw.

Many game species, ranging from white-tailed deer and wild turkey to bobwhite quail and rabbit, thrive in longleaf pine forests, especially those maintained in an open condition by frequent thinnings and prescribed fire. These open habitats are in high demand by hunters and provide landowners the opportunity to lease their lands to sports enthusiasts. Fee hunting provides a means of allocating access to public resources on private lands.

Another option in longleaf pine management is woodland grazing for beef cattle. Longleaf pine forests kept open (basal areas 50 to 70 ft^2/ac or less) by prescribed fire and thinning maintain relatively high forage yields throughout the timber rotation. For longleaf pine-wiregrass ranges late winter or early spring burns on a two-year rotation work well after pines are large enough to tolerate fire.

Restoration of the Longleaf Pine Ecosystem

One of the keys to restoration of the longleaf pine ecosystem is to ensure that its recovery benefits society in general and private landowners in particular. Without economic benefits, long-term and broad-scale conservation projects are usually doomed to failure (Kimmins 1992; Oliver 1992). Harvesting need not be eliminated or even moderately restricted to restore and maintain longleaf pine ecosystems, as evidenced by the fact that logging at the turn of the century apparently had little effect on groundcover diversity (Noss 1989). Any restrictions on harvest would be a disincentive to many landowners and could result in elimination of much of the remaining longleaf on private lands.

Restoration appears achievable. As seen from its present distribution *(fig. 2)*, longleaf pine still occurs over most of its former range, albeit in remnant pockets. By expanding these pockets, it should be feasible to gradually expand longleaf pine acreage. Education, research, commitment on the part of resource managers, and a landscape perspective are essential ingredients in any such effort.

Education of the public regarding the current status of the longleafpine ecosystem, its potential economic value, its outstanding biodiversity, and the role of fire in maintaining the system is an initial step in securing support for restoration. With public support, federal, state, and local laws can be changed to provide restoration incentives.

Foresters and other resource managers, in partnership with conservation groups, can also promote the use of fire as an ecological force necessary for maintenance of fire-dependent natural communities. Frequent prescribed burning, including the use of growing-season fires where appropriate, promotes the diversity and stability of these communities (Noss 1989; Frost 1990). In 1990, Florida passed a Prescribed Burning Act authorizing and promoting prescribed burning for ecological and other purposes. As other southern states follow suit, the ability to use this tool for restoring and maintaining longleaf pine ecosystems will be greatly enhanced.

Federal and state agencies, universities, forest industries, and research organizations are beginning to cooperate and commit to research and technology transfer promoting the ecological and economic attributes of the longleaf pine ecosystem. Technology is now available that allows regeneration of longleaf pine to approach parity with the other southern pines. Mechanical site preparation techniques, however, should be carefully evaluated if adverse effects on associated species such as wiregrass are to be avoided (Clewell 1989). Natural regeneration methods using a regime of frequent fire are already compatible with maintenance of these communities (Boyer and White 1990).

While many private landowners are concerned about the environment and the amenities their land provides, most are also motivated by the need to generate income from their land. Longleaf pine can be managed in an ecologically sensitive manner that generates a satisfactory income (Landers et al. 1990).

Agencies administering public cost-share programs, such as the Forest Incentives Program and the Stewardship Incentives Program, could promote longleaf pine regeneration. Many of the actions suggested by Oliver (1992) to resolve pressures facing Pacific Northwest forests would also be useful in restoring the longleaf pine ecosystem. For example, subsidies or tax deferrals could provide longleaf pine landowners with incentives to regenerate longleaf pine and maintain the balance of age classes and stand structures necessary to protect plant and animal diversity across the landscape.

Longleaf pine occurs on approximately 3.2 million acres *(table* I). Almost two-thirds of this acreage is in Florida, Alabama, and Georgia. North Carolina, South Carolina, Mississippi, and Louisiana each contain more than 200,000 acres. About 31% of the longleaf pine acreage is owned by public agencies, 18% by forest industry, and the remaining 51% by a variety of private owners, most of them not farmers. This mix of ownerships emphasizes that effective restoration will require a multi-owner approach across the landscape. A balanced longleaf pine forest, supplementing other forest types, could help achieve greater productivity and stability throughout the forest economy of the Southeast.

Restoration of small, fragmented stands of longleaf pine is helpful but will not suffice to sustain a functioning ecosystem. The challenge is to restore this ecosystem in an economically viable way so that private landowners can be voluntary partners who benefit in the process. Existing disincentives and longstanding biases must be overcome and incentives added, so that landowners are encouraged to regenerate and manage longleaf pine using methods that simulate historical processes.

Restoration of longleaf pine forests should not be viewed as competition for intensive pine plantation management so common in the South. Intensive forestry aimed at high productivity is also an essential component of the southern landscape. By maintaining high yields, intensive plantation management reduces pressure on other parts of the landscape, allowing other land uses such as longleaf pine ecosystem restoration. In turn, diverse and productive longleaf pine forests, growing large, high-value products under relatively long rotations, would complement the economic contribution made by other species while preserving environmental values that are a part of the heritage of the southern landscape.

The future will likely reveal unforeseen values in native forest ecosystems that will greatly benefit society and translate into additional economic incentives for landowners. Restoring the longleaf pine ecosystem could serve as a prime example of forest ecosystem management-how a once diminished ecosystem was restored as a sustainable, functioning paradigm through wise stewardship. JOF

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