Chapter 29.

Population Growth and the Decline of Natural Southern Yellow Pine Forests

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Abstract—*Population growth has created social and economic pressures that affect the sustainability of naturally regenerated southern yellow pine forests. Major causes of this decline include (1) a shift in public attitudes regarding woods burning (from one favoring it to one that favors fire suppression) and (2) an increase in land values (especially near urban centers). The increase in land values reduces the chance of farmland abandonment, which was common in the first half of the 20th century. Abandoned farmlands provided many of the sites for the naturally regenerated pine stands that are being harvested today. Also, higher land values and higher taxes put pressure on landowners to subdivide their land for development or to establish more profitable tree plantations. These population-related factors and outbreaks of the southern pine bark beetle have resulted in a decline in naturally regenerated southern pines of more than 38 million acres since 1953. As population pressures reduce the incidence of wildfire, prescribed burning, and the abandonment of old fields, the decline in naturally regenerated southern yellow pine will continue. By 2030, only 23 million acres of natural southern yellow pine may remain.*

INTRODUCTION

Population growth is the principal factor placing pressure on forest lands (Barlow and others 1998; Wear and others 1998, 1999). In some cases, the effect is immediate as when naturally regenerated forests are converted to developments, pastureland, rangeland, cropland, plantations, or other uses. In the United States, 11.7 million acres of forests were converted to developed land during the period from 1982 to 1997 (fig. 29.1). Population growth also influences forests in subtle ways that take place over decades. The public generally overlooks gradual changes in species composition, even when millions of acres are affected. Naturally established southern yellow pines[2] are disappearing over Eastern North America. This trend is exacerbated by southern pine bark beetle (*Dendroctonus frontalis* Zimmermann) epidemics.

With the exception of spruce pine (*Pinus glabra* Walt.), southern yellow pines are intolerant of shade, and exposed mineral soil is generally required for their successful establishment. Pines were often the primary tree cover over much of the Southeast when the first historians recorded plant names. However, during the second half of the 20th century, the combined effects of fire

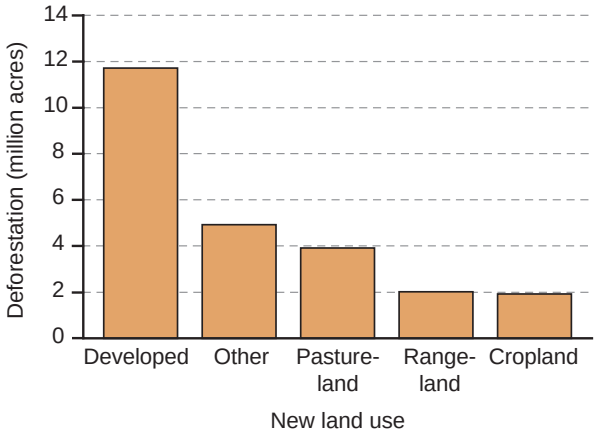

Figure 29.1—The conversion of forested land to other land uses in the United States from 1982 to 1997 (U.S. Department of Agriculture, Forest Service 2001).

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[2] For the purpose of this chapter, the southern yellow pines are defined as eight members of the genus *Pinus* (subsection *Australes* Loud.) plus sand pine and Virginia pine. "Natural" stands of pine are those that are regenerated by seedfall and not by direct seeding or planting.

suppression, increases in naturally regenerated hardwoods, and conversion of old-field pine stands to plantations of loblolly pine (*P. taeda* L.) and slash pine (*P. elliottii* Engelm. var. *elliottii*) have resulted in a decline in natural southern yellow pine timberland[3] from 72 million acres in 1953 to 34 million acres in 1997 (fig. 29.2). In contrast, oak (*Quercus* spp.), hickory (*Carya* spp.), red maple (*Acer rubrum* L.), sweetgum (*Liquidambar styraciflua* L.), and other hardwoods have increased. Oak-pine and oak-hickory stands have increased by more than 25 million acres (fig. 29.3). Pine plantations (many established on former agricultural lands) have also increased by an estimated 30 million acres (table 29.1).

If foresters had not planted pine seedlings and not used herbicides and prescribed burning, we estimate that there would be < 30 million acres of southern yellow pine forests today (instead of 63 million acres). This is because pine plantations are more productive than natural stands. Although plantations represent about 14 percent of the southern forests, they provide more than half of the wood harvested each year.

FIRE AND POPULATION GROWTH

When populations of counties increase, the value of land and timber in those counties increases. Also, the number of houses "in the woods" in the South has increased dramatically since 1950. As property values increase, the need to protect these assets from wildfire increases. The management of fire is related to human population density. South (the author) hypothesizes that the number of wildfire burns of more than 1,000 acres is related to population density. Counties with population densities of < 6 persons per square mile will likely have a higher probability of a regeneration fire than counties with more than 1,000 persons per square mile. In addition, foresters find it harder to conduct prescribed burns as population density increases. The absence of fires discourages natural pine regeneration and allows hardwoods to replace pines.

Before Humans

Before humans settled North America, forest fires were started by lightning and occasionally by volcanoes. In the Southeast, southern yellow pines adapted to a variety of fire regimes. Some pines such as pond pine (*P. serotina* Michx.), Ocala sand pine [*P. clausa* var. *clausa* (Chapm. ex Engelm.) Vasey ex Sarg.], Table Mountain pine (*P. pungens* Lamb.), and some pitch pine (*P. rigida* Mill.) genotypes evolved serotinous cones. The chances of successful natural regeneration of these species were strongly tied to fire frequency and intensity. Although the cones of loblolly pine, slash pine, shortleaf pine (*P. echinata* Mill.), longleaf pine (*P. palustris* Mill.), and Virginia pine (*P. virginiana* Mill.) are not serotinous, fires helped to maintain viable populations of these species. Value judgments about species types, stand origin, and timber volumes were not made during this period, as humans were not part of this ecosystem.

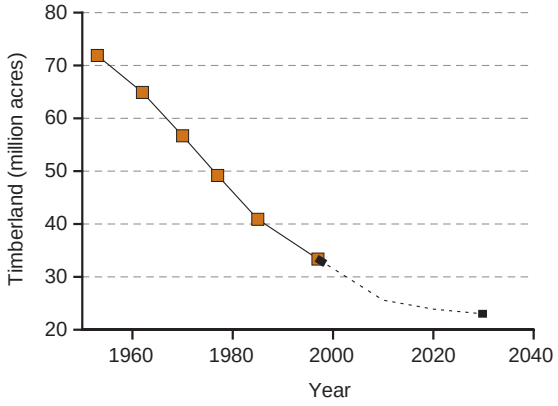


Figure 29.2—Actual and predicted decline of natural southern yellow pine timberland in the South (U.S. Department of Agriculture, Forest Service 1988; Wear and Greis 2002).

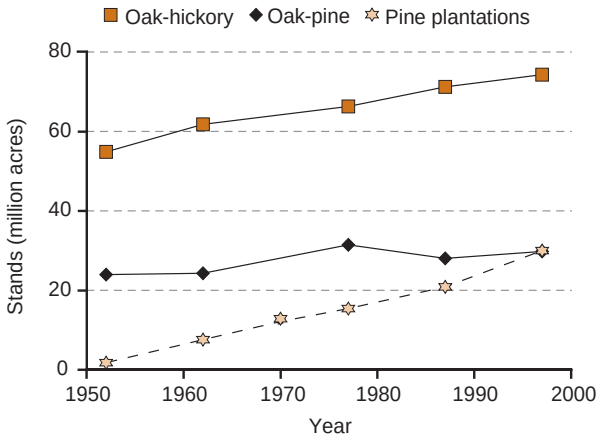


Figure 29.3—Increases in oak-hickory, oak-pine, and pine plantation stands from 1953 to 1997 (U.S. Department of Agriculture, Forest Service 2001).

[3] Natural pine timberland: stands in which 50 percent or more of the volume is composed of naturally regenerated pine and which are capable of producing crops of industrial wood. This does not include pine forests in national parks or other areas that are withdrawn from timber utilization by statute or administrative regulation.

Table 29.1—Changes in timberland area over a 44-year period for selected species in the United States

Region	Stand type	1953	1997	Change	Change
		- - - - *million acres* - - - -			%
South	Longleaf and slash	26.9	13.1	-13.8	-51
South	Loblolly, shortleaf, and others	51.8	49.7	-2.1	-4
North	Loblolly, pitch, shortleaf, Virginia	3.6	2.3	-1.3	-36
South	Longleaf	12.2	2.8	-9.4	-77
South	Loblolly[a]	35.6	39.1	+3.5	+10
South	Shortleaf[a]	7.8	4.7	-3.1	-40
South	Slash	14.7	10.3	-4.4	-30
South	Virginia, pond, pitch, sand[a]	8.4	5.9	-2.5	-30
South	Southern yellow pine timberland total	78.7	62.8	-15.9	-20
South	Oak-pine	24.0	29.8	+5.8	+24
South	Oak-hickory	54.9	74.3	+19.4	+35
South	Oak-gum-cypress	34.5	28.5	-6.0	-17
South	Oak total	113.4	132.6	+19.2	+10
South	All timberland	204.5	201.0	-3.5	-2

[a] Acreages are estimates made by the authors. Note: Timberland does not include land in national parks or wilderness areas where timber harvesting to produce crops of industrial wood is not allowed due to statute or administrative regulation. The total of forest land and plantations in the South was 226 million acres in 1953 and 214 million acres in 1997 (U.S. Department of Agriculture, Forest Service 2001).
Source: Outcalt and Sheffield (1996); Smith and others (2001); U.S. Department of Agriculture, Forest Service (1988).

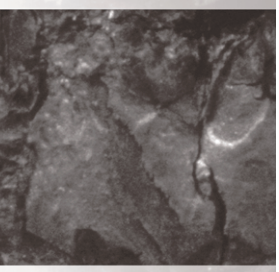
Prehistoric Cultural Impacts

As humans moved into North America from Asia 12,000 years ago, they brought fire with them as a cultural tool. They often burned both grasslands and woods. These activities "superimposed a new and extensive fire regime over the existing natural one" (Pyne 1982). Fire was employed to replace forests with grasslands and thereby support grassland browsers as a food source. Fire was also used as an aid to hunting, as a tactical weapon, as a method of weed control, and sometimes in hope of altering weather (Pyne 1982). Blankets were used to extinguish accidental fires in lodges and villages. Backfires were set to keep wildfires from reaching villages. There are no references supporting the idea that early inhabitants of North America suppressed wildfires in forests.

Early European Settlement Fires in the South

European explorers who traveled along the eastern coast of North America frequently saw fires and thick smoke. When Europeans settled along the east coast, most adopted the practice of burning the woods. "Perhaps nowhere else in the country were Indian burning practices more thoroughly adopted and maintained than in the piney woods, in the remote hills, and on the sandy soils . . ." of the South (Pyne 1982). Pyne (1982) further claims that

> Early settlers on the coastal plains learned broadcast burning from local tribes. As they moved inland, crossing some of the premier fire regimes of North America, pioneers carried their fire habits with them. The northern woods might be cleared and settled without fire, but not the southern rough. Skill in broadcast



fire was essential to southern frontier survival: nearly all dimensions of southern agrarian economy relied on it - for landclearing, for hunting and habitat maintenance, and for range improvement. It was employed for fuel reduction in naval stores operations, the antecedent to industrial logging, and it was used by homesteaders to protect themselves from the fires that others were sure to light. Fire protection was even built into the architecture of frontier cabins: the cleared yards around wooden structures acted as firebreaks and as points for igniting protective backfires - doing double duty, as fish ponds did for rural houses in New England. What made the South special, however, was the confluence of economic, social, and historical events that worked to sustain this pattern of frontier economy long after it disappeared elsewhere in the United States, a pattern that created a socioeconomic environment for the continuance of woodsburning.

20th Century Fires in Southern Forests

Even though laws were passed that penalized woods arson, it continued to be a common practice throughout most of the 20th century. With an increase in population, there was an increase in the number of incendiary fires (U.S. Department of Agriculture, Forest Service 1968). The 50-year average (1917–66) for incendiary fires in the South equates to 39 percent of all wildfires. In comparison, the 5-year average (1973–78) for incendiary fires rose to 55 percent (U.S. Department of Agriculture, Forest Service 1980). In 1978, there were 35,850 incendiary fires in the South (U.S. Department of Agriculture, Forest Service 1980). This was far more than occurred in other regions such as the Eastern States (2,589) and the Pacific States (3,135).

As populations grew, the number of people employed to suppress fire also grew. The result was a decline in the total area of woods burned annually. In 1917, 14 million acres were burned on protected areas of the South. By 1999, only about 1 million acres burned annually. Each year, < 0.4 percent of the South's forest land is now burned. The average fire size was about 13 acres in 1978 (U.S. Department of Agriculture, Forest Service 1980).

Over recent decades, public attitudes toward woods burning have changed. As population increased, the acceptability of fire in the environment has decreased. For example, a 1996 survey showed that a majority of respondents disagreed with the statement, "Using fire as a management tool in the national forest is a good idea" (Southern Appalachian Man and the Biosphere 1996). Today, natural and arson fires are rapidly extinguished to protect human investments. Suppression of wildfires has increased to the point that when 7 million acres burn, it is considered a "bad fire year." We certainly do not wish to see our homes and cabins go up in smoke. As a result, few biologists would suggest that forest fires should be allowed to reach a "natural equilibrium."

POPULATION GROWTH AND HARVESTS

The amount of forest land available for timber harvesting in a region is negatively related to the region's population density (Wear and others 1998, 1999). In North Carolina, the percentage of a county in timberland might decline from 70 to 30 percent as the population level increases from 40 to 990 people per square mile (Wear and others 1998). A decline in forest land will reduce both the acreage harvested and the acreage in early stages of natural pine regeneration. In the absence of wildfire and management to obtain natural pine regeneration, a reduction in harvesting will favor succession from pine to hardwoods.

INCREASE IN HARDWOODS

A reduction in the acreage burned results in a decrease in natural regeneration of pines while that of hardwoods increases. Even though relatively few oaks, red maples, or hickories are planted in the South (Boyer and South 1984), there have been large increases in the acreage of upland hardwood stands since 1953 (table 29.1). Since 1953, the increase in oak-hickory and oak-pine stand types totals more than 25 million acres. Ingrowth of hardwoods likely converted 5 million acres of pine stands into oak-pine stands (in which hardwoods make up 50 percent or more of the basal area). Continued aversion to the use of fire and herbicides in pine stands will result in additional conversion of pine stand types to oak-pine or oak-hickory stand types. Currently, the acreage of natural oak-hickory forest type (fig. 29.4) is twice that of all southern yellow pine types combined.

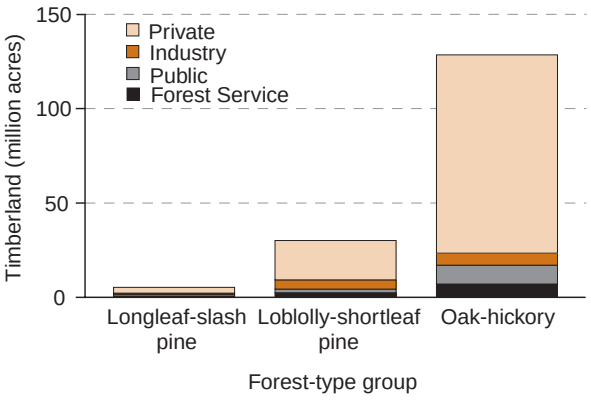


Figure 29.4—Acreage of naturally regenerated longleaf-slash pine, loblolly-shortleaf pine, and oak-hickory forests in the Eastern United States in 1997 by ownership class (U.S. Department of Agriculture, Forest Service 2001).

High-grading is a common harvesting method on private lands. For example, a landowner might remove all of a stand's merchantable pines, leaving 25 percent of the stand's original basal area in low-quality hardwoods. The resulting stand would be reclassified as an oak-hickory forest type. This trend is much greater on lands owned by individuals than on land owned by industry (Alig and others 1986). Since most of the land in the East is owned and managed by private individuals (fig. 29.4), there has been an overall decline in southern yellow pine since 1953 (table 29.1). About 60 percent of the forest acreage harvested annually in the South is harvested by methods other than clearcutting (U.S. Department of Agriculture, Forest Service 2001), but this percentage is higher on privately owned lands. Only about 1 percent of the forest area in the South is clearcut annually (Rudis 1998). Even-aged regeneration harvesting on national forests in the Southern Appalachian region is declining (Southern Appalachian Man and the Biosphere 1996).

Southern pine beetles generally kill pines that are under stress caused by drought or from high-stocking levels or both. Droughts increase the incidence of outbreaks, but overstocking is often the prime factor that weakens the pines (Ku and others 1980). The absence of management practices to control stocking will increase the risk of mortality from southern pine beetles. Recently, thousands of acres of natural pines have been killed throughout the South.

INCREASE IN PLANTATIONS

In 1926, there were only about 3,000 acres of pine plantations in the South. By 1953, pine plantations occupied 2 million acres, and plantation acreage increased to more than 32 million acres by 1999 (Wear and Greis 2002). Today, approximately 17 percent of forest land in the South is in pine plantations. Even though pine plantation acreage has increased by 33 million acres since 1953, pine types have declined by about 16 million acres (table 29.1). This decrease is due largely to the inaction of nonindustrial private landowners (Alig and others 1986) who do not use artificial or managed natural regeneration to maintain their land in pine-dominated ecosystems. Natural regeneration of pines after harvesting can be difficult without fire, herbicides, or mechanical site preparation.

Pine plantations have been established widely on former farmland. The Soil Bank Program was responsible for the stabilization of 1.9 million acres of mostly "worn out" farmland between 1956 and 1961. During the 1980s, the Conservation Reserve Program stimulated widespread establishment of pine plantations. This effort was responsible for the planting of more than 2.6 million acres on farmland. In addition, subsidy programs helped to establish more than 180,000 acres of longleaf pine plantations on farmland. Between 1982 and 1997 more than 22 million acres of afforestation occurred on former pastureland, cropland, and rangeland (fig. 29.5). A large portion of this was from artificial regeneration. Of the 30.3 million acres of pine plantations that existed in 1997, at least 2.7 million acres were afforested through Government incentive programs. We estimate that by 1997, more than 5 million acres of southern

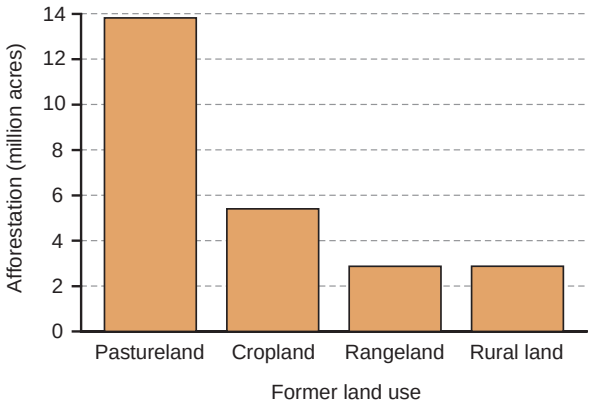


Figure 29.5—The afforestation of nonforested land to timberland in the United States from 1982 to 1997 (U.S. Department of Agriculture, Forest Service 2001).

Table 29.2—Acres of southern yellow pines in the Eastern United States during the 1990s, number of Forest Inventory and Analysis survey plots (data generated from Forest Inventory Mapmaker Version 1.0: run October 15, 2001), and the authors' predicted decline in natural stands for the mid-21st century[a]

Species	Total	Natural stands	Planted or direct-seeded stands	Natural stands	Survey plots	Predicted decline of natural stands
	acres			*percent*	*number*	*percent*
Spruce	39,416	39,416	—	99	7	10
Table Mountain	92,830	92,830	—	100	28	50
Sand	676,321	238,067	438,254	35	276	30
Pitch[b]	854,826	826,462	28,364	97	165	50
Pond	916,474	910,732	5,742	99	361	20
Longleaf	2,819,804	2,346,513	473,290	83	864	45
Virginia	3,424,405	3,163,475	260,931	92	920	50
Shortleaf	5,322,636	4,837,941	484,695	91	1,142	50
Slash	10,722,061	3,335,145	7,386,917	31	3,495	25
Loblolly	39,385,704	17,860,361	21,334,218	45	9,680	35
Total	64,254,477	33,650,942	30,412,411	52	16,938	38

[a] The total decline of natural pine stands is based on predictions by Wear and Greis (2002) and Alig and others (2002).
[b] Assumes no artificially regenerated stands of pitch pine in New Jersey.

yellow pine plantations had been established by afforestation under Government-assisted and nonsubsidized programs. Some predict that an additional 23 million acres of agricultural land will be afforested by the year 2040 (Wear and Greis 2002).

Acreages in plantations and natural stands are listed by species in table 29.2. Loblolly pine accounts for most plantations, and it is also the predominant species in natural stands. In contrast, there are few or no plantations of spruce pine and Table Mountain pine, and their natural stand area is small.

There appears to be a relationship between amount of land supporting a pine species and the amount of young natural regeneration recorded for that species (fig. 29.6). It is often overlooked that pine plantations provide seed trees for regeneration of adjacent areas. For example, although the area supporting natural slash pine stands is about the same as for Virginia pine (table 29.2), there is much more natural regeneration of slash pine. This may simply be due to the existence of about 7 million more acres of slash pine plantations than Virginia pine plantations (table 29.2). Establishing pine plantations on what was previously farmland and on upland hardwood sites increases the chance of subsequent natural regeneration of pines.

The use of prescribed fire is more likely in plantations than in natural stands. During the 1980s, about 54 percent of the yellow pine plantations showed evidence that they had been burned during the past 10 years, while fire effects were evident in only 35 percent of the natural pine stands (Rudis and Skinner 1991). Both

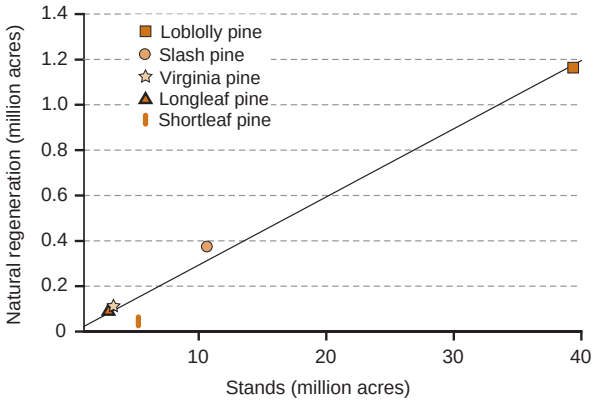


Figure 29.6—The amount of land in pine stands and amount of natural regeneration (age class 1 to 5 years) for five southern yellow pines.

percentages will likely decline as the population of rural counties increases. Public opinion, risk of liability, smoke regulation, and residential developments are important barriers to burning on private lands in the South (Haines and others 2001).

REDUCED PINE REGENERATION

When yellow pine stands remain unburned for about 10 years, hardwoods such as oaks, hickories, and red maple become abundant in the understory (Wahlenberg 1960). Where fire continues to be excluded and no action is taken to reduce the ingrowth of hardwoods, the basal area represented by pines declines as that of hardwoods increases. The area classified as oak-pine (where pine makes up 25 to 50 percent of the stocking) increased by 24 percent between 1953 and 1997 (table 29.1). This accounts for an estimated 5.8 million acres of the decline in natural pine. Approximately 4.5 million acres of pine plantations now have more than 50 percent of their basal area in hardwoods (Rosson 1995).

Since 1953, acreage in oak-hickory stands has increased by almost 20 million acres (table 29.1). Practices that have caused this include (1) fire exclusion, (2) high-grading of pine-hardwood stands, and (3) harvesting of pine stands without replanting pines or implementing successful measures to naturally regenerate pine. In spite of tree planting efforts over the past 44 years, the acreage in loblolly-shortleaf-longleaf-slash pine cover types has declined by more than 15 million acres (table 29.1). Although forest industries plant seedlings to keep their land in pines, practices used by private nonindustrial landowners have favored the conversion of pine stands to hardwoods.

Forest Inventory and Analysis data were used to determine the distribution of stand-age classes for natural stands of several southern yellow pines (fig. 29.7). These data indicate a peak in natural pine regeneration between 1930 and 1950 (equivalent to age classes 40 to 60). A more recent peak during the 1980s can be observed for loblolly pine and slash pine. To some extent it is also evident for longleaf pine. This recent peak may be due to the abandonment of pastureland, and to some extent to the Conservation Reserve Program (which takes cropland out of production). Some of the "natural" regeneration may have occurred on abandoned agricultural fields that were adjacent to loblolly or slash pine plantations.

During the 1990s, the area in natural yellow pine was as follows: 2.3 million acres of longleaf pine, 3.3 million acres of slash pine, 4.6 million acres of shortleaf pine, and 17.8 million acres of loblolly pine (table 29.2). Alig and others (2002) predicted a 38-percent decline for all the southern pines by the mid-21st century. We took their prediction and subdivided it by species (table 29.2).

Spruce Pine

Spruce pine is the rarest southern pine species in terms of total number of trees, total volume, and number of acres. Since supporting data are not readily available, we do not know if the population of spruce pine is increasing or declining. However, the standing volume of spruce pine increased from about 464 million cubic feet in 1963 (Sternitzke and Nelson 1970) to about 587 million cubic feet in 1993. So far, few are concerned about the reproductive success of this species since it is classified as very shade tolerant. In addition, it is highly susceptible to fire and is naturally adapted to areas where fire is infrequent. A small decline in natural spruce pine acreage over the next 50 years could result from development and from utilization of this species as a less expensive source of wood for finishing material.

Table Mountain Pine

Many Table Mountain pines on western and northern exposures have serotinous cones that open only when exposed to high temperatures. Fire exclusion will cause continued decline of this species (Southern Appalachian Man and the Biosphere 1996). Prescribed burning can be conducted to encourage natural regeneration, but only certain types of burns will be effective (Welch and Waldrop 2001). Although prescribed burns may be attempted on public lands where population levels are low, it is doubtful that prescribed burns will be conducted on private lands that are close to residential areas. For these reasons, we believe that this species is the most threatened of the southern yellow pines. Although inventory data suggest that there has been an increase in the numbers of Table Mountain pine (table 29.3), this difference might be related to having a small number of sample plots (28) and the use of sampling methods that do not distinguish between ingrowth and ongrowth. In the absence of major wildfires, a 50-percent decline in Table Mountain pine might occur by 2050.

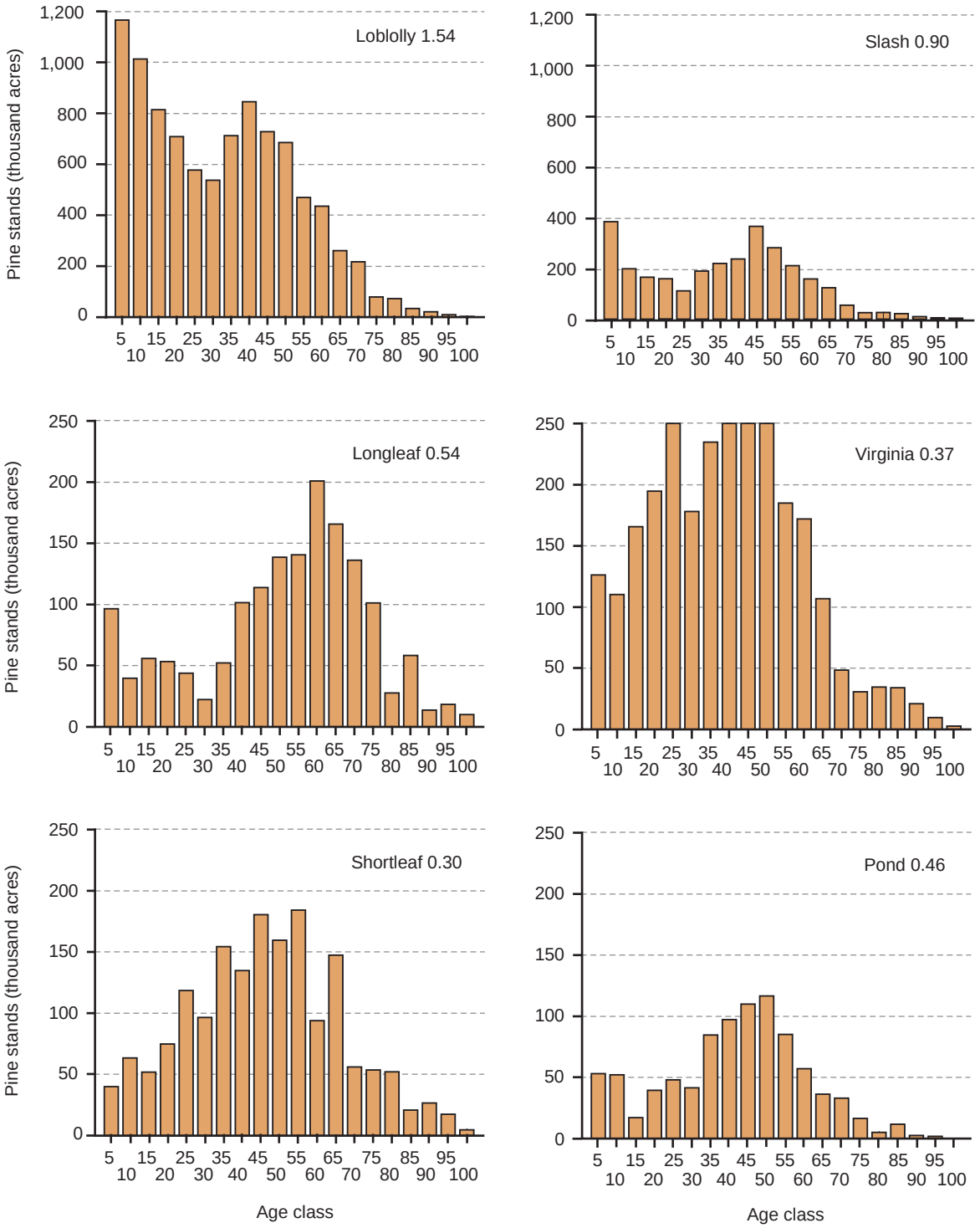


Figure 29.7—Acreage of natural even-aged pine stands by species and 5-year age classes. The number on each graph represents the ratio obtained by dividing the number of acres in the 0- to 10-year age class by the number of acres in age class 41 to 50 years.

Table 29.3—Inventory of Table Mountain pine growing stock by diameter class for two periods

D.b.h. class	About 1977	1989–99
	million trees	
6	5.6	8.6
8	4.3	5.8
10	2.2	3.7
12	1.4	2.2
14	0.9	1.6
16	0.3	0.4
18	0.08	0.05
20	0.02	0.03

Source: Della-Blanca (1990); 1989–99 data (28 plots) generated from Forest Inventory Mapmaker Version 1.0: run October 15, 2001.

Sand Pine

In central Florida, there are many even-aged stands of Ocala sand pine that regenerated naturally after wildfire. Sand pine was not utilized or planted much before World War II, but planting began around 1956 when 8,000 seedlings were grown at a nursery in Florida (Sampson 1973). Today, more than 60 percent of the stands of sand pine are plantations established mainly by planting. The Choctawhatchee variety occurs in the panhandle of northwest Florida and is rarely planted. Recently, some natural pine stands have been replaced by longleaf pine plantations. Rapid urbanization of the Florida landscape could result in a 30-percent decline in natural sand pine acreage by 2050 (table 29.2).

Pitch Pine

Cones of pitch pine at the north end of its range tend to be serotinous, while this trait disappears in the southern end of the range. In 1978, the National Parks and Recreation Act established 1.1 million acres in New Jersey as the Pinelands National Preserve. Organizations like The Nature Conservancy and the New Jersey Conservation Foundation continue to purchase property within the borders of the preserve while the Pinelands Preservation Alliance alerts the public to developments within the preserve. The New Jersey Forest Fire Service has the task of prescribed burning the Pine Barrens. It will be interesting to learn how effective legislation will be in slowing development and keeping prescribed burning as a tool for managing the Pine Barrens. By 2050, we expect a 50-percent decline in natural pitch pine as a consequence of development.

Pond Pine

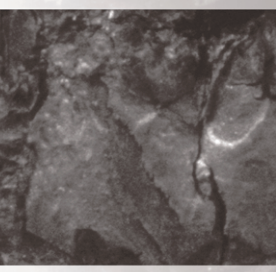
Confined to the lower Coastal Plain from Virginia to Florida, pond pine is an ecological enigma. Its serotinous cones and sprouting ability attests to its dependence on fire for regeneration, yet it exists in pocosins and swamps. These traits identify intense fires at long intervals as the primary regeneration vector. The Pond Pine Wilderness Area was established in North Carolina in 1984 and contains 1,685 acres. Because this area is in an isolated location, development will have little effect on new regeneration. However, if intense wildfire is excluded from this region, a gradual decline could occur over the next half century.

Longleaf Pine

Natural longleaf pine has excellent wood properties, and as a result is a preferred species at many sawmills. Good seed crops are infrequent and several years may be required before forest managers achieve successful natural regeneration of longleaf stands. Even when afforestation is attempted on former cropland that has no hardwood competition, success rates are sometimes less than desired. These factors have encouraged landowners who harvest longleaf pine to plant other pine species. As a result, longleaf pine timberland has declined by 77 percent in just 44 years (table 29.1). A Longleaf Pine Alliance has been established to slow the rate of decline. Even though this organization encourages landowners to manage for longleaf pine, we predict that natural longleaf pine will continue to decline as a consequence of fire exclusion and a lack of effort to obtain adequate natural regeneration. We predict a 45-percent decline in acreage of natural stands over the next 50 years (table 29.2).

Virginia Pine

This species was important to the stabilization of badly eroded fields following agricultural abandonment after the Great Depression. Today, many of these naturally regenerated stands are being replaced by hardwoods. Virginia pine will continue to decline over the next several decades, although small groups and individual trees will become established in disturbed areas. Except for use as Christmas trees, planting of this species by landowners is rare. Although there may be over



3 million acres of natural stands today, we predict that fewer than 1.6 million acres will exist by 2050 (table 29.2).

Shortleaf Pine

Shortleaf pine is the most widely naturally distributed southern yellow pine species. Although it is valued as a sawtimber tree, it is rarely planted by forest industry. Also, the planting rate by the U.S. Department of Agriculture Forest Service in Arkansas has been reduced since 1985. Shortleaf pine was often grown at high seedbed densities, and survival of the smaller seedlings after planting tended to be lower than that for larger loblolly pine seedlings. Many areas that supported shortleaf pine have been replanted with loblolly pine after timber harvesting. Although there will continue to be natural regeneration, use of "soft touch" regeneration techniques, such as shelterwood and individual tree selection, will likely result in less natural regeneration of shortleaf than clearcutting and burning. The most recent inventories suggest natural regeneration is about 70 percent less than previously (fig. 29.7). Although individual trees will continue to be found throughout its range, the acreage on which shortleaf pine constitutes more than half of the basal area will continue to decline due to replacement of shortleaf by hardwoods and by loblolly pine plantations.

Slash Pine

Because slash pine has rapid early growth and good wood quality traits, this species has been favored by forest industry in Florida and Georgia, and many plantations can be found outside of its natural range. Many natural stands have been harvested for economic reasons and have been replaced by plantations. Some future stands will develop from seed on areas adjacent to plantations. Although these stands will contain some genes from the genetically improved plantation, future surveys will likely classify these as stands showing no signs of artificial regeneration. While the acreage of natural stands will continue to decline as a result of development, hardwood competition, and conversion to plantations, the rate of decline in acreage of the more common variety of slash pine might be among the lowest of the southern pines. This may be because many new "natural" stands are being established adjacent to existing plantations. However, natural stands of slash pine (var. *densa*) will likely decline due to housing development and low levels of natural regeneration.

Loblolly Pine

It is likely that more seedlings of this species are planted each year than any other tree species in the World. Loblolly does well on a range of site conditions, and trials have shown that at age 20 years, it typically produces more biomass on upland sites in the South than other species with which it has been compared. Into the foreseeable future, it will continue to be the most commonly planted tree in the region. Natural regeneration of loblolly pine appears to be as common now as it was during the 1950s (fig. 29.7), perhaps because loblolly plantations are very widespread (table 29.2).

HERBICIDES IN PLACE OF FIRE

Prescribed burning can keep pine ecosystems viable by suppressing competing hardwoods and preparing seedbeds. The effects of herbicides are not identical with the effects of prescribed fire, but certain herbicides can sometimes substitute for prescribed burning. In some cases, both fire and herbicides are used to manipulate species composition. However, foresters are burning fewer acres each year as population pressures (in the form of clean air regulations, housing developments, and liability suits) are gradually eliminating fire as a management tool. About 4.1 million acres (< 3 percent of our forest land) are prescribed burned in the South each year (Haines and others 2001). Although herbicides could be used to promote natural regeneration of pines, an increase in urban and rural populations will likely limit the use of herbicides around homes, near highways, and even in plantations.

PREDICTIONS

Between 1990 and 2000, the population of Georgia increased by 25 percent. Some predict the population of the 13 Southern States will double between 1996 and 2046, with 70 percent of this increase in urban areas. During this period, the U.S. population is predicted to increase by 67 percent. As the population increases, land values and property taxes will increase, placing additional pressure on pine forests. In some areas annual tax on forest land exceeds $25 per acre. When taxes equal or exceed the revenue landowners get from their natural pine stands, owners will be encouraged to seek ways to make the land more economically productive. Taxation can result in forest fragmentation as forest products companies sell large tracts for residential development

(Flick and Newman 1999). After forest land is transferred to individual private landowners, many will choose not to establish new forests with either natural or artificial regeneration methods.

Population pressures over the South will continue to increase into the foreseeable future. This will result in an increase in forest fragmentation (Rudis 1998). The presence of more houses in forested landscapes will be especially threatening to pine management strategies. Some people living in these new homes will want clean air (no smoke from prescribed burns), no wildfires, no use of herbicides, and no chipping of hardwoods. Some will want to establish forest "preserves," and succession in these preserves will favor hardwoods at the expense of natural pine stands.

Alig and others (1986) reported that natural pine stands in the South decreased at a rate of about 1.2 million acres per year between 1977 and 1985. They predict there will be 20 million acres in natural yellow pine timberland in the South in 2030. This represents a decline of 20 million acres over a 45-year period (or 450,000 acres per year). Others predict a decline of 23 million acres by 2030 (fig. 29.1). The rate of decline is not expected to be as great in the future as it was between 1977 and 1985. Although one computer model suggests the acreage of natural pines might increase by 45 percent by midcentury (Zhou and others 2003), this scenario is based on mathematics and not on the opinions of foresters.

A Longleaf Pine Alliance has been established to help slow the decline in the acreage of longleaf pine. However, we believe that Table Mountain pine is the most threatened of the southern yellow pines. Professor South predicts a "Table Mountain Pine Alliance" will be formed in the future.

We do not expect that important causal factors will change in ways that will favor an increase in the rate of natural pine regeneration. Except for loblolly pine and slash pine, the acreage in new natural pine stands (age class 0 to 10 years) is < 60 percent of that for age class 41 to 50 years (fig. 29.7). This ratio is only 30 percent for shortleaf pine. If these trends continue, there will be significantly fewer natural stands of shortleaf pine, longleaf pine, Virginia pine, and pond pine in the year 2030.

Factors that might contribute to an increase in natural regeneration of pines include large wildfires after droughts, an increase in prescribed burning, an increase in the average rotation age of natural pine stands, a reduction of tree planting after logging of natural pine forests, a reduction in tree planting after wildfires, an increase in the use of herbicides to favor natural pine regeneration, and the abandonment of pastureland or cropland. Pressures from increased urban and rural populations will discourage the implementation of most of these factors. As a result, the loss of natural pine ecosystems will continue at an alarming rate.

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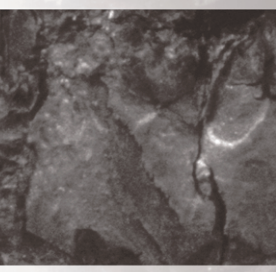

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