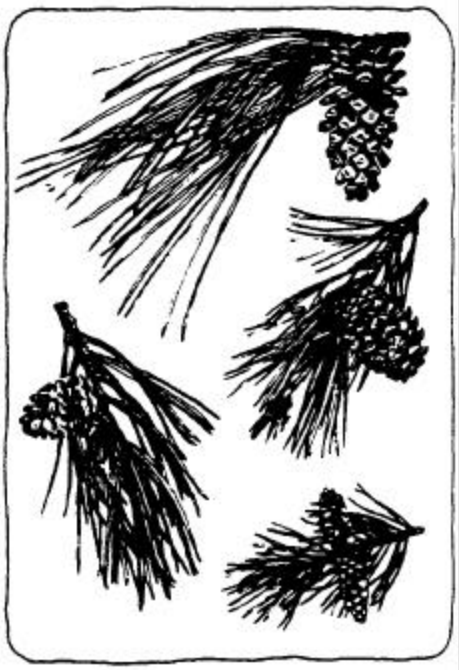
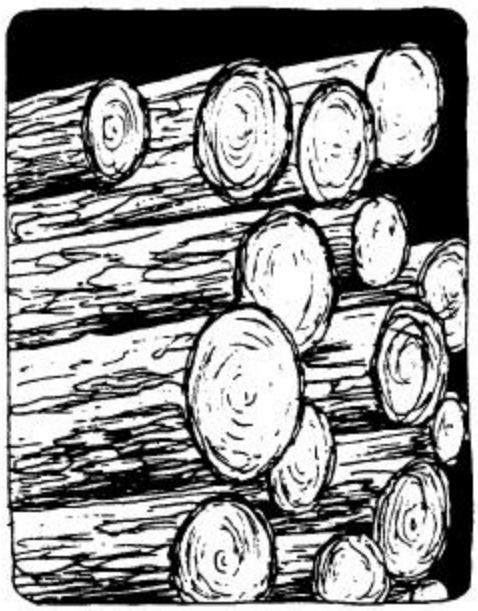
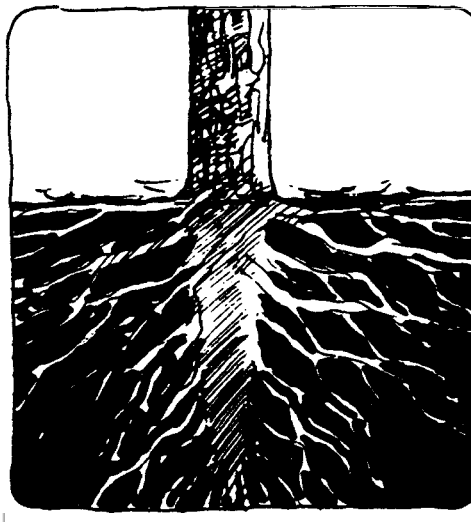
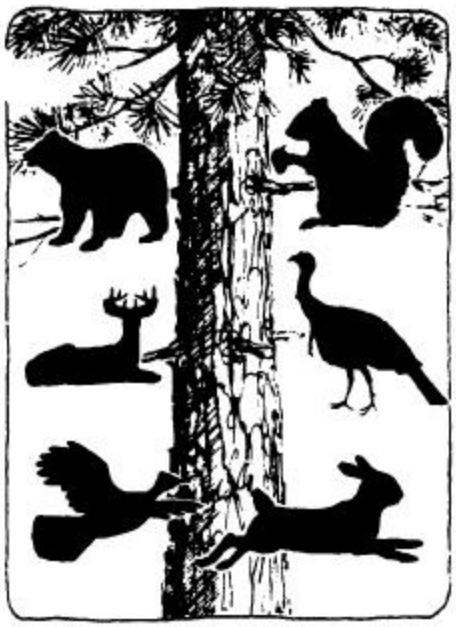
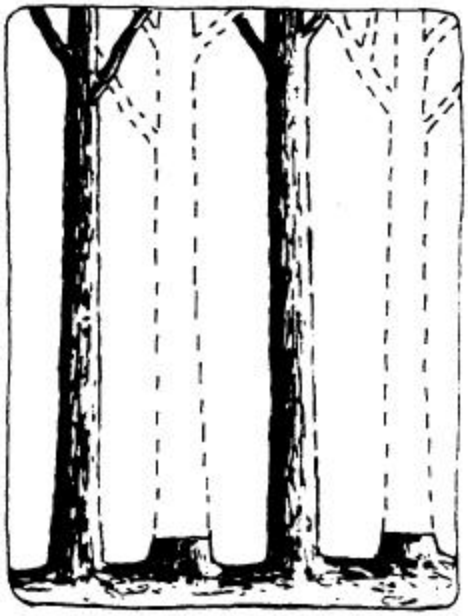
Landowner's Handbook for Managing Southern Pines











THE CHAPTERS INCLUDE

1. The Southern Pine Forest
2. Forestry as an Investment
3. The Major Southern Pines
4. Importance of Soil to Tree Growth
5. Regenerating Southern Pines
6. Intermediate Stand Management
7. Pine Insects. Diseases & Wildfire
8. Timber and Wildlife
9. Harvesting Southern Pines
10. Marketing Southern Pines
11. Forestry Terms (Glossary)
12. Forestry Assistance Available

Information in this handbook was developed jointly by

Cooperative Extension Service

USDA Forest Service

Southern Region

1 SOUTHERN PINE FORESTS

Robert L. McElwee
VA Cooperative Extension Service

Of the 200 million acres of commercial forest land in the 13 southern states, 181/2 million acres are publicly owned, 36' /2 million acres are owned by wood-based industries, and by far the lion's share, 145 million acres, belongs to private individuals and groups. (Figure 1) U.S. Forest Service reports indicate that 94 million acres of southern forest land support, in whole or in part, commercial quantities of at least one of the four major southern pine species.

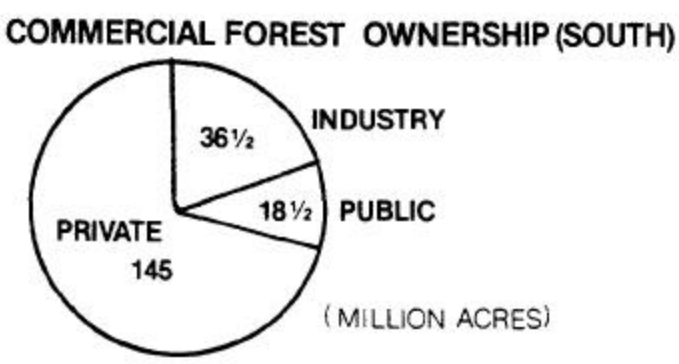


Figure 1

The history of these vast pine forests has been tied closely to the development of the region since tile days of the earliest settlers. To the first settlers, these forests were both a blessing, offering forest products of all kinds for commerce and local use, and a hindrance to be removed for the establishment of agricultural crops. As the south and the nation developed, much of the original pine font was removed to provide building materials for towns and railroads, factories and ships, and naval stores. Cleared land was planted to cotton, tobacco, rice and other crops. As agricultural uses for these sites declined or expanded, southern pine acreage increased and decreased. Prior to the 1940's and 1950's, most regeneration of new pine stands was by natural seeding on old fields following agricultural abandonment. Since the 1950's however, a larger and larger portion of new stand establishment has been through artificial regeneration by seeding or planting. Today, there is a place for both natural and artificial regeneration of pine.

Demand for southern pine timber has increased dramatically over the past 40 years, and all projections are that this demand will continue to increase. Several factors, some related and others unrelated, are responsible for this demand. Among the most important factors are the rapid growth of southern pine throughout its range, the reduction of timber removals in the northwest, the establishment of a large pulp and paper industry in the southeast, acceptance of southern pine building materials, and the favorable transportation rates for southern products to eastern markets and to major wood-importing countries throughout the world. These, plus other factors lead to estimates that demand for southern pine timber will double in the next half century.

THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

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If this increased demand for southern pine is to be met, what are the implications for owners of land supporting or capable of supporting southern pines? It is apparent from the ownership figures that the largest share of any increased production will come from the non-industrial private landowners. These owners control three-quarters of the land in the south capable of producing southern pine timber. While some increased production will come from industrial lands, total removals from these will provide only a fraction of the needs. Forests owned by governmental agencies provide several services and cannot be expected to satisfy demand for timber. The timber of non-industrial landowners will be in high demand and this demand should be reflected in increased stumpage prices and higher returns to the landowner.

Meeting an increased demand in volume during the first quarter of the next century requires that stands from which this volume is to be taken must be established in the 1980's and early 1990's. Recent surveys in all southern states, conducted by the U.S. Forest Service, show that sufficient seedlings and small trees (2 to 4 inches in diameter) are not now established to meet anticipated needs, and local timber shortages will develop after the turn of the century (Figure 2). This trend can be turned around during the first quarter of the new century if hardwoods on pine sites are controlled and sufficient southern pine establishment is accomplished during the 1980's.

Historically, investment in timber has been a profitable undertaking, with growth in value of timber leading inflation rates by several percentage points (Figure 3). The relative value of timber will increase even more as the demand for southern pine timber increases over the next several decades. Investments in timber production will be a profitable venture for non-industrial landowners in the south. Consequently, they should seriously consider managing their forests more intensively especially to promote the growth and harvest of the four major commercial species of southern pine - loblolly, slash, shortleaf, and longleaf.

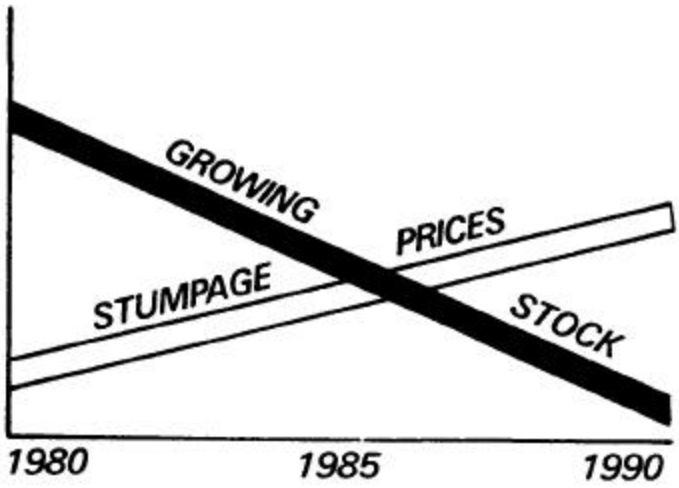

Figure 2

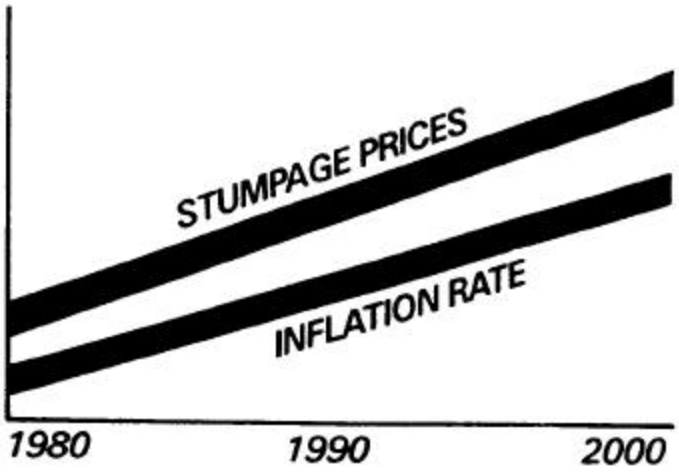

Figure 3

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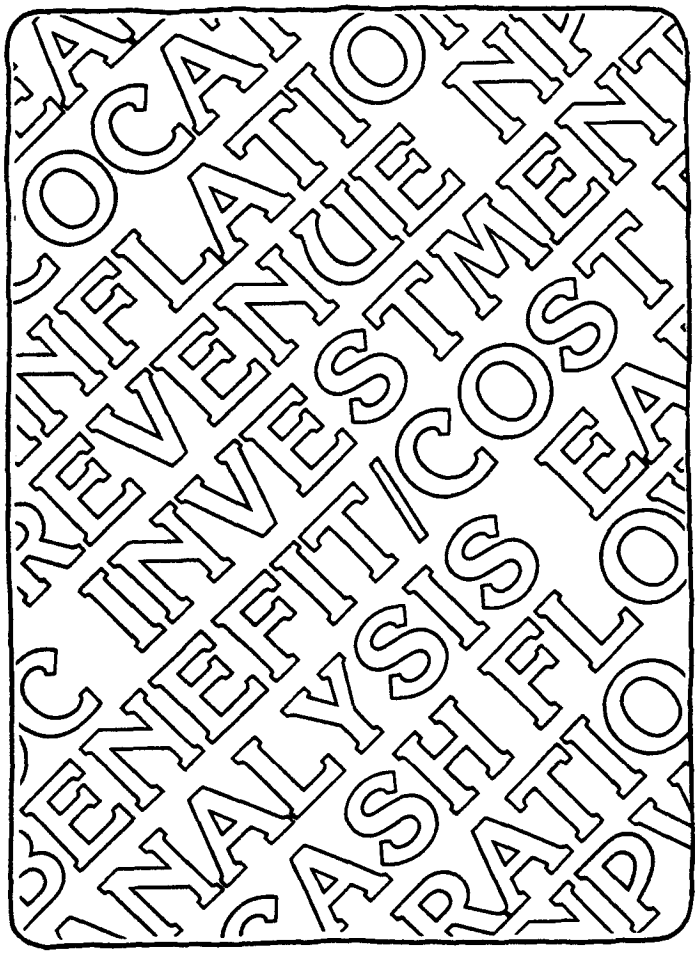
2 FORESTRY AS AN INVESTMENT

Harry L. Haney, Jr.
VA Cooperative Extension Service



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Is forestry a good investment? Most foresters like to think the answer is "yes"! The answer, however, depends on the facts and circumstances of each case. As competition for money and other resources increase, decisions of foresters and investors need to be based upon all available information. Investors have disposable income for use in forestry enterprises, but there are many alternatives available to them. The objective of this paper is to describe how evaluations are made and illustrate these points with an example.

I. Framework for Analysis

A. Time Line

Cash flows from a forestry investment occur over a long period. A time line is a device that helps the user visualize the spacing of the costs and revenues and how they relate to each other. It is useful in understanding the investment because all relevant monetary items are seen in perspective. Figure 1 shows a forestry investment example on a time line. The investment period shown is 30 years. Cost items are shown with a minus below the time line. Revenue items are shown with a plus above the time line. Your management plan should insure that all cash flows for the investment cycle are recorded.

B. Investment Inputs

All costs that are required to undertake the forestry investment should be included. Care should be taken to distinguish between capital costs and expense items because of differential tax treatment.

1. Land. The capital cost of forest land and improvements is included when forestry investments are compared with alternative uses of funds (e.g., forestry vs. stock, certificates of deposit, or other investments). In the example shown in Figure 1, the purchase price for cutover land is $300 per acre. Note that the terminal value of the land and improvements is also shown as a revenue at the end of the investment period.

It sometimes may be appropriate to exclude land cost. If the land is already owned, the investment comparison may be made on the alternative uses of land ignoring the opportunity of selling the land and using the capital elsewhere. Examples include comparisons of forestry vs. agricultural use and intensive forestry (planting) vs. extensive forestry (natal regeneration).

Important considerations when purchasing forest land include productivity (site index), operability (slope, soil conditions, etc.), accessibility (the nearness of roads), and location. Location is especially important for markets to sell timber, competition from other land uses and regulations of forest management activities (e.g., air quality regulations affect the ability to prescribe bum).

2. Adequate growing stock must be present to realize the productive potential of the land. Site preparation is usually necessary on cutover timberland to regenerate a site. This can be done by planting or seeding. Planting is preferred because it gives control over stocking levels. The need for release of regeneration depends upon the method of site preparation and the amount of competing vegetation. These costs of establishing a stand are capital improvements for tax purposes and must be capitalized (i.e., recorded in a set of books for recovery when timber is sold). Other tax considerations are explained below.

3. The "ordinary and necessary" management expenses for making a timber investment profitable are deductible on a yearly basis for federal and most state income tax purposes. These include, salaries, professional fees, and maintenance of roads, fences, firelines buildings, etc. Costs for protection from fire, insects, disease and theft are also deductible expenses. In Figure 1, annual property taxes, annual management, and the timber stand maintenance cost in year 10 are tax deductible expenses for the investment.

C. Investment Outputs

All revenues that accrue to the land as a result of the investment and management activities should be included in the accounting.

1. Timber sales are normally the primary revenue source of a forestry investment. The final harvest may include a combination of pulpwood, chip-n-saw, sawtimber, peelers, and poles and piling, depending upon the local market. One or more intermediate harvests, such as the thinning at age 20 (Figure 1), may also produce revenue. These revenues qualify for long-term capital gains treatment of the net taxable income when sales are conducted in accordance with Internal Revenue Service Regulations. They permit the taxpayer to exclude 60% of long-term gain from taxable income.

2. Hunting leases are sources of annual revenue in many localities. The fees range from $0.25 to $ 10.00 per acre per year depending on the location, size of the tract, and quality of hunting. Often hunting agreements with neighbors and persons living in the vicinity are made to lower the risk of fire or trespass. In Figure 1, hunting or grazing leases are shown from year 3 through year 13. This period before crown closure offers the greatest potential for use by wildlife or cattle. Multiple uses of the forest land may produce additional revenue, but they may also involve additional capital outlays and management expenses. Reduced timber output may result from these marginal additions. Multiple uses such as grazing must be analyzed carefully since they may include the benefits of reduced vegetative competition and lower risk of fire. Grazing may also carry hidden costs of damage or reduction to growing stock.

3. Recreational uses of the forest generate revenue in some cases. However, camping is an example of a recreational use that may involve modifications of forestry practices and increased costs. Intensive recreational opportunities should be analyzed separately from forestry uses.

4. Mineral revenues may involve oil and natural gas, coal or extractive ores, and others. Some mineral revenues are very lucrative and develop into the primary use of the resource. Costs vary with the activity and may impair or destroy site productivity in extreme cases.

This list is intended to suggest the variety of costs and revenues that may be encountered during analysis of timber tracts for purchase or management. Timber revenues and some mineral royalties may qualify for long-term capital gains benefit. The remaining revenues are subject to ordinary income tax rates. All that affects the economic outcome should be considered. The results must be based on net productive acres to accurately assess the expected returns from the investment. Typical tree farms may have 20 to 25 percent of their surface area in roads, right-of-ways, water and other nonproductive acres.

D. Economic Considerations

The personal objectives and financial situation of the investor affect the analysis. These must be considered with general economic conditions to arrive at conclusions regarding any particular investment at a given time.

1. Landowner characteristics.

The individual's tax rate affects the after-tax cash flows. For ordinary income the after-tax cost of a deductible expense or revenue is equal to (1 - t) times the before-tax cost where t is the taxpayer's marginal tax rate. For long-term capital gains revenue, the marginal tax rate, t, is multiplied by 0.4, the amount of long-term gain included as income, to arrive at the marginal tax rate on long-term gains. The maximum effective tax rate on long-term capital gains is currently 20 percent, for those in the highest tax rate category.

Other important tax considerations include the decision to include or exclude cost-share payments in income. When cost-share payments are reported as income, a taxpayer may amortize up to $10,000 annually in qualifying reforestation costs, and he may also claim an investment tax credit (ITC). In situations where the $10,000 annual ceiling has been reached, it is to a taxpayer's advantage to exclude cost-share payments from income to avoid the unnecessary tax cost. When a full 10 percent ITC is elected, the basis for amortization must be reduced by one-half of the credit taken. Alternatively, the ITC may be reduced from 10

percent to 8 percent in order for 100 percent of the basis in qualifying costs to be amortized. The first option is preferable for most taxpayers.

When an investor borrows funds, it is his cost of capital (COC) after the deduction of interest that is important. If investment funds come from equity (bank accounts, sale of stock, etc.), it is the after-tax earning of these assets which is foregone that is used as a discount rate. If borrowing and equity are used, a weighted average of the two is appropriate. In no event should a cost of capital be used that is lower than the after-tax earnings in alternative opportunities for these funds. Obviously, your cost of capital will vary depending upon your tax rate, credit record, and the alternative investments that are available.

It is assumed that wealth maximization is the objective of investors considering tree farm projects. When personal objectives include nonfinancial considerations, these must either be quantified or handled subjectively.

2. General Economic Trends.

Inflation affects all future cash flows. The basis in land, timber, equipment and reforestation costs are capitalized in today's dollars, but are recovered in future periods of deflated dollars. Therefore, most analyses should be made in current or inflated terms to avoid inflation-induced errors in making decisions. All cash flows should reflect projected inflation and a current or inflation-adjusted discount rate must be used.

Differential price trends can cause miscalculations in investment analyses. Real price appreciation for southern pine sawtimber has received much attention, but other product prices and costs are also affected. Use the best information available in predicting future changes in cash flows.

II. Economic Decision Criteria

The analysis of long-term forestry investments requires the use of decision tools that take the time value of invested capital into account. Discounted cash flow using compound interest satisfies that requirement. Four criteria are introduced that help an investor decide whether it is desirable to undertake a forestry project. They also guide the choice among mutually exclusive alternatives. An example of a mutually exclusive choice would involve deciding whether to plant or depend on seed trees to regenerate a site.

A. Net Present Value (NPV) discounts all revenues and all costs to the present at the investor's cost of capital. If this result is positive the investment should be undertaken. Between mutually exclusive alternatives, accept the investment with the highest NPV The results are interpreted as an increase in the present value of an investors wealth from undertaking a project. This is conservative because all intermediate cash flows are reinvested at the cost of capital. Projects must have the same investment life for NPV comparisons to be valid.

B. Internal rate of return (IRR) expresses the average compound interest rate that will be earned over the investment period. It is found by setting the sum of discounted revenues and discounted costs equal to zero (i.e., the NPV will be 0), and calculating the discount rate. If the IRR exceeds the cost of capital a project is accepted; a mutually exclusive project with the highest IRR is chosen. IRR assumes that intermediate cash flows are reinvested at the internal rate of return. This is a more liberal assumption than NPV; however, the IRR seems intuitively easier for most investors to understand. Projects must have a similar scale for IRR comparisons to be held.

C. The benefit/cost ratio (B/C) (profitability index) discounts all costs and revenues to the present at the cost of capital and takes the ratio of the two. This normalization gives the expected present value that can be expected per dollar invested. Projects with B/C ratios greater than 1:1 are accepted; mutually exclusive projects are selected on the basis of the highest BIC ratio. Again, the scale and investment periods must be approximately equal for B/C ratio comparisons to be valid. B/C ratios are frequently used by public agencies.

D. Equal Annual Equivalent (EAE) (Equal Annual Income), spreads the benefits of an investment over its useful life in the same way that installment payments spread the cost of a loan over its payback period. This permits comparisons between projects with annual returns and also permits valid comparisons with projects that have a different investment period. This is not a restrictive assumption because all discounted cash flow criteria weight current cash flows more heavily than those farther into the future. All investments with a positive EAE should be accepted since it is computed with the cost of capital. Accept mutually exclusive projects with the highest EAE.

A number of microcomputer programs are available to analyze forestry investments." They generally compute all the decision criteria noted above as well as a composite rate of return (CRR), similar to IRR, but with intermediate cash flows reinvested at the COC. It gives correct investment decisions for an analysis, but the interpretation of the result is not straightforward. Caution should be exercised in using microcomputer packages that do not distinguish between a before-tax Cost of Capital (COC_{BT}) and an after-tax Cost as Capital (COC_{BT}).

FN: Example Analized with QUICKSILVER by Vasievich and Friebis.

III. A Forest Management Example

The forestry information on the time line in Figure 1 will be used to illustrate how an example forestry investment is analyzed. Cutover land is available for purchase at $ 300 per acre. Site preparation ($ 100/ac), planting ($50/ac) are completed in the first year. A release ($40/ac), often needed in year 2 or 3 to keep the trees free to grow is not included in the example. These are all capital expenditures. In addition, annual property taxes of $2 per acre and management costs of $3 per acre are included. A timber stand maintenance ($20/ac-year 10) is allowed to control competition that the site preparation and chemical release missed. These are ordinary deductible expenses.

The revenues for this example show a thinning income at age 20 (9.1 cords) and a harvest at age 30 (8.4 cords and 10.686 MBF). These quality for long-term capital gains treatment. In addition, a hunting lease for $4 per acre is shown for years 3-13. It is ordinary income, but is omitted from the example. A summary of the included transactions is shown in Table 1.

Timber yields are based on old field loblolly data. The thinning volume projected with PC WTHIN yields 9.1 cords for a combination row-low thinning that reduces the stocking to 80 square feet of basal area (BA) per acre." I At thirty, when the stand is harvested, 8.4 cords and 10.68 MBF are removed in a clearcut. The example is not intended to be an optimal harvest regime, but simply an illustration of one harvest scheduling option.(2! Prices for both pulpwood ($11) and sawtimber ($ 100) are assumed to be for average timber from thinned, well-managed stand; real price appreciation of 2 percent is assumed plus general inflation to continue at a 4 percent pace. This seems reasonable based on current economic projections of differential price changes. Other cash flows are assumed to continue at current levels. The taxpayer is assumed to be in the 38 percent marginal tax bracket (i.e., 1984 taxable income is between $45,800 and $60,000); the effective long-term capital gains tax rate is 15 percent (0.4 x 0.381.

The hypothetical example is analyzed for the amortization tax option (100%), thus an 8% investment tax credit is taken. No cost-share payments were included. Discount rates or cost of capital (COC) were picked for before-tax rates of 8, 10, 12, 14, and 16 percent (including 4 percent inflation). After-tax rates for this taxpayer, assuming a fifty-fifty mix of ordinary and long-term capital gains alternatives, would be 5.9, 7.4, 8.8, 10.2 and 11.8, respectively. 13, If any of the computed rates fall below after-tax alternative rates of return from other sources (e.g. after-tax stock earnings rates or tax free bonds), they must be ignored. Since all of the computed rates are after-tax, only the analysis of after-tax cash flows are valid. Results from mixing after-tax cash flows with before tax discounts rates, and vice versa, are nonsensical.

In Table 2, the after-tax decision criteria for our hypothetical investment are shown. NPV (present net worth) for an 8.8 percent COC4* is $134 per acre. At 8.8 percent, the present value of the investment will increase the investor's wealth by $134 per acre if it is undertaken for one 30-year investment period. The B/C ratio for an 8.8 percent COC,,- is 1:121; that is, for each dollar invested, the present value of benefits that will accrue to the owner are $1.21. The annualized value of the returns, an EAE of $12.81 for an 8.8 percent COC;,. can be compared to annual uses from the alternative commitment of their resources. Finally, the IRRA- is 9.83 percent. h is earning this average annual rate over the investment period. For all COC4- lower than 9.83 percent, NPV, B/C and EAE will be positive and the investment should be accepted. For all COCAT greater than 9.8 percent, decision criteria will be negative and investments in alternatives should be undertaken. At 9.8 percent, the investor would be equally well off investing in forestry or his alternative choice; NPV by definition would equal 0, B/C would be 1:1 and EAE would equal 0.

In Table 2, the selection of 5 discount rates gives a sensitivity analysis to this critical input variable. The eked COCAT can be analyzed as well as outcomes if her or lower COCA- actually occur. Similarly, other critical assumptions such as the price of land, stumpage prices, real price appreciation and others can be varied one at a time to analyze the impact of each input into the results.

SUMMARY

A forestry investment must be specified within the context of the landowner's investment objectives. An objective decision framework that takes account of the time value of money is required for long-term forestry investments. The best information that can be obtained on management inputs should be used. The expected

(1) PCWTHIN. Burk, et al. School of Forestry and Wildlife Resources, VPI&SU. A row-low assumes that every 5th row is removed for access for harvesting and the balance is taken from the lower diameter classes to simulate a timber stand improvement cut. This approximates actual practices in well-managed thinnings

(2) In practice, numerous options may be analyzed to arrive at a pattern that will maximize financial returns using the above decision criteria le c; the highest EAE).

(3) (0.5) 1 0.38)(0.08) - (0.5))1 - 0.15)(0.08) = .059or5.9%, etc.

values for economic inputs should be chosen, but any variance in expected values for economic inputs can be analyzed in a sensitivity analyses. Acceptor reject the investment based on the decision criteria established beforehand.

Decisions such as this are constantly made on the basis of limited information because none can see into the future. Fortunately, only a small part of our investment resources must be committed at any given time. The analysis is only valid for the specific assumptions and information used to make the analysis. As the variables change, so will the expected outcomes and the forest landowner's investment decisions. This framework puts forestry on equal footing with other uses for an owner's money when all information affecting the outcome is considered. Good judgment fostered by experience is essential to temper the choice of inputs and to evaluate the outputs.

Figure 1 - A time line for a forestry investment in the South, per acre

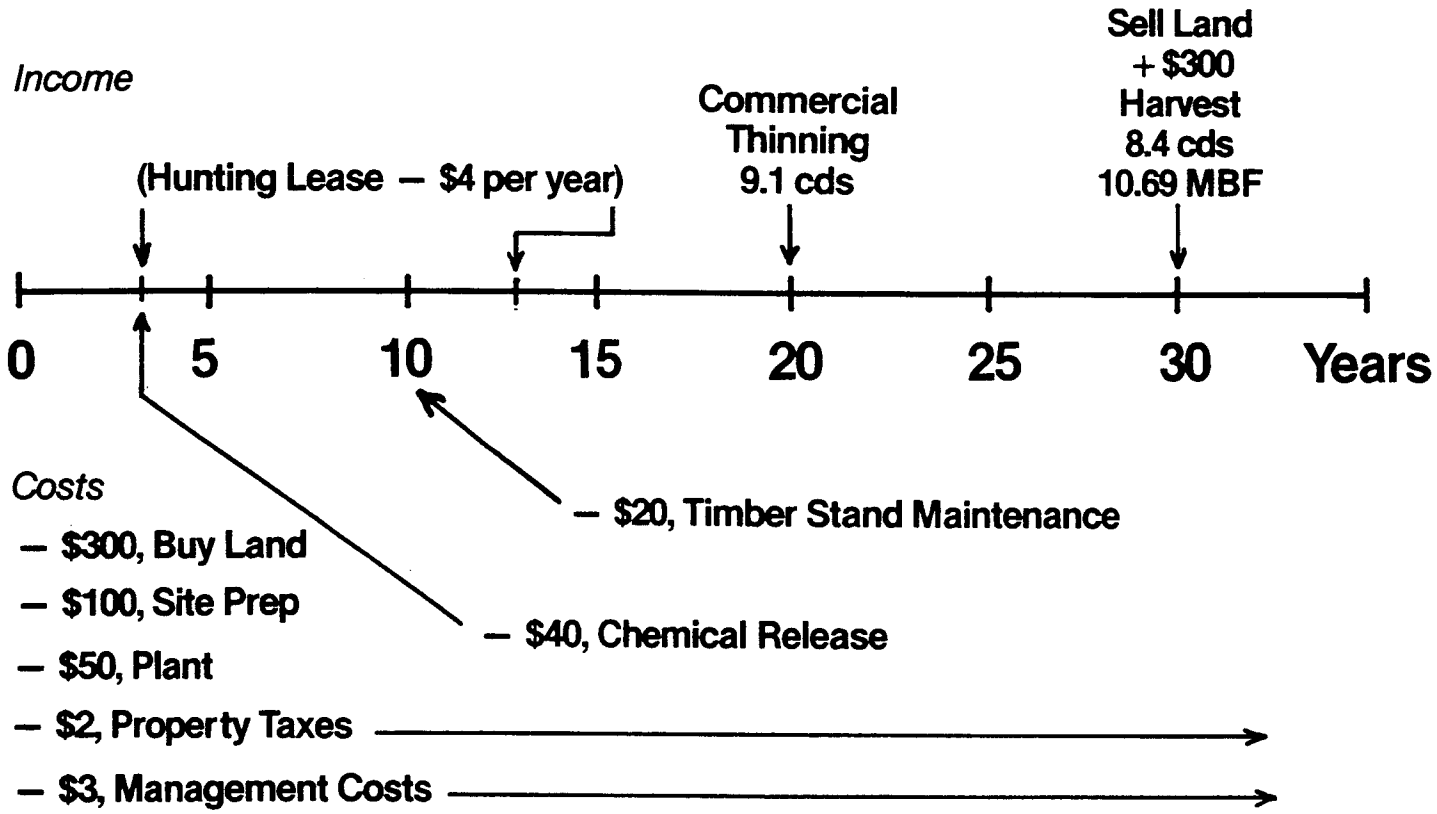

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Table 1. **Management transactions for** an example forestry investment

No. Activity Tax Class	First Year	Last Year	Step Years	Current Value ($/Unit)	Rate of Change (%/Yr)	Quantity Units (Product)
1 Buy Land						
Land Capital	0	0	0	-300.00	0.00	1.00 Acres
2 Site Prep						
Reforestation Cost	1	1	0	-100.00	0.00	1.00 Acres
3 Planting						
Reforestation Cost	1	1	0	-50.00	0.00	1.00 Acres
4 Mgmt Fee						
Ordinary Expense	1	30	1	- 3.00	0.00	1.00 Acres
5 Ad-Val Tax						
Ordinary Expense	1	30	1	- 2.00	0.00	1.00 Acres
6 TSI						
Ordinary Expense	10	10	0	-20.00	0.00	1.00 Acres
7 Com. Thin	20	20	0	11.00	2.00	9.10 Cords
Timber Sale						Pulpwood
8 Final Harvest	30	30	0	11.00	2.00	8.40 Cords
Timber Sale						Pulpwood
9 Final Harvest	30	30	0	100.00	2.00	10.69 MBF
Timber Sale						Sawtimber
10 Land Sale	30	30	0	300.00	0.00	1.00 Acres

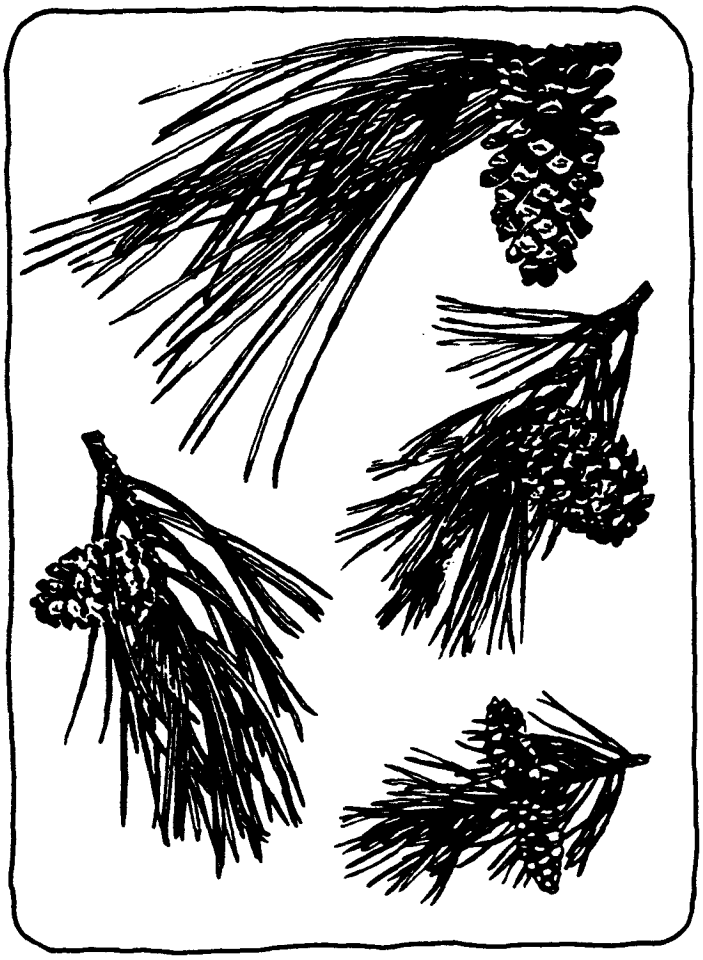
Table 2 Decision criteria for an example forestry investment.

BEFORE TAXES					
Discount Rate (%)	5.9	7.4	8.8	10.2	11.8
Present Value (Costs)	- 578.69	- 554.43	- 536.47	- 521.88	-508.29
Present Value (Benefits)	1499.52	993.59	681.03	469.68	309.49
Present Net Worth	920.83	439.17	144.56	- 5220	-198.80
Benefit/Cost Ratio	259	1.79	127	0.90	0.61
Annual Equivalent Value	66.18	36.82	13.82	- 5.63	- 24.32
Composite Rate of Return	9.31	9.51	9.67	9.81	9.97
Internal Rate of Return	9.77	9.77	9.77	9.77	9.77

AFTER TAXES					
Discount Rate (%)	5.9	7.4	8.8	10.2	11.8
Present Value (Costs)	-795.56	- 698.18	- 635.04	- 589.89	-553.13
Present Value (Befits)	1607.35	1090.16	769.05	550.59	383.62
Present Net Worth	811.79	391.98	134.01	-39.30	-169.51
Benefit/Cost Ratio	202	1.56	1.21	0.93	0.69
Annual Equivalent Value	58.35	3287	1281	- 4.24	-20.73
Composite Rate of Return	8.41	9.01	9.50	9.95	10.44
Internal Rate of Return	9.83	9.83	9.83	9.83	9.83

3 THE MAJOR SOUTHERN PINES

Michael J. Walterscheidt
TX Agricultural Extension Service



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There are four major species of pine widespread throughout the southern states: shortleaf, loblolly, longleaf and slash. These species have numerous traits in common, yet each has characteristics unique to itself. They may occur on different sods and have differences in management requirements. There are other pine species in the south, but they are limited in their natural range to one or several adjoining states.

Loblolly Pine

Loblolly pine (Pinus *taeda L.)* has the second largest range of the southern pines, but because of is site adaptability, high yields, and ease of seed and nursery management, it is the most widely planted and utilized pine in the South. It occurs naturally on the coastal plain from New Jersey to Florida and west to Texas, throughout the Piedmont, and into Tennessee, Arkansas, and Oklahoma. The factor limiting further northward expansion of the range is temperature, and westward expansion is limited by rainfall and soil conditions. (Range MAP Figure 1)

There are some drawbacks to loblolly pine. Those found east of the Mississippi River are often highly susceptible to fusiform rust which can cause mortality in planted sites. Nantucket Pine tip moth can seriously attack young trees, causing a slowdown in growth until the trees reach a height of about 20 feet. Of the four major southern panes, it is the most susceptible to fire damage.

Loblolly pine occurs on a wide variety of soils, but grows best in sods with poor surface drainage, a deep surface layer, and a firm subsoil. In the coastal plain, the productivity of soils decrease with improvement in surface drainage. The presence of a hardpan, as well as excessively drained sands, can reduce productivity

.

Off the coastal plain, loblolly site quality generally increases from ridge tops to bottoms due to such soil differences as surface soil thickness and past land-use practices. Erosion has contributed to poor site quality on ridges.

Pure loblolly stands can be found throughout its range; but, quite often, it is mixed with sweetgum, shortleaf pine, and various oaks. On wetter sites, it can be found associated with sweetbay, sweetgum, green ash, and red maple.

Loblolly pine produces seed as early as ten years, but abundant production does not occur until trees are 30 to 50 years old. Some seed is produced every year, and, good crops occur on a 3- to 5-year basis. It usually falls within 300 feet of tile tree. Studies have shown that one

out of nine seeds produces one seedling on a fresh seedbed, one out of 15 on a burned surface, and one out of 40 on undisturbed litter or Jogging debris.

During the first five to ten years, height growth may average 2.5 feet per year. The best grown rate is obtained in open areas and the least under a full canopy. Competition from hardwoods reduces height growth an often kills the young trees. If the seedlings can survive the first three years, the chances are good for continued survival.

As trees mature, they outgrow the hardwood competition, but hardwoods can readily become established in the understory of loblolly pine stands. Periodic prescribed burning can reduce this competition.

Loblolly pine prunes itself at an early age, making it a desirable species for timber users. The main uses of loblolly pine are for softwood lumber and pulpwood, actual use depending on the size of the tree harvested. Plywood producers have become major users in recent years. The better trees in many stands can be used for poles and piling.

Shortleaf Pine

Shortleaf pine (Pinus echinata Mill) has the widest natural range of the four principal southern pines. h is ford in 22 states, extending from extreme southeastern New York through southern Ohio; southern Illinois, Missouri and Oklahoma; south to eastern Texas, and east to Florida. The northern and western range appears to be limited by winter precipitation. (Range Map Figure 2)

Shortleaf pine does not prune well naturally, with dead lower branches persisting for as long as 50 years. It does, however, grow rapidly, produces high quality wood, and sprouts readily. The rapid sprouting is a distinct advantage if a young stand is burned. Shortleaf pine withstands ice damage better than any other of the four principal southern pines. It is damaged easily by Nantucket Pine tip moth and does not recover as readily as loblolly pine. *ft* is not readily infected with fusiform rust, but a closely related disease, eastern gall rust, can severely infect some stands. The most serious problem associated with shortleaf pine is littlelleaf disease, a soil-bane disease, which slows growth dramatically and will kill mature trees

.

Shortleaf pine has the ability to grow on a wide variety of soils. In the Piedmont, site quality is related to the depth of the surface soil and consistency of the subsoil. The best combination is surface soil over nine inches deep and friable subsoil. The best sites are fine sandy foams or sift foams with good internal drainage; these are often found in the flood plains of small streams. Usually, sandy soils with excessive internal drainage are very poor shortleaf sites. It will grow on all aspects and ridge tops in the Southeast up to 3,000 feet. Best development is found from 600 to 1500 feet in the Piedmont and 150 to 1000 feet in Arkansas and Louisiana

Pure stands of shortleaf pine are found in some areas, but, quite often, it is mixed with loblolly pine which has a similar range. In many parts of its range, shortleaf is found with various species of oak in mixed stands.

Seeds of shortleaf pine begin to fall in late October, and over 70 percent of the seed falls during the first month. Cores will stay on a tree long after they are empty, giving an impression of a large seed crop each year. As with loblolly pine, some seed is produced each year, but good crops occur at intervals from 3 to 10 years. Most of the seed falls within 250 feet of the tree.

As with other pines, a prepared seedbed will result in the best seedling crop. The average height growth is about 2.5 feet per year. Competition must be removed, or seedling survival will be extremely low and the growth will be slow.

Shorleaf pine reproduction will persist in very dense stands. However, to obtain the best growth, a release cut is often necessary in natural stands

.

The uses of shortleaf pine are much the same as for loblolly. Sawtimber and pulpwood make up the greatest portion of uses, and poles are cut from good studs. In certain areas, there is also a market for peeler logs for theplwood industry.

Slash Pine

Slash pine (Pinus eliottii *Engelm,* var eliottii) has the most restricted range of the four major southern pines. *ft* extends from the coastal plain of South Carolina to extreme southeastern Louisiana. Its range has been extended westward by plantings in western Louisiana and Texas where it now reproduces naturally. Rainfall is believed to be the major limiting factor to the northward and westward range of slash pine. Another factor restricting its range is its susceptibility to breakage during ice stomps, especially in thinned plantations. (Range Map Figure 3)

The early widespread acceptance of slash pine west of the Mississippi River has been dampened by is susceptibility to fusiform rust. In east Texas plantations where slash pine and loblolly pine have been planted together, the slash pine wilt have up to five times more fusiform rust than loblolly.

The species is easy to manage in nurseries. h is a better natural pruner than loblolly a shortleaf pine. Slash pine grows best on sandy soils underlain with poorly defined hardpans 18 to 24 inches deep. Its juvenile fire

susceptibility has, until recently, confined it to wet areas of the flatwoods a in narrow bands along creeks and other drainages. Deep well-4ained sands or very poorly drained sites are least productive. Changes of elevation of one to two feet in the flatwood areas can result in a pronounced change in site quality.

There are few large native stands of slash pine. Although several species are associated with slash pine throughout its range, it is often associated with longleaf pine. Many of the hardwoods that do well on moist sites, such as water oak, swamp tupelo, and redgum, are also found with slash pine. An association with cabbage palmetto is widespread throughout is range.

Slash pines begin to bear conies in large numbers when they are 20 years old, and good seed crops occur about every three years. Most slosh pine seeds fall during October, and, about 90 percent of them fall within 150 feet of their source.

Early growth of slash pine is good, with an average five-year growth of 10 feet. On some good sites, trees five years old have been measured at 20 feet. Slash pine can be managed in either al-age or even-age stands; but, because of its susceptibility to fire, it is easier to manage in even-age stands. Old field sites have better growth than forest sites because of lack of competition at an early age.

Slash pine has many of the same uses as the other major southern panes -- sawtimber, pulpwood, poles, and peeler logs. Additionally, slash pine is a good source of naval stores; in the past, it was heavily worked for turpentine production.

Longleaf Pine

Longleaf pine (*Pinus palustris mill*) is found in the coastal plain from Virginia to southern Florida and west to eastern Texas. There is some northward extension of the range to the Appalachian foothills of northern Alabama and Georgia. (Range Map Figure 4)

Longleaf has several advantages over the other major southern pines; 11 it will grow at an acceptable rate on soils too poor for tile other pines, 2) it is resistant to fusiform rust, and 3) it is resistant to fire. It also has several distinct disadvantages: 11 it is highly susceptible to brown spot needle blight which can cause slow growth and eventually kill the seedling, and 2) it remains in a "grass stage" for three to seven years and occasionally up to 20 years. During the grass stage, there is little height and diameter growth, but there is extensive root growth. After the grass stage, the growth can be quite comparable to other southern pates, but the three-to five-year loss in growth can be quite costly, especially with the present-day shorter rotations. There are, however, some sites where longleaf would be the only acceptable species. It will occur in stands with the other southern pines and hardwoods.

A longleaf pine generally does not bear seed until it is about six inches in diameter. Open grown trees will bear some seed every year; but, generally, the seed crops are quite sporadic, and good crops occur infrequently. The seeds begin to fall in September and remain within 100 feet of their source.

Burning of the grass and litter just prig m seedfall will produce a good seedbed. The seed germinates rather easily, but seedlings tend to remain in the grass stage for a prolonged period of time. Saplings will grow one to three feet per year after emerging from the grass stage.

Longleaf pine is one of the finest timber trees, but it does not produce large volumes per acre. h cannot do well in competition or heavy shade and will soon be overtopped by other pines or hardwoods. Prescribed fire is one of the best management tools for longleaf pine.

Longleaf pine is an excellent source of naval stores. Many stands in the past were worked for turpentine and rosin as well as for timber production. Since stands are not extremely dense, there is less pulpwood production in longleaf pine than the other southern pies. There is considerable sawtimber and pole production from quality stands.

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Southern Region

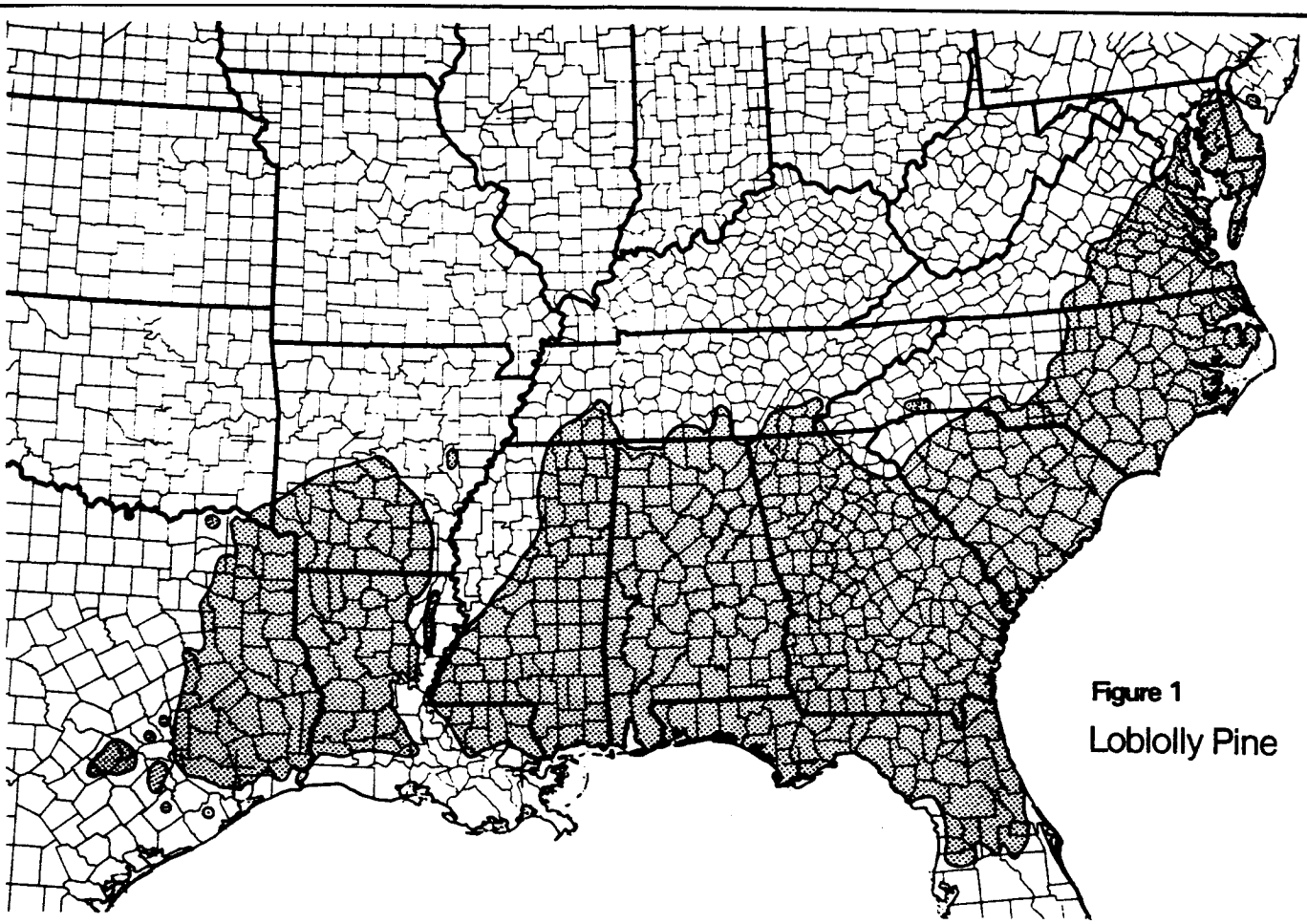


Figure 1
Loblolly Pine

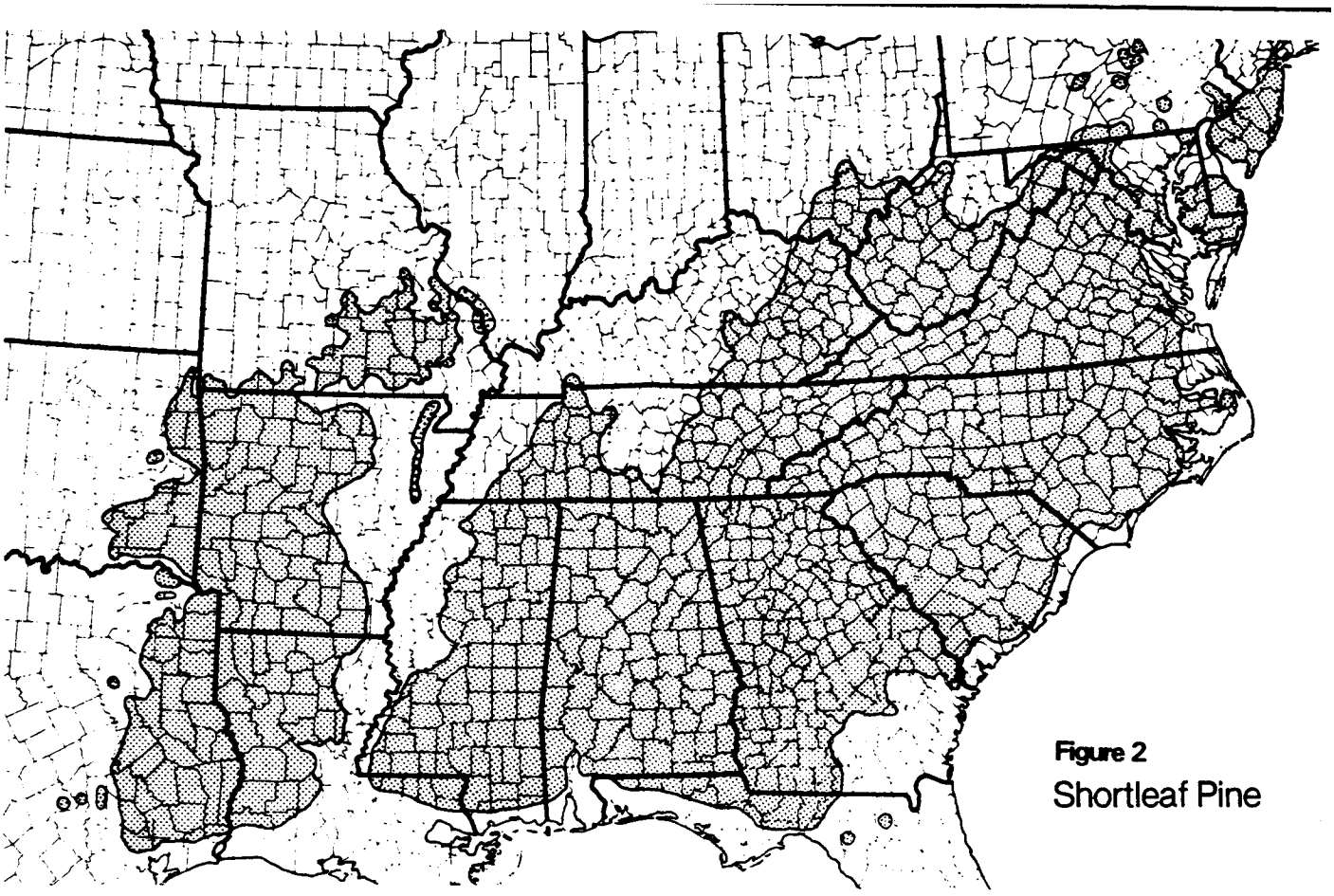


Figure 2
Shortleaf Pine

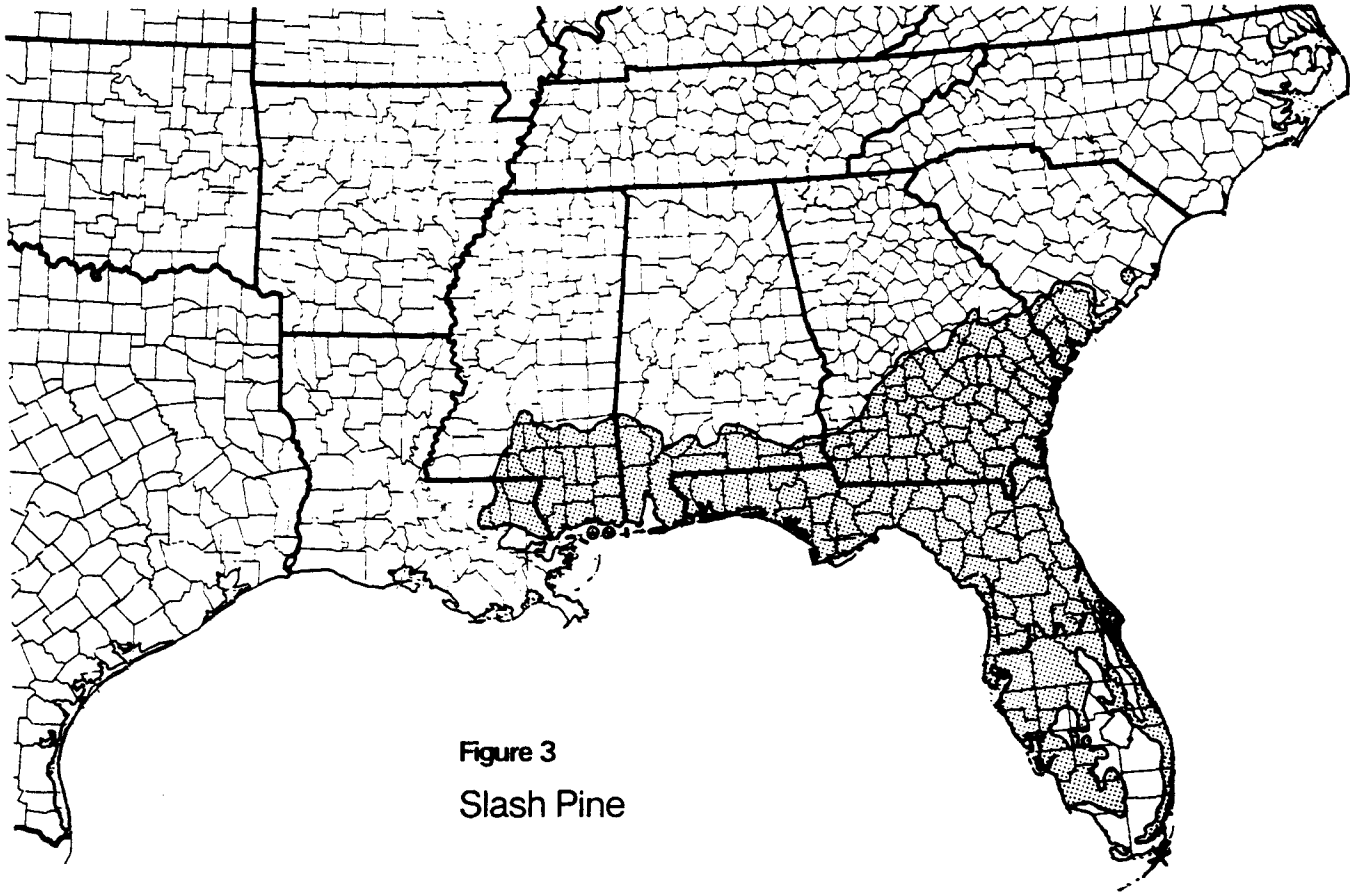


Figure 3
Slash Pine

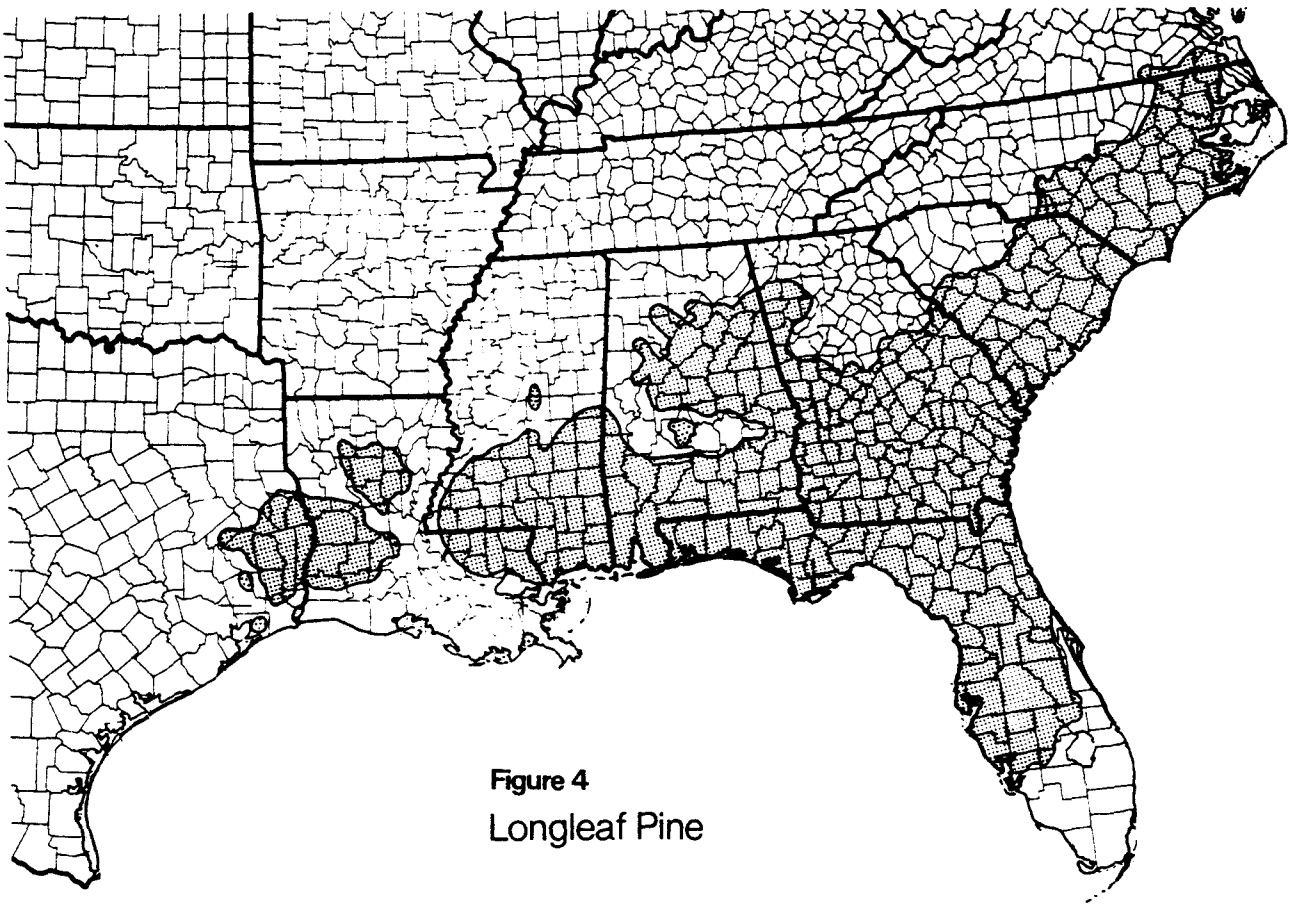
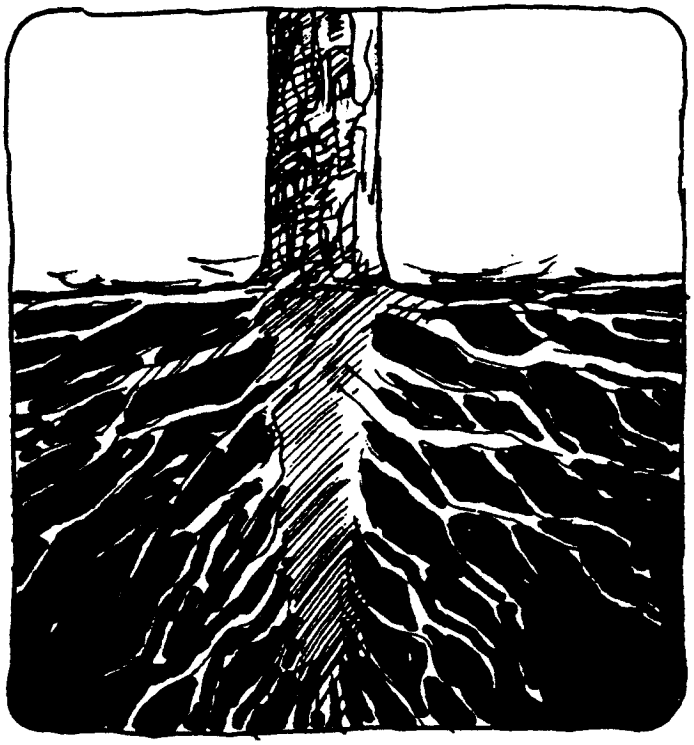


Figure 4
Longleaf Pine

4

IMPORTANCE OF SOIL TO TREE GROWTH

Rickey A. Hamilton
NC Agricultural Extension Service



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Soil quality is an all important factor in forest management decisions. Soils influence which tree species will grow best and yield the highest timber product volume, the length of time required to grow a timber crop, and the amount of money a landowner can invest to yield an acceptable economic return from forest management.

Trees will grow on many soils, but soils vary greatly in their ability to produce merchantable volumes of pulpwood, sawtimber, veneer, poles, piling, or other wood products in a reasonable amount of time. Past land use greatly affects soil productivity. In the Southeast, land that has been farmed is often eroded and lacking in one or more nutrients. The old saying "plant your sorry, worn out acres to trees" does not yield the highest return to the landowner. Just as with any other crop, the better the land, the more productive the forest. Landowners must be aware of factors limiting forest production when investing in forest regeneration and management.

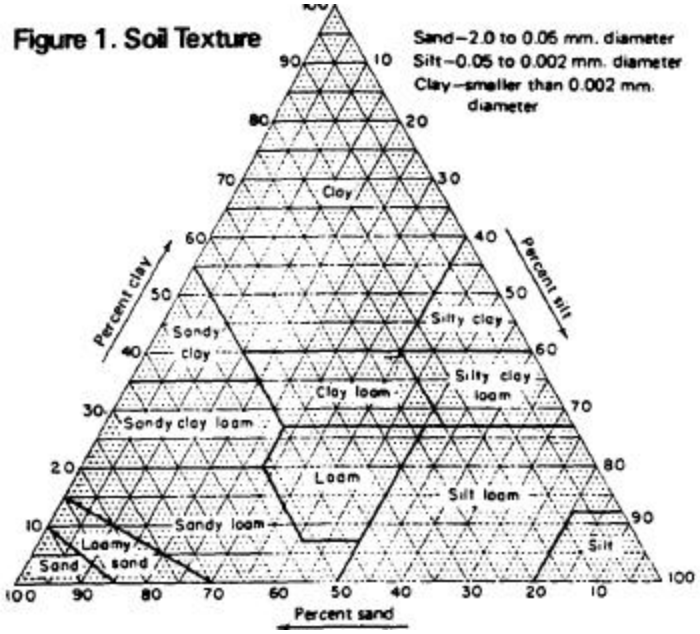
Soil Characteristics

One or more of the southern yellow pines will grow well on many sites. The following factors have a major impact on forest soil productivity.

1. Topsoil Depth - The depth of the uppermost soil layer is the most critical factor affecting the growth of southern pine. This zone is where many of the small "feeder" roots, through which water and nutrients enter the tree, are located. Logically, topsoil is highest in organic matter and nutrients, is usually well aerated and drained, and allows maximum root growth and root penetration. Erosion on many sites has reduced the topsoil depth to a few inches or less. In such cases, the characteristics of the second and third soil layers become increasingly important.

2. Soil Texture - The relative amounts of sand, sift, and day in the topsoil and subsoil layers is called texture. Sandy soils are comprised of large individual sand grains, are normally very well drained, but often lack nutrients through constant loss by leading. On deep pure sands, longleaf pine normally is selected for management since it is best adapted to this low moisture, low nutrient environment. On the other end of the texture spectrum are the pure day soils comprised of very small, fine soil particles. Generally, days exhibit higher water holding capacity, often to the point that soil aeration and root growth is inhibited. Some days contains adequate nutrients and are sufficiently well-drained between the extremes of pure sand and pure day. The combination of particle size along with the physical and chemical properties of each individual particle type in a given soil determine the soil's productivity. (Figure 1)

3. Subsoil Consistence Class - In addition to topsoil depth, consistency of the subsoil layer has been



recognized as an important determining factor in forest soil productivity, particularly for loblolly and shortleaf pine. Consistency is defined as the tendency for soil particles to adhere (dump together) particularly when wet. Consistency affects the ability of feeder roots to grow in the soil and absorb both nutrients and moisture. The following consistency classes will help you understand the productivity of your soil:

Class 1 - Very friable Non-plastic when wet, cannot be molded into a "wire." Loose or non-coherent when dry. Typical of coarse-textured soils (sands, loamy sands, sandy loams). Low to medium productivity.

Class 2 - Friable. Only slightly Plastic when wet. Crushed into aggregates under gentle pressure when moist. Soft when dry. Medium to high productivity.

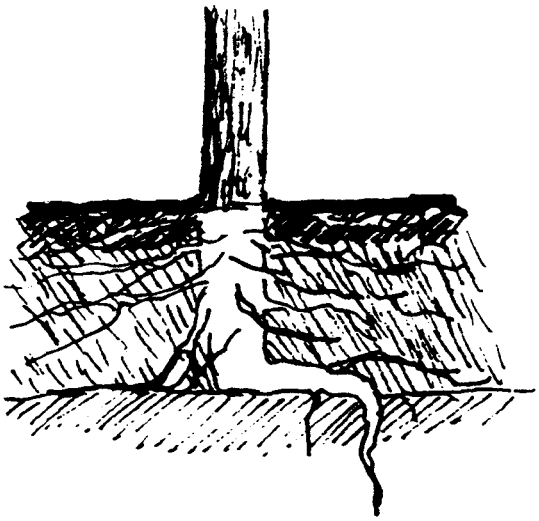
Class 3 - Semi-plastic. Can be deformed and will "ribbon-out" when worked while wet. When moist it will tend to crumble somewhat when ribboned out between the thumb and finger. When relatively dry, the soil is firm. Medium to high productivity.

Class 4 - Plastic. The soil is easily deformed and holds impressions when wet. When it is moist, it can be molded continuously into various shapes without breaking. It is hard when dry. Low to medium productivity.

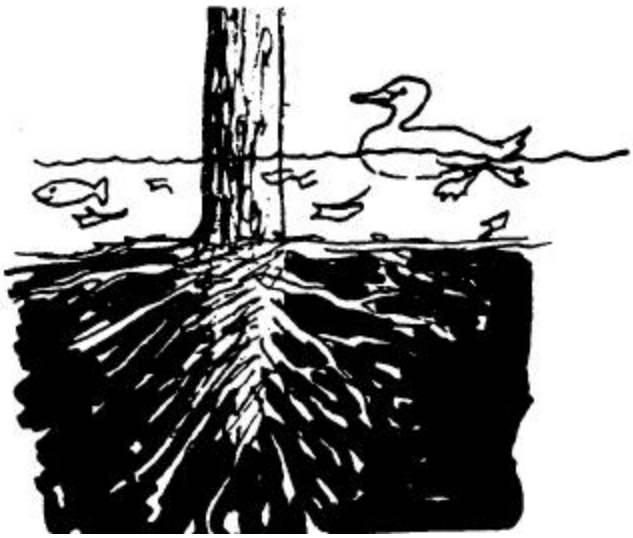
Class 5 - Very plastic. Soil has the properties of putty. When wet it can be molded into various shapes and will form a long ribbon when worked. h is firm but can be molded under moderate pressure at intermediate moisture contends. When dry, it is extremely hard. Usually low in productivity.

Class 2 and 3 soils are considered the best for forest tree growth, followed by Class 4.

4. Limiting layers - Any soil layer which limits the downward penetration of a tree's root system will reduce tree growth. In coastal plain soils, mineral and organic matter particles often form a cement-eke layer below the soil areas. These "hardpans" are typical of poorly drained areas with fluctuating shallow water tables, and they limit the depth to which roots, penetrate. Farmland may be underlain by a than layer of consolidated soil material just below the plow layer. These "plow pans" may be broken up by deep plowing, unlike permanent hardpans, which cannot be broken.



5. Internal Drayage. - Few trees species can grow in sots which are constantly wet. Poor drainage can "drown" tree roots by blocking the exchange of oxygen and carbon dioxide between the soil and roots. Drainage can sometimes be improved by ditching or by using bedding in site prepration. Internal drainage properties can be estimated by measuring the depth to "mottling" in a soil. Mottling refers to the coloration of sod caused



by minerals under poorly drained conditions. Mottled soils are usually red, yellow, or gray in comparison to surrounding soil color. In the very poorly drained soils, the entire soil profile may be ashy gray. (Table 1)

Table 1. Internal Drainage Classes

Class	Depth to Mottling
Well drained	over 36 inches
Moderately wet	24-36 inches
Somewhat poorly	12-24 inches
Poorly	less than 12 inches
Very poorly	Gray soil color

Soils in the first three drainage classes usually are medium to highly productive while the latter two classes are low to medium in productivity.

6. Fertility - The southern pines grow over a wide range of soil fertility levels. Soil fertility is a measure of the nutrients available in the soil for plant growth. Supplemental fertilization is normally not recommended for southern pine species except in cases of major nutrient deficiency. Phosphorous is deficient in some soils, and early tree survival and growth can sometimes be improved by adding phosphorous. A soil test made prig to site preparation will alert a landowner to critical deficiencies. Soil tests are made by the Cooperative Extension Services in each state. Your Extension agent can arrange to have your soils tested. Research has shown conflicting response by forest trees to fertilization with nitrogen fertilizer, particularly early in a rotation. Growth suppression may occur if the fertilizer increases the growth of competing weeds. Best results from early fertilizer use arise from a combination of fertilization with control of competing vegetation by herbicide or mechanical methods, not a usual forestry practice. Late rotation fertilization applied within 5 to 8 years before final harvest has been shown to increase timber yields in some situations. Landowners should have soils tested to determine the nutrient status and consult a forest soils specialist (contacted through the local Extension agent) to determine if the cost of fertilization will yield an acceptable increase in timber growth and yield.

Site Index

Foresters use site index to evaluate a soil's capability to support tree growth. Site index is measured by the total height to which dominant trees of a particular tree species will grow on a given site at some index age, usually 50 or 25 years in the southeast. Dominant trees are those which occupy the uppermost layer of the tree canopy; that is the tallest trees in the stand. The index age muse be stated as well as the tree species when referring to site index. Site index for one tree species will be different from another on the same site. Soil characteristics tend to vary considerably within an area, making it advisable to determine site index stand-by-stand.

If the site index for loblolly pine in a stand is 70 feet at 50 years, then we expect loblolly seedlings planted on that area today to be 70 feet tall in 50 years. There is a close relationship between site index and the volume of merchantable wood produced. Volumes increase rapidly with improvement in site index. When timber yields are estimated, dollar value projections based on site index can be made.

Site index of an area can be determined in several ways. The simplest and most reliable is to measure the height of dominant trees on the site at age 50. This is seldom possible on a given area, since seldom will trees be exactly 50 years old. Site index can be, estimated by measuring dominants at a younger or older age and determining height at site index age from index curves for that species.

A common method for measuring site index is based on physical properties of the soil. Tables giving site index by this system are available for several important species. The information used is the depth of topsoil and plasticity rating of the subsoil. In deep sands, the depth

to a finer-textured horizon and fine particle content of that horizon are used instead of topsoil depth and subsoil plasticity.

Subsoil plasticity, a measure of suitability for root growth depends on the amount of clay present. It indicates water-holding capacity, water availability to roots, and aeration. As plasticity increases, root aeration decreases. Roots of most plants need better aeration for good growth than exists in plastic and very plastic soils. Consequently, in the Piedmont for example, with its shadow topsoils, an increase in plasticity of subsoil means a decrease in site when topsoil depth remains constant. (Figure 2)

Coastal Plain topsoils are coarser-textured and deeper. They have poor water-holding capacity. So we see that an increased plasticity of the subsoil is an advantage in this physiographic region because of different topsoil characteristics. (Figure 3 and 4)

In the mountains, factors such as slope, position on the slope, and aspect (facing direction of the slope) complicate site index determination. Tables to estimate growth and acceptance in the local markets. constructed for these areas.

Landowners should consult professional foresters to evaluate the site index of a property for a particular tree species. Site index information is also included in county soil surveys that are being made throughout the South.

Site index can be determined for virtually any commercial tree species with reasonable accuracy. If a particular species is not present, and direct investigations of soil properties do not apply, some species can be cross-referenced. For instance, by referring to the proper tables, a site index derived for white oak growing on a site can be converted to a site index for one or more of the tern pines with reasonable accuracy

Species Selection

Selecting the proper sues of southern pine to manage on a site requires several decisions:

1. Know your objectives. If timber production is to be the major objective, select a species that will economically produce timber products. If wildlife, recreation, aesthetics, or other uses is the objective, select species accordingly.

2. Know the capabilities of your site; its productive potential.

3. Select species with a proven track record in terms of site index by soil physical characteristics have not been

4. If two or more species could be selected and timber production is the major objective, select the species that will yield the greatest return on your investment.

5. Invest only in those species and on those acres capable of producing an acceptable economic return.

Table 2. Site Index Values for loblolly and Shortleaf fines in the piedmont Plateau as Influenced by Sol (Cole, 1952).

Sub-Soil class	Subsoil Consistence When Moist	Species	Depth to Subsoil (inches)						
			2	4	6	8	10	12	18
1	Very Friable	Loblolly	57	79	82	86	88	89	91
		Shortleaf	51	62	66	68	69	70	71
2	Friable	Loblolly	52	74	77	81	83	84	86
		Shortleaf	47	59	62	64	65	66	67
3	Semi-plastic	Loblolly	46	68	71	75	76	77	79
		Shortleaf	43	54	58	60	61	62	63
4	Plastic	Loblolly	38	60	63	68	69	70	72
		Shortleaf	38	49	53	55	56	57	58
5	Very plastic	Loblolly	32	54	57	61	62	64	66
		Shortleaf	33	44	48	50	51	52	53

Table 3. Site Index (50 years) of Loblolly Pine in the Coastal Plains of Veer, North Carolina, and Northeastern South Carolina as Influenced by Well and Imperfectly Drained Soil.

Subsoil Characteristics		Depth to Subsoil in Inches					
Consistence when moist	Texture	6	12	18	24	30	36
		Site Index					
Very Friable (noncoherent)	Sands	65	70	73	75	77	79
Friable	Loamy sands to light sandy hams	70	75	79	81	83	85
Friable	Sandy hams	73	79	82	85	87	89
Friable	Loams	75	81	85	88	90	92
Semiplastic	Sandy day bums to day hams	77	83	87	90	92	94
Plastic	Sandy Clays	78	85	89	92	94	96

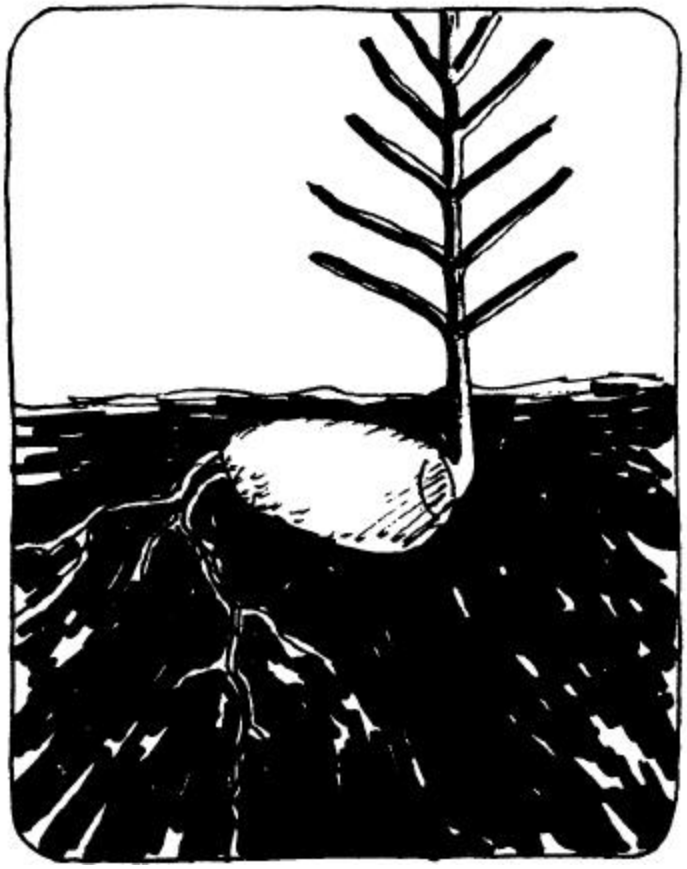
Table 4. Site Index (50 years) of Loblolly Pine in the Coastal Plats of Virginia, North Carolina, and Northeastern South Carolina as Influenced by the Characteristics of Poorly Drained Sol.

Subsoil Characteristics		Depth to Subsoil in Inches						
Consistence	Texture	6	12	18	24	30	36	42
		Site Index						
Friable	Sandy hams to sandy days	75	81	85	88	90	92	93
Semiplastic to plastic	Sandy days	81	88	92	95	97	99	101
Very plastic	Clays	85	92	96	99	102	104	106

REGENERATING SOUTHERN PINES

5

James W. Chandler
TX Agricultural Extension Service



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The needs for pine timber in the United States are expected to double in the next 40 years. The South is expected to supply over ha of the nation's pine timber at that time. To meet these needs, the pir forests of the future must be established in the 1980's. If this is to b accomplished, two factors loom important. Frst, over 70 percent of t total southern timberlands are owned by private, non-industrial owne and second, only one of every nine harvested acres is currently bein regenerated by this non-industrial ownership. Consequently, if futur needs for pine timber are to be satisfied, regeneration and management of their forests for pine production must be prime objectives of private, non-industrial owners of southern forestlands.

A first consideration must be how best to establish pine forests o non-stocked sites such as cutover and recently harvested stands ar old fields. There are two basic ways to restock such sites: by natura regeneration resulting from seedfall from adjacent trees or from see stored in the soil, and artificial regeneration by planting seedlings o direct seeding. Each method has advantages and disadvantages ar each requires some degree of site preparation to enhance the probability of stand establishment.

As with most enterprises, the amount of money to be invested in site preparation and regeneration varies with the potential of the enterprise (productive potential of the land), the capital available, an the returns expected from a given level of investment. The more time and money invested in site preparation and regeneration, the greate will be the expected returns. Some investment in site preparation is usually necessary to assure adequate regeneration and growth; however, adequate but lesser returns can be expected from lesser degrees of site preparation.

Natural Regeneration

Natural regeneration can be a viable, less expensive alternative t planting; however, site preparation is often necessary for adequate natural regeneration. Several factors must be considered in establishing a pine stand by natural means.

Seed Supply. Successful natural regeneration requires an adequa seed supply. This seed must come from trees present on the site, o from seed stored in the soil. The seed a tree or stand will supply ca usually be predicted in advance. Pine "flowers" appear in the early spring, are pollinated, and develop into small conelets. Conelets remain small until the spring of the second year when they begin to enlarge into green cones. During the fall these cones turn brown, ripe open, and release seed, the entire period taking 18 months. Observations prior to the harvest of an existing stand can thus assist timber grower in assuring that seed for natural regeneration will be present following harvest. Seed of southern pines remain viable on th ground for only one or two years.

Seeding characteristics of the southern pines vary with several factors including location and weather conditions. In general, loblolly and shortleaf pine are the most dependable seed producers. Trees of these spades with adequate growing space usually produce a good seed crop every two to three years. Slash pine norm* produces a good seed crop on three-year cycles although some cones are home nearly every year. Longleaf pine is not a prolific seed producer. On average sites, a satisfactory seed crop can be expected at three-year intervals after trees reach 30 years of age.

Site Preparation. When a good seed crop is evident, the site must be prepared prior to seed dispersal. The small, winged seeds must come into direct contact with the soil on the forest floor to adequately germinate and grow. A thick litter deposit of leaves, branches, grasses, and weeds serves as a barrier against such contact.

Prescribed burning is an excellent method to remove this barrier. Although many landowners feel uncomfortable with the use of fire in the management of their forests, fire can be a beneficial and economical management tool when handled properly by experienced persons. There are a limited number of days in a year when the temperature, humidity, wind velocity and direction are suitable for burning. Some general recommendations to follow for prescribed burning are:

1. Burn only under the supervision of a forester trained and experienced in prescribed burning.

2. Double-plow a wide firelane around the area to be burned.

3. Prepare areas to be burned by plowing interior firelanes 600 to 800 feet apart. Interior lines should be parallel to each other and perpendicular to expected wind direction.

4. Alert neighboring landowners well ahead of your burning schedule.

5. Notify your state forestry agency before the bum has begun. Follow agency regulations precisely.

6. Bum only after rains and when humidity is high (30% or more). Bum against the wind, when is speed is 5-10 miles per hour and when it is blowing from north, northwest, or west. Do not bum with easterly or southern winds. They are unpredictable and not consistent in direction or velocity.

7. Have fire-fighting equipment and five or six firefighters available for each 300 to 1,000 acres to be burned.

8. Make certain all fires are extinguished before leaving the area.

A prescribed bum should be made during the summer months. This fire will remove small vegetative material, including small hardwoods with a stem diameter of two inches a less. Evaluations must also be made of the logging slash remaining after harvesting, since heavy logging slash can lead to a fire hot enough to destroy seed trees.

Once the seed has germinated and small seedlings begin to develop, they must have direct sunlight. A prescribed bum before seedfall will remove most vegetative competition, leaving large diameter hardwoods. This hardwood competition must be removed if the seedlings are to survive and develop properly. If possible, they should be sold as sawtimber, veneer, pulpwood, or firewood. If markets are not available, the hardwoods can be removed from the stand by chemical or mechanical means. They can be felled and left in place or girdled. To kid large standing trees, the cambium (inner bark) must be disrupted completely around the circumference of the trunk.

The larger hardwoods can also be killed chemically with an herbicide. The herbicide may be placed in the girdle, injected into the tree, put into the soil where it will be picked up by the tree roots, or sprayed onto the foliage from the ground or an airplane. Competition from large hardwoods often is removed prior to, rather than after, seedfall.

Natural Regeneration Following Harvest. There are four basic methods of harvesting southern pine to obtain natural regeneration: seed-tree cutting, shelterwood cutting, selection cutting, and clearcutting. These cutting methods assist nature with restocking, with some help from man.

Seed-tree cutting results in an even-aged stand. Six to eight trees are left per acre as a seed source following harvest. These seed trees should be mature, healthy, non-deformed and at least 14 inches in diameter at breast height (DBH). Leaving the best trees in the stand as seed producers offers some genetic improvement by upgrading seedling quality.

The seed tree method of regeneration offers several advantages:

1. Low establishment costs. Site preparation and planting can cost several times more than natural regeneration. However, the economic value of the seed trees that are not harvested must be considered. Seed trees are sometimes lost to lightning, insects, disease, or wind, their volume being too low to justify harvesting after stand establishment.

2. A local seed source is assured with natural regeneration. Sometimes seedlings obtained from a nursery for planting are from a different geographic region. Extensive studies have shown that growth and disease problems can occur when seedlings from a given source are moved into a different region.

3. Natural regeneration is less disturbing to soil and aesthetics. Soil disturbance, an unavoidable result in preparing some planting sites, can initiate soil erosion. Minor soil disturbance can be beneficial in exposing the soil for seed germination and seedling establishment. Also, when the site is cleared of all trees the area is not attractive to sane people. When the seed-tree method is used, several dominant trees remain in the landscape and soil disturbance is limned to that created during logging.

Disadvantages to natural regeneration is that genetically-improved growing stock cannot be used, and there is little control over seedling density. Some areas may have an over-abundance of seedlings, requiring precommercial thinning (cutting small trees with no economic value); while in other areas, insufficient numbers of seedlings are established.

Sheherwood cutting, like the seed-tree method, results in an even-aged stand. With this harvesting method, additional trees (20 to 40 trees per acre) are left in the initial cut to provide site protection and increase the quantity of seed available for regeneration. The additional number of trees per acre helps insure reproduction and aids in suppressing competing hardwood brush. In addition, residual volume is sufficient for a second logging operation following seedling establishment.

A two-cut shetterwood is recommended for loblolly pine. The first cut opens the site for regeneration, leaving an adequate number of good seed trees. The second cutting removes the remainder of the good trees plus any smaller and less valuable material left in the first cut. Thus, the first cut provides sufficient material for a profitable cut, and the second cut consists mainly of high-value material. Seed trees are harvested in the send cut approximately five years after a stand of seedlings is established. If reproduction is too dense, precommercial thinning can be accomplished by skidding logs through dense patches of seedlings.

Selection cutting results in uneven-aged stands (with seedlings, saplings, pulpwood, and sawtimber all present). With this regeneration method, growing space is constantly utilized. Periodic harvesting at 5 to 10-year intervals from all merchantable diameter classes provides frequent income. When regeneration is not needed, single-tree selection is adequate. If regeneration is required, larger areas are created by cutting groups of trees.

Advantages of selection cutting are: (1) the site is completely utilized; (2) a stand of fast-growing, equality trees is favored; (3) the stand is not as vulnerable to complete destruction by fire, biotic, or climatic agents; (4) because of the diversity of the stand, more varieties of wildlife will reside in the area; and (5) aesthetics will be improved.

Disadvantages to the selection method include: (1) there is high risk of logging damage to residual trees; (2) more skill and supervision is required for the complex management operation; (3) timber stand improvement (Prescribed burning, chemical injection, etc.) is more difficult to apply; and (4) harvesting is more costly since smaller volumes are removed at each harvest.

Clearcutting, in patches or strips, is the fourth natural regeneration method. The harvest area is laid out perpendicular to prevailing winds so that seed from adjacent stands is blown into the harvested area. The clearcut width should not exceed 400 feet to ensure adequate seeding over the entire area. Undergrowth in the clearcut area must be sparse if there is to be a good seedling catch.

The stand should be harvested between November and March (after the seeds have fallen, but before they germinate). If logging cannot be completed in that time period, it should be delayed until August when new seedlings are firmly rooted.

Advantages of this method are: (1) areas to be cut are easily marked and treated; (2) all harvest work on the site is done at one time; and (3) technical skill and supervision are minimal.

Disadvantages are: (1) large numbers of tree tops may remain on the site, leading to fairly intensive site preparation and sizeable capital investment; (2) the site is unprotected for a period of time; and (3) a relatively long period of time (12 to 15 years) is needed before additional income is generated from the site.

Artificial Regeneration

Artificial regeneration methods used in southern pine forests are planting or direct seeding of areas that have been clearcut.

Planting after Clearcutting The most common artificial regeneration method is clearcutting and planting. When using this method, clearcutting must be clearly defined. Frequently, the definition of clearcutting means simply the removal of merchantable sawtimber and pulpwood leading to costly site preparation. When large tops and low-grade hardwood material remain on the site, materials which might have been salvaged for fuelwood or other uses must be removed, increasing site preparation costs.

When preparing a site for planting, all vegetation that will compete with the planted seedlings for sunlight and soil moisture must be eliminated. All overstory vegetation should be removed, but the litter layer of the forest floor should be left intact. If it is not so thick as to seriously impede the planting of seedlings, an undisturbed litter layer is the best condition for planting. The fitter protects against erosion, conserves soil moisture, and provides nutrients to the seedlings from decomposition of organic matter.

The three basic types of site preparation are: mechanical, chemical and fire. When the amount of debris remaining after a clearcut harvest is large, mechanical site preparation is the predominant site preparation method. Several types of mechanical treatments are used individually or in combination.

Drum chopping is one of the most effective means of reducing woody competition with minimum soil disturbance. A rolling chopper is applicable to a wider variety of sites than most other pieces of site preparation equipment because of its size, weight, and cost effectiveness. The chopper is a rolling drum with cutting blades attached, pulled by a tractor. When used in tandem, choppers are offset for better tearing action. Tandem drums are, however, limited to relatively level sites.

Chopping is normally followed by burning. A hot fire removes debris, facilitates machine planting, and reduces the amount of hardwood sprouting. Drum chopping results in less site disturbance than other heavy site preparation equipment.

Shearing and KG blading provides a means of removing large diameter trees. A KG blade is an angled, V-shaped, sharpened blade mounted on the front of a medium to large tractor. A "stinger" at the point of the blade allows splitting of larger stems. Tree trunks are sheared at or near ground level and pushed into windrows. With reasonable care, scalping of the soil surface can be avoided. Precautions should be made so that topsoil is not plied into windrows. h may be feasible to bum windrows prior to planting to increase the available planting acreage. Windrows should follow the contour of the land, especially on slopes greater than 10 percent. Openings at least 20 feet wide should be made every 150 feet of windrow to facilitate the movement of equipment and tow access for fire suppression.

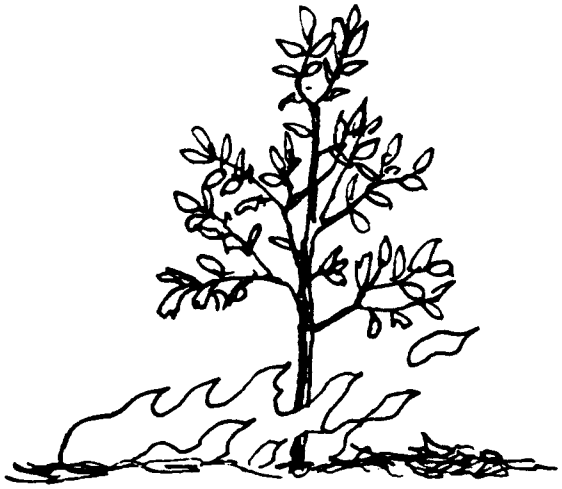
Root raking and piling involves the use of a large, toothed blade mounted on a bulldozer. This toothed blade rips roots and stumps from the ground. This method of site preparation causes extensive disturbance to the site. Debris is piled into windrows on the contour. Piling with a straight blade increases the accumulations of topsoil in the windrow and should be avoided. Root rakes should be restricted to non-erosive soils on sites with minimum slopes.

Disking is a method especially useful in improving soil aeration, often needed on compacted soils. The disk must break the soil to a minimum of six to eight inches in depth and should be accomplished at least three months prior to planting to allow time for the soil to settle. Disking should not be attempted on steep slopes or erosive soils.

Bedding is a method used to improve soil aeration and drainage. The objective of bedding is to raise seedling root systems above an existing high water table. Beds are established by special disk harrows which throw tilled soil to the cent,-- -. covering organic matter present. Beds must be oriented to channel excess water from the site. Beds should be built immediately prior to the planting season to avoid bed deterioration, particularly on wet sites. Bedding also has value for upland sites when the topsoil or organic matter is thick. Bedding concentrates nutrients, making them more available to the developing seedlings.

Other factors to consider during clearcutting and site preparation are: (1) leave an undisturbed strip at least 66 feet wide between the prepared site and any streams or water bodies, and (2) on heavy soils, site-prepare only during dry periods.

Herbicides may be used for site preparation to remove unwanted vegetation prig to planting. It is preferable, however, to sell as much unwanted material as possible for posts, pulpwood, or firewood. Material that can be solo returns a cash income and reduces site preparation costs. The decision to use chemical site preparation is based on such factors as size, amount and quality of material on the site, soils and topography, and relative cost as compared to other site preparation alternatives.

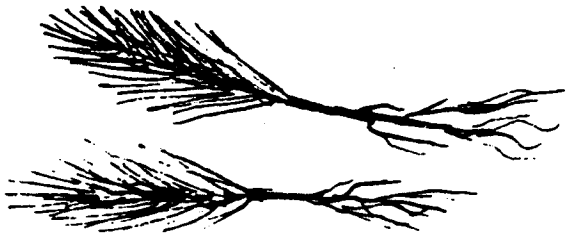


Fire is used as a site preparation technique both by itself and in conjunction with mechanical or chemical site preparation. Fire will kill most small hardwood stems and brush. On some areas where grass, herbaceous vegetation, and scattered stems dominate the site, fire alone may provide a sufficient degree of site preparation. In conjunction with mechanical or chemical site preparation, controlled homing serves to reduce the mass of material on the ground and improve planting conditions. h usually reduces sprouting of hardwood stumps and roots. Occasionally, fire cannot be used because of the absence of sufficient fuel to "carry" the fire. This may be particularly true where the site has been logged by harvesting complete trees, and tops are not left in place. Fire should never be used except under safe weather and fuel moisture conditions and then only by those trained in its use.

A mater decision concerning selection of the proper pine species must be made before site preparation takes place. Location of the planting site, soil type, and timber products to be produced are all factors that influence the selection. Figures 1 and 2 contain information on species selection as influenced by geographic region and soil drainage class.

Seed source (the geographic location of the parent tree) is an important consideration. Seed collected from within a 100-mile radius of the planting site should prove satisfactory. Improper seed origin can result in poor survival, slow growth, and disease problems. Gains in survival, volume growth, or disease resistance can often be made by using seed originating from a specific area. Guidelines given in Figures 3 suggest areas from which seed collections can be made if local seed is not available.

Planting season is from mid-December to mid-March under normal conditions. Never plant when the ground is frozen. Proper care of seedlings from the time they are lifted and bundled at the nursery until the time they are planted is extremely important. Do not allow the root system of a seedling to dry out or freeze. If a delay in planting is anticipated, cold storage of seedlings is recommended. Dormant seedlings can be held at temperatures ranging from 32 F to 40 F for up to 10 weeks. If cold storage is not possible, seedlings can be placed on racks under shelter from the wind and weather. Their root systems should be watered at least twice a week. Seedlings should be kept no longer than two weeks out of cold storage. If proper storage facilities are not available, seedlings can be "heeled-in" (Figure 41. Seedlings that are heeled-in should be planted within four weeks.



Care must be taken to avoid damage to seedlings during planting. Never tear bundles of seedlings apart because of the likelihood of root damage. Cull all poor-quality seedlings. Seedlings should be kept in water or stored in moss and wet soil at the planting site.

Root pruning can be done in the field if the need exists. Prune for balance between the green stem and the root system. Never prune the tap root any shorter than eight inches from the root collar.

There are two ways to plant pine seedlings: by hand, and by machine.

Hand planting with a planting bar or "dibble" is suited for small acreages. Use the dibble to make a hole in which the seedling is inserted. Place all roots in the hole, ensuring that none are turned upward in the bottom of the hole ("J-rooted"). Figure 5 depicts the correct procedure and root configuration in the ground. Plant seedlings slightly deeper (about 1 inch) than they grew in the nurserybed.

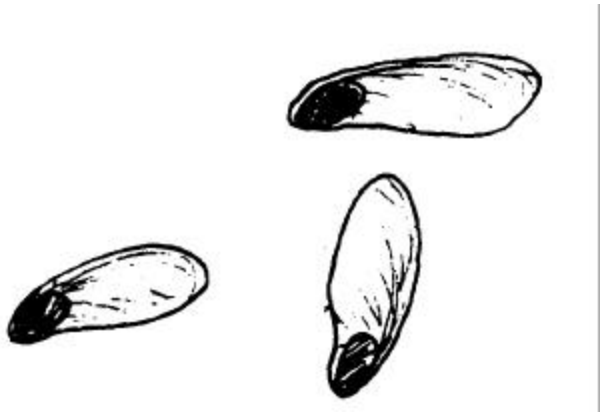
Hand planting is slower than machine planting. The number of trees planted per crew per day depends on the hardness of the soil, experience of the planting crew, quality of site preparation, and size of the planting crew. An experienced man can plant 800 to 1,000 seedlings per day.

Machine planting is much faster than hand planting. A planting machine is pulled behind a tractor and makes a narrow slit or furrow with a modified subsoiler point. A man riding on the planter places one seedling at a time in the slit which is then closed tightly around the seedling by two rollers or packing wheels to lock the seedling in place. In good weather, a two-man crew (planter and tractor operator) can plant 5,000 to 10,000 trees per day.

If 400 to 500 seedlings per acre are alive and well spaced at the end of the first growing season, the stocking is adequate.

Clearcutting and planting requires capital inputs for site preparation and regeneration. Income is not realized for 12 to 15 years before even a pulpwood thinning takes place. There are definite advantages, however, to this method of regeneration. The landowner can restock the site with genetically-improved seedlings that increase volume yields approximately 10 percent. Uniform spacing of trees can be assured. These factors provide a shorter rotation period than natural regeneration and lead to maximum returns on the investment.

Direct Seeding After Clearcutting The alternate method of artificial regeneration is direct seeding. On sites where ate, terrain, or drainage conditions make planting difficult, direct seeding is less costly than planting. The most attractive feature of this method is its speed; hundreds of acres of cutover areas can be sown in a single day. Consequently, direct seeding has lower initial costs (one-third to one-half) than planting. While not as effective as planting, direct seeding does provide some opportunities for both stocking control and genetic improvement.



Disadvantages to direct seeding are: (1) unfavorable weather and soil conditions following seeding can result in a complete failure; (2) longer rotations are needed; (3) lower yields are achieved than with planted seedlings; (4) density is not controlled, as with the natural regeneration methods; (5) precommercial thinning may be required; and (6) seed movement on steep slopes can result in loss of seed or uneven distribution.

Prior to direct seeding, selection of the pine species should be directly related to the chosen site. Soil plays an important part in the relationship. Loblolly and shortleaf pine are best adapted to Upper Coastal Plain well-drained sites. Slash pine is best adapted to lowland, flatwood sites with fair to poor drainage. Longleaf pine should be seeded only on areas where it formerly grew.

Site preparation plays two vital roles in direct seeding: it(1) exposes the mineral soil necessary for seeds to germinate, and (2) controls competing vegetation that interferes with initial survival and early growth. Prescribed burning is the most cost-effective site preparation method for direct seeding. Often times, burning is done in conjunction with chopping, shearing, or bulldozing. In addition to these operations, disking and furrowing are sometimes used to prepare the seedbed.

Upon receipt of seed (the same seed source guidelines apply as did for planting), seed must be stored in a cool, dry place and preferably in a sealed bag. Storage should be at temperatures ranging from 34 F to 36 F

Sow loblolly, shortleaf, and slash pine in late winter or early spring. Longleaf pine should be sown in the fall or early spring.

Rapid germination is important when seed is sown in the spring to reduce its exposure to predators and adverse weather conditions. If seed is in a dormant condition, cold stratification is required. Cold stratification serves as a substitute for the time that seed in a natural state lies on the forest floor during the winter. After stratification, seed is treated with a mixture of pesticides to protect it from birds, seed-eating mammals, and insects.

Seed application rates vary by species and the quality of the site. Loblolly and slash pine have rates ranging from 1/2 to 3/4 pound per acre. The rate for longleaf pine is 2 1/4 pounds per acre. The rate for shortleaf pine is1/4 pound per acre.

Two basic types of direct seeding are used; aerial equipment (small, fixedwing aircraft or helicopters) and ground broadcast methods (hand-operated cyclone seeders or rowseeding machines). Aerial seeding is best on larger acreages and areas that have limited access from the ground. Ground application is made on smaller acreages and conditions where soil cover limit the use of aerial methods.

Regardless of the cutting method or regeneration technique used, the landowner is encouraged to reforest harvested stands and return acreages to full production. Economically, future demand coupled with increased stumpage prices make forest management investments very attractive when compared to most other long-range investment opportunities.

Figure 1. Physiographic regions of the South.

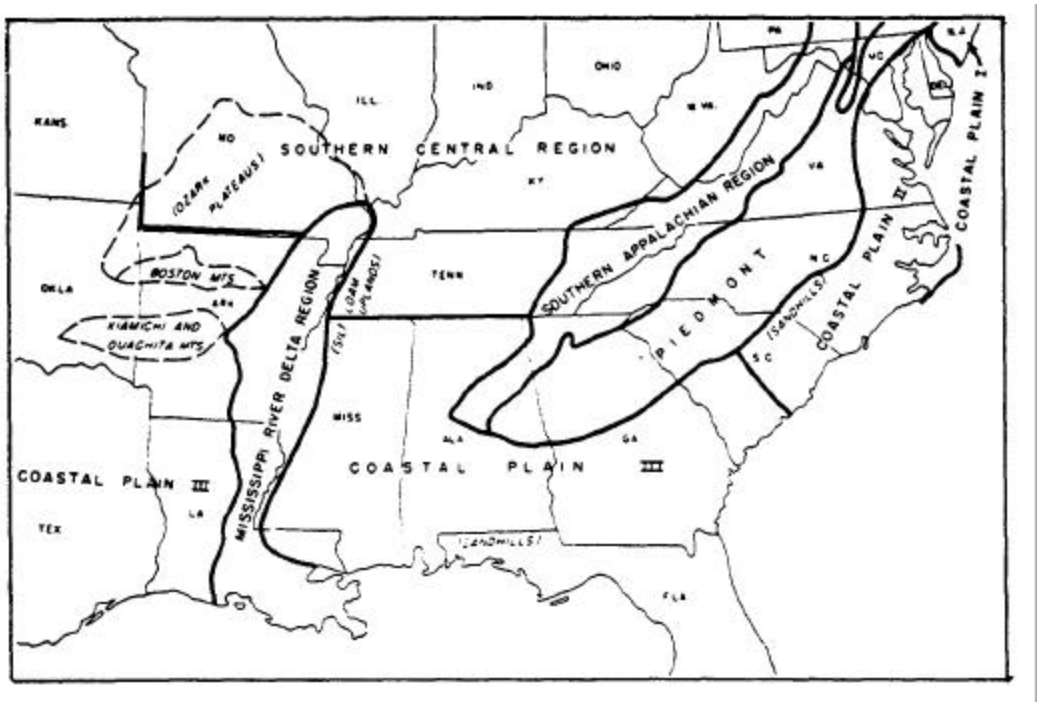


Figure 2. Species-site guide for planting the southern pine.

Physiographic Region	Poorly Drained Sites	Moderately Drained Sites	Dry Sites
Coastal Plain			
Northern	Loblolly	Loblolly	Virginia or Loblolly, Longleaf on sandhill sites only
Southern	Slash	Slash or Loblolly	Longleaf, Choctawhatchee Sand Pine in FL, GA, and S. Carolina
Upper	Loblolly	Loblolly	Shortleaf or Virginia
Piedmont			
Upper	Loblolly	Loblolly	Virginia or shortleaf
Lower	Loblolly	Loblolly	Virginia or shorteaf
Blue Ridge		White	Virginia or shortleaf
Valley and Ridge		White	Virginia or shortleaf
Appalachian		White	Virginia or shortleaf
Interior Low Plateaus	Loblolly	Loblolly, Virginia and shortleaf white pine except in AL	Virginia pine or shortleaf
Ozarks		Loblolly (AR or OK)	Shortleaf
Ouachias	Loblolly		Shortleaf

Figure 3. Geographic seed source recommendations for various regions of the South

Species	For Planting	Use Seed From
Loblolly	Louisiana west of the Mississippi; southern Arkansas; eastern Texas; and southeastern Oklahoma	Southeastern Texas
	Southeastern Louisiana; southern two-thirds of Alabama and Georgia; and northwestern Florida	Livingston Parish, Louisiana; and Southeastern Mississippi
	Southern two-thirds of Mississippi	Southwestern Mississippi
	Western Tennessee	Northern Mississippi, northern Alabama and northern Georgia
	Central and eastern Tennessee; Kentucky	Maryland and Virginia
	Ozarks	Central Arkansas, northern Mississippi, and northern Alabama
	North and South Carolina Coastal Plain	Coastal Plan of either state
	North and South Carolina Piedmont	Piedmont of either state
	Virginia; Maryland; and Delaware	Local sources preferred
	Northern Mississippi; northern Alabama; and northern Georgia	Northern Mississippi; northern Alabama; and northern Georgia
Longleaf	Southern Mississippi; Alabama; western Florida; and 150 miss north and 250 to 300 miles east and west of Mobile, Alabama	Southern Mississippi; southern Alabama; and western Florida
	All other than above	Local sources only
Sand	Sued his of northern Florida, Georgia, and South Carolina	Choctawhatchee variety
Shortleaf	Mississippi; central and southern sections Of Alabama and Georgia; and southern South Carolina	Southern Mississippi, southern Alabama, southern Georgia and northern Florida
	Northern Arkansas; northern Alabama; northern Georgia; northwestern South Carolina; central and western Tennessee; and ventral and northeastern North Carolina	Northern and central Mississippi, southern Arkansas, central Georgia, southern South Carolina, central Alabama, and southeastern North Carolina
	Missouri; eastern Kentucky; eastern Tennessee; eastern West Virginia; Virginia; and farther north	Local sources only
	Eastern Texas; western and northern Louisiana; southern Arkansas; and eastern Oklahoma	Eastern Texas, western and northern Louisiana, southern Arkansas, and eastern Oklahoma
Slash	North and West of the natural range	Natural stands in Mississippi, Louisiana, Alabama, South Carolina, and southeastern Georgia
	Anywhere within a near natural range	Natural stands anywhere north or west of Lake City Florida or plantations of similar provenance
Virginia Pine	Widen natural range	Local source preferred
White Pine (Eastern)	Appalachian areas of Georgia, Kentucky North Carolina, Tennessee and Virginia	Local or southern source

Figure 5. Method of planting pine seedlings with a dibble.

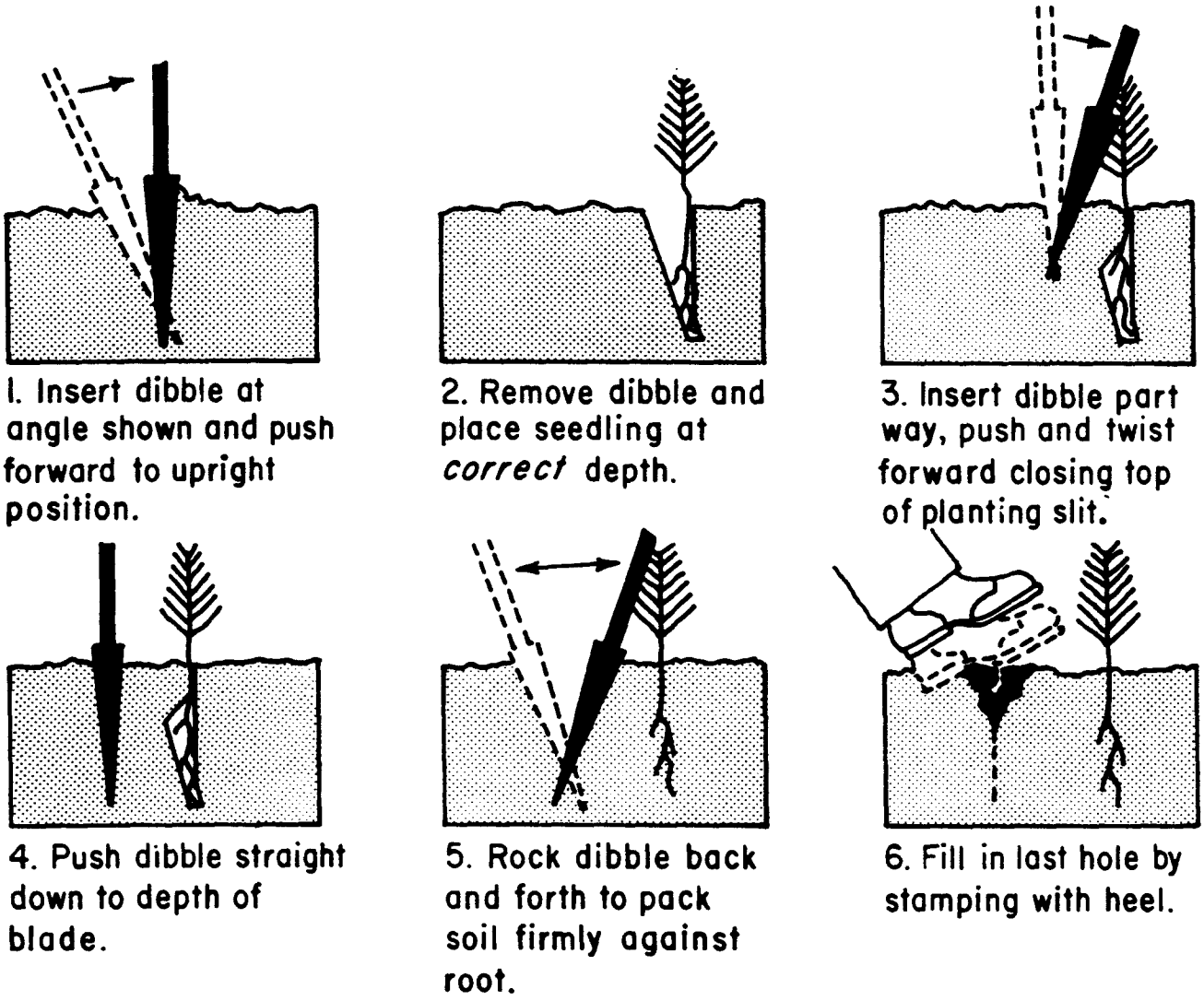
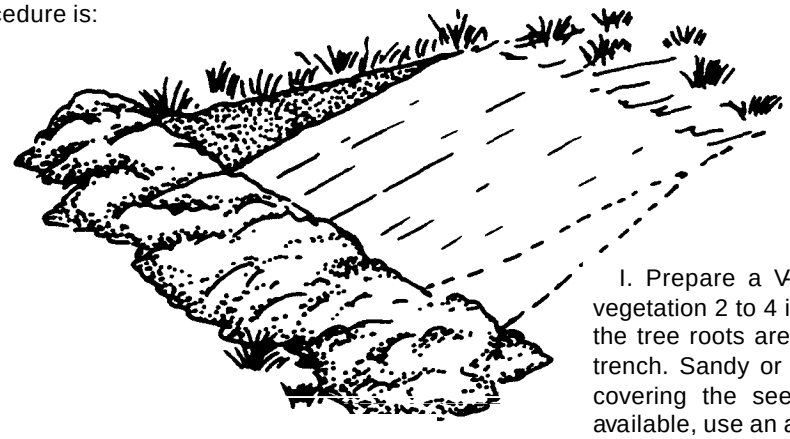


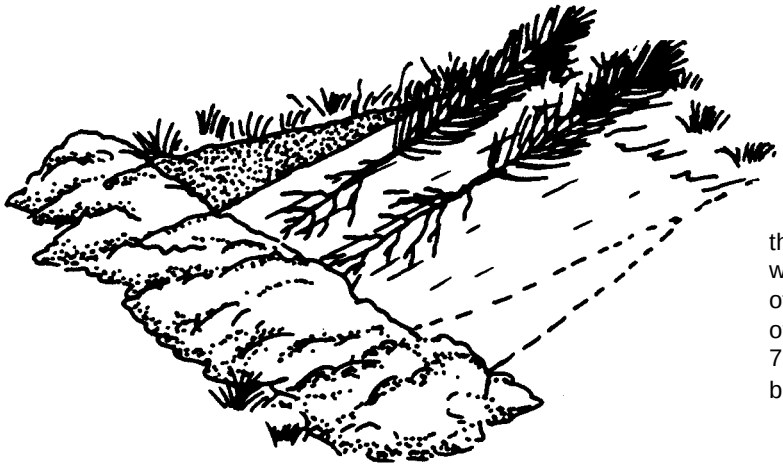
Figure 4. Process of heeling-in seedlings prior to planting.

"Heeling In"

If seedlings must be kept for an additional period of time before planting, "heeling in" is an accreted practice. The procedure is:



I. Prepare a V-shaped ditch in soil dared of vegetation 2 to 4 inches (3 to 10 an) deeper than the tree roots are long. Smooth one side of the trench. Sandy or loamy soil is best for ease of covering the seedlings and watering them. If available, use an area with some shelter from the sun and wind and near a source of water.



2. Remove the seedling from their package. Lay the seedlings on the smooth side of the trench with roots straight and 1 to 1 inches (2.5 to 3 cm) of the top below the surface of the soil. The layer of sags should be no more than 2 to 3 inches (5 to 7.6 era) thick. It tray be necessary to break large bundles.

3. Refill the trench with loose soil, pack firmly, and water. Be sure all of the roots are covered.

4. Water as needed to keep the soil moist. Remember, whatever the method of storage, it is best to plant the seedlings as soon as weather and soil conditions permit. Plant seedlings stored the longest first. Do not expose seedling roots to air

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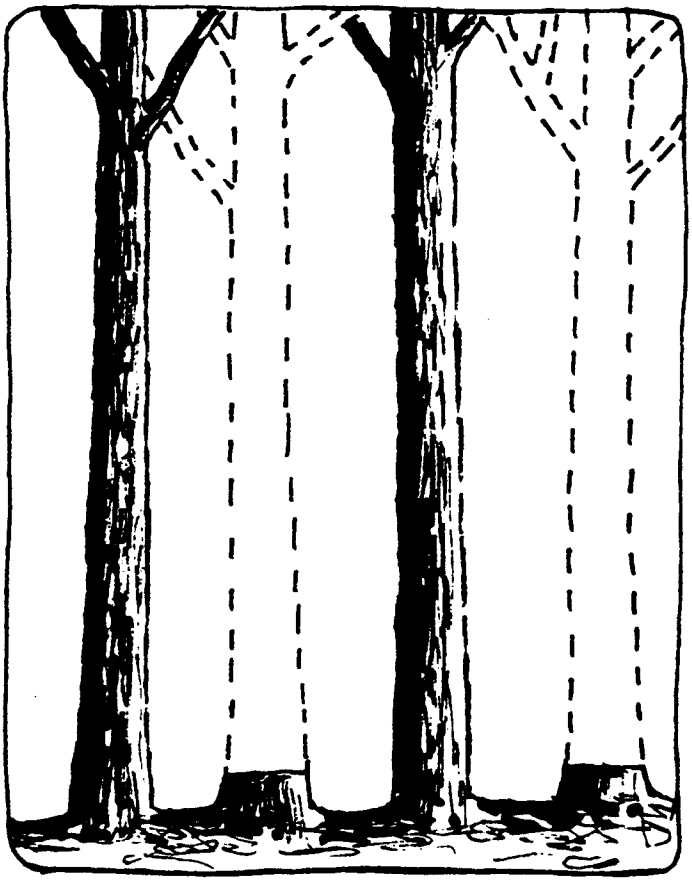
INTERMEDIATE 6 STAND MANAGEMENT

William Gardner
NC Agricultural Extension Service



THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

1. The Southern Pine Forest
2. Forestry as an Investment
3. The Major Southern Pines
4. Importance of Soil to Tree Growth
5. Regenerating Southern Pines
6. Intermediate Stand Management
7. Pine Insects, Diseases & Wildfire
8. Timber and Wildlife
9. Harvesting Southern Pines
10. Marketing Southern Pines
11. Forestry Terms (Glossary)
12. Forestry Assistance Available

Cultural treatments applied in established pine stands are called intermediate stand management practices. These are often desirable or necessary to improve survival and growth rate of crop trees. No standard schedule can be suggested for intermediate cultural activities. Their application is affected by such factors as stocking, growth rate, site quality, competition, and products to be harvested from the stand. Such activities as release, precommercial and commercial thinning, prescribed burning, pruning, timber stand improvement, and supplemental fertilization are among the intermediate stand management options which may be applied to protect woodlands and improve economic returns.

Some management practices such as thinning can generate immediate income. Other activities initially involve costs, and they are only undertaken when they are expected to increase the forest's value by an amount greater than the treatment cost. While the economic returns generated by stand management depend on local markets, site, weather, stand conditions, and costs, the biological objectives are to increase the amount of value of merchantable material beyond what would otherwise be produced. As a rule, those practices applied to older vigorous stands (nearer to harvest age) and those used in stands most needing attention result in the greatest economic return to the landowner.

Releasing Pine Regeneration

Release of southern pine involves removing hardwood trees, brush, and other heavy vegetation that shades or otherwise interferes with the growth and survival of the pine seedlings. The need for release usually is evident within five years after stand establishment. Once pine seedlings are taller than the competing hardwoods, shading (overtopping) is no longer a danger and release is not necessary.

The purpose of releasing pine is to assure a stand of 450-600 individual trees per acre that are "free to grow". To determine the need for such a release and the likely response of the pine stand, estimate the basal area per acre of both pine and hardwood. Release will probably be helpful if the amount of pine is noticeably less in number and basal area than the amount of competing hardwoods. If, however, pines already comprise two-thirds or more of the stand, response to release is unlikely since many of the individuals already should be free to grow. Where hardwood competition has commercial potential on the site, the value of release is reduced.

It is possible to release young trees by removing competition from around individual seedlings and young trees with an ax or other hand tool. This is costly but may be used by a landowner who devotes personal time to the release effort. Sprout regrowth can require follow-up treatments. Most pine release is accomplished

using herbicides. Overtopping hardwoods are killed outright or their vigor is reduced to allow the pines to dominate the site. Herbicides may be applied by injection or spot gun treatment of individual sterns, mist blowing, aerial application, or broadcast pellet application.

Injection or other individual stem treatment is more expensive for small and numerous stems. Chemicals which are lethal to pines can be used for release if applied as directed spray, avoiding the crop trees. Mist blowing, aerial spraying, and broadcasting of palletized herbicides are the techniques most frequently used. Pines should generally be 4 years old before spraying, but if competition is severe, earlier treatment may be necessary. The chemical selected must be labeled for forestry use. Sensitivity of most spades to the herbicide should be indicated on the label. Both timing and rate of application may result in damage to crop trees or ineffective weed control. A list of chemicals which are currently being used for pine release is included in Table 1.

Table 1. Chemicals Used for Pine Release in the South

Common Name	Often Recommended Amount per Acre	Remarks
2,4-DP Dichlorprop (Weedone)	1-2 Quarts	Apply after first growth flush (loblolly), when brash is in full leaf and growing vigorously.
Glyphosate (Roundup)	1.5-2 Quarts	Apply in early fall after rapid growth of loblolly has ceased, before frost and leaf fall.
Hexazinone (Velpar L 25%)	4-8 Pints per acre	Do not use on trees with poor vigor. Apply before bud break in spring or direct spray avoiding new foliage. Allow 2 months after transplanting.
Trichlopyr Garton)	1.5-3.0 Pounds active	Apply when plants actively growing.

This list may not be complete, nor does the inclusion of an herbicide constitute a use recommendation or imply labeling for forestry usage. Some herbicides are labeled only for minor uses or are labeled only in certain states under state local needs (FIFRA Sec. 24C1. Contact local Extension Foresters, research foresters, or state forest service personnel for specific recommendations in the state or area where the herbicide is to be used. This listing should be considered a guide for preliminary planning. Consult labels to be certain an herbicide is appropriate for the intended use, and for instructions on application.

Precommercial Thinning

Pine stands established by natural regeneration or direct seeding alien have too many seedlings per acre (up to 20,000). Overcrowding causes extremely slow growth or stagnation of the developing stand. Stagnation is more likely to occur on poor, dry sites where trees are slow to express dominance and where natural thinning occurs later. Precommercial thinning of pines can result in healthier stands with faster growth and greater economic value.

Precommercial thinning may be done with hand tools or by such machines as rolling drum choppers a rotary cutters. Stands should be thinned as soon as overstocked conditions are identified, but after the risk of competitive regrowth by hardwoods is past (normally 5 to 10 years). When thinned manually, no fewer than 450-600 of the best developed trees per acre should be left. Mechanical precommercial thinning generally involves chopping 7- to 8-foot wide parallel swaths through the stand, leaving 1 to 3 foot strips of trees between swaths. Trees in the strips may be left undisturbed or manually thinned. A checkerboard pattern can be created by chopping swaths in two directions, leaving small groups of trees at 7 to 8 foot spacing. The currently preferred method of precommercial thinning is a combination of mechanical thinning followed by manually thinning to about 450-600 trees per acre.

The use of prescribed fire, chemicals, or fertilizers to reduce stocking levels has not generally been successful and is not recommended.

Commercial Thinning

The number of trees per acre, also called stand density or stocking, is second only to site quality in its effect on yield. Too many trees, like too many tom plants per acre, leads to reduced quantity and quality at harvest.

Stocking control is generally accomplished by intermediate harvests called thinnings. In thinnings, some of the merchantable trees are harvested for present use or sale, improving the growth rate and quality of the remaining stand. It is important that each acre support an

adequate number of well spied, high quality vigorous crop trees following thinning. In this way, the value gains from intermediate cutting are potentially three-fold: concentrate growth on fewer faster growing trees (each additional inch of average diameter adds 3 to 4 percent to the board-foot yield at final harvest); utilize trees that would die before final harvest; and grow only the highest quality trees to final harvest (eliminating volume growth on low value stems).

The way trees live and grow affects the timing and intensity of thinning. Trees compete for water, nutrients, and fight. Southern pines need full sunlight. When overtopped and shaded, the branches thin out and die, leaving a smaller live crown. A tree must retain approximately its top third in live crown for good diameter growth

The most successful competitors (fastest growing trees) remain dominant in a stand. Others slow down in growth and eventually die. A young natural stand having thousands of stems per acre, or a plantation with 600-1000 seedlings per acre, will each have fewer than 400 trees remaining by age 40, even without thinning. This reduction in number of trees represents a "natural thinning" process. However, "natural thinning" only occurs when stands are so dense that the growth rate of most crop trees is also reduced.

In marking a stand for thinning, each acre should be managed to produce as much wood as possible on the highest value crop trees. Remove the smaller, crooked, diseased, damaged, limby, forked and other low quality stems. Keep in mind that large trees do not usually benefit from removal of smaller neighbors. Also, smaller trees can only benefit if they have sufficiently large gowns. Most sites can produce nearly the same total volume growth on fewer good stems as they could on

Since the number of trees per acre decreases as average size increases, foresters generally use "basal area" to evaluate stocking or stand density. The basal area or cross sectional area of a stem increases with diameter. Diameter may be estimated by placing a measuring tape around the trunk 4.5 feet above the ground, and dividing the resulting number (the circumference) by 3.14. Tree diameter can also be read directly from a "diameter tape" (calibrated to read diameter directly from the measured circumference), from a tree caliper, or from a tree scaling stick. The diameter, basal area, and the number of stems of each diameter which would result in basal area totals of 80, 90 and 100 square feet per acre are shown in Table 2. This range of 80-100 square feet per acre is considered the best stand density for managed pine stands under most conditions. Unmanaged stands may have twice this much basal area, severely reducing tree diameter growth.

Table 2. Bash Arms of Trees of Various Diameters and Number of Trees Per Acre for Given Basal Areas.

Diameter Breast Height (DBH)	Basal Area Per Tree (Square Feet)	Number of Trees to Have The following Basal Area per Acre		
		80 sq.ft.	90 sq.ft.	100sq.ft.
4	.087	920	1034	1149
5	.136	588	662	735
6	.196	408	459	510
7	267	300	337	375
8	.349	229	258	287
9	.442	181	204	226
10	.545	147	165	183
11	.660	121	136	152
12	.785	102	115	127
13	.992	87	98	108
14	1.069	75	84	94
15	1.227	65	73	81
16	1.396	57	64	72

The intensity of thinning determines the number of trees to remove and the number to leave. The number of tees per acre to be retained and the approximate distance between trees depends on their diameter. Most thinning recommendations call for approximately 80 square feet per acre of basal area in crop trees to be left following thinning.

Rules of thumb are sometimes helpful in marking a stand for thinning. One such rule, the " 1.75 x D" Rule calls for an approximate spacing among trees to be left (in feet) of "1.75 times the diameter (in inches)". For example, two 12-inch trees to be left should be separated by 21 feet (12 x 1.75 = 211. (See Table 3). Application of this spacing rule of thumb results in many smaller ones approximately 80 square feet of residual basal area regardless of tree size.

Table 3. Pine Thinning Guide Applying the “1.75 x D” Rule

Diameter (DBH) (inches)	Spacing Between Trees to be Left (feet)	Leave Trees Per Acre	Basal Area (square feet)
6	11	400	80
7	12	300	80
8	14	225	80
9	16	175	80
10	17	150	80
12	21	100	80
14	25	70	80

Rules of thumb ignore stand age, site quality, and environmental conditions. Better results may be obtained using a table for the species being managed, such as Table 4 for loblolly pine. Such tables generally call for

more basal area to be left in stands on good sites than on low quality sites, and for more basal area in old stands than in young ones. The basal area to be left is usually somewhat lower in longleaf stands, and higher in shortleaf or slash (particularly young stands).

Table 4. Loblolly Pine Thug Guide Applying 57 Percent Normal Stocking.

Leave Basal Area (square feet) for Site Index (Age 50)

Age	60	70	80	90	100	110
15				58	63	
20	61		67	72	76	81
25	66	73	78	82	85	89
30	74	80	83	87	90	95
35	79	84	87	89	93	98
40	83	86	89	92	96	100
45	85	88	91	94	97	102
50	87	89	92	95	99	104

Foresters frequently alter the recommendation of standard thinning guides, based on experience with local conditions. Thus, in areas of frequent blown down trees, they often leave more basal area to compensate for tree loss. In areas subject to ice and snow damage "lighter" thinnings would also be made to leave additional trees per acre.

Timing and repetition of thinnings:

Longleaf: Thinnings may be necessary as often as every 10 years to reduce the basal area from about 120 to 80 square feet per acre. Precommercial thinning is usually not necessary, but where dense young stands do occur, they should be thinned early to about 500 well-distributed seedlings per acre.

Slash: On flatwood sites, slash pine may need thinning when 15 to 25 feet tall to about 600 trees per acre to prevent stagnation. Sapling- and pole-sized stands may respond to thinnings as often as every four years, beginning as early as age 12, whereas a 10-year thinning interval probably is adequate for sawtimber.

Loblolly: On most suitable pine sites loblolly is the fastest growing of the southern pines. Intensive management calls for thinning as frequently as every five years starting at age 12 on the best sites, starting later with a longer interval on poorer sites. Such a schedule can produce sawtimber in less than forty years on good sites.

Shortleaf: This species is slower growing than loblolly on most sites. In loblolly-shortleaf stands, the shortleaf is frequently removed in intermediate cuttings. In overstocked pure stands, thin less frequently than for loblolly to a basal area of approximately 80 square feet.

An intensive commercial thinning schedule may not always be practical. Volumes available to be removed are often too small and local prices too low to cover harvesting and hauling costs. Where conditions do allow commercial thinning, good responses may be obtained from even a single intermediate harvest. Thinning should be performed as early in the rotation as practical since growth rate and response decline as age increases.

Thinning guidelines are similar for plantations and natural stands. In plantations entire rows may be removed at intervals to improve access. In remaining rows, as in natal stands, leave a good distribution of high quality stems.

Prescribed Burning

Indians and early settlers knew that fire could be used to control brush in pine stands. They deliberately set fires for this purpose which were not controlled and frequently were quite devastating to the forest. Today, foresters carefully apply prescribed fire to accomplish several management objectives. It is a most economical tool for:

-reducing hazardous fuel accumulation

-improving wildlife habitat and browse

-controlling understory hardwoods

-controlling certain diseases

-enhancing appearance and value of a stand

-improving access

-preparing sites for seeding or planting

Longleaf pine is well adapted to fire. h may be burned while in the "grass seedling" stage to control Brownspot fungus infection. This disease restricts height growth. Persistent infections may require an additional bum two or more years later. Once height growth starts, longleaf pine trees can be damaged by fire until they are 10-12 feet tall.

The other southern pines are not resistant to fire while in the seedling stage. All four major species may be prescribed burned when trees are more than 15 feet tall (usually 8-10 years old). The initial bum is the most difficult and hazardous, requiring cooler temperatures and steady wind to dissipate heat and avoid scorching the crowns. Prescribed fires can be repeated at 2-5 year intervals, depending upon the rate of litter and brush accumulation.

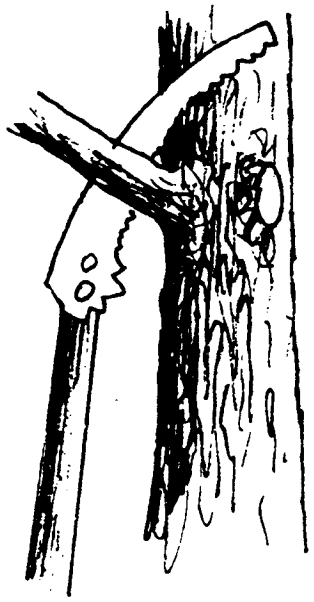
Where hardwood understory control is an objective, follow the initial winter burn with one a more summer

bums. Summer bums icy most thinner-barked hardwoods less than three inches in diameter. Periodic bums may also decrease root rot diseases and can even be used near the end of the rotation for seed bed preparation. A hot fire can expose enough mineral soil to improve seed germination for regeneration.

It is difficult to determine the correct burning conditions (wind, rain, relative humidity, temperature, fuel accumulation and mixture, and air stability). Also adequate firebreaks (fire fines) are essential. Therefore, forest landowners are urged to consult their state forestry agency for advice, assistance, and any necessary permits. Done properly, prescribed burning is well worth the few dollars per acre cost. If fire lines are maintained, later bums are even less expensive.

Pruning

Branches cause knots, the most common defect in wood marketed as sawtimber. Controlling branch growth can thus be an important factor in increasing value production. Fortunately, the major southern pines prune themselves naturally when grown in well stocked stands to typical rotation ages. Economically there is little advantage gained by pruning unless all branches on the lowest sawlog (17 feet) are removed and healed over. Such pruning is labs intensive and expensive. However, a landowner with time available to manage his pine stands may bereft from an understanding of the value and methods for pruning.



Natural pruning progresses from the ground up as a result of shading. In poorly stocked stands and widely-spaced plantations, natural pruning is delayed. Dead branches, being slow to fall off, develop into "loose" or "black" knots, a defect more serious than knots from living limbs. Large branches leave larger knots, and take longer to prune. Wounds created by pruning live branches heal more rapidly than those formed by cutting dead branches. Removing lower limbs, leaving the top 4.0 percent of the tree with rive crown will maximize the volume growth of dear steam wood.

Landowners desiring to prune should follow these guidelines

1. Only prune "crop" trees; those 100 or so per acre of the largest and best trees to be retained to final sawtimber harvest.

2. Prune stems 6-12 inches in diameter, generally no later than mid-rotation.

3. Prune in several stages; first to head-height, then the lowest remaining limbs in two or three later stages over a period of years until the lowest 17 feet are pruned. This procedure will leave a small knotty core, and allow the first log to produce more clear wood.

4. Prune close to the bark of the main stem.

5. Prune in the dormant season, late winter to early spring, using hand or pole saws.

6. Prune in stands where density is controlled by thinning to maximize growth of pruned "crop" stems.

7. Keep good records of pruning so that potential buyers may expect unusually high quality dear wood.

Timber Stand Improvement (TSI)

Timber Stand Improvement (TSI) is the term used to describe such intermediate stand management activities as removing cull trees and unwanted species from a stand. TSI is performed to make growing space available for desirable crop trees. It involves killing unwanted stems by chemical or mechanical means.

Trees to remove during TSI operations include suppressed trees that will not live until the next thinning; trees too crooked, forked, or limby to make quality sawlogs; trees with fire scars and juries from insects, disease, wind or ice; trees of a species not suited to the site; trees that are mature, overmature, or stow growing; and "wolf" trees with excessively large crowns that occupy too much growing space, or shade out more desirable species.

Methods recommended for elimination of undesirable trees include:

• **Cut and Remove** - Where practical, use these low quality trees for products such as firewood.

• **Girdle** - Cut and remove a band of bark and cambium layer from around the stem (some species are very difficult to kill in this manner).

• **Frill girdle** - Make a continuous cut around the stern going through the cambium and into the sapwood and applying herbicide to the cut

.

• **Cup girdle -** Space cuts at intervals around the base of a steam (usually by an axe) for application of herbicide.

• **Basal spray -** Apply herbicide to small stems (less than 3 inches in diameter) by spraying bark of lower stem.

• **Spot treatment -** Application of herbicide is made to individual tree using a directed spray or spot gun.

• **Stump treatment -** Apply herbicide by spray or brush to the fresh stump surface after felling the tree, to prevent sprouting.

• **Injection** - Application of herbicide to individual stems using a tree injector or hypo-hatchet. These tools insert a metered amount of herbicide beneath the bark at intervals around the stem.

The effectiveness of herbicide treatment is affected by such factors as season of year, vigor and size of tree, species, and weather conditions. Injection of oaks and red maple works best in the fall; other species are injected in the spring or summer. Root grafts may allow herbicide transmission to nearby untreated trees, particularly those of the same species, causing death to additional stems (flashback). Species vary in their response to chemicals (See Table 5).

Table 5. Examples of General Tolerance of Several Species to Many Herbicides

Easy to Kill	Hard to Kill
basswood, birch, blackgum, boxelder, cherry, elm, ironwood, plum, sassafras, sumac, sweetgum, willow, yellow-poplar	ash, beech, cedar, hackberry, hickory, holly, maple, poison ivy, honeysuckle, kudzu

Contact a county agent or forestry professional for information on herbicides and application equipment.

Supplemental Fertilization

Fertilizers are applied annually to about one million acres of forestland. Southern pines, particularly slash and loblolly, do respond to fertilization. Response is best When other intensive management practices are being applied, and on nutrient deficient sites. Knowledge of soil type and soil conditions combined with chemical soil testing helps identify sites and stands which respond to

phosphorus (P) and nitrogen (N), the two most commonly applied nutrients. Many foresters prefer foliar analysis as a basis for fertilizer recommendations.

Phosphorus generates a response on sites where its deficiency is limiting growth. Soil tests are advisable on most lower Coastal Plain, and deep, sandy upper Coastal Plain sites. Phosphorus deficiency is commonly treated before planting by incorporating concentrated (triple) super phosphate (CSP or TSP) or diammonium phosphate (DAP) into the beds. Typical rates could call for 40-50 pounds per acre of elemental P. Fertilization with P in combination with weed control has been used to boost longleaf seedlings out of the "grass" stage.

Established stands generally respond to Nitrogen fertilization. Aerial application is usually in spring or fall. A significant amount of N can be consumed by understory species and weeds. They should be controlled by burning before fertilizer application. If the stand is clean, vigorous stems respond to N application (usually 100-150 pounds per acre of elemental N) for about five years. Intermediate and suppressed trees seldom respond to fertilizers, dropping out of the stand quicker than if no fertilizer is applied. Weed control and stand density control enhance fertilizer response.

Refer to Table 6 for some commonly applied fertilizers.

Table 6. Common Fertilizers and Their Percent by Weight *of* Nitrogen and Phosphorus.

		Percent by Weight	
Name	**N***	**P_2O_5***	**P (elemental)**
CSP (TSPI Concentrated (Triple) Super Phosphate		45	20
DAP Diammonium Phosphate	18	46	20
Urea	46		
Ammonium Nitrate	34		

**N and PO, are the first and second numbers in the analysis on the fertilizer container, for example 18-46-20 for DAP means that 100 pounds of fertilizer contain 18 pounds of elemental N and 46 pounds of P_2O_5 1(20 pounds of elemental P).*

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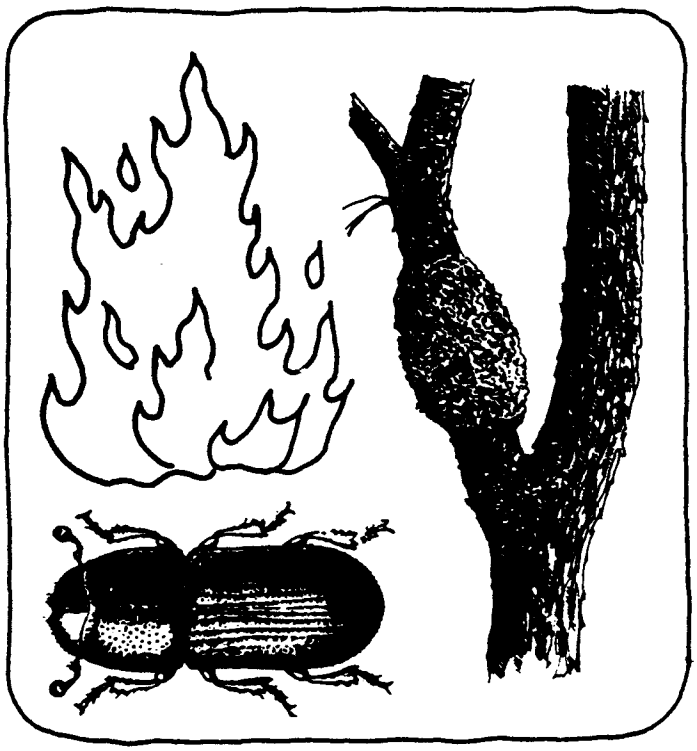
7 PINE INSECTS, DISEASES AND WILDFIRE

Donald L. Ham
SC Cooperative Extension Service



THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

1. The Southern Pine Forest
2. Forestry as an Investment
3. The Major Southern Pines
4. Importance of Soil to Tree Growth
5. Regenerating Southern Pines
6. Intermediate Management Stand
7. Pine Insects, Diseases & Wildfire
8. Timber and Wildlife
9. Harvesting Southern Pines
10. Marketing Southern Pines
11. Forestry Terms (Glossary)
12. Forestry Assistance Available

Potential losses to insect and disease pests and to wildfire are a major concern of the forest landowner and manager. Wildfires bum over one million acres of southern forests each year. While damage by wildfire is sudden and spectacular, it is not nearly as extensive as losses caused by insects and diseases. Losses caused by forest pests in the South exceed 3 billion cubic feet annually.

Preventing losses to wildfire is important. However, it is important to become familiar with management practices which reduce losses from insects and diseases. Reducing such losses often requires performing different operations in an "integrated pest management" approach. For instance, thinning or draining a wet site to reduce stress and promote vigorous growth reduces losses to some pests. Yet, additional management practices may be needed to further protect a stand. Matching tree species to site, using seedlings with fusiform rust resistance, chemically treating freshly cut stumps, using prescribed fire, fertilizing and salvaging infested trees are but a few of the techniques used in integrated pest management.

To reduce insect and disease losses, forest managers need to understand pest biology and how site, stand, and climatic factors affect pest populations. Several important insects and diseases and those silvicultural practices used to reduce losses to pests and wildfires are described in this chapter.

Southern Pine Beetle

During the 1970's, enough trees were killed by the southern pine beetle (SPB) to build 55,000 houses. All species of southern pines can be attacked, but loblolly and shortleaf are the most susceptible. The first signs of a SPB attack are popcorn-size masses of yellowish-white resinous pitch tubes appearing in the bark crevices from the base of the tree to the lower limbs. Pitch tubes may not form during dry weather, but a reddish boring dust will be found in the bark crevices.

Fading needle color from green to yellow, red and brown is a sign that attacked trees will die. The adult APB, which is blackish and about the size of a grain of ice, makes winding, S-shaped galleries on the inside of ;he bark. The SPB intros a blue stain fungus into the tree. The fungus eventually plugs the water-conducting :issue of the tree and it dies. Hazard rating systems are available to evaluate the relative susceptibility of pine stands to SPB attack. Contact a forest pest management specialist for the appropriate system for your area.

Trees under stress are most susceptible to SPB attack. Causes of tree stress and possible SPB outbreaks include poorly drained sites, diseased or storm damaged stands, and physical damage caused by lightning or logging.

To reduce SPB problems, maintain vigorously growing trees and stands through good forest management. Recommended practices include:

1. Harvest all mature and overmature trees and stands, and regenerate the site.

2. Properly match site and tree species to be planted. Use best suited species where possible.

3. Thin overstocked stands.
4.
4. Promptly salvage trees damaged by storms, lightning, or logging activities.

5. Harvest diseased stands on littleleaf sites and regenerate with loblolly.

6. Minimize site and stand disturbance from logging equipment and road building. Avoid wet weather logging.

7. Promptly salvage SPB-infested trees

Engraver Beetles

Engraver (Ips) beetles usually attack single, scattered trees that are weakened by drought, ice, wildfire, lightning and logging damage. Occasionally, as after extended droughts, the beetles may kill groups of trees. All the southern pines are susceptible to attack.

The three common species of engraver beetles form reddish pitch tubes about the size of popcorn. The pitch tubes may be found at different heights on the trunk, depending on the beetle species. On weak trees, pitch tubes may be lacking, but reddish boring dust will be in the bark crevice. Needles of infested trees fade from green to yellow, red and brown.

Adult beetles, which are 1/8 to 1/4 inches long, construct Y- or H-shaped galleries under the bark. These beetles, like the southern pine beetle, introduce the blue stain fungus into the tree. The fungus kills the tree by blocking the water conducting tissue.

Engraver beetles are most likely to be a problem in poorly managed, slow growing stands. As with the southern pine beetle, maintaining healthy, vigorously growing stands is the best way to avoid problems. Since engraver beetles infest trees that have been damaged by storms, lightning, or fire, salvaging such trees quickly will reduce breeding places. These beetles also live in logging slash. If the slash is lying on the ground and not leaning against standing trees, surrounding trees will not ordinarily be attacked. Follow the silvicuttural practices recommended for southern pine beetles to minimize the risk of attack.

Black Turpentine Beetle

The black turpentine beetle attacks all species of southern pines and can be a serious pest. Attacks are often associated with such stand disturbances as lightning, wildfire, logging, storm damage and infestations of other insects.

The adult black turpentine beetle is larger, 1/4- to 1/8-inch long, than the other pine bark beetles. It makes broad irregular galleries under the bark. The first evidence of attack is reddish to brownish-white masses of resin or pitch tubes the size of quarters or fifty-cent pieces. Turpentine beetles do not introduce the blue stain fungus into the trees.

Attacks by the black turpentine beetle can occasionally kill trees. More commonly; however, attacks weaken a tree, so that it can be overcome by other destructive insects such as the southern pine beetle.

Problems with black turpentine beetle can be prevented by minimizing site disturbance and damage to residual trees during harvesting operations. Wet weather logging should be avoided. Badly damaged trees should be salvaged.

Pine Tip Moth

All species of southern pines except longleaf are attacked by tip moths, but slash pine is somewhat resistant. Only small trees, usually less than 15 feet tall, are infested. Moderate to heavy tip moth infestations can cause a 3-5 cord/acre growth loss over a 25-30 year rotation. Attacks also cause tree deformity that may necessitate harvesting the tree as a less valuable product (for instance, pulpwood instead of sawtimber).

Tip moth larvae bore into the growing twigs of young pines. The first symptom of attack is resin-coated webs found at the shoot tips. The hollow, infested tips eventually turn brown and die. Small larvae or pupae can sometimes be seen when the tips are broken open.

Chemical control of tip moth is possible but currently impractical. Approaches used to minimize tip moth damage are:

1. Plant slash pine or longleaf pine within their natural range instead of loblolly or shortleaf.

2. When planting, retain such surrounding vegetation as deadened hardwoods in conversion plantings and grass and weeds n field plantings. Pines are only tightly infested under dense vegetation.

Reproduction Weevils

Two species of reproduction weevils, the pales weevil and the pitch-eating weevil, are the most important. These weevils attack all species of southern pine seedlings planted in cutover, storm-damaged, burned, or otherwise disturbed areas. Mortality can be as high as 60 percent.

Adult weevils are attracted to the odor of fresh pine resin. Eggs are laid in the large roots of fresh pine stumps where the larvae develop. Adult weevils emerge and feed on the tender bark of young seedlings. Most damage occurs from February through June, with lesser amounts during the remainder of the summer and early fall. The following management practices will help reduce damage:

1 . Harvest timber and prepare sites 6 to 9 months before planting. Weevil larvae in large roots or stumps will have matured and left prior to planting. Time operations to take advantage of the weevil's life cycle (Table 1).

2. Prepare with prescribed fire. Mechanical methods may prolong the attractiveness of the area to weevils.

3. Plant chemically treated seedlings in March and April on heavily infested sites.

4. Make regeneration cuts during seedfall, because newly germinated seedlings suffer only minor damage. Weevils should be gone when the seedlings are in the second growing season.

Table 1. Hazard-rating schedule for timing operations to minimize potential problems from weevils.

Harvest date	Site prep date	Site hazard	Recommended
Before June	Before June	None	Plant Pines Nov-Mar
	After June (cutting less than 5 cords/acre)		Plant Pines Nov-Mar
After June (cutting over 5 cords/acre)		Low-Moderate	Plant pines the following year or contact insect control specialist

Annosus Root Rot

This fungus disease can cause significant growth loss and kill pines in recently thinned stands in certain areas of the South. Loblolly and slash pine are very susceptible, but all southern pines can be infected. Spores of the fungus infect freshly cut stumps, and the fungus colonizes the root system. Roots of adjacent trees are infected where they contact infected roots.

Infected trees develop thin crowns, and trees begs to die two to three years after thinning the stand. Irregular infection centers develop as patches of trees die. Infected trees are also susceptible to attack by southern pine beetles. Fruiting bodies of the fungus can sometimes be found at the bases of infected trees, often the site partially buried in the litter. They are irregularly shaped, brown on top, and white to light tan below.

Stands should be evaluated to determine the relative susceptibility to annosus, and the possible need for special management practices. Generally, stands growing in deep, sandy, well-drained soils have a greater chance of severe infection. Low-hazard sites have poor internal soil drainage and high seasonal water tables, or the depth to clay is less than 12 inches.

Stands on high-hazard sites can be managed to reduce potential losses. Thinnings should be made only once, late in the rotation. Space trees wider than 8 x 8 feet apart, or thin them to basal areas of less than 70 square feet per acre. Prescribe bum at least twice before thinning, once within 6 months of the cut. Stumps should be treated when cut with borax or *Phlebia gigantea,* a competing fungus, to prevent growth of annosus spores. Thinning during the hottest months (May-August) may reduce the chance of infection. NonePlant pines Infected sites can be regenerated immediately following harvest.

Fusiform Rust

Fusiform rust is one of the most destructive pine diseases in the South. The rust fungus kills many young pines (under 5 years and deforms trunks and branches, reduces growth, and increases the risk of wind damage in older trees. Losses in the form of mortality, degraded

products, and growth reduction, are difficult to assess but are in the millions of dollars each year. Rust is a bigger problem on well-drained, sandy soils than on poorly drained, fertile soils.

Loblolly and slash are the most susceptible. To complete its life cycle, the fungus requires pines and oaks. The obvious symptom of the disease is spindle-shaped swellings on pine trunks and branches. Yellowish, powder-like spores on the swellings (galls) make them especially conspicuous in the spring. Infected trees often have cooked or multiple trunks.

Matching sites and species is important to avoid fusiform rust problems. Within its range, plant longleaf. In the Piedmont, shortleaf can be used on good sites where littleleaf disease is not a problem. Regardless of species, always plant disease-free seedlings. On high-hazard sites, planting should be at close spacings to promote early, natural branch pruning. This practice will minimize the fungus spreading from branch galls to the main stem.

In general, stands 9 to 15 years old, with less than 25 percent of the trees with main stem cankers, can be grown for pulpwood without early thinning. If more than 25 percent of the trees are infected, the stand may need to be selectively thinned to remove trees with severe trunk infections (galls around 50 percent or more of the trunk). Except for very heavily infected stands, maintaining adequate stocking until normal rotation age is more cost-effective than harvesting early and regenerating.

Littleleaf Disease

Littfeleaf disease is a major disease problem on 15 million acres in the Piedmont region of seven southern states. Shortleaf pine is very susceptible, loblolly less so. As the name implies, affected trees have sparse, yellowish, short needles. The trees usually produce heavy cone crops with poor seed. Trees over 20 years old are most affected and die within several years.

Littleleaf disease is caused by a complex of factors, including a soil fungus that kills root tips, poorly drained clay soils with poor aeration, low fertility, and periodic moisture stress. The poor soil conditions prevent the regeneration of feeder roots and trees slow die . Regeneration

On poorer sites, soils may be rebuilt by favoring hardwood species. Since loblolly is less affected than shortleaf, it should be favored in cutting and thinning operations. Some natural resistance to littleleaf disease has been discovered and could provide a remedy to the problem.

In affected stands, manipulation of cutting practices is the only realistic, presently available control:

1. If only an occasional tree is affected, cut lightly at 10-year intervals.

2. If 10-25 percent of trees in the stand show symptoms, cut at 6-year intervals, removing all diseased trees.

3. If over 25 percent of the trees are affected, clearcut as soon as the stand is merchantable.

Brown Spot Disease

This disease, a major problem in longleaf pine, is the main reason that loblolly and slash pine are favored on former longleaf sites. Infected seedlings in the grass age may lose some or all of their needles. Complete needle loss for three consecutive years kills the dings. Continued partial loss of needles prolongs the grass stage from the usual three to five years to as many as 20 years. This delay in height growth is an important economic problem and the reason other species are preferred.

Several management practices are used to minimize brown spot and promote early height growth. Resistant and/or high-quality, disease-free seedlings can be planted on intensively prepared sites. If regenerating longleaf naturally, prescribe burn immediately before seedfall. Fire will destroy diseased needles that would be a source of the fungus spores that would infect new seedlings. Additional bums, in the dormant season when the seedlings are about 0.3 inches in diameter at the groundline and again with the diameter at groundline is about 1 that have just begun height growth, but it is beneficial in removing diseased needles and competition once the seedlings are about 3 feet or more tall. Seed trees should be removed when seedlings are 1 to 2 years old.

Wildfire

Although extensive fire prevention and control programs have successfully reduced wildfire damage to southern forests, it is still a serious problem. Approximately one one million acres are burned in the South each year. Over half of this total is the result of arson.

Wildfires are more prevalent, bum more intensely, and cause more damage where there is a buildup of such forest fuels as grass, weeds, pine needles, hardwood leaves, and twigs and branches. Prescribed burning offers the most practical, economical means of reducing forest fuels and the risk of wildfires. (Table 2.)

A burning rotation of three years is usually adequate. However, the frequency of wildfire in the area, risk, and fuel accumulation, as well as landowner objectives, determine burning intervals. As the acreage of pine plantation increases, the need to "fireproof" stands with prescribed bums become increasingly important.

Table 2. Environmental Effects of Fire

Effect on:	Prescribed Fire:	Wildfire
Timber	No damage when property used	Varies greatly, can destroy all trees
Water	No adverse effects when properly used	Can contribute to sitting and reduce water quality
Soil	Litter layer not completely burned and soil not exposed	Bare soil often exposed, water runoff increases, erosion may become a problem
Wildlife	Improves cover and food conditions for some game species	Destroys animals, cover, and forage plants
Air	Less smoke per ton of fuel than wildfire; only lasts a few hours; atmospheric conditions favor smoke dispersal	Smoke reduces visibility, creates local hazards to transportation, may last many days
Recreation	Improves accessibility for hunting and other recreation uses	May completely destroy forest for recreational uses

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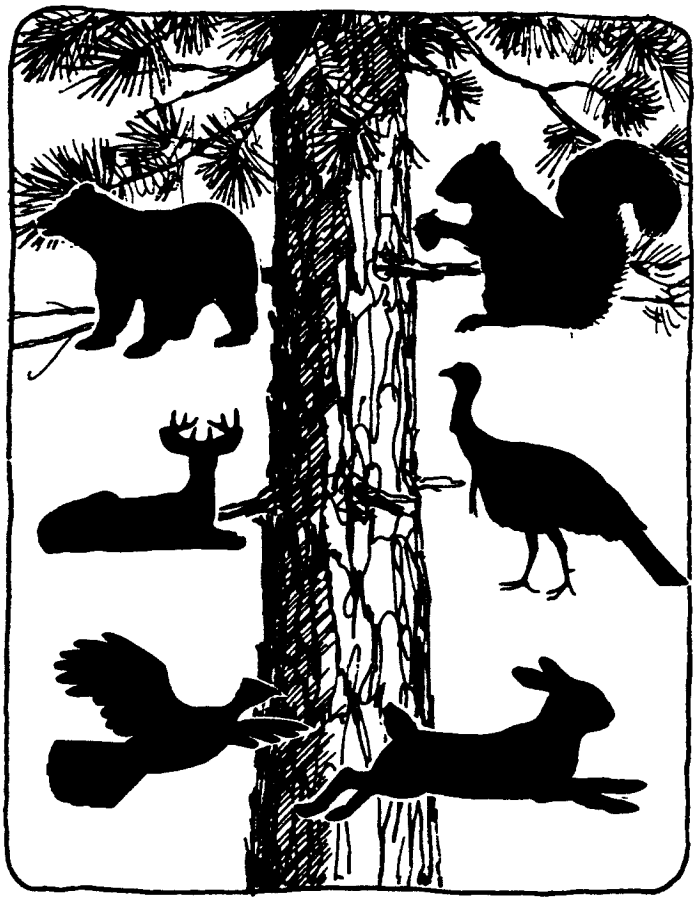
8 TIMBER AND WILDLIFE

Robert B. Hazel
NC Agricultural Extension Service



THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

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2. Forestry as an Investment
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Wildlife and timber are both products of the forest. Multiple use of forested lands can, therefore, include optimal use and sustained yield management of the wildlife resource. Southern pine forests can be managed successfully for both timber and wildlife.

Management Possibilities

Properly managed pine stands can provide good habitat for a variety of wildlife species. The key *is* *management*. Unmanaged pine forests generally constitute low-quality habitat for most wildlife species and are sometimes referred to as biological deserts. Good silvicultural practices, planned with wildlife in mind, are the primary means of providing wildlife habitat in conjunction with pine management. In many situations, additional measures can be taken to father enhance wildlife habitat and populations.

The intensity of wildlife management to be tamed out depends primarily on the interests and objectives of the landowner, the natural capabilities of the land, and the wildlife species present on the area. In most situations, good wildlife habitat can usually be maintained through normal silvicultural practices with little extra cost. All that is required is basic knowledge of wildlife habitat requirements, the effects of various timber management practices on wildlife habitat and proper advance planning.

All wildlife species require the basic necessities food, shelter and wing space. The kinds and amounts of these requirements differ widely between species; some species are adapted to the kind of habitat found in southern pine woodlands, while others are not. Furthermore, there are some compatibility differences in wildlife species, depending on the pine type and stage of plant succession.

Longleaf-Slash Pine Type

Longleaf-slash pine forests can be managed for quail, fox squirrels, doves, deer, bears, wild turkeys, and red-cockaded woodpeckers. The quality of the habitat for these species depends primarily on the timber management practices applied, the growth stage, and the size of the management unit. The big game species (deer, bear, turkeys) require large home ranges (from at least several hundred acres for deer to several thousand acres for bead, while small game species can exist on a few acres.

Opportunities for managing quail are usually good in this forest type, particularly if the area has numerous small streams. Management opportunity for the other species varies from fair to good, depending on such things as associated tree species, plantings, prescribed burning schedules, and size and distribution of cutting and regeneration areas.

Loblolly-Shortleaf Pine Type

This type of forest can be managed for deer and turkey, gray and fox squirrels, quail, and red-cockaded woodpeckers. Quality can range from good to poor for turkeys, depending on size and distribution of key areas of mast-producing hardwoods. The same requirements apply, to a large degree, to management for deer and squirrels. Good quail habitat can be provided in this type of forest.

Recommended Pine Management Practices for Wildlife

Pine stands tend to be used most heavily by wildlife species during the early successional stages. During the first five years, these plantations provide a large amount and variety of quail food and deer browse - the amount varying with the site preparation or regeneration method used. Generally, a pine stand becomes less attractive to wildlife as the stand- matures, the canopy closes, and the understory thins. Consequently, pine stands must be managed in order to maintain their value for wildlife.

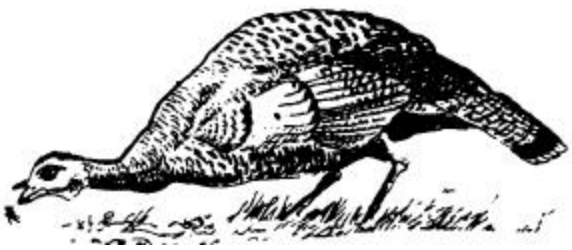
The most important single thing to achieve in management for wildlife habitat **is as much diversity as possible**. In general, the more variety of timber species, size and age classes, small openings, and edge, the better the wildlife habitat will be. Maintaining adequate food-producing plants attractive to the wildlife species desired is vital, along with escape and nesting cover and water.

Silvicultural practices beneficial to wildlife are:

1. Divide timber management units into small blocks (100 acres or smaller if possible), to achieve a variety of age and see classes. Even-aged management of small units of differing ages and sees provides the necessary interspersion of stands and productive understory conditions for wildlife.

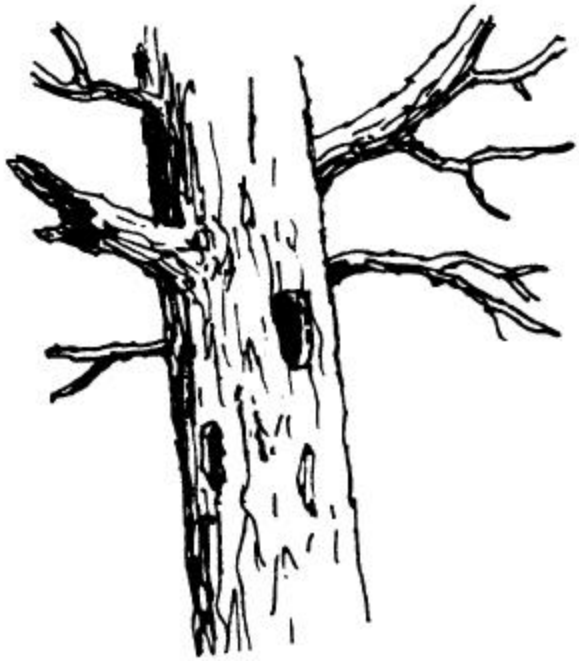
2. Make clearcuts in irregular shapes to achieve maximum edge. Avoid large clearcuts if possible. Deer, for instance, use the outside edge of a clearcut much more heavily than large open areas.

3. Leave hardwoods along drainages and streams to provide travel lanes, escape cover, and food for deer, turkeys, and squirrels. These stream buffer zones also protect the stream from siltation and clogging with logging debris.



4. When thinning or practicing timber stand improvement, leave snags and den trees (at least 2-3 per acre). Remove only those that are suppressing timber growth.

5. Leave areas of mast-producing hardwoods scattered through the area. These should be at least Y. acre in size, larger if possible.



6. Seed roads and other small openings to grasses, clovers, or other game food and cover plants adapted to your area. These provide food for deer, rabbits, turkeys, and brood openings for quail and turkeys. Cut trees to open the canopy along roads, allowing light to penetrate and enhance edge growth.

7. Use controlled burnings, particularly in the Coastal Plain, to stimulate growth of legumes and other wildlife food plants and to control undesirable undergrowth. Controlled burning should usually be done in small blocks in a 3-5 year rotation, beginning when stands are pole-sized, and following thinning operations. Bum in winter or early spring (December, January, and February are the best months).

Additional practices that can enhance wildlife habitat and populations are:

1. Planting strips of shrub lespedeza for quail food between rows of pines when a plantation is established or thinned. These plantings should be scattered units of at least ' /a acre for each 5-10 acres of plantation.

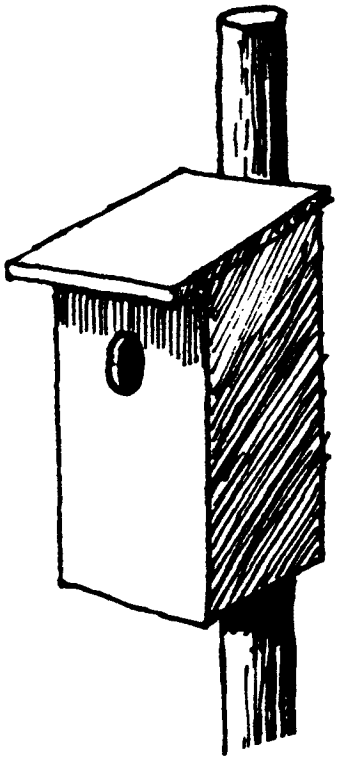
2. Allow volunteer vegetation to grow in the windrows for several years.

3. Plant small openings (1/5 to 1/2 acre) to grass or clover, with a shrub lespedeza border 10 feet wide to provide brood cover for quail and turkey and winter

feeding areas for quail, turkeys, and deer. Where deer are the primary species to be managed, opens can be large (1-5 acres). There should be at least one opening per 160 acres.

4. Where the forest borders agricultural lands, plant field borders with shrub and sericea lespedeza or annual game-food mixtures. These provide food and cover adjacent to woods. Also, leave border strips of such crops as corn and soybeans unharvested to provide food for game.

5. Erect squirrel nest boxes in or adjacent to hardwoods where den trees are not present in sufficient number. Wood duck nesting boxes should be placed in ponds or other water areas. Beaver ponds can provide excellent waterfowl habitat.



6. For red-cockaded woodpeckers, maintain colony sites undisturbed with at least a 200-foot buffer zone around each cavity tree. Also, provide foraging areas of pole-sized or larger pines adjacent to colony sites.

Most important, plan ahead. With advance planning, wildlife can be more than just an incidental by-product of forestry operations. Detailed advice can be obtained from professional wildlife biologists with state or federal wildlife agencies.

Incentives for Wildlife Management

Incentives for the landowner to manage wildlife are important. While wildlife is seldom managed as a major income-producing crop, there are some incentives that make wildlife management worthwhile to the owner. They are:

1. The presence of wildlife species in abundance for the landowner to enjoy through observation or hunting.

2. The sale of hunting privileges. This is usually done by means of a lease agreement with an individual or a group of hunters, or sale of hunting permits to individual hunters on a daily or seasonal basis.

3. The management of hunting through cooperative agreement with the state wildlife agency, wherein the state manages the hunting as a part of its program. This usually releases the landowners of liability, trespass, and other problems related to hunting activities. More detailed information on the above fisted incentives in your particular area can be obtained by consulting your state wildlife agency.

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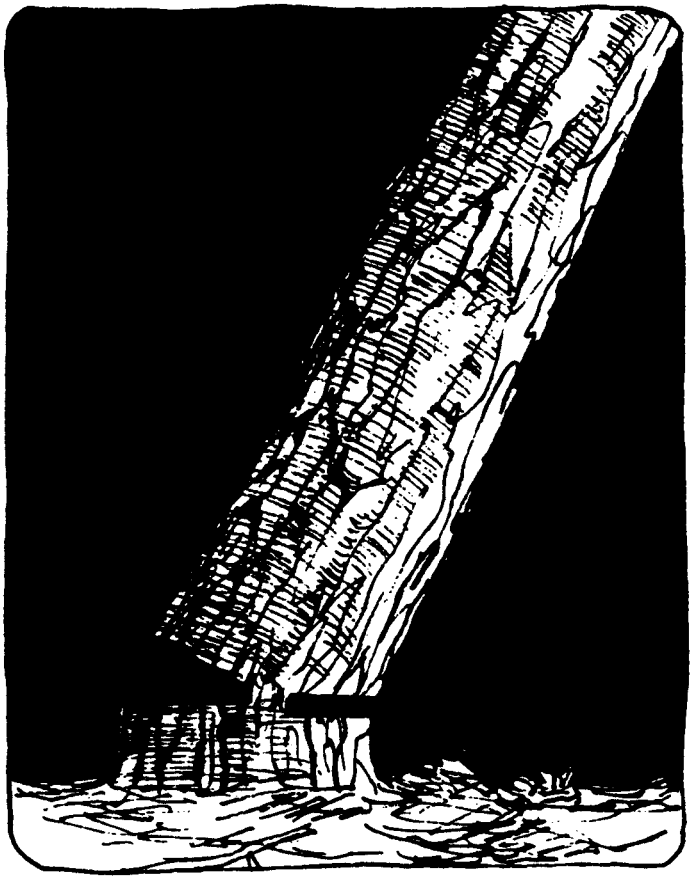
HARVESTING 9 SOUTHERN PINES

James Burrows
AL Cooperative Extension Service



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Most southern pine timber is harvested by independent logging contractors. Lesser amounts are harvested by logging crews employed directly by larger corporate wood-using organizations and by landowners themselves. Although the chances are that you will not harvest timber yourself, an understanding of what is involved in harvesting will better enable you to deal with prospective timber purchasers and work with the successful bidder for your timber.

The logging methods used and the logger's ability to carry out your plans are critical to the overall success of forest management. Well planned harvests ultimately determine the financial success of the venture. The cash return immediately available from the harvest is dependent upon the logger producing the most valuable timber products possible. Site preparation and establishment costs of the succeeding stand are, to a large degree, dependent upon the completeness of harvesting. Future productivity of the site will depend on how well or how poorly the harvesting operations are carried out. Finally, harvesting operations will influence both the landowner's and the public's impression of the desirability of producing timber for profit.

Harvesting includes as operations necessary to remove timber from the forest and deliver it to the mill. These operations are felling, limbing and bucking, skidding, loading, and hauling. Alternate methods for accomplishing each of these operations are available. The correct combination of methods to use on a given site depends on tract size, timber type, volume per acre, individual tree volume and see, type of cut (clearcut, thinning, etc.), terrain, weather, soils, road system, equipment availability, and landowner's desires.

Before cutting begins, a harvesting plan should be developed for the entire tract. This plan will include:

- the landowner's management objectives;
- map of the area;
- legal property boundaries;
- description of trees to be removed;
- method of marking trees to be removed;
- method of harvesting;
- the placement of haul roads, skid trails and log landings;
- placement and types of stream crossings;
- road and trail drainage structures;

- soil conservation measures, including Best Management Practices, to be used to protect water quality;

- maximum height of stumps;

- slash disposal methods;

- penalties for damaged fences, other man-made structures and residual trees.

In addition, any other landowner or legal requirements should be incorporated into the plan.

Next, a timber sale agreement or contract that incorporates the essential elements of the logging plan should be developed. It must be comprehensible, performable, and enforceable by both the landowners and logger: For example, if site preparation is to be the responsibility of the logging contractor, this should be a part of the contract and should stipulate the stocking level expected at termination of the contract. A landowner shod realize that each additional requirement is an expense to the contractor and will rest in a reduction of the stumpage price received.

The following abbreviated descriptions of the harvesting operations normally used for southern pines will help the landowner understand the harvesting . process and assist when negotiating with a contractor.

Felling

Felling is the act of severing standing trees from their stumps. Felling is normally accomplished with a chain saw or a hydraulic-powered felling head mounted on a self-propelled machine. The chain saw is used for felling both sawtimber and pulpwood, and is the primary tool used for cutting higher-value products such as poles and sawlogs. (Figure 1)

There are several types of felling heads available. Mainly used in cutting pulpwood, they have either one or two blades and shear the tree from the stump. They can cause damage to the butt log, thus limiting their use to pulpwood. Other heads use various methods to saw the tree, thereby reducing log damage. The felling head is mounted on a crawler tractor (Figure 2), rubber-tired crier (Figure 3), excavator (Figure 41, or specialized machine.

Delimbing and Bucking

This operation entails removing limbs from the trunk of the tree up to a minimum top diameter and cutting it into logs or bolts of predetermined lengths. Delimbing and bucking may take place where the tree is felled, or the entire tree may be skidded to a cleared area called a log landing for delimbing and bucking. Equipment used

includes chain saws or a variety of mechanized methods. In pulpwood operations, the entire tree (minus limbs) is often transported to the mill or concentration yard. In other pulpwood operations, the entire tree (limbs and all) may be reduced to chips at the log deck, with the chips blown into trailers for transport to the mill.

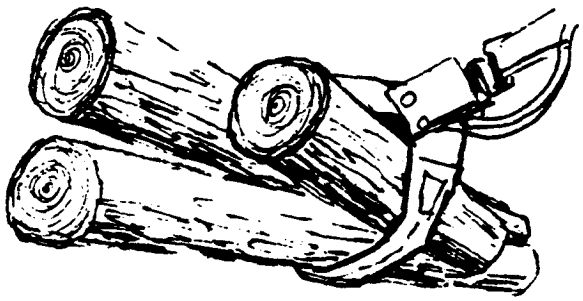
Skidding

In the South, most movement of wood from the stump to the landing is done with wheeled or tracked machines. Skidding, or dragging logs, is accomplished with rubber-tired skidders (Figures 5-6), crawler tractors (Figure 7), or even horses or mules. Skidders and crawlers can be equipped with wire nooses called chockers or grapples to secure the stems for transport. Forwarding or prehauling involves carrying the wood on a vehicle, from stump to landing. Skidder type machines, equipped with bunks or trailers (Figure 8) are commonly used. In mountainous areas, cable logging systems (Figure 9) are sometimes used. These have a tower, yarder, and cables to move the logs. Generally, there is less ground disturbance on steep slopes with cable yarding.

Depending on sod properties, terrain slope and rainfall patterns, ground skidding can sometimes cause unacceptable levels of soil disturbance of forestland, resulting in reduced tree growth and lower water quality through erosion. These impacts can be reduced by a combination of minimizing the area in skid trails and logging in dry weather: The location of skid tab should be determined in the logging plan. They shod be located in the field before logging begins.

Loading

Loading is the ink between logging and hauling operations. Loading is performed from log deck located at the landing. Several landings are often used on larger tracts so that skidding distances are minimized. Loading is done with a variety of machinery, rarely by hand. The most common machines are hydraulic knuckleboom



loader (Figure 10), front-end loader (Figure 11), and big-stick loader. If the end-product is wood chips, chippers are often located at the landing, and the chips are blown into special trailers.

Hauling

The final harvesting operation is the movement of belts, logs, trees, or chips from the deck to a local concentration yard or mull (Figure 12). All log decks should be located beside a haul road system developed for the tract. This transportation network, including deck and skid trail locations, shod be specified in the harvesting plan to minimize skidding distances, haul-road construction, maintenance costs, and soil and site disturbances.

Fig. 1. Power Saw.

Fig. 2. Feller Buncher on Crawler Tractor.

Fig. 3. Feller Buncher on Rubber Tired Carrier.

Fig. 4. Feller Buncher

Fig. 5. Choker Rubber Tired Skidder.

Fig. 6. Grapple Rubber Tired Skidder.

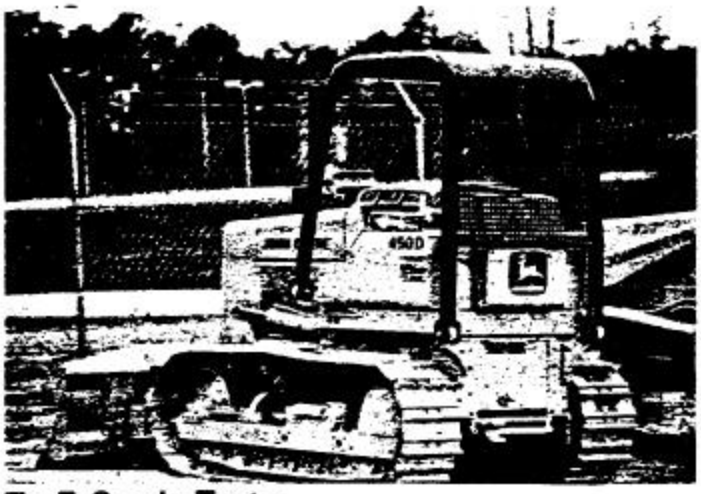


Fig. 7. Crawler Tractor.

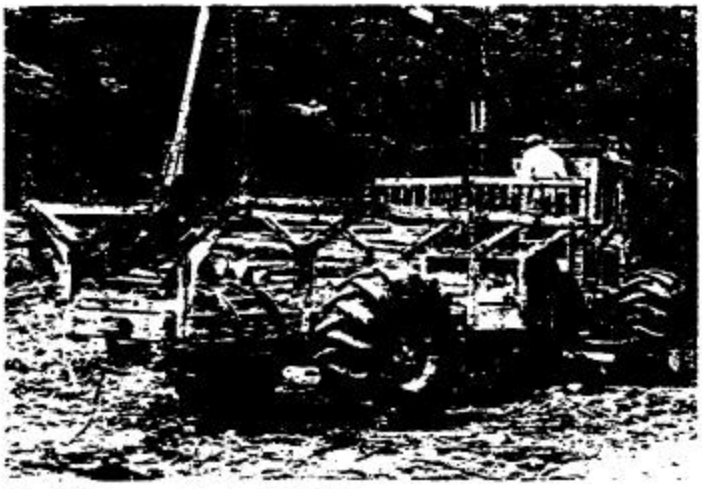


Fig. 8. Forwarder or Prehauler.

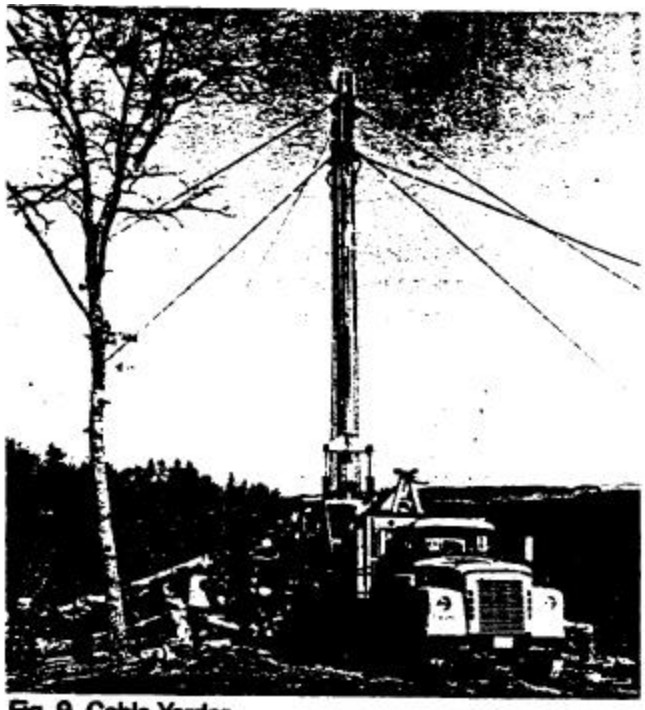


Fig. 9. Cable Yarder.

Fig. 10. Hydraulic Knuckle Boom Loader.

Fig. 11. Front End Loader

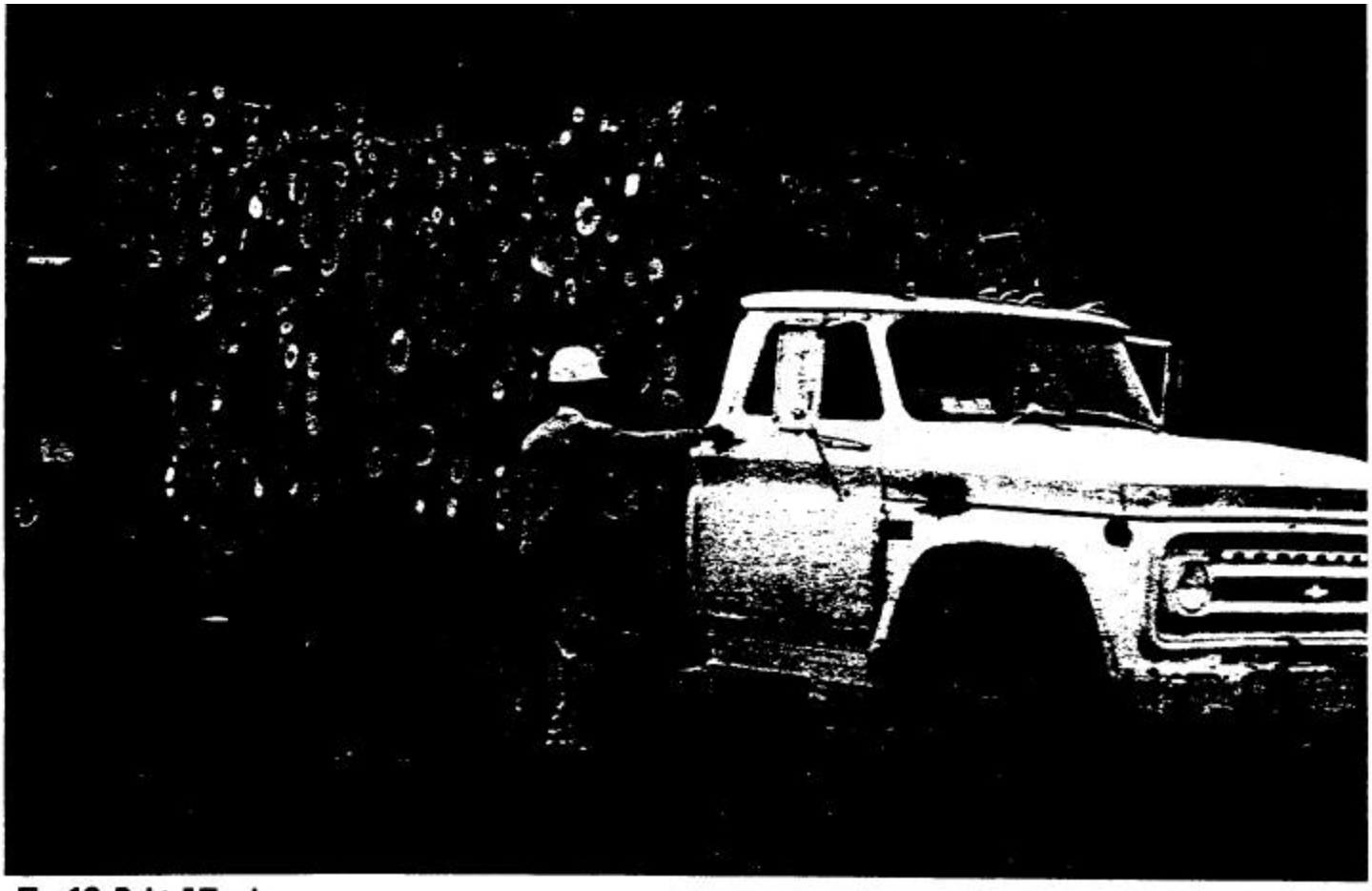


Fig. 12. Bobtail Truck

Fig. 13 Tree Length Logging Truck

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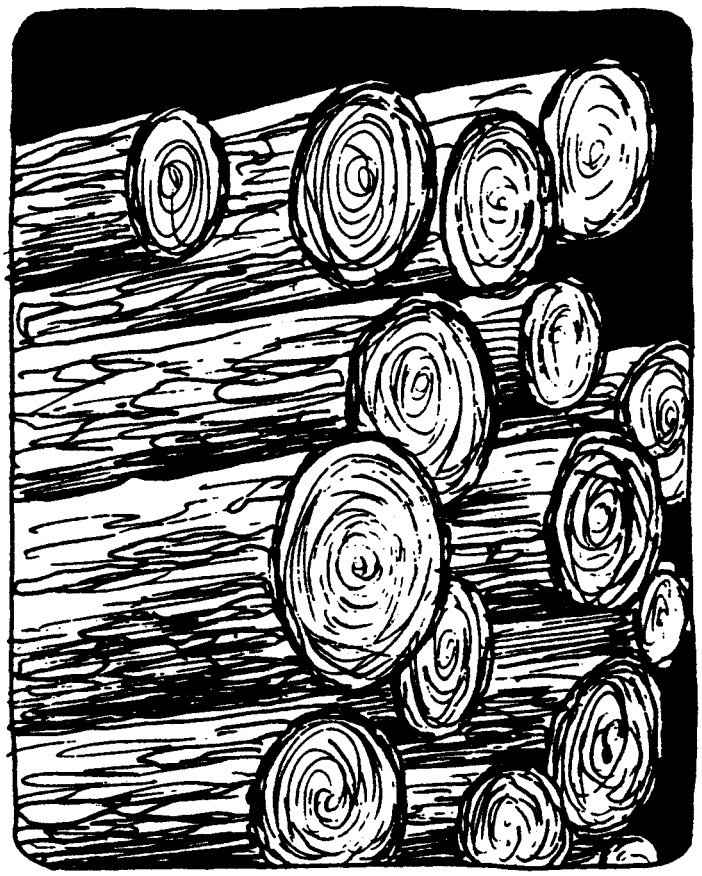
10 MARKETING SOUTHERN PINES

Charles Stayton and Lanny Dreesen
TX Agricultural Extension Service



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The economic future for timber products is sound. Projections indicate that the timber supply will fall short of demand, increasing timber stumpage prices and returns to the timberland owner. Timber historically has increased in value 2 percent a more above the annual inflation rate. This has been achieved during times of good timber supply. But, with the timber supply decreasing rapidly, returns on investment could show annual rates of 10 percent and more over the next timber growth cycle in the South.

Have Good Marketing Data

Your timber should be sold for the best price, whatever your reason for selling it. Marketing timber means offering it on the market to the highest bidder and selling it at an acceptable price.

Marketing requires you to know the products you have for sale, the volume of each product, current and projected values, and volume changes because of expected timber growth. You should use these data to make your decisions, regardless of the reasons for selling. Impulse selling without marketing data nearly always results in economic losses for the owner. But, with the right marketing information, sudden pressing monetary needs a seemingly attractive offers can be professionally evaluated. You may find that a bank loan is more economical than cutting your timber, because the timber may be growing at an annual rate of return higher than the interest rate on the bank note. Timberland clearing for agricultural use may not be the best financial choice: you might convert a high-profit timber stand into a marginal agricultural operation.

Timber marketing data can be confusing to timberland owners. A professional forester can assist in developing marketing data. Consulting foresters will provide the required data when handling your timber sale. Free educational assistance can also be obtained through publications and programs provided by the Cooperative Extension Service. You should contact your local Extension agent for publications and programs. Many forest products industries provide management and marketing assistance to timberland owners, and they can assist in developing marketing data. Also, state forestry services have professional foresters who provide on-the-ground timber marketing assistance. You should contact foresters in your area when making a sale. Compare their services by talking with other timberland owners who have sold timber.

Know What Products You Have to Sell

Marketing timber requires that you know the products you have available for sale. These can be hardwoods, softwoods, a both (Table 1). Softwoods are used primarily for construction framing, lumber and plywood, pulpwood, posts, poles, and piling. Hardwoods are used mainly for railroad ties, lumber, decorative veneers, or pulpwood, and are rarely used for construction framing.

Southern softwoods in demand include the southern yellow pines (SYP), primarily loblolly, slash, shortleaf, longleaf pine. The value of these pines is directly related to their size and quality.

Small SYP trees, 4 to 10 inches in diameter at breast height (DBH), are used for fence posts and pulpwood, pulpwood being the largest use. Quality is not a key factor for pulpwood, since the trees are debarked and chipped to make paper and board products. Pulpwood is purchased by volume (cords) and weight (tons) to measure the quantity and price of the sale.

Trees 10 inches and larger at DBH are considered sowings and peeler logs and are purchased by volume (thousand board feet) or weight (tons) to determine quantity of the she. Sawlogs are used for lumber and peeler logs for veneer to be laminated into construction plywood. Sawlog and peeler log timber is valued by size and quality. Larger trees with fewer limbs or other defects such as scars, crook, sweep and grooves will produce higher grade lumber and plywood, and bring higher prices to the landowner. Timber quality and size influence stumpage prices. Peeler logs require a minimum DBH of 12 inches, and those 15 inches and larger are preferred. Sowings are more valuable than Chip-N-Saw timber a pulpwood, but less valuable than peeler logs.

Very few older timber stands contain only one product; they usually contain a mixture of pulpwood, sawlogs, peeler logs, and poles and pilings. h is important that you know the volume of each product by diameter size classes to maximize your economic returns.

One non-pine softwood species, bald cypress, is in the special-use category. Although the demand for bald cypress has diminished, it is still used for paneling. "Pecky" cypress, caused by insect damage, may have particular decorative value. Cypress is not generally used for framing lumber and is solo separately from SYP timber.

Industry demand for southern hardwoods includes the hard hardwoods, soft hardwoods, and special use species (Table 1). Hardwood value is directly related to size, species, and quality. The special-use species are those especially suited for furniture, cooperage, paneling,

Table 1. Commercial Trees in the South

Southern Pines	Hard Hardwoods	Soft Hardwoods	Special Demand Species
Loblolly	Oaks	Sweetgum	Black Walnut
Slash	Elms	Tupelo	Black Cherry
		Blackgum	
Shortleaf	Hickories	Cottonwood	White Oak
Longleaf	Pecan	Poplar	Ash
Virginia		Sycamore	Bald Cypress
Sand		Magnolia	
Spruce		Catalpa	
Pond		Yellow popular	

and cabinetry. The value of pulpwood, sawlog, and peeler-log size classes are about the same as that for the softwoods. There is no Chip-N-Saw timber classification for hardwoods. All hardwood pulpwood, both hard and soft hardwoods, is used for containerboard products. Low quality hardwood sawlogs are used for railroad ties, lumber for pallets, and utility grade lumber for farm and ranch structures. Higher-grade sawlogs are sawn into dimension lumber for furniture, with oak, yellow popular, black walnut, black cherry, ash, and pecan in greatest demand. Highest-quality hardwood trees are used as veneer for furniture, paneling, arid cabinets, with oak, ash, black walnut, black cherry, and pecan being in him demand. Veneer-quality black walnut, black cherry, white oak, and ash trees demand highest prices and should be marketed separately for maximum value. Many soft hardwoods are teed in furniture for drawer bottoms and furniture backs and frames, bringing better prices than if sold for railroad ties or pallet lumber To maximize economic gains on hardwood timber sales, the timberland owner should retain a professional forester with knowledge of hardwood sawlog and veneer grades and how to relate these grades to the highest-value end-use.

Know What Quantities of Products You Will Sell

Marketing timber requires that you know both the products you have to sell and the quantity by species and size doss. If you have valuable hardwoods, particularly special-use species, quantities should be listed by species, size, and quality (preferably by tree grades, and distinguishing between sawlog trees and veneer trees). h is important to classify by DBH for assessing current value, and to estimate future value based on expected growth rate and project stumpage price changes. A forester can provide you with an estimate for quantities of products to be sold.

The forester will make a timber cruise to determine the quantities of products for sale. The purpose of a timber cruise is to determine the average sawlog, peeler log and pulpwood volumes which can be used to calculate reliable estimates of timber and pulpwood volumes for the entire timberland tract. The cruise, a statistical

sampling of the total tract, is made on a predetermined number of plots on which every tree is measured and listed by product. Heights of sawlog and peeler-quality trees are recorded by 16-foot logs. Heights for pulpwood (including Chip-N-Saw material) and poles and pilings are recorded by total usable length in feet. The number of plots sampled is determined by timber size and density variation of the tract, and the required accuracy. From this sample, the total quantity and value of products to be sold can be determined.

Example autse tally sheets for sawlogs, peeler logs and pulpwood are shown in Table 2 and 3. These field tally sheets record the number of trees within diameter and height categories. The volume is calculated using published volume tables. The volumes of sawlogs and peeler logs are recorded in thousands of board feet, pulpwood volume in cords.

Table 2: Example Timber Cruise Tally Sheet For Pine Sawlogs and Peeler Logs Representing Measured Trees On 25, 1/5 Acre Sample Plots = 5 Acres

NUMBER OF 16' LOGS

DBH	1	1 1/2	2	2 1/2	3	3 1/2	4	Volume Bd. Ft.
				Number of Trees				
10	10	15						395
12		10	25					1,435
14		5	50	5				4,480
16			12	5	5			2,797
18				10	5			2,975
20			5	20	5			7,236
22								
24				5	5			4,645
26					5			3,095
							TOTAL	27,058

Average board feet per acre = 27,058 bd.ft. ¸ 5 acres
= 5,412 bd.ft.

**Calculated using U.S. Forest Service published volume tables (Doyle Scale and Form Class 78)*

Table 3: Example Timber Cruise Tally Sheet For Pine Pulpwood Representing Measured Trees on 25, 1/5 Acre Sample Plots = 5 Acres

Merchantable Length of Stem in Feet

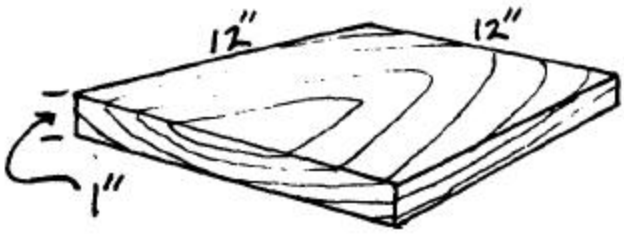
DBH	12	16	20	24	28	32	36	40	44	48	52	56 Volume (cu.ft.)
					Number of Trees							
6				60	21	9	6					
8				24	9	39	60					
10						24	24	6	3	3	3	
12								6	9	12		
										TOTAL		2, 593.2

Total cords = 2,593.2 cu. ft. ¸ 128 cubic feet per cord = 20.3 cords

Cords per acre = 20.3 cords = 5 acres = 4.1 cords/acres

* Values obtained using published U. S Forest Service volume tables.

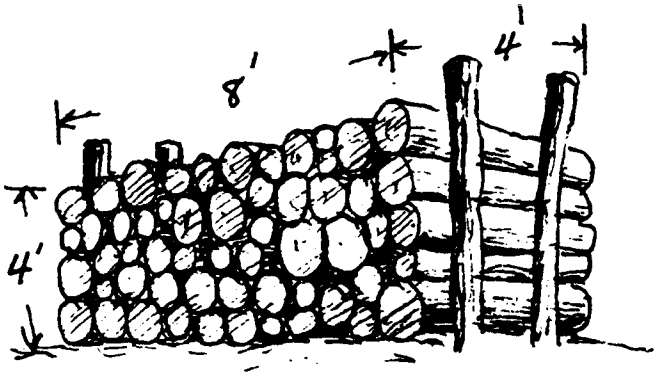
One board foot is the equivalent of a piece of wood 1 inch thick, 12 inches wide and 1-foot tong. The forester records the board feet in the sawlog and peeler log trees measured on the sample plots of the timber cruise (Table 2) using published volume tables giving board feet of each tree based on DBH and number of 16 foot logs. These volume takes were developed from log rules which estimate the board feet in a log before it is sawn into lumber minus losses from saw kerf, stem taper, and bark. Three log rules are used in the South: the Doyle, Scribner and International 1 /4 inch. Your forestry advisor is familiar with the log rule used in your area.



The total board foot volumes obtained from the cruise data are used to calculate an average board foot volume per acre (Table 2). This average value, since it is representative of the entire timber tract, is used to estimate the total board feet volume for the entire tract. This is achieved by multiplying this average volume per acre by the total number of acres in the tract of timber. For example, in Table 2, the average sawlog and peeler log volume combined is 5,412 board feet. Thus, if the total timberland tract is 129.34 acres, there is approximately 700,000 total board feet of sawlogs and peeler logs in the entire tract. This is the quantity of sawlogs and peeler logs you have for she.

You must know the quantity of products you have for sale to maximize your economic gains. For example, if a buyer offers a hump sum for all the sawlog and peeler log timber on your tract, divide the offered amount by the total number of board feet you have for sale to see how much was offered per thousand board feet. Then compare this to the average current price for sawlogs and peeler logs in your area. For example, if the current average price for sawlogs and peeler logs is $ 193 per thousand board feet, and someone offers $60,000 for the 700,000 board feet given in the above example, the offer appears law. But, if one didn't know he had 700,000 board feet to sell, the $60,000 may seem like a lot of money and he might quickly agree to the offer.

The current average value per thousand board feet of sawlogs and peeler logs can be obtained from your local Extension agent, state forester or consulting forester to compare to the offered price. Prices quoted represent average values. Your timber may be worth more or less depending on tree quality and size, tract location, hauling distance to the mill, difficulty of terrain for logging and other factors. Price variation can be as much as $100 per thousand board feet between the low and high sales in the area.



The cruise data is also used by the forester to estimate the pulpwood cords available. A standard cord is a stack of wood containing 128 cubic feet, nominally 4' wide, 4' high and 8' long, but it can be any dimensions that give 128 cubic feet. The forester records the number of cords for the pulpwood trees measured on the sample plots of the timber cruise (Table 3) using published volume tables that give cubic feet of each tree based on DBH and merchantable tree stem length. The total cubic volumes obtained from the cruise are used to calculate the average acre of the entire timber tract, and to estimate the total. This is done by multiplying the average number of cords per acre by the total number of acres in the entire tract. For example, in Table 3, the average pine pulpwood volume is 4.1 cords per acre. Thus, if the total timberland tract is 129.34 acres, there is approximately 530.3 cords of pine pulpwood in the entire tract. This is the quantity of pulpwood you have for sale. The forester will make an additional notation on the cruise sheet to separate pine from hardwood pulpwood and from Chip-N-Saw material, to take advantage of price variation.

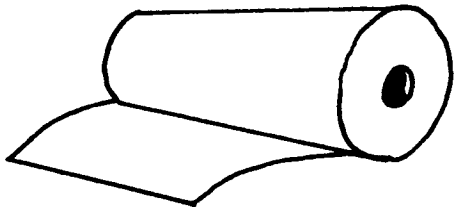
You must know the volume of pulpwood on your tract to have a complete estimate of the total quantity of products you have for sale. For example, we now combine the previous estimate of 700,000 board feet of sawlogs and peeler logs with the 530.3 cords of pine pulpwood to get the complete quantity of products available for sale on the example 129.34 acres of timberland. If the current average price for sawlogs and peeler logs is $193 per thousand board feet and $15 per cord for pine pulpwood, the total value of the timber products for sale is $143,054.50. Thus, one can now evaluate offers made for this tract of timber or make sound economic decisions regarding the management of this tract of land.

Weight Measurements

Weight is often used in purchasing pine sawlogs, peeler logs, and pulpwood. Owners need to know conversion factors to receive fair value for their timber.

Weight-to-volume relations, tons per thousand board feet or cord, vary by area, time of the year, and timber size and species. Most mills that purchase timber by weight use average conversion factors for a particular tree species.

Pulpwood is purchased on a green weight per cord basis. Weights per cord vary from area to area because of varying wood density and moisture content. Southern yellow pines show large differences. Loblolly and shortleaf pine ranges from 2.3 to 2.6 tons per cord, while longleaf and slash pines have an average value of 2.8 tons per cord. Consult your local Extension agent, state forester, or consulting forester for conversion factors for your area.



Sawlogs and peeler logs also may be purchased by green weight per thousand board feet. Weights per thousand board feet vary by area and species due to specific gravity and moisture content differences, as in pulpwood. Small logs do not yield as much lumber as large logs, because they have a higher residue percentage in bark, slabs, edging and sawdust. Consequently, a ton of large logs will usually produce more lumber than a ton of small logs.

Board feet to weight measurements are similar for loblolly and shortleaf pine, and these species can be grouped. Slash and longleaf pine are also similar, but are usually fisted individually. Conversion factors for loblolly and shortleaf pine average 8.9 tons per thousand board feet and 12.0 tons per thousand board feet for longleaf and slash pines. With board feet yields per ton varying with log diameter, conversion factors are grouped by DBH, usually 10-12 Indies, 14-16 inches and 18 inches and over. Again, check with your local Extension agent, state forester, or consulting forester to obtain conversion factors for your area. However, the average values given above can be used to quickly see if an offer for your timber is fair. For example, if you have 700,000 board feet of loblolly and shortleaf for sale, the average conversion factor for these species is 8.9 tons per thousand board feet. If the current price for pine timber is $200 per thousand board feet, a price based on weight is found by dividing $ 200 per thousand by 8.9 tons per thousand board feet to get a total of 6,230 tons. The total value is calculated by multiplying 6,230 tons by $22.47 per ton which equals $139,988.10. The same value is obtained by multiplying 700 thousand board feet by $200 per thousand board feet, $140,000 (the difference is due to rounding).

How to Sell Your Timber Products

Having the data to make economic decisions, how should you go about selling your timber? How do you put your timber up for bid, develop a written sales contract, determine if the logging operation meets contract agreements, or understand income tax benefits? If you plan to sell only a portion of your timber, how can you determine which trees to sell? You can obtain professional assistance from a variety of sources, including local Extension agents, state foresters, the Soil Conservation Service, the Agricultural Stabilization and Conservation Service, forest products industries, and state forestry associations. A consulting forester working for you can often maximize your economic gains. Contact several consulting foresters and select the one with whom you can best work. The consultant works for you and is paid to achieve your goals. He will inform you of the economic potential of alternative management methods. You can then determine how you want to proceed.

The forester who you hire should be familiar with industry product specifications and who the major buyers are in your locality. He can mark trees for sale to improve your timber stand, as well as meet industry specifications. He can tally the volume of the marked timber by DBH classes and send sale notifications to buyers. Interested buyers would then submit bids from which you can select a reject any offer. The highest bid is not necessarily the best choice if the bidder has a reputation for poor logging practices.

When you accept a bid, the offered money can be paid before any timber is cut. This is termed a lump-sum payment and is usually the best economical way to sell timber. Because it transfers risk from the seller to the buyer a consultant will usually insist that this method be used if the timber volume is large enough to attract several bidders.

The other common method of receiving payment is on an "as cut" basis where you receive periodic payments based upon weight or volume scale receipts from the mill when wood is delivered.

When you accept a bid for your timber, the professional forester will develop a written sales contract between buyer and seller. It will cover many items important to both, such as guaranteed entrance and exit to the timber, time allowed for the buyer to remove the timber, penalties for cutting unmarked timber, destroying fences, damaging timber improvements or landscape with equipment, and other limitations and agreements. Sample contracts are available from Extension agents, state forestry personnel, and others. Your forester will periodically inspect the harvest to assure that the buyer is meeting contract agreements.

The consultant's fee is generally based on a percentage of the gross timber sale. The percentage varies with services rendered. For example, if the timber tract is to be clearcut, there is little need to mark and tally the timber since it will be sold based on timber cruise data. The forester may charge a smaller percentage fog this type of sale. He may prefer to charge a daily rate for time on this job, but the payment is what you and your forester agree upon prior to work being done.

If your timber is small, less than 75 thousand board feet or only a few hundred cords of pulpwood, it may be difficult to market your timber using the lump-sum payment method. You may have to accept a payment for each truckload hauled. Unless you are clearcutting, the timber should still be marked and tallied so you know the volume to be removed. If a clearcut is planned, use timber cruise data to determine the volume removed. A possible drawback to this method is that the buyer may not remove all trees, leaving the low quality timber that must be removed to improve your stand.

Whatever the sale method used, know what you have for sale by quantity and quality before selling. Without such information, it is impossible to know if you are getting a fair price. Would you sell your home without having it appraised? Obviously not, and you probably have a better idea of the value of your home than of the timber you wish to sell. So seek professional advice or services and receive full value for your timber.

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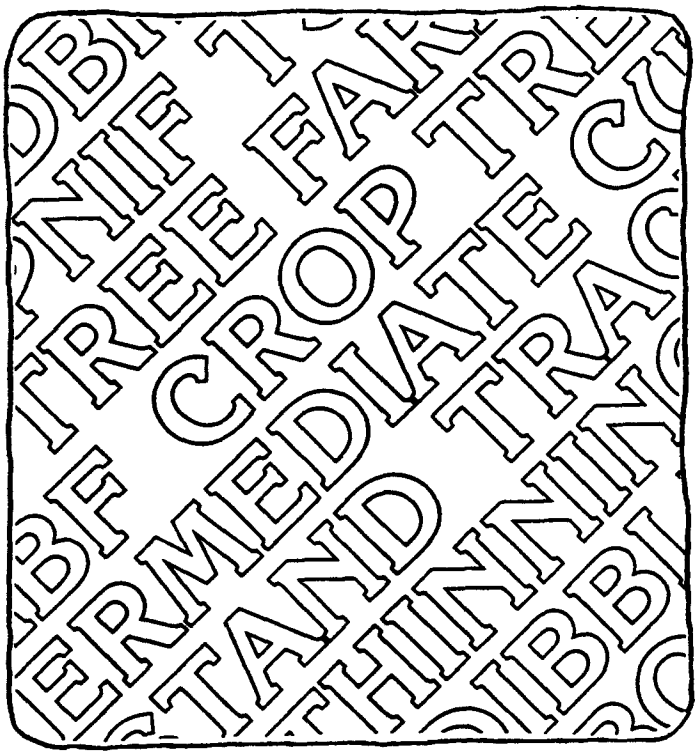
Southern Region

11

GLOSSARY

Thomas A. Monaghan
MS Cooperative Extension Service



THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

1. The Southern Pine Forest
2. Forestry as an Investment
3. The Major Southern Pines
4. Importance of Soil to Tree Growth
5. Regenerating Southern Pines
6. Intermediate Stand Management
7. Pine Insects, Diseases & Wildfire
8. Timber and Wildlife
9. Harvesting Southern Pines
10. Marketing Southern Pines
11. Forestry Terms (Glossary)
12. Forestry Assistance Available

As you manage your timber, you will come n contact with foresters who may use terms with which you are unfamiliar. This chart will help you better understand special terms and abbreviations commonly used in forestry and in making decisions about the productive management of your timber.

Titles of Foresters *

Acquisition Forester	A forester whose primary responsibility is to purchase or lease forestland for the organization he represents.
Area Forester	An industry or agency forester in charge of a particular area (or county) within an administrative district.
Consulting Forester	A self-employed forester, who, for a fee, assists private landowners with timber sales and forest management practices. Some consultants provide general assistance, others specialize.
County Forester (County ranger)	Usually a forester employed by a state forestry agency to accomplish agency functions in a particular county
District Forester	An administrative forester responsible for coordinating the operations of an agency or industry in a specific area.
Extension Forester	A forester who works for the Cooperative Extension Service to develop and provide technical information for state forestry interests. His primary responsibility is group education, and includes preparing materials for local aril regional educational activities. He works through local Extension personnel and uses local facilities.
Forest Ranger	A U.S. Forest Service forester in charge of part of a national forest referred to as a district. Forest rangers, or district rangers, supervise the management activities of their districts, including fire control, tree planting, recreational activities, and thinning and harvesting. District rangers do not normally provide assistance to private landowners.

These terms, as well as a number of others including Area Supervisor, Area Manager Regional Forester, Unit Forester Division Manager, Forest Manager and others are used b y various agencies, organizations, and companies to identify positrons held by foresters. The duties and responsibilities of these positions may vary dramatically from *one organization to another.*

Forest Supervisor A U.S. Forest Service employee who coordinates all activities in a particular national forest, but primarily supervises personnel and administers programs on the forest.

Industrial Forester A forester employed by a forest-based industry. This individual may manage company-owned woodlands to produce forest products, may work with private landowners to purchase forest products for the company (see Procurement Forester), or may provide assistance to PNIF owners (see Landowner Assistance program Forester).

Landowner Assistance Program Forester An industrial forester who provides advice and assistance to private, nonindustrial forest owners.

Procurement Forester An industrial forester who buys timber from private and pubic landowners.

Professional Forester In the usual context, this term refers to a person who has been graduated from a professionally accepted 4-year college forestry curriculum.

Registered Forester A person who has been registered and licensed by a state. Qualifications for registration may be gained by education and/or practical experience. Licensing of foresters is not required by all states.

Forestry Terms

Absentee Landowner Landowners who do not live in the county in which their land is located.

Acid soils Soils with a pH value below 7.0. Pines grow well in acid soils. Generally hardwoods do not grow well in soils with a pH value below 6.0. The pH scale ranges from 0 to 14 with midpoint of 7.0.

Acre An arms of land containing 43, 560 square feet or 10 square chains. A square acre would be about 209 feet by 209 feet. A circular acre would have a radius of 117.75 feet.

Ad valorem tax Annual taxes assessed on the basis of land value. In some states, timber value is included.

Aesthetics The natural beauty and other pleasing characteristics of a forest.

All-aged stand A forest stand with trees of many different ages and sizes. All-aged or uneven-aged contrasts with "even-aged."

All-aged or uneven-aged management Managing a forest by periodically removing individual mature trees or groups of mature trees from the stand while preserving its natural appearance. This type of management is common in hardwood forests. See selection method and all-aged stand.

Allowable cut The volume of wood that can be cut from a forest during a given period without exceeding the forest's net growth during that same time period. This concept is normally used in management of large ownerships.

Artificial regeneration Establishing a new forest by planting or direct seeding.

Basal area (a) Of a tree: the cross-sectional area (in square feet) of the trunk at breast height (4'/$_2$ feet above the ground). For example, the basal area of a tree 14 inches in diameter at breast height is about 1 square foot. Basal area = 0.005454 times diameter squared. (b) Of an acre of font: the sum of basal areas of the individual trees on the area. For example, a well-stocked pine stand might contain 80 to 120 square feet of basal area per acre.

Board foot A unit of wood equalling 144 cubic inches. The term is commonly used to measure and express the amount of lumber in trees, sawlogs or veneer logs. Board feet in a piece of wood is determined by: (length in feet x width in Inches x thickness in inched divided by 12.

Bole The main trunk of a tree.

Bolt A short log or section cut from a log less than 8 feet long. A common pulpwood bolt measurement is 5 feet, 3 inches. h may vary from 5 to 8 feet depending on method of transportation used.

Breast height Four and one-half (4'/~ 1 feet above ground level. See diameter breast height (DBH).

Browse Leaves, buds, and twigs of shrubs and trees which are eaten by wildlife, especially deer.

Bucking Sawing felled trees into shorter lengths.

one area to protect another area. Buffer strips of standing trees may be used to shield an area from view, to remove sediment from water before it enters a stream, or buffer strips of felled trees may be used to prevent the spread of forest pests.

Bunching Stacking logs together to form a load before being transported.

Canopy The layer of tree gowns in a forest.

Chain A unit of distance measurement used by foresters and surveyors. One chain = 66

Chip-N-Saw (Chip and saw) A sawing method in which trees in the 7- to 10-inch DBH loss are cut into lumber (usually 2x4s) and the remaining slabs are chipped for use in pulp and paper manufacturing. Also refers to trees (or stands of trees) that might be used as Chip-N-Saw material. The Chip-N-Saw allows lumber to be cut from pulpwood-size trees, thereby making chip-n-saw trees more valuable than pulpwood.

Choker A noose of wire rope for skidding logs.

Clearcut A harvesting and regeneration method which, when properly used, removes all the trees (regardless of size) from an area. Clearcutting, followed by site preparation and planting, is most used with species like pine which require full sunlight to reproduce and grow well. Clearcutting produces an even-aged forest stand.

Climax forest The final stage of plant succession, is usually made up of oak and hickory. In the South, pine is generally not part of the climax forest.

Codominant Trees with medium-sized crowns forming the general level of the crown cover. They are crowded and receive full light from above but little light from the sides.

Competition The struggle among adjoining trees for sunlight, nutrients, water, and growing space. Competition exists among both the roots and crowns of trees in the same stand.

Cone The "fruit" of pine trees and other conifers. Cones contain many seeds.

needle-like or scalelike foliage and conelike reproductive structures. They are usually evergreen and often are called softwoods.(Baldcypress is a deciduous conifer).

Conservation The protection, improvement, and wise use of natural resources to provide the present and future greatest social and economic value for the

Controlled burning See prescribed burning.

Coppice A regeneration method in which the forest stand regenerates primarily from stump and root sprouts after clearcutting.

Cord A stack of round or split wood containing 128 cubic feet including wood, bark, and air space. A standard cord measures 4 feet by 4 feet by 8 feet. A face cord or short cord is 4 feet by 8 feet of any length wood less than 4 feet.

Crap tree A tree identified to be grown to maturity and for final harvest cut. Crop trees are usually selected according to spacing, quality, and species.

Crown The branches and foliage of a tree.

Cruise A survey of forestland to locate timber and estimate its quantity (volume) by species, products, size, quality, and other characteristics.

Cubic foot A volume measurement containing 1, 728 cubic inches, such as a piece of wood measuring 1 foot on a side A cubic foot of wood contains about 6 to 10 usable board feet of lumber rather than 12 board feet because some wood is lost as sawdust and shavings during processing.

Cut A tree a log of merchantable size made useless for all but firewood because of shape, disease, insect infestation, or injury.

Cunit A pulpwood measurement meaning 100 cubic feet of solid wood.

Cutting cycle The planned time interval between harvesting operations in a stand. For example, a cutting cycle of 10 years In a hardwood stand means a partial harvest every 10 years.

Cutting contract A written, legally binding document used in a sale of standing timber. The contract states the provisions both the buyer and seller want and expect.

DBH Abbreviation for tree diameter at breast height. (4 ½ feet above the grand). DBH is usually measured in inches.

Deciduous tree A tree which loses all its leaves at some time during the year. These are primarily hardwoods such as oak, hickory, ash, sweetgum, but Southern magnolia and American holly are evergreen hardwoods.

Deck, log A concentration area where logs are stacked or piled for transportation or Processing.

Defect Any blemish or characteristic of a tree or keg that causes a loss of value. Defects include such things as rot, crookedness, cavities, excessive number of limbs, etc.

Delimbing Removing limbs from a felled tree.

Delivered price Price per cord or thousand board feet at the first point of concentration a the wood yard. Price includes expenses of labor, transportation, and cost of standing trees.

Dendrology The study of the identification, habits, and distribution of trees.

Diameter The length of a straight line passing through the center of a tree trunk. Tree diameter is usually measured 4 ½ feet above ground level. (see DBH), but log diameter is measured at the small end.

Diameter limit cutting A method of harvesting whereby all merchantable trees above a specified minimum diameter are harvested. Minimum diameter may be specified as breast height a stump diameter. This cutting method is a form of high-grading and is generally not recommended for hardwood stands. It should be used only in limited situations in pine stands.

Dibble (bar) Also called a planting bar. A tool used for planting bare-coated seedlings by hand. A dibble is about 4'/$_2$ feet in length with a 10-inch heavy, wedge-shaped blade.

Direct seeding A method *of* artificial regeneration whereby tree seeds are sown on the surface *of* a prepared site.

DOB (or d.o.b.) Abbreviation for diameter outside the bark. Used in estimating a tree's volume. For example, when counting the number of 1 6-foot sawlogs in a standing tree, the cruiser knows the merchantability limit is 6 inches d.o.b. (or 4 inches, or 8 inches).

Dominant tree Tree having a crown extending above the general level of the crown cover and receiving full light from above and partly from the side; larger than the average trees in the stand, with well developed crown, but possibly somewhat crowded on the sides.

Easement An interest a right to limited use of land granted by the owner to another party.

Entomology, forest The science that deals with insects in their relations to forests and forest products.

Even-aged forest A forest of trees which are about the same age (usually within 5-10 years). An even-aged forest may be a natural or an artificially regenerated stand.

Even-aged forest management Periodic harvesting of all trees (clearcutting) from an area, followed by artificial a natural regeneration. Periodic thinnings are usually included as intermediate practices.

Evergreen tree A tree which retains some or all of its leaves throughout the year. Usually, but not always, a conifer.

F.I.P. (Forest Incentive Program) A federal cost-sharing program administered by the Agricultural Stabilization and Conservation Service (ASCS) which provides payments to landowners who complete certain approved forest management practices such as site preparation and planting.

Firebreak (or fine lane) A natural or man-made barrier usually created by the removal of brush, trees, leaves, and other vegetation. Used to prevent the spread of fire.

Fire danger rating Numerical classification of the measurement of weather and fuel factors. It indicates how readily a fire will ignite and spread after 't starts. Classification is from 1 to 5; 1 = low and 5 = high.

Forest A plant community dominated by trees and woody plants. From a management standpoint, a forest is a collection of stands managed as a unit.

Forest Genetics The study of the inherited characteristics of forest trees.

Forest Management (a) Giving the forest proper care so it stays healthy and vigorous and provides the products and values the landowner desires. (b) Technical definition: Applying technical forestry principles and practices and business techniques (such as accounting, benefit-cost analysis, etc.) to forests.

Forest Management plan Usually a written document which includes overall guidelines and recommended practices for current and future management to meet the owner's objectives.

Forest type Groups of tree species commonly found growing together in the same stand because their environmental requirements are similar.

Forestry The science, art, and practice of managing and using trees, forests, and their associated resources for human

Forty A land tract of 40 acres, usually ¼ mile square.

Forwarding Carrying logs off the ground from stump to landing.

Girdling A man-made frill or animal, insect, a disease damage completely encircling the tree trunk, going through the bark and cambium, and penetrating the sapwood. Girdling usually kills the tree by stopping the flow of nutrients and water between the sown and roots.

Grading Evaluating and sorting trees, logs, or lumber according to quality and size.

Group selection See selection method.

Growing stock All five trees (except route and rotten trees) in a forest or stand, including sawtimber, pole timber, saplings, and seedlings.

Habitat The natural environment of a specific plant or animal. An area containing all the necessary resources for the plant or animal to live, grow, and reproduce.

Hardwood A term describing broadleaf, usually deciduous, trees such as oaks, maples, ashes, elms, etc. The term does not necessarily refer to the hardness of the wood. Some hardwoods (such as live oak and American holly) are evergreen.

Harvest (a) In general use, removing some or an the trees on an area. (b) Technical definition: Removing trees on an area to 1) obtain income; 2) develop the environment necessary to regenerate the forest; and, on occasion, 3) achieve some special objectives such as the development of special wildlife habitats.

Harvesting methods See clearcut, seed tree method, selection method, shelterwood harvest, and high-grading.

Height, merchantable Refers to the height (length) of a usable tree trunk. It is measured up to a point on the trunk where the diameter is too small to obtain a particular product. The product being cut determines the merchantable height. For example, if the minimum usable diameter of pulpwood is 4 inches, the merchantable height of a pine tree would be its height up to a trunk diameter of 4 inches.

Height, total Tree height from ground level to the top (of the tallest branch) of the crown (i.e.: the tip of the terminal bud).

Herbicides Chemicals used to kill plants.

High-grading The practice of removing only the biggest and best trees from a stand during a harvest, and leaving according to quality and lowest-quality culls to dominate only the e or reproduce the forest.

Improvement cut A type of intermediate harvest with the primary objective of improving the remaining stand. See TSI and intermediate cut.

Improved Seedlings See superior seedlings.

Increment borer A hollow auger-like instrument used to bore into a tree trunk to remove a wood core that shows the tree's growth rings.

Intermediate art Removing gyre trees from the forest sometime between reproduction and maturity to improve the quality of the remaining forest stand. An intermediate cut may or may not generate income (see

Intermediate trees Trees shorter than dominant and codominant trees, but with crowns extending into the crown cover formed by the dominant and codominant trees. These trees receive little light from above and none from the sides. They usually have small gowns considerably crowded on the sides.

Inventory See cruise.

Landing A place where logs are collected and prepared for further transportation.

Log (a) A piece of the woody stem (trunk or limb) of a tree. (b) The trunk portion of a tree. (c) In the East, a tree section exactly 16.3 feet in length, inducting trim allowance.

Logger An individual whose occupation is harvesting timber. He usually is in business for himself, owns his own equipment, and has one or more employees.

Logging The practice of harvesting timber.

Log scale See scale, log.

Lump-sum sale See sale, lump-sum.

Log rule An equation used to calculate the amount of lumber that can be cut from logs. Several log rules are in popular use.

Log yard See yard.

Management See forest management.

Mature tree A tree that has reached the desired size or age for its intended use. Size a age will vary considerably depending on the species and intended us. When a mature tree begins to deteriorate, it is considered to be overmature.

MBF An abbreviation meaning one thousand board feet. A unit of measure for tree a sawed lumber volume.

Mensuration That phase of forestry dealing with the measurement of present and future volume, growth, and development of individual trees and stands and their timber products; also measurement of forestlands.

Merchandising The practice of selling and using timber for the highest value product possible.

Merchantable height See height, merchantable.

Merchantable timber A stand in which trees are of sufficient size and volume per acre to provide a commercial cut.

Mill sale See sale, mill.

Mill scale See scale, mill.

Mineral rights The ownership of minerals (coat, (Al, gas, etc.) under a given surface and the legal right to enter that area and mine a remove them. Includes the right to use as much of the land surface as may be reasonably necessary for the conduct of mining operations.

Mortality Trees dying from natural causes.

Multiple use Land management for more than one purpose, such as wood production, water, wildlife, recreation, forage, aesthetics, and dean air.

Natural stand A stand of trees resulting from natural seed fag or sprouting.

National forests Public Ids administered and managed by the U.S. Forest Service. These are dedicated to the long-term benefit of present and future generations.

Net growth The net increase in volume of timber for a certain area of land for a certain period of time. This includes the gross increase in the volume of trees from beginning to end of the time period, plus the volume of trees which become merchantable during the period, minus the volume of trees which die a become rotten.

Overtopped trees Suppressed trees. Trees with crowns entirely below the general level of the crown cover. They receive little or no direct light from above or from the sides.

Pathology forest The science that deals with diseases of forest trees, stands, and products.

Pesticides A collective term meaning chemicals, including herbicides and insecticides, which are used to combat pests such as weeds, diseases, insects, or unwanted trees.

Photo-grammetry The science of interpreting and making reliable measurements from aerial photographs.

Plantation A forest established by planting, h is usually made up of a single species.

Pole timber Trees whose diameters range from 4 inches to about 8 to 12 inches DBH.

PNIF Private, nonindustrial forest.

Precommer-cial thinning See thinning.

Prescribed burn (a fire) The controlled use of fire to achieve forest management objectives. Prescribed fire can be used to reduce hazardous fuel levels, to control unwanted vegetation, improve visibility, and improve wildlife habitat.

Prescription, stand Usually a document written by a forester prescribing present and future treatments for a forest stand.

Preservation (a) With respect to land, maintaining a natural environment undisturbed by human influence or activities. (b) As applied to wood, treating wood products with chemicals to prevent damage by insects or decay orgasms.

Pruning Removing live or dead branches from standing trees. Some natural self-pruning occurs as lower limbs are shaded out by the forest canopy.

Pulpwood Wood cut primarily to be converted into wood pulp for the manufacture of paper, fiberboard, or other wood fiber products. Pulpwood size trees are usually a minimum of 4 to 6 Indies DBH.

Reforestation Re-establishing a forest by planting or seeding an area where forest vegetation has been removed.

Regeneration See reproduction.

Regeneration cut A harvest operation to remove the old trees and leave environmental conditions favorable for establishment of reproduction.

Release cutting A harvest made to improve the growing conditions for crop trees in young stands. Release cuttings are used to control species composition and improve the quality of forest stands.

Remote sensing A means of acquiring information using airborne equipment and techniques to determine the characteristics of an area. Aerial photographs from aircraft and satellites are the most common forms of remote sensing.

Reproduction (a) Young trees which will grow to become the older trees of the future forest. (b) The process of forest replacement or renewal. This may be done artificially by planting seedlings or seed, or naturally by sprouting or natural seeding.

Right-of-way The legal right of passage over another person's land. This is important in timber. harvesting operations when access is limited.

Rotation The number of years required to establish and grow trees to a specified size, product, or condition of maturity.

Roundwood Wood products which are round such as pulpwood, posts, piling, poles, firewood, and sawlogs.

Salvage cut Harvesting dead trees or those in danger of being killed (by insect, disease, flooding, etc.) so they can be sold before they lose their value.

Sampling Taking detailed measurements of selected smart parts of a forest in order to gain information about the whole forest.

Sanitation art Harvesting or killing trees infected or highly susceptible to insects or diseases to protect the rest of the forest land.

Sapling A small tree, usually between 1 and 4 inches DBH.

Sawlog A log large enough to be sawn into lumber, usually at least 10 to 12 inches in diameter, and 8 inches or larger at the small end.

Sawtimber stand A group of trees with many or most of the trees large enough to be sawn into lumber.

Sale, log The sale of sawlogs or sawtimber size trees.

Sale area The land area which contains the trees that are to be sold; the area that will! be affected by the harvesting operations.

Sale, lump-sum The sale of a specified number or volume of trees for an agreed total price. The price is paid, or committed through promissory notes, before the timber is cut.

Sale, mill Sale paying the landowner for the volume of lumber produced at the sawmill.

Scale, mill The volume of roundwood products, such as logs, expressed in board feet, cubic feet, etc.

Scale stick A flat stick, similar to a yardstick, calibrated so that the log volume can be read directly when the stick is placed on the small end of a log of known length.

Second growth Forests that reproduce naturally after removal of the original forest by cutting, fire, or other cause.

Section A legal unit of land containing approximately 640 acres; one square mile made up of 16-forties.

Seed tree method Removing all trees from the harvest area at one tune, except for a few scattered trees left to provide seed to establish a new forest stand. Seed trees are high quality trees, carefully selected and marked before the harvest.

Seedling (a) A tree, usually less than 1 inch in DBH, which has grown from a seed (in contrast to a sprout). (b) A nursery-grown tree which has not been lifted and replanted (see transplant).

Seed year A year in which a given species produces (over a considerable area) a large seed crop. Some species of trees have irregular or infrequent seed production.

Selection method Harvesting individual trees a small groups of trees at periodic intervals (usually 5 to 15 years) based on their physical condition or degree of maturity. This produces an uneven-aged stand. Trees selected are usually marked and tallied.

Severance tax A tax in some states on forest products after they are cut. It is usually paid by the first processor.

Shade tolerance A tree's capacity to develop and grow in the shade of, and in competition with, other trees.

Shelterwood harvest Removing trees on the harvest area in a series of two or more cuttings so new seedlings can become established from the seed of older trees. This method produces an even-aged forest.

Silviculture The art, science, and practice of establishing, tending, and reproducing forest stands of desired characteristics. It is based on knowledge of species characteristics and environmental requirements.

Site (a) A tract of land with reasonably uniform soil and climatic factors. (b) An area with the capacity to produce a particular forest or other vegetation because of biological, climatic, and soil factors.

Site index A measure of forest site quality based on the height (in feet) of the dominant trees at a specified age (usually 50 years for natural stands and 25 for planted stands). A site index of 95 means that the expected heist of the dominant trees at an index age of 50 years would be 95 feet on that land.

Site preparation Preparing an area of land for planting, direct seeding, or natural reproduction by clearing, chemical vegetation control, burning, disking, chopping, bedding, windrowing, raking, or some combination thereof.

Skidding Pulling logs (by machine or animal) from the stump to the skidway, landing, or mill.

Slash Tree tops, branches, bark, or other residue left on the ground after logging, pruning, or other forest operations.

Softwoods Trees such as pines, spruces, firs, and cedars that are usually evergreen, cone-bearing, and with needles or scalelike leaves. Baldcypress is not evergreen, but is a softwood.

Soil texture The "feel" or composition of a soil based on the amounts of sand, sift, and clay in the soil.

Species (of trees) A group of related trees with common characteristics; capable of inter-breeding and classified into the same category

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	Loblolly pine and slash pine are the common names of two different species.
Sprout	A tree growing from the base, stump, or root of another tree of the same species.
Stands, **timber**	(a) FULLY STOCKED. A forest stand with all the growing space effectively occupied but having ample room for the developing crop trees. (b) OVERSTOCKED. Overcrowding in a stand leading to slow growth. (c) UNDERSTOCKED. A stand with the growing space not effectively occupied by crop trees. (d) MIXED STAND. A stand having less than 80 percent of the trees of a single species in the main crown canopy. (e) PURE STAND. A stand with at least 80 percent of the trees of a single species in the main crown canopy. (f) POLETIMBER STAND. A stand where most trees are from 5 to 10 inches in diameter. (g) SAWTIMBER STAND. A stand where most trees are large enough in diameter (usually 10 to 12 inches DBH or larger) to be sawn into lumber. (h) RESIDUAL STAND. The stand remaining after cutting. (i) OLD FIELD STAND. A stud on land once used for agricultural crops a for pasture.
Stem	The trunk of a tree; a, the trunk and salable branches of a tree.
Stocking (or, stocking level)	The number of trees in a forest stand. Often, stocking level is compared to the desirable number of trees for best growth and management, such as partially stocked, well-stocked, or over stocked.
Stumpage value	The dollar value of a tree or group of trees as they stand in the woods uncut (on-the-stump).
Succession	The natural replacement of one plant community by another until a climax forest is achieved. For example, an abandoned farm, if left to nature, would gradually go through different stages of vegetative cover and finally reach the climax forest stage after 100 or more years.
Sucker	See sprout.
Suppressed	See overtopped trees.
Super pine	See superior seedlings.
Superior seedlings	These are seedlings grown from seed produced by parent trees of high genetic quality. Usually, these trees grow 10-20 percent faster than ordinary seedlings. Also see tree improvement.
Sustained yield	Management of forestland to produce a relatively constant amount of timber and/or revenue.
Tally	To keep a record of selected forest or tree measurements. It usually refers to the recording of certain tree measurements such as height and diameter or number of trees.
Thinning	Removing unwanted trees from a stand. Generally, a cutting in an immature stand to reduce the number of trees per acre so test the romping trees will grow faster and produce higher-quality trees.
Timber	(a) Trees capable of being used for wood products. (b) A large, dressed piece of lumber used in forming part of a structure such as bridge timber.
Timber market	A term used to refer to the price of timber, the demand for timber, and the supply of timber.
Timber marking	The process of designating trees to be cut or trees not to be cut. This is usually done by spraying a spot with brightly colored paint at the base of the tree and another spot at eye level.
Timber sale	Activities dealing with the exchange of timber for money.
Timber sale Contract	An agreement between buyer and seller for the sale of timber that protects the interests of the buyer and seller. Written agreements are more desirable than verbal agreements.
TSI (Timber stand	Improving the quality of a forest stand by removing cull trees and brush, leaving a improvement) stand of good-quality trees. Cull trees may be removed by chemicals, fire, girdling, or cutting. The killing of cull trees by injection of herbicides through the bark is often called "TSI."
Tolerance	See shade tolerance.
Topography	The physical and natural features of an area of land. It usually refers to the elevation, slope, and shape of the surface of the area.

Tract A parcel of land considered separately from adjoining land because of differences in ownership, timber type, management objectives, or other characteristics.

Transplant A seedling lifted from the seedbed and replanted at least once in the nursery.

Tree A woody plant having a well defined stem, a more or less definitely formed gown, and usually a height of at least 10 feet.

Tree farm A privately owned forest (woodland) in which producing timber crops is a major management goal. It may be recognized and certified as a "Tree Farm" by the American Tree Farm System, an organization sponsored by the American Forest Institute, Washington, DC.

Tree improvement The practical application of forest genetics, usually done by testing wild trees and determining which will grow best when planted on specific sites. Just as dairymen select the cows that produce the most milk, tree improvement foresters select the trees that grow faster and produce more wood.

Tree injectors Tools or equipment specialty designed to inject chemicals into a tree trunk. Most common injectors can be hand operated by an individual.

Uneven-aged forest A forest with many ages of trees present (technically, more than two age classes) and considerable differences in the ages. See all-age management.

Uneven-aged forest management See all-aged forest management.

Volume table A table estimating the volume of wood in a standing tree based on measurements of the tree. It is most commonly based on the DBH and merchantable height.

Windthrow; windfall, (blowdown) An area of trees blown over by high wind.

Wolf tree An old, large, low-quality tree with a wide spreading crown. These trees occupy too much space in the forest and should be

Wood pub Mechanically ground or chemically digested wood (composed primarily of wood fiber) used to manufacture paper a fiberboard.

Yard A place where logs, sections of logs, pulpwood bolts, etc. are collected and stored prior to being processed or transported to the mill.

Yarder A machine or system of winches used with a tower and cables to haul logs to a Landing.

Yield table A tabulation of volume, basal area, number of trees, etc. per acre found in full stands on specified sites at specified ages.

Yield tax See Severance Tax.

These publications developed jointly by:
Cooperative Extension Service
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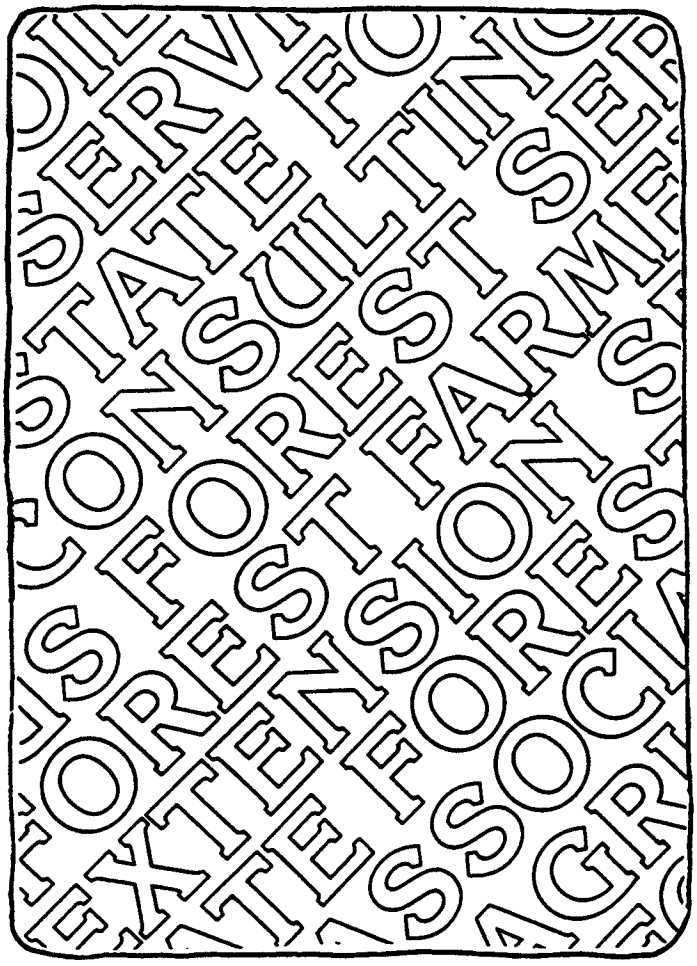
Southern Region

12 FORESTRY ASSISTANCE AVAILABLE

Robert L. McElwee
VA Cooperative Extension Service



THIS FORESTRY PUBLICATION IS ONE OF A SERIES ON SOUTHERN PINE MANAGEMENT.

1. The Southern Pine Forest
2. Forestry as an Investment
3. The Major Southern Pines
4. Importance of Soil to Tree Growth
5. Regenerating Southern Pines
6. Intermediate Stand Management
7. Pine Insects, Diseases & Wildfire
8. Timber and Wildlife
9. Harvesting Southern Pines
10. Marketing Southern Pines
11. Forestry Terms (Glossary)
12. Forestry Assistance Available

Precise answers and recommendations about your specific forest property are available from several sources, and you are encouraged to contact them.

These sources can provide educational, technical, and, in many instances, cost-share financial assistance to non-industrial landowners throughout the South. These sources:

1. State Forest Services - Each state in the south has a state forestry agency responsible for many activities important to forestry. Although responsibilities may vary slightly from state-to-state, most have as a portion of their work the production and sale of seedlings for plantation establishment, fire prevention and suppression, preparation of management prescriptions for landowners, administration of state and/or federal cost-share programs, enforcement of forestry practices and laws, and information programs. Each state forestry agency has county or regional offices where professional advice is available to landowners. Offices are listed in your telephone directory or the State Forester's Office can be contacted. State Forester's offices in the South are:

Alabama Forestry Commission
513 Madison Avenue
Montgomery, AL 36130

Arkansas Forestry Commission
Box 4523 Asher Station
3821 W Rosevelt Rd.
Little Rock, AR 72214

Florida Division of Forestry
3125 Corner Blvd.
Tallahassee, FL 32304

Georgia Forestry Commission
Box 181
Dry Branch, GA 31202

Kentucky Division of Forestry
627 Comment Trail
Frankfort, KY 40601

Louisiana Office of Forestry
P0. Box 1628
Baton Rouge, LA 70821

Mississippi Forestry Commission
908 Robert E. Lee Bldg.
Jackson, MS 39201

North Carolina Division of Forest Resources
PO. Box 27687
Raleigh, NC 27611

Oklahoma Forestry Divisi
2800 N. Lincoln Blvd.
Oklahoma City, OK 73105

South Carolina Forestry Commission
R O. Box 21707
Columbia, SC 29221

Tennessee Division of Fo
701 Broadway-Customs H
Nashville, TN 37203

Texas Font Service
College Station, TX 77843

Virginia Division of Forest
PO. Box 3758
Charlottesville, VA 22903

2. Cooperative Extension Service - State Cooperative Extension Services are responsible for the public educational and informational activities for the land-grant universities located in each state. Working

cooperatively between the U.S. Department of Agriculture, the universities and colleges, and cooperating local governments, extension specialists and agents provide educational programming for all interested groups and individuals. Educational programs and material are available on all aspects of natural resources management and utilization. Extension's assistance is available through your local Cooperative Extension Service agent fisted in the telephone directory under local government. Extension forestry specialists can be reached through your County Extension agent or by contacting the Cooperative Extension Service at the land-grant universities and colleges listed below:

ALABAMA

Auburn University
Auburn, AL 36830

Alabama A&M
PO. Box 53
Normal, AL 35762

Tuskegee University
108 Extension Bldg.
Tuskegee University,
AL 36088

ARKANSAS

University of Arkansas
PO. Box 391
Little Rock, AR 72203

University of Arkansas
Pine Bluff
PO. Box 82
Pine Bluff, AR 71601

FLORIDA

University of Florida
Gainesville, R. 32611
3428 Newins Ziegler Hall

Florida A&M University
PO. Box 339
Tallahassee, FL 32307

GEORGIA

University of Georgia
Athens, GA 30602

Fort Valley State College
P0. Box 4061
Fort Valley, GA 31030

KENTUCKY

University of Kentucky
Lexington, KY 40546

Kentucky State University
Box 196
Frankfort, KY 40601

LOUISIANA

Louisiana State University
Knapp Hall
Baton Rouge, LA 70803

Southern Univ. A&M College
PO. Box 10010
Baton Rouge, LA 79813

MISSISSIPPI

Mississippi State University
PO. Box 5426
Mississippi State, MS 39762

Alcorn A&M University
PO. Box 479
Lorman, MS 39096

NORTH CAROLINA

North Carolina State University
Biltmore Hall
Raleigh, NC 27650

North Carolina A&T State University
PO. Box 21928
College Greensboro, NC 27420

OKLAHOMA

Oklahoma State University
Agricultural Hall
Stillwater, OK 74078

Langston University
PO. Box 970
Langston, OK 73050

SOUTH CAROLINA

Clemson University
Forestry Bldg.
Clemson, SC 29631

South Carolina State College
Box 1765
Orangeburg, SC 29117

TENNESSEE

University of Tennessee
FO. Box 1071
Knoxville, TN 37901

Tennessee State University
Box 650
Nashville, TN 37203

TEXAS

Texas A&M University
College Station, TX 77843

Prarieview A&M University
PO. Box B
Prarieview, TX 77445

VIRGINIA

Virginia Tech
Cheatham Hall
Blacksburg, VA 24061

Virginia Stage University
Box 540
Petersburg, VA 23803

3. Consulting Foresters - Consultants throughout the South offer complete forestry services from site preparation and stand establishment through timber harvesting and marketing. Consultants can be found in the yellow pages of your telephone directory, and directories listing consultants can be obtained from your county Extension agent, Extension forester or state forestry representative.

4. Forest Farmers Association - Organized in 1941 to give private landowners a greater voice in matters effecting their interests. The membership includes private landowners, representatives from wood products industries, professional foresters manufacturers, and leaders in related fields. Costs are minimal and include a magazine subscription. Their address is: Forest Farmers Association, P0. Box 95385, Atlanta, GA 30347.

5. Forest Industry - Many wood-using industries offer assistance to landowners in the form of technical advice, management planning, site preparation and planting services and matching seedling programs. Local wood-using industries can be contacted to determine the extent of services available in your area.

6. State Forestry Association - Membership in state associations is open to all groups and individuals interested in good forestry practices. They sponsor many types of informational, educational, and service functions

for landowners and the general public. State associations in the South are:

Alabama Forestry Association, 555 Alabama St., Montgomery, AL 36014

Arkansas Forestry Association, 501 Woodlane Dr., Little Rock, AR 72201

Florida Forestry Association, PO. Box 1696, Tallahassee, FL 32302

Georgia Forestry Association, 40 Marietta, Suite 1020, NW, Atlanta, GA 30303

Kentucky Forestry Industries Assoc., Box 35, Morehead, KY 40351

Louisiana Forestry Association, P O. Drawer 5067, Alexandria, LA 71301

Mississippi Forestry Association, 201 Realtors Bldg., 620 N. State St., Jackson, MS 39201

North Carolina Forestry Association, Box 19104, Raleigh, NC 27609

Oklahoma Forestry Association, Box 517, Broken Bow, OK 74728

South Carolina Forestry Association, 4811 Broad River Rd., Columbia, SC 29210

Tennessee Forestry Association, 1720 West End Ave., Nashville, TN 37203

Texas Forestry Association, R O. Box 1488, Lufkin, TX 75901

Virginia Forestry Association, 1205 East Main St., Richmond, VA 23219

7. Southern Forest Institute - A non-profit, non-political organization supported by the forest products industry in the South to encourage the full development of the forest resource. It is a division of the American Forest Institute. Its programs include news and information services for media, group conferences, conservation communications training, Project Learning Tree and the American Tree Farm Program in the South. SFI manages the Tree Farm Program through State Tree Farm Committees. Its address is: Southern Forest Institute, 2900 Chamblee Tucker Road, Bldg., #5, Atlanta, GA 30341.

8. Sol Conservation Service - SCS conservationists and foresters include woodland advice in their farm conservation planning and are available to advise landowners on specific forestry questions. Contact them through your local SCS office.

9. Agricultural Stabilization and Conservation Service - ASCS county offices distribute funds to private non-industrial landowners for woodland conservation practices. An ASCS office is located in most counties in the South.

10. U.S. Forest Service - An agency of the U.S. Department of Agriculture, the USFS manages our national forest Ids in the South. In addition, the Forest Service conducts research applicable to management of privately owned lands and publishes information that is available from the Southeastern Forest Experiment Station, Box 2570, Asheville, NC 28802, and the Southern Forest Experiment Station, U.S. Postal Service Bldg., 701 Loyola Ave., New Orleans, LA 70113. The State and Private branch of the Forest Service assists state forestry agencies, industry, and individual landowners through publications, consultation, and other types of assistance. Headquarters for State and Private Forestry in the South is: U.S. Forest Service, 1720 Peachtree Rd., NW, Atlanta, GA 30367. USFS forestry specialists can also be contacted through your state forest service.

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