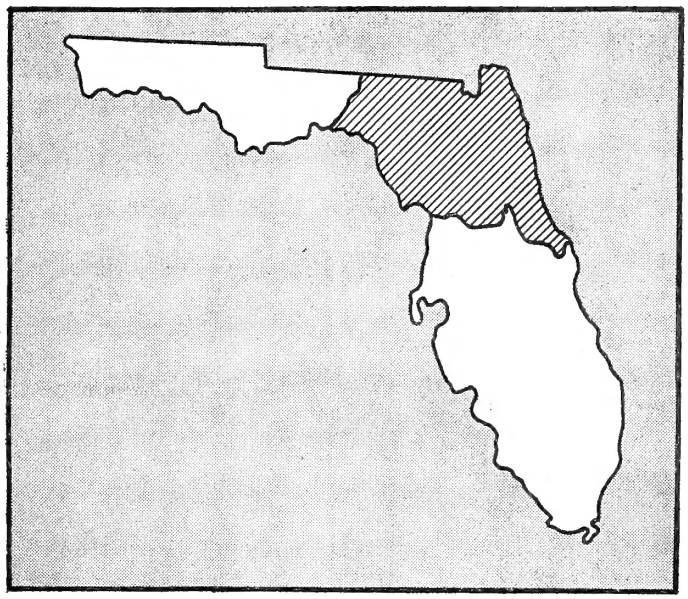
FOREST RESOURCES of Northeastern Florida



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Forest Resources of Northeastern Florida

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SOUTHERN FOREST EXPERIMENT STATION

FOREST SERVICE

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The Forest Survey

EFFECTIVE rehabilitation and constructive management of this country's forest resource require not only protection against neglect and destruction but, with equal urgency, provision for permanent and wise use of that resource. Wisdom in forest land-use planning must rest on a long-time economy backed up by reliable facts as to supply and requirements for wood and other forest products, production and consumption, depletion and growth, and the location, area, and condition of existing and prospective forest lands. This requirement for dependable and comprehensive technical information is now being translated into action through the provisions of the McSweeney-McNary Forest Research Act of May 22, 1928, authorizing a Nation-wide forest survey.

The Forest Survey, as constituted under that act, is obtaining essential field information and, through interpretation thereof, is aiding in the formulation of guiding principles and policies fundamental to a system of planned management and land use for each forest region and for the Nation.

The five-fold purpose of the Forest Survey is: (1) To make a field inventory of the present supply of timber and other forest products, (2) to ascertain the rate at which this supply is being increased through growth, (3) to determine the rate at which it is being diminished through industrial and domestic uses, windfall, fire, disease, and other causes, (4) to determine the present consumption and the probable future trend in requirements for timber and other forest products, and (5) to interpret and correlate these findings with existing and anticipated economic conditions, as an aid in the formulation of both private and public policies for the effective and rational use of land suitable for forest production.

It is planned to publish the results of this investigation as they become available. These publications apply to large areas and should not be interpreted as portraying correctly the forest situation for small sections, the condition of which may be either better or poorer than the average for the entire unit. They supply the general framework upon which to base intensive studies of critical situations.

The investigation is conducted in the various forest regions by the forest experiment stations of the Forest Service, and in the South by the Southern Forest Experiment Station, with headquarters in New Orleans, La.

Contents

Introduction and Explanation of Terms Used

NORTHEASTERN Florida is distinctly different from any other section of similar size in the United States. As soon as one crosses the State line from Georgia, he finds ownership of land in larger tracts, a different tax situation, and less intensive management of forests. Over three-fourths of the survey unit is in forest, and most of the sites here are better than those to the south and west. Furthermore, this section is unusual in that the principal transportation systems focus on a single point, Jacksonville, to which turpentine, rosin, and the other forest products are brought for redistribution throughout the world.

In planning for the development of northeastern Florida, it must be recognized that forests have long been the most important source of its basic raw materials. A knowledge of the kind, character, and quantity of these materials and of the industries engaged in their utilization is essential to the formulation of sound forest policies that will benefit both present and future generations. A summary of present knowledge of these factors is presented in this report, together with their significance and their relation to the industries and communities dependent upon the forest resources. Certain lines of action in regional planning can be suggested now, but the solution of the general problems of forest land use and industrial development must wait until the whole southern pine region, of which this survey unit forms a part, is analyzed.

This report on northeastern Florida, or Florida Unit No. 1—one of several key units in the South covered by the Forest Survey—is based on a survey conducted between the latter part of November 1933 and the end of July 1934. A number of trained three-man crews recorded the conditions on 11,956 quarter-acre plots distributed at ⅛-mile intervals along lines 10 miles apart, running approximately east and west. For each plot the crews recorded the class of land use; and on forest plots they recorded the forest type and condition, tallied the trees by species and diameter classes, and determined the rate of growth of the timber during the past 10 years. The data obtained, when used as a statistical sample, indicate that the larger figures for the major classifications are reliable to within 5 percent. For relatively small figures in a given classification the reliability may be less, however, and such figures should be regarded only as indicative. Also, data concerning industrial conditions and forest depletion were obtained on all of the naval stores still operations and on a large number of the wood-products industries. Present consumption and probable future trends in national requirements for timber and other forest products are being studied on a Nation-wide basis and will be treated in a separate report.

The following definitions of the technical and unusual terms used in this report are given below to facilitate easy grasp of the forest situation discussed herein.

General

Forest Survey Unit.—The term "forest survey unit" means an area of 2 to 10 million acres in which forest, economic, and industrial conditions are reasonably homogeneous. The division of a State in this manner facilitates analysis and discussion of the forest situation.

Naval stores unit.—This unit is equivalent to one 50-gallon barrel of turpentine and three and one-third 500-pound (gross) barrels of rosin.

Land-use Classes

Productive forest land.—Forest land that has the qualities essential for the growth of commercial timber.

Nonproductive forest land.—Forest land that does not have the qualities essential for the growth of commercial timber.

Cultivated agricultural land.—Land being used for the production of farm or orchard crops, or that shows evidence of having been so used during the preceding 2 years.

Idle agricultural land.—Cultivated land that has been idle for 2 years or more but has not reached the abandoned stage.

Abandoned agricultural land.—Formerly cultivated land that shows distinct signs of having been abandoned for agricultural crop production; no attempt has been made to maintain it as improved pasture.

Improved pasture.—Cleared or open land that is under fence, used primarily for grazing and upon which an attempt has been made to maintain a sod.

Other areas.—Areas included within the corporate limits and suburban or industrial sections of cities and communities; power, rail, and highway rights-of-way; marsh; nonmeandered waterways; and prairie.

Forest Types

Longleaf pine.—Longleaf pine constitutes at least 75 percent of the board-foot volume in sawlog-size stands and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands. This type is found on the drier soils of both the flatwoods and rolling uplands. Scrub oak areas that show promise of coming back to longleaf pine are included in the longleaf type.

Longleaf-slash pine.—Longleaf and slash pine together constitute at least 75 percent of the board-foot volume in sawlog-size stands and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands, neither species alone accounting for 75 percent. This type is found in a few areas in the flatwoods that are dry enough for longleaf pine, and that have escaped fire for a sufficient length of time to permit the slash pine to become established.

Slash pine.—Slash pine constitutes at least 75 percent of the board-foot volume in sawlog-size stands and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands. This type is confined largely to the flatwoods and adjacent ponds and swamps—that is, to moist situations where sufficient time elapses between fires to permit the establishment of slash pine. Scrub oak areas that show promise of coming back to slash pine are included in the slash pine type.

Slash pine—cypress.—Slash pine and cypress together constitute at least 75 percent of the board-foot volume in sawlog-size stands and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands, neither species alone accounting for 75 percent. This type is found principally in low depressions in the flatwoods, and in deeper swamps and ponds than the pure slash pine type.

Turpentine pine—hardwood.—Neither pines nor hardwoods alone constitute 75 percent of the board-foot volume in sawlog-size stands, nor 75 percent of the dominant and codominant trees in under-sawlog-size stands; but at least half of the pine consists of longleaf and slash pines.

Nonturpentine pine.—Loblolly, shortleaf, pond, sand, or spruce pines, alone or in mixture, constitute at least 75 percent of the board-foot volume in sawlog-size stands, and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands. Scrub-oak areas that show promise of coming back to nonturpentine pines are included in the nonturpentine-pine type.

Nonturpentine pine—hardwood.—Neither pines nor hardwoods alone constitute 75 percent of the board-foot volume in sawlog-size stands, nor 75 percent of the dominant and codominant trees in under-sawlog-size stands; but more than half of the pine consists of nonturpentine pines.

Scrub pine.—Sand or other scrub pines constitute at least 75 percent of the board-foot volume in sawlog-size stands, and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands.

Bottom-land and swamp hardwood.—Hardwoods constitute at least 75 percent of the board-foot volume in sawlog-size stands, and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands. This type is characteristic of the larger stream bottoms, and swamps, bays, and branch heads.

Upland hardwood.—Hardwoods of good form and quality constitute at least 75 percent of the board-foot volume in sawlog-size stands, and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands.

Scrub oak—scrub hardwood.—Scrubby or stunted oaks and hardwoods that have come in after fire or cutting characterize this type, which usually occupies areas originally stocked with longleaf pine and is ordinarily found in the rolling uplands.

Cypress.—Cypress constitutes at least 75 percent of the board-foot volume in sawlog-size stands, and 75 percent or more of the dominant and codominant trees in under-sawlog-size stands.

Topographic Situations

Flatwoods.—Low, flat topography with resulting poor drainage; the soils are generally sandy and usually support a stand of mixed pines.

Rolling uplands.—Rolling or hilly topography, well-drained, with light soils (a small sand-dune area is included with the rolling uplands in this report).

Swamps, bays, ponds, river bottoms, branch heads.—These topographic situations are grouped because of the similarity in their physical features and in the timber species they support. They are low, wet, poorly drained areas, frequently under water, or alluvial forest land subject to inundation, bordering rivers and their tributaries, supporting mixed stands of cypress, pine, and some hardwoods.

Forest Conditions

Old-growth uncut.—Old-growth stands from which less than 10 percent of the volume has been cut.

Old-growth partly cut.—Old-growth stands from which 10 percent or more of the volume has been cut, but in which the remaining old-growth sawlog-size timber contains at least 1,000 board feet of hardwood or hardwood and pine mixed, or 600 board feet of pine per acre.

Second-growth sawlog-size uncut.—Second-growth stands from which less than 10 percent of the sawlog-size trees have been

cut, and in which the remaining sawlog-size timber contains at least 600 board feet per acre.

Second-growth sawlog-size partly cut.—Second-growth stands from which 10 percent or more of the sawlog-size trees have been cut, but in which the remaining sawlog-size timber contains at least 400 board feet per acre.

Second-growth under-sawlog-size.—Second-growth stands composed predominantly of under-sawlog-size trees at least 1 inch d. b. h. In uncut stands the sawlog-size timber present contains less than 600 board feet per acre. In partly cut stands there is less than 400 board feet per acre of sawlog-size timber.

Reproduction.—Areas not falling into any of the other classifications and bearing per acre more than 80 seedlings less than 1 inch in diameter.

Clear-cut.—Cut-over areas on which insufficient young growth has come in to classify as either second growth or reproduction.

Turpentine Tree Conditions

Round.—Longleaf and slash pine trees that have never been worked for naval stores.

Working.—Longleaf and slash pine trees that are now being worked for naval stores.

Front-faced (or front-cupped).—Longleaf and slash pine trees on which a first face is now being worked.

Back-faced (or back-cupped).—Longleaf and slash pine trees on which at least one turpentine face has already been worked and on which a back (second or third, etc.) face is now being worked.

Resting.—Previously worked longleaf and slash pine trees that are now resting prior to the working of back faces.

Worked-out.—Longleaf and slash pine trees on which as many faces have been worked as the trees will stand. These trees have served their purpose in the production of naval stores and are now available for other uses.

Species Groups

Pines.—Turpentine: Longleaf and slash pines. Nonturpentine: Loblolly, shortleaf, pond, sand, and spruce pines.

Hardwoods.—Pulping: Red gum, black gum, bay, soft maple, magnolia, and associated minor species. Nonpulping: Red oaks, white oaks, ash, elm, hickory, holly,[1] persimmon,[1] and associated minor species.

Cypress.—Cypress only.

Tree Classes

Good tree.—Any sawlog-size tree that is, or an under sawlog-size tree that gives promise of becoming, a saw-timber tree.

Sawlog-size tree.—A tree with the following minimum diameter outside of bark: Hardwood, 13 inches at 4½ feet above ground; cypress, 9 inches at 2½ feet above the butt swell; all pine except turpentined longleaf and slash pine, 9 inches at 4½ feet above ground; turpentined longleaf and slash pine, 9 inches at 10 feet above ground.

Saw-timber tree.—A sawlog-size tree 50-percent sound, that would produce at least one 12-foot usable log.

Sound cull tree.—A sawlog-size tree that is not a saw-timber tree, owing to form, crook, knots, extreme limbiness, or other similar defects; or an under-sawlog-size tree that will not become a saw-timber tree for similar reasons.

Rotten cull tree.—A sawlog-size tree less than 50-percent sound; or an under-sawlog-size tree sufficiently unsound to indicate the likelihood of its future loss from the stand.

Log Rules

Doyle log rule.—The formula for a 16-foot log was used: $V=(D-4)^2$.

Scribner log rule.—The formula for a 16-foot log, with allowance for a ¼-inch saw kerf, was used: $V=0.79D^2-2D-4$. This formula was derived by Donald Bruce and Francis X. Schumacher from the values of the original Scribner log rule.

International log rule.—The formula for a 4-foot log, with allowances for a ¼-inch saw kerf and 1/16-inch shrinkage was used: $V=(0.22D^2-0.71D)\ 0.904762$.

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[1] Since holly and persimmon are used primarily for special purposes, such as bobbins, shuttles, and handles of sporting goods, they were not included in the saw-timber estimate.

Summary of Findings

IN VIEW of the multiplicity of data presented in the following pages, it will be helpful to indicate briefly at this point some of the more significant of the survey findings, with references to the tables presented later in which more detailed figures are given.

Area and General Conditions

The gross area surveyed in northeastern Florida is 9,515,600 acres, as shown in table 1 and the type map (last page). The principal land uses are:

	Acres
Forest	7,378,900 (77.5 percent).
Agricultural	1,442,800 (15.2 percent).
Other areas	693,900 (7.3 percent).

In August 1934 a large number of tracts totaling more than 4 million acres, or almost 42 percent of the survey unit, were tax delinquent.

The Forest

Almost 4 million acres, or over 50 percent of the forest area, are in flatwoods; the remainder is about evenly divided between rolling uplands and swamps, bays, river bottoms, and the like (table 2).

Turpentine pine types are present on almost 70 percent of the forest area. They dominate nearly 90 percent of the flatwoods, 60 percent of the rolling uplands, and 35 percent of the swamps, bays, and river bottoms (table 2).

More than 1½ million acres of the forest area is classified as old growth (table 4). Of this area 63 percent is in swamps, bays, river bottoms, etc., 26 percent in flatwoods, and the remainder in the rolling uplands.

Second growth covers over 4½ million acres, of which 35 percent is in sawlog-size stands, 57 percent in stands classified as under sawlog size, and 8 percent as reproduction (table 4).

Almost 15 percent of the forest area is clear cut and thus far has failed to restock (table 4).

Naval Stores

The 174 active turpentine stills in 1934 made up 15 percent of the total number in the South.

Production during 1933–34 amounted to 81,610 naval stores units, or about 17 percent of the gum naval stores production of the entire country.

The gross area classified as the field for continuing turpentine production is roughly 5 million acres. Over 63 percent of the turpentine area is in flatwoods, 21 percent in the rolling uplands, and 16 percent in swamps, bays, branch heads, ponds, and river bottoms (table 6).

More than 37 percent of the turpentine area during the 1934–35 season was in round timber, nearly 27 percent was being worked, and 36 percent worked out or resting (table 6).

Of about 22 million cups worked during the 1934–35 season, more than 60 percent were on front faces (table 8).

Nearly 12 million tons of well-seasoned stumps suitable for the production of wood naval stores could be removed by blasting (table 10), with an additional 4 million tons available in the future.

Wood Products

About 58 percent of the 11 billion board feet (International ¼-inch rule) volume in 1934 was pine, 24 percent hardwood, and the remainder cypress (table 11).

More than 85 percent of the saw-timber volume (Doyle rule) of hardwoods and cypress is still in

old-growth stands, but only 47 percent of the pine volume was so classified (table 12).

Of nearly 37½ million cords of material unsuited or at present too small for sawlogs, nearly 50 percent was hardwood, 38 percent pine, and the remainder cypress (table 14).

It is estimated that in 1934, under rather strict specifications, nearly 26 million trees were suitable for poles or piles. More than half of these were in the 20-foot length class; 3,343,000 sticks were in the 35-foot or longer classes (table 16).[1]

There are more than 53 million cords of material of all sizes and quality in species suitable for pulping; 55 percent is pine, the remainder hardwoods and cypress (table 17).[1]

During 1934 the longleaf-slash pine forests, if they had not been turpentined, would have grown an additional 210 million board feet (table 19).

The total increment of all species in 1934 amounted to over 223 million board feet (International ¼-inch rule). The increment in old-growth stands was negative, but second-growth stands had an increment of nearly 240 million board feet (table 20).

In 1934 there were 8 sawmills, each with a daily capacity of 40 M feet b. m. or more, 90 medium-sized mills (10 to 40 M feet), and 52 small mills with a daily capacity less than 10 M feet (table 21).

Altogether more than 3½ million 10-hour man-days of labor were required in the woods and at the plants in the production of naval stores and wood products in 1934 (p. 17 and table 22).

The total commodity drain of saw-timber material in 1934, including incidental waste, was over 425 million board feet (International ¼-inch rule). Approximately 47 percent of this drain was in lumber, 29 percent in cross ties, 10 percent each in veneers and fuel wood, and the remaining 4 percent in minor wood products (table 23).

The saw-timber growing stock in this section was reduced 1.8 percent, or 202 million board feet in 1934. The stock of hardwoods nearly held its own, but pine decreased 1.1 percent and cypress 5.9 percent (table 25). In 1934, 77 percent of the total commodity drain on saw-timber material was from old-growth stands which had a negative increment. The net board-foot increment of second-growth pine, which is increasing yearly, already equals the total sawlog drain for wood products from both old-growth and second-growth pine. The old-growth cypress is being rapidly depleted and shows no promise of being replaced by second growth.

[1] These items represent volumes already included in previous paragraphs.

Forestry Measures Essential

Because northeastern Florida is so favorable for forest activities, there is not only an opportunity but also a strong justification for intensive efforts that will build up the growing stock to something approaching the maximum possibilities to assure the continuance of present forest industries and to provide for expansion. With the development of second-growth longleaf and slash pine forests, which yield adequate gum for naval stores but which do not yield the same high-quality wood products obtained from the original old growth, it seems inevitable that the main forest industry will continue to be the production of naval stores. Since the gum naval stores and wood-products industries are integrated, the future of the latter will depend principally upon the condition of the stands left by the turpentine operator. Deep chipping, hanging too many cups on the tree, cupping small trees, inserting tins too deeply, and failure to protect resting and worked-out turpentine trees from fire have not only materially retarded the diameter growth of the individual trees and reduced their volume of merchantable saw timber, but have in addition abnormally reduced the number of trees. To remedy this situation and to build up (perhaps double) the growing stock to full capacity, the following measures appear essential:

1. The producers of gum naval stores should work their woods much more conservatively in order to decrease the susceptibility of turpentine pines to wind and fire damage, to increase their rate of growth, and to leave a higher quality of timber for the wood-products industries.

2. Nearly a million acres of abandoned naval stores forest scattered throughout northeastern Florida, and now stagnating, should be logged off in order to remove the overburden of worked-out pines and allow a return to productivity.

3. Immediate steps should be taken to assure the early reforestation of the larger clear-cut areas

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and the filling in of seriously understocked stands. The State and Federal Governments should cooperate in the regeneration of the scrub-oak area to pine.

4. In order to increase the density of second-growth stands and to obtain larger trees, a large proportion of the present excess of increment over drain in these stands should be allowed to accumulate for a number of years. The growing stock of timber can be increased in volume and in value through intelligent action in the forest, but there can be no assurance of permanency unless the size of the industrial installation set up for its utilization is gaged to operate well within the growth possibilities.

5. State legislation should be enacted which would give the State a clear title to tax-delinquent land, and wherever possible the forest land thus acquired should be placed under management designed to build up and protect the growing stock.

6. Because of the favorable outlook for profitable returns from well-managed forest lands, forest-land owners should be encouraged, educated, and aided by public agencies to handle their lands wisely for timber production, so that they themselves, the forest industries, and the communities may enjoy to the fullest possible extent the benefits of the forest. To this end the forest extension activities of the State should be materially increased.

7. The outstanding need is more intensive and effective control of fires. Only 30 percent of northeastern Florida forests was under organized fire protection in 1938. The prevalence of fire is mainly responsible for the open nature of the stands and their relatively low increment. Effective control of fire is essential to reduce the excessive mortality rate which now exists. It will result quickly and certainly in the filling in of large tracts of understocked stands and in the natural regeneration of many of the clear-cut stands. Only with effective control of the fire situation can this area be expected to increase materially its annual output of forest wealth.

General Description

THE gross area surveyed in northeastern Florida includes 21 counties and embraces 9,515,600 acres.[1] It extends from the Georgia line on the north to the southern boundaries of Levy, Marion, and Volusia Counties; and from the Aucilla River and the Gulf of Mexico on the west to the Atlantic Ocean on the east. (See map at end of report.) Jacksonville, the principal city, serves as a focal point to which the leading transportation systems bring the products of this section for redistribution throughout the world. The chief industrial development has long been the production of primary forest products. Situated in the heart of the longleaf and slash pine region of the South, northeastern Florida ranks second only to southeastern Georgia in its yield of turpentine and rosin.

Land Use

TABLE 1.—*Land area of northeastern Florida, classified according to use*[1]

Land use[2]	Area	
	Acres	*Percent*
Forest:		
Productive	7,297,700	76.7
Nonproductive	81,200	.8
Total	7,378,900	77.5
Agricultural:		
In cultivation	950,800	10.0
Out of cultivation:		
Idle	315,400	3.3
Abandoned	128,500	1.4
Improved pasture	48,100	.5
Total	1,442,800	15.2
Other areas	693,900	7.3
Total	9,515,600	100.0

[1] Does not include 263,000 acres in the Ocala National Forest.
[2] For explanation of terms used see p. 1.

[1] This does not include 263,000 acres within the former boundary of the Ocala National Forest, a description of which is given on p. 9.

Today over 77 percent of the survey unit is still classified as forest land despite the demands of agriculture, the growth of communities, and the expansion of transportation facilities (table 1). Agriculture has largely confined its inroads on the forest to the rolling uplands, which extend through the central portion from northwest to southeast, and to artificially drained portions of the flatwoods.

Topography

The general outline of the rolling uplands is roughly defined by the areas dominated by three distinct associations of forest species—longleaf-slash, loblolly pine-hardwood, and sand pine (see map at end of report). The area dominated by loblolly pine-hardwoods has proved better adapted for agriculture than either of the other areas. The sand pine type has practically no agricultural value. Longleaf and slash pines and cypress (the last found principally in characteristic cypress ponds) dominate the flatwoods, the outline of which corresponds in general with that of the longleaf-slash-cypress area on the map. The rivers which traverse the flatwoods and rolling uplands are bordered by hardwood stands. There are also appreciable tracts of lowland hammock and swamp dominated by hardwoods. Nearly 500,000 acres are in marsh and prairie.

Climate

Northeastern Florida has relatively mild, dry winters and long, warm summers with frequent rains. Usually the growing season, the period between severe frosts, lasts from the first week in March until the middle of November. This influences the activity of the gum naval stores in-

dustry, which is dependent upon the flow of gum from the longleaf and slash pines. Extreme temperatures are rare, but a freeze during the winter of 1894–95 caused widespread damage to citrus groves, many of which were abandoned for lands farther south. Today most of these abandoned groves have reverted to forest.

Rainfall is generally well distributed, with the heaviest coming in the summer. The yearly average is approximately 50 inches. Extensive droughts, occurring usually once in 5 years, may bring about periods of high fire hazard in the forests; on the other hand, excessive rainfall may render woods work, especially logging, difficult in the poorly drained flatwoods for 3 months out of the year. Trees which have been weakened by excessive turpentining or fire are often easy victims of high winds which occur almost annually. Occasional severe hurricanes, like that of September 1935, cause considerable damage locally.

Transportation

Northeastern Florida is well supplied with transportation facilities. Formerly the St. Johns, St. Marys, Nassau, and Suwannee Rivers were important channels of trade, but today seven railroad lines, with approximately 2,500 miles of track, and a network of highways serve as the primary means of transportation. The harbors at Jacksonville and Fernandina accommodate large vessels, while shipments in small vessels can be made also from St. Augustine, New Smyrna, Palatka, and Cedar Keys. The route of the trans-Florida ship canal crosses this unit and the canal, if completed, will play an important role in its development.

Ownership [2]

Over 90 percent of the rural portion of the survey unit is in the hands of private owners. The Federal Government administers approximately 425,000 acres in the Osceola and Ocala National Forests, and the State owns about 100,000 acres. Lumbermen own the largest proportion of the land in the western Gulf coast counties. Farm ownership is most important through the central and northwestern agricultural belt, and real-estate operators control most of the land along the east coast. The east coast resort counties and the forested counties of the Gulf coast are characterized by holdings of 1,000 acres or larger. In the greater portion of the remaining counties ownership is broken up into smaller holdings.

Taxation

In August 1934, more than 4 million acres, or almost 42 percent of the survey unit, was in tax default for 3 or more years. Delinquency was greatest in heavily indebted counties along the east coast, where taxes were in default on over 60 percent of the land. Tax delinquency on forest properties was relatively greatest in those counties with the smallest tracts of forest land. The State does not actively prosecute trespass on tax-delinquent properties, and most of them are still being operated by owners or tenants pending redemption, adjustment, or abandonment.

Agriculture

Only about 950,000 acres, or 10 percent of northeastern Florida, were in cultivation in 1934 (table 1). More than 300,000 acres of agricultural land were standing idle, and almost 130,000 acres had been definitely abandoned for agricultural-crop production. Of this latter, 77 percent is suitable for pine, and the remainder for hardwoods. Based on nearby forest stands, it is estimated that more than 50 percent of the potential pine and over 70 percent of the hardwood acres are poor forest sites. Less than 2 percent of all agricultural land and about 1 percent of the forest land show evidence of erosion.

The value of farm products per farm ranged in 1929, according to the agricultural census of 1930, from more than $6,000 in St. Johns County to less than $700 in Dixie County. This variation reflects the concentrated production of potatoes, garden truck, strawberries, and citrus fruits on relatively small holdings and the scattered agricultural activities over the rest of the survey unit. For a relatively short season the specialty farmers employ a large body of laborers who are available for work

[2] The data in this paragraph are from the following: CRAIG, R. B. LAND OWNERSHIP IN SURVEY UNIT NO. 1, FLORIDA, 1934. Southern Forest Expt. Sta. Occas. Paper 56. [Mimeographed.]

in the forests or in other industries during the remainder of the year. Many small farmers supplement their production of food for home consumption with cash wages in forest work. Some dairying is carried on around the larger cities, and beef cattle, grazed in the open forests, are an important source of income.

In recent years, agricultural expansion has been dependent on the development of specialty crops rather than on a larger production of staples. Owing to climatic factors, the specialty crops can reach the market when prices are high, but these crops do not require large acreages, and it is doubtful whether any great amount of forest land will be cleared for agriculture in the near future. Small tracts are being planted to tung trees (*Aleurites fordii*), but it will be several years before this trend can be appraised.

Population

With the exception of the East Coast resorts, the towns are supported by commerce and industry. The population is about 450,000, of which 63 percent is white. In 1930, approximately 48 percent of the people lived in towns and cities of 2,500 or more. Almost every town, as shown in figure 5, has one or more plants for the conversion of forest products—sawmills, planing mills, turpentine stills, and cooperage, veneer, and container plants. A large proportion of the rural population is directly or indirectly supported by employment in the woods, in turpentine and logging camps.

Ocala National Forest

The Ocala National Forest, a gross area of 263,000 acres, was not included in the field survey, because of the existence of a recently completed management plan and inventory covering the greater part thereof. The total area under Federal administration in this forest on December 31, 1936, was 245,000 acres. The management plan prepared by the Forest Service covers 183,800 acres, of which 157,320 is timbered. An outstanding feature is the extensive stand of young sand pine which covers 151,700 sandy upland acres, or 96 percent of the timbered portion. The 20,000 acres and more of sand pine barren, which may be reforested by planting, are not included in the timbered portion. Scattered around the central block of sand pine occur stands of longleaf and slash pines and some bottom-land types totaling 5,600 acres. The national forest is dotted with springs, lakes, and prairies, totalling nearly 6,400 acres. The plans for management provide for production of sand pine pulpwood on a 40-year rotation. When mature the stands will average 10 inches in diameter and 30 to 40 feet in height and, it is estimated, will yield annually by 1942 more than 35,000 cords. Protection is of great importance in the dense young stands of sand pine where fire may cause very serious losses.

Forest Description

WHEN the first white men set foot in northeastern Florida, almost 95 percent of the land was in forest. For many decades this condition was undoubtedly a handicap to the pioneer settler, who had to destroy the forests in order to provide space for the cultivation of necessary food crops. Today nearly 1½ million acres of former forest land is cleared for agricultural use; and an additional 173,000 acres is in towns, villages, and transportation systems. Slightly more than 81,000 acres of the present forest area lacks the qualities essential for growth of commercial timber and is classified as nonproductive. The remaining forest (7,297,700 acres) is the most valuable known natural resource in this survey unit.

Forest Types

In the forests of northeastern Florida certain species tend to dominate large sections (see map at end of report). Within these broad boundaries, however, other species occur groupwise on sufficient acreage to be recognizable as distinct forest types. Single forest species seldom occur in absolutely pure stands; usually several species intermingle.

Because of the economic purpose of the Forest Survey, key species of known value were used to designate the 12 forest types recognized. In general, the key species or groups of species constitute at least 75 percent of the board-foot volume in sawlog-size stands, or 75 percent of the dominant and codominant trees in under-sawlog-size stands. Furthermore, in the case of the pine-hardwood types, the pine species group which designates the type, makes up more than 50 percent of the pine component.

In order to simplify the description and correlation of data on area, volume, and turpentine history, the forest types and species have been assembled into four groups, namely, turpentine pines, nonturpentine pines, hardwoods, and cypress which represent distinctive economic and natural differences.

TURPENTINE-PINE TYPES

The turpentine-pine-type group consists of those types dominated by longleaf and slash pines. It includes the longleaf pine, longleaf-slash pine, slash pine, slash pine-cypress, and turpentine pine-hardwood types. These types are present on almost 70 percent of the forest area and dominate nearly 90 percent of the flatwoods, 60 percent of the rolling uplands, and 35 percent of the swamps, bays, ponds, and river bottoms (table 2). More than 80 percent of the gross cubic-foot volume in the turpentine-pine-type group is in turpentine pines; almost 10 percent is in cypress; 7 percent is in hardwoods, and less than 3 percent is in nonturpentine pines (table 3).

A century ago longleaf pine probably occurred in almost pure stands on more than 4 million acres of this section. The clearing of the forest for agriculture, the development of fire protection that enabled slash and loblolly pines to encroach on the drier areas, and the failure of lumbermen to leave sufficient seed trees for restocking, have greatly reduced the longleaf-pine area. More than 500,000 acres from which the longleaf pines were removed is today classified as scrub oak and scrub hardwood type and is not now restocking to pine (fig. 1); but the pure longleaf-pine type still occupies nearly 3 million acres, or 39 percent of the total forest area (fig. 2).

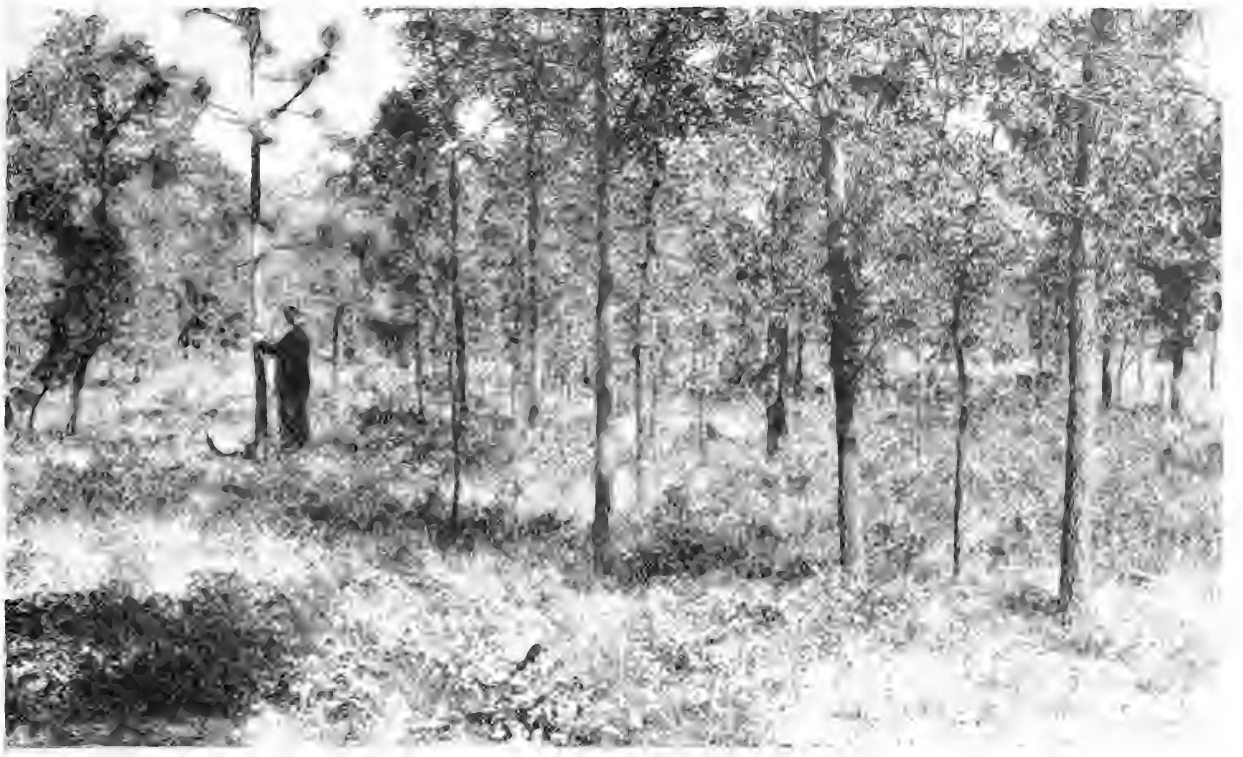

FIGURE 1.—*Scrub oak type, Clay County, Fla.* F255195

FIGURE 2.—*Second-growth longleaf pine, Baker County, Fla.* F249549

TABLE 2.—*Forest area of northeastern Florida, classified according to forest type and topographic situation* [1]

Forest type [2]	Flatwoods	Rolling uplands	Swamps, bays, etc.	All situations	
	Acres	*Acres*	*Acres*	*Acres*	*Percent*
Turpentine pine:					
Longleaf pine	1,962,400	894,900	11,800	2,869,100	39.3
Longleaf-slash pine	273,600	18,900		292,500	4.0
Slash pine	950,900	29,100	314,600	4,294,600	17.8
Slash pine-cypress	36,300		276,700	313,000	4.3
Turpentine pine-hardwood	65,500	34,600	78,100	178,200	2.4
Total	3,288,700	977,500	681,200	4,947,400	67.8
Nonturpentine pine:					
Nonturpentine pine	249,100	74,100	57,600	380,800	5.2
Nonturpentine pine-hardwood	24,400	48,900	84,400	157,700	2.2
Scrub pine	5,500	37,100	3,900	46,500	.6
Total	279,000	160,100	145,900	585,000	8.0
Hardwood:					
Bottom land and swamp hardwood	16,600		631,500	648,100	8.9
Upland hardwood	11,800	86,000		97,800	1.3
Scrub oak-scrub hardwood	154,500	428,100	23,700	606,300	8.3
Total	182,900	514,100	655,200	1,352,200	18.5
Cypress	10,200		402,900	413,100	5.7
All types	3,760,800	1,651,700	1,885,200	7,297,700	
	Percent 51.5	*Percent* 22.7	*Percent* 25.8		100.0

[1] Data for areas less than 70,000 acres are indicative only.
[2] For explanation of terms used see p. 1.

TABLE 3.—*Composition of forest type groups, by species*

[Expressed in percent of total cubic volume] [1]

Species	Turpentine pine	Nonturpentine pine	Hardwood	Cypress	All type groups
Longleaf	35.6	1.7	0.7	(2)	19.0
Slash	44.7	3.8	.9	5.4	24.8
Loblolly	1.6	52.4	1.2	.3	7.1
Other pine	1.2	16.8	.7	.1	2.7
Red gum	.5	6.5	11.6	.6	3.7
Black gum	2.9	2.5	25.5	8.6	8.8
Other pulping hardwoods	1.2	4.2	17.6	2.4	5.4
Red oaks	.9	5.3	14.1	.2	4.4
White oaks	.2	1.9	3.1	(2)	1.0
Other nonpulping hardwoods	1.5	4.1	16.4	1.5	5.2
Cypress	9.7	.8	8.2	80.9	17.9
All species	100.0	100.0	100.0	100.0	100.0

[1] These figures are based on gross cubic volume outside bark and do not include volume of sound and rotten cull trees, turpentine butts, or tops and limbs of hardwoods and cypress, but do include sound scrub oak which is ordinarily considered sound cull.
[2] Negligible.

The pure slash pine type is second in importance, occupying almost 18 percent of the forest area. Slash pine is also the most important component of the mixed types of this group, making up 52 percent of the longleaf-slash, 47 percent of the slash-cypress, and 40 percent of the turpentine pine-hardwood types. Unlike longleaf, which has withstood repeated burning even in the "grass" stage on the drier sites, slash pine is confined largely to moist situations, where a sufficient time elapses between fires to permit its establishment.

NONTURPENTINE PINE TYPES

Types composed principally of loblolly, shortleaf, pond, sand,[3] or spruce pines characterized only 8 percent of the forest area. Loblolly pine, which makes up 60 and 42 percent of the nonturpentine pine and nonturpentine pine-hardwood types, respectively, is the principal species. This pine is found throughout the survey unit on the more fertile soils and in swamps along streams and has taken over much of the abandoned farm land in the agricultural sections of the uplands.

HARDWOOD TYPES

The bottom land and swamp hardwood type is characteristic of the larger streams, the swamps, and the branch heads. In this type black gum, red gum, bay, red maple, magnolia, and other hardwoods make up 88 percent of the cubic-foot volume. The upland hardwoods have a larger proportion of mixed oaks—often of good quality and form—on the better sites. The scrub oak-scrub hardwood type occurs where blackjack and other unmerchantable oaks and hardwoods occupy the land, which is not expected to restock with pine. Although found principally in the rolling uplands, this type also occurs in the drier ridges in the flatwoods (table 2).

CYPRESS TYPE

Only one type, the pure cypress type, is included within this group. It occurs almost entirely in the deeper swamps and ponds characteristic of the flatwoods area. Cypress makes up 81 percent of the volume of this type; black gum, with nearly 9 percent, is the second most abundant species.

[3] An almost pure sand pine type occupies more than 150,000 acres within the former boundaries of the Ocala National Forest, which was not covered in this survey.

Forest Conditions

In order to describe adequately the appearance and condition of the forest stands, they have been classified according to their age, quality, size, and the degree to which they have been cut.

Stands having the characteristics of the original mature forests of the section are called old growth. Young stands which have come in as a result of cutting or other causes are called second growth. Second-growth stands are classified as reproduction, under-sawlog size, or sawlog size, depending upon their stage of development. If more than 10 percent of the board-foot volume in sawlog-size stands has been removed, such stands are known as partly cut. The lower limits of volume per acre of old-growth or sawlog-size second growth stands, as here classified, represent the lowest volume of each class which is in general included in commercial operations. The lower limits used were 1,000 board feet of hardwood or hardwood and pine mixed, and 600 board feet of pine in old-growth stands, and 600 and 400 board feet, respectively, for the uncut and partly cut second-growth stands. When the stands are cut below this minimum and no satisfactory stocking of young growth or reproduction is left, they are recorded as clear-cut.

The old-growth stands are often quite open, owing either to cutting or to natural factors. Young growth establishes itself in the openings and, when the old growth is removed, forms the nucleus of second-growth stands in various stages of development. Sawlog-size stands of second growth are usually cut into when a considerable body of the under-sawlog-size trees is still present. Clear-cut areas usually restock with sufficient seedlings. These become reproduction, reproduction grows into under-sawlog size, and under-sawlog size into saw-log size. There is, therefore, at all times a continuous and involved progression of forest conditions.

More than 1½ million acres, or almost 21 percent of the forest area, are still classified as old growth (table 4). Almost 58 percent of these stands have been partly cut; and 63 percent of the entire old-growth forest occurs in the swamps, bays, and river bottoms—notably in Taylor, Dixie, Lafayette, and Levy Counties, and in the vicinity of the St. Johns River—probably because of the difficulty and cost of logging in such situations. The early concentration of logging in the flatwoods and rolling uplands has left only 10 percent of the present forest area of these situations in old growth. Almost 48 percent of the old-growth hardwoods and nearly 55 percent of the old-growth cypress stands have been partly cut. In most cases the cypress, red gum, and other valuable species were removed, leaving only the swamp black gum and other species of low value.

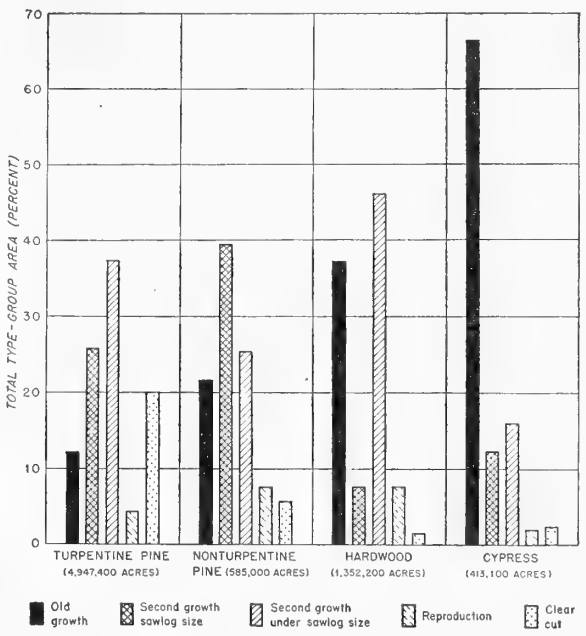

FIGURE 3.—*Relative proportion of the different forest conditions in each type-group area.*

Almost 65 percent of the forest area has restocked to second growth. More than 70 percent of the second-growth stands are in the turpentine pine type group. Of these, about 40 percent have reached sawlog size and furnish the bulk of the longleaf and slash pines which are being worked for gum by the naval stores industry (fig. 3).

Clear cutting has been practiced in the old-growth turpentine pine stands until today 20 percent of this type, or over a million acres, supports neither merchantable timber nor young growth. These clear-cut tracts are in general, however, scattered throughout the cut-over lands and if adequate attention is given to fire protection, most of them will restock naturally. Selective cutting is

TABLE 4.—*Forest area of northeastern Florida, classified according to forest condition and type group*

Forest condition	Turpentine pine	Nonturpentine pine	Hardwood	Cypress	All type groups	
Old growth:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Percent*
Uncut	174, 200	77, 300	261, 800	123, 800	637, 100	8. 7
Partly cut	429, 700	49, 600	240, 500	150, 600	870, 400	12. 0
Total	603, 900	126, 900	502, 300	274, 400	1, 507, 500	20. 7
Second growth:						
Sawlog size:						
Uncut	1, 183, 400	191, 600	94, 600	43, 400	1, 513, 000	20. 7
Partly cut	91, 400	39, 400	7, 900	7, 900	146, 600	2. 0
Under-sawlog size	1, 849, 600	149, 000	622, 900	68, 600	2, 690, 100	36. 9
Reproduction	217, 700	44, 900	102, 500	8, 600	373, 700	5. 1
Total	3, 342, 100	424, 900	827, 900	128, 500	4, 723, 400	64. 7
Clear cut	1, 001, 400	33, 200	22, 000	10, 200	1, 066, 800	14. 6
All conditions	4, 947, 400	585, 000	1, 352, 200	413, 100	7, 297, 700	100. 0

practiced to a larger degree in the mixed-type groups, and a relatively insignificant clear-cut area has resulted. The cypress type, which is usually clear-cut, generally restocks to hardwoods or slash pine soon after logging and thereby loses its earlier characteristics.

Stocking of Forest Stands

Although well-stocked second-growth stands occur on large tracts, principally in the north-central and northeastern portions, of the survey unit, the forests are generally open and poorly stocked. An analysis of the second-growth longleaf pine stands indicates that more than 60 percent are seriously understocked. Longleaf, however, often occurs in open-grown stands; and the other types show a better degree of stocking.

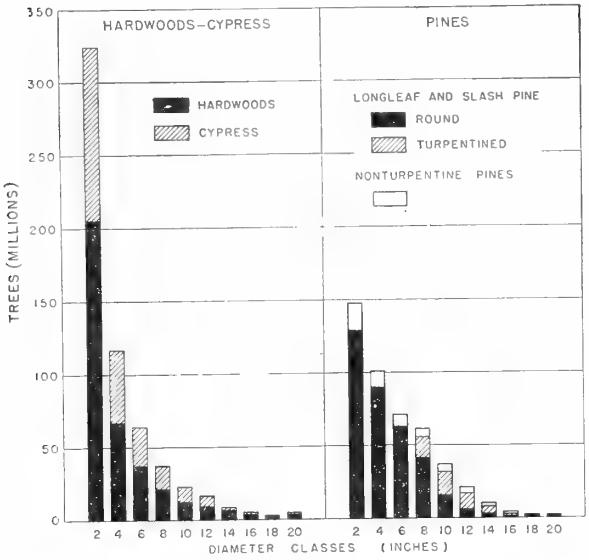

FIGURE 4.—*Stand tables of hardwood and cypress and of pines for northeastern Florida*

The predominance of young second-growth stands is reflected in the number of small trees of all species. Trees that have been turpentined comprise approximately one-fourth of the 8-inch longleaf and slash pines, one-half of the 10-inch, and two-thirds of the larger sizes. Hardwoods are next to the longleaf and slash pines in point of numbers, followed by cypress and the nonturpentine pines (fig. 4).

The data of the Forest Survey show that, in the second-growth uncut stands of the pure longleaf type, both the under-sawlog-size and the sawlog-size stands support per acre on the average 123 good trees 1-inch and larger of all species. In addition, there are 48 cull trees in the under-saw-log-size, and 31 cull trees in the sawlog-size stands, the removal of which would improve the stands. Only 5 longleaf pines in the under-sawlog-size stands are over 9 inches, in contrast to 27 in the sawlog-size stands. The average ages of the dominant trees in these stands, based on measurements at breast height, are 27 and 40 years, respectively.

The second-growth uncut stands of the pure slash pine type are more heavily stocked than the corresponding acres in the longleaf type. The average acre bears 165 and 187 good trees and only 13 and 16 cull trees, respectively, in under-sawlog- and sawlog-size stands. Although only 7 slash pines are over 9 inches in the under-sawlog-size stands, 32 have reached that diameter in the sawlog-size stands. The average ages of the dominant trees in the slash pine stands are 29 and 44 years, respectively.

The average volume per acre of each principal species group and of the several forest conditions in each type group also give an indication of relative stocking. The volumes for such average acres are shown in table 5 for the turpentine pine type group, as representing a combination of many variations in site, age, and density that occur in the forest stands of this type group in northeastern Florida, and as by far the most extensive type group occurring on two-thirds of the forest area. The board-foot volumes given are net mill tally; that is, allowance has been made for material that would be left in the woods because of rot, fire-scar, crook, limbiness, and similar defects. Also allowance has been made for loss at the mill due to sweep and hidden defects.

TABLE 5.—*Average net volume per acre, by species group and forest condition for the turpentine pine type group*

BOARD-FOOT VOLUME (INTERNATIONAL ¼-INCH RULE)

Forest type and species group	Old growth		Second growth			Average, all conditions [2]
	Uncut	Partly cut	Sawlog size: Uncut	Sawlog size: Partly cut	Under sawlog size [1]	
	Board feet	*Board feet*	*Board feet*	*Board feet*	*Board feet*	*Board feet*
Turpentine pine:						
Round	4,108	706	811	717	111	461
Worked	1,459	1,497	1,036	1,058	130	508
Nonturpentine pine	100	51	90	133	13	38
Pulping hardwoods	249	44	12	56	3	18
Nonpulping hardwoods	46	34	16	19	1	9
Cypress	864	287	124	188	15	94
Total	6,826	2,619	2,089	2,171	273	1,128

CORDWOOD VOLUME (OUTSIDE BARK) OF GOOD TREES

Turpentine pine:	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*	*Cords*
Round	10.9	2.3	4.9	3.6	2.1	2.7
Worked	3.8	4.3	4.5	4.7	.9	2.1
Nonturpentine pine	.4	.2	.3	.4	.1	.1
Pulping hardwoods	2.0	.7	.4	1.0	.1	.3
Nonpulping hardwoods	.5	.2	.1	.1	.0	.1
Cypress	3.2	1.2	.7	1.0	.1	.4
Total	20.8	8.9	10.9	10.8	3.3	5.7

[1] Does not include areas of reproduction, clear-cut, and fire-killed forest conditions.
[2] Includes areas of reproduction, clear-cut, and fire-killed forest conditions.

Site Quality

Within each forest type the rapidity of development of the stands depends to a large degree on the inherent quality of the site. The relative height growth of the dominant trees is a useful measure of site quality. For southern pines, height at 50 years is the customary index in practice. Better sites produce merchantable stands at an earlier-than-average age and have, therefore, a special economic significance.

The average site index of longleaf pine in northeastern Florida is 65 feet; of slash pine, 67 feet; and of loblolly pine, 79 feet. Less than 13 percent of the land on which longleaf and slash pines occur qualifies as site index 80 or better, whereas almost 58 percent of the loblolly area is so classified. The poorest sites on which either longleaf or loblolly pines occurred were in the flatwoods.

Three broad site classes based on the form, height, and general thriftiness of individual trees were used to rate the quality of the hardwood and cypress types. More than 40 percent of the hardwood sites along such larger rivers as the St. Johns and Suwannee were rated "good" and 50 percent "fair." Approximately 75 percent of the upland-hardwood sites are rated fair or good and over 90 percent of the scrub oak-scrub hardwood as poor. Most of the cypress grows on fair to good sites with the slowest growth occurring in the poorly drained ponds scattered throughout the flatwoods.

Reproduction

The occurrence of reproduction is of greatest economic importance where the mature trees have been removed. In this section young seedlings of longleaf and slash pine and scrub oak occur most frequently. The latter often forms dense stands on cut-over longleaf pine land and retards the development of young pine.

About 30 percent of the reproduction area in the longleaf type and more than 35 percent in the slash pine type are stocked at a rate of 900 or more seedlings per acre; while less than 35 percent of this area in the former type and less than 20 percent in the latter are stocked at 80 to 300 seedlings per acre. The clear-cut area supports less than 80 seedlings per acre, but prospects are fair for 53 percent of it that bears three or more pine seed trees per acre and an additional 30 percent with at least one or two. These trees, assisted by those on adjacent lands, should furnish sufficient seed to reclothe the major portion of these lands with pine seedlings if adequate fire protection is provided.

The brown-spot needle fungus, which may seriously retard the growth and development of young longleaf under 18 inches in height, is serious on less than 1 percent of the survey unit. Hogs also damage longleaf by feeding on the roots of trees in the seedling and sapling stages. While hogs are a serious factor outside the palmetto and gallberry range, evidence of hog damage was present on only 1 percent of the area of sapling stands and on 5 percent of the reproduction area of northeastern Florida.

Fire Damage

The survival of pine reproduction depends to a large degree upon the prevention of fires. Visible evidence of forest fires, such as dead reproduction, charred stumps, and burned turpentine faces was present on 85 percent of the forest area. Many of the fires in the longleaf and slash pine types, 94 percent of whose acreage showed evidence of fires, are due to the practice of raking and burning in the turpentine stands to protect turpentine trees with working faces. Undoubtedly much of the damage to the other types is due to these fires proceeding unchecked into the bays and river bottoms. Damage to hardwoods is usually confined to the formation of open wounds, through which rot-producing fungi enter and reduce the merchantable volume.

Slightly over 3 percent of the entire forest area showed heavy damage from fire. Particularly heavy damage occurred during 1931 and 1932 when a severe drought increased the fire hazard. The hardwood bottoms and bays and many cypress ponds dried out, with the result that they sustained a proportionately heavier damage than did the pine. Of all the heavy fire damage recorded, it is estimated that 19 percent occurred during 1931 and 1932.

Only 30 percent is now (1938) under organized fire protection, and large improvement is therefore possible. Progress has been made, but redoubled efforts are essential to preserve reproduction, accelerate growth, maintain satisfactory turpentine areas, and reduce the fire drain on merchantable volume.

Naval Stores Aspects

THE gum naval stores industry obtains over three-fourths of the United States production of turpentine and rosin from the gum of longleaf and slash pines. The remainder is produced by the wood naval stores industry through extraction from pine stumps and lightwood and as a by-product of paper manufacture. During the latter half of the Nineteenth century the gum naval stores industry migrated south from the nearly exhausted turpentine orchards of the Carolinas and established its financial and export center at Savannah, Ga. Later, in 1905, Florida assumed the lead in production and maintained it for 18 years, developing the port of Jacksonville as its marketing center. In 1923 Georgia regained the lead in production and still retains it. Research for the naval stores industry is conducted by the Southern Forest Experiment Station, which maintains a branch at Lake City specializing in gum naval stores problems, and by the Bureau of Chemistry and Soils, which has a naval stores experiment station at Olustee, Fla.

Gum Naval Stores Industry

In 1934 more than 90 percent of the turpentine and approximately 80 percent of the rosin produced in northeastern Florida was produced by the gum naval stores industry. This industry has been responsible for much of the physical development which has taken place. In 1933 gum naval stores, with a value of more than $3,000,000, ranked second among the products of the area. In number of wage earners (almost 7,500) the industry ranked first, and the total wages paid turpentine workers exceeded all but those paid in the lumber industry. In 1934 the industry required approximately 1,400,000 10-hour man-days of labor in the woods and nearly 80,000 man-days at the stills.

Owing to the long periods over which loans are required and the risk involved, banks hesitate to serve the industry. As a result, the factorage system has developed, which in 1934 served 85 percent of the industry. Three factorage houses in Jacksonville serve practically all of the producers in this section—lending money, furnishing commissary supplies and equipment, and acting as commission merchants in the disposal of the turpentine and rosin to dealers. Since 1934 there has been an extensive development of central stilling, including the recently developed method known as "processed oleoresin," throughout the southeastern portion of the naval stores belt. Farmers with a few thousand trees of turpentine size need not now lease them to an operator with a still, for they can themselves produce gum and sell it to one of the central stills or processed oleoresin plants. The processing plant at Jacksonville is already drawing heavily on northeastern Florida for the gum it requires. This development tends to reduce the control of factors and may result in several radical changes in the make-up of the gum naval stores industry.

In 1934 the 174 active stills in northeastern Florida made up 15 percent of the total number in the South, but the 30 gum producers without stills constituted less than 0.5 percent of their group.[1] All gum producers combined—less than 2 percent of the total in the South—worked 2,240 crops (1

[1] The data in this paragraph and following are from a still-to-still canvass made during 1934, part of the results of which were issued informally in the following: SOUTHERN FOREST EXPERIMENT STATION, STATISTICS OF GUM NAVAL STORES PRODUCTION. South. Forest Expt. Sta. Release 17. December 31, 1935.

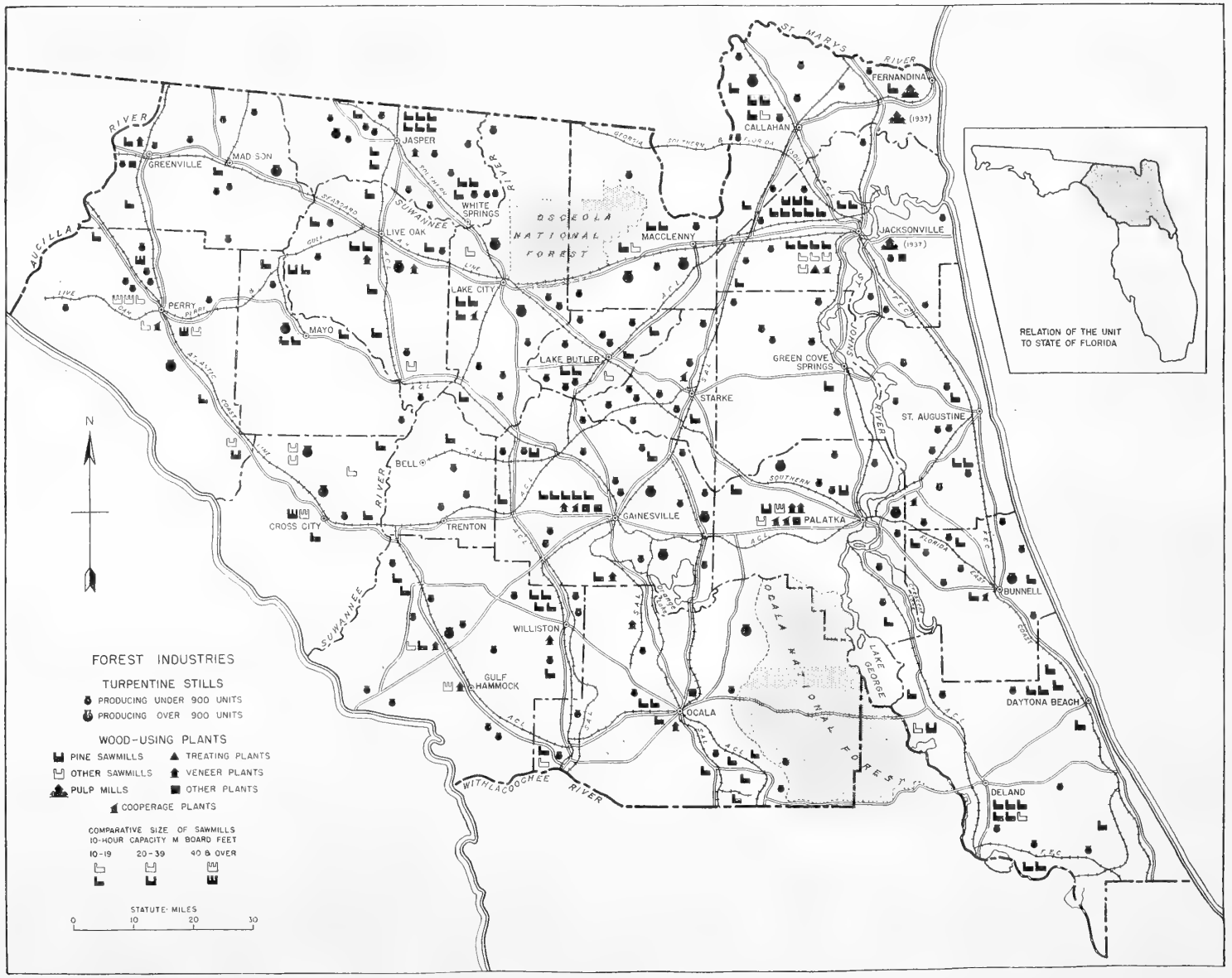

FIGURE 5.—*Location of turpentine stills and wood-using plants in northeastern Florida, 1934.*

crop equals 10,000 cups), or 17 percent of the total working crops. Approximately 78 percent of the crops were on leased timber, as compared with the 73-percent average for the South. Still operators, or processors, during the 1933–34 season, worked an average of 11.2 crops, from which 479 naval stores units were produced, an average yield per crop of 43 units.

Production during 1933–34 amounted to 81,610 naval stores units—more than 60 percent of the Florida and about 16 percent of the total United States production of gum naval stores. About 20 of the larger stills accounted for a third of the production (fig. 5).

Gum Naval Stores Resources

The activities of the gum naval stores industry in the forests are limited by the distribution and frequency of occurrence of longleaf and slash pines. The collection of gum is not economically feasible where the turpentine pines are widely scattered and infrequent over large tracts. In classifying the forest area as to its turpentining possibilities, the area immediately surrounding each sample plot was taken into consideration. Clear-cut areas, reproduction areas, and nonturpentine pine and hardwood types intermingling with areas suitable for turpentining are therefore included in a gross turpentine-area figure—typifying the heterogeneous area over which an active turpentining operation is spread. The largest acreage not adapted to turpentining is in the hardwood and cypress types and in the nonturpentine pine types in the northwestern and south-central portions of northeastern Florida. Altogether, slightly more than 2 million acres of the forest land was classified as unsuited for turpentining (table 6). The relatively rapid development and spread of second-growth slash pine (fig. 6) is indicated by the fact that 55 percent of the working and resting trees were of this species.

The gross area classified as the field for continuing turpentine operations is more than 5 million acres. Over 84 percent of the turpentine acreage is in the flatwoods and rolling uplands, and the remainder is in swamps, bays, ponds, branch heads, and river bottoms. Seldom will an

FIGURE 6.—*Chipping and dipping in a slash pine stand, Bradford County, Fla.* F247935

operation be confined to a single topographic situation, for the river bottoms intersect both the flatwoods and rolling uplands; bays and branch heads are found principally in the uplands, and swamps and ponds in the flatwoods.

TABLE 6.—*Classification of forest area according to turpentining history and topographic situation in the 1934–35 season*

Turpentining history [1]	Flatwoods	Rolling uplands	Swamps, bays, etc.	All situations	
	Acres	*Acres*	*Acres*	*Acres*	*Percent*
Round area	1,069,900	481,700	389,500	1,941,100	26.6
Working area:					
Front-faced	320,100	112,000	54,400	486,500	6.7
Back-faced	646,500	123,700	124,600	894,800	12.3
Resting and worked-out areas	1,244,200	384,000	239,600	1,867,800	25.5
Total turpentining area	3,280,700	1,101,400	808,100	5,190,200	71.1
Unsuited for turpentining	480,100	550,300	1,077,100	2,107,500	28.9
Total forest area	3,760,800	1,651,700	1,885,200	7,297,700	100.0

[1] For explanation of terms used see p. 1.

The incidence of turpentine operations has been used in classifying the turpentine acreage for descriptive purposes. Round-timber areas still bearing unturpentined longleaf and slash pines in sufficient quantity to justify future working amount to almost 2 million acres, the stands ranging from reproduction to old-growth timber. Areas on which trees are being chipped are designated as "working." If the trees are cupped for their first set of faces, the area is known as "front-faced"; if a significant proportion of the trees are being worked for a second set of faces, it is known as "back-faced." In northeastern Florida there is about twice as much back-faced as front-faced area, totaling almost 1½ million acres.

Areas which have been but are not now working, on which the indications are that a subsequent set of faces may be possible, are termed "resting." Where the present crop of trees has been exhausted and further production must await the growth of an adequate number of round trees, the area is designated as "worked out." Owing to the difficulty of determining what constitutes stocking sufficient to justify another operation in the near future, the resting and worked-out areas are grouped together; but it is estimated that more than 1 million acres of this class are in a resting condition and that turpentining can be resumed there in the next few years. The remainder of the area classified for continuing turpentine operations (about 850,000 acres) either bears a stagnating stand of worked-out trees, which must be removed before restocking can take place, or will require an extended period of waiting before sufficient round trees develop to justify another operation.

Operations in second-growth timber conform in general to a fairly uniform pattern. The front-faced area is worked for 6 years and then allowed to rest for about 2 years. Cups are then hung on back faces of most of the trees previously worked, and front faces are started on round timber that during the 8-year period attained sufficient size for cupping. The second period of operation also lasts 6 years, and again the area is allowed to rest, this time usually for 4 years. A third period follows, with cups being hung on turpentined trees with available space for back faces and on additional round timber. After this third 6-year period, the area is often completely worked out, and when the worked-out trees are removed it must be set aside to grow a new stand of round timber.

ROUND-TIMBER AREA

Round-timber areas, which bear in the main the reserve growing stock of the naval stores industry, are principally represented by large bodies of second growth in the northeastern counties and by the remaining old growth in the Gulf Coast counties. Not all of the round-timber area is readily accessible for turpentine operations. Small bodies of timber, principally in the rolling uplands, may be isolated by agricultural land. Also, under normal conditions many portions of the swamps are inaccessible. The flatwoods are apparently most available, for during the 1934–35 season only 33 percent of the turpentine acreage in this topographic situation remained in round timber, whereas 44 percent of the rolling uplands, and 48 percent of the swamps, bays, etc., were so classified (table 6).

With the exception of the round-timber areas still in old growth, practically all of the turpentine area has witnessed operations. The old-growth trees have usually been worked for gum during at least 3 years prior to logging. Most of this acreage then restocked to young pines and now bears the bulk of the round timber. Small bodies of second

growth have been completely worked out and the exhausted timber removed. Longleaf and slash pines are equally represented in the round timber. In addition to about 17½ million round trees of turpentine species 9 inches and larger in diameter in the round-timber area (table 7), there are 110½ million in the sizes between 1 and 9 inches, more than 15 million of which have already reached 7 inches. All of these round trees constitute the reserve growing stock, a large proportion of which should with good forest management reach a suitable size for turpentining. Under current chipping practices some trees under 9 inches are chipped. It is believed, however, that the best general practice would be to refrain from chipping trees smaller than 9 or 10 inches.

TABLE 7.—*Round turpentine pines 9 inches or larger in diameter and turpentined pines in different conditions on the various areas*

Turpentining history	Round trees	Working trees	Resting trees	Worked-out trees	All conditions	
	Mtrees	*Mtrees*	*Mtrees*	*Mtrees*	*Mtrees*	*Percent*
Round-timber area	17,431	----	432	176	18,039	23.9
Working area:						
Front-faced	801	7,897	375	234	9,307	12.3
Back-faced	1,028	13,507	1,867	3,586	19,988	26.5
Resting and worked-out areas	5,840	----	13,690	8,547	28,077	37.3
Total	25,100	21,404	16,364	12,543	75,411	----
	Percent	*Percent*	*Percent*	*Percent*		
	33.3	28.4	21.7	16.6	----	100.0

WORKING TURPENTINE AREA

The working turpentine area of nearly 1½ million acres is well distributed. It is least concentrated in the developed agricultural areas, where only scattered blocks of timber remain. Several large operations are confined to old-growth timber in the Gulf Coast counties for 3 or 4 years prior to logging, but the bulk of production already comes from second growth. Relatively few stands of old growth remain, and it will not be long before all turpentine operations will be in second growth.

On the working area, in addition to more than 20 million working trees at the beginning of the 1934–35 season, more than 2 million were resting, and nearly 4 million worked out. There were also more than 1¾ million round trees 9 inches in diameter or larger, over 12½ million 7 and 8 inches, and 88½ million between 1 and 7 inches, all of which form the nucleus for future operations in this area. More than a third of the working trees were in front-faced tracts, where they average 16 trees per acre as compared with 15 per acre in the back-faced tracts. As is to be expected, most of the resting (83 percent) and of the worked-out trees (94 percent) were in back-faced tracts (table 7).

The number of cups hung on virgin or first-year faces each year reflects (1) the replacement of faces worked out in the previous season, and (2) the expectations of producers as to the demands of consumers for the ensuing few years. After an area has been worked for two or more periods of 6 years each, the average number of potential faces per acre is greatly reduced. Only operators with little overhead, or small gum producers who handle only a few thousand cups, can work these areas profitably.

Large producers are willing to pay the higher leasing costs necessary to operate in round timber, because of its higher productivity per acre and consequently lower unit cost of operation. The activities of these larger producers are reflected in the front-faced operations which are more sensitive to changes in market conditions, actual or anticipated, than are back-faced operations. At the beginning of the 1932–33 season, only 65 crops were hung in front-faced areas as compared with nearly 211 crops for the 1934–35 season (table 8). The former figure probably reflects anticipation of a poor market; the latter figure was undoubtedly influenced by the proposed program under the Agricultural Adjustment Administration, adopted in 1934, which resulted in limiting naval stores production to certain-sized trees for the purpose of promoting economic use and conservation of land and diminution of unscientific use of soil resources.

Altogether, about 22½ million cups, over 60 percent of which were on front faces, were worked during the season of 1934–35. The proportion of front faces ranged from 94 percent in front-faced operations to only 40 percent in back-faced operations. In spite of the fact that a 9-inch or larger diameter limit has been advocated for several years, 24 percent of the working trees were below this size. At the beginning of the 1934–35 season, cups were hung on 26 percent of the 7- and 8-inch round trees in the area converted into first-year crops; and on 83 percent of the 9- and 10-inch, 96 percent of the 11- and 12-inch, and 100 percent of

TABLE 8.—*Turpentine cups hung during the 1934–35 season, by year of working* [1]

Working area and manner of cupping	First year	Second year	Third year	Fourth year	Fifth year	Sixth year and later	All years	
Front-faced areas:	*Crops*	*Crops*	*Crops*	*Crops*	*Crops*	*Crops*	*Crops*	*Percent*
On front faces	198.1	126.1	61.5	135.9	106.0	160.2	787.8	35.2
On back faces	12.6	8.2	3.8	8.5	6.6	10.1	49.8	2.2
Total	210.7	134.3	65.3	144.4	112.6	170.3	837.6	37.4
Back-faced areas:								
On front faces	76.9	73.5	106.9	106.3	102.5	101.6	567.7	25.3
On back faces	182.3	190.8	97.4	101.3	132.1	131.2	835.1	37.3
Total	259.2	264.3	204.3	207.6	234.6	232.8	1,402.8	62.6
All working areas:								
On front faces	275.0	199.6	168.4	242.2	208.5	261.8	1,355.5	60.5
On back faces	194.9	199.0	101.2	109.8	138.7	141.3	884.9	39.5
Total	469.9	398.6	269.6	352.0	347.2	403.1	2,240.4	
	Percent 21.0	*Percent* 17.8	*Percent* 12.0	*Percent* 15.7	*Percent* 15.5	*Percent* 18.0		100.0

[1] Recorded in crops of 10,000 cups each.

the larger round trees. Only 8 percent of the front-faced trees carry two cups. These practices are relatively conservative when compared with those in other naval stores sections in the Southeast.

RESTING AND WORKED-OUT AREA

Nearly 2 million acres, an area almost as large as that remaining in round timber, had been turpentined prior to 1934 but was not then working. Very little of this acreage is in old growth, which is usually turpentined up to a short time before logging. Most of it is scattered throughout the second growth as a portion of some turpentine farm. It is in large blocks only where an operator has thoroughly worked out and abandoned an entire turpentine place.

It is estimated that 1 million acres resting or worked out bears adequate round trees of the necessary sizes and sufficient possibilities for new faces on trees previously worked to justify the start of a new operation in the next decade. This resting acreage bears approximately 10 million resting trees, almost 4 million round trees 9 inches in diameter and larger, and more than 20 million round trees between 5 and 9 inches in diameter. Some of this area is ready for immediate working; a large part of it, however, must wait several years for enough round trees to attain working size.

The remaining 867,000 acres classified as resting and worked out is made up largely of land on which it is estimated that there are insufficient potential cups to justify working during the next decade. Much of this area has stagnated because of the presence of more than 7 million worked-out trees (fig. 7). Here are also nearly 4 million resting trees, 2 million round trees 9 inches or larger in diameter, and more than 10 million round trees between 5 and 9 inches, all forming a reserve growing stock for future working. After a decade or so of growth, a portion will again be ready for working; but at least half a million acres have been completely worked out and definitely abandoned. The worked-out trees must be removed if this area is to restock with a satisfactory stand of round timber and take its place in the cycle of turpentine operations.

Future Outlook for Gum Naval Stores

Since the naval stores industry is well established throughout this survey unit, practically all of the round turpentine pines, with the exception of those in parks, or on inaccessible islands in swamps, will sooner or later be available for naval stores operations. During the next 20 years, some 4½ million round trees will each year become 9 inches or larger (with allowance made for mortality in present stands), unless the supply of round trees is reduced for pulpwood or other purposes. Some areas of round trees must stand for several years after the first trees reach turpentine size before there is a sufficient concentration to justify working.

FIGURE 7.—*A stand rendered nonproductive by worked-out slash pines.* F273052

It is the common practice to hang cups on only a portion of the trees 9 inches in diameter and larger; but since the trees on which two or more cups are hung make up for the uncupped trees, the total number of incoming trees 9 inches and larger can be expected under current practices to yield more than 4¼ million cups each year if they are all dedicated to gum naval stores operation. An analysis of naval stores operations in northeastern Florida indicates that, in a continuous (or sustained-yield) operation, approximately 11½ crops of 10,000 cups each must be hung each year on new round trees to maintain a total working body of 100 crops. The annual addition of new faces on round trees would, therefore, maintain a total working body of nearly 37½ million cups, or 3,740 crops. Since an increase in cupping must start with virgin faces and is extended into the working body year by year, it would probably take about 15 years to arrive at the full working body justified by the annual sustained income of new faces.

If it be assumed that production of naval stores will average 45 units per crop (in 1933–34 production averaged 43 units per crop when 24 percent of the cups were hung on trees under 9 inches d. b. h.), an annual sustained yield of 168,000 units appears possible. This figure may be compared with the 1933–34 production of 81,610 units. In 1934, less than 100,000 round turpentine pines were cut for wood products. An annual cut of this size from 9-inch and larger trees would reduce the attainable sustained yield by only 450 units. If the present practice of hanging cups on trees smaller than 9 inches is continued in the future, the number of cups that could be hung on fresh trees each year would be increased to about 4¾ million. The inclusion of the smaller trees would, however, reduce the yield per crop and although an annual sustained yield of 168,000 units could be maintained, it would come from a larger number of trees. A much larger production than that indicated above could be maintained for several years, but this would probably result in a reduction in the sustained-yield possibilities for the area until the restocking of second growth could overcome the inroads in the present growing stock. In some sections, owing to the scattered nature of suitable timber, naval stores men will probably be hard pressed to maintain their operations at present levels without sacrificing a part of the basic growing stock.

It is generally conceded that a relatively low market price for turpentine and rosin is essential to the wider use and distribution of naval stores. One solution of this problem lies in increasing the yield of gum per acre, thereby decreasing the unit cost of production. In order to do this, the growing stock should be built up and the density of existing stands increased. The accumulated worked-out turpentine timber should be removed, open areas assisted in restocking naturally or through planting, and the forest protected from uncontrolled fire. Better woods, producing, and marketing practices should be followed. The naval stores industry as a whole suffers from periods of overproduction, during which returns from the sale of turpentine and rosin drop below costs of production. It might be well, therefore, to maintain naval stores production at its present level for some years and to reserve the present surplus of round timber to build up the growing stock for use when increased markets or decreased supplies in other sections may justify a production more in line with the sustained-yield possibilities.

Although the current local turpentining practices are relatively conservative when compared with those in other parts of the region, the naval stores industry exacts an excessive toll from the forest, even here. As a result of chipping small trees, placing too many cups on some trees, deep chipping, and carelessness with fire, turpentining has caused an excessive reduction in rate of growth and an increase in rate of mortality of turpentine pines, as well as an actual reduction in saw-timber volume due to the scars which result from the work. During 1934 the longleaf-slash pine forests in northeastern Florida, if they had not been turpentined, would have produced 210 million board feet (lumber tally) more than they did. This is a part of the price paid for the naval stores industry. The significance of the loss in annual increment is shown by the fact that it equals the drain from the combined cut of pine for lumber, ties, poles, piles, and all other wood products during that year. It seems inevitable that the naval stores industry will continue to be an important user of the forests, and that the outlook for other forest industries will be limited accordingly in scope, character, and volume of production.

Wood Naval Stores Industry and Resources

The wood naval stores industry in northeastern Florida is at present of minor importance and is confined to two plants which use the destructive-distillation process in the production of wood turpentine, pine tar with its derivatives, and charcoal. Old-growth longleaf and slash pine stumps along with lightwood (dead pine heartwood) are used as raw material. The 50,000 to 75,000 tons of stumps used annually make up 85 to 95 percent of the total consumption. The industry employs more than 150 men on a full-time basis in its plants and a large number of men in the woods. In 1934, the laborers at the plants and in the woods worked more than 100,000 10-hour man-days.

Suitable supplies of merchantable stumps are found mainly in the longleaf, longleaf-slash, and scrub oak types—the last-named occupying lands formerly in old-growth longleaf. Generally speaking, land that has been clear-cut and has not yet reforested is considered the best source of stumps, particularly if crawler-type stump-pulling machines are used. The difficulty and the cost of extracting stumps with stump pullers increase markedly as it becomes necessary to avoid reproduction, standing trees, and other obstacles, or to enter the rolling uplands. Also, landowners are generally hesitant about allowing the use of stump-pulling machines on land that bears well established young growth, since the damage to the stands often is greater than any possible return from the sale of stumps. The acreage from which stumps can be obtained readily (table 9) constitutes 42 percent of the total forest

TABLE 9.—*Merchantable stump-land area, classified according to abundance of stumps and topographic situation*

Stumps per acre (number)	Flatwoods	Rolling uplands	Swamps, bays, etc.	All situations	
	Acres	*Acres*	*Acres*	*Acres*	*Percent*
5 or less	313,000	197,100	11,800	521,900	17.1
6 to 13	492,000	314,600	8,600	815,200	26.8
14 to 25	533,800	223,900	7,900	765,600	25.1
26 or more	786,800	149,000	9,500	945,300	31.0
Total stump-land area	2,125,600	884,600	37,800	3,048,000	
	Percent	*Percent*	*Percent*		
	69.7	29.0	1.3		100.0

land of the survey unit. As the supply becomes locally less abundant, stumps from the more difficult situations will, no doubt, become merchantable.

Because of the prevalent use of explosives in removing stumps, the estimates of stump volume are given here on a blasting basis (table 10). Since blasting leaves a larger proportion of the stumps in the ground, only 60 percent as much volume is obtained by this method as may be obtained with the use of pullers. Of the 12 million tons of well-seasoned merchantable stumps that could be blasted, about 85 percent is obtainable at the rate of 14 or more stumps per acre. Almost 25 percent of the stump lands are clear-cut, and half of these lands bear 26 or more stumps per acre. Of the stump-land area nearly half is in sapling stands of second growth, the density of which is increasing each year.

TABLE 10.—*Volume of merchantable stumps (blasting basis), classified according to abundance of stumps and topographic situation*

Stumps per acre (number)	Flatwoods	Rolling uplands	Swamps, bays, etc.	All situations	
	M tons	*M tons*	*M tons*	*M tons*	*Percent*
5 or less	125	79	5	209	1.7
6 to 13	984	629	17	1,630	13.6
14 to 25	2,135	895	32	3,062	25.5
26 and over	5,901	1,118	71	7,090	59.2
Total stump-land area	9,145	2,721	125	11,991	--
	Percent 76.3	*Percent* 22.7	*Percent* 1.0		100.0

An additional 3 million tons of stumps that might be removed with the use of explosives would come in part from the many advanced second-growth stands, where stumps cannot be pulled without damage to surrounding trees or because of high cost. Also, freshly cut old-growth stumps, which must season 8 to 10 years after cutting before becoming suitable for use, form another source of supply. A considerable volume of stump wood will also be available from the stumps of old-growth timber now standing—at a conservative estimate of 3 tons per acre. This would add another million tons, making the total additional supply 4 million tons.

With a present and future supply of nearly 17 million tons of merchantable stumps, northeastern Florida has obviously a much greater tonnage than is needed to meet the annual requirements of its two plants that now use 50,000 to 75,000 tons per annum. There are thus enough stumps to allow a very considerable expansion in the production of wood naval stores. It is probable that the use of stumps for naval stores production should be considered from a mining rather than a renewable-crop standpoint, for present processes use only old-growth stumps, and only 12 percent of the turpentine pine stands are still old growth. If the utilization of the present and future stump supply were extended over the next 25 years, the annual yield would be about 700,000 tons or enough to support a number of large steam-solvent plants. It is interesting to contemplate that with a yield from the steam-solvent process of 6.6 gallons of turpentine, 7.5 gallons of pine oils, and 348 pounds of rosin per ton of stumps, a full exploitation of the stump-wood resource during the next 25 years would produce 80,000 barrels of turpentine and 650,000 barrels (500 pounds gross) of rosin per year. This may be compared with the production of the gum naval stores industry in this survey unit in 1933–34, which was about 82,000 barrels of turpentine and 270,000 barrels of rosin. It is also of interest to note the possibility of a large production of pulping material from the spent-chip residue of the steam-solvent process.

Regardless of the adequacy of the supply of stump wood, any considerable expansion of the wood naval stores industry in northeastern Florida must, in all likelihood, await a marked increase in the demand for turpentine and rosin. The gum naval stores situation in the naval stores belt as a whole indicates no probability of a prolonged reduction of output due to scarcity of timber supply. Unless there is a marked increase in consumption, a full utilization of available and future supplies of both stump wood and turpentine timber would undoubtedly bring about a chronic condition of overproduction with its attendant demoralization of both the gum and wood naval stores industries.

Wood-Products Aspects

THE group of manufacturing industries producing lumber and other wood products in northeastern Florida has exceeded all others in importance for many years. For several decades after 1880 extensive railroad building made the resources of the interior progressively more acessible and, through the development of agriculture, increased the demand for wood products. From 1909 until 1929, lumber production in Florida approximated a billion feet annually. Cross-tie production became second to lumber from the standpoint of volume of timber used. The growth of the naval-stores industry stimulated the production of rosin barrels; and the increase of area devoted to specialty crops made a market for fruit and vegetable containers and slack barrels.

Saw-timber Volumes

In estimating present saw-timber volumes, only live trees of commercial species were included. Pine and cypress trees 9 inches and larger and hardwood trees 13 inches and larger in diameter at breast height, were considered merchantable if they were 50-percent sound and would produce one 12-foot usable log. Usable portions of turpentined butts are included in the inventory figures. All figures are net, deductions having been made for both woods and mill cull, i. e., portions of the tree which could not be made into lumber on account of rot, fire scars, crooks, bad knots, or other defects.

The Doyle rule has been used in the tables herewith because it is commonly used in the South and is the statute rule of Florida. Even though commonly used and although it approximates mill tally in logs of 25 to 35 inches in diameter, it is an inaccurate measure of volume in that it underestimates the lumber which may be cut from small logs and overestimates the contents of large logs. The Scribner rule in general underestimates mill tally, but is usually more accurate than the Doyle rule. Although the International (¼-inch kerf) rule is not used commercially, it is of especial value in that it very closely approximates actual green-lumber tally and for all practical purposes may be so used. The entire saw-timber volume in this area as estimated by the Doyle rule is less than 60 percent of that shown by the International rule and less than 70 percent of the Scribner-rule volume (table 11).

TABLE 11.—*Net board-foot volume expressed in Doyle, Scribner, and International (¼-inch saw kerf) log rules*

Tree species group	Doyle rule	Scribner rule	International rule
	M board feet	*M board feet*	*M board feet*
Pines:			
Longleaf	967, 500	1, 608, 900	1, 959, 500
Slash	1, 619, 300	2, 563, 300	3, 075, 800
Loblolly	717, 000	985, 700	1, 133, 800
Other	180, 300	279, 100	326, 600
Total	3, 484, 100	5, 437, 000	6, 495, 700
Hardwoods:			
Red gum	395, 600	473, 900	517, 200
Black gum	467, 700	585, 200	677, 400
Red oaks	412, 800	495, 600	537, 500
White oaks	119, 900	140, 500	151, 500
Other	538, 400	690, 800	761, 700
Total	1, 934, 400	2, 386, 000	2, 645, 300
Cypress	1, 154, 700	1, 687, 400	2, 017, 800
All species	6, 573, 200	9, 510, 400	11, 158, 800

Practically all of the forest area in northeastern Florida is accessible for logging during some season of the year. The excellent network of railroads and highways (fig. 5) makes it possible to get within a few miles of any part of it with railway cars or trucks. In fact, more than 90 percent of it has been logged over in the removal of the original timber. Woods labor is usually plentiful at relatively low

TABLE 12.—*Net board-foot volume (Doyle rule), by major species groups and forest conditions*

Species group	Old growth		Second growth			Reproduction and clear-cut	All forest conditions	
	Uncut	Partly cut	Sawlog size		Under sawlog size			
			Uncut	Partly cut				
	M board feet	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*Percent*
Pines:								
Longleaf	132, 500	274, 100	382, 200	20, 000	132, 500	26, 200	967, 500	14. 7
Slash	531, 900	292, 200	652, 000	61, 100	69, 400	12, 700	1, 619, 300	24. 7
Loblolly	234, 600	74, 200	333, 200	57, 900	14, 800	2, 300	717, 000	10. 9
Other	54, 500	28, 300	66, 100	5, 100	20, 700	5, 600	180, 300	2. 7
Total	953, 500	668, 800	1, 433, 500	144, 100	237, 400	46, 800	3, 484. 100	53. 0
Hardwoods:								
Red gum	208, 800	127, 200	46, 600	8, 200	4, 800	----------	395, 600	6. 0
Black gum	210, 300	215, 800	29, 100	5, 100	7, 300	100	467, 700	7. 1
Red oaks	259, 700	97, 200	41, 700	7, 100	6, 900	200	412, 800	6. 3
White oaks	73, 000	33, 100	9, 700	1, 500	2, 600	----------	119, 900	1. 8
Other	290, 700	184, 100	48, 400	5, 400	9, 600	200	538, 400	8. 2
Total	1, 042, 500	657, 400	175, 500	27, 300	31, 200	500	1, 934. 400	29. 4
Cypress	578, 800	411, 400	120, 200	14, 300	27, 000	3, 000	1, 154, 700	17. 6
All species	2, 574, 800	1, 737, 600	1, 729. 200	185, 700	295, 600	50, 300	6, 573, 200	----------
	Percent 39. 2	*Percent* 26. 4	*Percent* 26. 3	*Percent* 2. 8	*Percent* 4. 5	*Percent* 0. 8	----------	100. 0

wages. Because of the accessibility of timber, the ease of logging, and the availability of labor, the sawmill and other wood-products industries generally find it feasible to log areas if they bear 600 board feet or more per acre of pine or 1,000 board feet or more per acre of hardwoods in relatively large blocks. In this study all areas bearing these minimum volumes per acre were included in sawlog-size stands, even though some of them were widely scattered or in fence corners and could not now be economically logged. In the survey unit as a whole, old-growth uncut stands averaged almost

TABLE 13.—*Diameter-class distribution of net board-foot volume (Doyle rule), by species groups and forest conditions*

Species group and tree diameter class (inches)	Old-growth		Second growth			Reproduction and clear-cut	All forest conditions	
	Uncut	Partly cut	Sawlog size		Under sawlog size			
			Uncut	Partly cut				
	M board feet	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*Percent*
Pine:								
10 and 12	137, 500	168, 500	673, 900	57, 000	161, 700	27, 200	1, 225, 800	35. 2
14 and 16	274, 000	246, 500	506, 500	46, 700	62, 500	14, 700	1, 150, 900	33. 0
18 and 20	225, 300	147, 000	160, 000	26, 100	12, 100	4, 700	575, 200	16. 5
22 and over	316, 700	106, 700	93, 000	14, 400	1, 100	----------	531, 900	15. 3
Total	953, 500	668, 700	1, 433, 400	144, 200	237, 400	46, 600	3, 483, 800	100. 0
Hardwood:								
14 and 16	258, 600	214, 600	89, 600	13, 700	21, 800	500	598, 800	30. 9
18 and 20	271, 500	208, 900	49, 800	8, 200	8, 700	----------	547, 100	28. 3
22 and over	512, 300	233, 900	36, 100	5, 400	700	----------	788, 400	40. 8
Total	1, 042, 400	657, 400	175, 500	27, 300	31, 200	500	1, 934, 300	100. 0
Cypress:								
10 and 12	91, 600	114, 000	63, 500	7, 100	15, 900	1, 200	293, 300	25. 4
14 and 16	113, 000	121, 600	38, 400	4, 300	8, 100	1, 300	286, 700	24. 8
18 and 20	116, 800	51, 700	8, 900	1, 100	400	600	179, 500	15. 5
22 and over	257, 400	124, 100	9, 400	1, 800	2, 600	----------	395, 300	34. 3
Total	578, 800	411, 400	120, 200	14, 300	27, 000	3, 100	1, 154, 800	100. 0
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
Total pine	27. 4	19. 2	41. 2	4. 1	6. 8	1. 3	100. 0	----------
Total hardwood	53. 9	34. 0	9. 1	1. 4	1. 6	(1)	100. 0	----------
Total cypress	50. 2	35. 6	10. 4	1. 2	2. 3	0. 3	100. 0	----------

[1] Negligible.

6,000 board feet per acre; partly cut old-growth stands, over 3,000; second-growth sawlog-size uncut and partly cut stands, more than 2,000. Only 7 percent of the total board-foot volume (International ¼-inch rule) occurred in under sawlog-size, reproduction, and clear-cut stands, all of which had less than 600 board feet per acre.

More than 50 percent of the volume of saw timber measured by the Doyle rule was in pine, nearly 30 percent in hardwoods, and the rest in cypress (table 12). Slash pine accounted for 46 percent of the pine volume. Black gum was the most important hardwood from the standpoint of volume, accounting for 24 percent. Of the volume in longleaf and slash pine, approximately 50 percent was in trees that had been or were being turpentined.

The pine in old-growth stands makes up almost 47 percent of the pine saw-timber volume. Although some of this pine volume is in other than pine types, the proportion given contrasts significantly with the 13 percent of the pine types that is in old-growth stands. This is due mainly to the prevalence in this class of relatively large trees and heavy stands (table 13). More than 85 percent of the volume of hardwood and some 80 percent of the cypress is still in stands of old growth. Red oaks have the largest volume in the uncut old-growth stands and black gum in the partly cut. Almost half of the hardwood volume in the uncut old-growth and over a third in the partly cut stands are in trees 21 inches and over in diameter. The largest individual species volume in the old growth is in cypress, of which practically 20 percent is in trees 29 inches and larger in diameter. Only 2 percent of the total pine volume (Doyle rule) is in trees 29 inches and larger in diameter.

Cordwood Volumes

There is a considerable additional volume in standing timber of such small size or poor quality that it must go, if utilized now, into such products as pulpwood, fuel wood, and fence posts. This volume is expressed in terms of standard cords (4 by 4 by 8 feet), which are measured and sold with the bark included.

In addition to the cordwood volume in sound and rotten culls and in the tops and limbs of sawlog-size trees, all good trees below saw-timber size, but at least 5 inches in diameter, are included (table 14). It does not follow that this latter material is available or should be cut for cordwood; on the contrary, a very considerable part of this class of trees must be held on the land as a source of continuing supply for lumber, poles, ties, and similar wood products. There is an ample supply of cordwood material available for fuel and farm use in cull trees and in the tops and turpentined butts of sawlog-size trees. A discussion of the growing stock from the standpoint of pulpwood supply is given in the section on "Pulpwood Resources."

TABLE 14.—*Net cordwood volume of material unsuited for sawlogs by species groups and quality classes* [1]

Species group	Good trees under saw-log-size	Tops and limbs of saw-log trees [2]	Sound culls [3]	Rotten culls [3]	All quality classes	
	Cords	*Cords*	*Cords*	*Cords*	*Cords*	*Percent*
Pines:						
Round	6,891,900	1,193,500	43,400	5,200	8,134,000	21.7
Turpentined	2,233,200	[4] 2,032,900	37,400	5,500	4,309,000	11.5
Nonturpentine	922,800	616,100	115,900	16,300	1,671,100	4.4
Total	10,047,900	3,842,500	196,700	27,000	14,114,100	37.6
Hardwoods:						
Pulping	5,450,000	2,223,500	1,426,600	670,900	9,771,000	26.1
Nonpulping	[5] 2,589,900	1,339,900	4,031,100	857,300	8,818,200	23.5
Total	8,039,900	3,563,400	5,457,700	1,528,200	18,589,200	49.6
Cypress	2,689,000	1,581,800	265,500	249,300	4,785,600	12.8
Total	20,776,800	8,987,700	5,919,900	1,804,500	37,488,900	
	Percent	*Percent*	*Percent*	*Percent*		
	55.4	24.0	15.8	4.8		100.0

[1] Cordwood volume computed from cubic-foot volume including bark.
[2] Includes cordwood volume in top stems of pines to a 4-inch minimum top and in tops and limbs of hardwoods and cypress.
[3] Includes cordwood volume in top stems of pine culls and in tops and limbs of hardwood and cypress culls; sound culls also include all sound scrub-oak volume.
[4] Includes approximately 580,700 cords in turpentined butts.
[5] Includes all sound special-use species to approximately a 4-inch top.

TABLE 15.—*Net cubic-foot volume (inside bark), by species groups and quality classes*

Species group	Good sawlog-size trees		Good trees under sawlog size [2]	Total good-tree volume	Culls, sound and rotten culls [3]	All quality classes	
	Sawlog material	Tops and limbs [1]					
	M cubic feet	*M cubic feet*	*M cubic feet*	*M cubic feet*	*M cubic feet*	*M cubic feet*	*Percent*
Pines	1, 165, 730	[4] 290, 690	701, 790	2, 158, 210	16, 540	2, 174, 750	48. 1
Hardwoods	[5] 449, 140	[5] 222, 730	[6] 502, 830	1, 174, 700	[7] 451, 960	1, 626, 660	36. 0
Cypress	377, 970	111, 790	190, 020	679, 780	37, 720	717, 500	15. 9
All groups	1, 992, 840	625, 210	1, 394, 640	4, 012, 690	506, 220	4, 518, 910	
	Percent 44. 1	*Percent* 13. 8	*Percent* 30. 9	*Percent* 88. 8	*Percent* 11. 2		100. 0

[1] Top stems to a 4-inch minimum for pines; tops and limbs for hardwoods and cypress.
[2] Includes trees 5.0 to 8.9 inches in diameter in case of pine and cypress, to a 4-inch top; 5 to 12.9 inches in diameter in the hardwoods, to a 4-inch top.
[3] Includes trees of diameter 5.0 inches or larger to a 4-inch minimum top; limb wood included only on hardwood and cypress trees of sawlog size.
[4] Includes 52,270 M cubic feet in turpentined butts.
[5] Does not include special-use species or scrub oak.
[6] Includes all special-use species to approximately a 4-inch top. Does not include scrub oak.
[7] Includes all sound scrub oaks to approximately a 4-inch top.

Cubic-foot Volumes

The cubic-foot measure for solid wood is used here only as a means of expressing the combined board-foot and cordwood contents of the forest stand 5 inches and larger in terms of a single unit. It constitutes the base used in determining the net result of changes which are occurring in the forest as a result of growth, natural mortality, and industrial drain.

Less than 1 percent of the pine and only 5 percent of the cypress cubic-foot volume is in sound and rotten cull tress, but almost 28 percent of the hardwood cubic-foot volume is in this class of timber (table 15). Although 54 percent of the good-tree volume in pine is sawlog material, only 38 percent of the hardwood good-tree volume is in this size and quality of material.

Poles and Piles

Because of the difficulty of judging the suitability of standing trees for poles and piles, the timber cruisers tended to apply the specifications rather strictly, and it is believed that the estimate of the number of qualified trees is correspondingly conservative. In the following estimates, only longleaf, slash, and loblolly pines are included.

To meet pole and pile requirements, trees must have a uniform taper and be free from decay, injurious scars, and bird or insect holes. They must also be free from large knots or knots so located as to impair the strength of the pole, and from short crooks and excessive twist or spiral grain. They may have a slight one-way sweep, but a straight line drawn from the center of the top to the center of the butt must not fall outside the bole.

TABLE 16.—*Pole and pile resources,*[1] *by tree-diameter classes and length of product*

Tree-diameter class (inches)	20 feet	25 feet	30 feet	35 feet	40 and 45 feet	50 and 55 feet	All lengths	
	M sticks	*M sticks*	*M sticks*	*M sticks*	*M sticks*	*M sticks*	*M sticks*	*Percent*
8	7, 420	1, 949	893	126	------	------	10, 388	40. 1
10	3, 885	1, 772	1, 044	565	303	------	7, 569	29. 2
12	1, 760	1, 104	693	558	448	38	4, 601	17. 7
14	577	524	388	334	366	69	2, 258	8. 7
16	114	167	161	138	161	60	801	3. 1
18	13	57	72	67	72	38	319	1. 2
Total	13,769	5, 573	3, 251	1, 788	1, 350	205	25, 936	
	Percent 53. 1	*Percent* 21. 5	*Percent* 12. 5	*Percent* 6. 9	*Percent* 5. 2	*Percent* 0. 8		100. 0

[1] Round and turpentined longleaf and slash pines and loblolly pine. Poles and piles of saw-timber size are also included in the saw-timber and cubic-foot volumes; those under sawlog size, in the cordwood and cubic-foot volumes. Material recorded here does not constitute additional volume.

It is estimated that in 1934 there were nearly 26 million potential poles and piles in northeastern Florida (table 16). Over half of these were in the 20-foot class; 21 percent were in the 25-foot class. Inasmuch as the annual demand for poles is less than 50,000 and is principally for the 25-foot class, it is significant that over 12 million sticks were in this class or in classes of greater length. Considering all lengths, approximately 62 percent of the qualified pole and pile trees are in round longleaf or slash pines, 32 percent in pines that have been (or are being) turpentined, and the remainder in loblolly and other pines.

Pole and pile trees are scattered singly and in groups throughout the pine stands. The relative

occurrence of pole and pile lengths shown (table 16) should be of particular interest to the wood-treating industry and to large consumers of poles and piles, in that it indicates the run of lengths in the forest stands. It should be understood that the sawtimber, cordwood, and cubic volumes of the pole and pile trees given in table 16 have already been included in the previous tables and *do not constitute an additional volume item.*

Pulpwood Resources

From the standpoint of a prospective consumer of pulpwood for the manufacture of kraft paper and similar commodities, it is of interest to consider the total pulping resources expressed in standard cords. The following estimates include all trees of pulping species, such as pines, cypress, gums, magnolias, bays, maples, and other soft hardwoods, 5 inches in diameter and larger, regardless of their suitability for other use. As in the case of poles and piles, these estimates deal with volumes included in previous tables and are not to be added to them.[1]

It is obvious that not all of this material should be used for pulp. Much of it is in trees that are more valuable for saw timber, poles, ties, and other products, either immediately, or in the form of growing stock for future supplies. These younger trees should be left untouched except for improvement cuttings. Then, too, a considerable part of the volume is not immediately available for pulping because it is in round slash and longleaf pines that are likely first to be turpentined. Investigators of prospective pulp-mill sites must appreciate, therefore, that only a part of the volume shown in table 17 is free from the competitive requirements of other wood-using industries or can be used for pulpwood without seriously endangering the future timber supply of such industries.

The most available source of pulpwood is the enormous volume of worked-out turpentined trees in the abandoned turpentine areas, of which there is in this section almost a million acres. These worked-out trees, except in old-growth stands, usually average less than 12 inches in diameter. Trees of this size bearing one face or more are of low value for saw timber, and only a small percentage is valuable for poles and ties. A heavy proportion, therefore, of the timber volume in abandoned turpentine areas may be considered available for conversion into pulpwood.

In 1934 there were more than 2¾ million cords in worked-out turpentine pines. It is estimated on a basis of the cups hung during the 6 years prior to 1935–36 that the naval stores industry annually adds about 350,000 cords to the present accumulation. During 1934 the use of turpentined pines for saw timber, poles, ties, etc., amounted to nearly 400,000 cords. More than 250,000 cords of this cut

[1] A detailed presentation of the volume of material in pulping species is given in the following: SOUTHERN FOREST EXPERIMENT STATION. ADVANCE INFORMATION ON THE SUPPLY OF PULPWOOD IN SURVEY UNIT NO. 1—FLORIDA. Southern Forest Survey Release 9.

TABLE 17.—*Net cordwood volume of pulping species, by quality classes* [1]

Pulping species group	Good trees, 5–13 inches	Good trees, 13 inches and larger		Sound and rotten culls	All quality classes	
		Sawlog material	Tops and limbs [2]			
	Cords	*Cords*	*Cords*	*Cords*	*Cords*	*Percent*
Pines:						
Turpentine:	11,137,300	2,361,600	311,100	48,600	13,858,600	26.1
Round	5,022,300	2,088,600	600,400	31,300	7,742,600	14.6
Working and resting	1,649,400	939,000	246,900	11,600	2,846,900	5.3
Worked out	2,382,900	2,140,300	310,800	132,200	4,966,200	9.3
Nonturpentine	20,191,900	7,529,500	1,469,200	223,700	29,414,300	55.3
All pines	5,450,000	4,201,100	2,223,500	2,097,500	13,972,100	26.3
Hardwoods	5,535,600	2,717,200	1,025,800	514,800	9,793,400	18.4
Cypress	31,177,500	14,447,800	4,718,500	2,836,000	53,179,800	
All pulping species	*Percent* 58.6	*Percent* 27.2	*Percent* 8.9	*Percent* 5.3		100.0

[1] These estimates cover volumes included in previous tables and are not to be considered as additional items.
[2] Top stems to a 4-inch minimum for pines; tops and limbs for hardwoods and cypress.

came from stands of old-growth pine, which are rapidly being removed. The large quantity of second-growth turpentine pines coming in will enable the naval stores industry to maintain its present production at least during the next 20 years, and possibly to increase it materially. Under a sustained-yield naval stores program, utilizing the full resources of the survey unit, about 485,000 cords in worked-out turpentine trees would be made available annually. If the wood-products industries which remain after the old growth has been cut out require 200,000 cords, as is estimated, then a remainder of 285,000 cords will also be available for wood products from this source of supply alone.

The top stems of saw-timber pines are seldom used in lumber and similar operations, and in 1934 the greater part of more than 100,000 cords of such material was left in the woods in logged-over areas. Some tops were utilized for fuel, but a large proportion of the volume remained in the woods as waste and may be considered an additional source of pulpwood. The forest would be considerably improved if all sound and rotten cull trees were removed. Of the more than 2¾ million cords of sound material in such trees, nearly 8 percent is in pine and the remainder in pulping hardwoods and cypress.

Wood-products industries already established utilized in 1934 a volume of nonturpentine pines equivalent to the annual increment in both the old-growth and second-growth stands. Any heavier cutting would mean a reduction in the growing stock of this species group; but on an area not covered by the field survey, the Ocala National Forest, it is estimated that by 1942 the sand pine stand will produce annually more than 35,000 cords of wood not now used by other industries. It does not appear likely that a pulpwood industry will compete seriously for old-growth cypress and pulping hardwoods. In 1934 there was a surplus of increment over use in second-growth pulping hardwoods of more than 80,000 cords and in second-growth cypress of about 40,000 cords.

In 1934 there was, therefore, an accumulation of more than 3 million cords in sound and rotten cull pines and in worked-out turpentine pines, a large portion of which may be considered immediately available for pulpwood. Looking into the future, it is estimated that more than 400,000 cords of pine would be available for pulpwood annually from turpentine areas, tops and limbs, and the sand pine on the Ocala National Forest. In addition, there is now a surplus of increment over use of 120,000 cords in second-growth pulping hardwood and cypress; and more than 2½ million cords of culls in these species have accumulated.

A steady market for pulpwood could materially benefit this survey unit. All classes of stands could be improved by a reduction in the number of sound and rotten cull trees and in some stands by the thinning of dense second growth (fig. 8). Worked-out turpentine timber, which is now stagnating large areas (fig. 7) and threatening to accumulate further, could be removed to make room for round turpentine pine. Turpentine operators, by supplementing their regular activities with the cutting of pulpwood, could materially reduce the cost of their naval stores operations. The seasonal nature of agricultural activities would make it possible for farms and agricultural workers to obtain an additional cash income, and established communities could be further stabilized. If sound forest-management policies are adopted and practiced by pulp and paper manufacturers on their own lands and enforced through contracts on the lands of those from whom they purchase pulpwood, the pulpwood industry can become established in northeastern Florida and at the same time the growing stock can be built up. If, on the other hand, destructive methods are employed or permitted, the pulpwood industry can transform productive, rapidly growing stands of second-growth pine into nonproductive clear-cut lands or scrub oak stands. The removal of young pine at a time when rapid growth is taking place will be detrimental to established industries, cause a material loss to owners of land who could later sell their timber for higher priced products, and possibly drive into decadence established communities.

A mill has already been erected at Fernandina and others are being constructed at Fernandina and Jacksonville. The establishment of any new plant in this survey unit should be decided upon only after careful consideration has been given to the wood requirements of existing industries and to the

FIGURE 8.—*Longleaf pine stand immediately after thinning, Clay County, Fla.*

sustained-yield possibilities of the tributary territory, since only thus can assurance be given that it will be a permanent installation and a genuine benefit.

Forest Increment

Individual trees increase in volume from year to year through growth in diameter and height, provided that they are sound and that any loss of volume due to rot, turpentining, or other damage does not offset growth. Timber stands, made up of many thousands of individual trees, likewise show an increase in volume if the aggregate net growth of the constituent trees more than offsets the constant attrition caused by fire, windthrow, turpentining, natural crowding out, and other causes of tree mortality. Such increases or decreases in tree and stand volume constitute a plus or minus increment. The volume growth of an individual tree can be accurately measured, but computation of increment, even for a year, of a forest area of several million acres, involving as it does many complicating factors of species, density of stand, forest condition, site, weather and the presence or absence of unfavorable utilization practices, cannot be precise.

PERIODIC ANNUAL INCREMENT

It is estimated that trees are harvested each year from less than 250,000 acres of forest land in northeastern Florida. The remainder is unaffected by utilization practices during any one year, and forest-land owners are, therefore, interested in the rate at which these forest stands are increasing in volume.

The increment percent—that is, the rate at which timber bodies increase in volume—is principally affected by the forest condition and by the rates of growth and mortality of the species making up the stand. The percents shown in table 18 can be used in approximating increment of the several species groups in average stands of the various forest conditions shown, provided that the area considered is large enough to smooth out the extremes of site, density of stand, and effects of utilization.[2] The board-foot increment rates include both the increase in volume of trees already of saw-timber size and the volume in trees that reach saw-timber size during the year. The cordwood rates include the increase in volume of all trees 5 inches and larger

[2] Note that these rates must be compounded for the period over which the user desires to compute increment.

plus the volume of those reaching 5 inches during the year. Reproduction and clear-cut areas have an insufficient volume of trees 5 inches or larger to justify increment calculations.

TABLE 18.—*Annual increment percent,*[1] *by species groups and forest conditions*

BOARD-FOOT INCREMENT (BASED ON INTERNATIONAL ¼-INCH RULE)

Species group	Old growth		Second growth	
	Uncut	Partly cut	Sawlog size	Under sawlog size
	Percent	*Percent*	*Percent*	*Percent*
Turpentine pines:				
Round	−1.18	−0.95	8.12	15.66
Turpentined	−6.96	−6.01	−.43	
Nonturpentine pine	1.28	1.38	4.37	9.52
Hardwood	1.97	1.92	4.76	7.18
Cypress	.96	.22	2.16	.68

CORDWOOD INCREMENT

Turpentine pines:				
Round	−1.77	−2.18	4.35	8.92
Turpentined	−7.58	−6.94	−2.28	−4.07
Nonturpentine pine	.84	1.40	3.02	7.21
Hardwood	1.38	.99	3.51	7.05
Cypress	.52	−.02	1.74	1.74

[1] The increment percents are periodic annual compound interest rates based on a 10-year period computed for good trees only.

INFLUENCE OF TURPENTINING AND FIRE ON INCREMENT

In northeastern Florida the natural conditions of soil and climate in general are favorable for tree growth, but there are several factors that have tended to restrict volume increment. Chief of these is an abnormally high mortality rate, especially in the turpentine pines. This must be charged mainly to practices that have prevailed in the past in the production of gum turpentine and rosin and in woods burning. Deep chipping, hanging too many cups on the trees, cupping small trees, inserting tins too deeply, and failure to protect resting or worked-out turpentine trees from fire have not only materially retarded the diameter growth of the individual trees and reduced their volume of merchantable saw timber, but have in addition resulted in an abnormal loss of trees (fig. 9). Wholesale woods burning is most common in longleaf and slash pine types.

The reduction in rate of growth and the increased rate of mortality of turpentined trees accounts for the negative increment for that species group (table 18). The remaining round old-growth

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FIGURE 9.—*Wind damage in second-growth slash pine stand, Union County, Fla.*

turpentine pines do not put on sufficient growth annually to offset the losses due to fire, wind-throw, and other causes; this accounts for the negative rate of increment in such stands. During 1934 the loss in increment of longleaf and slash pines attributable to turpentining was as great as the drain on all species of pine for the production of wood products (table 19).

TABLE 19.—*Loss in increment due to turpentining of longleaf and slash pines, 1934*

Effect	Board-foot volume [1]	Cubic-foot volume [2]
	M board feet	*M cubic feet*
Growth if left round	236, 200	35, 500
Growth when turpentined	122, 600	21, 180
Loss in growth	113, 600	14, 320
Mortality if left round	113, 100	26, 580
Mort lity when turpentined	187, 200	52, 890
Increased loss in mortality	74, 100	26, 310
Unusable volume	22, 600	1, 560
Total loss	210, 300	42, 190

[1] International ¼-inch rule.
[2] Cubic-foot figures are for solid wood inside bark.

Both in and out of the turpentine woods, the almost universal practice of uncontrolled woods burning has had a markedly unfavorable effect on the increment of the stands, and one that reaches back for many decades. This is due not only to a slowing down of the growth rate of the individual trees but also to the prevention of any approach to full stocking. If the effects of this factor, together with those of destructive turpentining, wind-throw, natural crowding out, and other causes of tree mortality, could be lessened appreciably, important increases could be made in the net increment. These factors reduced net increment for all species nearly 400 million board feet (International ¼-inch rule) in 1934, almost as great a reduction as the utilization of all wood products combined. This tremendous waste can be materially lessened with more attention to good forest management, adequate control of fire, conservative turpentining, thinning of dense stands, and more complete utilization.

NET INCREMENT FOR THE ENTIRE SURVEY UNIT

The increment figures given in table 20 are an estimate of the net increases (growth less mortality) taking place in the stands during 1934. The board-foot figures represent net increases in the volume of saw-timber material only; the cubic-foot figures include all good trees 5 inches in diameter and above. The influence of turpentining is reflected in the minus increment for turpentined pines.

TABLE 20.—*Total net increment, classified according to forest condition and species group*

BOARD-FOOT INCREMENT [1] (INTERNATIONAL ¼-INCH RULE)

Forest condition	Turpentine pine		Non-turpentine pine	Hardwood	Cypress	All species groups
	Round	Turpentined				
	M board feet	*M board feet*	*M board feet*	*M board feet*	*M board feet*	*M board feet*
Old growth	−13, 000	−65, 800	7, 000	46, 900	9, 500	−15, 400
Second growth:						
Sawlog size	107, 400	−17, 800	35, 300	16, 300	7, 000	148, 200
Under sawlog size	73, 400	−700	10, 800	4, 800	800	89, 100
Reproduction and clear-cut	4, 000	−2, 700	(2)	(2)	−100	1, 200
Total	171, 800	−87, 000	53, 100	68, 000	17, 200	223, 100

CUBIC-FOOT INCREMENT [1] (INSIDE BARK)

	M cubic feet	*M cubic feet*	*M cubic feet*	*M cubic feet*	*M cubic feet*	*M cubic feet*
Old growth	−5, 010	−15, 320	1, 030	9, 080	1, 240	−8, 980
Second growth:						
Sawlog size	20, 320	−11, 240	5, 890	6, 180	2, 240	23, 390
Under sawlog size	30, 410	−5, 390	3, 120	5, 790	970	34, 900
Reproduction and clear-cut	110	−1, 300	80	10	20	−1, 080
Total	45, 830	−33, 250	10, 120	21, 060	4, 470	48, 230

[1] Minus sign (−) indicates loss. [2] Negligible.

The growing interest in better forest management, the spread of the use of fire-protection measures, and the opening of markets for material formerly unutilized, lend color to the belief that the annual increment can be doubled in a few decades if these movements grow to the extent that now seems possible.

Wood-Products Industries

In northeastern Florida the manufacture of lumber is the most important of the wood-products industries; cross-tie production ranks second; the making of veneer, third; and the cooperage industry, fourth. The larger sawmills are found principally in the rapidly disappearing old growth of Taylor, Dixie, and Levy Counties on the Gulf coast; the veneer industry is located within and

adjacent to the agricultural belt that bisects the area from north to south; the cooperage plants are scattered throughout (fig. 5). According to the 1931–32 Census of Crops and Manufactures of the State Department of Agriculture, the average number of wage earners employed by the wood-products industries was 7,051, with wages of $3,183,605 for the year. Although the lumber industry in general is very important, the cypress portion is of particular significance, for Florida ranks first in production of cypress and contains most of the remaining cypress saw timber in the United States.

LUMBER

Eight large sawmills with a daily capacity of over 40 M board feet each were active in 1934 in northeastern Florida (table 21), but three of these expect to cut out before 1944. The original logging operations were often of a selective nature, and smaller mills have moved into the partly cut old-growth stands to utilize the remaining timber. Attracted principally by second growth of sawtimber size were 126 small mills with an average daily production capacity of less than 20 M board feet each and 16 with a capacity of 20 to 39 M board feet. In 1936, the number of mills under 20 M board feet daily capacity increased more than 20 percent; there was no change in the other classes of mills. The lumber cut in 1934 was 204,600 M board feet lumber tally (table 22), almost 60 percent of which was pine. The logging and manufacture of this lumber required more than 700,000 man-days of labor.

TABLE 21.—*Number of sawmills, classified according to species cut and capacity, 1934*

Daily (10-hour) capacity (M board feet)	Pine	Hardwood	Cypress	Mixed[1]	All species
Under 10	41	2		9	52
10 to 19	49		6	19	74
20 to 39	6	2	3	5	16
40 and over	2	1	3	2	8
All mills	98	5	12	35	150

[1] Mills cutting less than 80 percent of any 1 of the species groups listed are classed as mixed mills.

VENEER

Altogether 13 rotary veneer plants, producing box stock, crate headings, and hamper bottoms, used during 1934 the equivalent of more than 36 million board feet (lumber tally), which was nearly equally divided between pine and hardwoods; practically no cypress was used. These plants were operating at about 60 percent of capacity in 1934. Half of the companies own timber but, like the others, also buy logs. A large part of the production is consumed in Georgia and Florida; there is a small export to Cuba. Some 2,400 people are employed for all or part of an 8- to 10-month season and in 1934 worked a total of more than 270,000 man-days in the woods and in the veneer and assembly plants. Six package plants to the south use veneer logs, largely hardwood, from as far north as Alachua, Clay, and St. Johns Counties. Because of the requirements of the citrus and truck crops for containers, this industry is of particular local significance.

COOPERAGE

There are nine slack-cooperage plants, two making cooperage for produce barrels, five for rosin barrels, and two for both products. Produce barrels, which are principally used for potatoes and fish, are made in the southeast section. Most of the rosin-cooperage plants are closely associated with the gum naval stores industry in the north and central portions of the survey unit. These plants use material of small size, most of them taking bolts to a 6-inch minimum diameter. In 1934 the slack-barrel plants operated at about 65 percent capacity and the rosin-barrel plants at around 55 percent. Together they employed 620 persons during all or part of 6 to 10 months (55,000 man-days) and used more than 25,000 cords of wood, nearly 90 percent of which was pine.

PIECE PRODUCTS

In addition, a large volume of material is utilized by the piece-products industries. Almost 2 million cross ties were produced in 1934, 56 percent from cypress, 41 percent from pine, and the remainder principally from gum. Nearly 40,000 pine and 5,000 cypress poles and piles were also produced. Those produced from pine are marketed at creosoting plants, from which they are distributed to consumers. The production of cross ties, poles, and piles required 285,000 man-days of labor in the woods.

TABLE 22.—*Production and employment in the wood-products industries, 1934*

Industry and use	Units produced	Employment [1]	
		In the woods	At the plant
	M board feet	*Man-days*	*Man-days*
Lumber	[2] 204,600	261,000	448,000
Veneer	[2] 36,300	72,500	[3] 199,700
	Pieces		
Cross ties	1,974,600	271,900	
Fence posts	[4] 1,618,200	[4] 28,000	
Poles and piles	45,400	13,900	[5] 44,100
	Cords		
Cooperage	25,800	29,200	26,500
Fuelwood	[6] 536,800	[6] 614,900	
Miscellaneous [7]	9,700	10,400	6,300
	M board feet		
	[2] 700	200	
Total man-days of employment		1,302,000	724,600

[1] In man-days of 10 hours.
[2] Lumber tally.
[3] Includes fabrication in crate and package plants.
[4] Includes 236,300 commercial fence posts on which 4,000 man-days of labor were expended.
[5] Labor in treating plant.
[6] Includes 83,900 cords of commercial fuel wood on which 116,700 man-days of labor were expended and 80,200 cords of nonforest fuel wood on which labor was not computed; also includes 12,500 cords of fuel wood used in stilling operations, but the labor for this (12,500 man-days) is accounted for in the section on Gum Naval Stores Industry.
[7] Shingle and excelsior plants, miscellaneous farm use, and export logs.

In 1934 more than 1½ million fence posts were cut. Over 75 percent were of lightwood, almost 20 percent of cypress, and the remainder of green pine and of oak and other hardwoods. It is estimated that almost 250,000 of these posts were produced for sale, most of the others being used locally on the farms.

Less than 100,000 of the 456,000 cords of fuel wood obtained from the forest were sold commercially. About one-quarter of all fuel wood produced was of lightwood, the quantity of which is rapidly diminishing through use. The production of fence posts and fuel wood in 1934 required almost 650,000 man-days of labor, the greater proportion of which was expended by farm laborers.

MISCELLANEOUS

In addition to the industries and products already mentioned, there are a shingle mill, an excelsior plant, and a hamper-bottom plant. A few logs are exported each year and there is some miscellaneous farm use other than for fence posts and fuel. Altogether these miscellaneous items require less than 20,000 man-days of labor each year.

Commodity Drain

Commodity drain includes the volume utilized from this survey unit by the several forest-products industries located either within or without its boundaries, plus any additional unutilized volume of the trees cut which is included in the inventory estimates of the survey. The drain figures do not include that part of the cut of the wood-products industries shown in table 22 which was obtained from the forests outside the survey unit, but do include the drain on this unit by industries located outside its boundaries. The Forest Survey includes in its saw-timber volumes the entire stem that, in the opinion of its timber estimators, could be used with close utilization. Some of this material may be utilized and some may be wasted, depending upon local practices, i. e., upon the degree of utilization.

The saw-timber commodity drain exceeded 425 million board feet (International ¼-inch rule) in 1934 (table 23). Almost 47 percent of this

TABLE 23.—*Commodity drain from saw-timber growing stock expressed in board feet (International ¼-inch rule), 1934*[1]

Commodity	Pine	Hardwood	Cypress	All species	
	M board feet	*M board feet*	*M board feet*	*M board feet*	*Percent*
Lumber	103,600	36,600	59,100	199,300	46.9
Veneer	18,200	22,200	100	40,500	9.5
Cooperage	9,400	[2]	1,300	10,700	2.5
Cross ties	46,000	3,700	74,600	124,300	29.3
Poles and piles	4,800	[2]	800	5,600	1.3
Fence posts		200		200	[2]
Fuel wood	26,400	15,700		42,100	9.9
Miscellaneous	1,600	400	500	2,500	.6
Total	210,000	78,800	136,400	425,200	100.0

[1] The International ¼-inch rule closely approximates lumber tally.
[2] Negligible.

TABLE 24.—*Commodity drain of good trees 5 inches and larger expressed in cubic feet (inside bark), 1934*

Commodity	Pine	Hardwood	Cypress	All species	
	M cubic feet	*M cubic feet*	*M cubic feet*	*M cubic feet*	*Percent*
Lumber	18,390	5,260	8,440	32,090	42.8
Veneer	3,200	3,190	10	6,400	8.5
Cooperage	2,270	10	210	2,490	3.3
Cross ties	8,700	570	11,280	20,550	27.4
Poles and piles	960		120	1,080	1.4
Fence posts	20	30	250	300	.4
Fuel wood	7,670	3,530		11,200	15.0
Miscellaneous	720	80	90	890	1.2
Total	41,930	12,670	20,400	75,000	100.0

drain was occasioned by the manufacture of lumber, 29 percent by cross-tie production, and almost 10 percent each by fuel-wood and veneer uses. Pine composed nearly 50 percent and cypress 32 percent. The total commodity drain in all trees 5 inches and larger, including saw-timber material, reduced to a common factor, amounted to 75 million cubic feet (table 24).

It is recognized that the commodity drain calculated for 1934 is below what may be expected during more prosperous years. Indications are that the drain due to lumber manufacture in 1936 exceeded that of 1934 by more than 50 percent, and it is likely that some increase has taken place in other commodities. It is difficult, if not impossible, to predict the drain during the next 10 years because of the difficulty of weighing the many factors involved; but it might not be unreasonable to assume that the average annual commodity drain during the next 10 years will be 25 percent greater than that in 1934.

Comparison of Increment With Commodity Drain

Data representing the many factors influencing the increment of the pines, hardwoods, and cypress (table 20) and the toll which the many wood-products industries exact (tables 23 and 24) are here reassembled for comparison and consideration of their net influence upon the growing stock of northeastern Florida (table 25, fig. 10).

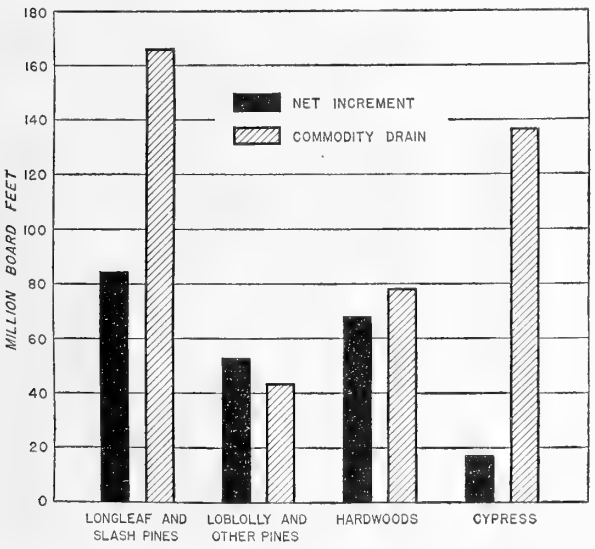


FIGURE 10.—*Comparison of board-foot (International ¼-inch rule) net increment and commodity drain in each forest condition, 1934.*

TABLE 25.—*Comparison of increment* [1] *with commodity drain*

IN BOARD FEET (INTERNATIONAL ¼-INCH RULE)

Item	Pine	Hardwood	Cypress	All species
	M board feet	*M board feet*	*M board feet*	*M board feet*
Growing stock, Jan. 1, 1934	[2] 6,518,300	2,645,300	2,017,800	11,181,400
Growth	+470,900	+113,900	+52,100	+636,900
Mortality	−310,400	−45,900	−34,900	−391,200
Unusable volume	−22,600			−22,600
Net increment	+137,900	+68,000	+17,200	+223,100
Commodity drain	−210,000	−78,800	−136,400	−425,200
Net change in growing stock	−72,100	−10,800	−119,200	−202,100
Growing stock, Jan. 1, 1935	6,446,200	2,634,500	1,898,600	10,979,300

IN CUBIC FEET (INSIDE BARK)

	M cubic feet	*M cubic feet*	*M cubic feet*	*M cubic feet*
Growing stock, Jan. 1, 1934	[3] 2,159,770	[4] 951,320	[5] 567,990	3,679,080
Growth	+115,810	+42,360	+15,080	+173,250
Mortality	−91,550	−21,300	−10,610	−123,460
Unusable volume	−1,560			−1,560
Net increment	+22,700	+21,060	+4,470	+48,230
Commodity drain	−41,930	−12,670	−20,400	−75,000
Net change in growing stock	−19,230	+8,390	−15,930	−26,770
Growing stock, Jan. 1, 1935	2,140,540	959,710	552,060	3,652,310

[1] Plus sign (+) indicates increase; minus sign (−) indicates decrease.
[2] Includes 22.6 million board feet in the butts of newly cupped trees not shown in the inventory summarized in table 11.
[3] Includes 1½ million cubic feet in the butts of newly cupped trees not shown in the inventory summarized in table 15.
[4] Does not include over 223 million cubic feet of tops and limbs of hardwoods, of which 650,000 cubic feet is in special-use species included in table 15.
[5] Does not include over 111 million cubic feet in tops and limbs of sawlog trees included in table 15.

In 1934 the total commodity drain on saw-timber material exceeded net increment by more than 202 million board feet. On January 1, 1935, there was, therefore, 1.8 percent less saw-timber growing stock than on January 1, 1934. The corresponding decreases in growing stock for pines, hardwoods, and cypress were 1.1, 0.4, and 5.9 percent, respectively.

The principal factors responsible for these decreases—namely, inadequate stocking of the stands, low growth and high mortality rates, and the output of wood products—may vary greatly from decade to decade. It is incorrect, therefore, to project the present rate of decrease in growing stock into the future and to predict the wiping out of the forests by the end of some indicated period.

The natural stocking of bare areas and the increased density of stands resulting from adequate fire protection, aided by artificial reforestation measures where necessary, can increase materially the number of trees upon which growth may occur. Adequate fire protection and conservative turpentining will do more than any other measures to increase the rate of growth and to decrease the rate of mortality in the forests. Results of the application of essential measures of sound forest management will become noticeable almost immediately.

In northeastern Florida, 77 percent of the total commodity drain on saw-timber material is from old-growth stands. As already shown (table 20) the net increment in the old growth was negative for pines and relatively small for hardwoods and cypress. If the commodity drain on old-growth pine continues for 12 years at the 1934 rate, the volume of this timber will be reduced to a negligible quantity. Although this is a serious situation, inasmuch as old growth cannot be replaced in a short time, a large industry has already developed to utilize the rapid-growing second-growth pine, the increment of which exceeded commodity drain against it by more than 120 million board feet in 1934. In the same year the volume of increment of old-growth hardwoods was sufficiently close to that of the cut to suggest the possibility that, through regulation of the cut, the industries dependent upon the hardwood old growth might indefinitely prolong their life. Repeated cutting, however, has greatly reduced the quantity of high-quality old-growth hardwoods, and the increment is largely in material of lower quality. Only a small utilization is made of hardwood second-growth saw-timber material at this time, principally because it is of lower quality than the old growth. There is, however, a surplus of increment over drain in second-growth hardwoods which may be utilized to supplement and maintain the old-growth stands. An analysis of the cut of old-growth cypress in 1934 shows that it was more than 14 times the increment. The growing stock of low-quality slow-growing second-growth cypress now amounts to less than 20 percent of the volume of old growth which is being rapidly diminished by cutting. The cypress industry in this survey unit, therefore, must be curtailed within the next two decades if utilization continues at its present rate.

When the entire growing stock, including saw timber and smaller material, is expressed in cubic feet, a more favorable relation appears to exist between increment and commodity drain. Pine growing stock decreased only 0.9 percent, hardwood increased 0.9 percent, and cypress decreased 2.8 percent. This better showing is due to the fact that logging outfits do not cut heavily into the tremendous number of small trees under sawlog size (fig. 4) that are growing up in the stands despite adverse conditions. It is this growing stock of young trees upon which the future of all forest industry depends, and every effort should be made to increase its quantity and quality and to reduce the prevailing high mortality.

Future Needs

NORTHEASTERN Florida is especially well situated for the continuous output of forest products. The large proportion of the area in forests, a climate that favors forest growth, the presence of important local markets for forest products, an excellent local transportation system augmented by shipping facilities to northern centers, and a rural population of long experience in the forest industries, all combine to assure that the turning out of forest products will always be one of its major activities. Turpentine and rosin production and the associated cooperage industry have been active here for more than a century; and the manufacture of lumber, cross ties, poles and piles, and other piece products has been (and still is) of great importance. A large package-veneer industry has developed with the cultivation of citrus and truck crops. With the recent construction of pulp and paper mills, a new industry enters the picture.

In discussing the outlook for all forest industries, it must be realized that the quantity of increment which annually accrues on the growing stock limits the forest use that can be sustained for any great length of time. In other words, the forest industries cannot reduce the amount of the growing stock without eventually paying for it with curtailed activities. With conditions so favorable for forest activities, there is not only a need and an opportunity but also a strong justification for intensive efforts that will build up the growing stock to something approaching the possibilities of the section, not only to assure the continuance of present forest industries but also to provide for expansion.

It seems inevitable that the main forest industry will continue to be the production of naval stores, and the outlook for other forest industries will be limited thereby in scope, character, and volume of production. This appears particularly probable with the development of second-growth longleaf and slash pine forests, which yield adequate gum but which do not yield the same high quality of wood products as that obtained from the original old growth. The supply of naval stores timber is favorable to an increasing production of turpentine and rosin, provided the growing competition of wood-products industries for the same timber does not seriously reduce the available supply. The limited supply of timber in some other sections of the naval stores belt may also cause an excessive expansion of the industry here. It appears essential that immediate steps be taken by naval stores operators to insure an adequate future supply of workable timber through increased ownership of forest land, longer leases, and the education of small landowners as to the returns possible from naval stores production prior to use for woods products.

An outstanding feature of the gum naval stores industry is the unfavorable effect its activities have on the forest through a reduction in rate of growth, an increase in rate of mortality, and a degrading of residual lumber, pole, and tie trees. This excessive drain can be greatly reduced through more conservative turpentining practices and by protecting from fire not only working trees but also those worked out or resting. The closer integration of wood-products requirements with the production of naval stores should bring about a fuller realization of the byproducts value of a turpentined tree and thus favor the application of better forest management.

If the gum naval stores and the wood-products industries are integrated, the future of the latter will depend principally upon the condition of the stands left by the turpentine operator. In any case, a

large volume of the timber discarded annually by the naval stores industry will have neither the size nor the quality for the production of lumber. With the diminishing supply of old-growth saw timber, lumber here appears to have a place in industry somewhat different from that in other parts of the South. The management of hardwoods and non-turpentine pines for high-grade products and an intensive use of worked-out turpentine pines, however, can assure the continuance of a lumber industry of respectable size, but one made up principally of small plants. Conservative naval stores operations should not appreciably reduce the quantity of poles, piles, and cross ties (particularly in the smaller sizes), and with proper attention to integrated use the available quantity of these products can certainly be maintained and possibly expanded.

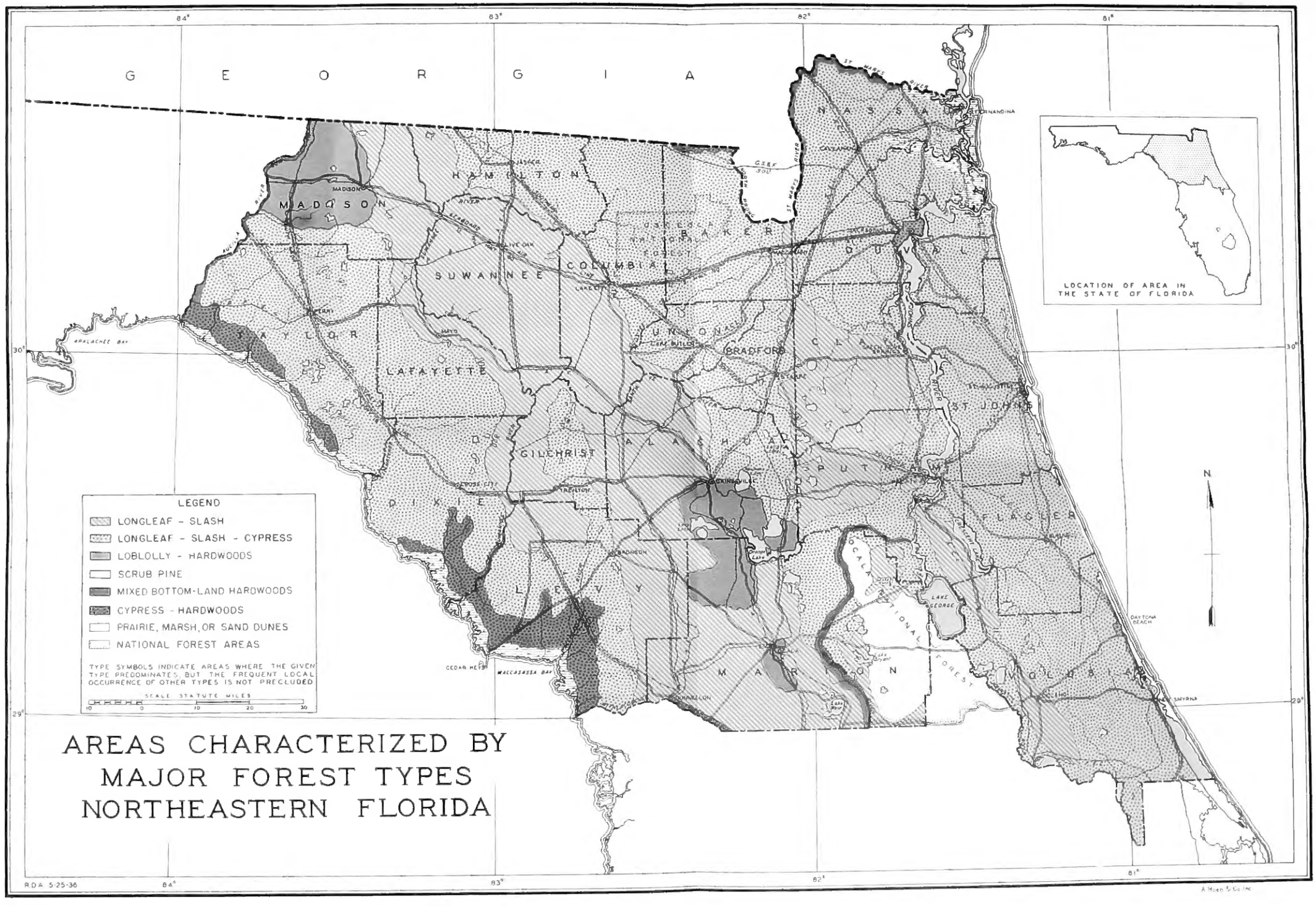
There is evidently a place for a pulp and paper industry. All classes of stands could be improved by reducing the number of sound and rotten cull trees and by the removal of worked-out turpentine trees which are now preventing a large aggregate acreage from returning to productivity. With adequate fire protection and forest management, including planting where natural reproduction fails, the land can grow more trees than can be brought to maturity. Trees which normally would be crowded out of developing stands, or which are hindering the normal development of others potentially more valuable, should be removed, and the thinnings (in pine) are well suited for pulpwood. The Osceola National Forest located within the survey unit and the Apalachicola located just over the border to the west are excellent examples of the possibilities in proper forest management.

Because of the increasing competition for raw material, the leaders of the larger industrial establishments are seriously concerned for future supplies. This concern should result in action to safeguard their interests through the purchase of lands upon which to grow the raw material needed for the future. The solution of this problem does not, however, lie entirely in their hands; a great many small owners together hold a large part of the forest land. These small owners must be encouraged, educated, and aided to handle their forest lands wisely to the end that they themselves, the forest industries, and the communities will be benifited. In this section, where the people are becoming increasingly aware of the returns and benefits that can be realized through skillful forest management and integrated utilization, there is a great opportunity for the intensification of the educational work of the State and Federal forest services in fire protection and sound forest management.

A very considerable area of potentially valuable forest land is covered with scrub oak and is making little or no economic contribution. It may be beyond the capacity of private enterprise to restore this land to productivity within any reasonable time, and consideration should be given to the possible participation of the Federal and State Governments in artificially restocking it to pine.

The outstanding need is more intensive and effective control of fires. Only about 30 percent of northeastern Florida was under organized fire protection in 1938. The prevalence of fire is mainly responsible for the open nature of the stands and their relatively low increment. Effective control of fire is essential to reduce the excessive mortality rate which now exists. It will result quickly and certainly in the filling in of large areas of understocked stands and in the natural regeneration of many of the clear-cut lands. Only with effective control of the fire situation can this part of Florida be expected to increase materially its annual output of forest wealth.

Although the forests of northeastern Florida already support a considerable population, a fuller utilization and better management of the forest resources would appreciably increase the opportunities for employment. The logical combination of farm and forest activities, the growing need of industry for raw material, the development of forms of outdoor recreation most effective in forest settings, the desirability of bringing submarginal forest lands into economic use, the need for community stabilization in order to offer adequate economic and social security to the present and future populations, all justify the intensive development of these forests.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GILCHRIST
ALACHUA
PUTNAM
DIXIE
LEVY
MARION
FLAGLER
VOLUSIA
LOCATION OF AREA IN THE STATE OF FLORIDA
LEGEND
LONGLEAF - SLASH
LONGLEAF - SLASH - CYPRESS
LOBLOLLY - HARDWOODS
SCRUB PINE
MIXED BOTTOM-LAND HARDWOODS
CYPRESS - HARDWOODS
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