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FOREST RESEARCH IN THE SOUTHEAST

by
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Territory of the Southeastern Forest Experiment Station.

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INTRODUCTION

As most of you probably know, the salient fact for foresters or other natural scientists in the Southeast is the division of the region into three distinct provinces. They are: the Blue Ridge and Great Smoky Mountains comprising the south end of the Appalachian range; the Piedmont, which rolls away for about a hundred miles at the foot of the mountains; and last, the sandy, level coastal plain, wet and laced with tidal streams. These three provinces have different climates, different soils, different tree species, and even rather different people. The Piedmont is the place where King Cotton used to rule. But he has bowed out, and the gullied fields, by the millions of acres, are being handed over to the forester, who always gets the leavings, doesn't he? The Coastal Plain boasts the fastest pine growth of any region in the country; with long growing seasons and plenty of rain, the crescent-shaped pine belt extending from Virginia to East Texas is the great reservoir of raw material for the southern pulp and paper industry. As for the mountain region, it is the former home of what were perhaps the finest hardwood forests in the world--now severely high-graded and producing but a fraction of the oak, yellow-poplar, basswood, ash, walnut, maple, birch, cherry, and white pine that would be possible under good management. The mountain, too, is the great water storage reservoir for cities and industries that may be hundreds of miles away.

The five Southeastern states from Virginia to Florida contain a very sizeable part of the Nation's forest wealth. Commercial forests of the Southeast (covering 86 million acres, or 58 percent of the total land area of 149 million acres) represent 20 percent of the total for the United States. Its forest industries include between 12,000 and 13,000 sawmills, 30 pulp mills (with 5 additional ones under construction), and more than a thousand units of secondary forest industries.

To serve this varied region, the Forest Service has for 30 years maintained a research headquarters at Asheville, N. C. This is the Southeastern Forest Experiment Station. Its field studies are concentrated at eight research centers located in various parts of its territory. These centers were selected as typical of the forest conditions in a section, so that the results of field studies will be applicable to wide areas or broad forest types.

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The Station is set up to serve the timberland owners of the Southeast. Its customers include the national forests (5 percent of the commercial forest land ownership); state and other public forests (3 percent); and the private landowners (92 percent), of which farmers own 44 percent and other private owners 48 percent of the total. The lumber industry still continues to be the principal user of the southeastern forests (accounting for about 50 percent of the total drain on the forest), but the pulp and paper industry has expanded greatly in recent years, now owning about 7 million acres of forest land and using at least 20 percent of all the wood harvested in this region each year.

Much of the Station's program is carried out in cooperation with state forestry departments, with schools of forestry, and with the forest industries. Its program at the various centers is reviewed periodically by local advisory councils representative of local forest landowners and forest users. The results of Station studies appear in numerous station papers, technical notes, annual reports, Government bulletins, and in professional and trade journal articles. Its experimental forests serve as demonstration areas to illustrate various types of forest and range management. The Station also works closely with forest pathologists, entomologists, and biologists from other bureaus.

In this short discussion, it will not be possible to report on all of the Station's many activities. I will attempt, however, to give a few examples of how research is helping point the way towards better forest management and better land use in the Southeast.

FOREST MANAGEMENT

The largest share of the Station's work is forest management research. In this field, the major single project is a long-time research comparison of the forest management systems which may be applicable to each major forest type. On each of six different experimental forests in various parts of the region, this project includes a great many 40-acre compartments on which are applied different silvicultural systems, usually comparing two rotations, and two intensities of forest management: (1) for small-sized products such as pulpwood and (2) large-sized products such as veneer logs and sawlogs. In addition to the long-time purposes for which they were set up, these compartments are invaluable in providing conditions for detailed studies of individual silvicultural problems.

Following are several examples of Station findings in the forest management field during the past few years:

New Methods of Naval Stores Gum Production

One of the most concrete examples of the contributions of forest research in the Southeast comes from the Lake City, Florida, Branch where

new techniques for gum naval stores (turpentine and rosin) production have been developed. When I first came to the South in 1925, naval stores gum production was a relatively crude and wasteful process that left millions of small worked-out trees each year to burn or blow over before they reached saw-log size. Deep chipping of second-growth trees yielded a meager return to the gum producer for the amount of labor required. Due to research and to the changing times, naval stores practices have radically changed during the last 25 years. The Station has found that nearly half of the chipping labor can be saved with no loss in gum yield by spraying sulfuric acid on the fresh cut to prolong the flow of gum. Here is an instance where the Russians apparently can make a bona fide claim to an initial basic discovery, but the perfection of the technique and its application to United States conditions was worked out at Lake City, Florida. It is estimated that this one research development will save the naval stores industry about a million dollars in 1951 when applied to about one-fourth of the producing trees. If it were used throughout the industry, it would save a million man days of labor each year. This is all the more important when it is realized that during past emergencies, naval stores production has dropped below industrial needs through labor moving to better paying industries.

During the research on acid treatment, it was found that chipping into the wood was unnecessary if acid was applied. The Station developed a new type of chipping tool which removes only a strip of bark, and leaves the bole of the tree round. If these round butts are freed of nails and harvested promptly, they are practically as good as the butts of untapped trees for pulp and other wood products.

Paralleling research on turpentinizing methods, the Station is cooperating with the University of Florida in the development of new equipment for gum production. Station personnel invented a remarkably simple and effective acid sprayer resembling the soft plastic sprayers now used for perfume and other products. This squeeze sprayer has also been built into a combination chipping and spraying tool.

The natural rubber industry, in which I worked for a number of years, has made great technological strides through the application of genetics in developing high-yielding strains of Hevea rubber trees. We can use this as an example of what might be done for the naval stores industry. A small-scale start has already been made in developing high-yielding strains of longleaf and slash pines. We now have at Lake City cross-bred seedlings six years old and rooted cuttings over 20 feet tall, grown from selected parent slash pines that yielded twice as much gum as average trees of the same size. Interest in the whole field of the genetic improvement of southern pines is awakening, and a regional committee on Southern Forest Tree Improvement has been set up. Though forest planting now exceeds two hundred million seedlings a year in the South, we know all too little about the importance of seed source, and much less about selection and breeding of superior strains.

Chemical Control of Hardwoods

There is perhaps no more important forestry problem in the Southeast than that created by the rapid encroachment of hardwoods into the valuable loblolly pine stands of the Piedmont and Coastal Plain. In South Carolina, for example, the forest survey found that the hardwood area increased by 59 percent between 1936 and 1946. The major research job here is to develop economical ways for controlling inferior hardwoods on pine sites.

The Station's studies of this problem have been centralized at our Central Coastal Plain research center at Charleston, S. C. After testing numerous chemicals, concentrations, and dosages on different tree species by different methods and at various seasons of the year, our men have worked out several practical poisoning techniques. A new Station publication just off the press summarizes this information in convenient form for the forest landowners of this region ("The Use of Chemicals to Control Inferior Trees in the Management of Loblolly Pine," by L. E. Chaiken, Station Paper No. 10, September 1951). Undoubtedly, these findings are also applicable in many localities outside this region.

Our branch at Charleston is also working on the role of prescribed fire for the control of hardwoods. Eventually, increased utilization of these poorer quality or slower growing hardwoods will help ease this problem, but in the meantime, timber growers can benefit from hardwood control measures.

Methods for Reproducing Loblolly Pine

Nature had a much easier job of seeding in good stands of loblolly pine on old fields than we have now in reproducing these same stands. One of the difficulties of obtaining full restocking to pine is the competition of small hardwoods, but another is shortage of pine seed, particularly when stands are cut on short rotations. Some research has been done on this problem at Duke University and at the Station's research center at Franklin, Va., where there are many well-stocked loblolly pine stands ready to harvest. Station studies have shown that from 20 to 37 thousand pine seeds per acre from a single seed crop are required to insure adequate restocking where the seedbed is favorable. The average number of seeds needed to produce one established seedling varies from 83 on a slash-covered seedbed to 7 on exposed mineral soil. Seed dispersal is effective to a distance equal to about twice the height of the seed trees. Also, it has been found that pre-harvest release of seed trees to a distance about equal to the crown diameter stimulates seed production. In the third year following such release, loblolly pines usually produce several times more seed than similar unreleased trees.

A method has been worked out for predicting loblolly pine seed crops six months to a year in advance. From information on the size of the current year's seed crop, and the ratio of number of cones in the current crop to next year's crop, a good approximation of the size of the next seed crop can

be computed. This type of information is particularly valuable in planning for seed collection and for regeneration cuttings. Also, it is extremely important to harvest mature loblolly in a good seed year and get prompt regeneration before the hardwood understory takes over.

Farm Woodland Management

The biggest opportunity for improving forest land management in the Southeast rests with the 3/4 million small landowners (a majority of them farmers) who own two-thirds of all the commercial forest land. Much of the Station's forest management research applies to farm woodlands in one way or another. However, the farmer works under a unique set of conditions with respect to labor supply, equipment, home-use requirements, markets, and the timing of his income. Experience has shown the desirability of setting up on our research areas one or more test woodlots where silvicultural and management information is readily available to farmers through field-day demonstrations or otherwise. I know that all of you must have seen published reports on the income possibilities shown by these experimental farm forestry woodlots.

FIRE

The Southeast still has a long way to go in securing adequate fire protection. In 1950, 14.8 million acres or 17 percent of its entire forest area still lacked protection. During that year 90,191 fires occurred, burning over 8-1/2 million acres of forest land. It is recognized that 1950 was a relatively severe fire year for the Southeast, due to an extended dry fire season, so the fire record was worse than for the previous few years. One percent of the fires were started by lightning; the balance were man-caused, the major source (43 percent of total) being incendiarism.

Fire statistics for calendar year 1950 on all forest land in the five Southeastern States

State	Area needing: protection	Area protected	Total: fires	Area burned	Protected area burned	Total ex- penditures	
	<u>Million acres</u>	<u>Million acres</u>	<u>Percent</u>	<u>No.</u>	<u>Thousand acres</u>	<u>Percent</u>	<u>Thousand dollars</u>
Va.	14.6	14.6	100	2,110	21	0.14	575
N. C.	18.4	16.6	90	4,357	485	2.79	1,581
S. C.	11.9	11.9	100	8,190	239	2.01	1,280
Ga.	21.0	15.0	71	43,284	2,944	2.01	776
Fla.	21.2	14.2	67	32,250	4,818	2.87	835
Total	87.1	72.3	83	90,191	8,507	2.00	5,047

There are two main projects in the Station's fire research program. The first concerns developing improved methods of measuring fire danger and applying danger measurements to fire control planning. At present there are more than 500 fire danger stations from Maine to Texas using methods developed by the Station.

In addition to the day-to-day use, fire danger measurements have been found valuable in long-range fire control planning. In the Northeast, because of the continuity of good fire records furnished by the States, it has been possible to determine trends in fire occurrence. A strong relationship has been found between number of fires and measured fire danger. On the basis of measured danger, we can now predict for a district, state, or region, the number of fires likely to occur during this month or this year. By studying monthly or yearly trends, fire control officers can now get a reliable comparison between one year's record and another or between districts.

In the past when the number of fires decreased below previous years, the tendency has been to credit the reduction to greater effectiveness of the fire organization. When the number of fires increased, the tendency was to blame it on the weather. What research has done is to take out some of the guesswork, so that administrators can better judge the effectiveness of their organizations.

Another use of fire danger measurements is through adding up the daily readings. This makes it possible to follow closely the build-up of danger in a district and to take special precautions, such as closure, when conditions are especially threatening.

The second main fire project at the Station is the study of fire behavior, both for wild fires and for prescribed burning. Most of this work has been done on the Francis Marion National Forest, near Charleston, S. C. It is important to know the conditions of fuel and weather when prescribed burning can be done to obtain the desired effect.

Fire is now recognized as a valuable tool in the management of southern pines. It can be used for the control of brownspot disease in longleaf pine seedlings, as well as for hazard reduction, seedbed preparation, reducing hardwood competition, and for improving forage conditions and wildlife habitats. When properly used, fire can serve all of these purposes with very little or no damage to the stand. However, there are cases where severe damage has resulted when prescribed fires burned with greater intensity than was intended. We still do not know nearly as much as we should about when to burn and how to burn.

One Station study has revealed that in grassy fuels headfires are cooler near the ground than backfires. This means that when burning for brownspot control of longleaf pine seedlings, for example, and when there is little chance of damaging the overstory, headfires will do less harm than backfires. It is, of course, possible to burn a much larger area with a headfire than with a backfire in the same length of time, which means lower

costs. Also, because there may be but few good burning days during the season, the faster the prescribed burning can be done the better.

Another Station finding is that vegetation temperature greatly influences the effect of fire. For example, on a cold day when the temperature is around 40° a pine tree can tolerate a fire 2-1/2 times as intense as on a day when the temperature is near 100°. This is of practical significance in prescribed burning. On the Francis Marion National Forest undesirable hardwoods 3 and 4 inches in diameter have been killed with summer fires. Conversely, in pine reproduction stands, less damage will result if burning is done on a cold day in winter.

A phase of our fire behavior work that shows great promise is the study of erratic fire behavior. Every experienced fire fighter knows that at times fire will behave in a way that cannot be explained on the basis of fuel or weather; that they will crown and spot unpredictably. Such "blow-up" fires have occurred in every region but have been particularly severe in the West.

In the spring of 1950, in the Coastal Plain region, there were a few days when fires behaved in a very unusual way. Although winds were light or moderate, fire fighters could observe no reason why large whirlwinds in the fires sometimes developed, and fires crowned and spotted. Fire research technicians suspected that atmospheric phenomena might account for this behavior. Radiosonde records (by releasing balloons) from the U. S. Weather Bureau in Charleston showed that on those days there was a highly unstable layer of air 300 to 500 feet above ground. Although undoubtedly certain combinations of fuel, stand density, and size of fire are contributing factors, it seems likely that the explosive qualities of these 1950 spring fires were related in some way to rapid changes of temperature in the lower 1,000 feet of air. Perhaps we are now on the track of a major factor causing "blow-up" fires. Perhaps a way can be found to predict days of high atmospheric turbulence. At any rate, the Station plans to study this subject as intensively as we can with present facilities. Such studies can well be carried on in the Flatwoods region because here there is no confounding effect of topography.

WATER

Water and watershed protection were the major reason for establishing national forests in the East--as the Weeks Law makes plain. But in those early years, it was timber that paid off in cold cash and timber that foresters were principally concerned with. Now the pendulum is swinging again; water becomes more valuable every year, and there are times and places where it is already priceless. The rapid expansion of industries and municipalities in the Southeast is bringing a realization that even here there is a limit to available water supplies. Just where this limit will lie depends in large part on the management of the 60 percent of the

Southeast that is forest land, for the forests are in effect huge detention reservoirs, vaster than any Grand Coulee that man has ever made. Foresters are beginning to have it impressed upon them that water may be the most valuable product of the mountain forests. Also, we foresters must recognize that we have a responsibility for the production of water as well as timber.

The Southeastern Station has under way a research program in water resource management at two work centers. The Coweeta Hydrologic Laboratory, a watershed covering 5,400 acres in the high rainfall belt of the mountains of Western North Carolina, is one of these. Here, since 1933, the Station has been working out ways and means of integrating water yields with uses of the land for the production of timber, forage, fish and wildlife, and for recreation. For example, the effect of clearing steep forest land for farming has been measured by actually carrying out each step of the process on a carefully gaged experimental watershed. Similarly, studies are being made of the effect of woodland grazing, of fire, and of logging on water quality and yield. These studies have shown that any damage to the forest soil is unfavorable to good watershed management. In the past, foresters have usually failed to recognize the inconspicuous early stages of changes in soil structure that ultimately result in severe damage to the water resource.

In addition to the land-use approach, the Station has studied some of the fundamental effects of the relation of trees to stream flow. Such basic considerations have included the measurement of the amount of rain intercepted by tree crowns and evaporated back into the air. Few realize that in a 40-inch annual rainfall area, only about 32 inches actually reach the forest floor during the year; the other 8 inches, or 20 percent, is caught by the tree canopies and evaporated. The tree roots, therefore, have only 32 inches of rain water available instead of the 40 inches as measured in the open. Measurements are also made of moisture and ground water stored in the soil at different seasons of the year, and their rate of withdrawal from storage through transpiration and as runoff in streams.

At the Calhoun Experimental Forest in the Central Piedmont of South Carolina, the objective is to determine the place of forests and forestry practices in maintaining or restoring soil and water resources. Measurements are being taken of soil and climatic factors to better rebuild worn-out land through practical forestry measures. We have already worked out some of the effects of litter from different forest stands in adding nutrients to the soil. Hardwood litter adds more calcium and nitrogen to the soil than does pure pine litter. These studies have also indicated that moisture conditions for plant growth are extremely unfavorable on the depleted and abandoned cotton fields now constituting the principal sources of erosion and flood in the Southeast.

It is apparent that unfavorable soil-water relations play a major role in the occurrence of the littleleaf disease. As the soil structure improves over the years and as conditions more nearly approach those of

the original virgin forest, some of the factors predisposing to little-leaf may gradually disappear.

There are many problems related to water control and management where further research is needed. One such study would determine the effect of the height of the water table on tree growth in the Coastal Plain and Flatwoods region. It is possible that heavy harvest cuttings may result in a permanent rise of the water table. There is ample evidence in some localities that sites which once produced good saw-timber stands have changed to sedge and swamp land. Drainage of forest land is another problem that needs investigation. Many drainage projects are now under way, but what effect they will have on tree growth is not yet known.

FOREST SURVEY

Since 1946 the Forest Survey, with help from the South Carolina State Commission of Forestry and the Florida Forest Service, has completed the second survey of the timber resources of both South Carolina and Florida. A similar resurvey is now under way in Georgia, and it is planned to start work soon in North Carolina in cooperation with the North Carolina Department of Conservation and Development.

These resurveys clearly show what is happening to a State's forest resources. In South Carolina, for example, the volume of saw timber decreased 10 percent between the time of the first survey in 1936 and the resurvey of 1946; the volume of all timber 5.0 inches d.b.h. and larger decreased by five percent. In the southern part of the Coastal Plain, the decline was substantially greater. In the face of this, South Carolina forest industries have been expanding. Total timber drain increased from four million cords in 1936 to five million in 1946, and no easing of the pressure for timber is in sight. In 1950 the pulpwood cut alone amounted to 1,182,000 cords, 16 percent more than in 1946.

The Survey has found many of the reasons why timber yields have not kept pace with growing demands for timber. A decline in the amount of forest land is not one of them, as the forest area of South Carolina increased by 1.2 million acres during the 10 years between the two surveys. Instead, we find that 4.5 million acres of forest land, out of a total of 11.9, are poorly stocked and are not growing very much timber. Also, 20 percent of the total woodland area is overstocked with trees and should be thinned to increase growth.

The quality of the timber has also declined. Now, one tree in five is a cull, compared to one tree in ten in 1936. The cull tree volume, which was only 11 percent of the total in 1936, increased to 18 percent of the total volume in 1946. Practically all of this cull volume is in hardwoods.

Along with the increase in cull hardwoods, there has been a 1.7 million-acre increase in the acreage of hardwood types. In the Sandhills, scrub oaks took over more than 400,000 acres, and in both the Piedmont and Coastal Plain, heavy cutting of pine allowed hardwoods to increase. This threatens future usable timber supplies, as a high proportion of these hardwoods are of low quality.

The amount of forest growing stock is now considerably less than is needed to provide the annual timber needs of industry. Saw timber is deficient over all of South Carolina, and young trees below saw-timber size are particularly scarce in the Coastal Plain. Only in the Piedmont is there a surplus of young timber.

These highlights of the forest situation in South Carolina provide the basis for planning a forestry program aimed at improving forest conditions within the state. Similar surveys at about 10-year intervals should provide accurate information for planning state forestry programs and the basis for industrial development on a sound scale.

FOREST GRAZING

Research in forest grazing, in cooperation with Federal and state agencies, is being carried on in the Southeastern coastal plain pineries--principally in the states of North Carolina and Georgia. Much has been learned about the natural forage value of the most promising vegetation types, as to quality and quantity of forage produced, effects of fire on forage values, occurrence of poison plants, and the value of supplemental feeding. Current studies have to do with methods of integrating cattle and timber production, methods of forest range improvement, and increasing grazing capacity. One Station finding indicates that switch cane areas of North Carolina may have the highest grazing capacity of any native range in the United States today.

FOREST UTILIZATION SERVICE

The Station's Forest Utilization Service project represents a connecting link between the Forest Products Laboratory at Madison, Wisconsin, and the wood-using industries of the Southeast. The Forest Utilization Service men have been mainly concerned with how to reduce wood waste, how to use more low-grade wood and little-used tree species, and how to improve the use of the declining supplies of high-quality raw material. Among other things they have designed an automatic wood-burning furnace for curing bright-leaf tobacco, which enables farmers to utilize home-grown, low-grade wood as fuel, and at the same time improve their woodlands.

The Station has also stimulated a program of research at the Forest Products Laboratory to find additional uses for hickory, much of which is now left in the woods because it does not meet the standard for products such as skis, picker sticks, and handles. However, our studies in cooperation with private concerns show that by improved drying methods to reduce checking, some of this low-grade hickory can be used for cross ties. Also, it has been found possible to laminate hickory with ash for baseball bats.

Improvements in air-drying and kiln-drying practices in furniture manufacture have resulted from courses in drying techniques arranged by the Station. Similar courses have been arranged to show improved techniques in gluing wood. Many requests for advice and guidance in the field of wood utilization have been met by Station technicians. At present, we are completing the development of simplified log and tree grades for southern pine, in cooperation with the Southern Station and Region 8 of the Forest Service. These grades should improve marketing practices and help channel high-quality raw material into products requiring the highest grades for manufacture.

CONCLUSION

Forest research in the Southeast is providing information of value to landowners in obtaining better forest management. However, the Station is still unable to work on many important regional problems due to lack of sufficient facilities and technical manpower. Among the areas of the Southeast where the Station has not yet been able to undertake a real research program are the northern Piedmont belt, the sand hills of North and South Carolina and Georgia, the slash pine and cypress areas in South Florida, and in the bottomland hardwood and pond pine types.

State foresters are and should be among the foremost customers of forest research. State foresters in this region have always taken a keen interest in the Station's work, have used our findings widely, and in many instances have contributed manpower and other facilities to furthering research. This has been particularly true of the forest survey, the results of which are immediately useful for many purposes such as in plans for the expansion of forest industries. Undoubtedly, there are many other ways in which state foresters can use the Station's facilities to greater advantage. I have in mind the opportunity offered by the Station's research centers and experimental forests for state personnel training purposes.

I think I speak for all forest experiment station directors in saying that we are anxious to keep Station programs oriented to help solve your pressing technical forestry problems. To this end we welcome constructive criticisms and suggestions concerning our programs. We also welcome your support for our work and your assistance in getting research findings applied in woods practices. We want you to feel that these are your stations and that your problems and ours are mutual. With a combined attack on these problems, American forestry should make more rapid strides than ever before, to the social and economic betterment of our country.

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