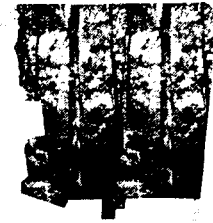


Hardwoods in North Mississippi:



Resource Information from Two Forest Surveys

FWRC BULL. 001-0895 • August 1995

Executive Summary

The USDA Forest Service periodically conducts forest surveys for Mississippi and other states. Survey results for a 26-county area designated as "North Mississippi" were most recently published in late 1993. We compared the hardwood acreages, volume, growth, removals and other values to the survey results published in 1987 for this region, and several significant results are evident:

- Increased demand and new markets have led to greatly increased harvest levels for hardwoods in North Mississippi. Removals have been particularly heavy in the pulpwood and small sawtimber size classes of oak species groups.
- Further study is needed to address concerns over longer-term hardwood timber availability in commercially important size classes and species groups. Removals exceeded growth for sawtimber and for total growing stock of oak species, for example, as well as for "hard" hardwoods overall. Increased growth is therefore necessary to sustain harvest levels and patterns of the recent past.
- Declining inventory in commercially important species groups and sizes may continue to lead to higher prices for standing hardwood timber in North Mississippi. Resource trends are leading to substitution of other products for solid hardwoods in manufacturing industries. Greater emphasis is needed on research and technology transfer for efficiently growing, managing, and processing hardwood timber products for manufacturing applications.

MFWRC

S MISSISSIPPI FOREST AND WILDLIFE RESEARCH CENTER

U John Gunter, Director Mississippi State, MS 39762
Donald W. Zacharias, President Mississippi State University R. Rodney Foil, Vice President

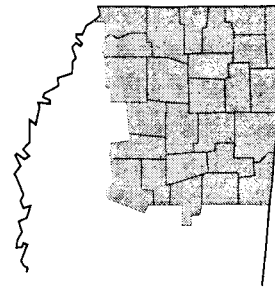
Hardwoods in North Mississippi: Resource Information from Two Forest Surveys

By Steven H. Bullard, Clay Robertson, Joshua Idassi, and Joanne L. Faulkner¹

Introduction

Increased demand for hardwood timber in North Mississippi has resulted in increased harvests – leading to new concerns over hardwood timber availability. The USDA Forest Service recently published new information on the forest resources of the region. We examined the published values for hardwoods to objectively address an important, basic question...

“What does the new information tell us specifically about trends in hardwood timber growth and utilization, and thus the potential future availability of hardwoods for use in manufacturing?”



"North Mississippi" refers to a 26-county area – as used by the USDA Forest Service in periodic forest surveys for the state.

Demand has increased

Demand for hardwood timber in North Mississippi has increased significantly in recent years. Demand for hardwood pulpwood has increased due to the expanded use of hardwoods in pulp and paper manufacturing, and because the capacity of pulp and paper producers has increased greatly in North Mississippi. Another important factor in increased hardwood pulpwood demand has been the opening of the Tennessee-Tombigbee Waterway in the mid-1980s. The Waterway “has made the hardwood resources of north Mississippi economically available to pulp mills in south Alabama, Florida and the world” (Daniels 1991).

North Mississippi also has important markets for hardwood lumber and other solid wood products, however. Dominant industries in the region produce hardwood lumber, furniture, furniture frames and parts, hardwood flooring and other traditionally important solid wood products.

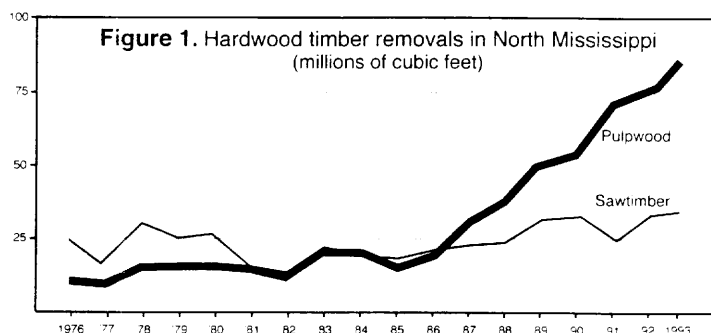
1. The authors are Professor and Graduate Research Assistants, Department of Forestry, Mississippi Forest and Wildlife Research Center, Mississippi State University, Box 9681, Mississippi State, MS 39762-9681, and Research Forester, USDA Forest Service, Southern Forest Experiment Station, Forest Inventory and Analysis Unit, P.O. Box 906, Starkville, MS 39759.

Introduction *(continued)*

Harvest levels have increased

Increased demand for hardwood timber in North Mississippi has led to increased harvest levels – a fact clearly reflected by annual severance tax records for pulpwood and sawtimber in the region (Figure 1). Sawtimber removals fluctuated during the 18-year period in Figure 1, generally following trends in U.S. economic activity. Sharp decreases are only evident in recessionary periods such as 1991 and the early 1980s, for example. For hardwood pulpwood, however, dramatic increases have occurred in removals in North Mississippi. Hardwood pulpwood removals increased over 5-fold between 1985 and 1993 – from 16.6 to 88.0 million cubic feet.

***Hardwood pulpwood removals
have increased dramatically
since the mid-1980s...***



Source: Mississippi Cooperative Extension Service Annual Reports (1977-1994)
Data were converted to cubic feet.

Increased harvests have led to concerns over long-term availability

In a discussion paper titled “**Mississippi’s hardwood resource: What’s its status today?**,” Dr. Bob Daniels (1991) highlighted the increased demand for hardwood pulpwood throughout the state, and described increased harvest levels in selected counties in the northern half of the state through 1989. Daniels also discussed an important result of the increased harvest of hardwood pulpwood – serious concerns have been expressed by sawmill managers and others over the future availability of hardwood sawtimber. Daniels phrased the following as examples of important questions by hardwood sawmill managers in Mississippi:

- *How much grade 1 red oak sawtimber (or other species) is in a particular 20-county area?*
- *How much of the red oak being cut for pulpwood today would make quality red oak sawlogs in 15 years?*
- *How can we be sure quality sawlogs of desirable species will be available in our area at reasonable prices in 20 years?*

He concluded that “*the answers to these questions can’t be readily answered today because we don’t have the information needed to construct an answer. It’s clear that in the future Mississippi will have plenty of hardwood, overall. The big questions are what size, species and quality will these hardwoods be, where will they be concentrated, and what will they cost?*”

As Dr. Daniels stated, there has been a need for more information on the hardwood resources of Mississippi. New information is now available for North Mississippi that can be used to help address these and other important questions. Although we don’t address the overall issue of timber “availability” in the present paper, we do review what the new information tells us about hardwood timber growth and utilization. Also, we emphasize information on oaks and other “hard” hardwoods as commercially important groups of timber in the region.

We therefore address resource factors that will directly influence the future availability of hardwood timber for use in manufacturing lumber and other solid wood products.

The Source of New Information

Forest survey data

Forest Inventory and Analysis (FIA) is a program of the USDA Forest Service that provides “unbiased, accurate, current, and relevant forest resources information” to meet diverse needs of society (USDA Forest Service 1993). The FIA unit in Starkville, Mississippi is affiliated with the Southern Forest Experiment Station of the Forest Service, and is therefore referred to as SO-FIA. The SO-FIA unit collects, compiles, and distributes forest resource inventory information for Mississippi, Alabama, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

Forest resources in the South are inventoried for individual states on a periodic basis. Within states, specific groups of counties are referred to as forest survey “units,” and these are treated separately for data collection and analysis. Mississippi forest surveys conducted and distributed by SO-FIA include those for 1977 and 1987, and unit reports are currently being completed and published for 1994.

The data we used

The source of new information used in our analysis of hardwoods is **Forest Statistics for North Mississippi Counties–1994**, a report by SO-FIA that was distributed in the fall of 1993. The information is based on field data collected from December 1992 to May 1993, and since this period is prior to the 1993 growing season, we refer to the information in the present report as “1992” forest survey information.

For comparison and trend analysis, we used the 1987 forest survey information, but since the “1987” data were collected from April to December of 1986, we refer to this data as “1986” information in the present report. We therefore compare hardwood growth, volume, removals and other information for 1986 and 1992 for the 26-county area included in the

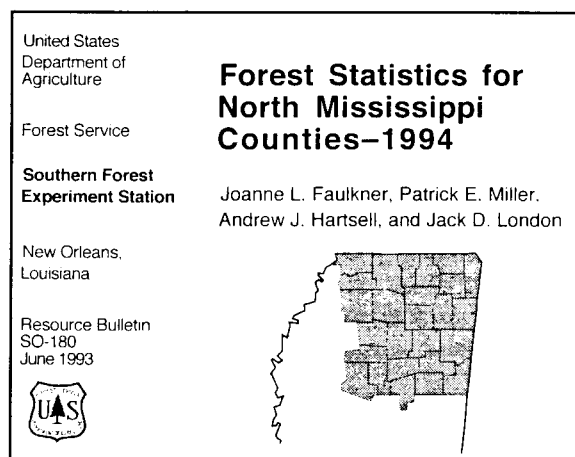
North forest survey unit.

Changes in the data

Forest survey techniques evolve to make use of improved methods and to achieve greater compatibility among FIA units. The unit report for North Mississippi describes several changes between the two most recent surveys – changes in how trees are classified, for example, as well as changes in total land area based on USDC Census Bureau estimates for 1990.

The unit report for North Mississippi states that “these changes may, in some cases, affect the ability to discern minor shifts in resource trends.” In the present report, where comparisons are made between the 1992 and 1986 inventory results, the inventory values for 1986 have been reprocessed to reflect current survey definitions and to minimize other potential problems in comparability of the data.

We review only a small part of the information in the Forest Service survey report for North Mississippi.



Copies of the SO-FIA report for North Mississippi may be obtained by writing to the Forest Service at P.O. Box 906, Starkville, MS 39759.

Orientation and Definitions

Level of aggregation

All of the results we summarize in the present report are for the entire 26-county area designated as North Mississippi. The Forest Service publishes resource information at the county level, but since values for individual counties are subject to high sampling errors, they caution users about using data for single counties. County-level data may be aggregated, however, and users may thus specify a group of counties of interest, combine the timber volume or other information for those counties, and calculate the sampling error associated with the estimates they obtain. Users are shown how to calculate such values in the Forest Service unit reports.

Physical resources versus “availability” issues

The FIA program is intended to collect, compile, and distribute *physical* information on forest resources. Many factors influence the relative “availability” of such resources for specific uses, however (see McWilliams and Rosson 1986). Examples relating to commercial use of hardwoods include government regulations, landowner attitudes, and resource accessibility issues. These factors are not discussed in the present report, and we therefore do not directly address “availability” as an issue.

We do, however, emphasize aspects of the physical resource information that are most directly related to the processing of lumber, flooring, and other solid wood products. That is, we emphasize oaks and “hard” hardwoods as species groups, and we emphasize information

Where possible, we emphasize growing stock information, thus excluding rough and rotten trees and non-commercial species.

on sawtimber, changes in stand size classes, growth and removals comparisons, etc. Also, where the data are available, we focus on “growing stock” since this measure excludes rough and rotten trees and non-commercial species of trees.

“Hardwoods” and other terms defined

The results presented here are only for hardwood timber, where we include as “hardwood” the following forest types: elm-ash-cottonwood, oak-gum-cypress, oak-hickory, and oak-pine. We include “oak-pine” types since the Forest Service defines such forests as those where “hardwoods (usually upland oak) comprise a plurality of the stocking, but in which softwoods, except cypress, comprise 25 to 49 percent of the stocking” (Faulkner *et al.* 1993).

Other definitions from the SO-FIA report:

D.b.h. (diameter at breast height)—tree diameter in inches, outside bark, usually measured at 4.5 feet above ground.

Seedlings—trees less than 1.0 inch in d.b.h. and greater than 1 foot tall for hardwoods.

Saplings—trees 1.0 to 4.9 inches in d.b.h.

Poletimber trees—5.0 to 10.9 inches in d.b.h. (for hardwoods).

Sawtimber trees—11.0 inches in d.b.h. and larger (for hardwoods).

Basal area—the area in square feet of the cross section at breast height of a single tree or of all the trees in a stand, usually expressed in square feet per acre.

Sawlog portion—that portion of the bole of a sawtimber tree between a 1-foot stump and the point on the bole above which a sawlog cannot be produced (minimum sawlog top is 9.0 inches for hardwoods).

Tree grade—a classification of the sawlog portion of sawtimber trees based on: (1) the grade of the butt log or (2) the ability to produce at least one 12-foot or two 8-foot logs in the upper section of the sawlog portion. Grade 1 is the best quality.

Growing-stock trees—living trees of commercial species classified as sawtimber, poletimber, saplings, and seedlings. Trees must contain at least one 12-foot or two 8-foot logs in the sawlog portion currently or potentially (if too small to qualify) to be classed as growing stock. The log(s) must meet dimension and merchantability standards to qualify. Trees must also have currently or potentially one-third of the gross board-foot volume in sound wood.

Hard hardwoods—species with an average specific gravity greater than 0.50 (such as oaks, hard maples, hickories, and green and white ash).

Source: Appendix pages 4-6, Faulkner *et al.* (1993)

Results – Resource Changes From 1986 to 1992

In the following discussion, we summarize the new forest survey information on growing-stock growth, removals, volume, and area for commercially important species categories. We also assess important impacts of increased hardwood removals by examining new information on the diameter distribution of hardwood growing stock. We must emphasize, however, that this examination of hardwood resource change information is preliminary – further work is needed, including tests of statistical significance in the resource change data. Since resource changes have not yet been verified by applying statistical tests to the data, the results presented here should be interpreted as *indicators* of changes that occurred from 1986 to 1992.

Note that since the data used here were collected in 1986 and 1992, the information does not reflect the ice storm damage experienced in North Mississippi in February 1994. Early estimates are that the storm caused \$1.3 billion of timber damage in a 26-county area (Waldrop 1994). The USDA Forest Service and the Mississippi Forestry Commission are currently cooperating in an effort to obtain more accurate damage estimates.

Hardwood Resource “Indicators”

The new forest survey information has results that may be considered “positive” and other results that may be considered “negative” from a hardwood resource standpoint:

Positive

These factors indicate *increased* or *increasing* hardwood resources in North Mississippi.

- Total *area* of hardwood timberland has increased by about 8%.
- The total estimated *number of growing stock trees* increased by nearly 12%. The number of growing stock trees increased in *all* of the larger diameter classes. In diameter classes above 19” the number of growing-stock trees of all *oak species* groups increased – the total increase was nearly 30%.
- *Sawtimber volume* was up by over 6%. Volume increased in both soft and hard hardwoods, in total growing stock and in sawtimber alone.
- The *volume of growing stock in the sawlog portion of sawtimber trees* increased overall by 5%. This volume category increased substantially for *oak species* in large diameters; total volume in the sawlog portion of sawtimber trees increased for *hard hardwoods* by about 20%.
- The *volume of sawtimber in grades 1 and 2* increased by 58% for all hardwoods, and also increased by 57% for oak species only.

Negative

These factors indicate *decreased* or *decreasing* hardwood resources in North Mississippi.

- *Poletimber acreage* decreased by about 11%. Poletimber acreage in the oak-pine forest type went down by over 40%.
- For hard hardwoods, the *volume of poletimber trees* decreased by almost 8%.
- Hardwood *basal area* decreased in all size classes—from 7 percent for sawtimber to 18 percent for poletimber.
- Average annual removals exceeded average net annual growth for hard hardwoods and for oak species considered separately—this was true for both growing stock and sawtimber in both species categories.
- The *number of growing-stock trees* decreased in all but the very smallest and largest diameter classes.
- The *volume of growing stock in the sawlog portion of sawtimber trees* decreased by 6% for oak species between 11 and 18.9” d.b.h.

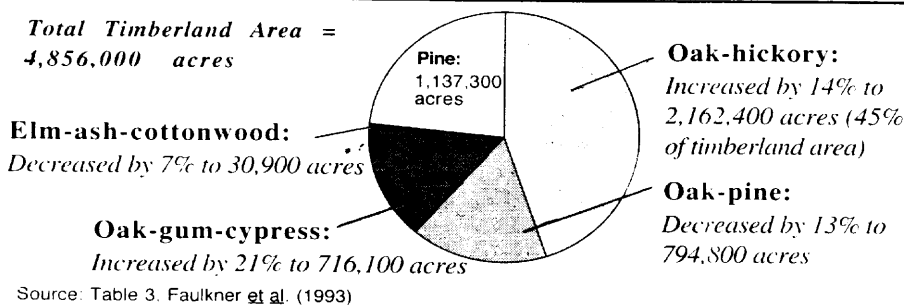
“Bottomline:” *The indicators above generally show increased hardwood resources in total, that is, increases occurred for aggregate resource measures like total area and total volume. The aggregate increases are minimal, however; negative indicators are clearly evident in the poletimber and small sawtimber size classes. It therefore appears that growth has not been sufficient to offset the increased removals in commercially important size and species groups.*

Results – Resource Changes From 1986 to 1992 *(continued)*

Acreage increases

Many of the “positive” factors in the new forest survey information on hardwoods are aggregate or “total” values. Consider, for example, total hardwood acreage. From 1986 to 1992, hardwood timberland area in North Mississippi increased by an estimated 268 thousand acres. The increase was about 8%, to over 3.7 million of the 4.856 million acres of timberland in the region. Timberland area increased in three hardwood forest types during the intersurvey period (Figure 2).

Figure 2. Timberland area by forest type in 1992.



An increase in total hardwood acreage is a “positive” resource indicator, but emphasis on aggregated estimates alone may overlook related, more detailed information that may be “negative” from the standpoint of continued availability of timber for commercial harvest. Acreage increases were significant for hardwoods as a group, for example, but the increases occurred primarily in the very small and the very large size-classes of timber—sapling-seedling stands increased by 234,700 acres in the oak-hickory forest type alone.

Although hardwood acreage was increased by the federal Conservation Reserve Program (about 25,000 acres in the 26-county area), much of the increase in small size classes may also be attributed to increased removals, particularly in poletimber and small sawtimber size classes. The estimated acreage of oak-pine stands in the poletimber size class, for example, decreased by over 40% from 1986 to 1992. For all hardwood forest types together, the poletimber acreage

decreased by 11% – from 877 to 785 thousand acres. The harvesting levels of pulpwood shown in Figure 1 (based on severance tax records) are therefore clearly reflected by this and other forest survey information.

Increases in large diameter class measures

Other areas where increases have occurred are in numbers of growing-stock trees, total growing-stock volume, and total sawtimber volume. In general, relatively large diameter classes of hardwood timber increased in most forest survey measures, including a measure that should be highly relevant to commercial

use for lumber and other solid wood products manufacturing – the volume of growing stock in the sawlog portion of sawtimber trees. This volume category increased by 5% in total, and the increase was particularly large for oak species in large diameters –

29% for diameter classes 19” and above. The trend is also reflected by overall increases in tree quality – there were large increases in sawtimber volumes in tree grades 1 and 2 – for hardwoods in total (58%) and for oak species considered separately (57%).

How does one explain these apparently significant resource increases in light of the continuing concern of sawmill operators and others interested in obtaining hardwood sawtimber for processing?

Although this paper is not directly concerned with economic availability of hardwood timber, a significant point is that among merchantable timber sizes, resource increases have occurred only in the largest diameter classes. The fact that larger hardwood timber is apparently “maturing” may indicate that significant portions of the hardwood resource in North Mississippi are in areas that are not operable, areas that are reserved for non-timber uses, or that these resources are not economically available for commercial use for other reasons. Of course these factors may or may not be involved – further study is needed to isolate the true reasons for the anomaly between physical increases in large hardwood timber and apparent problems in availability for commercial use.

Results – Resource Changes From 1986 to 1992 *(continued)*

Removals exceeded growth in some timber categories

The Forest Service reports “growth” as the average net annual volume increase of growing stock for the intersurvey period. “Removals” are “average net annual volume of growing-stock...removed from the inventory by harvesting, cultural operations, land clearing, or changes in land uses for the intersurvey period” (Faulkner *et al.* 1993).

In several important hardwood categories, removals levels increased greatly between 1986 and 1992 (Table 1). Although average annual growth rates also increased for some categories of hardwood timber, the increases were not enough to offset the high levels of

removals. Therefore, in several commercially important hardwood timber categories, more timber was estimated to be removed than was estimated to be grown in North Mississippi between 1986 and 1992 (Figure 3). As noted in Figure 3, removals of oak and hard hardwood sawtimber also exceeded growth during the six-year intersurvey period.

Since average annual removals exceeded average annual growth, declining inventory would be projected for oaks and hard hardwoods – major categories of commercially important hardwood timber in North Mississippi. Without increased growth, therefore, recent levels of removals cannot be sustained in the long-run.

Table 1. Removals of oak and hard hardwoods for 1986 and 1992.

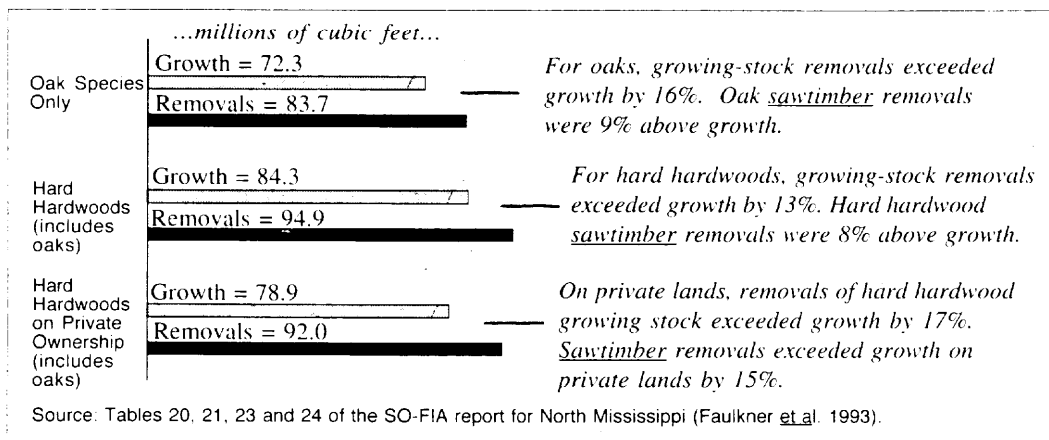
1. Removals of oak hard hardwoods for and 1992.			
	Average Annual Removals in ...		Change from 1986 to 1992
	1986	1992	
<i>Oak Species</i>			
<i>Growing-stock</i>	43.7 mmcf	83.7 mmcf	+92%
<i>Sawtimber</i>	149.2 mmbf	311.5 mmbf	+109%
<i>Hard Hardwoods (includes oaks)</i>			
<i>Growing-stock</i>	50.2 mmcf	94.9 mmcf	+89%
<i>Sawtimber</i>	167.1 mmbf	350.6 mmbf	+110%

mmcf = million cubic feet; mmbf = million board feet

Source: Tables 20, 21, 23, and 24 of the SO-FIA report for North Mississippi (Faulkner et al. 1993)

The increase in pulpwood harvest levels shown in severance tax data (Figure 1) is also reflected by the substantial increase in removals of oaks and hard hardwoods in the forest survey data.

Figure 3. Average annual growth and removals of growing stock, 1986 to 1992.



The increased removals exceeded growth in several important categories of growing-stock.

Results – Resource Changes From 1986 to 1992 *(continued)*

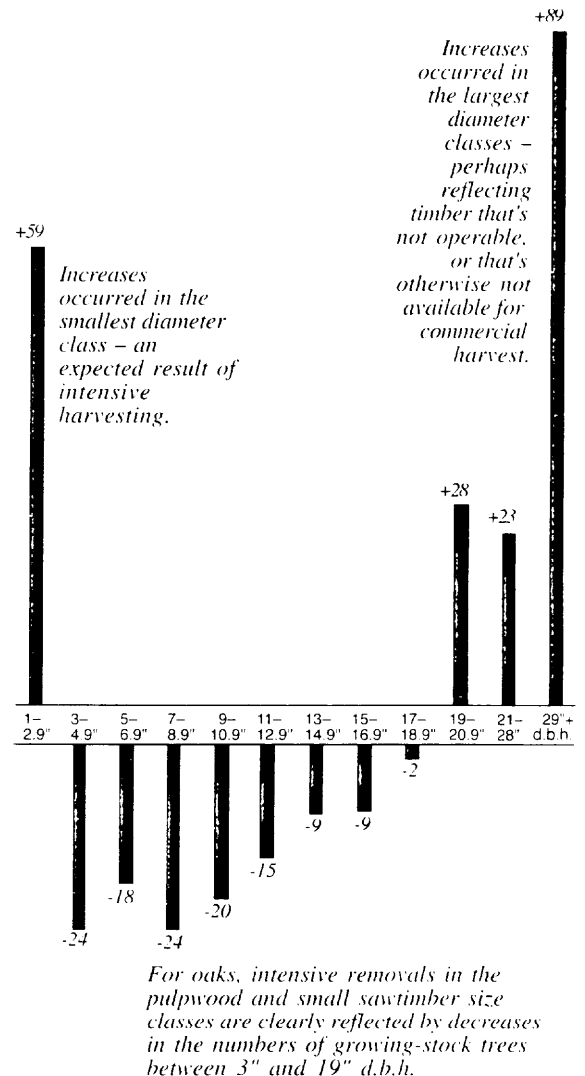
Diameter class impacts of oak removals

The increased level of hardwood removals has had a direct influence on the size class distribution of oak and hard hardwood timber in North Mississippi. Increased removals in poletimber and small sawtimber size classes have greatly reduced the number of standing trees of oak species in the smaller merchantable diameter classes (Figure 4). The number of trees of oak species in the growing-stock category increased only in the very smallest and the very largest diameter classes.

The pattern of change shown in Figure 4 also occurred for other important measures of oak and other hardwood resources in North Mississippi. Nearly identical diameter class changes occurred between the surveys for oak species growing-stock volume (Table 35, Faulkner *et al.* 1993), and for oak species volume of growing stock in the sawlog portion of sawtimber trees (Table 36, Faulkner *et al.* 1993). The same pattern has also resulted for the change in number of growing-stock trees in all hardwood species together.

As summarized previously, there were several “positive” indicators of hardwood resource change between surveys – examples include an overall increase in sawtimber volume (up 6%), and a volume increase of 57% for oak species in grades 1 and 2. The diameter class information clearly indicates the extent to which the merchantable volume increases occurred in the largest diameter classes for commercially important species groups.

Figure 4. Percentage change in the number of growing stock trees between 1986 and 1992, oak species, by diameter class. (Source: Table 11, Faulkner *et al.* 1993)



Summary and Discussion

Harvest sustainability

Hardwood harvest levels have increased dramatically in North Mississippi in recent years. The harvests are a result of increased demand for hardwood timber for pulping and other uses, and also a result of access to new markets provided by the opening of the Tennessee-Tombigbee Waterway in the mid-1980s.

Dramatic increases in harvesting have led to concerns over the longer-term availability of hardwood timber for processing solid-wood products. The new information on hardwoods in North Mississippi from the USDA Forest Service shows that such concerns may be valid for specific categories of commercially important timber. Without increased growth, harvest levels of the recent past may not be sustainable for commercially important size classes of oaks and “hard” hardwoods in general.

Resource trends and utilization

Several results of the hardwood timber supply and demand “situation” are evident in North Mississippi.

First, demand increases have led to

to price increases, and emphasis on hardwood timber production will therefore continue to grow. Prices for standing timber have increased significantly in North Mississippi recently, particularly for oak species

of timber (Daniels 1994). Increased prices typically lead to increased production in the long-term as more stands are actively regenerated and managed. Also, although timber supply relationships are not highly responsive to price changes in the short-run, production increases do occur in the short-run as marginally operable areas become economically viable and as more landowners become aware of the increased dollar value of the resources they own or control.

Another important result of hardwood resource trends in North Mississippi has been product substitution.

Many furniture manufacturers in the region, for example, now use a very different mix of wood-based raw materials than they did as recently as 5 years ago. A 1989 survey of wood-based raw materials in the industry showed heavy reliance on hardwood lumber, framestock, and dimension parts, particularly in the dominant upholstered furniture industry in North Mississippi (Glaeser *et al.* 1992). Today, however, many of the region’s manufacturers have greatly increased their use of plywood, particleboard, and other reconstituted panel products. Substitution of non-wood products is also occurring – one example is a manufacturer of recycled, high-density plastic products who has specifically targeted the upholstered furniture industry in North Mississippi (Anonymous 1994).

Finally, in North Mississippi and throughout the U.S. there is a great need for increased efficiency in harvesting, processing, and using hardwood timber-based products. A recent report stated that up to 25 percent of hardwood lumber is lost in planing boards for size and smoothness (Budiansky 1994). Immediate

Some responses to hardwood timber resource trends in North Mississippi:

- *higher prices* are leading to *increased growth and production*,
 - *product substitution* is occurring, and
 - *increased efficiency* through research and technology transfer is increasingly important.
-

gains in lumber recovery are seen in hardwood sawmills changing from circle headrigs to band headrigs – this change increases lumber yields

by at least 12 percent in most mills (Denig 1990).

Efficiency increases are needed in processing hardwoods in North Mississippi, of course, but also needed is increased emphasis on growing and managing hardwood timber stands for commercial production. Research and technology transfer are therefore essential components in responding to resource change in North Mississippi. Research and technology transfer are increasingly important for helping ensure the long-term development and continued utilization of one of the region’s most important natural resources.

References and Additional Information

- Anonymous. 1994. Plastic plans announced. Starkville Daily News, April 5.
- Araman, P. and J. Tansey. 1991. U.S. has plenty of hardwood, but much of it's not for sale. Forest Industries 118(9):16-17.
- Barrett, G. 1988. Our hardwood resource. Weekly Hardwood Review 4(10):1,19.
- Barrett, G. 1988. Future supply problems for the industry? Weekly Hardwood Review 4(20):19.
- Budiansky, S. 1994. On the cutting edge. U.S. News and World Report. May 30th. 116(21):48-50.
- Daniels, B. 1991. Mississippi's hardwood resource: what's its status today? Tree Talk 13(1): 17-19, 34.
- Daniels, B. 1994. 1993 Harvest of Forest Products (June 1994). Mississippi Cooperative Extension Service Report. Mississippi State, MS.
- Denig, J. 1990. Hardwood sawmillers can profit from problems. Forest Industries 117(7):13-14.
- Faulkner, J.L., P.E. Miller, A.J. Hartsell, and J.D. London. 1993. Forest Statistics for North Mississippi counties-1994. Resource Bulletin SO-180. USDA Forest Service, Southern Forest Experiment Station, New Orleans, LA. 41p.
- Faulkner, J.L. 1994. Hardwood timber in Mississippi: Recent trends in the resource and its use. Unpublished Master of Science Thesis, Department of Forestry, Mississippi State University, Mississippi State, MS, 129p.
- Glaeser, M.A., S.H. Bullard, and M.L. Doolittle. 1992. Raw materials use by Mississippi furniture manufacturers. Mississippi Forest Products Utilization Laboratory Research Report 19, 15p.
- Harpole, G.B. 1988. Hardwood resource availability: Quality and quantity. In: Executive Summaries, Forest Products Research Society 43rd Annual Meeting, Reno, NV, pp. 45-46.
- McWilliams, W.H. and J.F. Rosson. 1988. Hardwood supply and availability in the Midsouth highlands. In: Availability of Hardwoods in the Upland South, Hardwood Research Cooperative Series No. 7, Hardwood Research Council, Memphis, TN, pp. 47-95.
- Mississippi Cooperative Extension Service. 1977-1994. Harvest of Forest Products Annual Reports. Mississippi State, MS.
- Waldrop, B. 1994. Information issued about ice storm damage. Tree Talk 16(2):13
- USDA Forest Service. 1993. A blueprint for forest inventory and analysis research and vision for the future. Program Aid No. 1512, Washington, D.C., 20p.