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Analysis of the Timber Situation in Florida, 1995 to 2025

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Cover photo: Loblolly pine stand. (Photo by Bill Lea.)

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Contents

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Abstract

The nationwide demand for wood fiber is expected to increase in the foreseeable future. Harvesting restrictions on forest lands in the West have increased pressure on the South's forest resources to provide more wood. The ability of Florida and other Southern States to respond is uncertain. The authors describe the extent, condition, and availability of Florida's timber resource, and they project levels of growing-stock volume, net annual growth, and annual removals to the year 2025. Those projections are based on future timber demand, as reflected in harvest requests. The extent of the State's timber resource is determined by 1995 estimates of forested acres and the rate at which acres are being added or removed from the timber base due to natural or human-caused activities. Forest condition is represented by annual rates of growth and mortality and their combined effect on levels of timber volume. Timber availability is largely dictated by ownership holdings and, for the purposes of this paper, by the age of forest stands. Future timber harvest requests for Florida are derived from projections of estimated removals throughout the South as documented in the 1993 Resources Planning Act report. The Aggregate Timberland Assessment System (ATLAS) was the model used to project future estimates of growing stock, net growth, and removals in response to harvest requests. Overall, the projections suggest that Florida is well positioned to meet increased demand for wood, in spite of an expected shortfall of available southern yellow pine volume on forest-industry timberland by 2010. However, crucial factors influencing future timber availability in Florida are retaining the current timber base and working with ever-changing public expectations of forest-management practices.

Keywords: ATLAS simulations, FIA, final harvest, forest industry, forest-management types, harvest scenarios, nonindustrial private owners, partial cutting, public, timber projections, yield tables.

Introduction

The nationwide demand for wood fiber is expected to increase well into the future. Although the United States is rich in forest resources, not all those resources are readily available. Harvest restrictions on national forest timberland, particularly in the West, have severely limited the supply of wood cut from public lands. Such reductions in harvest elsewhere have increased the demand for timber in the South (Prestemon and Abt 2002). The potential to produce more wood in the future depends to some degree on the extent and condition of Florida's timber resource, as well as the future availability of trees for harvest. The extent of the State's timber resource is determined by estimates of current (1995) forested acres and the rate at which acres are being added or removed from the timber base due to natural or human causes. Forest condition is evaluated by annual rates of growth and mortality and their combined effect on levels of timber volume. Timber availability is largely dictated by ownership and, for the purposes of this paper, by the age of forest stands.

Based on the most recent (1995) Forest Inventory and Analysis (FIA) estimates, Florida ranked 7th among all 13 Southern States in total timberland area, with 14.6 million acres (Brown 1996). The State's 7.4 million acres of softwoods, including 4.6 million acres of planted pine, represent 8 percent of the total area of softwoods in the South. Volume of growing stock in Florida amounted to 15.4 billion cubic feet in 1995. Reported estimates of annual removals from growing stock averaged 560.7 million cubic feet and accounted for 9 percent of removals from all Southern States. These data illustrate Florida's importance to the South's timber industry. We analyze the timber situation in Florida as of 1995 and project timber inventory, growth, and removals levels for the next 30 years in response to expected changes in demand for wood. Our primary objective was to determine whether Florida's timberland resource could supply the volume of wood needed to meet projected increases in demand. Results from this study will serve as a baseline to assess changes in the state's timber supply-and-demand situation as new annual inventory data become available.

Methods

We used the Aggregate Timberland Assessment System (ATLAS) to project timber inventory. ATLAS is a time-based deterministic timber projection model originally developed by the U.S. Department of Agriculture Forest Service to provide projections for the 1989 national timber assessment (Mills and Kincaid 1992). Basic data requirements to run an ATLAS simulation include an initial inventory, a base yield table, and projected future harvest levels. To accurately adjust and project the estimate of available wood volume, it is necessary to forecast changes in Florida's timber base. Projected changes in the State's timberland area are taken from results of "The South's Fourth Forest" report (U.S. Department of Agriculture Forest Service 1988). We updated the area projections in that report based on data from the 1995 survey of Florida (Brown 1996) conducted by the Southern Research Station's FIA Research Work Unit.

We provide data from the 1980, 1987, and 1995 FIA surveys to establish trends and to compare our projected estimates of area, volume, growth, and removals with past levels to gauge relative change. The 1995 FIA survey data also serve the more important function as baseline estimates of growing-stock volume, timberland area, changes in land use, net annual growth, and annual removals. We aggregated the 1995 inventory data into three strata, or forest-management types, based on ownership, differences in growth and yield, and harvest options, all arrayed by 5-year age classes. The three forest-management types developed for this analysis are planted pine/oak-pine, natural pine/oak-pine, and hardwood. The pine management types include only southern yellow pine species. All other softwoods—composed almost entirely of cypress—are included in the hardwood management type. Cypress is typically managed and processed much like hardwood species and occurs primarily in stands classed as hardwood forest types. Management types are defined for each ownership group: nonindustrial private forest (NIPF), forest industry, and public. The two primary ownerships that comprise the public ownership group are national forest and other public. The latter includes State, county, and municipal holdings. Rather than project the demand for wood from each, we combined national forest and other public into a single ownership group.

Defining Supply and Demand

Each ATLAS simulation requires estimates of wood supply and demand. In traditional timber supply studies, definitions for supply and demand typically include economic criteria that account for consumer and producer responses to price changes (Prestemon and Abt 2002). However, in this assessment we do not consider the influence of price on the amount of wood consumed or produced. Instead, we use the projected demand for wood volume, which is represented by estimates of future harvest requests. Future harvest requests for Florida were derived from projected estimates of removals volume for the entire Southeast, as documented in the 1993 Resources Planning Act update (Haynes and others 1995). The percent change in regional removals levels, calculated for each 5-year projection period, was applied directly to Florida. For example, if projected softwood removals for the entire Southeast increased by 15 percent over a given 5-year period, then the projected harvest request, or demand for pine removals volume from Florida was increased by the same percentage. The supply side of each simulation is represented by the removals volume cut from available inventory in response to a particular projected harvest request. When removals volume equals requested harvest volume, we assume that supply equals demand. A shortfall occurs when the available removals volume (supply) is less than the harvest request (demand).

Base Yield Tables

The ATLAS model requires a base yield table for each management unit. Yield tables were derived by combining volumes per acre by age class using data from the 1995 and 1987 inventories of Florida. A weighted mean volume per acre yield table was calculated for pine/oak-pine and hardwood forest-management types. The yield table for the planted pine forest-management type was derived using data from the 1995 survey alone. Basing yields for planted pine on the latest (1995) survey alone was done to capture any recent improvements in stand productivity attributable to genetic improvement or other intensive management practices.

Model Assumptions

ATLAS relies on the assumption that stand density follows an "approach to normal" concept. This means that over time, stand stocking will approach an equilibrium or maximum density characteristic of a normal undisturbed stand (Husch and others 1982). This assumption allows for development of density change functions which adjust stand stocking and "grows" the stand over time. Projected volume is found by applying the projected stocking to the yield table value in the next older age class. We used resource data from the 1986 and 1995 surveys in Florida to develop regression coefficients for density-change equations. We developed specific equation coefficients for the pine and hardwood stands within each ownership group. A detailed description of the development and use of density-change equations is provided by Mills and Kincaid (1992).

Projection Assumptions

We assumed that all of Florida's nonreserved timberland acres were available for timber production and harvest. Availability constraints due to adverse terrain, permanent water or temporary flooding, tract size, restricted-use areas, owner attitudes, timber quality, or other factors that might limit harvesting or prohibit logging entirely were not considered. Obviously, eliminating acres from Florida's timber base would reduce the volume available for harvest, which would limit the State's ability to meet future increases in the demand. Brown (1990) estimated that adverse sites alone could restrict or preclude timber management on as much as 10 percent of the total timberland area in five Southeastern States. Estimates from the 1995 FIA survey show > 927,000 acres of forest land as having adverse sites where management opportunities are severely limited due to poor drainage. Using the 1995 statewide average of 1,049 cubic feet of growing-stock volume per acre, "unavailable" volume on these acres would total as much as 973.6 million cubic feet.

Therefore, the volume and estimated future timber inventory we report may show a greater supply of wood than would be available if adverse sites and other timber availability constraints were considered.

Defining Harvest Scenarios

ATLAS provides four harvesting options: partial cutting, final harvest, thinning, and volume recovery from area loss. Area loss occurs when acres are removed from the timber base due to conversion of forest land to nonforest—primarily to urban or agricultural land uses. The partial cutting harvest option simulates an oldest first harvest method, removing the oldest trees from a mixed-age stand. Final harvest simulates clearcutting. The volume removed by partial cutting or final harvest is done in direct response to the requested harvest volume (demand). Thinning and recovery volumes are acre-dependent, that is, volume removed depends on number of acres thinned or "lost" and volume per acre. Thinning and recovery from area loss occur first and occur regardless of the requested harvest volume. Volume harvested from lost acres reduces the partial cutting and final harvest volume needed to meet demand. Removals volume from all four of the harvest methods counts toward fulfilling the harvest request for each projection period.

We established a harvest scenario for each ownership and forest-management type. Each harvest scenario was derived from trends in timber management activity indicated by recent FIA surveys. Based on those trends, the scenario defined for NIPF timberland included one thinning on a portion of the planted pine/oak-pine acres and a final harvest on the remaining acres in that management type. Acres of the natural pine/oak-pine and hardwood forest-management types on NIPF timberland underwent either partial cutting or a final harvest. For forest industry lands, past management activity indicated that a partial cutting harvest option would be an appropriate harvest scenario for both the natural pine/oak-pine and hardwood forest-management types. Past activity also dictated that a small percentage of industry-owned planted pine/oak-pine stands would be thinned. Additional forest industry acres cut to fulfill harvest requests underwent a final harvest. Based on predominant harvest activity shown in past surveys, a final harvest was the only option used for all forest-management types under public ownership.

Stands considered available for harvest were those that met the minimum harvest age—determined from past management activity—set for each ownership and management type. We found 18 years to be the minimum harvest age for planted pine/oak-pine stands on NIPF and forest industry timberland. Natural pine/oak-pine stands under both NIPF and forest industry ownership had to be at least 28 years old, and hardwood stands were considered available at 38 years. Minimum harvest ages for the three management types on public timberland were 23, 33, and 43 years, respectively.

Estimates of Timberland Area: Past Trends and Projected Changes

Changes in Florida's timberland area affect the supply and availability of wood. Timberland area in Florida is expected to gradually decline. Total timberland area in the State dropped from 18.1 million acres in 1952 (U.S. Department of Agriculture Forest Service 1988) to 14.7 million acres by 1995 (Brown 1996). Beyond 1995, projections show a reduction of 839,000 acres by 2025, down to 13.8 million acres. Factors in the reduction are many and varied, but urban development has been a primary reason for the change in land use in the past and likely will remain as a major factor (Alig and others 1986, De Steiguer and others 1989). If Florida's population continues to increase, then demands on the State's forest resources to provide homesites, recreation activities, and other amenities also will likely increase. These pressures, coupled with a shrinking forest land base, will make the task of maintaining a sustainable supply of raw material for traditional timber products all the more challenging.

Changes in species composition and stand origin also affect timber availability. Our study shows these changes as shifts in the distribution of timberland acres among natural stands, planted stands, and hardwoods. The area of Florida's natural pine/oak-pine stands for all ownerships combined has been on the decline for decades, while acres of planted pine/oak-pine have shown a steady increase (fig. 1). In 1952, Florida's natural pine/oak-pine stands occupied 11.1 million acres, or 61 percent of the total timberland area. Planted pine/oak-pine stands then occupied only 291,000 acres. By 1987, planted pine/oak-pine area was 4.1 million acres whereas natural pine/oak-pine comprised 4.6 million acres (table 1; fig. 1). In 1995, acres of planted pine/oak-pine exceeded acres of natural stands for the first time. The 1995 estimates show 4.9 million acres of planted stands, while the area of natural stands decreased to 4.0 million acres. This divergent trend in stand types is likely to continue. Based on data from "The South's Fourth Forest" (U.S. Department of Agriculture Forest Service 1988), natural pine stands in Florida are projected to continue to decline over the next 30 years, falling to 3.1 million acres by 2025. Concurrently, planted pine/oak-pine area is projected to increase to nearly 6.0 million acres. In addition, the area of planted pine/oak-pine in Florida is projected to exceed hardwood acres in 2005, marking the first time that planted stands constitute the dominant stand type in Florida. In any case, planted pine

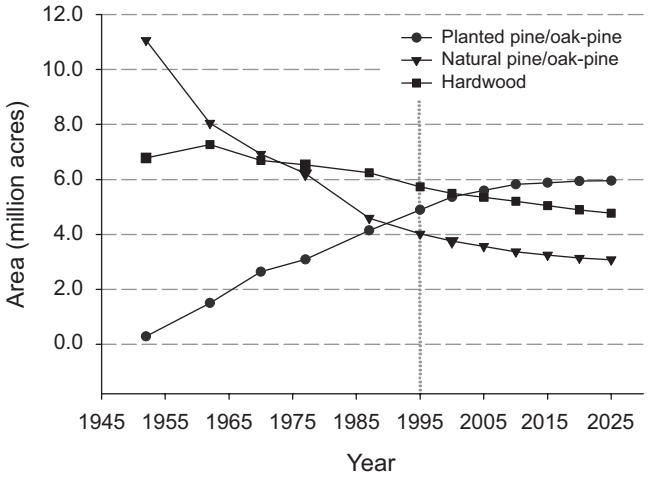

Figure 1—Timberland area in Florida by forest-management type, 1952 to 1995, with projections to 2025. Vertical line indicates transition from measured trends to projected estimates.

stands will provide a greater share of the softwood volume in future years.

Florida's hardwood resource has declined steadily from earlier area estimates. In 1952, the area occupied by hardwoods totaled 6.8 million acres, and by 1962 it had peaked at 7.3 million acres. A downward trend over the next three decades reduced the area of hardwoods to 5.7 million acres, a 21-percent decline. Projections for the area of hardwoods indicate a similar trend: a steady decline over the 30 years, falling to 4.8 million acres by 2025. Artificial regeneration to a softwood forest type will account for some of the reduction in hardwood timberland area. However, urbanization is the larger threat, because this change in land use will remove acres from timber production permanently.

Table 1—Area of timberland by owner group, forest-management type, survey year, and projection, Florida, 1980 to 2025

Owner group and forest-management type	Survey year			Projection [d]					
	1980 [a]	1987 [b]	1995 [c]	2000	2005	2010	2015	2020	2025
	thousand acres								
Nonindustrial private									
Planted pine/oak-pine	927.0	1,060.4	1,718.9	1,891.0	1,975.0	2,058.0	2,063.0	2,067.0	2,055.0
Natural pine/oak-pine	3,001.7	2,376.1	2,125.6	2,042.0	1,951.0	1,859.0	1,777.0	1,695.0	1,652.0
Hardwood	4,120.2	3,656.7	3,372.9	3,239.0	3,155.0	3,070.0	2,968.0	2,866.0	2,783.0
Total	8,048.9	7,093.2	7,217.4	7,172.0	7,081.0	6,987.0	6,808.0	6,628.0	6,490.0
Forest industry									
Planted pine/oak-pine	2,178.6	2,678.5	2,606.8	2,851.0	2,966.0	3,080.0	3,119.0	3,157.0	3,176.0
Natural pine/oak-pine	1,505.4	979.6	656.0	499.0	424.0	348.0	329.0	310.0	303.0
Hardwood	1,753.2	1,788.3	1,338.6	1,267.0	1,207.0	1,147.0	1,099.0	1,051.0	1,015.0
Total	5,437.2	5,446.4	4,601.4	4,617.0	4,597.0	4,575.0	4,547.0	4,518.0	4,494.0
Public									
Planted pine/oak-pine	312.2	408.3	569.5	625.0	654.0	683.0	700.0	716.0	723.0
Natural pine/oak-pine	1,268.8	1,234.5	1,239.9	1,217.0	1,190.0	1,162.0	1,147.0	1,132.0	1,127.0
Hardwood	597.2	800.3	1,022.4	996.0	992.0	987.0	984.0	980.0	978.0
Total	2,178.2	2,443.1	2,831.8	2,838.0	2,836.0	2,832.0	2,831.0	2,828.0	2,828.0
All owners									
Planted pine/oak-pine	3,417.8	4,147.2	4,895.2	5,367.0	5,595.0	5,821.0	5,882.0	5,940.0	5,954.0
Natural pine/oak-pine	5,775.9	4,590.2	4,021.6	3,758.0	3,565.0	3,369.0	3,253.0	3,137.0	3,082.0
Hardwood	6,470.5	6,245.3	5,733.9	5,502.0	5,354.0	5,204.0	5,051.0	4,897.0	4,776.0
Total	15,664.2	14,982.7	14,650.7	14,627.0	14,514.0	14,394.0	14,186.0	13,974.0	13,812.0

[a] Bechtold and Sheffield (1981).
[b] Brown and Thompson (1988).
[c] Brown (1996).
[d] Mills and Kincaid (1992).

Trends in Forest-Management Types by Ownership

Table 1 and figure 2 display past trends and projections of NIPF land area by forest-management type. Few planted stands existed 40 years ago, when natural pine/oak-pine stands dominated Florida's NIPF timberland. Much has changed. Planted pine/oak-pine acres on private timberland were projected to exceed the area occupied by natural stands in 2005. After 2005, the area of planted stands is projected to remain at about 2.1 million acres. Acres occupied by natural stands will decline from 2.1 million acres in 1995 to a projected 1.7 million acres by 2025. NIPF hardwood acreage has continually declined since 1962 and is expected to drop from 3.4 million acres in 1995 to 2.8 million acres by 2025. In total, NIPF timberland area will decrease to 6.5 million acres by 2025, down from the current 7.2 million acres. Again, urbanization is the primary cause of projected area loss.

The shift toward more planted stands has been the trend for forest industry timberland as well. As natural stands were harvested and regenerated, planted stand acreage rose from just 125,000 acres in 1952 to 2.6 million acres in 1995 (table 1; fig. 3), and accounted for 57 percent of the timberland area under forest industry ownership. Planted stands exceeded the area of natural stands and hardwoods in the late 1970s. By 2025, planted stands are projected to comprise 71 percent of industry's holdings in Florida, or 3.2 million acres. By contrast, natural pine/oak-pine stands

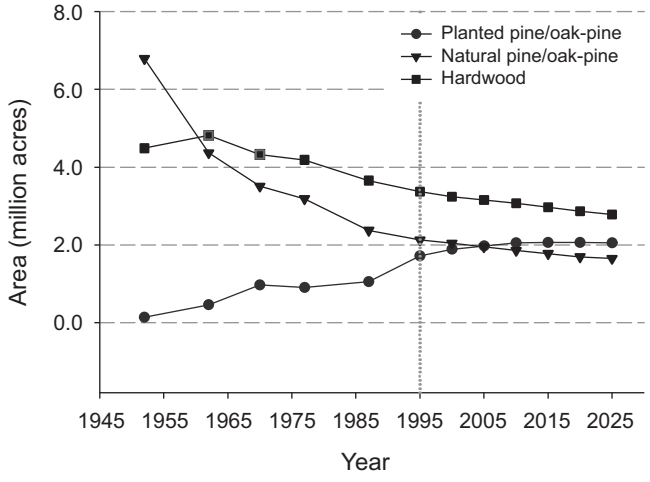

Figure 2—Nonindustrial private timberland area in Florida by forest-management type, 1952 to 1995, with projections to 2025. Vertical line indicates transition from measured trends to projected estimates.

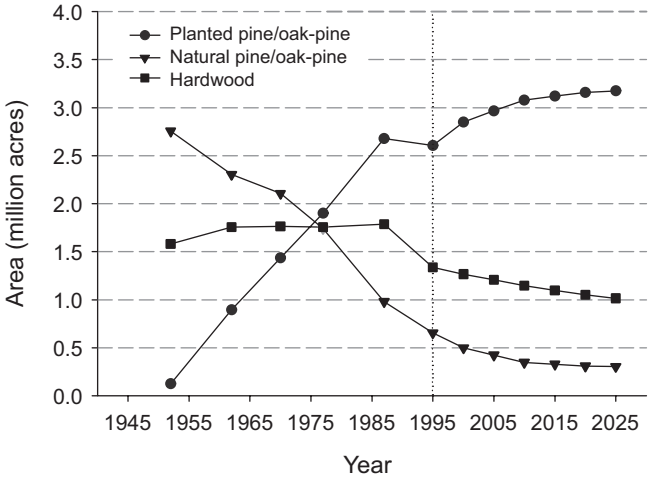

Figure 3—Forest industry timberland area in Florida by forest-management type, 1952 to 1995, with projections to 2025. Vertical line indicates transition from measured trends to projected estimates.

will occupy fewer acres of forest industry timberland. From a high of 2.8 million acres in 1952, natural pine/oak-pine stands occupied just 656,000 acres in 1995. Projections show that less than one-half of that area is projected to remain by 2025. The area of hardwoods under forest industry ownership remained relatively stable at 1.8 million acres between 1962 and 1987. Hardwoods declined by nearly 450,000 acres between 1987 and 1995, down to 1.3 million acres. The projected area of hardwoods shows an additional decline to 1.0 million acres over the next 30 years. Based on past trends, forest industry timberland is projected to incur only modest losses in total timberland area, from the current 4.6 million acres to 4.5 million acres by 2025.

The area of timberland under public ownership in Florida also has undergone some recent changes. Since 1987, the area of planted stands rose 39 percent to almost 570,000 acres as of 1995 (table 1; fig. 4). The area of planted pine/oak-pine is expected to increase to 723,000 acres over the next 30 years. Natural pine/oak-pine acres have remained relatively unchanged since 1987 at 1.2 million acres and are projected to decline by only 100,000 acres to 1.1 million acres by 2025. Between 1987 and 1995, public agencies in the State added 222,000 acres to their hardwood base in an effort to expand and protect critical watersheds. However, these acres likely would not be available as a source of wood fiber. In total, public timberland is projected to remain at roughly 2.8 million acres over the study period.

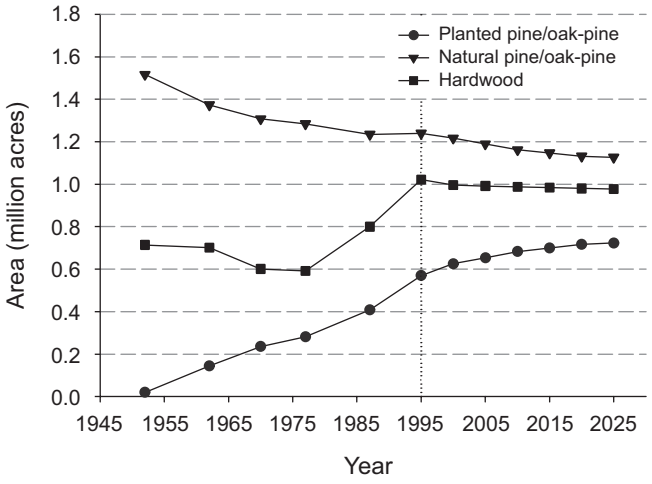

Figure 4—Public timberland area in Florida by forest-management type, 1952 to 1995, with projections to 2025. Vertical line indicates transition from measured trends to projected estimates.

Results

Growth, Removals, and Harvest Requests

The first three columns of tables 2 through 5 provide summaries of net annual growth, annual removals, and growing-stock volume by species group and forest-management type taken from past surveys of Florida. Data from the 1980 and 1987 surveys are presented to establish trends for comparison with projected changes. The remaining columns show the 1995 base-year survey estimates and the ATLAS projections through 2025. Table 2 provides a summary for all timberland owners, while tables 3 through 5 provide estimates for each ownership group considered in this assessment. The 2000 to 2025 estimates for growing-stock volume, growth, and removals volume shown in the tables are the result of harvesting timber to meet the projected harvest request set by each ATLAS simulation. As previously discussed, harvest requests represent "demand," while "supply" is the removals volume cut from available growing stock in response to each projected harvest request. Figures 5 through 12 illustrate the projected changes in growth and removals by species group and ownership for each periodic harvest request.

Data from FIA surveys since 1980 indicate that Florida's timber resource statewide was in very good condition with respect to growth and removals relationships. Removals from all owners and all management types averaged 541.8 million cubic feet per year in 1980, with pine species accounting for 427.0 million cubic feet and hardwoods contributing 114.8 million cubic feet (table 2). Removals increased to 540.6 million cubic feet per year in 1987 and rose to 560.7 million cubic feet per year by 1995. In each case, total net growth outpaced removals by a substantial margin, indicating that there was enough wood available at the State level to respond relatively easily to future increases in demand. However, the ATLAS simulations revealed some potential shortages of available wood by 2010 and another possible shortfall in 2025. Simulation results for individual management types and owner groups identify the source of projected shortages in available timber volume.

Projections for Southern Yellow Pine

Figure 5 shows the projected estimates of removals and requested volume for southern yellow pine from all ownerships. In 1995, FIA estimates showed average annual removals of pine amounted to 431.4 million cubic feet statewide. The projected harvest request for pine volume in 2000 was expected to rise to 462.4 million cubic feet, a 7-percent increase in demand over the 1995 base-year removals levels. Over the next 5 years, harvest requests for pine volume are projected to increase to 487.7 million cubic feet. Projected harvest requests peak at 519.2 million cubic feet annually in 2020. The removals columns in figure 5 show the pine volume cut in response to each harvest request. Within the constraints of the projections, Florida apparently has the pine volume available to supply the projected increases in demand for pine over the next 30 years, with one possible exception: a supply shortfall of 119.9 million cubic feet is projected to occur by 2010. Part of the reason for the potential shortfall in pine volume is due to the model constraints on harvest age and the distribution of the harvest requests among ownerships. A redistribution of the removals volume among the other ownership groups is indicated if the shortfall is to be avoided. Also, the fact that net annual growth for southern yellow pines exceeds removals over the entire 30-year projection period indicates that the resource has the growth capacity to make up this supply shortfall. Therefore, the volume of wood needed to respond to the increased demand is "on the stump," again limited only by simulation constraints on removals among owner groups and minimum age classes. The next sections discuss the simulation results for projected harvest requests and removals for each owner and species group.

Projections of Pine Harvest Requests by Owner Group

Projected demand for pine volume from Florida's nonindustrial private timberland is expected to increase modestly relative to base-year (1995) removals estimates, which averaged 176.7 million cubic feet (table 3). Requested harvest volume is expected to rise 8 percent to 190.9 million cubic feet during the initial 5-year projection period, then decline to 184.0 million cubic feet by 2010 (fig. 6).

Table 2—Growing-stock volume, net annual growth, and annual removals by species group, forest-management type, survey year, and projection for all owners, Florida, 1980 to 2025

Inventory item, species group, and forest-management type	Survey year			Projection [d]					
	1980 [a]	1987 [b]	1995 [c]	2000	2005	2010	2015	2020	2025
	million cubic feet								
Growing stock									
Pine									
Planted pine/oak-pine	1,531.6	2,028.4	2,772.2	3,909.7	4,596.9	5,659.4	5,883.4	6,176.4	6,316.0
Natural pine/oak-pine	4,424.6	4,058.6	3,751.9	3,042.3	2,704.1	2,668.2	2,769.0	2,902.8	3,004.0
Hardwood	368.1	459.5	451.0	472.8	487.8	493.4	494.8	491.3	486.9
Total	6,324.3	6,546.5	6,975.1	7,424.8	7,788.8	8,821.0	9,147.2	9,570.5	9,806.9
Hardwood									
Planted pine/oak-pine	28.5	41.4	67.3	95.3	113.3	138.9	145.3	154.2	158.8
Natural pine/oak-pine	704.6	741.2	850.2	625.2	526.1	518.1	543.3	577.8	596.9
Hardwood	6,562.5	7,640.4	7,473.9	7,824.6	8,071.4	8,166.3	8,184.6	8,126.9	8,051.7
Total	7,295.6	8,423.0	8,391.4	8,545.1	8,710.8	8,823.3	8,873.2	8,858.9	8,807.4
Net annual growth									
Pine									
Planted pine/oak-pine	222.4	247.5	333.5	438.7	454.6	494.9	474.8	494.4	436.0
Natural pine/oak-pine	282.0	156.1	133.7	105.0	95.5	95.7	98.5	101.3	99.9
Hardwood	39.5	23.6	21.5	9.8	9.6	8.9	8.1	7.4	6.9
Total	543.9	427.2	488.7	553.5	559.7	599.5	581.4	603.1	542.8
Hardwood									
Planted pine/oak-pine	3.1	3.6	6.3	10.7	11.1	12.2	11.5	12.2	10.8
Natural pine/oak-pine	35.4	24.7	28.9	24.4	22.1	22.4	23.2	24.0	23.5
Hardwood	203.1	172.8	168.7	160.4	156.5	145.1	133.3	121.9	111.2
Total	241.6	201.1	203.9	195.5	189.7	179.7	168.0	158.1	145.5
Annual removals									
Pine									
Planted pine/oak-pine	85.2	190.2	231.1	211.3	317.3	282.5	429.9	435.9	404.3
Natural pine/oak-pine	316.9	238.3	188.4	246.9	163.2	102.9	78.3	74.6	79.6
Hardwood	24.9	12.7	11.9	5.5	6.7	7.8	7.9	8.2	7.6
Total	427.0	441.2	431.4	463.7	487.2	393.2	516.1	518.7	491.5
Hardwood									
Planted pine/oak-pine	1.9	1.3	2.2	5.0	7.5	6.9	10.3	10.5	9.8
Natural pine/oak-pine	14.6	16.9	15.6	66.8	39.8	22.1	17.1	16.0	19.2
Hardwood	98.3	81.2	111.5	72.5	96.8	115.0	116.8	117.8	112.9
Total	114.8	99.4	129.3	144.3	144.1	144.0	144.2	144.3	141.9

[a] Bechtold and Sheffield (1981).
[b] Brown and Thompson (1988).
[c] Brown (1996).
[d] Mills and Kincaid (1992).

Table 3—Growing-stock volume, net annual growth, and annual removals by species group, forest-management type, survey year, and projection for nonindustrial private owners, Florida, 1980 to 2025

Inventory item, species group, and forest-management type	Survey year			Projection [d]					
	1980 [a]	1987 [b]	1995 [c]	2000	2005	2010	2015	2020	2025
	million cubic feet								
Growing stock									
Pine									
Planted pine/oak-pine	615.2	553.5	997.8	1,507.7	1,996.4	2,400.8	2,629.5	3,016.2	3,237.7
Natural pine/oak-pine	1,969.6	1,856.6	1,676.9	1,329.2	1,104.9	1,065.1	1,156.9	1,255.8	1,365.8
Hardwood	217.0	242.7	250.7	262.7	269.0	267.6	261.3	252.3	242.5
Total	2,801.8	2,652.8	2,925.4	3,099.6	3,370.3	3,733.5	4,047.7	4,524.3	4,846.0
Hardwood									
Planted pine/oak-pine	6.3	12.2	28.8	43.4	57.5	69.2	75.7	86.9	93.3
Natural pine/oak-pine	385.5	400.2	449.2	356.1	296.0	285.4	310.0	336.4	365.9
Hardwood	3,901.9	4,247.0	4,074.0	4,265.9	4,369.2	4,346.9	4,243.3	4,097.9	3,938.5
Total	4,293.7	4,659.4	4,552.0	4,665.4	4,722.7	4,701.5	4,629.0	4,521.2	4,397.7
Net annual growth									
Pine									
Planted pine/oak-pine	83.4	58.8	119.8	162.3	182.1	196.2	188.2	223.1	193.6
Natural pine/oak-pine	122.0	79.0	72.5	57.4	53.6	55.0	58.6	61.4	61.5
Hardwood	18.3	11.4	12.1	5.9	5.7	5.3	4.8	4.4	4.1
Total	223.7	149.2	204.4	225.6	241.4	256.5	251.6	288.9	259.2
Hardwood									
Planted pine/oak-pine	1.1	1.2	3.0	4.7	5.2	5.7	5.4	6.4	5.6
Natural pine/oak-pine	19.4	13.9	16.8	15.3	14.4	14.7	15.7	16.4	16.4
Hardwood	120.5	103.3	99.6	96.6	93.9	86.7	79.1	72.2	66.5
Total	141.0	118.4	119.4	116.6	113.5	107.1	100.2	95.0	88.5
Annual removals									
Pine									
Planted pine/oak-pine	47.4	77.5	74.0	60.3	84.4	115.4	142.4	145.8	145.6
Natural pine/oak-pine	119.0	95.9	95.5	127.0	98.5	63.0	40.2	41.6	39.5
Hardwood	11.8	8.1	7.2	3.6	4.5	5.6	6.1	6.2	6.0
Total	178.2	181.5	176.7	190.9	187.4	184.0	188.7	193.6	191.1
Hardwood									
Planted pine/oak-pine	1.1	0.3	0.8	1.7	2.4	3.3	4.1	4.2	4.2
Natural pine/oak-pine	5.4	9.8	9.4	33.6	25.5	15.9	9.9	10.3	10.1
Hardwood	46.6	43.4	61.7	51.3	67.5	85.2	92.4	93.9	92.4
Total	53.1	53.5	71.9	86.6	95.4	104.4	106.4	108.4	106.7

[a] Bechtold and Sheffield (1981).
[b] Brown and Thompson (1988).
[c] Brown (1996).
[d] Mills and Kincaid (1992).

Table 4—Growing-stock volume, net annual growth, and annual removals by species group, forest-management type, survey year, and projection for forest industry owners, Florida, 1980 to 2025

Inventory item, species group, and forest-management type	Survey year			Projection [d]					
	1980 [a]	1987 [b]	1995 [c]	2000	2005	2010	2015	2020	2025
	million cubic feet								
Growing stock									
Pine									
Planted pine/oak-pine	826.7	1,319.0	1,428.6	1,790.0	1,722.8	2,129.7	1,908.9	1,641.5	1,438.8
Natural pine/oak-pine	1,187.7	821.1	542.6	200.4	102.9	111.4	109.3	123.9	86.3
Hardwood	105.5	153.5	121.6	128.4	134.0	138.5	144.2	148.3	152.5
Total	2,119.9	2,293.6	2,092.8	2,118.8	1,959.7	2,379.6	2,162.4	1,913.7	1,677.6
Hardwood									
Planted pine/oak-pine	20.6	26.8	31.2	39.0	37.3	46.0	41.3	35.4	31.0
Natural pine/oak-pine	219.7	195.0	205.2	75.8	38.9	42.1	41.3	46.8	32.7
Hardwood	2,012.8	2,148.3	1,688.8	1,782.6	1,860.2	1,922.3	2,001.3	2,058.2	2,117.0
Total	2,253.1	2,370.1	1,925.2	1,897.4	1,936.4	2,010.4	2,083.9	2,140.4	2,180.7
Net annual growth									
Pine									
Planted pine/oak-pine	124.9	168.3	183.3	217.5	209.5	234.4	224.3	214.6	193.7
Natural pine/oak-pine	88.7	34.6	27.7	12.2	9.5	9.7	9.8	10.1	8.8
Hardwood	17.1	9.5	7.5	2.7	2.7	2.5	2.3	2.1	1.9
Total	230.7	212.4	218.5	232.4	221.7	246.6	236.4	226.8	204.4
Hardwood									
Planted pine/oak-pine	2.0	2.3	2.9	4.7	4.5	5.1	4.8	4.6	4.2
Natural pine/oak-pine	11.5	6.5	6.4	4.6	3.6	3.7	3.7	3.8	3.3
Hardwood	64.2	45.2	38.5	37.3	37.5	34.9	32.4	29.3	26.1
Total	77.7	54.0	47.8	46.6	45.6	43.7	40.9	37.7	33.6
Annual removals									
Pine									
Planted pine/oak-pine	32.6	107.6	146.3	145.3	223.0	153.0	268.4	268.1	234.2
Natural pine/oak-pine	160.7	99.8	53.8	80.6	29.0	8.0	10.2	7.2	16.3
Hardwood	12.4	4.2	3.3	1.3	1.6	1.6	1.2	1.3	1.0
Total	205.7	211.6	203.4	227.2	253.6	162.6	279.8	276.6	251.5
Hardwood									
Planted pine/oak-pine	0.8	1.0	1.3	3.2	4.9	3.3	5.8	5.8	5.1
Natural pine/oak-pine	7.2	6.4	4.7	28.3	9.9	2.3	3.7	2.5	6.1
Hardwood	33.2	37.1	35.2	10.0	17.7	17.8	11.4	10.1	7.2
Total	41.2	44.5	41.2	41.5	32.5	23.4	20.9	18.4	18.4

[a] Bechtold and Sheffield (1981).
[b] Brown and Thompson (1988).
[c] Brown (1996).
[d] Mills and Kincaid (1992).

Table 5—Growing-stock volume, net annual growth, and annual removals by species group, forest-management type, survey year, and projection for public owners, Florida, 1980 to 2025

Inventory item, species group, and forest-management type	Survey year			Projection [d]					
	1980 [a]	1987 [b]	1995 [c]	2000	2005	2010	2015	2020	2025
	million cubic feet								
Growing stock									
Pine									
Planted pine/oak-pine	89.7	155.8	345.8	612.0	877.7	1,128.9	1,345.0	1,518.7	1,639.5
Natural pine/oak-pine	1,267.2	1,380.9	1,532.4	1,512.7	1,496.3	1,491.7	1,502.8	1,523.1	1,551.9
Hardwood	45.5	63.2	78.7	81.7	84.8	87.3	89.3	90.7	91.9
Total	1,402.4	1,599.9	1,956.9	2,206.4	2,458.8	2,707.9	2,937.1	3,132.5	3,283.3
Hardwood									
Planted pine/oak-pine	1.6	2.4	7.3	12.9	18.5	23.7	28.3	31.9	34.5
Natural pine/oak-pine	99.4	146.1	195.8	193.3	191.2	190.6	192.0	194.6	198.3
Hardwood	647.8	1,245.1	1,711.1	1,776.1	1,842.0	1,897.1	1,940.0	1,970.8	1,996.2
Total	748.8	1,393.6	1,914.2	1,982.3	2,051.7	2,111.4	2,160.3	2,197.3	2,229.0
Net annual growth									
Pine									
Planted pine/oak-pine	14.1	20.5	30.4	58.9	63.0	64.3	62.3	56.7	48.7
Natural pine/oak-pine	71.2	42.4	33.5	35.4	32.4	31.0	30.1	29.8	29.6
Hardwood	4.1	2.7	1.9	1.2	1.2	1.1	1.0	0.9	0.9
Total	89.4	65.6	65.8	95.5	96.6	96.4	93.4	87.4	79.2
Hardwood									
Planted pine/oak-pine	0.1	0.1	0.4	1.3	1.4	1.4	1.3	1.2	1.0
Natural pine/oak-pine	4.5	4.3	5.7	4.5	4.1	4.0	3.8	3.8	3.8
Hardwood	18.3	24.4	30.6	26.5	25.1	23.5	21.8	20.4	18.6
Total	22.9	28.8	36.7	32.3	30.6	28.9	26.9	25.4	23.4
Annual removals									
Pine									
Planted pine/oak-pine	5.2	5.1	10.8	5.7	9.9	14.1	19.1	22.0	24.5
Natural pine/oak-pine	37.1	42.5	39.1	39.3	35.7	31.9	27.9	25.8	23.8
Hardwood	0.7	0.5	1.4	0.6	0.6	0.6	0.6	0.7	0.6
Total	43.0	48.1	51.3	45.6	46.2	46.6	47.6	48.5	48.9
Hardwood									
Planted pine/oak-pine	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.5
Natural pine/oak-pine	2.0	0.7	1.5	4.9	4.4	3.9	3.5	3.2	3.0
Hardwood	18.5	0.7	14.6	11.2	11.6	12.0	13.0	13.8	13.3
Total	20.5	1.4	16.2	16.2	16.2	16.2	16.9	17.5	16.8

[a] Bechtold and Sheffield (1981).
[b] Brown and Thompson (1988).
[c] Brown (1996).
[d] Mills and Kincaid (1992).

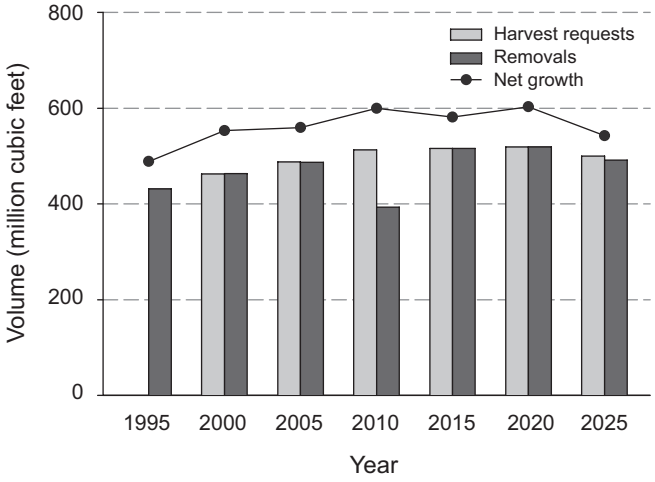

Figure 5—Projected harvest requests, removals, and net annual growth of growing stock for southern yellow pine, Florida, 1995 to 2025 (base year 1995).

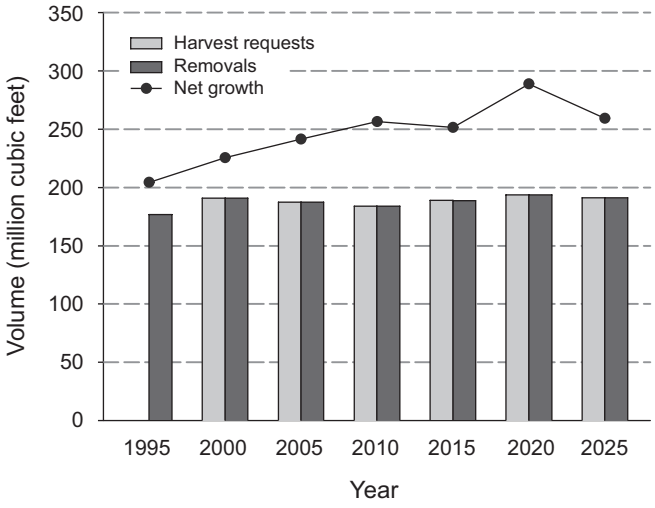

Figure 6—Projected harvest requests, removals, and net annual growth of growing stock for southern yellow pine from nonindustrial private timberland, Florida, 1995 to 2025 (base year 1995).

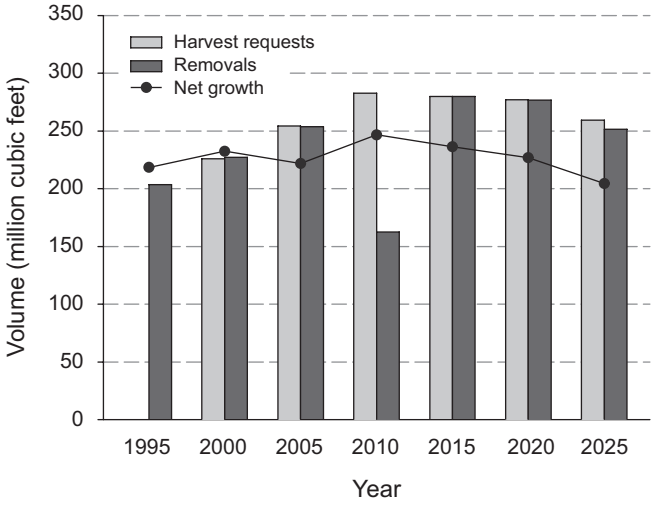

Figure 7—Projected harvest requests, removals, and net annual growth of growing stock for southern yellow pine from forest industry timberland, Florida, 1995 to 2025 (base year 1995).

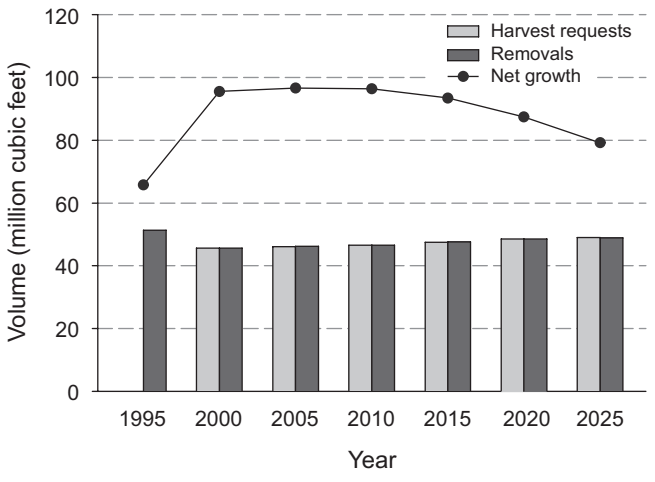

Figure 8—Projected harvest requests, removals, and net annual growth of growing stock for southern yellow pine from public timberland, Florida, 1995 to 2025 (base year 1995).

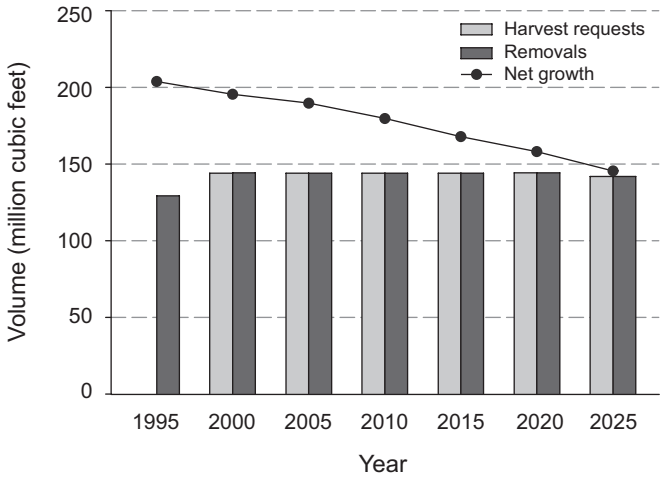

Figure 9—Projected harvest requests, removals, and net annual growth of growing stock for hardwoods, Florida, 1995 to 2025 (base year 1995).

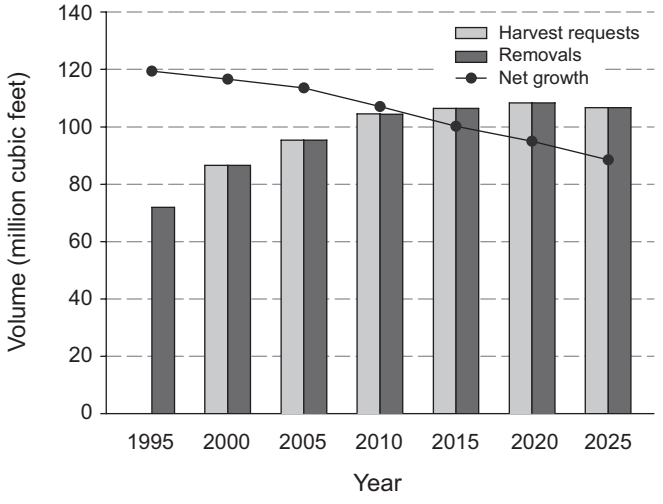

Figure 10—Projected harvest requests, removals, and net annual growth of growing stock for hardwoods from nonindustrial private timberland, Florida, 1995 to 2025 (base year 1995).

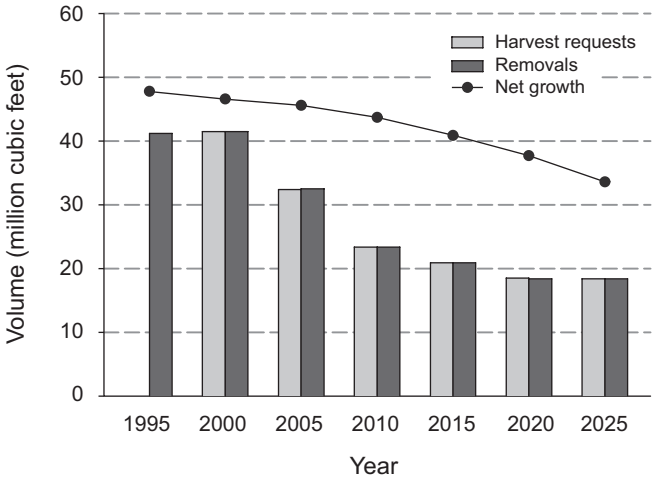

Figure 11—Projected harvest requests, removals, and net annual growth of growing stock for hardwoods from forest industry timberland, Florida, 1995 to 2025 (base year 1995).

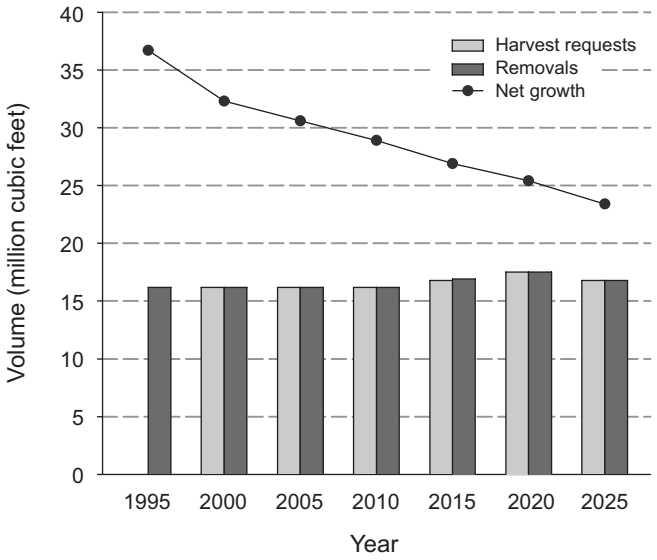

Figure 12—Projected harvest requests, removals, and net annual growth of growing stock for hardwoods from public timberland, Florida, 1995 to 2025 (base year 1995).

Projected demand for pine volume from private timberland peaks in 2020 at 193.6 million cubic feet. As the removals columns in figure 6 show, the supply of pine volume is available to meet future demand in each 5-year period. Noteworthy is the shift in annual removals from natural to planted stands (table 3). By 2025, seventy percent of the pine removals volume from NIPF land is projected to be cut from planted pine/oak-pine stands.

Throughout the 30-year simulation, net annual growth of pine on NIPF land exceeds average annual removals by a substantial margin (table 3; fig. 6). Growth-to-cut ratios for pine on NIPF land range from a low of 1.18 in 2000 to a high of 1.49 by 2020. Given the simulation assumptions and constraints, pine harvest volume from nonindustrial private timberland in Florida could be increased and sustained well into the future.

Pine removals from forest industry timberland averaged 205.7 million cubic feet per year between 1970 and 1980, including 32.6 million cubic feet (16 percent) cut from planted pine/oak-pine stands (table 4). At that time, forest industry's timber base included 2.2 million acres of planted pine/oak-pine (table 1). By 1987, planted acres increased to 2.7 million acres, and total pine removals from industry timberland rose to 211.6 million cubic feet, including 107.6 million cubic feet cut from planted stands. Acres of planted pine/oak-pine fell to 2.6 million acres in 1995, and total removals of pine declined to 203.4 million cubic feet per year. However, the decline in planted acres had little effect on removals from planted stands. Removals from planted pine/oak-pine increased to 146.3 million cubic feet per year and made up 72 percent of the current pine removals volume.

Based on regional demand projections (Haynes and others 1995), the outlook is for increased reliance on forest industry timberland for future pine harvest volume in the South. Figure 7 displays the effect this regional demand for pine harvest is projected to have on forest industry holdings in Florida. Pine removals from forest industry timberland amounted to 203.4 million cubic feet in 1995 (table 4). Pine harvest requests were projected to have totaled 225.9 million cubic feet in 2000 and were to reach 254.2 million cubic feet in the following 5-year period. Industry timberland was able to respond reasonably well to the increased demand in both cases with pine removals of 227.2 and 253.6 million cubic feet, respectively (table 4; fig. 7). This is not the case for the 2005 to 2010 projection period. The pine harvest request in 2010 is projected to average 282.6 million cubic feet annually, while annual pine removals volume from the harvestable age classes in all three management types averages just 162.6 million cubic feet. The projected shortfall in southern yellow pine removals volume discussed earlier occurs entirely on forest industry land. The annual 120 million cubic-foot shortfall amounts to a total deficit of 600 million cubic feet over the 5-year period. A smaller supply shortfall in available pine removals volume also occurs in 2025. By that year, pine harvest request volume amounts to 259.5 million cubic feet per year, while removals average 251.5 million cubic feet per year.

Although pine harvest requests are met in all other projection periods, the projected harvest request volume exceeds future pine net annual growth on forest industry timberland after the year 2000. Growth-to-cut ratios for industry's southern yellow pine resource fall to as low as 0.81 by 2025, which translates to 1.23 cubic feet of wood cut for every cubic foot of growth. These results indicate that forest industry timberland in Florida could support modest increases in pine demand, relative to the base year, but not at the levels used in our projections. Without additional acres of pine or increased management efforts to improve pine growth rates on industry timberland, the removals volume needed to supply the projected demand for southern yellow pine will have to come from NIPF land, public timberland, or sources outside the State.

The apparent surplus of pine volume on NIPF land is more than enough to make up for the possible shortfall on industry timberland projected for 2010. To make up for the 600 million cubic foot shortfall, annual removals of pine volume from NIPF timberland would have to rise from the projected 184.0 million cubic feet (table 3) to 304.0 million cubic feet for the 2010 projection period. That annual rate of removals would represent an increase of 72 percent over the base-year level of pine removals from NIPF timberland and would exceed pine net annual growth by 18 percent during this 5-year period. It would also result in a reduction of available pine removals volume from NIPF land in future projection periods.

Public timberland has typically accounted for a small percentage of Florida's pine removals volume. The 43.0 million cubic feet of pine removals from public lands in 1980 (table 5) accounted for 10 percent of the total 427.0 million cubic feet of pine removals for that survey period (table 2). Public timberland accounted for 11 percent of total pine removals volume in 1987 and 12 percent in 1995. Future harvest requests and removals of southern yellow pine volume from public timberland are expected to remain within this 11- to 12-percent range throughout the projection period. This is based on the assumption that harvesting from public timberlands will continue at recent-past levels.

Projected pine harvest requests from public timberland are shown to decline to 45.6 million cubic feet per year by 2000, down from the 51.3 million cubic feet of pine removals reported in 1995 (table 5; fig. 8). Average annual pine harvest requests remain near 2000 levels until 2015, when the request rises to 47.5 million cubic feet per year. Pine harvest requests from public timberland peak between 2020 and 2025 at 49.0 million cubic feet per year. The pine volume requested from public timberland equals roughly 10 percent of the total annual harvest request for pine throughout the projection period. Net annual growth of pine volume on public timberlands far outpaces the annual removals volume needed to meet future demand. Should the need arise to increase pine harvests to help make up the projected shortfall from other ownerships, the southern yellow pine resource on public timberland has the surplus volume available to easily respond. This assumes that any additional increase in harvesting from public timberland would not come at the expense of other management objectives.

Projections for Hardwoods

Florida's hardwood resource, as in other Southern States, is considerably underutilized with respect to timber harvesting. This is due largely to the low desirability of hardwood species and, at the time of this study, a general lack of new markets for hardwood volume. As a result, the 30-year projection of harvest requests for hardwoods shows little increase in demand over the 1995 base-year removals levels. Total hardwood harvest requests were projected to rise to 144.2 million cubic feet per year in 2000, a 12-percent increase, during the first 5-year period (fig. 9). Requests are projected to remain near this level through 2020 then decline to 141.9 million cubic feet per year over the final 5 years. Hardwood removals volume is available to meet each projected harvest request throughout the simulation.

Although total hardwood net annual growth exceeds projected harvest requests and removals in each period, the rate of hardwood net growth declines steadily (table 2; fig. 9). Growth-to-cut ratios fall from a peak of 1.6 in 1995 to a growth-equals-cut relationship by 2025. A primary force driving this possible trend in reduced hardwood net growth is the low removals levels projected for each period. The need to harvest less volume results in increased acres of hardwoods left to move into the older age classes where growth rates are comparatively slower and mortality rates higher than in younger stands. Hardwood net annual growth declines from 203.9 million cubic feet per year in 1995 to an average of 145.5 million cubic feet per year by 2025. This trend is likely to continue beyond the projection period if Florida's hardwood resource remains underutilized and continues to mature.

Projections of Hardwood Harvest Requests by Owner Group

Projections show modest but steady increases in demand for hardwood volume from NIPF land. Harvest requests rise from the 71.9 million cubic feet of removals reported in 1995 to 86.6 million cubic feet per year during the initial

projection period (fig. 10). Hardwood harvest requests from private land are expected to increase to 106.4 million cubic feet per year by 2015 and peak at 108.4 million cubic feet per year by 2020. Ample removals volume is available to readily supply all increases in demand (table 3; fig. 10). Hardwood net annual growth declines over the entire projection period, and by 2010 growth and removals are nearly equal. With each 5-year projection period, the distribution of nonindustrial private hardwood acres becomes ever more skewed toward the older age classes as fewer mature stands are cut and replaced by young, vigorous stands. As a result of the lower growth rate, hardwood removals exceed net growth over the final 15 years of the projection (table 3; fig. 10).

Hardwood removals from forest industry timberland amounted to 41.2 million cubic feet per year in 1995, down 7 percent from 1987 (table 4). Projections show a slight increase in harvest requests for hardwood volume, up to 41.5 million cubic feet per year in 2000 (fig. 11). Beyond 2000, projected requests for hardwood volume from industry timberland decline, falling to less than one-half that amount—18.4 million cubic feet per year—by 2025. Available hardwood growing-stock volume exists on forest industry timberland to easily meet all harvest requests. Projected hardwood net annual growth exceeds removals on industry timberland throughout the projection period, indicating the potential to increase hardwood harvest rates substantially, if needed. Again, there is a downward trend in the rate of net growth over the 30-year period due to higher mortality rates in over-mature hardwood stands.

Through the first 15 years of the simulation, hardwood harvest requests from public timberland remain unchanged from the 16.2 million cubic feet of annual removals reported in the base year (fig. 12). In the latter half of the projection, harvest requests from public lands rise to 16.9 million cubic feet per year by 2015 and peak at 17.5 million cubic feet annually by 2020 (see table 5). As with other ownerships, hardwood removals volume on public timberland is readily available to match projected increases in demand in each projection period. Hardwood net annual growth exceeds removals on public timberland in all periods (table 5; fig. 12), but the relationship is approaching a one-to-one ratio as losses to mortality in aging hardwood stands offset an increasingly larger proportion of total stand growth.

Impacts on Growing-Stock Volume

As each simulation is run, ATLAS tracks the growth-to-removals relationships and reports the effect they have on levels of growing-stock volume. Overall, total growing-stock volume for all ownerships combined is projected to increase over the 30-year simulation. The increase occurs despite the future loss of timberland acres to other uses and the expected increases in removals in response to increased harvest request volume. Combined hardwood and softwood growing-stock volume rises from 15.4 billion cubic feet in base year 1995 to a total of 18.6 billion cubic feet by 2025 (table 2). Southern yellow pine growing stock increases by 41 percent, amounting to 9.8 billion cubic feet by the end of the projection. Hardwood volume rises only 5 percent over the simulation and totals 8.8 billion cubic feet by 2025. The modest increase in hardwood inventory reflects the higher mortality rates and resulting lower net annual growth.

Among ownership groups, southern yellow pine volume is expected to increase on NIPF land and public timberland but is projected to decline on forest industry timberland after 2010. The 2.9 billion cubic feet of pine growing-stock volume on NIPF land in 1995 grows to 3.7 billion cubic feet by 2010 and peaks at 4.8 billion cubic feet by 2025 (table 3; fig. 13). The increase on public timberland is also substantial as pine volume rises 68 percent, from 2.0 billion cubic feet in 1995 to 3.3 billion cubic feet in 2025 (table 5; fig. 13).

Pine growing stock on industry timberland increases 14 percent during the first half of the projection period, rising from 2.1 billion cubic feet in the base year to 2.4 billion cubic feet by 2010. The volume decline after that year is to be expected. Figure 7 shows that the pine removals volume from industry timberland cut to meet projected harvest requests exceeds net growth over virtually the entire simulation. The result is a drop in pine growing-stock volume on forest industry timberland after 2010 (table 4; fig. 13). By 2025, pine growing-stock volume on forest

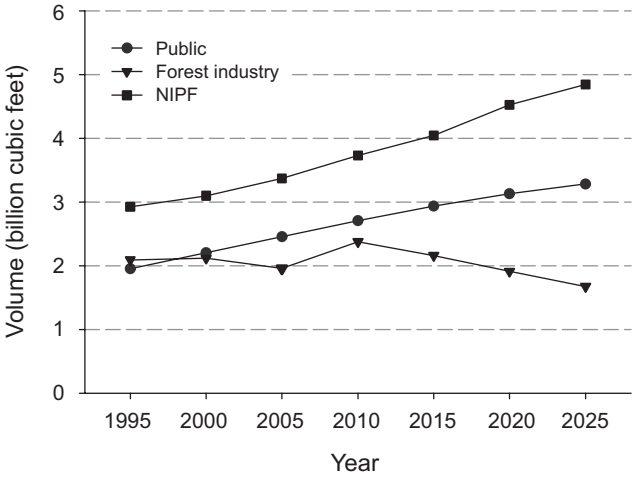

Figure 13—Projected softwood growing-stock volume by owner group, Florida, 1995 to 2025 (base year 1995). NIPF = nonindustrial private forest.

industry timberland is projected to be less than one-half that on public land (fig. 13). Nearly one-third of the southern yellow pine volume in Florida will be on public timberland within the next 20 to 25 years. With current constraints and possible future limits on harvesting from public timberland, the availability of such a large portion of Florida's total pine volume is questionable.

The future shift toward more acres in planted pine/oak-pine brings an accompanying increase in the proportion of total pine growing-stock volume on planted acres. Florida, much like other Southern States, will be increasingly dependent on pine plantations for future pine removals volume. In 1995, the 2.8 billion cubic feet of pine volume in planted pine/oak-pine stands (table 2) accounted for 40 percent of the total southern yellow pine growing stock statewide. As of 2000, pine growing stock on planted acres accounted for 53 percent of the total pine inventory, or 3.9 billion cubic feet. In another 10 years, it increases to 64 percent and remains there through 2025. Pine volume on planted acres is projected to account for 6.3 billion of the 9.8 billion cubic feet of pine growing stock by 2025.

A concurrent trend shows less pine volume coming from natural stands. Growing-stock volume from natural pine/oak-pine stands for all owners accounted for 54 percent of the total pine inventory volume in 1995. From the 3.8 billion cubic feet present in 1995, it is projected to decline by 709.6 million cubic feet in the first 5 years (table 2). The downward trend continues through 2010, when pine volume in natural stands reaches a low of < 2.7 billion cubic feet. By 2025, natural pine/oak-pine stands are projected to account for 3.0 billion cubic feet, or just 31 percent of the total pine growing stock in Florida.

Projections show hardwood growing-stock volume will increase on public and forest industry timberland acres, albeit very slowly. Hardwood growing-stock volume for each owner group rises from 1.9 billion cubic feet in 1995 to about 2.2 billion cubic feet by 2025 (tables 4, 5; fig. 14). On NIPF land, hardwood growing-stock volume peaked at 4.7 billion cubic feet in 2005, then declines to 4.4 billion cubic feet in the final years of the projection (table 3; fig. 14).

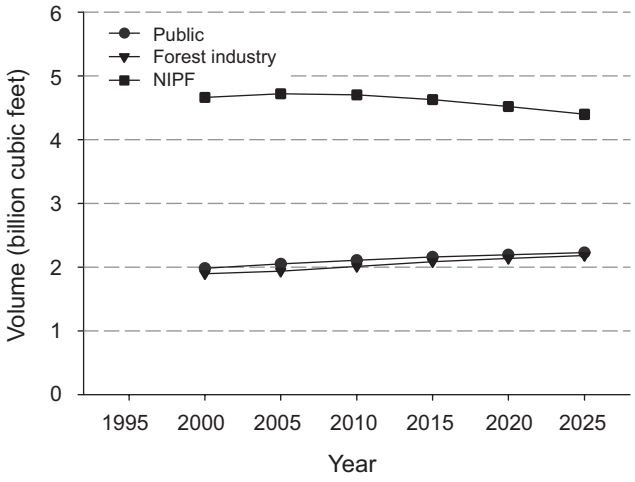

Figure 14—Projected hardwood growing-stock volume by owner group, Florida, 1995 to 2025 (base year 1995). NIPF = nonindustrial private forest.

Discussion

The demand for wood in the United States is likely to increase over the foreseeable future. Based on results from the 1993 timber update (Haynes and others 1995) and the more recent Southern Forest Resource Assessment (Wear and Greis 2002), the South probably will be expected to supply more wood fiber. Using the ATLAS timber projection model, we have considered the current (1995) timber resource situation in Florida and, based on projected increases in demand, analyzed the State's ability to produce and provide more wood over a 30-year period. FIA's recently implemented annual inventory system will provide new data to update model inputs and assumptions, making it possible to closely monitor Florida's timber situation on an ongoing basis. The results we have presented, combined with results from planned ATLAS simulations for the other Southern States, will help stakeholders predict how well the South will be able to respond to changing regional and nationwide demands.

Maintaining an available timber base is a key factor in Florida's ability to meet increased timber supply demands in the future. The State's area of forest land is projected to lose 839,000 acres over the next few decades, falling to 13.8 million acres by 2025. Much of the decline in Florida's forest area is due to urbanization on private land. We used estimates of forest land loss documented by the most recent (1995) FIA survey showing changes in area since 1987. However, decade-old land use change estimates do not accurately capture recent increased rates of loss due to urbanization. Therefore, model results likely underestimate future reductions in forest land. Wear (2002) forecast losses of forest land Southwide totaling 12 million acres between 1992 and 2020, and much of this loss will occur in Florida and other Coastal States due to urbanization. In addition, changing social demands concerning how the state's forests should be managed and what amenities they should provide could reduce timber availability as well.

Changing ownership patterns further complicate timber production and availability projections. The majority of Florida's forest land is under NIPF ownership, and these private acres historically have been the source for much of the wood volume harvested in the State. There will be fewer acres of NIPF timberland from which to harvest this volume in the future, as projections show a decline from the reported 7.2 million acres in 1995 to 6.5 million in 2025. Further declines in NIPF forest land could necessitate a shift in harvesting toward other ownerships or to sources outside the State.

Timberland owned by forest industry also is expected to decline but by just 100,000 acres, to 4.5 million acres by 2025. However, recent evidence reveals that this projected rate of loss may not accurately portray future reductions in forest industry land. An emerging trend in the South is the transfer of forestry industry land to private landowners and, more often, to investment corporations such as timber investment and management organizations (TIMOs) or real estate investment trusts (REITs). The 1995 survey data for Florida used in our projections captured some of this redistribution of forest land as industry landholdings in the State fell from the 5.4 million acres reported in 1987 to 4.6 million as of 1995. Future reductions may be even greater if changes in Florida's industry timberland follow those revealed by more recent surveys of other Southern States. It is uncertain at this point whether forest land held by TIMOs and REITs will continue to be managed for timber production or removed from the timber base for other uses. In any event, monitoring changes in forest industry ownership and analysis of the impacts these changes might have will be assessed as new annual inventory data become available.

Public timberland area remains relatively unchanged over the projection period. Past survey data indicate that public agencies in the State typically neither acquire nor lose substantial areas of forest land. Public lands play a relatively small role in Florida's timber supply dynamics at this time, and projection results suggest that this will continue to be the case in the near future.

Change in forest management type, specifically shifts from natural to planted stands, is another key to monitoring potential timber supply. Our projections for Florida's pine resource show an eventual predominance of planted pine stands as natural stands are harvested and artificially regenerated. By 2025, total planted pine/oak-pine acres combined are projected to exceed the area of natural pine by a margin of more than 2 to 1, and net growth on planted stands will outpace that of natural stands by a 4-to-1 margin. As this occurs, more of the volume needed to meet increased future demand for wood will come from artificially regenerated stands. Florida's southern yellow pine total growing-stock volume rises from < 7.0 billion cubic feet in 1995 to 9.8 billion by 2025 (table 2). Over the same time, the pine inventory on planted pine/oak pine acres rises from 2.8 billion cubic feet (40 percent of total pine volume) to 6.3 billion (64 percent of total pine volume) due primarily to the higher rates of growth in planted stands. By 2025, 70 percent of the pine removals volume from NIPF land is projected to be cut from planted pine/oak-pine stands.

Pine net growth under all owners exceeds removals throughout the projection. The increased growth and the gains in total pine inventory (from 6.9 billion cubic feet to 9.8 billion over the projection) enable Florida's pine resource to respond to future increases in demand. Although a shortfall of pine volume is projected to occur on forest industry timberland in the near term (fig. 7), increasing harvests from other ownerships, notably NIPF land, could more than make up for any projected shortage. Sources elsewhere in the South, though not considered in this analysis, also could compensate for the shortfall.

Forecast changes for Florida's hardwood area show declines for all ownerships, down 17 percent to 4.8 million acres by 2025. The decline in hardwood acres is greatest for NIPF owners, but this group still controls the majority of the resource throughout the projection. Hardwood timberland area for other owner groups declines slightly. Despite the projected loss of hardwood timberland area to other land uses, our simulation results show that Florida's hardwood timber resource could easily sustain or even increase removals from growing stock over the next 2 to 3 decades.

Our data suggest that the State's hardwood resource is underutilized—a situation that reduces future productivity due to increased mortality and declining net growth in aging hardwood stands. Based on past removals levels, we projected nearly constant demand for hardwood volume over the 30-year period. This continued low utilization of hardwood volume skews the distribution of hardwood acres toward the older stand age classes. As a result, the decline in net growth continues to the point where hardwood removals outpace net growth for all ownerships combined by the end of the projection. The decline in productivity results in a smaller increase in future hardwood inventory (only a 5 percent increase over 30 years). Reversing this situation calls for increased management and utilization of Florida's hardwood resource. An apparent lack of diversified markets for hardwoods, however, seems to be a factor currently limiting increased investment in hardwood management. Again, the age of the base-year data (1995) is problematic in that it does not capture trends or changes in demand for

hardwood volume occurring over the past decade or changes in hardwood management that may result. Therefore, tracking the dynamics of Florida's timber industry, including changes in utilization standards and creation of markets for new products, is key to accurately projecting both hardwood and softwood timber supply. Updating the ATLAS model with new annual inventory data will greatly improve future projections.

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The demand for wood fiber nationwide is expected to increase in the foreseeable future. Harvesting restrictions on forest lands in the West have increased pressure on the South's forest resources to provide more wood. The ability of Florida and other Southern States to respond is uncertain. The authors describe the current extent, condition, and availability of Florida's timber resource and project levels of growing-stock volume, net annual growth, and annual removals to the year 2025. They base those projections on future timber demand, as represented by harvest requests. The extent of the State's timber resource is determined by 1995 estimates of forested acres and by the rate at which acres are being added or removed from the timber base due to natural or human-caused activities. Forest condition is represented by annual rates of growth and mortality and their combined effect on levels of timber volume. Timber availability is largely dictated by ownership and, for the purposes of this paper, by the age of forest stands. Future timber harvest requests for Florida are derived from projections of estimated removals throughout the South as documented in the 1993 Resources Planning Act report. The Aggregate Timberland Assessment System (ATLAS) was the model used to project future estimates of growing stock, net growth, and removals in response to increased harvest requests. Overall, projections suggest that Florida is well positioned to meet increased demand for wood, in spite of an expected shortfall of available southern yellow pine volume on forest-industry timberland by 2010. However, crucial factors influencing future timber availability in Florida are retaining the current timber base and working with ever-changing public sentiments about forest-management practices.

Keywords: ATLAS simulations, FIA, final harvest, forest industry, forest-management types, harvest scenarios, nonindustrial private owners, partial cutting, public, timber projections, yield tables.

The Forest Service, United States Department of Agriculture (USDA), is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.