United States
Department of
Agriculture

Forest Service

Southeastern Forest
Experiment Station

Resource Bulletin
SE-143

Incidence and Impact of Damage to and Mortality Trends of Florida's Timber, 1987

Elizabeth A. Brantley, Clair Redmond, and Michael Thompson

The Authors:

Elizabeth A. Brantley is Pathologist, Southern Region, Forest Health, Asheville, NC; **Clair Redmond** is Economist, Southern Region, Planning & Budget, Atlanta, GA; and **Michael Thompson** is Forester, Southeastern Forest Experiment Station, Forest Inventory and Analysis, Asheville, NC.

March 1994

Southeastern Forest Experiment Station
P.O. Box 2680
Asheville, North Carolina 28802

The Authors:

Elizabeth A. Brantley is Pathologist, Southern Region, Forest Health, Asheville, NC; **Clair Redmond** is Economist, Southern Region, Planning & Budget, Atlanta, GA; and **Michael Thompson** is Forester, Southeastern Forest Experiment Station, Forest Inventory and Analysis, Asheville, NC.

March 1994

Southeastern Forest Experiment Station
P.O. Box 2680
Asheville, North Carolina 28802

Foreword

The Southeastern Forest Experiment Station, headquartered in Asheville, NC, periodically inventories and evaluates forest resources in Florida, Georgia, North Carolina, South Carolina, and Virginia. The Southern Region, Forest Health Staff unit, provides training, field support, and evaluation of the data on forest insects, diseases, and other damaging agents.

The forest damage information presented here was gathered during the fifth and sixth inventories of Florida's forest resources. More information was gathered in the latest inventory than in previous ones. This information makes it possible to estimate damage incidence and trends in mortality.

This Bulletin describes damage incidence and mortality trends, but does not recommend specific prevention measures. Residents of Florida who need technical assistance with forestry problems on State and private land should contact:

State Forester
Florida Division of Forestry
3125 Conner Boulevard
Tallahassee, FL 32699

Abstract

In 1987, Florida had 15.0 million acres of timberland, containing 20 billion cubic feet of timber. Approximately 190 million cubic feet of timber were lost annually to mortality and cull between 1980 and 1987. The annual cost of this loss was $78.1 million. Among broad management classes–pine plantation, natural pine, oak-pine, upland hardwoods, and bottomland hardwoods–the greatest loss occurred in bottomland hardwood stands. Approximately half of the loss occurred in nonindustrial private forests. Fusiform rust caused the greatest damage to pines, but weather and logging activities also caused serious volume losses. Hardwood borers and basal defects were the most significant causes of damage in sawtimber-size hardwoods. Increases in hardwood and softwood sawtimber mortality occurred across all management classes between 1980 and 1987.

Keywords: Insect damage, disease damage, fusiform rust, bark beetles, forest insects, forest diseases.

Incidence and Impact of Damage to and Mortality Trends of Florida's Timber, 1987

Elizabeth A. Brantley, Clair Redmond, and Michael Thompson

Forest Inventory and Analysis (FIA) crews surveyed Florida's forests in 1980 (fifth survey) and 1987 (sixth survey), and recorded damage to and mortality of sample trees. Damaging agents and causes of mortality were identified where possible. This Bulletin reports conditions observed during the sixth survey, the associated costs, and changes in mortality between the two surveys. It was not possible to directly compare damage trends between the two surveys because new damage categories were added in the sixth survey.

Inventory Procedures

Inventory procedures have been described in detail by the USDA Forest Service (1985). Some of them influence the kinds of information that can be compiled and the ways in which data can be interpreted. This Bulletin explains procedures and definitions that affect the understanding of survey results.

In each inventory, plots are visited only once, and the visit may take place at any time of year. Records, therefore, are kept only for damaging agents that produce symptoms or signs in all seasons. The agents or damage must be easily identified, and trees must be at least 1 inch in diameter at breast height (d.b.h.) to be included in the survey. Effects of seedling diseases (for example, brown-spot needle blight of longleaf pine) and of hardwood defoliation (which is not apparent in winter) are not included in this survey. On the basis of these limitations, the following damaging agents were recognized in the 1987 survey:

Insects
- Bark beetles
- Hardwood borers
- Other insects

Fire

Animals
- Beaver
- Sapsucker

Weather
- Flooding
- Lightning

Diseases
- Basal defects
- Branch stubs
- Fusiform rust
- Other rusts
- Hardwood cankers
- Littleleaf disease
- Root rots
- Other diseases

Other damaging agents
- Dieback
- Form (damaging)
- Damage caused by people
- Suppression and stagnation
- Turpentining
- Logging and related

The "Definitions" section of this Bulletin describes the signs and symptoms associated with these categories.

Forest Health trained the crews in the use of a Damage Identification Handbook prior to the field survey. During the survey, data collected by the crews were field-checked to ensure accuracy and consistency. Crew members also received specimen kits and forms to aid in identifying types of damage. It is important, however, to recognize that the data reported here were gathered by people experienced in forest inventory rather than by entomologists and pathologists.

Three factors cause the incidence and impact data to be understated. First, as explained previously, certain types of damage, such as that by hardwood defoliators, are excluded. Second, the damage caused by some agents, such as root-decay organisms, is extremely difficult to identify. Third, some damaging agents, such as southern pine beetles, cause trees to die rapidly, and inventory crews viewing the trees up to 7 years later may be unable to determine the cause of death. As a result, mortality estimates are accurate, but the numbers of deaths that can be attributed to specific agents are underestimated.

In spite of these problems, data reported here are important. They show that losses are significant, and they may help managers to plan forest protection programs.

Sampling Procedures

The inventory employs a sampling procedure designed to provide reliable statistics primarily for the entire State, for large groups of counties, and for tree species with relatively large total volumes in the State. Accordingly, errors associated with relatively minor species like American beech exceed those for major species like slash pine. Procedures are documented in "Florida's Forests" (Bechtold and others 1990).

Computations

Tree-size categories were: 1.0 to 5.0 inches d.b.h. for saplings; 5.0 to 9.0 inches d.b.h. for softwood poles; 5.0 to 11.0 inches d.b.h. for hardwood poles; 9.0 inches d.b.h. and above for softwood sawtimber; and 11.0 inches d.b.h. and above for hardwood sawtimber.

Merchantable and total cubic volumes were estimated with volume prediction equations. These equations were generated from volume measurements of standing and felled trees in Florida and from similar measurements of other trees throughout the Southeast.

Symptoms used to identify the causes of damage to living trees on the sample plots are described in the "Definitions" section. The percentage of incidence and the volume of cull associated with each damage class were determined for each species. Damage entries do not imply total-tree loss. The volume loss was determined by totaling the volume of cull associated with each damaging agent, by species. Only a part of the volume lost (due to cull) would fail to qualify for firewood or other commercial uses.

Although mortality of individual trees often could not be attributed to a specific agent, the volume loss from mortality was accurate for each tree species on each plot. By using total mortality by tree species, it was possible to calculate total volume loss for poles and sawtimber by species.

This Bulletin presents mortality and cull losses in both tabular and graphic form. Volumes and values of loss are given for each class of ownership (National Forest, other public, forest industry, and nonindustrial private) and broad management class (natural pine; pine plantation; oak-pine; and upland and bottomland hardwoods).

To estimate the value of the loss, an average age of harvest was calculated from FIA "removal" data by age, ownership, and species category. For each age class and type of loss, FIA volume loss data (in thousands of cubic feet) were converted to volumes per acre and "grown" to the assumed rotation age, based on the growth factors provided in tables 3.15-3.20 in "The South's Fourth Forest: Alternatives for the Future" (USDA Forest Service 1988). This process treats each age and ownership class as a group of acres in that class and estimates future volume affected by mortality with species-growth factors. Because large areas are involved, estimation of volume growth is not very precise. It was assumed that overestimates of volume due to the slow growth of trees in fully stocked stands are canceled by underestimates of volume in trees of a particular age class in understocked stands.

If the age class for volume loss was greater than the assumed rotation age, then growth was not calculated; it was assumed that the damaged trees could be harvested immediately. The resulting future harvest volumes were converted to board feet and cords with divisor factors of 200 cubic feet per thousand board feet and 90 cubic feet per cord.

Average statewide stumpage prices for the species and year of the FIA survey were taken from Timber Mart-South (Norris 1987) and increased from the year of the survey to 2030 by the real rates of increase for hardwood and softwood stumpage estimated in "The South's Fourth Forest: Alternatives for the Future." No further real increase in stumpage was assumed to occur after 2030. The resulting future stumpage values were multiplied by the estimated harvest volumes at rotation age.

All ownership classes except forest industry were assumed to have only a sawtimber product at rotation age. For forest industry land, a proportion of the softwood volume less than 25 years old and hardwood volume less than 30 years old was considered to be pulpwood.

Each age class future value was discounted to the present at a 4-percent real rate of interest and a time factor that equaled the difference between the assumed rotation age and the age class. Values of loss are based on an assumption that there would be a market available for the lost timber.

The analysis excluded timber on steep slopes where the cost of logging may be prohibitive. Thus, expected volume losses are conservative in all categories. Timber was assumed to have value only in areas where logging is

economically feasible. Furthermore, the analysis ignored the possibilities of ingrowth resulting from trees dying and accelerated growth of residual stems caused by mortality.

Total volumes and present values for mortality and cull loss were estimated for the 7.7 years between remeasurements. The annuity amount was calculated for the present value of loss over the 7.7 years to convert to an annual basis.

Mortality can be assumed to have occurred between surveys; however, cull loss is often a cumulative volume, and incremental loss between survey periods cannot be estimated until two survey periods are compared. For Florida, methods used for the fifth and sixth survey periods do not allow direct comparisons between the surveys. Data exhibited in the "Economic Losses" section are based on annual averages.

Results

In 1987, Florida had 15.0 million acres of timberland–4 percent less than in 1980. The survey results are presented in detailed tables that report mortality and cull by broad management class, ownership class, predominant tree species, and damaging agent. Interpreting some of the numbers presented in these tables requires information on forest acreage by broad management class and forest type. Removal figures will not equal the reported State totals, because the removals in this report do not include land clearing or timberland reclassified to reserved status. Similarly, the mortality figures will not equal the reported State totals because of rounding discrepancies. This information is provided for each management class. The following results are presented by broad management type.

Pine Plantation

Figure 1 shows the distribution of pine plantation plots across Florida. Between surveys, the aren of pine plantation increased from 3.3 to 4.0 million acres (fig. 2). Increases in pine plantation acreage are attributable to planting on former farmland and to the conversion of harvested stands of various types to plantations.

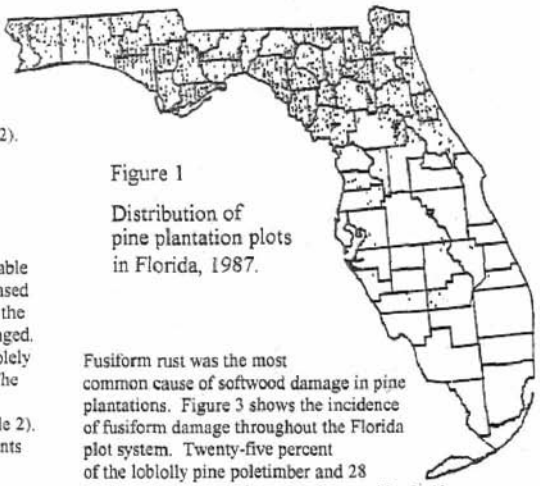

Figure 1

Distribution of pine plantation plots in Florida, 1987.

The total population of trees in the pine plantation management class increased between 1980 and 1987 (table 1). In 1987, the percentage of trees with damage increased with tree size: 12 percent of the saplings, 15 percent of the poletimber, and 18 percent of the sawtimber were damaged. The volume of associated cull is that which is caused solely by damaging agents that result in cubic or form cull. The associated cull volumes were 407,000 cubic feet for poletimber and 2,328,000 cubic feet for sawtimber (table 2). The large volume of cull associated with damaging agents in the sawtimber category is probably due to the high amount of fusiform rust reported in 1987 (table 3).

Table 3 shows the percentage of trees damaged in the pine plantation management class, by predominant tree species and type of damage. A type of damage was entered in the table if at least 5 percent of the trees in one of the size classes had that type of damage. Form damage, suppression, and stagnation were excluded from table 3 because they seldom indicate a serious problem. In a dense stand, some suppression of overtopped trees should be expected.

Fusiform rust was the most common cause of softwood damage in pine plantations. Figure 3 shows the incidence of fusiform damage throughout the Florida plot system. Twenty-five percent of the loblolly pine poletimber and 28 percent of the sawtimber were damaged by fusiform rust. Ten percent of the sand pine sawtimber trees suffered from diseases other than fusiform rust. These diseases included eastern gall rust and heart rot (Burns and Honkala 1990).

Table 4 shows annual removals and mortality, by tree species, for the pine plantation management class for 1980 and 1987. Increases in poletimber and sawtimber removals of all major tree species occurred between surveys. A significant amount of mortality in the poletimber population may be attributed to beetle outbreaks.

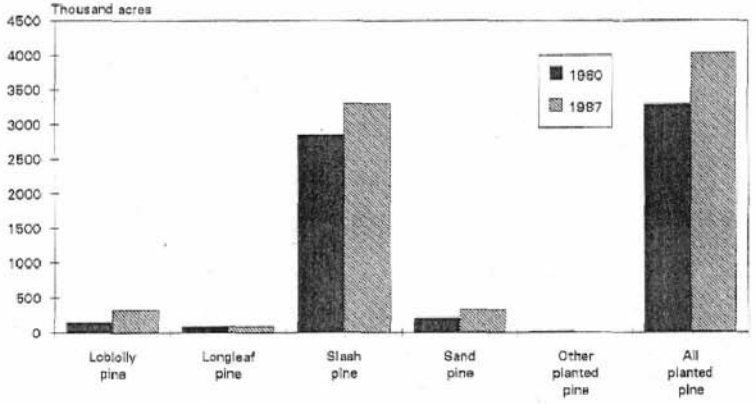

Figure 2–Distribution of timberland in pine plantation, by predominant tree species, in Florida, 1980 and 1987.

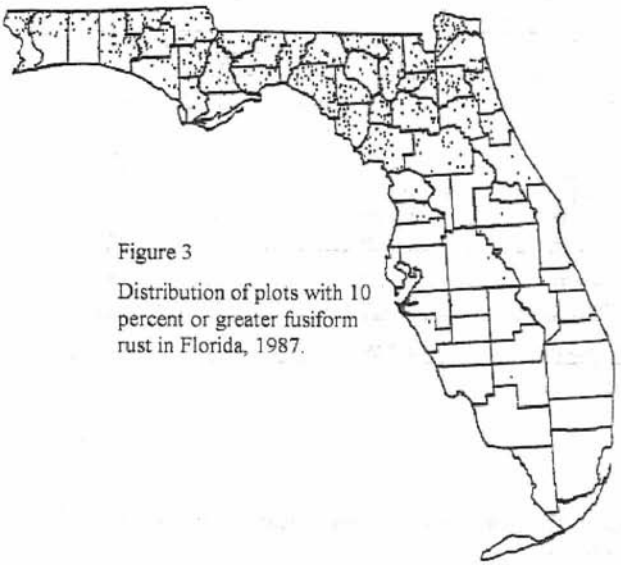

Figure 3

Distribution of plots with 10 percent or greater fusiform rust in Florida, 1987.

Table 1–Total-tree population and percentage of susceptible all-live trees damaged, by broad management class and tree size, in Florida, 1987

Management class	Total population		Trees damaged		
	1980	1987	Saplings	Poletimber	Sawtimber
	Thousands of trees		---------- *Percent* ----------		
Pine plantation	1,588,004	1,789,006	12	15	18
Natural pine	1,669,271	1,256,208	16	13	16
Oak-pine	811,336	671,933	14	20	25
Upland hardwoods	1,017,882	853,551	16	27	37
Bottomland hardwoods	3,236,226	2,941,148	14	22	28
Total	**8,322,719**	**7,511,846**	**14**	**19**	**24**

Table 2–Number of all-live trees, total volume, and cull volume in pine plantation, by predominant tree species, in Florida, 1987

Tree species	Number of trees	Total volume	Cull volume	
			Poletimber	Sawtimber
	Thousand	*Thousand cubic feet*		
Loblolly pine	88,395	106,459	--	23
Longleaf pine	32,939	82,282	--	65
Slash pine	1,105,609	1,724,226	185	194
Sand pine	162,246	102,502	56	--
Other softwoods	7,004	3,826	--	122
Total softwoods	1,396,193	2,019,295	241	404
Total hardwoods	392,813	59,959	166	1,924
All trees	**1,789,006**	**2,079,254**	**407**	**2,328**

Table 3–Incidence of damage in pine plantation, by predominant tree species and type of damage, in Florida, 1987

Tree species and damage	Trees damaged		
	Saplings	Poletimber	Sawtimber
		Percent	
Loblolly pine			
Fusiform rust	13	25	28
Longleaf pine			
Logging & related	0	0	5
Slash pine			
Fusiform rust	7	10	11
Sand pine			
Other diseases	3	4	10
Weather	1	4	7
Total softwoods			
Fusiform rust	6	10	11
Total hardwoods			
Hardwood borers	1	6	0
Basal defects	0	1	11
Dieback	0	2	7
Logging & related	1	6	8

Table 4–Annual poletimber and sawtimber removals and mortality in pine plantation, by predominant tree species, in Florida, 1980 and 1987

Tree species	Poletimber		Sawtimber	
	1980	1987	1980	1987
	Hundred cubic feet			
	Removals			
Loblolly pine	12,690	30,349	3,726	18,545
Longleaf pine	18,608	19,982	12,941	38,958
Sand pine	8,049	43,846	--	2,998
Slash pine	452,063	1,435,606	44,595	260,655
Other softwoods	1,589	1,020	682	2,204
All softwoods	**492,999**	**1,530,803**	**61,944**	**323,360**
	Mortality			
Loblolly pine	2,663	3,033	--	3,187
Longleaf pine	--	608	--	2,222
Sand pine	3,571	5,486	--	815
Slash pine	49,186	91,028	--	4,701
Other softwoods	--	1,636	1,063	655
All softwoods	**55,420**	**101,791**	**1,063**	**11,580**

Natural Pine

Figure 4 shows the distribution of natural pine plots in Florida. Between surveys, the area of natural pine decreased from 4.5 to 3.5 million acres (fig. 5). Part of the decrease in natural pine acreage may be attributed to urbanization. Some areas were cleared of trees and some were reclassified as woodland rather than as timberland (Bechtold and others 1990).

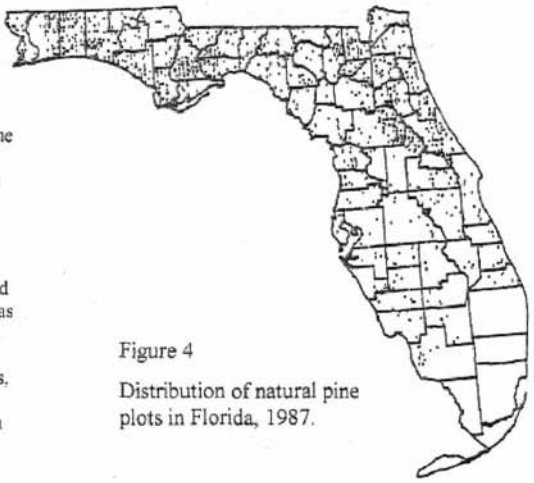

Figure 4

Distribution of natural pine plots in Florida, 1987.

In 1987, 12 percent of the saplings, 13 percent of the poletimber, and 16 percent of the sawtimber were reported with damage (see table 1). The associated cull volume was 1,399,000 cubic feet for poletimber and 6,925,000 cubic feet for sawtimber. Table 5 shows the predominant tree species in natural pine stands and their numbers, volumes, and cull volumes. Most of the damage to softwood sawtimber may be attributed to fusiform rust, as shown in table 6.

Table 6 shows the percentage of trees damaged in the natural pine management class, by predominant tree species and type of damage. Twenty-six percent of the spruce pine sampled population was reported as damaged by weather in 1987. Assuming the damage was in the form of breakage, the weather conditions involved were probably high winds during storms or ice.

Table 7 shows the annual removals and mortality, by predominant tree species, for the natural pine management class for 1980 and 1987. Decreases in softwood poletimber removal were reported. There was an increase of 55 percent in removal of all softwood sawtimber. Softwood poletimber mortality decreased, while hardwood poletimber mortality increased by 48 percent. Softwood sawtimber mortality increased by 64 percent, with slash pine contributing a substantial amount. No specific damaging agents met the threshold for listing under slash pine sawtimber in table 6, but the increase in mortality is probably attributable to bark beetle activity and root disease. Hardwood sawtimber mortality increased by 51 percent.

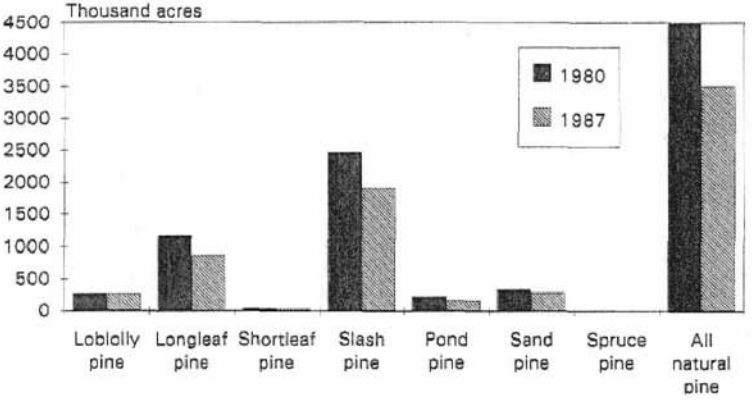

Figure 5–Distribution of timberland in natural pine, by predominant tree species, in Florida, 1980 and 1987.

Table 5–Number of all-live trees, total volume, and cull volume in natural pine, by predominant tree species, in Florida, 1987

Tree species	Number of trees	Total volume	Cull volume	
			Poletimber	Sawtimber
	Thousand	*Thousand cubic feet*		
Loblolly pine	63,448	316,129	24	133
Longleaf pine	106,046	913,428	--	915
Shortleaf pine	7,527	51,294	--	--
Slash pine	425,345	1,737,461	85	718
Spruce pine	781	1,962	--	--
Pond pine	26,177	121,015	43	242
Other softwoods	141,257	364,794	521	878
Total softwoods	770,581	3,506,083	673	2,886
Total hardwoods	485,627	269,339	726	4,039
All trees	**1,256,208**	**3,775,422**	**1,399**	**6,925**

Table 6–Incidence of damage in natural pine, by predominant tree species and type of damage, in Florida, 1987

Tree species and damage	Trees damaged		
	Saplings	Poletimber	Sawtimber
		Percent	
Loblolly pine			
Fusiform rust	13	13	23
Shortleaf pine			
Bark beetles	0	4	5
Logging & related	0	3	5
Spruce pine			
Weather	26	0	0
Pond pine			
Fusiform rust	3	4	15
Total softwoods			
Fusiform rust	4	3	5
Total hardwoods			
Basal defects	0	1	9
Fire	2	4	5

Table 7–Annual poletimber and sawtimber removals and mortality in natural pine, by predominant tree species, in Florida, 1980 and 1987

Tree species	Poletimber		Sawtimber	
	1980	1987	1980	1987
	Hundred cubic feet			
	Removals			
Loblolly pine	50,705	28,145	107,747	146,731
Longleaf pine	156,458	142,795	315,162	392,931
Pond pine	24,968	23,762	27,953	38,643
Sand pine	26,230	48,097	13,920	35,919
Shortleaf pine	--	4,434	956	10,716
Slash pine	501,842	411,472	406,724	706,766
Spruce pine	--	--	--	17,649
Pondcypress	1,972	2,938	2,633	9,575
Blackgum (bottomland)	917	4,717	2,261	--
Loblolly-bay	--	3,440	--	1,175
Red maple	--	3,057	--	1,330
Sweetbay	--	3,051	--	--
Sweetgum	787	2,202	2,697	1,023
Laurel oak	1,442	1,567	2,214	702
Southern red oak	--	--	887	682
Water oak	2,600	1,442	--	1,343
Scrub oak	--	1,535	--	387
Other softwoods	--	366	--	693
Other hardwoods	559	4,373	3,562	6,585
All softwoods	**762,175**	**662,009**	**875,095**	**1,359,623**
All hardwoods	**6,305**	**25,384**	**11,621**	**13,227**
	Mortality			
Loblolly pine	4,644	5,842	10,388	28,770
Longleaf pine	17,761	12,373	27,028	41,904
Pond pine	3,907	10,887	7,924	13,877
Sand pine	39,590	24,510	5,998	20,394
Shortleaf pine	5,162	1,567	3,992	1,889
Slash pine	73,248	59,834	63,428	90,142
Spruce pine	368	--	--	--
Pondcypress	3,762	1,342	2,078	942
Blackgum (bottomland)	4,316	1,825	1,617	1,340
Loblolly-bay	475	5,213	--	471
Red maple	1,908	733	1,209	--
Sweetbay	623	1,532	--	863
Sweetgum	3,375	738	814	564
Laurel oak	518	2,264	1,753	2,071
Southern red oak	436	626	1,665	1,674
Water oak	466	1,906	1,599	2,217
Scrub oak	3,740	12,073	995	2,239
Other softwoods	--	--	--	688
Other hardwoods	2,919	876	325	3,610
All softwoods	**148,442**	**116,355**	**120,836**	**198,606**
All hardwoods	**18,776**	**27,786**	**9,977**	**15,049**

Oak-Pine

Figure 6 shows the distribution of oak-pine plots in Florida. Between surveys, oak-pine acreage decreased by 15 percent (Bechtold and others 1990). Loss of oak-pine acreage is attributed to urbanization and reclassification from timberland to woodland. These changes must be considered when removal and mortality totals in the two surveys are compared.

There were 1,424,133 acres of oak-pine in 1980, compared with 1,210,769 in 1987. The decrease in acreage corresponded with a decrease in the total-tree population over the survey period. In 1987, the percentage of trees with damage increased with tree size: 14 percent of the saplings, 20 percent of the poletimber, and 25 percent of the sawtimber trees were damaged. Table 8 shows the number of trees and volumes of associated cull, by predominant softwood tree species. Much of the damage reported for hardwood sawtimber is attributable to basal defects (table 9).

Table 9 shows the percentage of trees damaged in the oak-pine management class, by predominant tree species and type of damage. No damaging agent contributed enough to the total softwood population to be included in this table (greater than 5 percent for inclusion). Basal defects were reported on 10 percent of the hardwood sawtimber trees in the oak-pine management class. However, high amounts of fusiform rust were recorded across all size classes of loblolly pine, and weather-related damage was present on 19 percent of the shortleaf pine sawtimber trees sampled. Shortleaf is susceptible to breakage in heavy storms (including ice and wind).

The oak-pine management class had increases in all removals and mortality between surveys, except for softwood poletimber (table 10). Mortality increased by 73 percent for the softwood sawtimber and by 58 percent for the hardwood sawtimber.

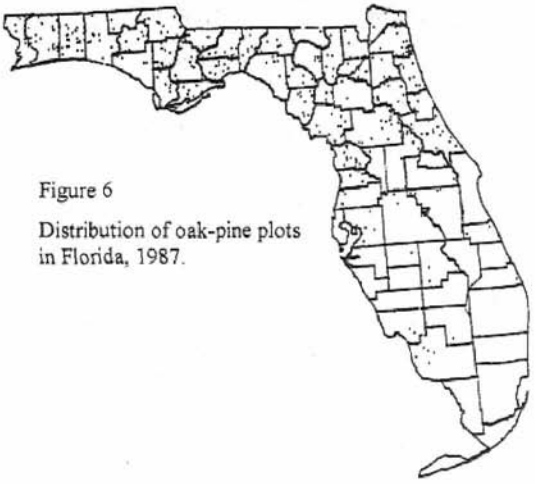

Figure 6

Distribution of oak-pine plots in Florida, 1987.

Table 8–Number of all-live trees, total volume, and cull volume in oak-pine, by predominant tree species, in Florida, 1987

Tree species	Number of trees	Total volume	Cull volume	
			Poletimber	Sawtimber
	Thousand	*Thousand cubic feet*		
Loblolly pine	15,245	144,163	--	235
Slash pine	57,396	317,411	10	308
Longleaf pine	19,636	118,384	--	369
Other softwoods	91,549	203,853	334	1,316
Total softwoods	183,830	783,811	344	2,228
Total hardwoods	488,103	496,716	2,505	8,861
All trees	**671,933**	**1,282,527**	**2,849**	**11,089**

Table 9–Incidence of damage in oak-pine, by predominant softwood tree species and type of damage, in Florida, 1987

Tree species and damage	Trees damaged		
	Saplings	Poletimber	Sawtimber
		Percent	
Loblolly pine			
Fusiform rust	13	25	17
Weather	0	0	5
Slash pine			
Fusiform rust	5	4	2
Shortleaf pine			
Weather	0	0	19
Longleaf pine			
Other diseases	5	0	0
Fire	2	5	3
Logging & related	2	5	1
Total hardwoods			
Hardwood borers	1	4	6
Basal defects	0	3	10

Table 10–Annual poletimber and sawtimber removals and mortality in oak-pine, by predominant tree species, in Florida, 1980 and 1987

Tree species	Poletimber		Sawtimber	
	1980	1987	1980	1987
	Hundred cubic feet			
	Removals			
Loblolly pine	7,764	4,638	44,764	62,919
Longleaf pine	6,887	4,949	23,401	23,584
Pond pine	2,157	2,106	4,301	7,903
Sand pine	--	3,410	1,465	1,096
Slash pine	34,264	22,075	66,873	49,129
Pondcypress	1,091	3,333	7,673	5,544
Redcedar	--	--	--	4,707
Blackgum (bottomland)	929	705	2,026	2,317
Red maple	--	2,097	--	--
Sweetbay	1,018	--	858	--
Sweetgum	4,765	1,253	4,575	6,235
Hickory	--	--	2,198	3,479
Laurel oak	2,308	7,944	3,645	9,812
Live oak	--	482	--	2,283
Southern red oak	--	2,089	5,594	3,029
Water oak	--	9,673	--	6,492
Other softwoods	--	--	2,499	--
Other hardwoods	852	1,368	3,472	1,327
All softwoods	**52,163**	**40,511**	**150,976**	**154,882**
All hardwoods	**9,872**	**25,611**	**22,368**	**34,974**
	Mortality			
Loblolly pine	6,744	3,091	7,442	9,165
Longleaf pine	1,441	2,820	4,379	7,589
Pond pine	286	337	496	681
Sand pine	1,498	1,271	2,205	2,847
Slash pine	9,939	8,917	8,035	14,432
Pondcypress	4,016	2,457	501	1,903
Redcedar	--	1,350	--	309
Blackgum (bottomland)	7,101	5,389	2,434	3,193
Red maple	1,581	2,047	1,387	--
Sweetbay	1,119	2,814	563	5,065
Sweetgum	2,587	391	664	--
Laurel oak	1,992	4,263	2,560	3,404
Live oak	1,647	2,534	--	1,561
Southern red oak	--	606	1,143	--
Water oak	7,611	6,674	6,976	6,452
Scrub oak	6,939	5,606	938	5,026
Other softwoods	1,206	1,174	--	2,868
Other hardwoods	6,335	10,120	1,801	4,508
All softwoods	**25,130**	**21,417**	**23,058**	**39,794**
All hardwoods	**36,912**	**40,444**	**18,466**	**29,209**

Upland Hardwoods

Figure 7 shows the distribution of upland hardwood plots in Florida. Between surveys, upland hardwood acreage decreased by 11 percent (fig. 8). Part of the decrease may be attributed to urbanization.

In 1987, 16 percent of the saplings, 27 percent of the poletimber, and 37 percent of the sawtimber trees in the upland hardwoods class were reported with damage (see table 1). Upland hardwoods had a higher reported damage than any other broad management class. Table 11 shows the predominant tree species in upland hardwoods and their numbers, volumes, and cull volumes. Most of the damage to upland hardwoods can be attributed to basal defects and hardwood borers (table 12).

Table 12 shows the percentage of trees damaged in the upland hardwood management class, by predominant tree species and type of damage. No individual softwood species met the minimum threshold for inclusion in the table, but the 26-percent incidence of fusiform rust in the total softwood category is noteworthy. The total hardwood sawtimber population was most often damaged by basal defects and hardwood borers. Basal defects were reported on 12 percent of the red oak and 17 percent of the red maple sawtimber trees. Red oak sawtimber trees had a higher percentage of hardwood borer damage (19 percent) than any other species in this management class. Weather-related damage to red maple poletimber was reported on 19 percent of the trees.

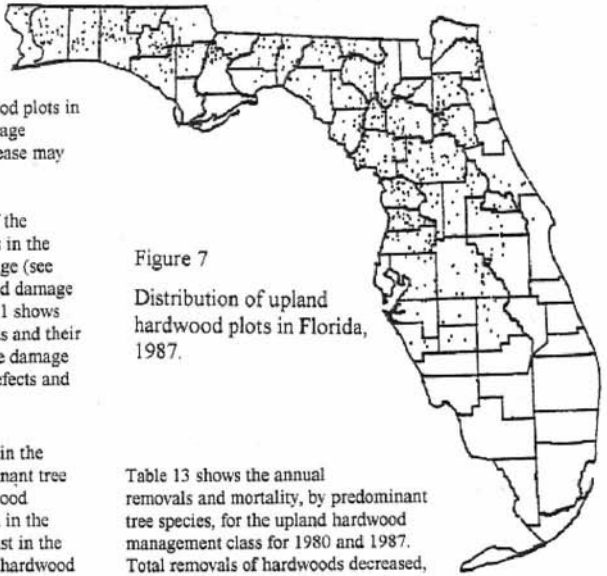

Figure 7

Distribution of upland hardwood plots in Florida, 1987.

Table 13 shows the annual removals and mortality, by predominant tree species, for the upland hardwood management class for 1980 and 1987. Total removals of hardwoods decreased, while softwood poletimber removals increased. Softwood poletimber mortality decreased, while hardwood poletimber mortality increased by 21 percent. Softwood sawtimber mortality increased by 74 percent, and hardwood sawtimber mortality increased by 29 percent. The increases in mortality may be due to interactive stress conditions, such as drought and site factors. Laurel oaks suffered the greatest average mortality.

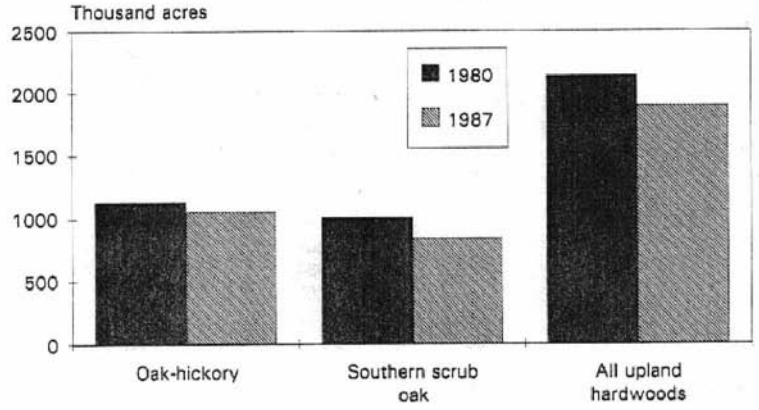

Figure 8–Distribution of timberland in upland hardwoods, by predominant tree species, in Florida, 1980 and 1987.

Table 11–Number of all-live trees, total volume, and cull volume in upland hardwoods, by predominant tree species, in Florida, 1987

Tree species	Number of trees	Total volume	Cull volume	
			Poletimber	Sawtimber
	Thousand		*Thousand cubic feet*	
Red maple	10,568	13,023	53	901
Sweetgum	37,698	103,333	318	2,351
Red oaks	212,378	403,581	2,118	11,083
White oaks	130,147	381,065	363	18,018
Hickories	21,229	73,305	138	1,487
Yellow-poplar	3,730	12,109	--	73
Other hardwoods	410,352	201,622	3,130	3,767
Total softwoods	27,449	132,013	48	203
Total hardwoods	826,102	1,188,038	6,120	37,680
All trees	**853,551**	**1,320,051**	**6,168**	**37,883**

Table 12–Incidence of damage in upland hardwoods, by predominant tree species and type of damage, in Florida, 1987

Tree species and damage	Trees damaged		
	Saplings	Poletimber	Sawtimber
		Percent	
Red maple			
Hardwood borers	2	8	6
Hardwood cankers	0	6	4
Branch stubs	0	7	3
Basal defects	0	8	17
Dieback	0	0	5
Fire	0	6	0
Weather	5	19	0
Logging & related	0	5	0
Sweetgum			
Basal defects	1	1	6
Dieback	0	2	5
Weather	3	7	8
Logging & related	6	2	4
Red oaks			
Hardwood borers	4	14	19
Basal defects	0	1	12
White oaks			
Basal defects	0	3	9
Hickories			
Other insects	1	6	4
Terminal stem borers	6	6	4
Basal defects	0	2	6
Sapsucker	0	3	9
Weather	5	0	3
Yellow-poplar			
Branch stubs	0	0	7
Basal defects	0	0	9
Logging & related	0	7	0
Total softwoods			
Fusiform rust	1	26	5
Total hardwoods			
Hardwood borers	2	5	7
Basal defects	0	2	9

Table 13–Annual poletimber and sawtimber removals and mortality in upland hardwoods, by predominant tree species, in Florida, 1980 and 1987

Tree species	Poletimber		Sawtimber	
	1980	1987	1980	1987
	Hundred cubic feet			
	Removals			
Loblolly pine	3,064	4,417	17,859	11,872
Longleaf pine	1,317	1,278	14,716	13,068
Slash pine	760	1,259	727	1,941
Blackgum	831	--	2,310	--
Magnolia	--	--	3,866	872
Red maple	3,127	643	1,744	509
Sweetgum	17,156	5,882	14,223	5,809
Hickory	2,101	4,904	12,841	7,418
Laurel oak	23,369	10,895	17,800	14,471
Live oak	--	5,970	1,436	12,149
Post oak	673	1,864	1,274	3,451
Southern red oak	1,120	2,102	11,257	4,070
Swamp chestnut oak	--	517	5,757	--
Water oak	12,203	11,555	15,136	5,888
Scrub oak	5,151	2,735	2,275	1,082
Noncommercial species	--	3,371	--	807
Other softwoods	--	1,437	6,115	2,777
Other hardwoods	2,490	1,671	9,382	2,222
All softwoods	**5,141**	**8,391**	**39,417**	**29,658**
All hardwoods	**68,221**	**51,592**	**93,544**	**58,748**
	Mortality			
Loblolly pine	1,346	--	2,587	3,886
Longleaf pine	1,917	--	1,414	1,801
Slash pine	--	--	--	1,280
Blackgum	1,325	--	4,544	--
Magnolia	--	965	--	460
Red maple	--	1,093	1,888	385
Sweetgum	4,093	4,700	4,694	3,882
Hickory	1,060	1,017	2,536	1,839
Laurel oak	8,379	23,231	17,657	27,796
Live oak	3,501	4,483	7,915	13,607
Post oak	660	2,627	629	--
Southern red oak	--	4,754	1,965	4,182
Water oak	9,805	9,250	12,833	17,324
Scrub oak	30,074	24,940	9,286	12,129
Noncommercial species	3,705	2,536	1,440	364
Other softwoods	1,993	472	--	--
Other hardwoods	5,626	2,831	3,519	5,193
All softwoods	**5,256**	**472**	**4,001**	**6,967**
All hardwoods	**68,228**	**82,427**	**68,906**	**88,661**

Bottomland Hardwoods

Figure 9 shows the distribution of bottomland hardwood plots across Florida. Between surveys the acreage of bottomland hardwood increased slightly (fig. 10). In this management class, high proportions of the stands are old and unmanaged (Bechtold and others 1990). Historically, removal rates have been low in bottomland hardwood stands, so tree ages are relatively high. Environmental constraints and inaccessibility preclude harvest and development of most of this land.

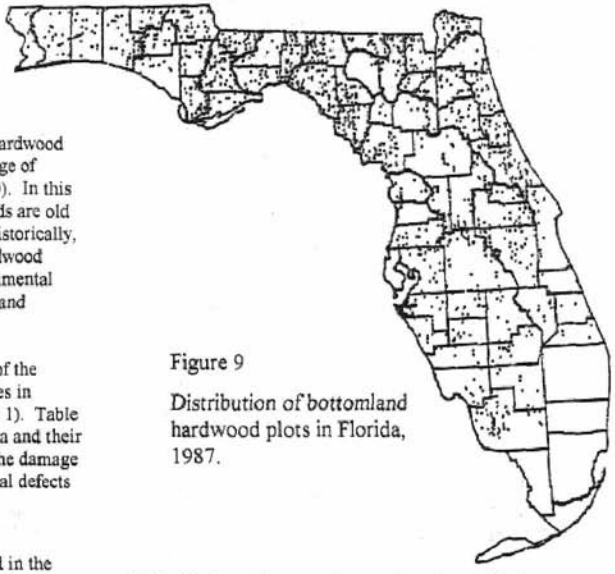

Figure 9

Distribution of bottomland hardwood plots in Florida, 1987.

In 1987, 14 percent of the saplings, 22 percent of the poletimber, and 28 percent of the sawtimber trees in bottomland hardwoods were damaged (see table 1). Table 14 shows the predominant tree species in Florida and their numbers, volumes, and cull volumes. Most of the damage to hardwood sawtimber may be attributed to basal defects and weather-related damage (table 15).

Table 15 shows the percentage of trees damaged in the bottomland hardwood management class, by predominant tree species and type of damage. In the poletimber class, red oaks and maples were most often damaged by hardwood borers, at 11 and 13 percent, respectively. Basal defects were reported on 15 percent of the hardwood sawtimber trees. Hardwood borer damage was reported on 14 percent of the red oak sawtimber. Weather-related damage corresponds with such events as extended drought, severe storms, and winter freezes (prior to the sixth survey).

Table 16 shows the annual removals and mortality, by predominant tree species, for the bottomland hardwood management class for 1980 and 1987. Increases in softwood and hardwood poletimber removals were 52 and 48 percent, respectively. Increases in softwood and hardwood sawtimber removals were 63 and 7 percent, respectively. The distribution of most of the hardwood sawtimber in wetlands and other ecologically sensitive areas may prohibit removal.

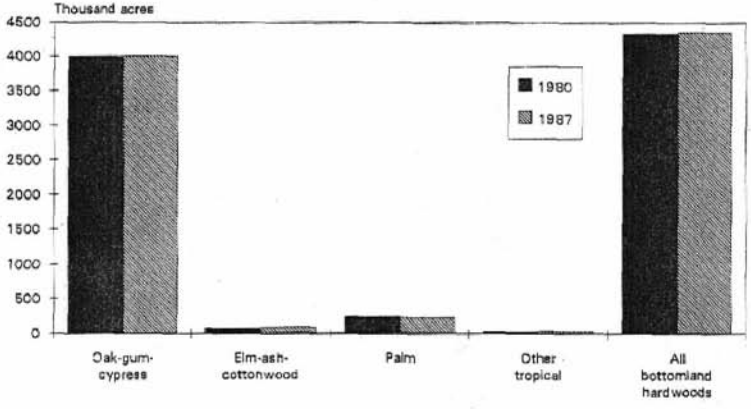

Figure 10–Distribution of timberland in bottomland hardwoods, by predominant tree species, in Florida, 1980 and 1987.

All categories of mortality increased between surveys. Softwood and hardwood poletimber mortality increased by 66 and 21 percent, respectively. Softwood and hardwood sawtimber mortality increased by 83 and 62 percent, respectively. Pondcypress increased most dramatically in both removals and mortality between surveys. Loblolly-bay, laurel oak, and water oak had the most significant increases in mortality. These species may be less tolerant of drought or site-specific stress agents than the other common hardwoods in this management class.

Table 14–Number of all-live trees, total volume, and cull volume in bottomland hardwoods, by predominant tree species, in Florida, 1987

Tree species	Number of trees	Total volume	Cull volume	
			Poletimber	Sawtimber
	Thousand		*Thousand cubic feet*	
Water tupelo	25,963	281,588	1,241	18,455
Blackgum	572,477	1,327,080	7,032	41,073
Cypress	685,022	2,591,159	3,872	46,086
Red oaks	226,733	825,544	2,302	33,562
White oaks	42,214	374,230	769	20,824
Ash	286,773	474,419	6,268	22,200
Sweetgum	119,661	392,704	1,392	5,294
Red maple	205,156	531,009	5,096	19,062
Other softwoods	57,578	406,304	372	1,702
Other hardwoods	719,571	1,120,569	8,409	33,138
Total softwoods	742,600	2,997,463	4,244	47,788
Total hardwoods	2,198,548	5,327,143	32,509	193,608
All trees	**2,941,148**	**8,324,606**	**36,753**	**241,396**

Table 15–Incidence of damage in bottomland hardwoods, by predominant tree species and type of damage, in Florida, 1987

Tree species and damage	Trees damaged		
	Saplings	Poletimber	Sawtimber
		Percent	
Water tupelo			
Basal defects	1	6	17
Weather	6	3	6
Blackgum			
Basal defects	0	4	16
Dieback	1	2	5
Weather	3	4	10
Cypress			
Basal defects	0	2	6
Red oaks			
Hardwood borers	3	11	14
Basal defects	0	2	12
Dieback	1	3	5
Weather	1	5	6
White oaks			
Basal defects	0	3	9
Weather	3	6	3
Ash			
Basal defects	0	8	21
Dieback	0	2	6
Weather	1	3	10
Sweetgum			
Dieback	0	3	6
Weather	3	4	5
Logging & related	5	4	9
Red maple			
Hardwood borers	4	13	13
Other diseases	0	3	5
Basal defects	0	5	15
Dieback	0	2	5
Weather	3	3	7
Total softwoods			
Basal defects	0	2	5
Total hardwoods			
Hardwood borers	2	4	5
Basal defects	0	4	15
Weather	2	4	8

Table 16–Annual poletimber and sawtimber removals and mortality in bottomland hardwoods, by predominant tree species, in Florida, 1980 and 1987

Tree species	Poletimber		Sawtimber	
	1980	1987	1980	1987
	Hundred cubic feet			
	Removals			
Loblolly pine	818	--	15,565	15,958
Slash pine	22,042	8,675	56,052	34,112
Atlantic white-cedar	--	--	915	3,241
Baldcypress	871	5,990	43,585	54,737
Pondcypress	16,560	46,809	40,022	146,620
Blackgum (bottomland)	8,187	20,620	54,416	47,529
Elm	1,333	1,488	3,945	2,918
Loblolly-bay	--	6,720	1,574	762
Red maple	14,649	10,757	14,688	9,515
Sweetbay	9,498	3,403	36,631	10,336
Sweetgum	10,770	17,980	15,323	36,830
Water tupelo	--	2,822	4,278	22,497
Ash	1,801	9,301	18,303	12,145
Hickory	--	742	7,133	3,829
Laurel oak	11,202	5,490	33,674	22,181
Live oak	3,060	478	--	2,486
Water oak	5,003	9,563	11,066	33,073
Other softwoods	531	561	5,496	6,820
Other hardwoods	2301	10,671	10,765	23,351
All softwoods	**40,821**	**62,035**	**161,634**	**263,998**
All hardwoods	**67,804**	**100,035**	**211,796**	**227,452**
	Mortality			
Loblolly pine	946	--	8,406	5,547
Slash pine	1,736	7,398	7,578	14,572
Atlantic white-cedar	--	195	4,592	5,028
Baldcypress	6,635	3,577	7,112	1,426
Pondcypress	27,594	48,666	18,188	53,436
Blackgum (bottomland)	35,832	27,345	51,462	61,682
Elm	5,279	4,786	3,893	8,383
Loblolly-bay	13,817	20,351	2,699	24,060
Red maple	32,211	31,319	32,862	44,435
Sweetbay	14,051	32,602	35,275	54,992
Sweetgum	14,836	17,587	21,903	23,617
Water tupelo	629	1,490	2,242	6,171
Ash	26,851	31,956	14,933	20,816
Hickory	820	1,084	4,544	3,163
Laurel oak	13,575	22,635	40,126	85,654
Live oak	4,524	2,578	5,474	13,802
Water oak	13,517	24,651	7,244	33,908
Noncommercial species	12,070	19,165	3,133	8,524
Other softwoods	558	2,499	4,310	11,733
Other hardwoods	27,993	23,937	22,427	13,847
All softwoods	**37,469**	**62,335**	**50,186**	**91,742**
All hardwoods	**216,005**	**261,486**	**248,217**	**403,054**

Economic Losses

From 1980 to 1987 the average loss to cull and mortality was estimated to be 190.0 million cubic feet of timber (table 17). The estimated annual equivalent of present value loss (the annuity) was $78.1 million per year when averaged across the 7.7-year remeasurement period, or about $5 per acre per year when averaged over the 15.3 million acres of commercial timberland.[1]

Table 17 shows the average annual losses for volume and value, by ownership and broad management class. About $41.2 million was lost annually in nonindustrial private forests. Approximately $29.3 million was lost in bottomland hardwoods and $26.3 million in natural pine stands across all ownership classes.

About half of the volume and value losses occurred on nonindustrial private forests (fig. 11). The next greatest losses (25 percent of the lost volume and 22 percent of the lost value) occurred on forest industry land. Among the broad ownership classes, losses were greatest in bottomland hardwoods (fig. 12). Fifty-five percent of the volume loss and 38 percent of the value loss occurred in these stands. Natural pine stands accounted for 20 percent of the volume loss and 34 percent of the value loss. Pine plantations suffered 17 percent of the annual value loss. Other management classes accounted for less than 15 percent of the volume and value losses.

Figures 13-16 stratify losses by management and ownership classes. Bottomland hardwoods had the greatest percentage of dollar and volume losses across all ownership classes, except on national forest land, where natural pines were most affected by damage. Value and volume losses of species on other ownership classes were less than 30 percent except for the pine plantations owned by forest industry.

[1] The difference between the tabular value (see table 17) and the economic value of the total commercial timberland acreage for Florida is due to a rounding discrepancy.

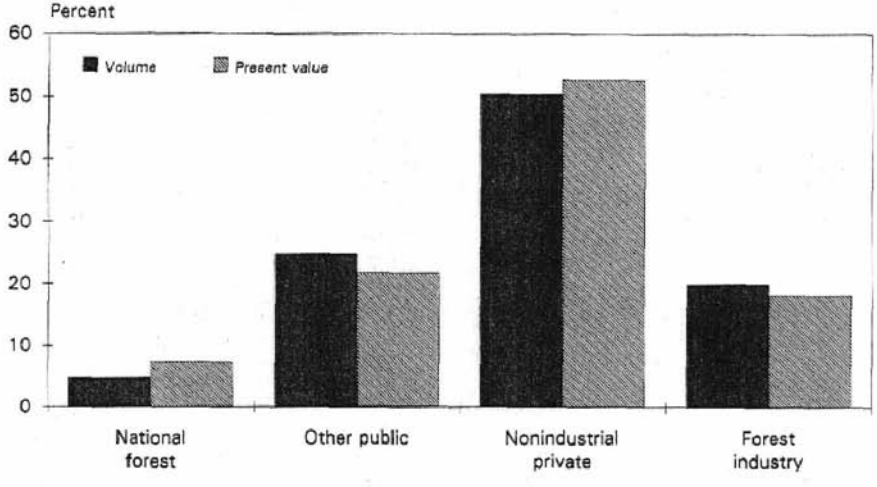

Figure 11–Percentage of annual affected volume of timberland and value of loss, by ownership, in Florida, 1980-1987. Total volume = 190,001 thousand cubic feet; total present value = $78.1 million.

Table 17–Volume and value of timber damaged or killed annually, by ownership and broad management class, in Florida, 1980-1987

Ownership and management class	Average annual volume affected	Average annual present value		
		Mortality	Cull	Total
	Thousand cubic feet	*Dollars*		
National forest				
Pine plantation	207	139,237	9,624	148,861
Natural pine	6,614	4,943,955	107,849	5,051,804
Oak-pine	251	40,822	7,045	47,867
Upland hardwoods	57	12,650	6,031	18,681
Bottomland hardwoods	1,868	355,243	151,568	506,811
Total	**8,997**	**5,491,907**	**282,117**	**5,774,024**
Other public				
Pine plantation	387	325,699	22,967	348,666
Natural pine	3,434	2,810,280	96,614	2,906,894
Oak-pine	1,659	442,922	24,992	467,914
Upland hardwoods	1,491	426,726	71,966	498,692
Bottomland hardwoods	40,233	10,565,708	2,154,559	12,720,267
Total	**47,204**	**14,571,335**	**2,371,098**	**16,942,433**
Nonindustrial private				
Pine plantation	7,890	8,273,690	228,959	8,502,649
Natural pine	20,649	14,469,219	233,061	14,702,280
Oak-pine	8,696	1,717,355	137,704	1,855,059
Upland hardwoods	18,444	4,272,563	914,290	5,186,853
Bottomland hardwoods	40,233	8,969,641	1,966,866	10,936,507
Total	**95,912**	**37,702,468**	**3,480,880**	**41,183,348**
Forest industry				
Pine plantation	4,320	4,038,636	265,958	4,304,594
Natural pine	5,663	3,488,067	114,652	3,602,719
Oak-pine	3,023	425,768	56,935	482,703
Upland hardwoods	2,572	404,897	196,847	601,744
Bottomland hardwoods	22,310	3,913,561	1,265,224	5,178,785
Total	**37,888**	**12,270,929**	**1,899,616**	**14,170,545**
All ownerships				
Pine plantation	12,804	12,777,262	527,508	13,304,770
Natural pine	36,360	25,711,521	552,176	26,263,697
Oak-pine	13,629	2,626,867	226,676	2,853,543
Upland hardwoods	22,564	5,116,836	1,189,134	6,305,970
Bottomland hardwoods	104,644	23,804,153	5,538,217	29,342,370
Total	**190,001**	**70,036,639**	**8,033,711**	**78,070,350**

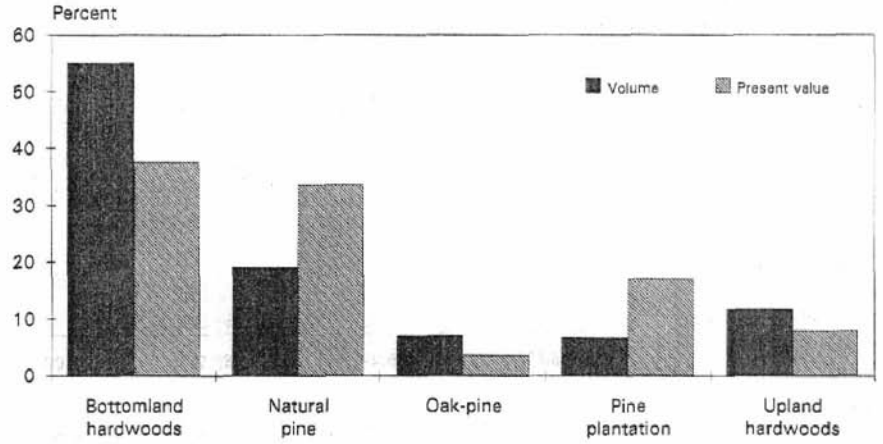

Figure 12–Percentage of annual affected volume of timberland and value of loss, by management class, for all ownership classes in Florida, 1980-1987. Total volume = 190,001 thousand cubic feet; total present value = $78.1 million.

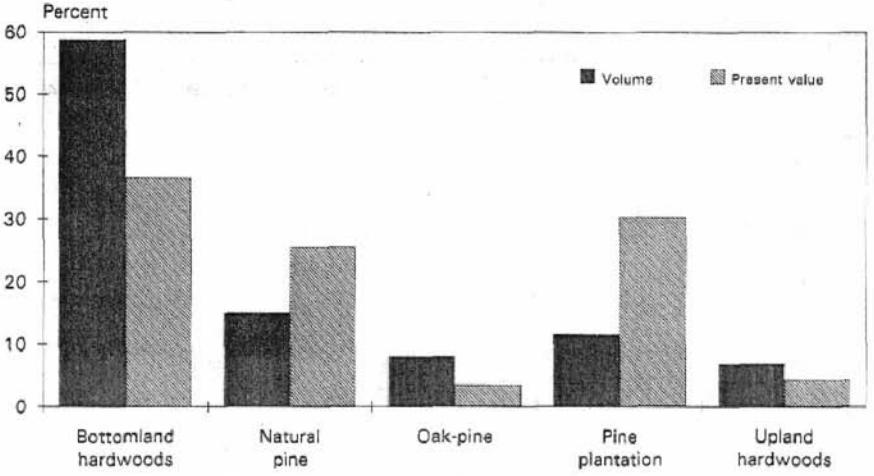

Figure 13–Percentage of annual affected volume and present value of loss, by management class, for forest industry in Florida, 1980-1987. Total volume = 37,888 thousand cubic feet; total present value = $14.2 million.

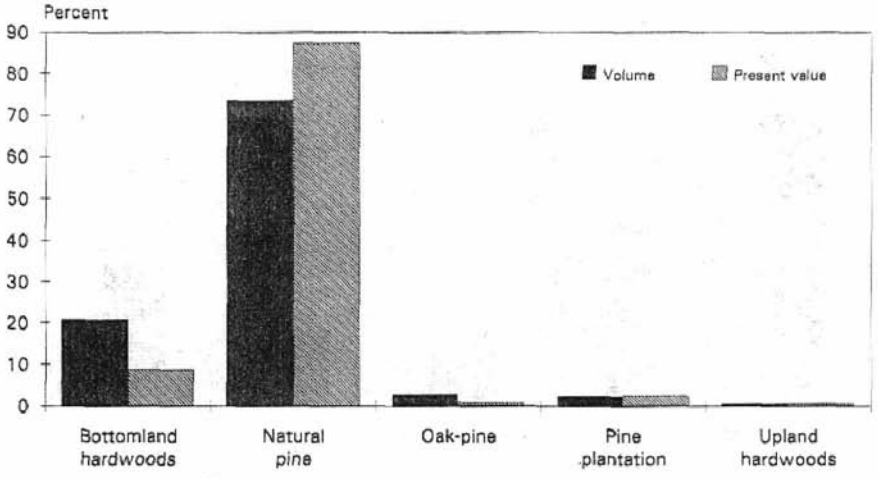

Figure 14–Percentage of annual affected volume and present value of loss, by management class, for national forests in Florida, 1980-1987. Total volume = 8,997 thousand cubic feet; total present value = $5.8 million.

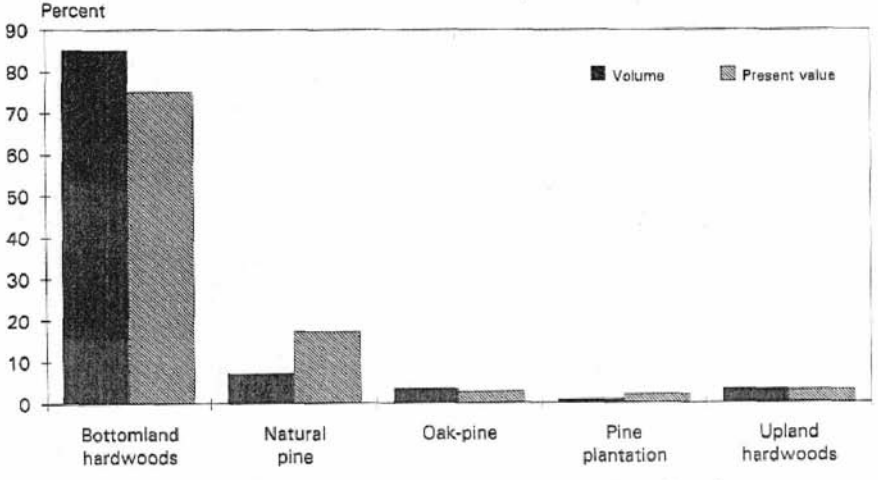

Figure 15–Percentage of annual affected volume and present value of loss, by management class, for other public forests in Florida, 1980-1987. Total volume = 47,204 thousand cubic feet; total present value = $8.6 million.

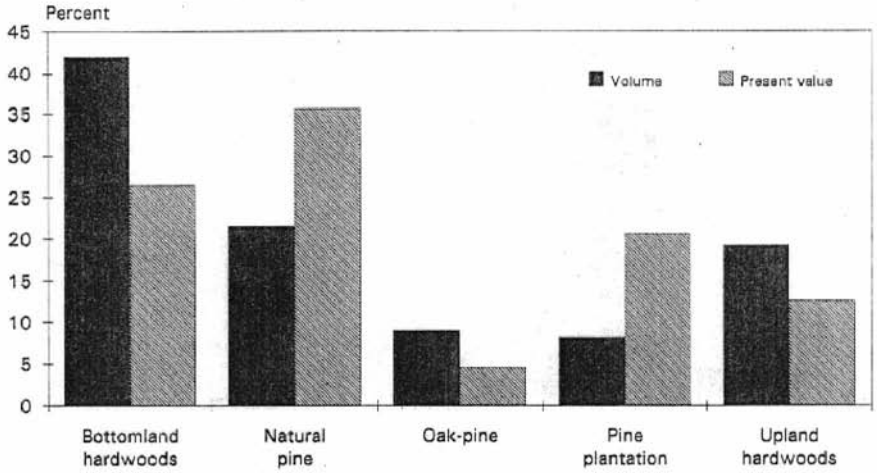

Figure 16–Percentage of annual affected volume and present value of loss, by management class, for nonindustrial private forests in Florida, 1980-1987. Total volume = 95,912 thousand cubic feet; total present value = $41.2 million.

Definitions

Damaging Agents and Their Symptoms

Hardwood borers. All hardwoods. The initial symptom is a dark sap spot on the bark surface (often mixed with frass). Eventually, coarse boring particles appear in bark cracks and crevices beneath the point of attack. Old damage appears as knobby overgrowths or scars on the bark surface.

Bark beetles. All pines. Cream to yellow and pinkish globs of resin resembling popped corn appear on the bark surface. If the infestation is well established and some trees still retain their foliage, tunnels or egg galleries may be evident on the inner-bark surface and on the sapwood surface. Streaks caused by blue stain fungi are often evident on sapwood. Foliage gradually yellows, then reddens.

Terminal shoot and stem borers. All species. Fresh attacks show boring dust and frass at entrance holes, which are most often located at the bases of leaf petioles and buds. White to pinkish globs of resin may appear at attack points. Attacks lead to terminal or branch dieback. Shoots turn yellow, then red, and finally brown (dead).

Other insects. All tree species. All damage caused by insects not identified separately are included in this category, which covers hardwood defoliators (such as variable oak leaf caterpillars) and pine defoliators (such as redheaded pine sawfly).

Fusiform rust. Slash, loblolly, pitch, pond, and longleaf pines. This rust typically causes the formation of spindle-shaped galls on the stem or branches; many older galls appear as cankers with sunken rotten centers encircled by a callus ridge. Witches'-broom is common at galls. The fungi fruit in the spring, producing bright-orange spores. Report all stem cankers, but only those branch cankers that occur within 12 inches of the bole.

Other rusts. Shortleaf and other pine species. Galls appear globose (round) rather than spindle-shaped. Otherwise, characteristics are similar to fusiform rust.

Root rots. All species. Look for groups of dead or windthrown trees–trees with tufted, thin crowns that may be yellowing. Conks (fruiting bodies) of various fungi may appear on or near the base of affected trees. Root rot is more frequent in trees of reduced vigor, in thinned stands, and in trees with butt or root injury. Bark beetles often attack weakened trees.

Littleleaf disease. Shortleaf and loblolly pines, with shortleaf more susceptible. Affected trees occur in groups. Typical symptoms include reduced needle length, yellow needles, reduced shoot growth, and large crops of undersized cones. This disease usually occurs on sites where heavy soils produce poor internal drainage.

Hardwood cankers. All hardwoods. Affected trees have dead sunken areas on the stem, frequently surrounded by annual callus ridges.

Branch stubs. All species. Branch holes or stubs are more than 4 inches in diameter on the stems of trees 5.0 inches d.b.h. and larger, and more than 1 inch in diameter on the stems of smaller trees.

Basal defects. All species. Symptoms include butt swelling, burls, V-shaped stump sprouts, frost seams, and branch stubs below d.b.h. Conks of decay fungi are often associated with defect.

Pitch canker. Primarily slash, shortleaf, and loblolly pines, but also Virginia, longleaf, eastern white, Scotch, Table Mountain, and pitch pines. Symptoms include flagging at the ends of branches, pitch flow from the affected area, slight swelling on affected stems and twigs, crooks in main stems, and wilting of new shoots. In early stages, there is a slight bark depression.

Other diseases. All species. All damages caused by diseases not separately identified are included in this category. Examples are red heart of pine, brown-spot needle blight, and leaf diseases.

Fire. All species. Fire scars are usually found at the base of the stem. Occurrence is widespread throughout the stand. On slopes, look for fire scars on the uphill sides of the tree. Signs of charring are generally present.

Animal. All tree species. Signs include chopped off or broken branches, removed bark, holes in the stem, and tears and toothmarks in the wood.

Beaver. All species. Beavers leave toothmarks and remove bark from the bole of the tree. Trees that are upstream from beaver dams often suffer from flooding.

Sapsucker. All species. Look for horizontal rows of small holes that may encircle the bole of the tree. The bark below the holes is usually streaked or stained by oozing sap.

Weather. All species. Severe weather causes windthrow, ice damage, frost crack (above d.b.h. for this Bulletin), broken tops, broken branches, marginal leaf burn, and winter burn.

Flooding. All species. Flooding causes yellowing and/or curling downward of leaves, premature leaf-fall, branch and top dieback, tree mortality, and high water and silt marks on tree boles.

Lightning. All species. Lightning causes bark stripping or cracks. Damage runs from the strike point to the ground, spirally or in straight lines. Tops may break or fade after root damage. Bark beetles often invade struck trees.

Suppression and stagnation. All species. Suppressed and stagnated trees have poor form. Because small crown-suppressed trees are overtopped, they receive only indirect sunlight and develop thin foliage. Stagnation usually occurs on poor growing sites or in overstocked stands.

Damage caused by people. All species. Examples include initials in bark, embedded nails, lantern burns, stripped bark, callused roots, wire around stems, and axe marks.

Logging and related. All species. Logging scars on the stem develop callus ridges within 1 to 2 years. They are scattered in the stand and show no charring. Limb breakage and/or stem scars near the crown are indicators of impact from the logging of neighboring trees. Also look for skid trails and stumps.

Form (damaging). All species. All trees with form damage that cannot be separately classified are included in this category.

Dieback. All hardwoods. The tips of branches are dead. At first, only a few branches are affected, but entire branches die in advanced stages. Tree death may occur.

Forest Inventory Terms

Acceptable trees. Growing-stock trees of commercial species that meet specified standards of size and quality but do not qualify as desirable trees.

Accumulated volume loss. Percentage of trees affected times the percent cull times the volume for the species.

Associated cull. Percentage of affected trees that contain cull associated with the indicated damaging agent.

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.

Broad management class. A classification of timberland based on forest type and stand origin.

Pine plantation. Stands that have been artificially regenerated by planting or direct seeding and with a southern yellow pine, white-pine-hemlock, or other softwood forest type.

Natural pine. Stands that have not been artificially regenerated and with a southern yellow pine, white pine-hemlock, or other softwood forest type.

Oak-pine. Stands with a forest type of oak-pine.

Upland hardwood. Stands with a forest type of oak-hickory, chestnut oak, southern scrub oak, or maple-beech-birch.

Bottomland hardwood. Stands with a forest type of oak-gum-cypress, elm-ash-cottonwood, palm, or other tropical.

Commercial species. Tree species presently or potentially suitable for industrial wood products.

Desirable trees. Growing-stock trees of commercial species with relatively high vigor and without serious defects in quality that would limit use for timber products, or pathogens that would result in death or serious deterioration before rotation age.

Diameter class. A classification of trees based on diameter outside bark, measured at breast height (4½ feet above the ground). Two-inch diameter classes are commonly used by FIA, with even-numbered whole inches serving as the approximate midpoints for classes. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

Growing-stock trees. Live trees of commercial species qualifying as desirable or acceptable trees.

Incidence. Percentage of susceptible trees affected by the agent.

Mortality. The merchantable volume in trees that have died from natural causes during a specified period.

Poletimber trees. Growing-stock trees of commercial species at least 5.0 inches d.b.h. but smaller than sawtimber size.

Saplings. Live trees 1.0 to 5.0 inches d.b.h.

Saw log. A log meeting minimum standards of diameter, defect, and length, at least 8 feet long, sound and straight, and a minimum inside-bark diameter of 6 inches for softwoods (8 inches for hardwoods).

Sawtimber trees. Live trees of commercial species containing at least one 12-foot saw log or two noncontiguous saw logs (each 8 feet or longer) with at least a third of the gross board-foot volume between the 1-foot stump and minimum saw log being sound. Softwood must be at least 9.0 inches and hardwoods at least 11.0 inches in diameter at breast height.

Sawtimber volume. Net volume of the saw-log portion of live sawtimber in board-feet based on the International ¼-inch rule.

Softwoods. Gymnosperms; in the order Coniferales, usually evergreen (includes the genus *Taxodium* which is deciduous), having needles or scalelike leaves.

Pines. Yellow pine species including loblolly, longleaf, slash, shortleaf, pitch, Virginia, Table Mountain, sand, spruce, and pond pines.

Other softwoods. Cypress, eastern redcedar, white-cedar, eastern white pine, eastern hemlock, spruce, and fir.

Stand-size class. A classification of forest land based on the diameter class distribution of growing-stock trees in the stand.

Sawtimber stands. Stands at least 16.7 percent stocked with growing-stock trees, with half or more of total stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

Poletimber stands. Stands at least 16.7 percent stocked with growing-stock trees, with half or more of this stocking in poletimber and sawtimber trees, and with poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands. Stands at least 16.7 percent stocked with growing-stock trees, of which more than half of the stocking is saplings and seedlings.

Timberland. Land at least 16.7 percent stocked by forest trees of any size, or formerly having had such tree cover, not currently developed for nonforest use, capable of producing 20 cubic feet of industrial wood per acre per year and not withdrawn from timber utilization by legislative action.

Literature Cited

Burns, Russell M.; Honkala, Barbara H., tech. coords. 1990. Silvics of North America: 1.Conifers. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture, Forest Service. Vol. 1, 675 pp.

Norris, F.W. 1987. Timber-Mart South. Publisher, P.O. Box 1278, Highlands, NC 28741.

Bechtold, William A.; Brown, Mark J.; Sheffield, Raymond M. 1990. Florida's forests, 1987. Resour. Bull. SE-110. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 83 pp.

U.S. Department of Agriculture, Forest Service. 1985. Field instructions for the Southeast, 1985. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 120 pp.

U.S. Department of Agriculture, Forest Service. 1988. The South's fourth forest: alternatives for the future. For. Resour. Rep. 24. Washington, DC: U.S. Department of Agriculture, Forest Service (tables 3.15-3.20). 512 pp.

Brantley, Elizabeth A.; Redmond, Clair; Thompson, Michael. 1994. Incidence and impact of damage to and mortality trends of Florida's timber, 1987. Resour. Bull. SE-143. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 29 pp.

Incidence and impact of 22 damage types and mortality trends to the forest resources of Florida in 1987 are described. Acres affected, volume losses, geographic distribution, and economic impact are discussed. About 190 million cubic feet of timber were lost per year from 1980 to 1987, with an estimated annual dollar loss of $78.1 million.

Keywords: Insect damage, disease damage, fusiform rust, bark beetles, forest insects, forest diseases.

Brantley, Elizabeth A.; Redmond, Clair; Thompson, Michael. 1994. Incidence and impact of damage to and mortality trends of Florida's timber, 1987. Resour. Bull. SE-143. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 29 pp.

Incidence and impact of 22 damage types and mortality trends to the forest resources of Florida in 1987 are described. Acres affected, volume losses, geographic distribution, and economic impact are discussed. About 190 million cubic feet of timber were lost per year from 1980 to 1987, with an estimated annual dollar loss of $78.1 million.

Keywords: Insect damage, disease damage, fusiform rust, bark beetles, forest insects, forest diseases.