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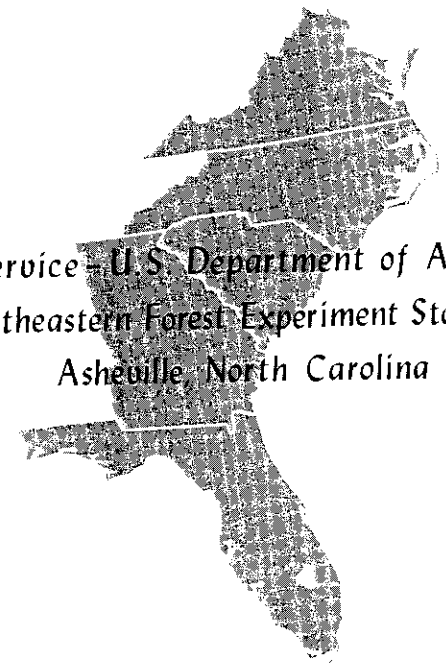
by

Herbert A. Knight



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INTRODUCTION

Most timber stands in North Carolina are even aged and appeared after some act of nature or man. The most common acts which lead to the establishment of a new stand are timber harvesting, retirement of farmland, wildfire, wind and ice storms, or insect and disease outbreaks. Most frequently, the new stand is a product of nature's healing process. Less often, some landowner plants a stand of seedlings.

The Statewide age distribution of stands reflects historical land use patterns, economic cycles, and forestry practices. It is important as an indicator of prospective timber supplies and, together with information on forest conditions, as input for the formulation of forestry programs.

This report focuses on relationships between age distribution and past trends in land use and timber harvesting. Average diameter distributions are given for different ages of stands by broad forest types. Key findings include further evidence that (1) retired cropland has been a primary source of pine timber, (2) renewed agricultural activity will require more effective regeneration practices at time of harvest to sustain the existing acreage of pine forests on private, nonindustrial land, (3) a continuation of current trends will result in a forest increasingly dominated by hardwoods, and (4) wood-using industries in North Carolina will be highly dependent upon timber from other private owners for the foreseeable future.

BACKGROUND

For years, Forest Survey crews have estimated stand age at sample locations in the Southeast, but with limited success. High-grading, partial cuts, advance reproduction, and volume sampling procedures that permitted plots to straddle two or more conditions have all tended to weaken the stand-age estimates. Furthermore, a wide range in tree diameters at a given location has often misled crews into assigning a mixed-age classification. Finally, some acres have so few growing-stock trees, which are worth favoring in management, that stand age has little meaning.

In the fourth Statewide Forest Survey of North Carolina, started in November 1972 and completed January 1975, steps were taken which enhanced the validity of the stand-age classifications: (1) an even-aged management objective was assumed at each sample location; (2) each sample plot was confined to a single forest condition, as identified by point 1 of the 10-point sample cluster; (3) based on stocking of trees worth favoring in timber management, the presence or absence of a manageable stand was noted at each sample location; (4) greater emphasis was placed on making enough increment borings to accurately determine stand age.

Collectively, these efforts provided the first credible measure of the distribution of commercial forest acreage by stand age on a statewide basis in the Southeast. Data collected at about 5,000 sample locations, distributed across the entire State, support the information presented. The ability to profile the age distribution of timber stands across entire States adds another dimension to forest resource analyses.

STAND ORIGIN

Since softwood stands in the Southeast often seeded onto retired cropland (Boyce and McClure 1975),[1] a correlation was sought between reductions in cropland harvested and the age distribution of softwood stands (table 1). If a 2- to 5-year lag is assumed for retired cropland to revert to forest, there

Table 1.--Comparison of the reported reduction in cropland harvested to the age distribution of softwood stands, North Carolina, as of the fourth Forest Survey

Cropland harvested		Age distribution of softwood stands	
Period	Reported reduction[1]	Age[2]	Area
Years	Acres	Years	Acres
1945-1950	343,594	20-24	424,803
1950-1954	278,203	16-19	315,024
1954-1959	757,840	11-15	612,115
1959-1964	760,460	6-10	679,916
1964-1969	513,597	0-5	593,702
1945-1969	2,653,694	0-24	2,625,560

[1] North Carolina Summary Data, 1969 Census of Agriculture, Table 1.
[2] Stand-age classifications made between November 1972 and January 1975.

[1]Boyce, Stephen G., and Joe P. McClure. 1975. How to keep one-third of Georgia in pine. USDA For. Serv. Res. Pap. SE-144, 23 p. Southeast. For. Exp. Stn., Asheville, N. C.

seems to be a fairly strong correlation between cropland retirement and the age distribution of softwood stands in North Carolina. Since cropland retirement--a primary source of softwood stands--is no longer occurring at a rapid rate in North Carolina, future supplies of softwood timber may be significantly reduced. Furthermore, the latest Forest Survey revealed that roughly one-half of the pine acreage now being harvested is not remaining in pine type because of inadequate site preparation and regeneration practices. More effective regeneration practices at time of harvest will be required to sustain pine on existing forest acreage. Forestry interests in North Carolina should be aware that without the rotation of large acreages of retired cropland to pine, the present rate of artificial planting will not sustain the existing pine acreage controlled by private, nonindustrial owners. Continued dependence upon natural regeneration by these owners seems inevitable.

Most hardwood stands in North Carolina originate after timber harvesting. More than half the hardwood stands are at least 40 years old and were established on forested acreage cutover prior to 1930. Based on reported and estimated lumber production (Steer 1948),[2] timber harvesting in North Carolina during this century peaked between 1909 and 1916. Lumber production then declined somewhat, but continued at a fairly active pace until the Great Depression hit in 1930. After 7 years of depressed markets, lumber and other wood products began a modest recovery in 1937, that extended through the end of World War II in 1945. Between 1946 and 1957, timber demands were strong and many of North Carolina's second-growth stands were liquidated. Between 1958 and the early seventies, lumber production again slowed, and many small portable sawmills closed as pulpwood became a more common timber product. Finally, the current economic recession interrupted a most rapid expansion in the rate of timber harvesting and utilization, which had developed during the early seventies. The age distribution of hardwood stands generally reflects the historical cutting pattern described, and seems to correlate rather well with lumber production up until 1940, if a 5-year lag is assumed between harvest and the establishment of a new stand (table 2).

High-grading and other forest practices and disturbances have created conditions which have either prevented or delayed the natural regeneration of some $2\frac{1}{4}$-million acres classified as hardwood type in the latest survey. Typically, these acres are occupied by rough and rotten trees and other vegetation that inhibits development of a manageable stand. Stocking will improve on a small portion of these acres, but most will require site preparation or treatment before they can produce significant amounts of timber that is merchantable by today's standards. Since poor cutting practices in pine stands create much of this poorly stocked and low-producing hardwood acreage, public programs aimed at increasing timber supplies might be most effective if directed toward improved harvesting practices rather than toward improving poor conditions after they appear.

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[2]Steer, Henry B. 1948. Lumber production in the United States 1799-1946. USDA Misc. Publ. 669, 233 p., Washington, D. C.

Table 2.--Comparison of estimated lumber production to the age distribution of hardwood stands, North Carolina, as of the fourth Forest Survey

Estimated lumber production		Age distribution of hardwood stands	
Period	Volume[1]	Age[2]	Area
Years	M board feet	Years	Acres
1900-1909	13,769	60-69	1,378,000
1910-1919	18,547	50-59	1,740,000
1920-1929	14,799	40-49	1,772,000
1930-1939	11,111	30-39	1,394,000

[1] Based on "Lumber Production in the United States, 1799-1946" (Steer 1948).
[2] Stand-age classifications made between November 1972 and January 1975.

AVERAGE STAND STRUCTURE

The survey data permitted computation of average diameter distributions for 10-year age classes in softwood and hardwood stands in North Carolina (table 3). Acreage classified as having no manageable stand was eliminated from this computation to reduce the stocking variability. Acreage occupied by stands less than 10 years of age was also eliminated because stems less than 1.0 inch d.b.h. were not counted. Elimination of these young stands excluded most of the plantations.

The softwood types include areas where southern yellow pines, white pine, hemlock, cedar, spruce, and fir, singly or in combination, comprised 50 percent or more of the stocking. Although cypress is also a softwood species, it is included with hardwood in the conventional separations of forest type throughout this report. Oak-pine type is also included with the hardwood acreage because, by definition, hardwood species comprise 50 percent or more of the stocking in this type.

The averages shown in table 3 cover wide ranges of conditions in natural timber stands in North Carolina. Where a sufficient number of samples were available, similar tables could have been prepared for specific forest types, site classes, and recent stand histories.

Table 3.--Average number of all live trees 1.0 inch d.b.h. and larger per acre of commercial forest land, by diameter class and by broad forest type and stand-age class, North Carolina, 1974

Broad forest type and stand-age class	All classes	Diameter class (inches)									
		2	4	6	8	10	12	14	16	18	20+
	Number										
Softwood types:											
10-19	1,236	805	266	107	43	11	3	1	--	--	--
20-29	1,099	622	258	115	63	27	9	4	1	--	--
30-39	1,024	620	180	98	62	35	16	8	3	1	1
40-49	888	543	144	79	53	33	19	10	4	2	1
50-59	957	621	142	74	43	37	20	11	6	2	1
60-69	716	433	123	52	39	25	19	11	7	4	3
70-79	860	571	130	47	37	28	19	14	6	5	3
80-89	745	460	98	59	36	40	22	14	8	4	4
90+	761	447	146	51	44	35	12	7	7	3	9
Hardwood types:											
10-19	1,358	1,028	217	65	27	10	6	2	1	1	1
20-29	1,180	789	231	84	39	19	9	5	2	1	1
30-39	973	595	192	86	46	26	14	7	3	2	2
40-49	854	513	159	73	44	28	17	10	5	3	2
50-59	786	456	149	67	44	28	18	12	6	3	3
60-69	724	425	122	68	35	27	19	12	8	4	4
70-79	707	390	136	66	38	23	19	13	9	6	7
80-89	612	332	121	54	31	22	17	12	9	5	9
90+	612	316	144	47	29	22	16	12	9	6	11

Even from the broad profiles of average stand structure shown, however, significant differences between softwood and hardwood stands are apparent. For example, if one converts the stem counts of trees in the 6-inch class and larger to basal area, the average within softwood stands reaches about 90 square feet per acre in the 30- to 39-year age class and then flattens out. In contrast, the hardwood stands did not contain an average basal area of 90 square feet in similar-sized trees until age 50 to 59 (table 4). Unlike the softwood stands, the average basal area of the hardwood stands continued to increase through age 70 to 79. The rotations applied by timber managers are generally consistent with these implied growth patterns; rotations of 30 to 40 years are typical in pine, and 80-year rotations are not unusual for hardwoods. The shorter rotations possible with softwoods give them a distinct economic advantage over hardwoods.

Table 4.--Average basal area of all live trees 5.0 inches d.b.h. and larger per acre of commercial forest land, by broad forest type and stand-age class, North Carolina, 1974

Stand-age class	Broad forest type	
	Softwood	Hardwood
Years	Square feet per acre	
10-19	45	40
20-29	72	60
30-39	89	78
40-49	89	86
50-59	91	91
60-69	88	95
70-79	91	106
80-89	105	101
90+	96	104

STAND-AGE PROFILES

In even-age management, allowable cut is based on area control. The objective is to achieve and maintain a stand-age distribution with approximately equal area in each age class within the applied rotation. Although the length of rotation varies because of differences in species composition, owner objectives, treatment, and site, some general stand-age profiles are useful in forest resource analyses. For example, separate age profiles for softwood and hardwood stands by ownership class provide considerable insight about prospective timber supplies and provide a measure of forestry progress, opportunities, and deficiencies.

The age profile for softwood types provides a measure of pine reforestation in the two youngest age classes--less than 10, and 10-19 (fig. 1). Pine plantations account for roughly half of the softwood acreage supporting stands less than 10 years of age, and 30 percent of the softwood stands 10 to 19 years old. These age classes reflect the common practice of pulp and paper companies to convert natural stands to plantations on all suitable acres owned or under their control. Without further land acquisition by these companies, their conversion schedules should soon exhaust their opportunities for increasing pine acreage within their holdings. The 10-19 age class includes the acreage of idle land planted with pine by other private owners under the Conservation Reserve Soil-Bank Program during the late fifties and early sixties. A decline in the rate of establishment of softwood stands on other private lands during the

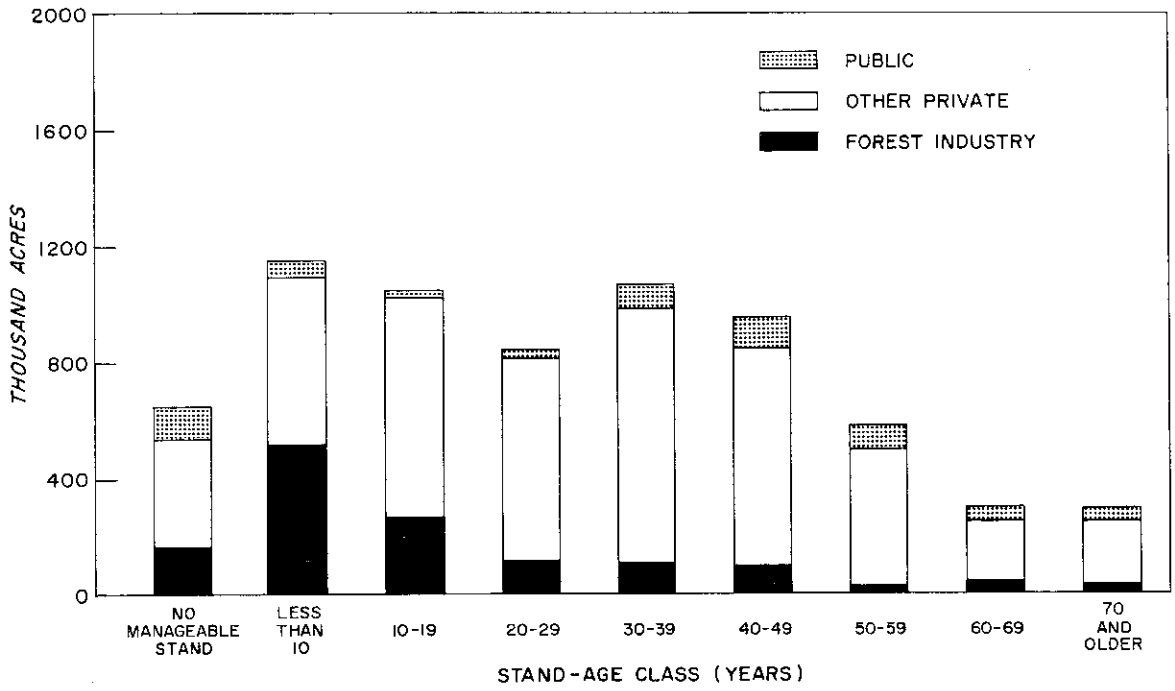

Figure 1.--Area of commercial forest land occupied by softwood forest types, by stand-age class by ownership class, North Carolina, 1974.

past decade reflects a sharp reduction in pine planting upon termination of the Soil-Bank Program and a slowdown in the natural reversion of idle fields to pine. The Survey was too early to provide any measure of the more recent Forestry Incentive Program.

There will be no substantial increase in acreage of softwood reaching merchantable age over the next 30 years. In fact, a sag in the profile at the 20- to 29-year age class identifies a prospective deficiency in the pine timber supply prior to the time when established plantations reach harvesting age. Thus, any increases in the pine harvest must come from increased yield per acre. Another conclusion is that wood-using industries in North Carolina will be highly dependent upon timber from the other private ownerships for the next several decades.

Tracts of softwood 40 years of age and older have been withheld from harvest at the normal rotation age for a variety of reasons: logging difficulties, public policy, owner objectives, and market deficiencies. Some resource analysts would view this acreage as a problem; others as a timber reserve that guards against the uncertainties of the future. Regardless of the view, substantial growth loss can occur when stands are carried beyond their maturity.

The age profile of acreage supporting hardwood types suggests that there will be an abundance of hardwood stands reaching maturity over the next several decades (fig. 2). Acreage deficiencies in young stands, together with the vast acreage inadequately stocked for management, pose problems over the longer run. Recent rates of successful hardwood establishment would have to be increased to correct the stocking deficiencies and age distribution of the

12.6 million acres now dominated by hardwoods; however, it is unlikely that existing hardwood markets in North Carolina could absorb the increase in hardwood harvesting implied in this age profile. If current trends continue, average hardwood rotations will be extended and a large reserve of mature and over-mature hardwood stands will accumulate. Substantial growth loss will continue at both ends of the age profile.

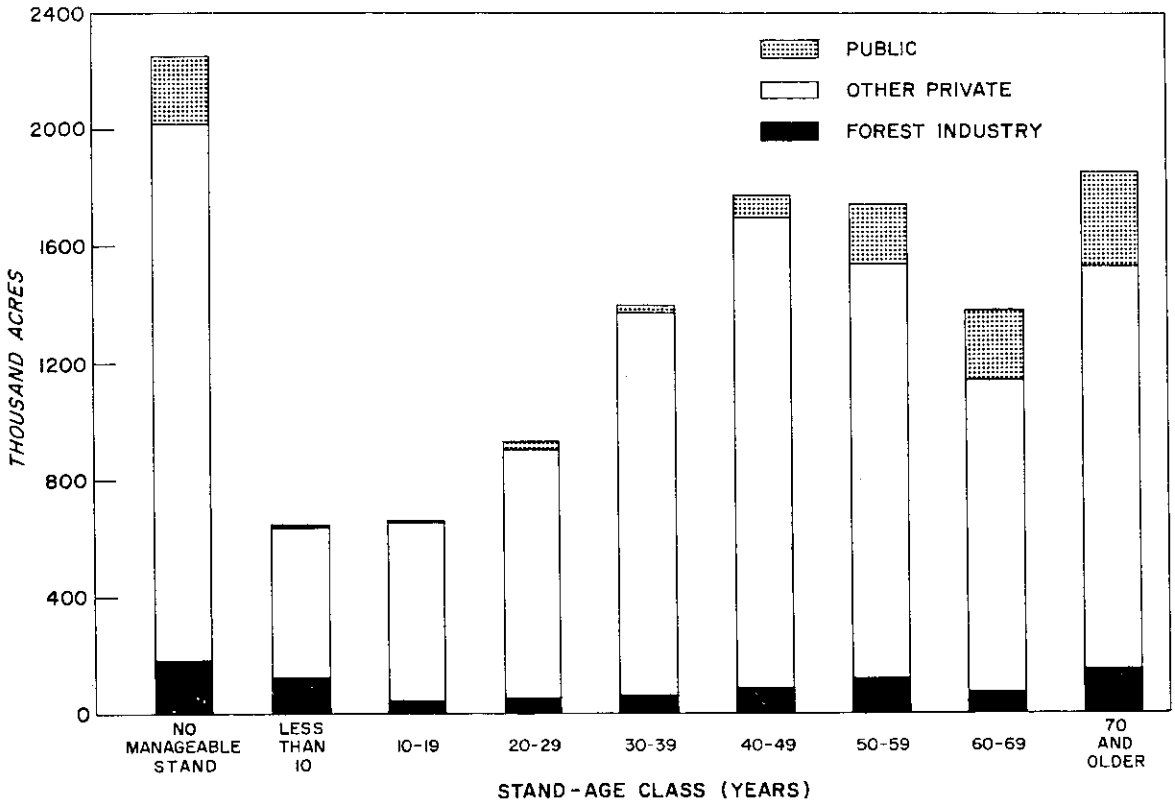

Figure 2.--Area of commercial forest land occupied with hardwood forest types, by stand-age class by ownership class, North Carolina, 1974.

STAND-AGE DISTRIBUTION BY SITE

The relation between site quality and stand age was examined (table 5). Here, the conventional Forest Survey classifications of site were grouped into three classes--good, medium, and poor--based on the forest area's capacity to grow industrial wood in fully stocked natural stands. Good sites are defined as capable of producing 85 or more cubic feet per acre annually; medium sites, between 50 and 85 cubic feet; and poor sites, less than 50 cubic feet.

No striking relationships were found between stand age and site on areas supporting a manageable stand. There was a slight tendency for old stands to be on poor sites. For example, 21 percent of the good sites supported stands 60 years of age and older; whereas, 26 percent of the poor sites supported such stands.

Table 5.--Area of commercial forest land, by broad site class and forest type and by stand-age class, North Carolina, 1974

Broad site class and forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Thousand acres										
Good sites:											
Softwood	1,222	46	156	170	176	251	202	124	65	23	9
Hardwood	2,441	272	145	90	166	311	393	456	234	186	188
Total	3,663	318	301	260	342	562	595	580	299	209	197
Medium sites:											
Softwood	4,002	197	864	690	516	618	516	296	148	77	80
Hardwood	8,132	1,231	465	471	614	931	1,171	1,099	923	514	713
Total	12,134	1,428	1,329	1,161	1,130	1,549	1,687	1,395	1,071	591	793
Poor sites:											
Softwood	1,681	412	131	190	155	199	239	160	87	54	54
Hardwood	2,067	752	41	101	156	152	208	185	221	71	180
Total	3,748	1,164	172	291	311	351	447	345	308	125	234
All sites:											
Softwood	6,905	655	1,151	1,050	847	1,068	957	580	300	154	143
Hardwood	12,640	2,255	651	662	936	1,394	1,772	1,740	1,378	771	1,081
Total	19,545	2,910	1,802	1,712	1,783	2,462	2,729	2,320	1,678	925	1,224

Several strong relationships between site and stocking were found (table 5). The better the site, the more likely that an area supports a manageable stand. Thus, while 90 percent of the good sites were adequately stocked with trees suitable for management, less than 70 percent of poor sites were so stocked. Better sites are probably attracting a better quality of timber management, and they restock better under custodial management.

Another finding is that hardwoods are more likely to dominate on good than on poor sites. Hardwood types accounted for 65 percent of the adequately stocked stands on good sites, and only 50 percent on poor sites.

The average volumes of growing stock per acre of commercial forest lend additional credibility to both the classification of site and stand age (table 6). The large spread in average volume between good sites and poor sites for a given age class certainly substantiates the importance of site selection for timber production investments. Furthermore, the low average volumes found on the poor sites imply that up to 20 percent of North Carolina's timberland is unlikely to attract investment dollars for timber production from knowledgeable land managers unless prospective yields can be increased through site improvement.

Although table 6 has many of the attributes of a conventional yield table, readers should fully understand that it does not reflect volume removed through thinnings and other intermediate cutting, or lost through mortality. The table, therefore, shows minimum yields as evidenced by actual stand performance

Table 6.--Average volume of growing stock per acre of commercial forest land, by broad site class and forest type and by stand-age class, North Carolina, 1974

Broad site class and forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Cubic feet										
Good sites:											
Softwood	1,996	252	162	1,191	1,995	2,561	2,757	3,105	3,387	2,718	2,798
Hardwood	1,839	532	641	674	1,314	1,790	2,114	2,233	2,404	2,729	2,935
All types	1,894	484	380	1,009	1,674	2,125	2,347	2,432	2,663	2,728	2,927
Medium sites:											
Softwood	1,070	139	99	637	1,168	1,543	1,918	1,989	1,967	2,473	2,676
Hardwood	1,309	525	255	631	935	1,255	1,474	1,742	1,906	2,097	2,358
All types	1,224	461	153	634	1,044	1,377	1,620	1,798	1,916	2,151	2,395
Poor sites:											
Softwood	643	230	87	314	576	827	1,045	1,256	1,017	1,244	1,191
Hardwood	760	347	259	343	799	723	989	1,375	1,466	1,395	1,400
All types	700	299	121	323	680	790	1,023	1,311	1,284	1,322	1,333
All sites:											
Softwood	1,127	205	107	673	1,225	1,627	1,884	2,002	1,994	2,090	2,114
Hardwood	1,335	467	343	597	980	1,338	1,579	1,840	1,940	2,207	2,345
All types	1,255	397	190	644	1,100	1,470	1,695	1,884	1,952	2,185	2,313

and as influenced by a variety of past forestry practices and natural disturbances. Although the volumes removed through intermediate cuttings or lost through mortality are undetermined, the average volumes by stand-age classes still suggest that mean annual increment culminates at an early age in the development of a stand. The average volumes by stand-age classes also indicate that growth culminates earlier on the better sites.

The volumes in table 6 include the net, solid-wood content of growing-stock trees 5.0 inches d.b.h. and larger from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem and primary forks. The volume in rough trees, rotten trees, and trees less than 5.0 inches d.b.h. is excluded.

STAND-AGE DISTRIBUTION BY REGION

The distribution of commercial forest acreage by stand-age class was examined by region (table 7). North Carolina contains three well-defined physiographic regions--Coastal Plain, Piedmont, and Mountain. Each of these regions has its own unique forestry problems and opportunities. One significant finding is that average stand age increased east to west. For example, less than 18 percent of the manageable stands were 60 years of age or older on the Coastal Plain, compared to almost 40 percent in the Mountain region. Differences in species composition help to explain this finding in that the proportion of commercial forest area dominated by hardwoods also increases east to

west. With inadequate hardwood markets and less than 15 percent of its manageable stands under 30 years of age, the Mountain region would require several decades to correct the skewed stand-age distribution under an even-aged objective.

More than 60 percent of the acreage without a manageable stand was on the Coastal Plain. Several factors contributed to the high proportion of poorly stocked acres in this region: (1) the highest rate of timber harvesting in the State; (2) extensive acreages of poorly stocked bays and pocosins; (3) a fairly large concentration of scrub oak.

Table 7.--Area of commercial forest land, by region and broad forest type and by stand-age class, North Carolina, 1974

Region and broad forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Thousand acres										
Coastal Plain:											
Softwood	4,350	604	745	585	464	636	604	311	189	107	105
Hardwood	5,152	1,187	331	313	389	598	768	597	344	321	304
Total	9,502	1,791	1,076	898	853	1,234	1,372	908	533	428	409
Piedmont:											
Softwood	2,096	31	358	414	299	346	273	222	99	38	16
Hardwood	3,932	557	274	284	410	422	500	526	389	233	337
Total	6,028	588	632	698	709	768	773	748	488	271	353
Mountain:											
Softwood	459	20	48	51	84	86	80	47	12	9	22
Hardwood	3,556	511	46	65	137	374	504	617	645	217	440
Total	4,015	531	94	116	221	460	584	664	657	226	462
All regions:											
Softwood	6,905	655	1,151	1,050	847	1,068	957	580	300	154	143
Hardwood	12,640	2,255	651	662	936	1,394	1,772	1,740	1,378	771	1,081
Total	19,545	2,910	1,802	1,712	1,783	2,462	2,729	2,320	1,678	925	1,224

When all forest types and conditions are grouped, average volume per acre also increases east to west (table 8). Regional differences in average stand age are one cause for this condition. Some of the highest average volumes of growing stock per acre, however, were in old wetland hardwood stands on the Coastal Plain, and in some old pine stands in the Piedmont.

STAND-AGE DISTRIBUTION BY OWNERSHIP

The final examination of the distribution of commercial forest acreage by stand age was by broad ownership class (table 9). All publicly owned holdings were grouped, while the private holdings were placed in two classes--forest industry and other. Other private acreage under long-term lease to forest industry was included with forest industry. Differences found in the stand-age

Table 8.--Average volume of growing stock per acre of commercial forest land, by region and broad forest type and by stand-age class, North Carolina, 1974

Region and broad forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Cubic feet										
Coastal Plain:											
Softwood	1,034	206	82	599	1,183	1,511	1,867	1,873	1,895	1,923	1,980
Hardwood	1,342	457	356	612	983	1,399	1,677	2,009	2,137	2,372	2,782
All types	1,203	372	169	604	1,090	1,455	1,760	1,965	2,051	2,262	2,585
Piedmont:											
Softwood	1,377	180	186	824	1,302	1,866	1,943	2,284	2,269	3,036	3,751
Hardwood	1,261	468	314	581	938	1,241	1,499	1,619	1,888	2,013	2,169
All types	1,301	451	242	724	1,094	1,520	1,660	1,819	1,963	2,146	2,234
Mountain:											
Softwood	1,472	180	157	832	1,371	2,158	1,852	1,921	2,306	1,326	1,957
Hardwood	1,431	523	358	529	1,147	1,261	1,347	1,724	1,744	1,924	1,863
All types	1,435	509	258	662	1,224	1,438	1,415	1,738	1,756	1,905	1,867
All regions:											
Softwood	1,127	205	107	673	1,225	1,627	1,884	2,002	1,974	2,090	2,114
Hardwood	1,335	467	343	597	980	1,338	1,579	1,840	1,940	2,207	2,345
All types	1,255	397	190	644	1,100	1,470	1,695	1,884	1,952	2,185	2,313

Table 9.--Area of commercial forest land, by broad ownership class and forest type and by stand-age class, North Carolina, 1974

Broad ownership class and forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Thousand acres										
Public:											
Softwood	602	114	54	28	30	85	114	81	48	25	23
Hardwood	1,143	234	13	3	31	22	76	203	236	76	249
Total	1,745	348	67	31	61	107	190	284	284	101	272
Forest industry:[1]											
Softwood	1,410	170	522	274	120	113	100	33	43	14	21
Hardwood	906	184	125	45	56	63	88	121	74	80	70
Total	2,316	354	647	319	176	176	188	154	117	94	91
Other private:											
Softwood	4,893	371	575	748	697	870	743	466	209	115	99
Hardwood	10,591	1,837	513	614	849	1,309	1,608	1,416	1,068	615	762
Total	15,484	2,208	1,088	1,362	1,546	2,179	2,351	1,882	1,277	730	861
All owners:											
Softwood	6,905	655	1,151	1,050	847	1,068	957	580	300	154	143
Hardwood	12,640	2,255	651	662	936	1,394	1,772	1,740	1,378	771	1,081
Total	19,545	2,910	1,802	1,712	1,783	2,462	2,729	2,320	1,678	925	1,224

[1]Includes acreage under long-term lease.

distributions among the three owner classes evidence differences in management and owner objectives. The largest differences were between public and forest-industry lands. For example, stands less than 30 years old occupied 58 percent of the industry acreage supporting manageable stands, but only 11 percent of the similar acreage under public ownership.

Another fact that stands out in table 9 is that softwood species dominate on the acreage owned and leased by forest industry, whereas hardwoods dominate on other lands. Naturally, forest industry manages its forests for profit and to meet its long-range wood requirements; therefore, it favors the production of southern yellow pine on short rotations. The required forestry practices are often difficult and costly in North Carolina, where maintaining pine runs counter to the natural succession towards hardwoods. Forest industry benefits from profit opportunities extending from stumpage through primary and secondary manufacturing; many of these advantages are not available to other forest owners. Society benefits from industrial forests primarily through the jobs, payrolls, and profits generated.

Hardwoods dominate the species composition on publicly owned forests for a number of reasons: (1) hardwoods already occupied much of this acreage when it was acquired; (2) with the longer rotations commonly used in the timber management of public forests, there are fewer opportunities for controlling species composition; and (3) society demands that public forests be managed to provide a wide range of goods and services, of which timber is only one product.

Hardwoods dominate the species composition on other private forests for somewhat different reasons: (1) the drier and more gentle terrain characteristic of pine sites attracts investments in agricultural activities, urban development, and other nontimber uses of the land, while forests are relegated to the swamps, bays, stream margins, and mountains where hardwoods are firmly entrenched; (2) custodial-type management prevails in this owner class, enabling widespread hardwood encroachment onto pine sites following harvesting; (3) short owner tenure tends to discourage long-term forestry investments.

A casual comparison of average volume per acre by owner class could lead to a conclusion that other private owners are outperforming both forest industry and public agencies (table 10). A primary reason for the relatively low average volumes on publicly owned acreage at given stand ages is the prevalence of poor sites. Almost 40 percent of the public sites were classified as poor, compared to less than 20 percent of the private sites. The influence of site on timber yields has already been confirmed in table 6. Higher averages for the other private than for industrial acreage are more difficult to explain. Sites averaged only slightly better on other private than on forest industry acreages. Forest industry has already liquidated most of its older pine stands on better sites and replaced them with young pine plantations. A sharp increase in the industry averages can be expected as these plantations develop. The low average volumes in the upper age classes for industry reflect a residual of old, low-volume pond pine stands in the Coastal Plain. The higher average volumes for old softwood stands within the other private class have probably accumulated on acreage where owners have been unwilling to sell their timber for a variety of reasons. The higher averages in young stands of other private owners reflect a significant acreage of densely stocked pine stands

Table 10.--Average volume of growing stock per acre of commercial forest land, by broad ownership class and forest type and by stand-age class, North Carolina, 1974

Broad ownership class and forest type	All classes	Stand-age class									
		No manageable stand	Less than 10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80 and older
	Cubic feet										
Public:											
Softwood	948	248	53	770	958	1,266	1,618	1,390	1,138	1,003	1,508
Hardwood	1,364	430	443	([1])	463	1,525	1,368	1,770	1,636	1,902	1,862
All types	1,185	350	150	694	727	1,318	1,524	1,650	1,497	1,645	1,818
Forest industry:											
Softwood	588	108	54	542	893	1,610	1,614	1,738	1,589	1,850	1,719
Hardwood	1,337	441	207	659	1,259	1,478	1,663	2,083	1,933	2,173	2,968
All types	890	284	83	564	1,013	1,559	1,636	2,003	1,815	2,121	2,703
Other private:											
Softwood	1,342	239	180	725	1,308	1,669	1,968	2,121	2,309	2,331	2,361
Hardwood	1,332	474	382	592	973	1,324	1,582	1,823	1,990	2,244	2,373
All types	1,335	428	278	665	1,128	1,469	1,715	1,905	2,055	2,260	2,371
All owners:											
Softwood	1,127	205	107	673	1,225	1,627	1,884	2,002	1,994	2,090	2,114
Hardwood	1,335	467	343	597	980	1,338	1,579	1,840	1,940	2,207	2,345
All types	1,255	397	190	644	1,100	1,470	1,695	1,884	1,952	2,185	2,313

[1] Sample was too small to provide a valid estimate.

which have developed on abandoned fields. Furthermore, the volume averages for other private are often boosted by a scattering of residual trees from the previous stand. More of the young stands on industry holdings are developing following clearcutting and site preparation.

In conclusion, this information is intended to supplement the fourth State-wide evaluation of North Carolina's timber resource (Knight and McClure 1975),[3] and provides additional input for more in-depth forest resource analysis. It is apparent that improved stand-age classifications can enhance the usefulness of Forest Survey data. They can serve to (1) better quantify current and prospective timber supplies; (2) help identify opportunities for increasing future supplies; (3) measure the forest resource's response over time to practices and actions which involve extensive acreages; and (4) provide an often missing link for expanding other research results to the State and Regional levels. Based upon these results, efforts to strengthen the stand-age classifications in North Carolina have been extended into Virginia. An accumulation of stand-age information will open up additional opportunities for forest resource analyses in the Southeast.

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[3] Knight, Herbert A., and Joe P. McClure. 1975. North Carolina's timber, 1974. USDA For. Serv. Resour. Bull. SE-33, 52 p. Southeast. For. Exp. Stn., Asheville, N.C.

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Knight, Herbert A.
1976. Stand-age profile of North Carolina's timberland. USDA For. Serv. Resour. Bull. SE-38, 15 p. Southeast. For. Exp. Stn., Asheville, N. C.

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Keywords: Commercial forest, stand age, stand origin, forest type, site class, physiographic region, ownership, manageable stand.

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