**Point and Fixed Plot Sampling Inventory Estimates
at the Savannah River Site, South Carolina**

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Bernard R. Parresol, Ph.D.

USDA Forest Service, Southern Research Station, Asheville, NC 28804

Introduction

This report provides calculation of systematic point sampling volume estimates for trees ≥ 5 inches diameter breast height (dbh) and fixed radius plot volume estimates for trees < 5 inches dbh at the Savannah River Site (SRS), Aiken County, South Carolina. The inventory of 622 plots was started in March 1999 and completed in January 2002 (Figure 1). Estimates are given in cubic foot volume. The analyses are presented in a series of Tables and Figures. In addition, a preliminary analysis of fuel levels on the SRS is given, based on depth measurements of the duff and litter layers on the 622 inventory plots plus line transect samples of down coarse woody material. Potential standing live fuels are also included. The fuels analyses are presented in a series of tables.

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Volume Analyses

Tree gross cubic volumes were calculated from USDA Forest Service Forest Inventory and Analysis (FIA) models for the southern states (Appendix A). Gross cubic volume is defined as volume inside bark from a 1-foot stump to a 4-inch top, regardless of species. For sawtimber trees, topwood volume was calculated as the difference between total cubic volume (volume inside bark of the entire stem) and gross cubic volume. FIA models are keyed to species. The list of tree species that occurred on the 622 SRS plots are given in Appendix B. For purposes of this report the following tree size categories are used.

Softwoods (<i>Pinus</i> , <i>Juniperous</i> , <i>Taxodium</i>)		Hardwoods
Fuel	< 5" dbh	< 6" dbh
Pulpwood	5.0" to 8.9" dbh	6.0" to 11.9" dbh
Sawtimber	≥ 9.0"	≥ 12.0" dbh

A data file called the Continuous Inventory of Stand Conditions (CISC) is maintained by the SRS. The 2002 CISC database contains a listing of acres and forest type for each of the 6,009 forested stands which occupy approximately 182,420 acres. For purposes of the inventory analysis, the forest type attributes in CISC were arranged into seven broad species composition groupings defined on the basis of the forest types as shown in Table 1 (and see Figure 1).

Table 1. The linkage between the broad species composition groups with the relevant Forest Service forest types used in the CISC database.

Group	Group Name	Forest Types Included	# Stands	Acres	Percent
1	Loblolly pine	25, 31, 32	1897	62,602	34.32
2	Longleaf pine	21, 26, 34	1151	43,294	23.73
3	Slash pine	22	618	17,716	9.71
4	Pine-Hardwood mix	12, 13, 14, 35	272	5,340	2.93
5	Hardwood-Pine mix	44, 46, 47, 48, 49	214	5,355	2.94
6	Hardwoods	51, 52, 53, 54, 56, 57, 58, 61, 62, 63, 64, 68, 72, 82, 98	1739	41,436	22.71
7	Cypress/Tupelo	67	118	6,677	3.66
			6,009	182,420	100.00

For forest management purposes, the SRS is divided into six management areas (Figure 2). From the 2002 CISC database, the forested acre breakdown by management area is listed in Table 2.

Table 2. The six management areas of the Savannah River Site.

Management Area [†]	Acres	Percent	Acres covered by inventory
Primary RCW HMA	82,171	45.05	82,064
Supplemental RCW HMA	43,054	23.60	43,054
Other or Industrial	31,987	17.53	31,687
Crackerneck WLMA	10,908	5.98	10,677
Savannah Swamp	10,037	5.50	10,037
Lower Three Runs Tail	<u>4,263</u>	<u>2.34</u>	<u>543</u>
	182,420	100.00	178,062

[†]Terminology: RCW is Red-cockaded Woodpecker, HMA is habitat management area, WLMA is wildlife management area

Figure 2. Display of the six broad management areas of the Savannah River Site.

The distribution of the 622 inventory plots across the six management areas and the seven broad forest type groups are given in Table 3. As can be seen in Table 3, not all forest type groups are covered by inventory plots within each management area. In particular, the Lower Three Runs Tail area has only 1 inventory plot which occurs in the loblolly forest type with 543 acres. Thus, the remainder of the 4,263 acres (i.e., $4263 - 543 = 3720$ ac) were eliminated from the analysis. Table 2 lists the actual acres covered by the 622 inventory plots. Due to lack of data, volume (and fuel) estimates cannot be projected onto 4,358 acres ($182420 - 178062 = 4358$ ac).

Table 3. Distribution of the inventory plots across management areas and broad forest types.

Frequency Percent Row Pct Col Pct	Loblolly	Longleaf	Slash	Pine/Hdw	Hdw/Pine	Hardwood	Cypress	Total
Primary RCW HMA	124 19.94 39.49 44.77	103 16.56 32.80 79.84	19 3.05 6.05 32.76	16 2.57 5.10 69.57	12 1.93 3.82 44.44	40 6.43 12.74 38.83	0 0.00 0.00 0.00	314 50.48
Supplemental RCW HMA	76 12.22 49.35 27.44	14 2.25 9.09 10.85	24 3.86 15.58 41.38	5 0.80 3.25 21.74	6 0.96 3.90 22.22	28 4.50 18.18 27.18	1 0.16 0.65 20.00	154 24.76
Other or Industrial	60 9.65 53.10 21.66	11 1.77 9.73 8.53	13 2.09 11.50 22.41	2 0.32 1.77 8.70	4 0.64 3.54 14.81	23 3.70 20.35 22.33	0 0.00 0.00 0.00	113 18.17
Crackerneck WLMA	16 2.57 47.06 5.78	1 0.16 2.94 0.78	2 0.32 5.88 3.45	0 0.00 0.00 0.00	5 0.80 14.71 18.52	8 1.29 23.53 7.77	2 0.32 5.88 40.00	34 5.47
Savannah Swamp	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	4 0.64 66.67 3.88	2 0.32 33.33 40.00	6 0.96
Lower Three Runs Tail	1 0.16 100.00 0.36	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	0 0.00 0.00 0.00	1 0.16
Total	277 44.53	129 20.74	58 9.32	23 3.70	27 4.34	103 16.56	5 0.80	622 100.00

The nature of horizontal point sampling selects trees with probability proportional to size, that is, to tree diameter. For trees equal to or larger than 5 inches in diameter a 7.5 basal area factor (BAF) was used during the inventory. This means each tree selected at a sample point represents 7.5 ft² of tree basal area in the stand. Around each sample point was a fixed area plot 1/60th-acre in size where trees less than 5 inches dbh were recorded. In horizontal point cruising a tree factor (TF) is computed based on the diameter of the tree and the BAF used (BAF=7.5 for this inventory), that is:

$$TF = BAF \div \pi dbh^2/576 = 4320 / (\pi dbh^2)$$

For the fixed area plots the tree factor is a constant 60, that is, TF = 60.

An estimate of a per acre characteristic, X_i , assuming m trees at one point can be obtained from the following formula, where $X_1, X_2, \dots, X_m$ represent the individual tree values for the characteristic being estimated:

$$X_i = X_1 \times TF_1 + X_2 \times TF_2 + \dots + X_m \times TF_m$$

Therefore, an average per acre estimate (A) obtained from n points visited in a sample can be obtained by dividing the sum of the point estimates by n, that is

$$A = \Sigma X_i / n$$

A total value for the inventory is obtained by multiplying the average per acre estimate by the total number of acres.

Volume Results

To begin, Table 1 shows that 67.8 percent of the SRS acres are in the 3 pine forest types (loblolly, longleaf, slash). From Table 3 we see that 464 inventory plots or 74.6 percent of the total sample occur in the 3 pine forest types. The 2 mixed types (pine-hdwd and hdwd-pine) occupy around 5.9 percent of the SRS and were sampled with 50 plots or about 8 percent of the

inventory. The hardwood type occurs on 22.7 percent of the SRS and were covered by 103 plots or 16.6 percent of the inventory. Finally, the cypress/tupelo stands cover approximately 3.7 percent of the SRS and were sampled with 5 plots representing 0.8 percent of the inventory effort. From this we can conclude that the 3 pine types and 2 mixed types were adequately sampled but that the hardwood types and cypress/tupelo stands were underrepresented in the inventory. However, since the pine types and mixed types are more valuable economically and are the habitats of interest for Red-cockaded Woodpecker management, placing more sampling effort in these types is justified.

The main results of the inventory analysis are presented in Tables 4 and 5. Total gross cubic foot volumes are given in Table 4 for each management area by broad forest type. Each broad forest type is subdivided into their pine and hardwood component and volumes are displayed by tree size category (sawtimber or ST, pulp, and fuel). Table 5 has the same structure as Table 4 except average gross cubic volume per acre is given in the table cells. The overall volume for the 178,062 acres is 520,586,019 ft³ giving an average per acre volume of 2,923.62 ft³. If one excludes the sawtimber top wood we have 468,730,146 ft³ giving an average per acre volume of 2,632.40 ft³.

Figure 3 shows the trend of gross cubic volume per acre over age for each of the seven forest type groups. The loblolly volume increases rapidly until age 25-30 and then slowly increases to age 70 where it seems to peak. The longleaf volume steadily increases and peaks around age 50 then volume starts declining with age. The slash and pine-hardwood types both show a nearly linear increase over the range of data from age 5 to 70-80. The hardwoods type volume peaks between 60 and 70 years of age and levels off. There are no clear trends with the hardwood-pine and cypress/tupelo types. Figure 4 gives the trend of basal area per acre over age

for each broad forest type and the same general conclusions hold as for the volume trends.

Finally, Figure 5 shows the average dbh-frequency distribution per acre for the broad groups pine, cypress, and hardwoods. The pine and hardwoods both display a reverse j-shaped trend as is typical of many-aged stands. The cypress trend is erratic and is reflective of old stands with low density and mainly large trees.

Fuels Analysis Starts on Page 18

Table 4. Total gross cubic volume estimates from the 1999-2001 SRS inventory of 622 plots.

Total Volume	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft
<i>Loblolly Type</i>	27,587 acres	18,313 acres	11,593 acres	4,566 acres	0 acres	543 acres	62,602 acres
Pine Gross Vol							
ST (≥ 9.0)	44,262,450	29,316,468	16,140,227	10,197,206		2,231,549	102,147,899
ST Top Wood	5,851,690	4,072,091	2,189,638	1,292,324		267,885	13,673,628
Pulp (5.0-8.9)	12,905,896	9,398,781	5,268,043	1,346,139		0	28,918,859
Fuel (< 5.0)	3,922,530	2,100,877	1,571,384	529,237		152,591	8,276,620
<i>Loblolly Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	1,422,081	1,222,528	697,576	201,496		0	3,543,682
ST Top Wood	282,610	227,225	152,400	48,877		0	711,113
Pulp (6.0-11.9)	2,713,018	2,575,174	650,972	876,942		73,249	6,889,355
Fuel (< 6.0)	2,920,197	2,581,942	2,202,915	1,285,881		3,656	8,994,591
<i>Longleaf Type</i>	30,279 acres	7,163 acres	5,626 acres	226 acres	0 acres	0 acres	43,294 acres
Pine Gross Vol							
ST (≥ 9.0)	41,863,449	10,122,823	7,599,703	0			59,585,975
ST Top Wood	5,509,686	1,340,956	1,028,609	0			7,879,251
Pulp (5.0-8.9)	5,321,636	690,970	1,787,536	0			7,800,143
Fuel (< 5.0)	2,883,166	667,560	820,963	11,217			4,382,905
<i>Longleaf Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	241,876	405,374	0	37,959			685,208
ST Top Wood	52,014	78,247	0	9,772			140,033
Pulp (6.0-11.9)	1,044,881	466,737	341,825	0			1,853,443
Fuel (< 6.0)	1,513,189	509,272	662,910	0			2,685,372
<i>Slash Type</i>	6,496 acres	6,716 acres	4,280 acres	224 acres	0 acres	0 acres	17,716 acres
Pine Gross Vol							
ST (≥ 9.0)	12,936,376	16,948,838	8,962,505	803,615			39,651,334
ST Top Wood	1,722,751	2,223,400	1,186,891	101,174			5,234,215
Pulp (5.0-8.9)	1,156,656	1,592,783	847,717	13,746			3,610,901
Fuel (< 5.0)	869,777	616,577	652,202	23,442			2,161,997
<i>Slash Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	0	499,561	219,517	0			719,078
ST Top Wood	0	102,468	53,705	0			156,173
Pulp (6.0-11.9)	172,768	727,056	473,966	0			1,373,790
Fuel (< 6.0)	328,572	807,485	776,195	43,246			1,955,497

Table 4. Continued.

Total Volume	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft
<i>Pine-Hdwd</i>	2,059 acres	1,112 acres	1,932 acres	231 acres	0 acres	6 acres	5,340 acres
Pine Gross Vol				<i>No Data</i>		<i>No Data</i>	5,103 acres
ST (≥ 9.0)	1,649,281	1,325,894	4,514,782	--		--	7,489,957
ST Top Wood	219,356	164,541	564,405	--		--	948,302
Pulp (5.0-8.9)	133,000	29,081	0	--		--	162,081
Fuel (< 5.0)	66,735	1,270	28,557	--		--	96,562
<i>Pine-Hdwd</i>							
Hdwd Gross Vol				<i>No Data</i>		<i>No Data</i>	
ST (≥ 12.0)	606,046	499,655	1,942,261	--		--	3,047,963
ST Top Wood	131,608	102,570	437,077	--		--	671,254
Pulp (6.0-11.9)	589,887	413,796	65,426	--		--	1,069,109
Fuel (< 6.0)	414,846	335,120	420,864	--		--	1,170,829
<i>Hdwd-Pine</i>	2,063 acres	1,687 acres	1,003 acres	282 acres	0 acres	320 acres	5,355 acres
Pine Gross Vol						<i>No Data</i>	5,035 acres
ST (≥ 9.0)	2,404,875	1,265,373	1,308,337	403,263		--	5,381,847
ST Top Wood	295,182	152,684	164,873	50,971		--	663,709
Pulp (5.0-8.9)	0	32,655	92,724	6,284		--	131,663
Fuel (< 5.0)	0	1,605	0	0		--	1,605
<i>Hdwd-Pine</i>							
Hdwd Gross Vol						<i>No Data</i>	
ST (≥ 12.0)	1,734,476	1,254,329	847,553	358,632		--	4,194,990
ST Top Wood	371,232	240,731	179,235	76,357		--	867,554
Pulp (6.0-11.9)	1,291,854	1,618,875	427,995	120,127		--	3,458,850
Fuel (< 6.0)	607,892	664,146	91,083	129,351		--	1,492,472
<i>Hardwood</i>	13,580 acres	7,659 acres	7,253 acres	4,662 acres	5,324 acres	2,958 acres	41,436 acres
Pine Gross Vol						<i>No Data</i>	38,478 acres
ST (≥ 9.0)	5,495,799	2,784,068	1,812,192	861,606	0	--	10,953,665
ST Top Wood	698,583	345,918	218,030	105,268	0	--	1,367,798
Pulp (5.0-8.9)	349,718	98,256	0	0	0	--	447,974
Fuel (< 5.0)	186,879	40,778	0	11,232	0	--	238,889
<i>Hardwood</i>							
Cypress Gross V						<i>No Data</i>	
ST(≥ 9.0)	0	0	283,123	259,682	1,021,682	--	1,564,487
ST Top Wood	0	0	73,656	57,464	197,966	--	329,087
<i>Hardwood</i>							
Hdwd Gross Vol						<i>No Data</i>	
ST (≥ 12.0)	11,157,384	12,281,892	14,595,889	7,703,407	11,565,809	--	57,304,380
ST Top Wood	2,243,533	2,153,969	2,938,197	1,407,949	2,262,978	--	11,006,626
Pulp (6.0-11.9)	7,586,946	5,299,796	4,856,611	2,765,807	3,269,129	--	23,778,289
Fuel (< 6.0)	4,366,130	2,286,903	2,747,857	1,057,181	676,844	--	11,134,916

Table 4. Continued.

Total Volume	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft
<i>Cypress/Tupelo</i>	107 acres	404 acres	300 acres	717 acres	4,713 acres	436 acres	6,677 acres
Cypress Gross V	<i>No Data</i>		<i>No Data</i>			<i>No Data</i>	5,834 acres
ST (≥ 9.0)	--	645,480	--	1,283,426	22,990,424	--	24,919,330
ST Top Wood	--	189,195	--	246,474	4,602,395	--	5,038,064
Pulp (5.0-8.9)	--	0	--	0	597,261	--	597,261
<i>Cypress/Tupelo</i>							
Hdwd Gross Vol	<i>No Data</i>		<i>No Data</i>			<i>No Data</i>	
ST (≥ 12.0)	--	1,188,959	--	4,655,397	6,824,568	--	12,668,924
ST Top Wood	--	240,213	--	1,086,053	1,842,800	--	3,169,067
Pulp (6.0-11.9)	--	582,655	--	845,413	9,339,573	--	10,767,641
Fuel (< 6.0)	--	141,946	--	113,768	1,164,097	--	1,419,811

Total Volume	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft	Cuft
	82,171 acres	43,054 acres	31,987 acres	10,908 acres	10,037 acres	4,263 acres	182,420 ac
<i>All Types</i>	82,064 acres		31,687 acres	10,677 acres		543 acres	178,062 ac
Pine Gross Vol							
ST (≥ 9.0)	108,612,229	61,763,464	40,337,746	12,265,690		2,231,549	225,210,677
ST Top Wood	14,297,247	8,299,589	5,352,445	1,549,737		267,885	29,766,903
Pulp (5.0-8.9)	19,866,907	11,842,526	7,996,020	1,366,169			41,071,622
Fuel (< 5.0)	7,929,087	3,428,667	3,073,105	575,128		152,591	15,158,578
<i>All Types</i>							
Cypress Gross V							
ST (≥ 9.0)		645,480	283,123	1,543,109	24,012,106		26,483,817
ST Top Wood		189,195	73,656	303,938	4,800,361		5,367,151
Pulp (5.0-8.9)					597,261		597,261
<i>All Types</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	15,161,863	17,352,299	18,302,796	12,956,890	18,390,377		82,164,226
ST Top Wood	3,080,997	3,145,422	3,760,613	2,629,008	4,105,778		16,721,819
Pulp (6.0-11.9)	13,399,356	11,684,089	6,816,794	4,608,288	12,608,702	73,249	49,190,478
Fuel (< 6.0)	10,150,826	7,326,814	6,901,823	2,629,427	1,840,941	3,656	28,853,488
						TOTAL:	520,586,019

Table 5. Average gross cubic volume estimates from the 1999-2001 SRS inventory of 622 plots.

Volume per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac
<i>Loblolly Type</i>	27,587 acres	18,313 acres	11,593 acres	4,566 acres	0 acres	543 acres	62,602 acres
Pine Gross Vol							
ST (≥ 9.0)	1,604.47	1,600.86	1,392.24	2,233.29		4,109.67	1,631.70
ST Top Wood	212.12	222.36	188.88	283.03		493.34	218.42
Pulp (5.0-8.9)	467.83	513.23	454.42	294.82		0	461.95
Fuel (< 5.0)	142.19	114.72	135.55	115.91		281.02	132.21
<i>Loblolly Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	51.55	66.76	60.17	44.13		0	56.61
ST Top Wood	10.24	12.41	13.15	10.70		0	11.36
Pulp (6.0-11.9)	98.34	140.62	56.15	192.06		134.90	110.05
Fuel (< 6.0)	105.85	140.99	190.02	281.62		6.73	143.68
<i>Longleaf Type</i>	30,279 acres	7,163 acres	5,626 acres	226 acres	0 acres	0 acres	43,294 acres
Pine Gross Vol							
ST (≥ 9.0)	1,382.59	1,413.21	1,350.82	0			1,376.31
ST Top Wood	181.96	187.21	182.83	0			181.99
Pulp (5.0-8.9)	175.75	96.46	317.73	0			180.17
Fuel (< 5.0)	95.22	93.20	145.92	49.63			101.24
<i>Longleaf Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	7.99	56.59	0	167.96			15.83
ST Top Wood	1.72	10.92	0	43.24			3.23
Pulp (6.0-11.9)	34.51	65.16	60.76	0			42.81
Fuel (< 6.0)	49.97	71.10	117.83	0			62.03
<i>Slash Type</i>	6,496 acres	6,716 acres	4,280 acres	224 acres	0 acres	0 acres	17,716 acres
Pine Gross Vol							
ST (≥ 9.0)	1,991.44	2,523.65	2,094.04	3,587.57			2,238.17
ST Top Wood	265.20	331.06	277.31	451.67			295.45
Pulp (5.0-8.9)	178.06	237.16	198.06	61.36			203.82
Fuel (< 5.0)	133.89	91.81	152.38	104.65			122.04
<i>Slash Type</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	0	74.38	51.29	0			40.59
ST Top Wood	0	15.26	12.55	0			8.82
Pulp (6.0-11.9)	26.60	108.26	110.74	0			77.55
Fuel (< 6.0)	50.58	120.23	181.35	193.06			110.38

Table 5. Continued.

Volume per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac
<i>Pine-Hdwd</i>	2,059 acres	1,112 acres	1,932 acres	231 acres	0 acres	6 acres	5,103 acres
Pine Gross Vol				<i>No Data</i>		<i>No Data</i>	
ST (≥ 9.0)	801.01	1,192.35	2,336.84	--		--	1,467.76
ST Top Wood	106.54	147.97	292.14	--		--	185.83
Pulp (5.0-8.9)	64.59	26.15	0	--		--	31.76
Fuel (< 5.0)	32.41	1.14	14.78	--		--	18.92
<i>Pine-Hdwd</i>							
Hdwd Gross Vol				<i>No Data</i>		<i>No Data</i>	
ST (≥ 12.0)	294.34	449.33	1,005.31	--		--	597.29
ST Top Wood	63.92	92.24	226.23	--		--	131.54
Pulp (6.0-11.9)	286.49	372.12	33.86	--		--	209.51
Fuel (< 6.0)	201.48	301.37	217.84	--		--	229.44
<i>Hdwd-Pine</i>	2,063 acres	1,687 acres	1,003 acres	282 acres	0 acres	320 acres	5,035 acres
Pine Gross Vol						<i>No Data</i>	
ST (≥ 9.0)	1,165.72	750.07	1,304.42	1,430.01		--	1,068.89
ST Top Wood	143.08	90.51	164.38	180.75		--	131.82
Pulp (5.0-8.9)	0	19.36	92.45	22.28		--	26.15
Fuel (< 5.0)	0	0.95	0	0		--	0.32
<i>Hdwd-Pine</i>							
Hdwd Gross Vol						<i>No Data</i>	
ST (≥ 12.0)	840.75	743.53	845.02	1,271.74		--	833.17
ST Top Wood	179.95	142.70	178.70	270.77		--	172.30
Pulp (6.0-11.9)	626.20	959.62	426.72	425.98		--	686.96
Fuel (< 6.0)	294.66	393.68	90.81	458.69		--	296.42
<i>Hardwood</i>	13,580 acres	7,659 acres	7,253 acres	4,662 acres	5,324 acres	2,958 acres	38,478 acres
Pine Gross Vol						<i>No Data</i>	
ST (≥ 9.0)	404.70	363.50	249.85	184.81	0	--	284.67
ST Top Wood	51.44	45.16	30.06	22.58	0	--	35.55
Pulp (5.0-8.9)	25.75	12.83	0	0	0	--	11.64
Fuel (< 5.0)	13.76	5.32	0	2.41	0	--	6.21
<i>Hardwood</i>							
Cypress Gross V						<i>No Data</i>	
ST (≥ 9.0)	0	0	39.04	55.70	191.90	--	40.66
ST Top Wood	0	0	10.16	12.33	37.18	--	8.55
<i>Hardwood</i>							
Hdwd Gross Vol						<i>No Data</i>	
ST (≥ 12.0)	821.60	1,603.59	2,012.39	1,652.38	2,172.39	--	1,489.28
ST Top Wood	165.21	281.23	405.10	302.01	425.05	--	286.05
Pulp (6.0-11.9)	558.69	691.97	669.60	593.27	614.04	--	617.97
Fuel (< 6.0)	321.51	298.59	378.86	226.77	127.13	--	289.38

Table 5. Continued.

Volume per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac
<i>Cypress/Tupelo</i>	107 acres	404 acres	300 acres	717 acres	4,713 acres	436 acres	5,834 acres
Cypress Gross V	<i>No Data</i>		<i>No Data</i>			<i>No Data</i>	
ST (≥ 9.0)	--	1,597.72	--	1,789.99	4,878.09	--	4,271.40
ST Top Wood	--	468.31	--	343.76	976.53	--	863.57
Pulp (5.0-8.9)	--	0	--	0	126.73	--	102.38
<i>Cypress/Tupelo</i>							
Hdwd Gross Vol	<i>No Data</i>		<i>No Data</i>			<i>No Data</i>	
ST (≥ 12.0)	--	2,942.97	--	6,492.88	1,448.03	--	2,171.57
ST Top Wood	--	594.59	--	1,514.72	391.00	--	543.21
Pulp (6.0-11.9)	--	1,442.22	--	1,179.10	1,981.66	--	1,845.67
Fuel (< 6.0)	--	351.35	--	158.67	247.00	--	243.37

Volume per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac	Cuft/ac
<i>All Types</i>	82,064 acres	43,054 acres	31,687 acres	10,677 acres	10,037 acres	543 acres	178,062 ac
Pine Gross Vol							
ST (≥ 9.0)	1,323.51	1,434.56	1,273.01	1,148.80		4,109.67	1,264.79
ST Top Wood	174.22	192.77	168.92	145.15		493.34	167.17
Pulp (5.0-8.9)	242.09	275.06	252.34	127.95			230.66
Fuel (< 5.0)	96.62	79.64	96.98	53.87		281.02	85.13
<i>All Types</i>							
Cypress Gross V							
ST (≥ 9.0)		14.99	8.93	144.53	2,392.36		148.73
ST Top Wood		4.39	2.32	28.47	478.27		30.14
Pulp (5.0-8.9)					59.51		3.35
<i>All Types</i>							
Hdwd Gross Vol							
ST (≥ 12.0)	184.76	403.04	577.61	1,213.53	1,832.26		461.44
ST Top Wood	37.54	73.06	118.68	246.23	409.06		93.91
Pulp (6.0-11.9)	163.28	271.38	215.13	431.61	1,256.22	134.90	276.25
Fuel (< 6.0)	123.69	170.18	217.81	246.27	183.42	6.73	162.04
						AVERAGE	2,923.62

Figure 3. Scatter graphs of plot gross cubic volume over age by broad forest type.

Figure 4. Scatter graphs of plot basal area over age by broad forest type.

Figure 5. Diameter distribution by broad forest type group.

Fuels Analysis

There are four generally recognized sources of fuel (tons dry weight) in forest ecosystems: 1) standing live and dead trees, 2) down coarse woody material, 3) litter layer, and 4) duff layer. For clarity, a ton is understood to be 2,000 pounds (lb). For this analysis, these components are defined as follows:

1. Fuel trees are conifers (*Pinus*, *Juniperous*, *Taxodium*) < 5" dbh and hardwoods < 6" dbh.
2. Coarse woody debris (CWD) is all downed live or dead woody material.
3. Litter is all dead, detached plant material lying loosely on the forest floor.
4. Duff includes all the partly decayed organic material between litter and the A1 soil horizon.

Computation of biomass for each fuel component was done in a different fashion. For standing fuel trees (i.e., non-merchantable arborescents) biomass equations were utilized (Brown, S., Schroeder, P., and Birdsey, R. 1997. Aboveground biomass distribution of US eastern hardwood forests and the use of large trees as an indicator of forest development. *Forest Ecology and Management* 96: 37-47). Brown and others pooled all hardwood species into one data set and all of the conifer species into a second data set and fitted the following nonlinear functions:

$$\text{Hardwoods: } W = \frac{0.5 + 25,000(D \cdot 2.54)^{2.5}}{(D \cdot 2.54)^{2.5} + 246,872}$$

$$\text{Conifers: } W = \frac{0.5 + 15,000(D \cdot 2.54)^{2.7}}{(D \cdot 2.54)^{2.7} + 364,946}$$

where W is aboveground dry biomass in kg per tree and D is tree diameter (dbh) in inches. To convert kg to lb multiply by 2.2046.

The coarse woody debris fuel component is normally calculated based on 5 size class subcomponents (Brown, J.K. 1974. Handbook for inventorying downed woody material. General

Technical Report INT-16. Ogden, UTAH: USDA Forest Service, Intermountain Forest and Range Experiment Station. 24 p.): 1) 0 - 0.25", 2) 0.25" - 1", 3) 1" - 3", 4) 3"+ sound wood, and 5) 3"+ rotten wood. These subcomponents were sampled using the planar intercept method where a series of line transects were laid out around each of the main inventory plots. Formulas to compute tons/ac are:

$$\text{0- to 3-inch material: } = \frac{11.64 \times n \times d^2 \times s \times a \times c}{L}$$

$$\text{3+-inch material} \quad : \quad = \frac{11.64 \times \Sigma d^2 \times s \times a \times c}{L}$$

where n is number of particles counted in each size class along a line transect, d is average particle diameter for the 0- to 3-inch size classes and d is measured diameter for pieces 3"+, s is wood specific gravity, a is the nonhorizontal angle correction factor (the correction factor adjusts weight estimates for the fact that all particles do not lie horizontally as assumed in the planar intersect theory), c is the slope correction factor for converting weight/ac on a slope basis to a horizontal basis, and L is the transect length in ft. The percent slope was measured at each inventory plot and the slope correction factor was calculated as $c = \sqrt{1 + (\text{percent slope}/100)^2}$.

The following values for average d^2 , s , a , and L were used:

Size class	d^2	s	a	L
0 – 0.25"	0.0151	0.7	1.13	40
0.25" - 1"	0.289	0.7	1.13	40
1" - 3"	2.76	0.58	1	80
3"+ sound	--	0.58	1	280
3"+ rotten	--	0.3	1	280

For the litter and duff calculations, a series of 8 litter plots and 8 duff plots were measured around each main inventory plot. Litter and duff depths were measured to the nearest 1/10inch. All sixteen subplots were averaged for a combined average litter/duff depth for each inventory plot. Currently research is being conducted at the SRS to determine appropriate bulk density values to convert litter/duff depths to tons/acre/inch. For this preliminary fuels analysis, the following scheme of fuel complexes was used to assign the tons/acre/inch factor.

Fuel Complex Types	Tons/Acre/Inch
Fuel Complex 1	2.104846
Fuel Complex 2	1.308462
Fuel Complex 3	1.518970
Fuel Complex 4	2.130545
Fuel Complex 5	1.642048
Fuel Complex 6	1.002941
Fuel Complex 7	1.420617
Fuel Complex 8	1.078125

The fuel complexes (FC) are defined as follows.

FC1. Immature loblolly pine plantation with no understory development. Canopy height of 30 feet.

FC2. Similar to that of fuel complex 1, but has fuel ladders as high as 12 feet. Composed of excessive needle cast and heavy vines.

FC3. Mature loblolly pine sawtimber with heavy concentration of pole staged loblolly and longleaf regeneration.

FC4. Similar to fuel complex 1. Immature loblolly sawtimber with a relatively clear understory.

FC5. Similar to fuel complex 1, but with developed discontinuous understory.

FC6. Longleaf stands after commercial thinning in open canopies. Forest floor covered in natural regeneration, grasses, and herbaceous vegetation.

FC7. Red cockaded woodpecker management areas in mature longleaf stands after midstory removal.

FC8. Predominately hardwood stands comprised of oak-hickory cover types.

Each of the 622 inventory plots was assigned to a fuel complex type based on forest type, age, understory density, and spatial location.

Fuels Results

The main results of the fuels analysis are presented in Tables 6 and 7. Total fuel weight in tons are given in Table 6 for each management area by broad forest type. Fuel weights are displayed by the fuel categories conifer fuel trees, hardwood fuel trees, CWD, and litter/duff. Table 7 has the same structure as Table 6 except average fuel weight in tons per acre is given in the table cells. The overall fuel tonnage for the 178,062 acres is 2,052,956 tons giving an average per acre value of 11.5 tons. This average breaks down as follows: 1.6 tons/ac in conifer fuel trees, 4.4 tons/ac in hdwd fuel trees, 4.1 tons/ac in CWD, and 1.3 tons/ac in litter/duff. The two categories with the highest fuel values are the non-merchantable hardwood arborescents and the CWD. To reduce fire risk these seem to be the categories of most concern. The average tons/ac of fuels in the 6 management areas are:

Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail
10.8	11.4	12.7	12.1	14.0	8.2

The two RCW management areas appear to have the lowest fuel tonnage (except the Lower Three Runs Tail, which is marginal forest land). These fuel values compare favorably against fuel values in second growth longleaf pine stands on the Osceola National Forest, near Lake City, FL. Unburned plots averaged about 17 fuel tons/ac and 4 year burn cycles averaged 9 tons/ac, 2 year burn cycle at 5 tons/ac and 1 year burn cycle about 4 tons/ac (<http://www.srs.fs.usda.gov/osceola/osceola2.htm>).

Table 6. Total fuel estimates in tons from the 1999-2001 SRS inventory of 622 plots.

Total Fuel Weight	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
<i>Loblolly Type</i>	27,587 acres	18,313 acres	11,593 acres	4,566 acres	0 acres	543 acres	62,602 acres
Conifer fuel trees	80,110.8	39,391.7	31,790.3	8,077.8		1,578.6	160,949.2
Hdwd fuel trees	80,817.8	65,271.8	54,374.9	31,719.7		72.0	232,256.3
CWD	122,037.5	63,812.2	32,233.1	13,903.0		2,008.7	233,994.5
Litter and duff	38,975.2	28,869.4	18,001.5	6,863.5		793.9	93,503.5
<i>Longleaf Type</i>	30,279 acres	7,163 acres	5,626 acres	226 acres	0 acres	0 acres	43,294 acres
l							
Conifer fuel trees	57,236.5	12,587.0	16,809.4	221.6			86,854.5
Hdwd fuel trees	48,363.7	12,796.2	19,279.5	0			80,439.4
CWD	102,738.5	28,178.7	17,575.5	1,808.6			150,301.2
Litter and duff	41,276.5	9,469.7	7,899.0	60.3			58,705.5
<i>Slash Type</i>	6,496 acres	6,716 acres	4,280 acres	224 acres	0 acres	0 acres	17,716 acres
Conifer fuel trees	14,891.5	10,346.1	10,700.4	304.4			36,242.4
Hdwd fuel trees	9,856.5	19,605.0	19,730.9	901.1			50,093.5
CWD	30,910.3	31,064.2	17,535.0	416.7			79,926.2
Litter and duff	10,419.0	12,928.3	7,823.8	474.2			31,645.3
<i>Pine-Hdwd</i>	2,059 acres	1,112 acres	1,932 acres	231 acres	0 acres	6 acres	5,340 acres
				<i>No Data</i>		<i>No Data</i>	5,103 acres
Conifer fuel trees	1,399.4	12.3	409.7				1,821.3
Hdwd fuel trees	13,812.5	7,223.0	13,583.9				34,619.4
CWD	7,292.0	4,889.4	16,474.2				28,655.6
Litter and duff	2,610.8	1,275.6	2,590.2				6,476.7
<i>Hdwd-Pine</i>	2,063 acres	1,687 acres	1,003 acres	282 acres	0 acres	320 acres	5,355 acres
						<i>No Data</i>	5,035 acres
Conifer fuel trees	0	15.5	0	0			15.5
Hdwd fuel trees	18,966.3	15,577.1	3,301.0	2,983.9			40,828.3
CWD	8,456.8	6,383.0	5,918.9	1,388.4			22,147.1
Litter and duff	2,224.2	1,928.7	941.1	308.6			5,402.6

Table 6. Continued.

Total Fuel Weight	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
<i>Hardwood</i>	13,580 acres	7,659 acres	7,253 acres	4,662 acres	5,324 acres	2,958 acres	41,436 acres
						No Data	38,478 acres
Conifer fuel trees	3,237.8	650.1	0	232.9	0		4,120.8
Hdwd fuel trees	130,547.8	67,456.3	69,330.7	27,454.1	19,454.8		314,243.7
CWD	42,840.7	37,891.4	30,536.0	20,224.7	18,127.6		149,620.5
Litter and duff	13,494.8	6,779.1	7,112.0	4107.4	5,174.9		36,668.3
<i>Cypress/Tupelo</i>	107 acres	404 acres	300 acres	717 acres	4,713 acres	436 acres	6,677 acres
	No Data		No Data			No Data	5,834 acres
Conifer fuel trees		0		0	0		0
Hdwd fuel trees		4,249.1		3,957.0	26,622.2		34,828.3
CWD		3,861.2		2,632.1	65,684.1		72,177.4
Litter and duff		408.3		818.9	5,192.4		6,419.6

Total Fuel Weight	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
	82,171 acres	43,054 acres	31,987 acres	10,908 acres	10,037 acres	4,263 acres	182,420 ae
<i>All Types</i>	82,064 acres		31,687 acres	10,677 acres		543 acres	178,062 ac
Conifer fuel trees	156,876.0	63,002.6	59,709.8	8,836.7	0	1578.6	290,003.7
Hdwd fuel trees	302,364.5	192,178.5	179,600.9	67,015.9	46,077.0	72.0	787,308.8
CWD	314,275.7	176,080.0	120,272.7	40,373.5	83,811.8	2,008.7	736,822.4
Litter and duff	109,000.5	61,659.2	44,367.7	12,632.9	10,367.3	793.9	238,821.4
						TOTAL:	2,052,956.4

Table 7. Average fuel estimates in tons from the 1999-2001 SRS inventory of 622 plots.

Fuel Tons per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac
<i>Loblolly Type</i>	27,587 acres	18,313 acres	11,593 acres	4,566 acres	0 acres	543 acres	62,602 acres
Conifer fuel trees	2.90393	2.15102	2.74220	1.76912		2.90712	2.57099
Hdwd fuel trees	2.92956	3.56423	4.69032	6.94694		0.13269	3.71005
CWD	4.42373	3.48453	2.78040	3.04490		3.69923	3.73781
Litter and duff	1.41281	1.57644	1.55279	1.50318		1.46201	1.49362
<i>Longleaf Type</i>	30,279 acres	7,163 acres	5,626 acres	226 acres	0 acres	0 acres	43,294 acres
L							
Conifer fuel trees	1.89030	1.75722	2.98781	0.98051			2.00616
Hdwd fuel trees	1.59727	1.78643	3.42686	0			1.85798
CWD	3.39306	3.93392	3.12397	8.00271			3.47164
Litter and duff	1.36320	1.32203	1.40402	0.26683			1.35597
<i>Slash Type</i>	6,496 acres	6,716 acres	4,280 acres	224 acres	0 acres	0 acres	17,716 acres
Conifer fuel trees	2.29241	1.54051	2.50009	1.35894			2.04574
Hdwd fuel trees	1.51731	2.91915	4.61002	4.02287			2.82758
CWD	4.75835	4.62540	4.09697	1.86034			4.51152
Litter and duff	1.60391	1.92499	1.82799	2.11706			1.78625
<i>Pine-Hdwd</i>	2,059 acres	1,112 acres	1,932 acres	231 acres	0 acres	6 acres	5,103 acres
				No Data		No Data	
Conifer fuel trees	0.67965	0.01102	0.21205				0.35691
Hdwd fuel trees	6.70836	6.49547	7.03102				6.78413
CWD	3.54151	4.39693	8.52703				5.61543
Litter and duff	1.26801	1.14715	1.34071				1.26920
<i>Hdwd-Pine</i>	2,063 acres	1,687 acres	1,003 acres	282 acres	0 acres	320 acres	5,035 acres
						No Data	
Conifer fuel trees	0	0.00918	0	0			0.00308
Hdwd fuel trees	9.19356	9.23358	3.29115	10.58126			8.10890
CWD	4.09927	3.78362	5.90117	4.92343			4.39862
Litter and duff	1.07813	1.14326	0.93831	1.09430			1.07300

Table 7. Continued.

Fuel Tons per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac
<i>Hardwood</i>	13,580 acres	7,659 acres	7,253 acres	4,662 acres	5,324 acres	2,958 acres	38,478 acres
						No Data	
Conifer fuel trees	0.23843	0.08488	0	0.04995	0		0.10710
Hdwd fuel trees	9.61324	8.80746	9.55890	5.88892	3.65416		8.16684
CWD	3.15469	4.94730	4.21012	4.33821	3.40489		3.88847
Litter and duff	0.99373	0.88512	0.98057	0.88103	0.97200		0.95297
<i>Cypress/Tupelo</i>	107 acres	404 acres	300 acres	717 acres	4,713 acres	436 acres	5,834 acres
	No Data		No Data			No Data	
Conifer fuel trees		0		0	0		0
Hdwd fuel trees		10.51755		5.51882	5.64868		5.96989
CWD		9.55748		3.67096	13.93680		12.37186
Litter and duff		1.01074		1.14214	1.10171		1.10038

Fuel Tons per Acre	Primary RCW HMA	Supplemental RCW HMA	Other or Industrial	Crackerneck WLMA	Savannah Swamp	Lower Three Runs Tail	All Forested Areas SRS
	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac	Tons/ac
<i>All Types</i>	82,064 acres	43,054 acres	31,687 acres	10,677 acres	10,037 acres	543 acres	178,062 ac
Conifer fuel trees	1.91163	1.46334	1.88436	0.82764	0	2.90712	1.62867
Hdwd fuel trees	3.68450	4.46366	5.66797	6.27666	4.59071	0.13269	4.42154
CWD	3.82964	4.08975	3.79565	3.78136	8.35028	3.69923	4.13801
Litter and duff	1.32824	1.43214	1.40019	1.18319	1.03290	1.46201	1.34123
						AVERAGE	11.52945

Appendix A

TOTAL CUBIC VOLUME/GROSS CUBIC VOLUME FACTOR EQUATIONS:

SPECIES	SAWTIMBER:		POLETIMBER:		SAPLING:	
	F=A+B (1/ (DBH-3.0) **2)		F=A+B (1/ (DBH-3.0) **2)		GCV=A+B (DBH**2*TH)	
	A	B	A	B	A	B
LOBLOLLY PINE	1.111780	2.473630	1.111780	2.473630	0.060342	0.002197
LONGLEAF PINE	1.107343	2.384360	1.107343	2.384360	0.058586	0.002429
PITCH PINE	1.139310	1.300282	1.139310	1.300282	0.081287	0.002219
POND PINE	1.125409	1.877110	1.125409	1.877110	0.047587	0.002354
SAND PINE	1.112564	2.775872	1.112564	2.775872	0.079225	0.002490
SHORTLEAF PINE	1.113788	2.208955	1.113788	2.208955	0.066654	0.002168
SLASH PINE	1.109247	2.429713	1.109247	2.429713	0.070229	0.002111
SPRUCE PINE	1.116228	2.142989	1.116228	2.142989	0.081287	0.002219
TABLE MT. PINE	1.127272	1.123936	1.127272	1.123936	0.081287	0.002219
VIRGINIA PINE	1.134089	1.531460	1.134089	1.531460	0.034943	0.002569
ATLANTIC WHITE CEDAR	1.152171	1.259555	1.152171	1.259555	0.010169	0.002839
BALDCYPRESS	1.188594	2.394869	1.188594	2.394869	0.094132	0.002743
FIR	1.146541	2.146242	1.146541	2.146242	0.065755	0.002813
HEMLOCK	1.131783	2.320512	1.131783	2.320512	0.065755	0.002813
NORTHERN WHITE CEDAR	1.146541	2.146242	1.146541	2.146242	0.065755	0.002813
PONDCYPRESS	1.237591	3.561137	1.237591	3.561137	0.101432	0.002744
REDCEDAR	1.176439	2.550195	1.176439	2.550195	0.052928	0.002853
SPRUCE	1.146541	2.146242	1.146541	2.146242	0.065755	0.002813
WHITE PINE	1.145631	1.610693	1.145631	1.610693	0.074791	0.002881
BASSWOOD	1.135107	1.257835	1.135107	1.257835	0.054564	0.002565
BLACK CHERRY	1.164183	1.513173	1.164183	1.513173	0.155471	0.002461
BLACKGUM (LOWLAND)	1.187896	2.444066	1.187896	2.444066	0.088427	0.002681
BLACKGUM (UPLAND)	1.156640	2.035818	1.156640	2.035818	0.048582	0.002498
BOXELDER	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
BUCKEYE	1.172535	1.535447	1.172535	1.535447	0.054564	0.002565
BUTTERNUT	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
COTTONWOOD	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
CUCUMBERTREE	1.158363	2.382274	1.158363	2.382274	0.051279	0.002641
ELM	1.159555	2.270106	1.159555	2.270106	0.032199	0.002589
HACKBERRY	1.188803	1.641479	1.188803	1.641479	0.054564	0.002565
LOBLOLLY-BAY	1.152686	2.649964	1.152686	2.649964	0.012745	0.003005
MAGNOLIA	1.158363	2.382274	1.158363	2.382274	0.051279	0.002641
RED MAPLE	1.179791	1.882807	1.179791	1.882807	0.023326	0.002860
SILVERBELL (IN MTS.)	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
SILVER MAPLE	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
SWEETBAY	1.166687	2.242538	1.166687	2.242538	0.057904	0.002603
SWEETGUM	1.122118	2.802714	1.122118	2.802714	0.045146	0.002357
SYCAMORE	1.150504	1.590116	1.150504	1.590116	0.054564	0.002565
WATER TUPELO	1.264347	1.821700	1.264347	1.821700	0.062785	0.002458
WILLOW	1.145017	2.255001	1.145017	2.255001	0.054564	0.002565
YELLOW-POPLAR	1.115123	1.788864	1.115123	1.788864	0.019361	0.002514
ASH	1.128655	2.349280	1.128655	2.349280	0.064004	0.002410
BEECH	1.219447	2.401295	1.219447	2.401295	0.058647	0.002378
BIRCH (EXCEPT YELLOW)	1.216170	1.355783	1.216170	1.355783	0.058647	0.002378
BLACK LOCUST	1.194258	1.609426	1.194258	1.609426	0.058647	0.002378
BLACK WALNUT	1.173659	1.863595	1.173659	1.863595	0.058647	0.002378
DOGWOOD	1.186636	2.417775	1.186636	2.417775	0.037005	0.002729
FLORIDA MAPLE	1.186636	2.417775	1.186636	2.417775	0.058647	0.002378
HICKORY	1.189261	3.074669	1.189261	3.074669	0.047620	0.002192
HOLLY	1.203433	1.865955	1.203433	1.865955	0.058647	0.002378
HONEYLOCUST	1.186636	2.417775	1.186636	2.417775	0.058647	0.002378
MULBERRY	1.186636	2.417775	1.186636	2.417775	0.058647	0.002378
PERSIMMON	1.214404	1.834798	1.214404	1.834798	0.034641	0.002546
SUGAR MAPLE	1.190063	1.712613	1.190063	1.712613	0.058647	0.002378
YELLOW BIRCH	1.212153	1.359713	1.212153	1.359713	0.058647	0.002378
BLACK OAK	1.214240	2.375921	1.214240	2.375921	0.042519	0.002613
BUR OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
CHERRYBARK OAK	1.223374	1.367666	1.223374	1.367666	0.041238	0.002603
CHESTNUT OAK	1.205365	1.671724	1.205365	1.671724	0.014284	0.002521
CHINKAPIN OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
LAUREL OAK	1.237288	2.395208	1.237288	2.395208	0.024511	0.002637
LIVE OAK	1.193954	4.298451	1.193954	4.298451	0.050820	0.002776
OVERCUP OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
PIN OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
POST OAK	1.237511	2.241176	1.237511	2.241176	0.051922	0.002631
N. RED OAK	1.224449	1.277306	1.224449	1.277306	0.041238	0.002603
SCARLET OAK	1.216303	1.553713	1.216303	1.553713	0.067831	0.002660
SHINGLE OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
SHUMARD OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
S. RED OAK	1.206835	3.453587	1.206835	3.453587	0.080702	0.002467
SWP. CHESTNUT OAK	1.237249	1.578554	1.237249	1.578554	0.041238	0.002603
SWP. WHITE OAK	1.218003	2.181659	1.218003	2.181659	0.041238	0.002603
WATER OAK	1.224892	2.664642	1.224892	2.664642	0.030987	0.002670
WHITE OAK	1.223605	2.051445	1.223605	2.051445	0.044339	0.002539
WILLOW OAK	1.202078	3.487957	1.202078	3.487957	0.041238	0.002603
SCRUB OAKS	1.218003	2.181659	1.218003	2.181659	0.053215	0.002475
NON-COMMERCIAL SPP.	1.218003	2.181659	1.218003	2.181659	0.062125	0.002494
LOBLOLLY PINE PLANTED	1.111780	2.473630	1.111780	2.473630	0.060342	0.002197
SLASH PINE PLANTED	1.109247	2.429713	1.109247	2.429713	0.070229	0.002111

GROSS CUBIC VOLUME BY TOTAL HEIGHT GCV = A+B (DBH**2*TOTAL HEIGHT)

SPECIES	A	B	A	B
POLE			SAW	
LOBLOLLY PINE	-0.819681	0.002140	-0.658316	0.002107
LONGLEAF PINE	-0.944222	0.002265	-0.443190	0.002165
PITCH PINE	-0.470660	0.002194	-0.379670	0.002171
POND PINE	-0.632942	0.002177	-0.279600	0.002093
SAND PINE	-0.514855	0.002472	0.377006	0.002239
SHORTLEAF PINE	-0.706167	0.002215	-0.687060	0.002211
SLASH PINE	-0.797881	0.002128	-0.611225	0.002088
SPRUCE PINE	0.248714	0.002143	0.118241	0.002168
TABLE MT. PINE	-0.013552	0.002453	0.870587	0.002205
VIRGINIA PINE	-0.284955	0.002264	0.333364	0.002118
ATLANTIC WHITE CEDAR	0.247418	0.002161	1.668389	0.001822
BALDCYPRESS	0.241431	0.002047	1.757944	0.001752
FIR	-0.099920	0.002097	0.879371	0.001845
HEMLOCK	-0.259181	0.001808	-0.216081	0.001798
NORTHERN WHITE CEDAR	-0.099920	0.002097	0.879371	0.001845
PONDCYPRESS	-0.296106	0.002037	1.044195	0.001712
RED CEDAR	-0.315878	0.002207	-0.104252	0.002145
SPRUCE	-0.099920	0.002097	0.879371	0.001845
WHITE PINE	-0.040964	0.002011	0.604023	0.001857
BASSWOOD	0.198966	0.001860	0.034400	0.001882
BLACK CHERRY	-0.547200	0.001948	-0.607326	0.001957
BLACKGUM (LOWLAND)	-0.466949	0.001972	1.284413	0.001760
BLACKGUM (UPLAND)	-0.225146	0.001902	0.690730	0.001767
BOXELDER	-0.451948	0.001921	0.518892	0.001802
BUCKEYE	-0.439762	0.001940	0.218924	0.001833
BUTTERNUT	-0.451948	0.001921	0.518892	0.001802
COTTONWOOD	-0.451948	0.001921	0.518892	0.001802
CUCUMBERTREE	-0.198410	0.001901	0.735415	0.001775
ELM	-0.155066	0.001828	-0.316005	0.001851
HACKBERRY	-0.193680	0.001770	0.500522	0.001670
LOBLOLLY-BAY	-0.198410	0.001901	0.735415	0.001775
MAGNOLIA	-0.198410	0.001901	0.735415	0.001775
RED MAPLE	-0.104018	0.001850	0.680247	0.001742
SILVERBELL (IN MTS.)	-0.451948	0.001921	0.518892	0.001802
SILVER MAPLE	-0.451948	0.001921	0.518892	0.001802
SWEETBAY	-0.198410	0.001901	0.735415	0.001775
SWEETGUM	-0.936122	0.001991	-0.629168	0.001955
SYCAMORE	0.229691	0.001901	2.326908	0.001649
WATER TUPELO	-0.267107	0.001904	1.749738	0.001659
WILLOW	-0.451948	0.001921	0.518892	0.001802
YELLOW-POPLAR	-0.553182	0.001922	0.485232	0.001807
ASH	-0.392822	0.001921	0.172701	0.001851
BEECH	-0.398996	0.002026	1.468854	0.001765
BIRCH (EXCEPT YELLOW)	0.371605	0.001773	0.543581	0.001751
BLACK LOCUST	-0.206213	0.001592	0.603856	0.001483
BLACK WALNUT	-0.033805	0.001656	0.421890	0.001596
DOGWOOD	-0.347844	0.001837	-0.202284	0.001818
FLORIDA MAPLE	-0.347844	0.001837	-0.202284	0.001818
HICKORY	-0.665929	0.001868	-0.793179	0.001884
HOLLY	-0.172555	0.002151	0.762909	0.001965
HONEYLOCUST	-0.347844	0.001837	-0.202284	0.001818
MULBERRY	-0.347844	0.001837	-0.202284	0.001818
PERSIMMON	-0.402944	0.001931	-1.173042	0.002028
SUGAR MAPLE	-0.052827	0.001891	0.352087	0.001838
YELLOW BIRCH	0.998628	0.001765	0.169526	0.001893
BLACK OAK	-0.513128	0.001775	-0.515373	0.001775
BUR OAK	-0.279035	0.001894	0.248363	0.001823
CERRYBARK OAK	0.046929	0.001950	1.212451	0.001791
CHESTNUT OAK	-0.377981	0.001859	-0.069945	0.001818
CHINKAPIN OAK	-0.279035	0.001894	0.248363	0.001823
LAUREL OAK	-0.351135	0.002014	0.846919	0.001840
LIVE OAK	0.459129	0.001560	0.344387	0.001580
OVERCUP OAK	-0.279035	0.001894	0.248363	0.001823
PIN OAK	-0.279035	0.001894	0.248363	0.001823
POST OAK	-0.361464	0.001892	0.301286	0.001791
N. RED OAK	-0.095806	0.001889	0.793996	0.001779
SCARLET OAK	-0.225632	0.001917	0.003343	0.001887
SHINGLE OAK	-0.279035	0.001894	0.248363	0.001823
SHUMARD OAK	-0.279035	0.001894	0.248363	0.001823
S. RED OAK	-0.316577	0.001817	-0.085426	0.001783
SWP. CHESTNUT OAK	0.343571	0.001822	0.376354	0.001818
SWP. WHITE OAK	-0.279035	0.001894	0.248363	0.001823
WATER OAK	-0.265687	0.001986	1.195722	0.001795
WHITE OAK	-0.376980	0.001948	0.148434	0.001880
WILLOW OAK	-0.383480	0.001893	-0.460755	0.001904
SCRUB OAKS	-0.183950	0.001841	-0.035319	0.001807
NON-COMMERCIAL SPP.	-0.378830	0.001855	0.823520	0.001630
LOBLOLLY PINE PLANTED	-0.819681	0.002140	-0.658316	0.002107
SLASH PINE PLANTED	-0.797881	0.002128	-0.611225	0.002088

Equation DBH Limits Softwoods: Saplings 1" to 4.9"
Poletimber 5" to 8.9"
Sawtimber 9" +

Equation DBH Limits Hardwoods: Saplings 1" to 4.9"
Poletimber 5" to 10.9"
Sawtimber 11" +

Appendix B

species	common_name	latin_name
60	Redcedar	<i>Juniperus virginiana</i>
107	Sand pine	<i>Pinus clausa</i>
110	Shortleaf pine	<i>Pinus echinata</i>
111	Slash pine	<i>Pinus elliotii</i>
121	Longleaf pine	<i>Pinus palustris</i>
128	Pond pine	<i>Pinus serotina</i>
131	Loblolly pine	<i>Pinus taeda</i>
221	Baldcypress	<i>Taxodium distichum</i>
222	Pondcypress	<i>Taxodium ascendens</i>
313	Boxelder	<i>Acer negundo</i>
316	Red maple	<i>Acer rubrum</i>
370	Birch (except yellow)	<i>Betula</i> spp.
373	River birch	<i>Betula nigra</i>
391	Blue beech	<i>Carpinus caroliniana</i>
400	Hickory	<i>Carya</i> spp.
401	Water hickory	<i>Carya aquatica</i>
402	Bitternut hickory	<i>Carya cordiformis</i>
403	Pignut hickory	<i>Carya glabra</i>
407	Shagbark hickory	<i>Carya ovata</i>
409	Mockernut hickory	<i>Carya alba</i>
461	Sugarberry	<i>Celtis laevigata</i>
491	Dogwood	<i>Cornus florida</i>
521	Persimmon	<i>Diospyros virginiana</i>
531	Beech	<i>Fagus grandifolia</i>
540	Ash	<i>Fraxinus</i> spp.
544	Green ash	<i>Fraxinus pennsylvanica</i>
591	Holly	<i>Ilex opaca</i>
602	Black walnut	<i>Juglans nigra</i>
611	Sweetgum	<i>Liquidambar styraciflua</i>
621	Yellow-poplar	<i>Liriodendron tulipifera</i>
652	Southern magnolia	<i>Magnolia grandiflora</i>
653	Sweetbay	<i>Magnolia virginiana</i>
660	Apple	<i>Malus</i> spp.
661	Chinaberry	<i>Melia azedarach</i>
680	Mulberry	<i>Morus</i> spp.
682	Red Mulberry	<i>Morus rubra</i>
691	Water tupelo	<i>Nyssa aquatica</i>
693	Blackgum	<i>Nyssa sylvatica</i>
694	Swamp tupelo	<i>Nyssa biflora</i>
701	Eastern hophornbeam	<i>Ostrya virginiana</i>
711	Sourwood	<i>Oxydendrum arboreum</i>
721	Redbay	<i>Persea borbonia</i>
722	Planertree (water elm)	<i>Planera aquatica</i>
731	Sycamore	<i>Platanus occidentalis</i>
760	Cherry/Plum	<i>Prunus</i> spp.
762	Black cherry	<i>Prunus serotina</i>
802	White oak	<i>Quercus alba</i>
806	Scarlet oak	<i>Quercus coccinea</i>
807	Bluejack oak	<i>Quercus incana</i>
812	Southern red oak	<i>Quercus falcata</i>
813	Cherrybark oak	<i>Quercus pagoda</i>
819	Turkey oak	<i>Quercus laevis</i>

820	Laurel oak	<i>Quercus laurifolia</i>
822	Overcup oak	<i>Quercus lyrata</i>
824	BlackJack oak	<i>Quercus marilandica</i>
825	Swamp chestnut oak	<i>Quercus michauxii</i>
827	Water oak	<i>Quercus nigra</i>
831	Willow oak	<i>Quercus phellos</i>
835	Post oak	<i>Quercus stellata</i>
837	Black oak	<i>Quercus velutina</i>
840	Dwarf post oak	<i>Quercus margarettiae</i>
841	Dwarf live oak	<i>Quercus minima</i>
850	Oak-evergreen	<i>Quercus</i> spp.
901	Black locust	<i>Robinia pseudoacacia</i>
920	Willow	<i>Salix</i> spp.
931	Sassafras	<i>Sassafras albidum</i>
970	Elm	<i>Ulmus</i> spp.
971	Winged elm	<i>Ulmus alata</i>
972	American elm	<i>Ulmus Americana</i>
975	Slippery elm	<i>Ulmus rubra</i>
999	Other miscellaneous trees	Unclassified spp.

Note: Common names and scientific names are taken from Miles et al. 2001. The forest inventory and analysis database: database description and users manual version 1.0. Gen. Tech. Rep. NC-218. St. Paul, MN: USDA Forest Service, North Central Research Station. 130 p.

Scientific names were updated using the **Integrated Taxonomic Information System** at www.itis.usda.gov and may differ from the Names in GTR NC-218.