



United States Department of Agriculture



# South Carolina's Forests, 2016

Thomas J. Brandeis, Consuelo Brandeis,  
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**Forest Service**

**Southern  
Research Station**

**Resource Bulletin  
SRS-215**





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Front cover: top left, a copperhead (*Agkistrodon contortrix*). (photo courtesy of Jeremy Rogers, U.S. Forest Service); top right, the Appalachian Mountains are an unexpected treasure to explorers of South Carolina's northwest confines. While known for its prolific pine forests, South Carolina's forests are almost equally composed of hardwood species. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission); bottom, tree planting rates in South Carolina increased 60 percent from 2011 to 2016. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission). Back cover: top left, Sugarloaf Mountain is one of several monadnocks that adorn the landscape of Sand Hills State Forest. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission); top right, a copperhead (*Agkistrodon contortrix*). (photo courtesy of Jeremy Rogers, U.S. Forest Service); bottom, snow in a pine plantation. (photo courtesy of the South Carolina Forestry Commission).



Forested wetlands are important ecosystems in the State of South Carolina. (photo courtesy of Jeremy Rogers, U.S. Forest Service)





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Snow in a pine plantation. (photo courtesy of the South Carolina Forestry Commission)



### FOREWORD

The Forest Service, U.S. Department of Agriculture, Southern Research Station's (SRS) Forest Inventory and Analysis (FIA) research work unit and cooperating State forestry agencies conduct annual forest inventories of resources in the 13 Southern States (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia), the Commonwealth of Puerto Rico, and the U.S. Virgin Islands. In order to provide more frequent and nationally consistent information on America's forest resources, all research stations and their respective FIA work units conduct annual surveys with a common sample design. These surveys are mandated by law through the Agricultural Research Extension and Education Reform Act of 1998 (Farm Bill).

The primary objective in conducting these inventories is to gather the multiresource information needed to formulate sound forest policies, provide information for economic development, develop forest programs, and provide a scientific basis to monitor forest ecosystems. These data are used to provide an overview of forest resources that may include, but is not limited to, forest area, forest ownership, forest type, stand structure, timber volume, growth, removals, mortality, management activity, down woody material, carbon storage and sequestration, and invasive species. The information presented is applicable at the State and survey unit level; although it provides the background for more intensive studies of critical situations, it is not designed to reflect resource conditions at small scales.

More information about Forest Service resource inventories is available in "Forest Resource Inventories: An Overview" (U.S. Department of Agriculture Forest Service

1992). More detailed information about sampling methodologies used in the annual FIA inventories can be found in "The Enhanced Forest Inventory and Analysis Program—National Sampling Design and Estimation Procedures" (Bechtold and Patterson 2005).

Data tables included in FIA reports are designed to provide an array of forest resource estimates, but additional tables can be obtained at <https://fia.fs.fed.us/tools-data/default.asp>. Additional information about the FIA Program can be obtained at <https://fia.fs.fed.us/>.

Additional information about any aspect of this or other FIA surveys may be obtained from:

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### ACKNOWLEDGMENTS

The SRS gratefully acknowledges the continued productive partnership with the South Carolina Forestry Commission (SCFC). This partnership extends from field data collection, data review, through to review of the final published results in documents such as this one. We also thank James Brown of SRS FIA Data Acquisition for editing the data, Samuel Lambert of SRS FIA Information Management for data review and processing, and the SRS Technical Publications Team for technical edit, layout, and overall production of this report.



A copperhead (*Agkistrodon contortrix*). (photo courtesy of Jeremy Rogers, U.S. Forest Service)

The following people made field measurements or checked the quality of the data collected for this most recent survey. SRS FIA appreciates their hard work and their consistent efforts to obtain high-quality data.

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Bent and toppled trees after the passing of Hurricane Matthew. (photo courtesy of the South Carolina Forestry Commission)



### HIGHLIGHTS

- The State of South Carolina had 12.9 million acres of forest in 2016, covering 67 percent of its total land area. Forest land area has remained relatively stable for the past 15 years.
- In terms of ownership, the most notable trend has been forest industry's divestiture of timberland and that lands acquisition by nonindustrial corporate entities, primarily Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). In 2001, forest industry owned just over 2.1 million acres of forest land. By 2016, that number dropped by 92 percent to 169.6 thousand acres.
- There was a decrease in the average annual number of agricultural acres reverting to forest land, from a high of 64,898 acres annually in 2006 to a low of 15,815 in 2015. The opposite trend, forest land being cleared for agriculture, surpassed forest land reversion in 2014. Developed land reverting to forest has been on the decline as well, with only 13,102 acres on average annually as recorded in 2016.
- Loblolly-shortleaf pine is the predominant forest type in the State, accounting for over 44 percent of all forests. Oak-hickory is the second most recorded forest type, representing over one-fifth of the forest land base. Oak-gum-cypress, oak-pine, longleaf-slash pine and elm-ash-cottonwood account for 14.8 percent,

11.6 percent, 4.3 percent and 3.0 percent, respectively.

- There were an estimated 636 million oven-dry tons of aboveground live-tree biomass. Volume of all-live trees with a diameter at breast height (d.b.h.)  $\geq 5$  inches on forest land in 2016 was slightly over 26 billion cubic feet.
- Loblolly pine was the State's most common tree species, leading both in number of trees (44 percent of all live-trees with d.b.h.  $\geq 5$  inches) and in total volume (42 percent of all volume). Sweetgum followed second, accounting for 10 percent of all trees and 9 percent of all volume.
- Close to 52 percent of the State's volume is found in softwoods. The majority of the standing volume, for both softwoods and hardwoods, is in the large diameter stand-size class which trended upwards during the 2006-2016 period. Overall, volume on medium diameter stand-size class decreased slightly for all species, in contrast to small diameter stand-size volume which trended upwards.
- During the 2006–16 period softwood annual net growth and removals trended upwards, with 2016 values over 25 percent higher than 2006 estimates. In contrast, estimates of annual net growth and removals for hardwoods were close to 8 percent lower in 2016, compared to 2006. Overall, annual mortality declined in softwoods and increased in hardwoods.



## Highlights

- Growth to removals ratio, a measure used to assess resource sustainability, remained stable during the 2006–16 period with an average rate of 1.4 in softwoods and 1.8 in hardwoods, indicating annual growth surpassed removals by approximately 40 percent in softwoods and 80 percent in hardwoods.
- Wildland forest fires was the most frequently recorded disturbance on forest land in South Carolina from 2012 to 2016, affecting an estimated 165,900 acres of forest land per year. Forest diseases, closely followed by weather, affected 49,300 acres and 48,900 acres annually, respectively.
- The forests of South Carolina hold an average of 2.3 tons of biomass per acre of down woody materials. A total of 15.5 million tons of carbon are stored in down woody materials and another 144.6 million tons on the forest floor in the form of duff and litter.
- Chinaberry (*Melia azedarach*), Chinese/ European privets (*Ligustrum* spp.), Japanese honeysuckle (*Lonicera japonica*), Nepalese browntop (*Microstegium vimineum*), and Chinese or sericea lespedeza (*Lespedeza cuneata*) were the most commonly encountered nonnative invasive plants on forested plots.



### INTRODUCTION

This resource bulletin provides an overview of forest resources in South Carolina based on an inventory conducted by the U.S. Forest Service, Forest Inventory and Analysis (FIA) program at the Southern Research Station in cooperation with the South Carolina Forestry Commission. This publication is the fourth, 5-year resource bulletin estimating the State's forest resources under the FIA program's annualized forest inventory and monitoring system. The data used to make the estimates presented in this report come from 3,652 FIA sampling points across the State of South Carolina that were surveyed from 2012 to 2016. Of those sampling points, 2,694 were forested and had an FIA forest inventory and monitoring plot. The remaining 958 points were not forested and the only data collected there was land use. The data used in this publication were accessed from the FIA database from May to September of 2017 unless otherwise indicated (<https://fia.fs.fed.us/tools-data/>).

Notable in this current resource bulletin is relative stability of forest land and timberland acreage and increasing maturity of the trees and stands that comprise it. Although there was a decrease in acreage from 2011 to 2016 documented here and in previous publications (Brandeis and others 2016, Rose 2015a, Rose 2015b), net volume on both forest land and timberland has been increasing. Forest stands are more typically comprised of fewer, larger trees. This means that even with slight drops in the total forest land acreage, stands are more fully stocked in terms of volume, as also shown in Rose (2015b). Net tree growth and mortality in terms of their volume has increased while removals from both harvesting and land clearing to nonforest land uses has shown fluctuations probably related to varying economic conditions like the recent recession (Brandeis and others 2016, Harper and Rominger 2013, Rose 2015a, Rose 2015b).



Forest flooded by the heavy rainfall that accompanies hurricanes. (photo courtesy of the South Carolina Forestry Commission)



## AREA

### Forest Land Area and Nonforest Land Uses

Total land area of South Carolina was 20.5 million acres, including census water. Of this, 12.9 million acres 67 percent was forested in 2016 (table 1). South Carolina is divided into three survey units (fig. 1). Each of the three units was between 65 percent and 69 percent forested (fig. 2). The Piedmont survey unit continues to have the highest percentage of forest cover at 69 percent (fig. 3). The Southern and Northern Coastal Plain survey units also have similar percent forest covers at 66 and 65 percent, respectively.

The previous three, 5-year cycles of FIA data collection under the annualized forest inventory have estimates of forest land acreage at 12.7 million (2001), 13.0 million (2006), 13.1 million (2011) forested acres for the State. While the 2016 estimate of 12.9 million acres would indicate a loss of over 200,000 acres of forest land, it is also only 1.5 percent of the total current forest land estimate. Fluctuations in forest land of this magnitude or greater have been seen in previous surveys and probably represent both dynamic forest land reversion and diversion, and the normal error associated with a sample-based estimate like FIA's. Tracking these changes in the coming years will indicate whether there are longer-term trends.

**Table 1—Area by survey unit and land status, South Carolina, 2016**

Unit	Total area	All forest	Unreserved			Reserved			Nonforest land	Census water
			Total	Timber-land	Unpro-ductive	Total	Pro-ductive	Unpro-ductive		
<i>thousand acres</i>										
Southern Coastal Plain	5,515.9	3,434.6	3,414.1	3,414.1	0.0	20.5	20.5	0.0	1,743.5	337.7
Northern Coastal Plain	8,112.7	4,898.7	4,808.4	4,798.7	9.7	90.3	90.3	0.0	2,616.5	597.5
Piedmont	6,864.4	4,582.8	4,531.7	4,525.9	5.8	51.0	51.0	0.0	2,078.3	203.4
All survey units	20,493.0	12,916.1	12,754.2	12,738.7	15.5	161.8	161.8	0.0	6,438.3	1,138.6

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value of >0.0 but <0.05.

Sugarloaf Mountain is one of several monadnocks that adorn the landscape of Sand Hills State Forest. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)



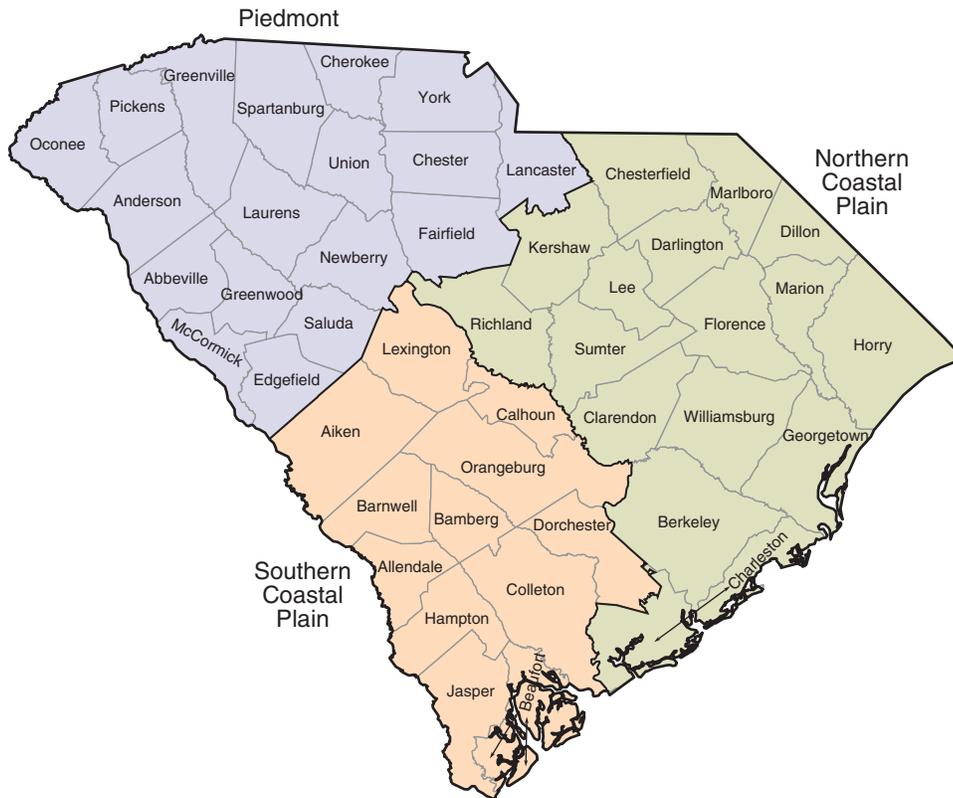


Figure 1—Counties and forest survey units, South Carolina, 2016.

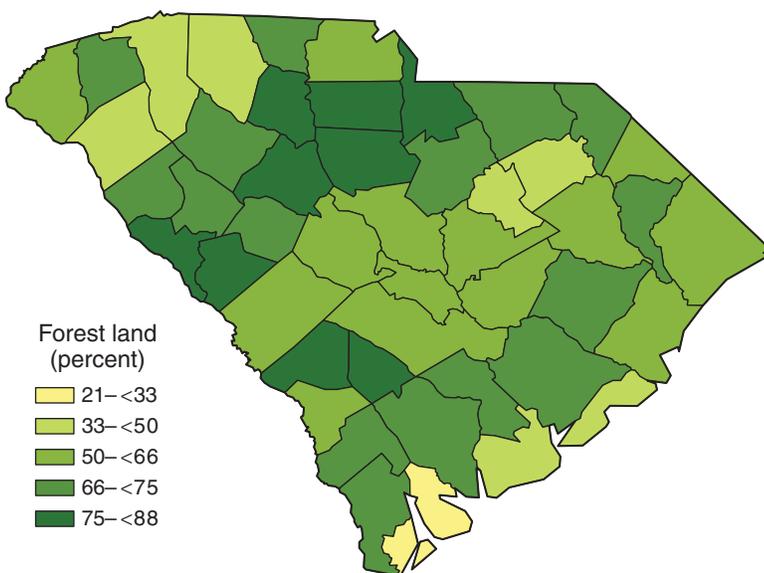


Figure 2—Percentage of county in forest land, South Carolina, 2016.

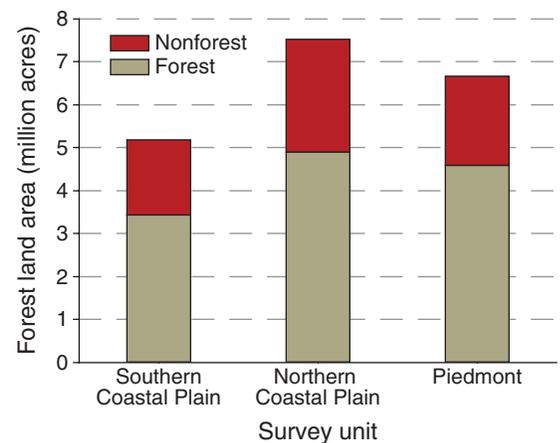


Figure 3—Forest land area by survey unit, South Carolina, 2016.



### Forest Ownership, Forest Types, Stand Age and Size

**Forest Ownership**—The FIA program surveys and tracks changes in forest ownership. The most outstanding feature of forest ownership in South Carolina is typical of most of the other Southern States, the predominance of nonindustrial private forest ownership (fig. 4). The most notable trend, also seen across the South, has been the divestiture of the forest products industry of its timberland and its acquisition by nonindustrial corporate entities, primarily Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). In 2001, forest industry owned just over 2.1 million acres of forest land (Harper and Rominger

2013). By 2016, that number dropped by 92 percent to 169.6 thousand acres.

**Forest Types**—The variation in South Carolinas’ forest types is shown in figure 5. Loblolly-shortleaf pine is the predominant forest type in the State, accounting for over 44 percent of all forests. Oak-hickory is the second most recorded forest type in 2016, representing over one-fifth of the forest land base. Oak-gum-cypress, oak-pine, longleaf-slash pine and elm-ash-cottonwood account for 14.8 percent, 11.6 percent, 4.3 percent and 3.0 percent, respectively. Nonstocked forests, lands under forest land use but are <10 percent stocked with live trees but are <10 percent stocked with live trees, are not included in figure 5. However, nonstocked forests in 2016 account for <1 percent of the total forest land base for the State.

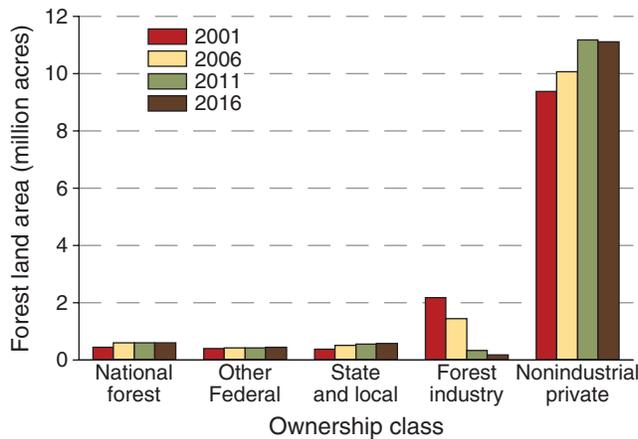


Figure 4—Forest land area by year and ownership class, South Carolina, 2001–16.

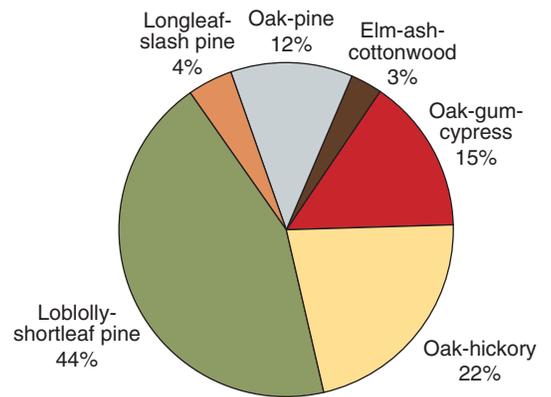
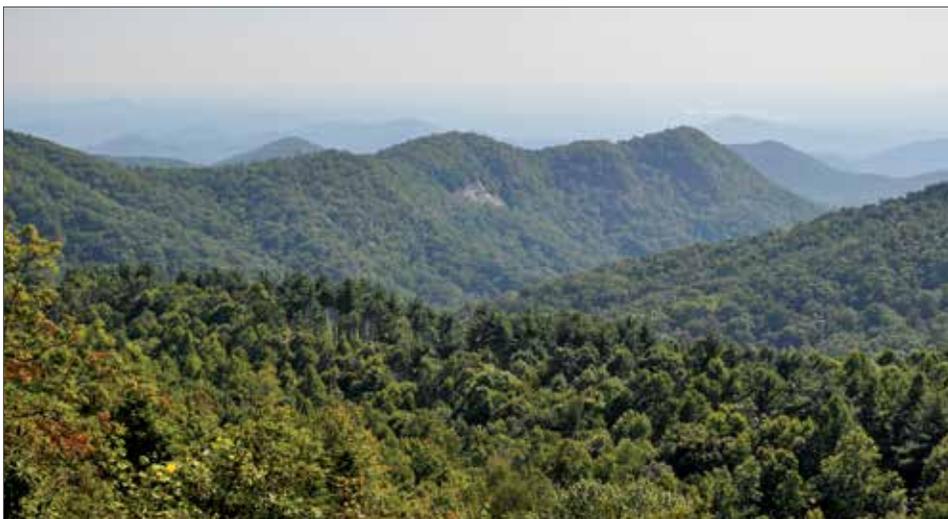


Figure 5—Percentage of forest land area by forest-type group, South Carolina, 2016.



The Appalachian Mountains are an unexpected treasure to explorers of South Carolina’s northwest confines. While known for its prolific pine forests, South Carolina’s forests are almost equally composed of hardwood species. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)



**Stand Age and Size**—The age distribution of South Carolina’s forests is evolving. A look at the stand age distribution of South Carolina’s forests gives insight into their history and past land use management. Much of the historic change over time can be attributed to Federal incentives such as the Agriculture Conservation Program of the 1930s and the Soil Bank Program of the 1950s. Additionally, the impact of the Conservation Reserve Program (CRP) of the late 1980s and the Hurricane Hugo recovery effort in 1989 are clearly evident even today (Conner and others 2004). The large number of stands established around the same time period has been referred to as the “Wall of Wood” in previous publications such as Conner and others (2009). In figure 6, we see a considerable cohort of

stands established between 11 (the 11–15 year stand age class) and 35 (the 31–35 year stand age class) years ago, peaking 21–25 years ago. In recent years we have seen lower acreages of younger stands (1–15 year age classes), indicating fewer stands are being clearcut and fewer new stands being established. This trend is reflected in the distribution of forest land area by stand size classes which shows an increasingly greater proportion in the large diameter stand size class (stands where the trees are predominately softwoods  $\geq 9.0$  inches d.b.h. and hardwoods  $\geq 11.0$  inches d.b.h., which are also known as sawtimber trees) versus the small (1.0 to 4.9 inches in d.b.h.) or medium stand-size classes (5.0 to 8.9 inches d.b.h. and hardwood timber species 5.0 to 10.9 inches d.b.h.) (fig. 7).

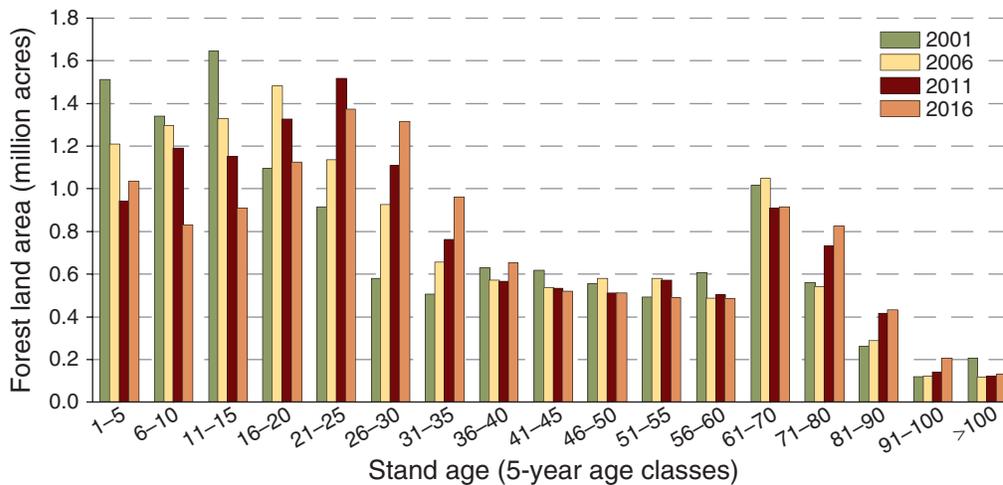


Figure 6—Forest land area distribution by stand age, South Carolina, 2001–16.



An abundance of sawtimber results in historically low stumpage prices and delayed final harvests by private timberland owners. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)

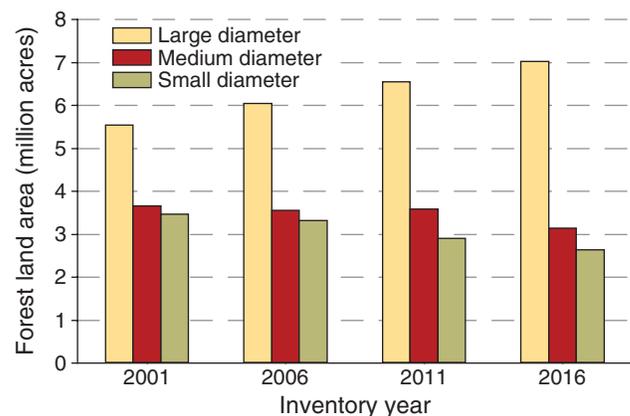


Figure 7—Forest land area distribution by stand-size class, South Carolina, 2001–16.



## Forests and Land Use Change

The FIA program records land use on both nonforest and forest plots (see the Forest Inventory and Analysis national core field guide for details on land use categories and how they are delineated on FIA plots) (U.S. Department of Agriculture Forest Service 2014). We are then able to create a matrix of land use change using the remeasured plots that are also used to calculate tree level growth, removals and mortality [see Scott and others (2005) for the methods used to calculate these components of change]. Forest and nonforest conditions on forested plots are categorized by land use allowing us to apply that condition's expansion factor to the land use and estimate area change.

For example, if a previously forested plot is found to have been cleared for development when remeasured, the 6,000 acres that plot represented will be seen as changing from forest to developed land. If the elapsed time period between plot measurements was 5 years, then that plot would represent 1,200 acres per year of forest land area that changed to a developed land use. If only half the plot was cleared for development, that change in condition would be mapped and the plot would represent 3,000 acres changing land use and 3,000 acres staying in forest, with an annualized change of 600 acres per year. All of these annually changed acres were then summed for statewide annual change totals.

There are limitations to FIA's ability to estimate land use change due to the lack of detailed nonforest land use mapping on FIA plots. While all changes in forest and nonforest conditions are delineated on forested plots and each condition's area is known and expansion factor calculable, only the first nonforest condition encountered on the plot is assigned a land use and all subsequent nonforest conditions are assigned to that initially encountered condition and land use. For example, if part of a forested plot falls in agricultural land and it is the first nonforest condition encountered, that condition is mapped and assigned a land use. As the measurement continues the field crew encounters a right-of-way. That new nonforest area is mapped but it is not assigned a new nonforest condition or land use, rather it is assigned to the agriculture condition and land use. The situation is similar on complete nonforest plots. If the entire plot is nonforest, then only the nonforest land use at the center of subplot 1 of the 4-subplot cluster is recorded, even if the nonforest plot has multiple nonforest land uses. For example, when one subplot would have fallen in agricultural land and another would have fallen in a developed area. (see FIA field guide for details on field plot data collection and the FIA plot layout.) (U.S. Department of Agriculture Forest Service 2014). This means that when we look for land use change information it is with the understanding that some complex nonforest land use scenarios on forest and nonforest plots are simplified.

Tree planting rates in South Carolina increased 60 percent from 2011 to 2016. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)





Annualized area change was estimated in South Carolina from 2005 to 2016. The most notable trend over the surveyed time period is the decrease in the average annual number of agricultural acres reverting to forest land, from a high of 64,898 acres annually in 2006 to a low of 15,815 in 2015 (fig. 8). This decline became particularly steep after 2009. The opposite trend, forest land being cleared for agriculture, has shown only relatively small increases, surpassing forest land reversion in 2014. Developed land reverting to forest has been on the decline as well, with only 13,102 acres on average annually as recorded in 2016. Clearance of forest land for development fluctuated prior to reaching its current low value of 24,790 acres per year. Overall, the current averages show the least amount of land use change during the study period, with a high of 168,536 acres changing land use annually in 2005 to a low of only 83,379 changing land uses in 2016. However, when we state the total forest acreage in South Carolina has been relatively stable in recent years, it is with the understanding that a degree of dynamic forest reversion and diversion underlies the total acreage estimates.

When interpreting land use change information over time, awareness of the magnitude of change relative to the total acreage in those categories (loss of forest land relative to the forested acreage of the State) also provides useful information. The rate of change over time can indicate

accelerating or decelerating land use change trends, particularly when both the total forest land area and annualized land use change acreages are in flux. Forest land use change as a percent of total forest land has been relatively low in South Carolina and the forest land base stable in recent years. The number of acres of forest annual cleared for agriculture (27,069 acres) or development (24,790 acres) annually from 2011 to 2016 is actually a small percentage (0.21 and 0.19 percent, respectively) of the total forest land in the State in 2016 (12.9 million acres). The reversion of agricultural land to forest land has progressively slowed from 2005 to 2016, with reversion being at a high in 2006 of 0.50 percent of the total forest land to a low in 2015 of 0.15 percent.



Compliance with streamside management zone Best Management Practices (BMPs) on harvested sites in South Carolina was 98.9 percent in 2016. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)

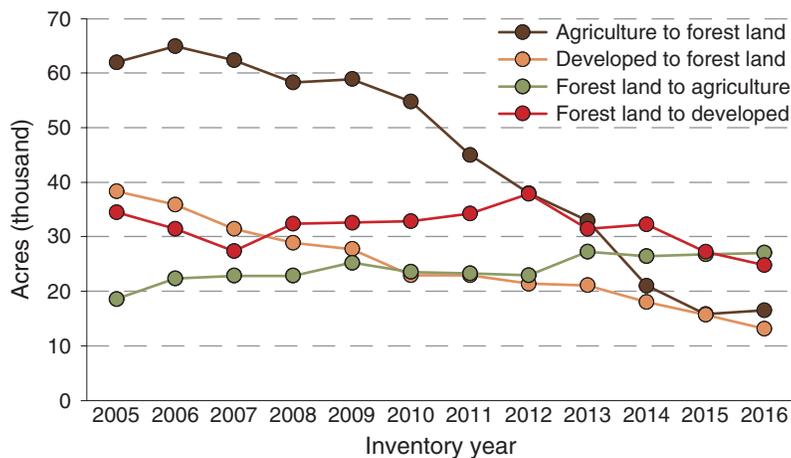


Figure 8—Annualized land use change, South Carolina, 2005–16.



**Trends in pine forest stand origins and age class distribution**—Currently, southern-yellow pine plantations account for 25 percent of all softwood forests (table 2). Thirty-six percent of the softwood forests controlled by private landowners are classified as originating from artificial regeneration. This differs greatly from publically owned forests which range from 9 percent (National forests) to 19 percent (State and local governments) artificially established (planted).

Another area change in the recent past that now appears to be stabilizing is the balance between naturally regenerated southern-yellow pine timberlands and artificially regenerated ones. In 1968, there were approximately 4.4 million acres of naturally regenerated pine stands and just under 1.0 million acres of southern-yellow pine

plantations (fig. 9). Twenty-five years later, these numbers have changed such that in 1993 there were 2.8 million acres of natural pine stands and 2.7 million acres of planted forests. Equilibrium between the two stand origins seems to have been achieved. Since 1993 both types have leveled off with slight fluctuations between the two, where one gains slight prominence over the other then the pattern reverses. In 2016 these estimates are 3.1 and 3.0 million acres for planted and natural southern-yellow pine, with increases in acreage due to the overall increase in southern pine stands over the past half-century but with almost the same distribution of stand origins recorded in 1993.

We can also describe important trends within the forest using land use change information. This report and previous FIA reports document the decreasing acreage of natural pine stands and the increase in southern-yellow pine plantations in South Carolina (Conner and others 2004). Figure 10 shows that from 2005 to 2016, however, more acres have gone from planted southern-yellow pine stands to naturally regenerated ones than vice versa each year, and that the rate of these changes gradually decreased until the year 2014 where an upward trends begins. This information fits with the trends in total southern-yellow pine timberland by regeneration type seen in figure 9.

**Table 2—Area of softwood stands by ownership group and stand origin (percentages in parentheses) in South Carolina forests, 2016**

Ownership group	Total	Natural	Planted
	<i>thousand acres</i>		
National Forest	613 (5)	564 (6)	49 (2)
Other Federal	438 (3)	369 (4)	69 (2)
State and local government	581 (5)	490 (5)	92 (3)
Private landowner	11,283 (87)	8,263 (85)	3,020 (94)
<b>Total</b>	<b>12,915 (100)</b>	<b>9,686 (100)</b>	<b>3,229 (100)</b>

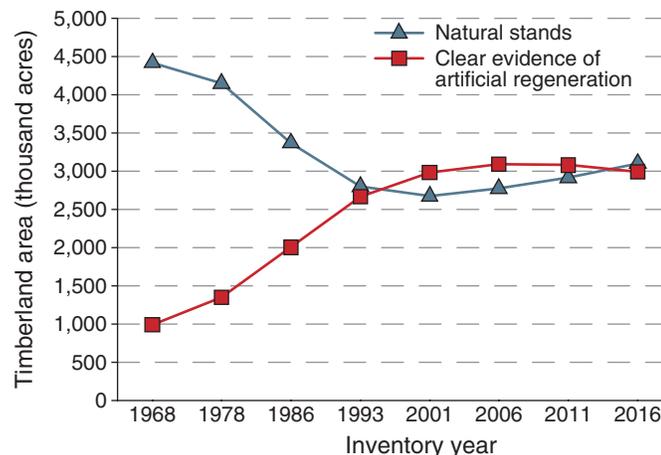


Figure 9—Natural and artificially regenerated softwood timberland area, South Carolina, 1968–2016.

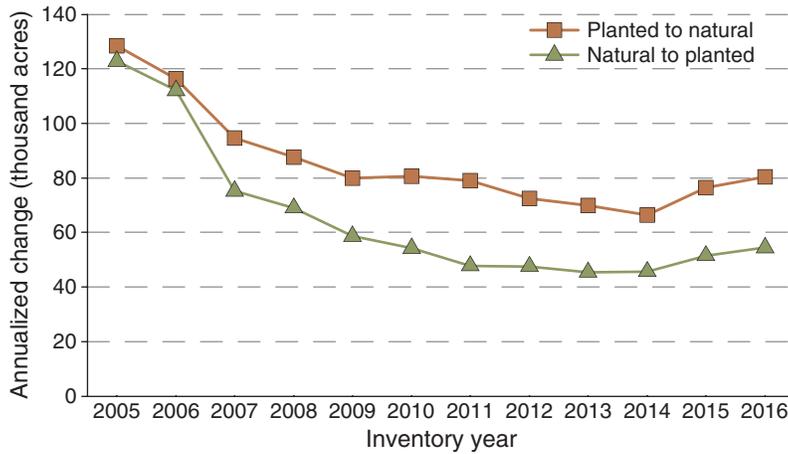


Figure 10—Annualized land use change of planted loblolly-shortleaf forest land, South Carolina, 2005–16.

As mentioned previously, we hypothesize that the current stand-age distribution of South Carolina’s forests is the result of Federally subsidized programs that encouraged private landowners to plant forests and recovery efforts to replace forests in the coastal plains survey units damaged by Hurricane Hugo. The plantation efforts were focused on southern-yellow pine. These newly established stands first appeared during the 1993 inventory as a peak in the 0–10 year class of for all southern-yellow pines (fig. 11). These planted stands grew into 11–20 year old stands for the 2003 and 2008 forest surveys.

Ten years later they became the current 21–30 year class. As of 2016, these lands planted in the late 1980s account for over 31 percent of the States pine forests, making it the most dominant stand age class for this forest type group in the State. The resulting stand-age distribution curve has a peak at the 21–30 year age class. In past forest surveys in the Southern United States, it was more common to have more area in the younger age classes with a tapering off in area as stand age increases. The CRP and post-hurricane recovery efforts appear to have altered this pattern.

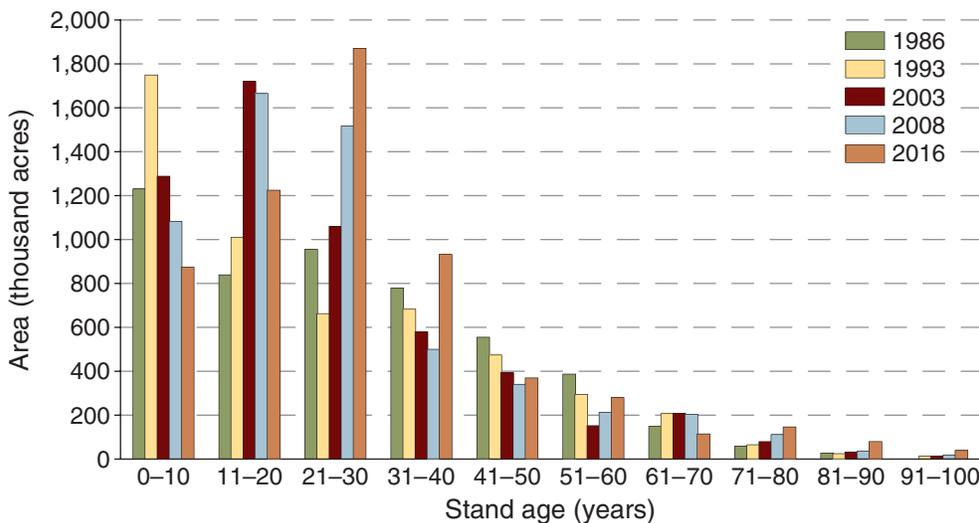


Figure 11—Pine timberland area distribution by stand age, South Carolina, 1986–2016.



### NUMBER OF TREES, VOLUME, AND BIOMASS

South Carolina’s 2016 forest inventory estimates there to be 9.5 billion trees with a d.b.h.  $\geq 1$  inch on all forest land (table 3). The trees with d.b.h.  $\geq 5$  inches hold over 26 billion cubic feet (bcf) of volume and 1.4 billion tons of aboveground live-tree biomass (table 3). Loblolly pine was the State’s most common tree species, leading

both in number of trees (44 percent of all live-trees with d.b.h.  $\geq 5$  inches) and in total volume (42 percent of all volume). Sweetgum followed second, accounting for 10 percent of all trees and 9 percent of all volume.

Volume on timberland overall has been trending upward since forest surveys began in 1968, with the proportions of hardwood versus softwood volume remaining relatively constant (fig. 12).

**Table 3—Number of live trees (d.b.h.  $\geq 1$  inch), net volume (in trees with d.b.h.  $\geq 5$  inches) and aboveground green weight (in trees with d.b.h.  $\geq 1$  inch) on forest land by species group, South Carolina, 2016**

Species group	Number of live trees <i>million trees</i>	Net volume <i>million cubic feet</i>	Aboveground green weight <i>thousand tons</i>
<b>Softwood</b>			
Longleaf and slash pines	249.9	862.7	46,037.1
Loblolly and shortleaf pines	2,229.8	11,343.0	527,167.5
Other yellow pines	106.4	456.8	21,770.3
Eastern white and red pines	9.1	119.8	4,398.0
Eastern hemlock	5.0	28.3	1,539.9
Cypress	52.2	506.7	23,650.2
Other eastern softwoods	201.3	154.5	9,819.7
<b>Total softwoods</b>	<b>2,853.7</b>	<b>13,471.8</b>	<b>634,382.9</b>
<b>Hardwood</b>			
Select white oaks	150.5	1,051.7	61,971.4
Select red oaks	32.2	423.4	24,889.3
Other white oaks	166.5	524.5	33,588.2
Other red oaks	1,110.3	2,756.5	173,181.8
Hickory	217.2	508.0	29,968.3
Yellow birch	1.4	1.1	115.2
Hard maple	44.1	12.9	1,300.4
Soft maple	830.2	970.7	62,344.0
Beech	30.6	55.5	3,639.1
Sweetgum	1,657.9	2,343.9	127,680.4
Tupelo and blackgum	382.9	1,374.4	67,580.3
Ash	183.1	303.7	14,248.0
Cottonwood and aspen	12.2	76.0	3,637.9
Basswood	1.9	4.4	190.4
Yellow-poplar	164.6	1,105.9	49,444.4
Black walnut	1.8	21.6	1,443.7
Other eastern soft hardwoods	688.6	755.3	44,185.3
Other eastern hard hardwoods	402.2	92.2	10,450.9
Eastern noncommercial hardwoods	548.5	187.5	17,172.0
<b>Total hardwoods</b>	<b>6,626.8</b>	<b>12,569.2</b>	<b>727,030.7</b>
<b>All species</b>	<b>9,480.6</b>	<b>26,041.0</b>	<b>1,361,413.6</b>

Numbers in rows and columns may not sum to totals due to rounding.

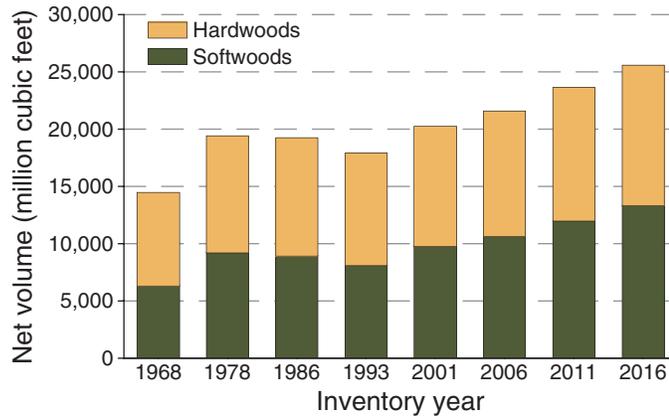


Figure 12—Net volume of live trees on forest land by major species group, South Carolina, 1968–2016.

As seen on table 4, South Carolina’s 2016 inventory estimates place the net volume of live trees on forest land at around 26 bcf, distributed almost equally between softwood and hardwood species (13.5 bcf or 52 percent softwoods and 12.6 bcf or 48 percent hardwoods). Twenty-one percent, or 5.5 bcf, of the standing volume originates from plantations, of which 94 percent corresponds to softwood species and 6 percent to hardwoods. Part or all the volume shown as planted hardwoods, however, could be hardwood trees that regenerated naturally within softwood

plantations rather than planted hardwood trees. Loblolly and shortleaf pines hold the most volume at 11.3 bcf, of which 43 percent (4.9 bcf) originates from planted stands. The species group of longleaf and slash pines was second in terms of standing volume, and cypress was third, representing 6 and 4 percent of the softwood volume, respectively. Within hardwoods, other red oaks, sweetgum, and tupelo and blackgum are the top three species by volume representing 22, 18 and 10 percent of the hardwood volume, respectively.



South Carolina logs headed for international markets through the Port of Charleston. (photo courtesy of Scott Danskin, South Carolina Forestry Commission)



## Number of Trees, Volume, and Biomass

**Table 4—Net volume of live trees on forest land by species group and stand origin, South Carolina, 2012–16**

Species group	Total	Stand origin	
		Planted	Natural
<i>million cubic feet</i>			
<b>Softwood</b>			
Longleaf and slash pines	862.52	201.71	660.81
Loblolly and shortleaf pines	11,342.63	4,896.68	6,445.95
Other yellow pines	456.86	9.32	447.55
Eastern white and red pines	119.82	0.17	119.65
Eastern hemlock	28.34	—	28.34
Cypress	506.91	0.46	506.46
Other eastern softwoods	154.49	10.95	143.54
<b>Total softwoods</b>	<b>13,471.57</b>	<b>5,119.28</b>	<b>8,352.29</b>
<b>Hardwood</b>			
Select white oaks	1,051.70	17.83	1,033.87
Select red oaks	423.46	8.80	414.66
Other white oaks	524.59	7.74	516.85
Other red oaks	2,756.40	90.22	2,666.18
Hickory	507.97	9.22	498.75
Yellow birch	1.06	—	1.06
Hard maple	12.89	0.20	12.68
Soft maple	970.75	15.48	955.27
Beech	55.52	0.25	55.27
Sweetgum	2,343.54	124.91	2,218.63
Tupelo and blackgum	1,374.64	14.25	1,360.39
Ash	303.79	2.50	301.29
Cottonwood and aspen	76.02	0.30	75.72
Basswood	4.40	—	4.40
Yellow-poplar	1,105.97	13.72	1,092.25
Black walnut	21.58	0.38	21.19
Other eastern soft hardwoods	755.33	34.20	721.13
Other eastern hard hardwoods	92.18	1.90	90.28
Eastern noncommercial hardwoods	187.48	6.05	181.43
<b>Total hardwoods</b>	<b>12,569.27</b>	<b>347.97</b>	<b>12,221.30</b>
<b>All species</b>	<b>26,040.84</b>	<b>5,467.25</b>	<b>20,573.59</b>

Numbers in rows and columns may not sum to totals due to rounding.

— = no sample for the cell.

Eighty-five percent of the wood volume in the State is found in forests owned by nonindustrial private landowners (fig. 13). The increases in standing volume for both softwoods and hardwoods has occurred primarily in the larger, sawtimber-sized diameter classes which have trended upwards particularly during the 2001–16 period (figs. 14 and 15). Seen from another

perspective, net volume in the saw-log portion of sawtimber trees has also been trending generally upward over the survey periods, reaching its highest level of 14.9 bcf in 2016 (table 5). Overall, volume in the medium diameter stand-size class decreased slightly for all species, in contrast to small diameter stand-size volume which trended upwards.

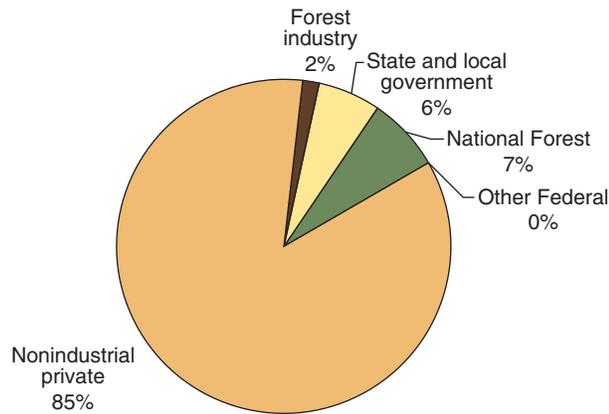


Figure 13—Net volume of live trees by ownership, South Carolina, 2016.

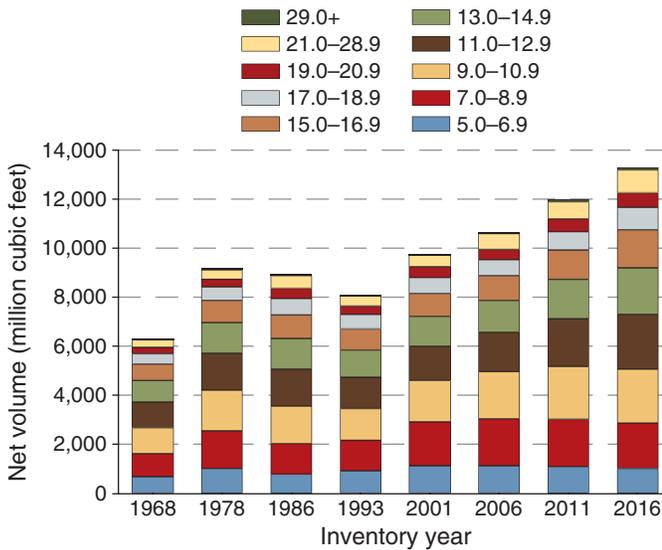


Figure 14—Net softwood volume by diameter class, South Carolina, 1968–2016.

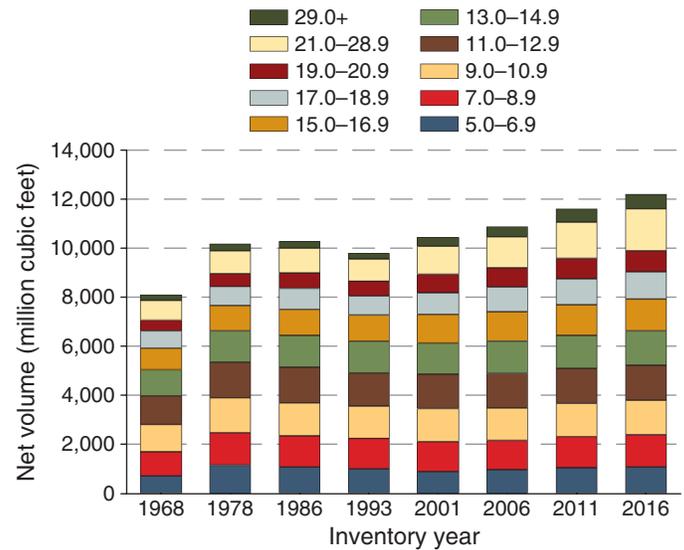


Figure 15—Net hardwood volume by diameter class, South Carolina, 1968–2016.

**Table 5—Net volume in the saw-log portion of sawtimber trees, in cubic feet, on timberland, South Carolina, 1978–2016**

Inventory year	Total	Softwoods	Hardwoods
<i>million cubic feet</i>			
1978	10,425	5,885	4,540
1986	11,190	6,229	4,960
1993	10,205	5,376	4,829
2001	11,289	6,056	5,233
2006	12,084	6,617	5,467
2011	13,104	7,613	5,491
2016	14,866	9,045	5,821



### GROWTH, REMOVALS, AND MORTALITY

Average annual volume of net growth, removals, and mortality (GRM) are calculated over plots measured during two consecutive inventories, providing a measure of inventory change. For instance, GRM estimates for South Carolina’s 2016 inventory are based on plots measured in the 2011 cycle that were remeasured during the 2016 cycle. As seen in figure 16, softwood annual net growth and removals volume increased consistently between 2006 and 2016 inventory cycles, while mortality fluctuated slightly downwards. Annual net growth and removals volume of hardwood species are both lower in 2016 than in the two preceding inventory cycles.

While examining net annual growth by stand-size class and species group (fig. 17), we observe softwood annual growth increasing from 2006 to 2011 across all stand-size classes. The trend changes, however, from 2011 to 2016 with annual growth declining for the small diameter stand-size class, remaining relatively stable in the medium diameter stand-size class and continuing upwards for the large diameter stand-size class. Hardwoods displayed a modest but continuous increase in average net annual growth in both small and medium diameter stand-size classes, and a

steady decline in net annual growth for the large diameter stand-size class.

The State’s annual total removals derive primarily from softwood removals, which account for over 70 percent of total annual removals as seen in figure 18. A large portion of removals occurs in the large diameter stand-size class (sawtimber size stands) especially within hardwoods. Removals from the medium diameter stand-size class (pole size stands) account for 30 to 40 percent of softwood removals and for 15 to 20 percent of hardwood removals. The 2011 inventory cycle shows an increase in softwood annual removals from the medium diameter stand size class accompanied by a drop in removals from large diameter stands, a shift that could be partly reflecting the 2007 to 2009 economic downturn which negatively affected saw-log demand. This pattern is not observed in hardwoods however, possibly due to strong exports markets that kept hardwood saw-log prices and demand up during this period (Stuber 2015).

Softwoods annual mortality (fig. 19) decreased on the medium diameter stand-size class and show mixed patterns for the large diameter stand-size class, with lower annual mortality in 2011 than in 2006, but levels rising in 2016 compared to 2011. Hardwoods also show this mixed

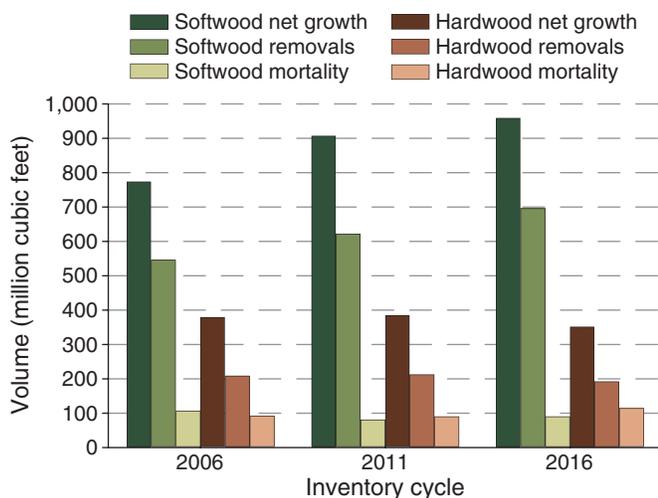


Figure 16—Average annual volume of net growth, removals, and mortality on forest land by survey year, South Carolina, 2006–16.

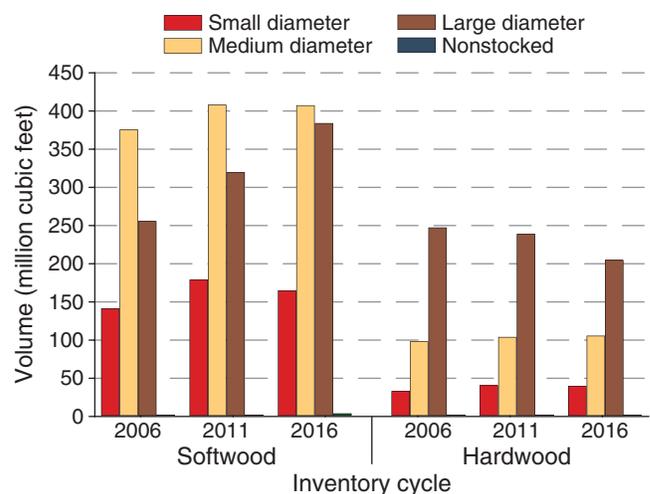


Figure 17—Average annual volume of net growth on forest land by species group and stand-size class, South Carolina, 2006–16.

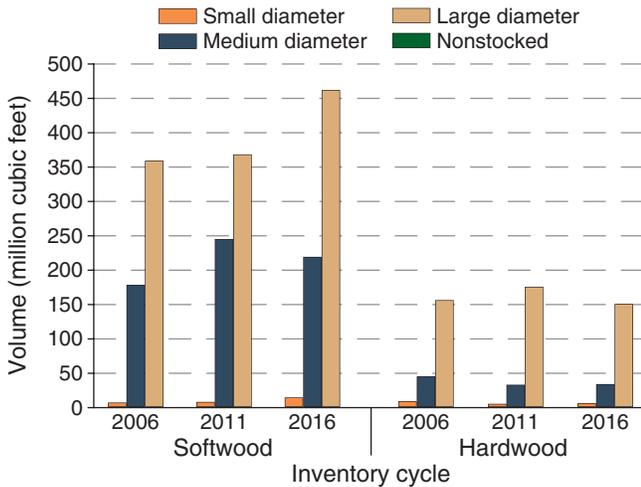


Figure 18—Average annual volume of removals on forest land by species group and stand-size class, South Carolina, 2006–16.

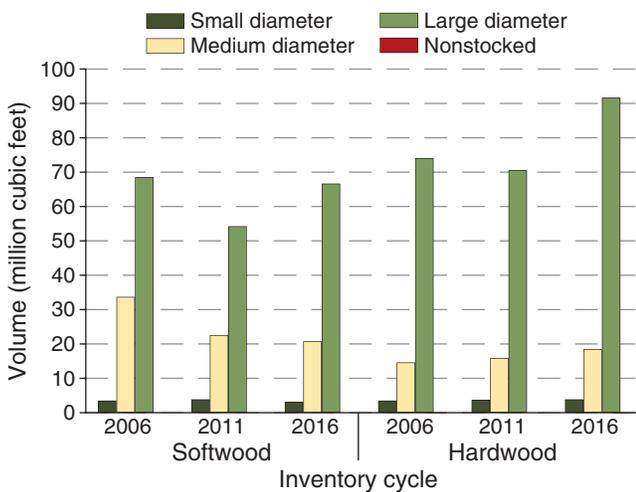


Figure 19—Average annual volume of mortality on forest land by species group and stand-size class, South Carolina, 2006–16.

trend on large diameter stand-size class annual mortality, but the increase observed in 2016 largely surpassed the 2006 annual mortality estimates. Hardwood mortality on medium and small diameter (sapling and seedling) stand-size classes increased continuously between the 2006 and 2016 inventory cycles.

A closer examination of annual growth and removals provide an indication of removals sustainability when annual growth exceeds removals, which is also indicated by a growth to removals ratio above 1. Analyzing hardwood net annual growth and removals by stand-size class, we observe net annual growth volumes surpassing annual removals for both medium and large diameter stand-size classes (fig. 20).

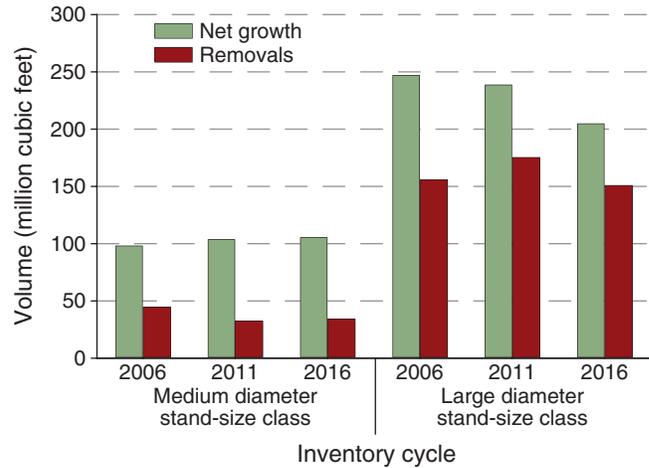


Figure 20—Hardwood average net annual growth and removals on forest land by stand-size class, South Carolina, 2006–16.

The trend shows a growth to removals ratio that is well above 1 for both stand-size classes. While the ratio for the medium diameter stand-size class increased significantly between 2006 and 2016, it decreased over 20 percent for the large diameter stand-size class. Hardwood large diameter stand-size growth to removals ratio decreased from 1.59 in 2006 to 1.36 in 2016, a trend that reflects lower net annual growth and relatively constant annual removals as previously mentioned. Softwood net annual growth and removals (fig. 21) display a pattern similar to that of hardwoods for medium diameter stand-size class, with net annual growth consistently surpassing removals.

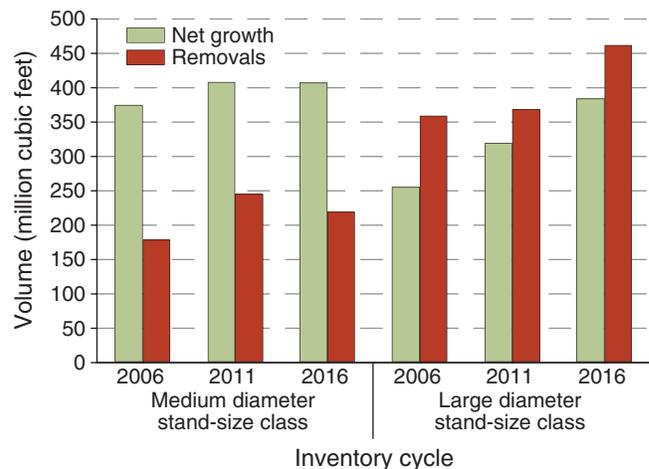


Figure 21—Softwood average net annual growth and removals on forest land by stand-size class, South Carolina, 2006–16.



However, softwood large diameter stand-size class shows the opposite association, with removals consistently exceeding net annual growth. Growth to removals ratio for large diameter stand-size in softwoods ranged from 0.71 in 2006 to 0.83 in 2016 signaling an average net annual growth 29 to 17 percent below that of annual removals for 2006 and 2016, respectively. While South Carolina's pine saw-log prices continue to be down, expected lower timber supply from Canada (due to reduced available supply caused by fires and pine

beetle outbreaks as well as the pending lumber trade agreement) and the significant investment of foreign firms acquiring existing mill capacity in the State signal a likely increase in future saw-log demand.

### Growth, Removals, and Mortality by Stand Origin and Species Group Composition

Total average annual removals in the 2012–16 period (table 6) are distributed almost equally between planted and natural

**Table 6—Average annual removals of live trees on forest land by species group and stand origin, South Carolina, 2012–16**

Species Group	Total	Stand Origin	
		Planted	Natural
<i>million cubic feet</i>			
<b>Softwood</b>			
Longleaf and slash pines	24.48	6.76	17.72
Loblolly and shortleaf pines	656.88	420.74	236.14
Other yellow pines	5.90	0.75	5.16
Eastern white and red pines	0.75	—	0.75
Eastern hemlock	—	—	—
Cypress	5.74	—	5.74
Other eastern softwoods	2.57	0.42	2.16
<b>Total softwoods</b>	<b>696.33</b>	<b>428.66</b>	<b>267.67</b>
<b>Hardwood</b>			
Select white oaks	14.42	0.15	14.27
Select red oaks	6.58	0.12	6.45
Other white oaks	5.55	0.05	5.50
Other red oaks	44.92	3.18	41.74
Hickory	4.01	—	4.01
Yellow birch	—	—	—
Hard maple	0.01	—	0.01
Soft maple	22.95	1.38	21.56
Beech	0.17	—	0.17
Sweetgum	45.38	5.52	39.86
Tupelo and blackgum	13.53	0.09	13.44
Ash	1.62	0.08	1.54
Cottonwood and aspen	—	—	—
Basswood	—	—	—
Yellow-poplar	16.33	0.68	15.65
Black walnut	0.24	0.02	0.22
Other eastern soft hardwoods	12.31	1.03	11.28
Other eastern hard hardwoods	1.73	0.12	1.61
Eastern noncommercial hardwoods	1.66	0.10	1.56
<b>Total hardwoods</b>	<b>191.41</b>	<b>12.55</b>	<b>178.86</b>
<b>All species</b>	<b>887.74</b>	<b>441.21</b>	<b>446.53</b>

— = no sample for the cell.



stands, with most softwood removals occurring in planted stands (62 percent) and hardwood removals taking place on natural stands (93 percent). Loblolly and shortleaf pines make up the majority of removals, accounting for approximately 656.9 million cubic feet (mmcf) or 94 percent of the softwood removals and 74 percent of all removals. Across hardwoods, sweetgum

and other red oak species have the highest volume of annual removals with 45.4 and 44.9 mmcf, or 24 and 23 percent of hardwood removals, respectively. Net annual growth (table 7) also shows loblolly and shortleaf pines ranking first, representing 68 percent of all species net annual growth and 93 percent of softwood species net annual growth.

**Table 7—Net average annual growth of live trees on forest land by species group and stand origin, South Carolina, 2012–16**

Species Group	Total	Stand Origin	
		Planted	Natural
<i>million cubic feet</i>			
<b>Softwood</b>			
Longleaf and slash pines	40.01	20.19	19.82
Loblolly and shortleaf pines	887.77	521.51	366.26
Other yellow pines	10.80	0.58	10.22
Eastern white and red pines	3.87	0.03	3.83
Eastern hemlock	-1.98	—	-1.98
Cypress	12.02	0.02	12.00
Other eastern softwoods	5.84	0.80	5.04
<b>Total softwoods</b>	<b>958.33</b>	<b>543.13</b>	<b>415.19</b>
<b>Hardwood</b>			
Select white oaks	30.68	0.89	29.79
Select red oaks	11.41	0.33	11.08
Other white oaks	10.19	0.41	9.78
Other red oaks	91.26	5.82	85.44
Hickory	9.94	0.37	9.57
Yellow birch	0.09	—	0.09
Hard maple	0.28	0.03	0.24
Soft maple	31.34	1.18	30.16
Beech	2.08	0.01	2.07
Sweetgum	82.40	8.98	73.42
Tupelo and blackgum	22.86	0.39	22.47
Ash	5.61	0.22	5.39
Cottonwood and aspen	1.43	0.00	1.43
Basswood	0.11	—	0.11
Yellow-poplar	28.40	1.36	27.04
Black walnut	0.57	0.06	0.50
Other eastern soft hardwoods	15.80	2.53	13.27
Other eastern hard hardwoods	1.39	0.13	1.27
Eastern noncommercial hardwoods	4.75	0.44	4.31
Other	—	—	—
<b>Total hardwoods</b>	<b>350.59</b>	<b>23.15</b>	<b>327.44</b>
<b>All species</b>	<b>1,308.92</b>	<b>566.29</b>	<b>742.63</b>

— = no sample for the cell.



### Treated Acres

The numbers of harvested acres in South Carolina are closely related to the amount of volume removed from the State's forests. The SRS FIA program not only notes harvesting activity on re-measured plots, it also categorizes the type of harvesting that took place. Clearcut harvesting is where the majority of the merchantable trees in a stand are removed and utilized, with residual stand stocking lowered to under 50 percent. Partial harvest are when primarily the highest quality trees are removed and the residual stand consists of lower quality trees in the case of high grading or selection harvest. This cutting type can also include silvicultural systems that involve partial harvesting but not necessarily the retention of lower quality trees like uneven-aged management. Seed-tree/shelterwood harvesting, where crop trees are harvested leaving seed source trees either in a shelterwood or seed tree, are also noted but not often recorded in the Southern States. Commercial thinning involves the removal of trees (usually of medium-diameter) from medium-

diameter stands leaving sufficient stocking of growing-stock trees to feature in future stand development. Also of note are timber stand improvements and salvage cutting. (See the Glossary for more details on SRS FIA harvesting categories.) Clear-cutting may have declined slightly in 2011 relative to the preceding survey (fig. 22). The acreage where partial harvesting occurred has decreased slightly in recent surveys. Acres thinned, however, increased from 2006 to 2011 and has equaled or exceeded the total acres where clear cut or partial harvesting occurred.

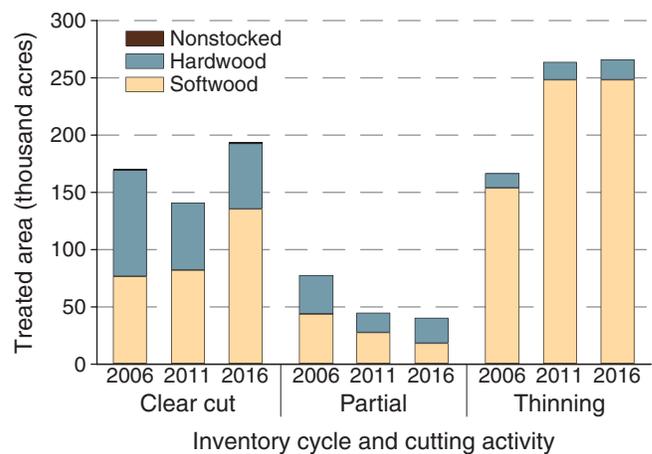


Figure 22—Average annual forest land acreage affected by cutting activity, South Carolina, 2006–16.

Personal consultations are a regular day's work for South Carolina Forestry Commission personnel. (photo courtesy of Michelle Johnson, South Carolina Forestry Commission)





## DISTURBANCE AND FOREST HEALTH INDICATORS

### Disturbance

Wildland forest fires (which includes prescribed burns) were the most frequently recorded disturbance on forest land in South Carolina from 2012 to 2016, affecting an estimated 165,900 acres of forest land per year (table 8). This was up from the average annual acreage (103,900 acres) affected by fire from 2007 to 2011 (Rose 2016). Forest diseases, closely followed by weather, affected 49,300 acres and 48,900 acres annually, respectively. While weather affected softwood and hardwood forest types about equally, the incidence of disease appeared to be higher in hardwood forests, particularly the oak-gum-cypress forest type.



Wildfires like the 2016 Pinnacle Mountain Fire were the most common cause of disturbance in South Carolina’s forests. (photo courtesy of the South Carolina Forestry Commission)

**Table 8—Area of forest land disturbed annually by forest-type group and disturbance class, South Carolina, 2012–16**

Forest-type group <sup>b</sup>	Disturbance class <sup>a</sup>							
	Insects	Disease	Weather	Fire	Domestic animals	Wild animals	Human	Other natural
	<i>thousand acres</i>							
<b>Softwood types</b>								
White-red-jack pine	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0
Longleaf-slash pine	0.0	0.0	2.7	23.2	0.0	0.0	8.5	0.0
Loblolly-shortleaf pine	6.4	11.1	19.2	105.7	0.7	1.1	7.0	7.2
Other eastern softwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>6.4</b>	<b>11.1</b>	<b>21.9</b>	<b>130.4</b>	<b>0.7</b>	<b>1.1</b>	<b>15.5</b>	<b>7.2</b>
<b>Hardwood types</b>								
Oak-pine	3.1	8.3	7.6	8.8	0.0	0.0	0.9	0.0
Oak-hickory	2.1	7.3	7.6	16.5	3.1	1.6	7.1	0.0
Oak-gum-cypress	1.2	21.4	7.3	6.5	0.0	4.2	0.9	0.0
Elm-ash-cottonwood	0.0	1.2	4.6	0.0	0.0	2.5	0.0	0.0
Other hardwoods	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exotic hardwoods	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
<b>Total hardwoods</b>	<b>6.4</b>	<b>38.2</b>	<b>27.0</b>	<b>32.7</b>	<b>3.1</b>	<b>8.3</b>	<b>8.8</b>	<b>0.0</b>
Nonstocked	0.0	0.0	0.0	2.8	0.0	0.3	0.0	0.0
<b>All groups</b>	<b>12.7</b>	<b>49.3</b>	<b>48.9</b>	<b>165.9</b>	<b>3.8</b>	<b>9.7</b>	<b>24.3</b>	<b>7.2</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.

<sup>b</sup>Based on past conditions.



Forests damaged by an ice storm in 2014. (photo courtesy of the South Carolina Forestry Commission)



### **Standing Dead Trees, Down Woody Materials, Forest Duff and Litter**

From the moment a tree dies or parts of a live tree are broken off, physical and chemical decomposition begin the process of returning the nutrients and carbon

sequestered in that wood back to the soil and atmosphere. Standing dead trees are an important part of the forest, both for carbon and for wildlife. Many forest species rely on standing trees during some or all of their life cycle. The number of standing dead trees  $\geq 5.0$  inches d.b.h. in forests of South Carolina was 83.8 million in 2016 (table 9). Forest down woody materials (DWM) are pieces of trees that have fallen to the ground, ranging from small twigs to logs that were once entire tree stems. The FIA program includes the inventory and monitoring of DWM biomass because of its important role in the functioning of healthy forest ecosystems. A forest's productivity depends on the recycling of the nutrients and carbon in this DWM. While DWM resides on the forest floor, it provides shelter and feeding sites for many wildlife species. When sufficiently dry, DWM is also part of a forest's fire fuel load.



High winds from Hurricane Matthew in 2016 damaged forests and deposited considerable amounts of down woody materials onto the forest floor. (photo courtesy of the South Carolina Forestry Commission)

Natural decomposition of DWM in temperate forests like South Carolina's may proceed at relatively predictable rates, which will vary by climate, local conditions, forest type, stand age, forest management



**Table 9—Number of standing dead trees on forest land by forest-type group and diameter class, South Carolina, 2016**

Forest-type group	Diameter class ( <i>inches at breast height</i> )										
	All classes	5.0– 6.9	7.0– 8.9	9.0– 10.9	11.0– 12.9	13.0– 14.9	15.0– 16.9	17.0– 18.9	19.0– 20.9	21.0– 28.9	29.0+
<i>number of trees</i>											
<b>Softwood types</b>											
White-red-jack pine	442,659	268,123	128,225	11,483	—	11,483	—	—	—	11,673	11,673
Longleaf-slash pine	1,554,685	974,297	216,835	45,713	94,275	45,920	—	70,150	37,437	70,058	—
Loblolly-shortleaf pine	31,303,442	14,868,243	7,823,736	4,019,737	2,257,565	928,159	734,831	425,848	82,765	127,438	35,121
<b>Total softwoods</b>	<b>33,300,786</b>	<b>16,110,663</b>	<b>8,168,796</b>	<b>4,076,933</b>	<b>2,351,840</b>	<b>985,562</b>	<b>734,831</b>	<b>495,998</b>	<b>120,202</b>	<b>209,169</b>	<b>46,794</b>
<b>Hardwood types</b>											
Oak-pine	12,706,957	5,611,322	3,370,094	1,539,285	671,375	411,583	537,436	143,332	177,644	174,737	70,150
Oak-hickory	17,972,362	7,159,551	3,987,956	2,136,284	2,041,974	968,982	681,425	475,043	299,909	174,634	46,604
Oak-gum-cypress	17,422,009	7,320,255	3,961,917	2,240,900	1,361,005	702,472	982,953	280,853	256,960	277,256	37,437
Elm-ash-cottonwood	1,908,364	694,147	370,854	271,264	128,236	152,856	116,943	57,994	11,483	104,587	—
Other hardwoods	23,345	11,673	—	11,673	—	—	—	—	—	—	—
Tropical hardwoods	37,057	—	—	—	—	—	37,057	—	—	—	—
Exotic hardwoods	103,903	—	103,903	—	—	—	—	—	—	—	—
<b>Total hardwoods</b>	<b>50,173,997</b>	<b>20,796,948</b>	<b>11,794,724</b>	<b>6,199,406</b>	<b>4,202,590</b>	<b>2,235,893</b>	<b>2,355,814</b>	<b>957,222</b>	<b>745,996</b>	<b>731,214</b>	<b>154,191</b>
<b>Nonstocked</b>	<b>149,369</b>	<b>—</b>	<b>—</b>	<b>—</b>	<b>37,437</b>	<b>37,057</b>	<b>37,437</b>	<b>37,437</b>	<b>—</b>	<b>—</b>	<b>—</b>
<b>All groups</b>	<b>83,814,060</b>	<b>36,985,805</b>	<b>20,075,232</b>	<b>10,276,340</b>	<b>6,591,868</b>	<b>3,258,512</b>	<b>3,128,083</b>	<b>1,490,657</b>	<b>866,198</b>	<b>940,381</b>	<b>200,984</b>

— = no sample for the cell.

regime, and many other factors. But the amount of DWM can change rapidly as natural disturbances such as forest fires and storm events can quickly increase the amounts of DWM on the forest floor. Also, a human-caused disturbance like wood product harvesting can dramatically change DWM pools in a very short period of time. The irregular frequency and localized nature of these disturbances make forest DWM pools dynamic and heterogeneous across the landscape.

Quantities of DWM are expressed by FIA in terms of total tons and tons per acre in various size classes. Time-lag fuel hour size classes, which are 1, 10, 100 and 1,000 hours, represent the time it would take for two-thirds of the piece of DWM to dry to the same moisture that is in the surrounding air. One-hour fuels are up to 0.01 to 0.24 inch in diameter, 10-hour fuels are 0.25 to 1.0 inch in diameter, 100-hour fuels are 1.0 to 2.9 inches in diameter, and 1,000-hour fuels are 3.0 to 8.0 inches in diameter. Where DWM has been piled after harvesting or other human activity

and cannot be practically separated into individual pieces, the total volume and mass of the pile is estimated and presented as slash. Details on how these data are collected and what type of material are included in each size class can be found in the FIA National core field guide (U.S. Department of Agriculture Forest Service 2014).

Table 10 presents the mean fuel loading on forest land by forest-type group and fuel class for South Carolina. Table 11 has mean fuel loading on a per acre basis. Note that the forest land acres used to make the calculations in table 11 differ from those that appear in other places in this publication. For example, appendix table C.3 will show there were an estimated 5,585,000 acres of loblolly-shortleaf pine in South Carolina in 2016 but the area of this forest type used to estimate DWM tons per acre was 6,889,643 acres (table 11). This is because separate forest land area estimates had to be made using only those plots where DWM were inventoried, approximately 1/16 of the FIA plots. These



## Disturbance and Forest Health Indicators

**Table 10—Mean fuel loading on forest land by forest-type group and fuel class, South Carolina, 2016**

Forest-type group	Down and dead wood by time-lag fuel hour classes				Forest floor fuels		
	1 hour	10 hour	100 hour	1,000+ hour	Slash	Duff	Litter
	<i>tons</i>						
White-red-jack pine	696.9	4,990.0	17,728.2	22,299.1	0.0	268,514.2	158,714.9
Oak-hickory	91,482.7	819,220.2	3,274,959.8	2,457,099.4	0.0	20,596,543.8	21,919,398.8
Tropical hardwoods	1,936.7	13,320.2	0.0	0.0	0.0	56,739.3	77,257.8
Oak-gum-cypress	60,972.7	398,899.0	1,356,056.5	1,867,993.2	0.0	17,652,471.4	7,302,768.9
Other eastern softwoods	2,441.1	10,073.2	35,977.5	37,606.6	0.0	193,922.1	251,338.7
Oak-pine	48,831.0	354,845.4	1,239,473.9	3,368,258.0	69,338.3	20,699,040.6	16,405,204.5
Elm-ash-cottonwood	20,997.2	135,510.6	599,155.5	884,139.2	0.0	913,564.7	2,769,650.5
Longleaf-slash pine	10,460.4	159,512.0	247,667.6	120,176.9	0.0	4,867,754.2	6,208,442.8
Other hardwoods	83.7	0.0	813.3	2,397.7	0.0	7,260.2	16,719.8
Loblolly-shortleaf pine	246,448.0	1,853,159.2	5,405,048.2	4,855,795.0	686,462.2	81,910,479.5	86,856,534.9
All groups	484,350.5	3,749,529.7	12,176,880.4	13,615,764.8	755,800.5	147,166,290.0	141,966,031.5

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

**Table 11—Mean fuel loading on forest land by forest-type group and fuel class, South Carolina, 2016**

Forest-type group	Area	Down and dead wood by time-lag fuel hour classes				Forest floor fuels		
		1 hour	10 hour	100 hour	1,000+ hour	Slash	Duff	Litter
	<i>acres</i>	<i>----- tons per acre -----</i>						
White-red-jack pine	12,913	0.1	0.4	1.4	1.7	0.0	20.8	12.3
Oak-hickory	2,367,879	0.0	0.3	1.4	1.0	0.0	8.7	9.3
Tropical hardwoods	27,640	0.1	0.5	0.0	0.0	0.0	2.1	2.8
Oak-gum-cypress	1,537,689	0.0	0.3	0.9	1.2	0.0	11.5	4.7
Other eastern softwoods	82,921	0.0	0.1	0.4	0.5	0.0	2.3	3.0
Oak-pine	1,345,402	0.0	0.3	0.9	2.5	0.1	15.4	12.2
Elm-ash-cottonwood	544,461	0.0	0.2	1.1	1.6	0.0	1.7	5.1
Longleaf-slash pine	590,268	0.0	0.3	0.4	0.2	0.0	8.2	10.5
Other hardwoods	1,177	0.1	0.0	0.7	2.0	0.0	6.2	14.2
Loblolly-shortleaf pine	6,889,643	0.0	0.3	0.8	0.7	0.1	11.9	12.6
All groups	13,399,994	0.0	0.3	0.9	1.0	0.1	11.0	10.6

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

area forest land estimates are less accurate because they are based on fewer plots but must be used to correctly calculate the tons per acre of DWM. If we had used the loblolly-shortleaf forest land acreage in table C.3, the tons per acres of DWM for that forest type would have been overestimated. Details for these DWM estimation procedures can be found in

Woodall and Monleon (2008) and Woodall and others (2011). Based on the FIA plots where DWM was sampled, the forests of South Carolina hold an average of 2.3 tons of biomass per acre of DWM (table 11). These estimates agree well with those made previously in Conner and others (2004) in which fine and coarse woody debris combined averaged around 2 tons per acre.



The forest floor organic material that is too small to be recorded as individual pieces of DWM is also measured and monitored by FIA. Litter is the layer of freshly fallen leaves, needles, twigs, cones, detached bark, dead moss, dead lichens and all other detached tree and plant parts that cover the forest floor (U.S. Department of Agriculture Forest Service 2014). Duff is the layer below the litter, located just above the uppermost layer of mineral soil, consisting of organic material derived from the decomposition of the litter (U.S. Department of Agriculture Forest Service 2014). Both of these biomass deposits play important roles in forest ecosystem functioning similar to those of the DWM. South Carolina’s forests have on average 21.6 tons of duff and litter biomass per acre (table 11). As with DWM, more detailed duff and litter definitions can be found in the Glossary and data collection details can be found in the FIA National core field guide (U.S. Department of Agriculture Forest Service 2014).

These forest floor biomass deposits are important forest carbon storage pools. The FIA program reports DWM in size categories useful for monitoring carbon cycling in the

forest. Fine woody debris (FWD) is counted in 3 size classes according to its diameter. Small FWD ranges from 0.01 to 0.24 inch, medium FWD is 0.25 to 1.0 inch, and large FWD is 1.0 to 2.9 inches, the same as the 1, 10 and 100-hour fuel classes. Coarse woody debris (CWD) is 3.0 inches and greater in diameter, unlike the 1,000-hour fuel category which ends at 8.0 inches. Once the number of tons of biomass in DWM is estimated, it is converted to tons of carbon stored, taking into account decay reduction factors for CWD. This conversion is described in detail in Woodall and Monleon (2008). In South Carolina, these data gave a total of 15.5 million tons of carbon stored in DWM and another 144.6 million tons in duff and litter (table 12). These estimates can be broken down further into forest-type groups and ownership categories which highlights the importance of the State’s loblolly-shortleaf pines forests in terms of carbon storage and sequestration (table 13).

The 2016 DWM, duff and litter estimates fall within the broad range of values previously observed for the Southern United States and South Carolina. Woodall and others

**Table 12—Carbon stocks of dead, down woody materials on forest land by forest-type group, South Carolina, 2016**

Forest-type group	Forest floor		Fine woody debris			Coarse woody debris	Slash
	Duff	Litter	Small	Medium	Large	CWD	Slash
	<i>thousand tons</i>						
White-red-jack pine	134.3	79.4	0.4	2.5	8.9	11.2	0.0
Longleaf-slash pine	2,433.9	3,104.2	5.2	79.8	123.8	62.5	0.0
Loblolly-shortleaf pine	40,955.2	43,428.3	123.2	926.6	2,702.5	2,485.5	343.2
Other eastern softwoods	97.0	125.7	1.2	5.0	18.0	18.5	0.0
Oak-pine	10,349.5	8,202.6	24.4	177.4	619.7	1,692.0	34.7
Oak-hickory	10,298.3	10,959.7	45.7	409.6	1,637.5	1,226.9	0.0
Oak-gum-cypress	8,826.2	3,651.4	30.5	199.5	678.0	940.1	0.0
Elm-ash-cottonwood	456.8	1,384.8	10.5	67.8	299.6	435.5	0.0
Other hardwoods	3.6	8.4	0.0	0.0	0.4	1.2	0.0
Tropical hardwoods	28.4	38.6	1.0	6.7	0.0	0.0	0.0
<b>All groups</b>	<b>73,583.2</b>	<b>70,983.0</b>	<b>242.2</b>	<b>1,874.8</b>	<b>6,088.4</b>	<b>6,873.3</b>	<b>377.9</b>

Numbers in rows and columns may not sum to totals due to rounding.  
 0.0 = no sample for the cell or a value of >0.0 but <0.05.  
 CWD = coarse woody debris.



## Disturbance and Forest Health Indicators

**Table 13—Biomass and carbon mass of down wood<sup>a</sup> on forest land by forest-type group, South Carolina, 2016**

Forest-type group	USDA Forest Service		Other Federal		State and local government		Corporate		Noncorporate	
	Biomass	Carbon	Biomass	Carbon	Biomass	Carbon	Biomass	Carbon	Biomass	Carbon
	<i>thousand tons</i>									
White-red-jack pine	22.3	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Longleaf-slash pine	19.7	10.3	0.0	0.0	0.0	0.0	0.0	0.0	100.5	52.2
Loblolly-shortleaf pine	687.3	350.6	525.8	272.1	343.6	171.8	39.2	19.3	3,259.8	1,671.7
Other eastern softwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.6	18.5
Oak-pine	204.8	103.3	22.3	10.9	251.6	130.5	0.0	0.0	2,889.6	1,447.2
Oak-hickory	252.0	126.1	0.0	0.0	97.1	47.7	0.0	0.0	2,108.0	1,053.1
Oak-gum-cypress	336.2	167.7	144.3	70.9	227.5	111.7	14.5	7.1	1,145.4	582.7
Elm-ash-cottonwood	12.9	6.3	0.0	0.0	0.0	0.0	0.0	0.0	871.2	429.2
Other hardwoods	2.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
All groups	1,537.5	776.7	692.4	353.9	919.9	461.6	53.8	26.4	10,412.2	5,254.6

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Down wood includes all pieces with a diameter more than 3 inches at the point of intersection. Thus, only includes coarse woody debris (CWD).

(2013) present State-level DWM estimates derived from field-based FIA measurements taken from 2002 to 2010 under different data collection protocols. Estimates for total DWM in SC 2010 were 28.7 million tons (Woodall and others 2013). The average South Carolina litter values of 21.6 tons per acre are considerably higher than the average values for the Southern United States observed in Domke and others (2016) (which ranged from 2.1 to 6.2 tons per acre) but within the range of maximum values observed (13.4 to 33.0 tons per acre). It is clear from this current work and previous publications that variation between States and measurement years is very high. DWM, duff and litter is highly heterogeneous across the landscape so statewide average estimates might be very different than estimates made at finer, local scales.

### Carbon

The need for information about forest carbon pools has increased in recent years due to concerns about global climate change. The FIA program has responded to these information needs by converting

field-measured estimates like tree volume to carbon and using models or ancillary sources of data to estimate carbon stored in other pools like tree roots and non-tree understory vegetation. The FIA program used models to estimate DWM, duff and litter carbon quantities prior to having field-based measurements. The models used geographic region, stand age, and species composition as predictive variables and were implemented as part of the larger Component Ratio Method (CRM) suite of forest carbon pool estimators. See U.S. Environmental Protection Agency (2012), Smith and Heath (2002), and Woodall and others (2011) for details on the modeling procedures for DWM and forest floor carbon, respectively. There are notable differences when the field-based estimates to the model-based estimates for South Carolina in 2016 are compared. At a national level, field-based litter estimates were 44 percent lower than model-based estimates (Domke and others 2016), while for CWD the model-based estimates were 9 percent higher than field-based estimates (Domke and others 2013).



For this report we chose to present the total quantities and percentages of forest carbon by carbon pool using the model-based estimates of forest floor litter and DWM (fig. 23). This is because they are more comparable to the previous modeled estimates and one cannot directly replicate the same categories of forest carbon produced by the models. For example, the model-based DWM estimate is part of a larger category that includes coarse tree roots and stumps. While the exact quantities are not the same, the distribution of carbon across the pools remains similar, again with almost half of forest carbon stored in the soil and about a third in the aboveground portions of live trees. The forests of South Carolina sequester approximately 967.3 million tons of carbon (table 14). Over 48 percent of this was in the forest soil (fig. 23).

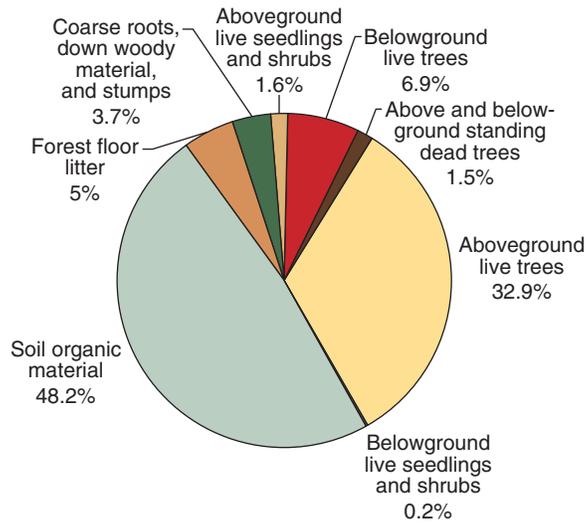


Figure 23—Percentage of forest carbon in the aboveground and belowground portions of live and dead trees [diameter at breast height (d.b.h.) ≥1 inch], seedlings and shrubs (d.b.h. <1 inch), coarse woody material, forest floor litter, and soil organic material by forest-type group, South Carolina, 2016.

Table 14—Carbon pool on forest land by forest-type group and carbon pool groups, South Carolina, 2016

Forest-type group <sup>a</sup>	Carbon pool groups								Total
	Above ground trees	Below ground trees	Standing dead trees	Above ground understory	Below ground understory	Down dead material	Forest floor Litter	Soil organic matter	
<i>thousand short tons</i>									
<b>Softwood types</b>									
White-red-jack pine	942.0	203.0	52.0	20.0	2.0	96.0	111.0	433.0	1,860.0
Longleaf-slash pine	9,689.0	2,199.0	225.0	776.0	86.0	1,332.0	2,742.0	27,202.0	44,252.0
Loblolly-shortleaf pine	128,843.0	29,030.0	4,787.0	7,743.0	860.0	17,281.0	24,867.0	181,717.0	395,129.0
Other eastern softwoods	261.0	58.0	62.0	37.0	4.0	70.0	125.0	404.0	1,022.0
<b>Total softwoods</b>	<b>139,735.0</b>	<b>31,490.0</b>	<b>5,126.0</b>	<b>8,576.0</b>	<b>952.0</b>	<b>18,779.0</b>	<b>27,845.0</b>	<b>209,756.0</b>	<b>442,263.0</b>
<b>Hardwood types</b>									
Oak-pine	34,173.0	7,166.0	1,461.0	1,984.0	220.0	3,471.0	6,251.0	41,170.0	95,896.0
Oak-hickory	69,445.0	13,696.0	3,862.0	3,545.0	394.0	6,710.0	7,342.0	56,025.0	161,019.0
Oak-gum-cypress	64,833.0	12,868.0	3,463.0	1,203.0	134.0	6,054.0	5,416.0	134,916.0	228,887.0
Elm-ash-cottonwood	9,199.0	1,794.0	851.0	254.0	28.0	987.0	1,001.0	16,566.0	30,680.0
Other hardwoods	15.0	3.0	1.0	8.0	1.0	4.0	7.0	374.0	413.0
Tropical hardwoods	61.0	12.0	3.0	1.0	0.0	12.0	3.0	119.0	211.0
Exotic hardwoods	324.0	67.0	30.0	17.0	2.0	45.0	39.0	2,000.0	2,524.0
<b>Total hardwoods</b>	<b>178,050.0</b>	<b>35,606.0</b>	<b>9,671.0</b>	<b>7,012.0</b>	<b>779.0</b>	<b>17,283.0</b>	<b>20,059.0</b>	<b>251,170.0</b>	<b>519,630.0</b>
Nonstocked	66.0	13.0	18.0	188.0	21.0	18.0	140.0	4,939.0	5,404.0
<b>All groups</b>	<b>317,851.0</b>	<b>67,109.0</b>	<b>14,815.0</b>	<b>15,776.0</b>	<b>1,752.0</b>	<b>36,080.0</b>	<b>48,044.0</b>	<b>465,865.0</b>	<b>967,297.0</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup> Based on past conditions.



**Nonnative Invasive Plants**

The increasing presence of nonnative invasive plants has been recognized as having potential, long-term ecological impacts on the forest ecosystems across the Southern United States, and South Carolina is no exception. Table 15 lists by frequency those invasive species of trees, shrubs, vines, grasses and herbs encountered on FIA plots in South Carolina during the 2016 survey period. The list includes two distinct samples, recorded as 4.0 and 6.0, to reflect a change from FIA field manual version 4.0 guidelines (U.S. Department of Agriculture Forest Service 2012) to field manual version 6.0 guidelines (U.S. Department of Agriculture Forest Service 2014) between

the previous and current survey cycles. The predominant change between the two manuals is the identification of additional species as nonnative invasives.

Chinaberry (*Melia azedarach*) and Chinese tallow tree (*Triadica sebifera*) were the most frequently encountered nonnative tree species on sampled forested plots. Chinese/European privets (*Ligustrum* spp.), were the most common shrub species and Japanese honeysuckle (*Lonicera japonica*) the most common vine. The most frequently detected invasive grass was Nepalese browntop (*Microstegium vimineum*), and Chinese or sericea lespedeza (*Lespedeza cuneata*) was the most commonly encountered invasive herb on forested plots.

**Table 15—Regionally recognized nonnative invasive plants identified on forest survey plots by common name, scientific name, and number of plots, South Carolina, 2016**

Common name	Scientific name	Survey plots			Proportion of total sample percent
		4.0 <sup>a</sup>	6.0 <sup>b</sup>	Total	
----- number -----					
<b>Trees</b>					
Callery pear	<i>Pyrus calleryana</i>	—	25	25	0.8
Chinaberrytree	<i>Melia azedarach</i>	21	50	71	2.4
Chinese tallow	<i>Triadica sebifera</i>	20	48	68	2.3
Princesstree	<i>Paulownia tomentosa</i>	2	4	6	0.2
Hardy orange	<i>Poncirus trifoliata</i>	—	9	9	0.3
Silktree	<i>Albizia julibrissin</i>	10	47	57	1.9
Tree of heaven	<i>Ailanthus altissima</i>	1	21	22	0.7
(Continued)					



**Table 15 (continued)—Regionally recognized nonnative invasive plants identified on forest survey plots by common name, scientific name, and number of plots, South Carolina, 2016**

Common name	Scientific name	Survey plots			Proportion of total sample percent
		4.0 <sup>a</sup>	6.0 <sup>b</sup>	Total	
		----- number -----			
<b>Shrubs</b>					
Japanese privet	<i>Ligustrum japonicum</i>	4	25	29	1.0
Sacred bamboo	<i>Nandina domestica</i>	1	22	23	0.8
Oleaster	<i>Elaeagnus</i> spp.	3	31	34	1.1
Chinese/European privet	<i>Ligustrum</i> spp.	127	575	702	23.3
Nonnative rose	<i>Rosa</i> spp.	6	50	56	1.9
Beale's barberry	<i>Mahonia bealei</i>	—	4	4	0.1
Honeysuckle	<i>Lonicera</i> spp.	1	1	2	0.1
Thorny olive	<i>Elaeagnus pungens</i>	—	56	56	1.9
<b>Vines</b>					
Japanese climbing fern	<i>Lygodium japonicum</i>	1	7	8	0.3
Japanese honeysuckle	<i>Lonicera japonica</i>	226	965	1,191	39.6
Periwinkle	<i>Vinca</i> spp.	2	7	9	0.3
Kudzu	<i>Pueraria montana</i> var. <i>lobata</i>	6	16	22	0.7
Wisteria	<i>Wisteria</i> spp.	10	42	52	1.7
Yam	<i>Dioscorea</i> spp.	1	1	2	0.1
Ivy	<i>Hedera</i> spp.	4	9	13	0.4
Chocolate vine	<i>Akebia quinata</i>	—	1	1	0.0
<b>Grass</b>					
Bamboo	<i>Bambusa</i> spp.	1	4	5	0.2
Nepalese browntop	<i>Microstegium vimineum</i>	17	110	127	4.2
<b>Herbs</b>					
Chinese or sericea lespedeza	<i>Lespedeza cuneata</i>	58	283	341	11.3
Lespedeza	<i>Lespedeza</i> spp.	9	49	58	1.9
Lilyturf	<i>Liriope</i> spp.	—	1	1	>0.1

— = no sample for the cell.

<sup>a</sup> Count of survey plots with at least one invasive plant present collected under Forest Inventory and Analysis Program field manual version 4.0 guidelines during inventory cycle.

<sup>b</sup> Count of survey plots with at least one invasive plant present collected under Forest Inventory and Analysis Program field manual version 6.0 guidelines during inventory cycle.



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### GLOSSARY

**All-live tree**—All living trees. All size classes, all tree classes, and both saw-log and nonsaw-log species are included. See: FIA tree species list in the field manual.

**Average annual mortality**—Average annual volume of trees  $\geq 5.0$  inches d.b.h. that died from human and natural causes during the intersurvey period, excluding those removed by harvesting, cultural operations, land clearing or changes in land use.

**Average annual removals**—Average annual volume of trees  $\geq 5.0$  inches d.b.h. removed from the inventory by harvesting, cultural operations (such as timber-stand improvement), land clearing, or changes in land use during the intersurvey period.

**Average net annual growth**—Average annual net change in volume of trees  $\geq 5.0$  inches d.b.h./d.r.c. without taking into account losses from cutting (gross growth minus mortality) during the intersurvey period.

**Biomass**—For the southern region, total aboveground biomass is estimated using allometric equations and is defined as the aboveground weight of wood and bark in live trees  $\geq 1.0$  inch d.b.h./d.r.c. from the ground to the tip of the tree, excluding all foliage (leaves, needles, buds, fruit, and limbs  $< 0.5$  inch in diameter). Biomass is expressed as oven-dry weight and the units are tons.

Note: the weight of wood and bark in limbs  $< 0.5$  inch in diameter is included in the biomass of small-diameter trees.

Additionally, biomass in the merchantable stem is estimated regionally, where the main and merchantable stems are defined as follows.

*Main stem*—The central portion of the tree extending from the ground level to the tip for timber species. Woodland species

includes from ground level to the tips of all branches of qualifying stems. For timber species trees that fork, the main stem refers to the fork that would yield the most merchantable volume.

*Merchantable stem*—That portion of the main stem of a timber species tree from a 1-foot stump to a minimum 4-inch top diameter inside or outside bark depending on species. That portion of a woodland species tree from the d.r.c. measurements to the 1.5-inch diameters of all the qualifying stems.

Nationally aboveground and belowground biomass is estimated from each tree's sound volume using a Component Ratio Method that is consistently applied in all FIA regions.

*Gross aboveground biomass*—Total tree biomass excluding foliage and roots with no deductions made for rotten, missing, or broken-top cubic-foot cull.

*Net aboveground biomass*—Gross aboveground biomass minus deductions for missing cull, broken-top, and a reduction for a proportion of rotten cull for live or standing dead trees  $\geq 5.0$  inches d.b.h (Rotten cull will have a factor to reduce specific gravity separately from sound wood). Live and standing dead trees 1.0 to 4.9 inches only have deductions for broken-top cull. Additional deductions are made for dead trees  $\geq 1.0$  inch using decay class.

*Belowground biomass*—Coarse roots only.

Further, the total net aboveground biomass estimated using the Component Ratio Method is divided into the following components:

*Top*—That portion of the main stem of a timber species tree above the 4-inch top diameter. For woodland species, this component of the biomass is included with branches.



*Branches*—All the branches of a timber species tree excluding the main stem. That portion of all the branches of qualifying stems of woodland species above the 1.5-inch diameter ends.

*Bole*—See: Merchantable stem.

*Stump*—That portion of timber species below 1-foot to ground level. That portion of woodland species from all the d.r.c. measurements to ground level.

**Blind check**—A reinstallation done by a qualified inspection crew without production crew data on hand; at least two full subplots are completely remeasured along with all the plot level information. The two datasets are maintained separately. Discrepancies between the two sets of data are not reconciled. See: Quality assurance and quality control.

**Bole**—Trunk or main stem of a tree. (See: Main stem.)

**Census water**—See: Land use.

**Coarse woody debris (CWD)**—Downed, dead tree and shrub boles, large limbs, and other woody pieces with a minimum small-end diameter of  $\geq 3$  inches and a length of  $\geq 3$  feet not attached to a living or standing dead source.

**Cold check**—An inspection done either as part of the training process, or as part of the ongoing quality control program. Normally the installation crew is not present at the time of inspection. The inspector has the completed data in-hand at the time of inspection. The inspection can include the whole plot or a subset of the plot. Data errors are corrected. See: Quality assurance and quality control.

**Components of change**—Volume increment and decrement values that explain the change in inventory between two points in time. Components of change are usually expressed in terms of growing-

stock or all-live merchantable volume. These components can be expressed as average annual values by dividing the component by the number of years in the measurement cycle. FIA inventories are designed to measure net change over time, as well as the individual components of change that constitute net change (e.g., growth, removals, mortality). Change estimates are computed for two sequential measurements of each inventory panel. Upon remeasurement, a new initial inventory is established for remeasurement at the next scheduled inventory. As such, computation of change components is not intended to span more than one inventory cycle. Rather, the change estimation process is repeated cycle by cycle. This simplifies field protocols and ensures that change estimation is based on short and relatively constant time intervals (e.g., 5 years). Change estimates for individual panels are combined across multiple panels in the same manner as panels are combined to obtain current inventory parameters such as total standing volume. FIA recognizes the following components of change as prescribed core variables; they usually are expressed in terms of growing-stock or all-live volume, where  $t$  is the initial inventory of a measurement cycle, and  $t + 1$  is the terminal inventory:

*Cut*—The volume of trees cut between time  $t$  and time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval (includes cut growth). Tree size at the midpoint is modeled from tree size at time  $t$ . Trees felled or killed in conjunction with a harvest or silvicultural operation (whether they are utilized or not) are included, but trees on land diverted from forest to nonforest (diversions) are excluded.

*Cut growth*—The growth of cut trees between time  $t$  and the midpoint of the measurement interval. Tree size at the midpoint is modeled from tree size at time  $t$ . This term also includes the



subsequent growth on ingrowth trees that achieve the minimum diameter threshold prior to being cut.

*Diversion*—The volume of trees on land diverted from forest to nonforest (or, for some analyses, this may also include land diverted to reserved forest land and other forest land), whether utilized or not, between time  $t$  and time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval (includes diversion growth). Tree size at the midpoint is modeled from tree size at time  $t$ .

*Diversion growth*—The growth of diversion trees from time  $t$  to the midpoint of the measurement interval. Tree size at the midpoint is modeled from tree size at time  $t$ . This term also includes the subsequent growth on ingrowth trees that achieve the minimum diameter threshold prior to diversion.

*Growth on ingrowth*—The growth on trees between the time they grow across the minimum d.b.h./d.r.c. threshold and time  $t + 1$ .

*Ingrowth*—The volume of trees at the time that they grow across the minimum d.b.h./d.r.c. threshold between time  $t$  and time  $t + 1$ . The estimate is based on the size of trees at the d.b.h./d.r.c. threshold which is 1.0 inch for all-live trees and 5.0 inches for growing-stock trees. This term also includes trees that subsequently die (i.e., ingrowth mortality), are cut (i.e., ingrowth, cut), or diverted to nonforest (i.e., ingrowth diversion); as well as trees that achieve the minimum threshold after an area reverts to a forest land use (i.e., reversion ingrowth).

*Mortality*—The volume of trees that die from human or natural causes between time  $t$  and time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval (includes mortality growth). Tree size at the midpoint is modeled from tree size at time  $t$ .

*Mortality growth*—The growth of trees that died from human or natural causes between time  $t$  and the midpoint of the measurement interval. Tree size at the midpoint is modeled from tree size at time  $t$ . This term also includes the subsequent growth on ingrowth trees that achieve the minimum diameter threshold prior to mortality.

*Reversion*—The volume of trees on land that reverts from a nonforest land use to a forest land use (or, for some analyses, land that reverts from any source to timberland) between time  $t$  and time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval. Tree size at the midpoint is modeled from tree size at time  $t + 1$ .

*Reversion growth*—The growth of reversion trees from the midpoint of the measurement interval to time  $t + 1$ . Tree size at the midpoint is modeled from tree size at time  $t + 1$ . This term also includes the subsequent growth on ingrowth trees that achieve the minimum diameter threshold after reversion.

*Survivor growth*—The growth on trees tallied at time  $t$  that survive until time  $t + 1$ .

The following components of change may be used to further quantify changes in growing-stock (but not all-live) volume:

*Cull decrement*—The net gain in growing-stock volume due to reclassification of cull trees to growing-stock trees between two surveys. Cull decrement is the volume of trees that were cull at time  $t$ , but growing stock at time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval. Tree size at the midpoint can be modeled from tree at time  $t$ , time  $t + 1$ , or both.

*Cull decrement growth*—The growth from the midpoint of the measurement interval to time  $t + 1$  on trees that were cull at



time  $t$ , but growing stock at time  $t + 1$ . Tree size at the midpoint can be modeled from tree size at time  $t$ , time  $t + 1$ , or both.

*Cull increment*—The net reduction in growing-stock volume due to reclassification of growing stock trees to cull trees between two surveys. Cull increment is the volume of trees that were growing stock at time  $t$ , but cull at time  $t + 1$ . The estimate is based on tree size at the midpoint of the measurement interval (includes cull increment growth). Tree size at the midpoint can be modeled from tree size at time  $t$ , time  $t + 1$ , or both.

*Cull increment growth*—The growth to the midpoint of the measurement interval between time  $t$  and  $t + 1$  of trees that were growing stock at time  $t$ , but cull trees at time  $t + 1$ . Tree size at the midpoint can be modeled from tree size at time  $t$ , time  $t + 1$ , or both.

**Condition class**—The combination of discrete landscape and forest attributes that identify, define, and stratify the area associated with a plot. Examples of such attributes include condition status, forest type, stand origin, stand size, owner group, reserve status and stand density.

**Cull**—Portions of a tree that are unusable for industrial wood products because of rot, form, or other defect. Cull is further categorized as the following:

*Broken-top cubic-foot cull*—The broken-top proportion of a timber species tree's merchantable portion from the break to the actual or projected 4-inch top diameter outside bark, or to where the central stem forks, where all forks are <4.0 inches diameter. For trees 1.0 to 4.9 inches diameter this is the proportion of the main stem missing due to a broken-top.

*Form board-foot cull*—The part of the tree's saw-log portion that is sound but not usable for sawn wood products due to sweep, crook, forking, or other physical culls.

*Missing cubic-foot cull*—The proportion of a tree's merchantable portion that is missing or absent. Does not include any cull deductions above actual length for broken-top timber trees. Does include cull deductions above actual length for broken-top woodland species. Trees with d.b.h./d.r.c. <5.0 inches have a null value in this field.

*Percent board-foot cull*—Percentage of sound and unsound board-foot volume, to the nearest 1 percent.

*Rotten cubic-foot cull*—The proportion of a tree's merchantable portion that is in a decayed state. Does not include any cull deductions above actual length for broken-top timber trees. Does include cull deductions above actual length for broken-top woodland species. Trees <5.0 inches d.b.h. have a null value in this field.

*Rotten/missing cull*—The part of the tree's merchantable portion that is decayed and/or absent due to other factors.

*Total board-foot cull*—The proportion of a timber species tree's saw-log portion that is rotten, missing, or sound but not useable for sawn wood products due to sweep, crook, forking, or other physical defects (form board-foot cull). Nonsaw-log species and softwoods <9.0 inches d.b.h. and hardwoods <11.0 inches d.b.h. have a null value in this field.

**Cull tree**—Live trees that are unsuitable for the production of some roundwood products, now or prospectively. Cull trees can include those with decay (rotten cull) or poor form, limbiness, or splits (rough cull). Rough cull is suitable for pulpwood and other fiber products.

**Cycle**—One sequential and complete set of panels.

**Diameter at breast height (d.b.h.)—**

The diameter for tree stem, located at 4.5 feet above the ground (breast height) on the uphill side of a tree. The point of diameter measurement may vary on abnormally formed trees.

**Diameter class—**A classification of trees based on diameter outside bark, measured at breast height (d.b.h.) above the ground or at root collar (d.r.c.). Note: Diameter classes are commonly in 2-inch increments, beginning with 2-inches. Each class provides a range of values with the class name being the approximate midpoint. For example, the 6-inch class includes trees 5.0 through 6.9 inches d.b.h.

**Disturbance—**Natural or human-caused disruption that is  $\geq 1.0$  acre in size and results in mortality and/or damage to 25 percent of all trees in a stand or 50 percent of an individual species' count or, in the case when the disturbance does not initially affect tree growth or health (e.g. grazing, browsing, flooding, etc.), affects 25 percent of the soil surface or understory vegetation. For initial forest plot establishment the disturbance must be within the last 5 years. For re-measured plots only those disturbances that have occurred since the previous inventory are recognized.

**Diversion—**See: Components of change.

**Down woody material (DWM)—**DWM is dead material on the ground in various stages of decay. It includes coarse and fine woody material. Previously named down woody debris (DWD). The depth of duff layer, litter layer, and overall fuelbed; fuel loading on the microplot; and residue piles are also measured as part of the DWM indicator for FIA.

**Dry weight—**The oven-dry weight of biomass.

**Federal land—**An ownership class of public lands owned by the U.S. Government. See: Ownership.

**Fine woody debris (FWD)—**Downed, dead branches, twigs, and small tree or shrub boles  $< 3$  inches in diameter not attached to a living or standing dead source.

**Fixed-radius plot—**A circular sampled area with a specified radius in which all trees of a given size, shrubs, or other items are tallied.

**Forest floor—**The entire thickness of organic material overlying the mineral soil, consisting of the litter and the duff (humus).

**Forest industry land—**See: Ownership.

**Forest land—**Land that is at least 10 percent stocked by forest trees of any size, or land formerly having such tree cover, and is not currently developed for a nonforest use. The minimum area for classification as forest land is 1 acre. Roadside, streamside, and shelterbelt strips of timber must be at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams and other bodies of water, or natural clearings in forested areas shall be classified as forest, if  $< 120$  feet in width or 1.0 acre in size. Forest land is divided into timberland, reserved forest land, and other forest land (such as woodland).

**Forest type—**A classification of forest land based upon and named for the tree species that forms the plurality of live-tree stocking. A forest-type classification for a field location indicates the predominant live-tree species cover for the field location; hardwoods and softwoods are first grouped to determine predominant group, and forest type is selected from the predominant group.

**Forest-type group—**A combination of forest types that share closely associated species or site requirements.

*Elm-ash-cottonwood—*Forests in which elm, ash, or cottonwood, singly or in combination, constitute a plurality of the stocking. (Common associates include willow, sycamore, beech, and maple.)



*Loblolly-shortleaf pine*—Forests in which loblolly pine, shortleaf pine, or other southern yellow pines, except longleaf or slash pine, singly or in combination, constitute a plurality of the stocking. (Common associates include oak, hickory, and gum.)

*Maple-beech-birch*—Forests in which maple, beech, or yellow birch, singly or in combination, constitute a plurality of the stocking. (Common associates include hemlock, elm, basswood, and white pine.)

*Oak-gum-cypress*—Bottomland forests in which tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, constitute a plurality of the stocking, except where pines account for 25 to 50 percent of stocking, in which case the stand is classified as oak-pine. (Common associates include cottonwood, willow, ash, elm, hackberry, and maple.)

*Oak-hickory*—Forests in which upland oaks or hickory, singly or in combination, constitute a plurality of the stocking, except where pines account for 25 to 50 percent, in which case the stand is classified oak-pine. (Common associates include yellow-poplar, elm, maple, and black walnut.)

*Oak-pine*—Forests in which hardwoods (usually upland oaks) constitute a plurality of the stocking but in which pines account for 25 to 50 percent of the stocking. (Common associates include gum, hickory, and yellow-poplar.)

**Growing-stock trees**—Live large-diameter timber species (excludes nonsaw-log species) trees with one-third or more of the gross board-foot volume in the entire saw-log portion meeting grade, soundness, and size requirements or the potential to do so for medium-diameter and small-diameter trees. A growing-stock tree must have one 12-foot log or two noncontiguous 8-foot merchantable logs, now (large diameter) or prospectively (medium diameter and small diameter), to qualify as growing stock.

**Hardwoods**—Tree species belonging to the botanical divisions Magnoliophyta, Ginkgophyta, Cycadophyta, or Pteridophyta, usually angiospermic, dicotyledonous, broad-leaved and deciduous.

*Soft hardwoods*—Hardwood species with an average specific gravity of  $\leq 0.50$ , such as gums, yellow-poplar, cottonwoods, red maple, basswoods, and willows.

*Hard hardwoods*—Hardwood species with an average specific gravity  $> 0.50$ , such as oaks, hard maples, hickories, and beech.

**Hot check**—An inspection normally done as part of the training process. The inspector is present on the plot with the trainee and provides immediate feedback regarding data quality. Data errors are corrected. Hot checks can be done on training plots or production plots. See: Quality assurance and quality control.

**Land**—The area of dry land and land temporarily or partly covered by water, such as marshes, swamps, and river flood plains.

**Land cover**—The dominant vegetation or other kind of material that covers the land surface. A given land cover may have many land uses.

**Land use**—The purpose of human activity on the land; it is usually, but not always, related to land cover.

Southern regional present land use categories are as follows:

*Accessible timberland*—Land that is within the population of interest, is accessible, is on a subplot that can be occupied at subplot center, can safely be visited, and meets the criteria for forest land (see: forest land).

*Accessible other forest land*—Land that meets the definition of accessible forest land, but is incapable of producing 20 cubic feet per acre per year of industrial wood under natural conditions because of adverse site conditions. Adverse conditions include



sterile soils, dry climate, poor drainage, high elevation, steepness and soil rockiness.

*Agricultural land*—Land managed for crops, pasture, or other agricultural use. The area must be at least 1.0 acre in size and 120 feet wide (with the exception of windbreak/shelterbelt, which has no minimum width). This land use includes cropland, pasture (improved through cultural practices), idle farmland, orchard, Christmas tree plantation, maintained wildlife opening, and windbreak/shelterbelt.

*Rangeland*—Land primarily composed of grasses, forbs, or shrubs. This includes lands vegetated naturally or artificially to provide a plant cover managed like native vegetation and does not meet the definition of pasture. The area must be at least  $\geq 1.0$  acre in size and  $\leq 120$  feet wide.

*Developed*—Land used primarily by humans for purposes other than forestry or agriculture. This land use includes cultural (business, industrial/commercial, residential, and other places of intense human activity), rights-of-way (improved roads, railway, power lines, maintained canal), recreation (parks, skiing, golf courses), and mining.

*Other*—Land parcels  $\geq 1.0$  acre in size and  $\geq 120$  feet wide, which do not fall into one of the uses described above. Examples include undeveloped beaches, barren land (rock, sand), marshes, bogs, ice, and snow. This land use includes nonvegetated, wetland, beach, and nonforest-chaparral.

*Census water*—Rivers and streams that are  $>200$  feet wide and bodies of water  $>4.5$  acres in size.

*Noncensus water*—Rivers, streams and other bodies of water that do not meet the requirements for census water.

*Nonsampled*—Not sampled due to denied access, hazardous conditions, being outside the U.S. or other reasons.

**Large-diameter trees**—Softwoods  $\geq 9.0$  inches d.b.h. and hardwoods  $\geq 11.0$  inches d.b.h. These trees were called sawtimber-sized trees in prior surveys. See: Stand-size class.

**Litter**—Undecomposed or only partially decomposed organic material that can be readily identified (e.g., plant leaves, twigs, etc.).

**Main stem**—The central portion of the tree extending from the ground level to the tip for timber species. For woodland species the main stem extends from the ground level to the tips of all branches of qualifying stems. For timber species trees that fork, the main stem follows the fork that would yield the most merchantable volume.

### **Measurement quality objective**

**(MQO)**—A data user's estimate of the precision, bias, and completeness of data necessary to satisfy a prescribed application (e.g., Resource Planning Act, assessments by State foresters, forest planning, forest health analyses). Describes the acceptable tolerance for each data element. MQOs consist of two parts: a statement of the tolerance and a percentage of time when the collected data are required to be within tolerance. MQOs can only be assigned where standard methods of sampling or field measurements exist, or where experience has established upper or lower bounds on precision or bias. MQOs can be set for measured data elements, observed data elements, and derived data elements.

**Medium-diameter tree**—Softwood timber species 5.0 to 8.9 inches d.b.h. and hardwood timber species 5.0 to 10.9 inches d.b.h. These trees were called poletimber-sized trees in prior surveys. See: Stand-size class.

**Microplot**—A circular, fixed-radius plot with a radius of 6.8 feet (0.003 acre) that is used to sample trees  $<5.0$  inches d.b.h./d.r.c., as well as other vegetation. Point center is 90 degrees and 12 feet offset from point center of each subplot.



**Mortality**—See: Components of change.

**National forest land**—See: Ownership.

**Noncensus water**—See: Land use.

**Nonforest land**—Land that does not support or has never supported, forests, and lands formerly forested where use for timber management is precluded by development for other uses. Includes areas used for crops, improved pasture, residential areas, city parks, improved roads of any width and adjoining rights-of-way, power line clearings of any width, and noncensus water. If intermingled in forest areas, unimproved roads and nonforest strips must be  $\geq 120$  feet wide, and clearings, etc.,  $\geq 1.0$  acre in size, to qualify as nonforest land.

**Nonindustrial private forest land**—  
See: Ownership.

**Other forest land**—Forest land other than timberland and reserved forest land. It includes available and reserved forest land that is incapable of producing 20 cubic feet per acre per year of wood under natural conditions because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

**Other public land**—See: Ownership.

**Other removals**—The volume of trees removed from the inventory by cultural operations such as timber stand improvement, land clearing, and other changes in land use, resulting in the removal of the trees from timberland.

**Ownership**—A legal entity having control of a parcel or group of parcels of land. An ownership may be an individual; a combination of persons; a legal entity such as corporation, partnership, club, or trust; or a public agency.

*National forest land*—Federal land that has been legally designated as national forests or purchase units, and other land

under the administration of the Forest Service, including experimental areas and Bankhead-Jones Title III land.

*Forest industry land*—An ownership class of private lands owned by a company or an individual(s) operating a primary wood-processing plant.

*Nonindustrial private forest (NIPF) land*—Privately owned land excluding forest industry land.

*Corporate*—Owned by corporations, including incorporated farm ownerships.

*Individual*—All lands owned by individuals, including farm operators.

*Other public*—An ownership class that includes all public lands except national forests.

*Miscellaneous Federal land*—Federal land other than national forests.

*State, county, and municipal land*—Land owned by States, counties, and local public agencies or municipalities, or land leased to these governmental units for 50 years or more.

**Phase 1 (P1)**—FIA activities related to remote sensing, the primary purpose of which is to label plots and obtain stratum weights for population estimates.

**Phase 2 (P2)**—FIA activities conducted on the network of ground plots. The primary purpose is to obtain field data that enable classification and summarization of area, tree, and other attributes associated with forest land uses.

**Phase 3 (P3)**—A subset of Phase 2 plots where additional attributes related to forest health are measured.

**Plantation**—Stands that currently show evidence of being planted or artificially seeded.



**Poletimber-sized tree**—Softwood timber species 5.0 to 8.9 inches d.b.h. and hardwood timber species 5.0 to 10.9 inches d.b.h. Now referred to as medium-diameter trees.

**Private land**—See: Ownership.

**Productivity class**—A classification of forest land in terms of potential annual cubic-foot volume growth per acre at culmination of mean annual increment (MAI) in fully stocked natural stands.

**Quality assurance (QA)**—The total integrated program for ensuring that the uncertainties inherent in FIA data are known and do not exceed acceptable magnitudes, within a stated level of confidence. Quality assurance encompasses the plans, specifications, and policies affecting the collection, processing, and reporting of data. It is the system of activities designed to provide program managers and project leaders with independent assurance that total system quality control is being effectively implemented.

**Quality control (QC)**—The routine application of prescribed field and laboratory procedures (e.g., random check cruising, periodic calibration, instrument maintenance, use of certified standards, etc.) in order to reduce random and systematic errors and ensure that data are generated within known and acceptable performance limits. Quality control also ensures the use of qualified personnel; reliable equipment and supplies; training of personnel; good field and laboratory practices; and strict adherence to standard operating procedures.

**Reserved forest land**—Forest land where management for the production of wood products is prohibited through statute or administrative designation. Examples include national forest wilderness areas and national parks and monuments.

**Reversion**—Land that reverts from a nonforest land use to a forest land use. See: Components of change.

**Sapling**—Live trees 1.0 to 4.9 inches d.b.h./d.r.c.

**Seedling**—Live trees <1.0 inch d.b.h./d.r.c. that are ≥6.0 inches in height for softwoods and ≥12.0 inches in height for hardwoods and >0.5 inch d.b.h./d.r.c. at ground level for longleaf pine.

**Small-diameter trees**—Trees 1.0 to 4.9 inches in d.b.h./d.r.c. These were called sapling-seedling sized trees in prior surveys. See: Stand-size class.

**Softwoods**—Tree species belonging to the botanical division Coniferophyta, usually evergreen having needles or scale-like leaves.

**Species group**—A collection of species used for reporting purposes.

**Stand**—Vegetation or a group of plants occupying a specific area and sufficiently uniform in species composition, age arrangement, structure, and condition as to be distinguished from the vegetation on adjoining areas.

**Stand age**—A stand descriptor that indicates the average age of the live dominant and codominant trees in the predominant stand-size class of a condition.

**Standing dead tree**—A dead tree ≥5.0 inches d.b.h. that has a bole which has an unbroken actual length of at least 4.5 feet, and lean <45 degrees from vertical as measured from the base of the tree to 4.5 feet.

**Stand origin**—A classification of forest stands describing their means of origin.

*Planted*—Planted or artificially seeded.

*Natural*—No evidence of artificial regeneration.



**Stand-size class**—A classification of forest land based on the diameter-class distribution of live trees in the stand. See definitions of large-, medium-, and small-diameter trees.

*Large-diameter stands*—Stands at least 10 percent stocked with live trees, with one-half or more of total stocking in large- and medium-diameter trees, and with large-diameter tree stocking at least equal to medium-diameter tree stocking.

*Medium-diameter stands*—Stands at least 10 percent stocked with live trees, with one-half or more of total stocking in medium- and large-diameter trees, and with medium-diameter tree stocking exceeding large-diameter tree stocking.

*Small-diameter stands*—Stands at least 10 percent stocked with live trees, in which small-diameter trees account for more than one-half of total stocking.

*Nonstocked stands*—Stands <10 percent stocked with live trees.

**Stand structure**—The predominant canopy structure for the condition, only considering the vertical position of the dominant and codominant trees in the stand and not considering trees that are intermediate or overtopped. As a general rule, a different story should comprise 25 percent of the stand.

*Nonstocked*—The condition is <10 percent stocked.

*Single-storied*—Most of the dominant/codominant tree crowns form a single canopy (i.e., most of the trees are approximately the same height).

*Multistoried*—Two or more recognizable levels characterize the crown canopy. Dominant/codominant trees of many sizes (diameters and heights) for a multilevel canopy.

**State, county, and municipal land**—See: Ownership.

**Stocking**—(1) At the tree level, stocking is the density value assigned to a sampled tree (usually in terms of numbers of trees or basal area per acre), expressed as a percent of the total tree density required to fully utilize the growth potential of the land. (2) At the stand level, stocking refers to the sum of the stocking values of all trees sampled.

**Subplot**—A circular area with a fixed horizontal radius of 24.0 feet ( $\frac{1}{4}$  acre), primarily used to sample trees  $\geq 5.0$  inches at d.b.h./d.r.c.

**Survivor tree**—A sample tree alive at both the current and previous inventories.

**Timberland**—Forest land that is producing or capable of producing 20 cubic feet per acre or more per year of wood at culmination of MAI. Timberland excludes reserved forest lands.

**Treatment**—Forestry treatments are a form of human disturbance. The term treatment further implies that a silvicultural application has been prescribed. This does not include occasional stumps of unknown origin or sparse removals for firewood, Christmas trees, or other miscellaneous purposes. The area affected by any treatment must be at least 1.0 acre in size.

*None*—No observable treatment.

*Cutting*—The removal of one or more trees from a stand. SRS FIA categories are the following:

*Clearcut harvest*—The removal of the majority of the merchantable trees in a stand; residual stand stocking is under 50 percent.

*Partial harvest*—Removal primarily consisting of highest quality trees. Residual consists of lower quality



trees because of high grading or selection harvest (e.g. uneven aged, group selection, high grading, species selection).

*Seed-tree/shelterwood harvest*—Crop trees are harvested leaving seed source trees either in a shelterwood or seed tree. Also includes the final harvest of the seed trees.

*Commercial thinning*—The removal of trees (usually of medium-diameter) from medium-diameter stands leaving sufficient stocking of growing-stock trees to feature in future stand development. Also included are thinning in large-diameter stands where medium-diameter trees have been removed to improve quality of those trees featured in a final harvest.

*Timber stand improvement (cut trees only)*—The cleaning, release, or other stand improvement involving noncommercial cutting applied to an immature stand that leaves sufficient stocking.

*Salvage cutting*—The harvesting of dead or damaged trees or of trees in danger of being killed by insects, disease, flooding, or other factors in order to save their economic value.

*Site preparation*—Clearing, slash burning, chopping, disking, bedding, or other practices clearly intended to prepare a site for either natural or artificial regeneration.

*Artificial regeneration*—Following a disturbance or treatment (usually cutting), a new stand where at least 50 percent of the live trees present resulted from planting or direct seeding.

*Natural regeneration*—Following a disturbance or treatment (usually cutting), a new stand where at least 50 percent of the live trees present (of any size) were established through the growth of existing trees and/or natural seeding or sprouting.

*Other silvicultural treatment*—The use of fertilizers, herbicides, girdling, pruning, or other activities designed to improve the commercial value of the residual stand, or chaining, which is a practice used on woodlands to encourage wildlife forage.

**Tree**—A woody perennial plant, typically large, with a single well-defined stem carrying a more or less definite crown; sometimes defined as attaining a minimum diameter of 3 inches and a minimum height of 15 feet at maturity. For FIA, any plant on the tree list in the current field manual is measured as a tree.

**Volume**—A measure of the solid content of the tree stem used to measure wood quantity.

*Gross board-foot volume*—Total board-foot volume of wood inside bark without deductions for total board-foot cull.

*Gross cubic-foot volume*—Total cubic-foot volume of wood inside bark without deductions for rotten, missing, or broken-top cull.

*Net board-foot volume*—Gross board-foot volume minus deductions for total board-foot cull.

*Net cubic-foot volume*—Gross cubic-foot volume minus deductions for rotten, missing, and broken-top cull.



## INVENTORY METHODS

The South Carolina 2016 inventory was a three-phase, fixed-plot design conducted on an annual basis. Phase 1 (P1) provides the area estimates for the inventory. Phase 2 (P2) involves on-the-ground measurements of sample plots by field personnel. Phase 3 (P3) is a subset of the P2 plot system, where additional measurements are made by field personnel to aid in the assessment of forest health. The three phases of the sampling method are based on a hexagonal grid design, with successive phases being sampled with less intensity. There are 16 P2 hexagons for every P3 hexagon. P2 and P3 hexagons represent about 6,000 and 96,000 acres, respectively.

Under the annual inventory system, 20 percent (1 panel) of the total number of plots in a State are measured every year over a 5-year period (1 cycle). Each panel of plots is selected on a subgrid that is slightly offset from the previous panel so that each panel covers essentially the same sample area (both spatially and in intensity) as the prior panel. In the sixth year, the plots that were measured in the first panel are remeasured. This marks the beginning of the next cycle of data collection. After field measurements are completed, a cycle of data is available for the 5-year report.

The South Carolina 2016 estimates were made using data from a total of 3,652 points sampled over the course of 5 years. Of these sampled points, 2,694 were found to have forest and a forest inventory plot measured and 958 were not forested. Of the forested plots, 2,468 were pre-existing plots that were remeasured and used for the estimates of change. Plots were measured following 5 field data collections protocols, versions 4.0 (525 plots), 5.1 (20 plots), 6.0 (1,093 plots), 6.1 (538 plots) and 7.0 (518 plots).

### Phase 1

For the 2016 inventory of South Carolina, the P1 forest area estimate was based on classifying National Land Cover Database points collected in 2011. Stratification of forest and nonforest was performed at the unit level. Area estimation of all lands and ownerships was based on the probability of selection of P2 plot locations. As a result, the known forest land area (for specific ownerships) does not always agree with area estimates based on probability of selection. For example, the acreage of national forests, published by the National Forest System, will not agree exactly with the statistical estimate of national forest land derived by Forest Inventory and Analysis. These numbers could differ substantially for very small areas.

### Phase 2

Bechtold and Patterson (2005) describe P2 and P3 ground plots and explain their use. These plots are clusters of four points arranged so that one point is central and the other three lie 120 feet from it at azimuths of 0, 120, and 240 degrees (fig. A.1). Each point is the center of a circular subplot with a fixed 24-foot radius. Trees  $\geq 5.0$

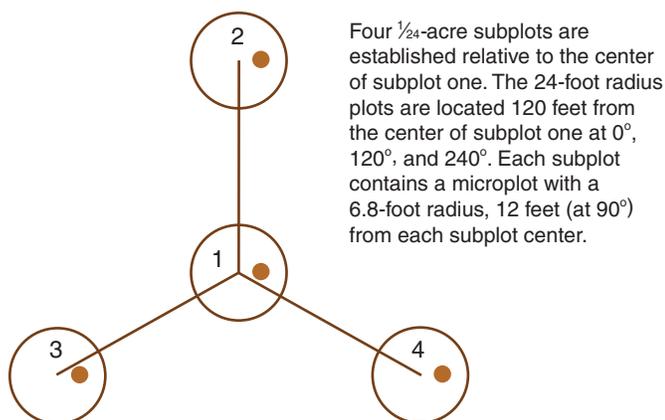


Figure A.1—Layout of annual fixed-radius plot design.



inches diameter at breast height (d.b.h.) are measured in these subplots. Each subplot in turn contains a circular microplot with a fixed 6.8-foot radius. Trees 1.0 to 4.9 inches d.b.h. and seedlings (<1.0 inch d.b.h.) are measured in these microplots (U.S. Department of Agriculture Forest Service 2014).

Sometimes, a plot cluster straddles two or more land use or forest condition classes (Bechtold and Patterson 2005). There are seven condition-class variables that require mapping of a unique condition on a plot: land use, forest type, stand size, ownership, stand density, regeneration status, and reserved status. A new condition is defined and mapped each time one of these variables changes during plot measurement.

### Phase 3

Data on forest health variables (P3) are collected on about  $\frac{1}{16}$ <sup>th</sup> of the P2 sample plots. P3 data are coarse descriptions and are meant to be used as general indicators of overall forest health over large geographic areas. P3 data collection has included variables pertaining to tree crown health, down woody material, and foliar ozone injury in the past. In recent years, however, the forest health monitoring data collection has evolved with some of the protocols changing and others being put on hiatus

pending renovation. Down woody materials data were collected for the past cycle of South Carolina forest health monitoring. That data collection took place under a more simplified set of field protocols that can be implemented on a greater number of plots to improve the sample size. This and other forest health monitoring data collection will continue to evolve as these protocols are refined.

### Summary

Users wishing to make rigorous comparisons of data between surveys should be aware of any changes in methodologies between measurements and the evolving nature of the FIA program. The most valuable and powerful trend information is obtained when the same plots are revisited from one survey to the next and measured in the same way. Determining the strength of a trend, or determining the level of confidence associated with a trend, is difficult or impossible when sampling methods change over time. Fortunately FIA data collection in South Carolina has followed the national annualized inventory protocols for 4 full cycles, 2001 (Conner and others 2004), 2006 (Conner and others 2009), 2009 (Rose 2016), and 2016 (this report) allowing us to track change over time with a high degree of confidence.



## DATA RELIABILITY

A relative standard of accuracy has been incorporated into the forest inventory. This standard satisfies user demands, minimizes human and instrumental sources of error, and keeps costs within prescribed limits. The two primary types of error are measurement error and sampling error.

### Measurement Error

There are three elements of measurement error: (1) biased error, caused by instruments that are not properly calibrated; (2) compensating error, caused by instruments of moderate precision; and (3) accidental error, caused by human error in measuring and compiling. All of these are held to a minimum by the Forest Inventory and Analysis (FIA) quality assurance (QA) program. The goal of the QA program is to provide a framework of quality control procedures to assure the production of complete, accurate, and unbiased forest assessments for given standards. These methods include the use of nationally standardized field manuals, the use of portable data recorders, thorough entry-level training, periodic review training, supervision, the use of check plots, editing checks, and an emphasis on careful work. Additionally, data quality is assessed and documented using performance measurements and post-survey assessments. These assessments are then used to identify areas of the data collection process that need improvement or refinement in order to meet the program’s quality objectives.

Each variable collected by FIA is assigned a measurement quality objective (MQO) and a measurement tolerance level. The MQOs are documented in the FIA National Field Manual (U.S. Department of Agriculture Forest Service 2014). In some instances, the MQOs are a “best guess” of what experienced field crews should be able to consistently achieve. Tolerances are somewhat arbitrary and are based on the crews’ ability to make repeatable measurements or observations within the assigned MQO.

Evaluation of field crew performance is accomplished by calculating the differences between data collected by the field crew and data collected by the QA crew on blind-check plots. Results of these calculations are compared to the established MQOs. In the analysis of blind-check data, an observation is within tolerance when the difference between the field crew observation and the QA crew observation does not exceed the assigned tolerance for that variable. For many categorical variables, the tolerance is “no error” allowed, so only observations that are identical are within the tolerance level. Tables B.1–B.5 show the results of various blind checks for South Carolina.

**Table B.1—Results of plot, subplot and boundary-level blind checks for South Carolina, 2016**

Variable	Number of observations	Number within tolerance	Percent within tolerance
<b>Plot variables</b>			
Plot status	1	1	100
Plot nonsampled reason	0	—	—
Distance to road	33	31	94
Water on plot	33	24	73
Latitude longitude	2	2	100
Plot in correct county	35	35	100
Corrected county	0	—	—
Plot accessibility	35	33	94
<b>Subplot variables</b>			
Subplot nonsampled reason	0	—	—
Subplot center condition	140	138	99
Microplot center condition	139	139	100
Subplot slope	63	61	97
Subplot aspect	63	52	83
Snow/water depth	63	62	98
<b>Boundary variables</b>			
Existance of change	9	7	78
Boundary change	5	3	60
Contrasting condition	9	7	78
Left azimuth	5	3	60
Right azimuth	5	2	40
Existance of corner	5	5	100
Corner azimuth	2	1	50
Corner distance	2	1	50
Boundary status	1	1	100

— = no sample for the cell.



## Appendix B—Data Reliability

**Table B.2—Results of condition-level blind checks for South Carolina, 2016**

Variable	Number of Observations	Number within Tolerance	Percent within Tolerance
<b>Condition variables</b>			
Condition status	53	53	100
Condition nonsampled reason	0	—	—
Reserved status	42	42	100
Owner group	42	42	100
Field forest type	42	39	93
Field forest type group	42	39	93
Stand size class	42	40	95
Regeneration status	42	38	90
Tree density	42	42	100
Artificial regeneration species	10	10	100
Owner class	42	41	98
Private owner industrial status	1	1	100
Stand age	42	33	79
Disturbance 1	42	41	98
Disturbance year 1	7	6	86
Disturbance 2	7	7	100
Disturbance year 2	0	—	—
Disturbance 3	0	—	—
Disturbance year 3	0	—	—
Treatment 1	42	41	98
Treatment year 1	10	10	100
Treatment 2	10	7	70
Treatment year 2	2	2	100
Treatment 3	2	2	100
Treatment year 3	1	1	100
Physiographic class	42	39	93
Present land use	42	42	100
Total acres	18	15	83
Percent forest	18	12	67
Stand structure	42	39	93
Operability	42	35	83
Site class	1	1	100
Fire	1	1	100
Grazing	1	1	100
Afforestation	0	—	—
Chaining	49	49	100
Harvest type 1	41	39	95
Harvest type 2	10	10	100
Harvest type 3	0	—	—
Live canopy	44	40	91
Live and missing canopy	45	43	96
Number of stems	0	—	—

— = no sample for the cell.



**Table B.3—Results of tree and seedling blind checks for South Carolina, 2016**

Variable	Number of Observations	Number within Tolerance	Percent within Tolerance
<b>Tree variables</b>			
Condition number	614	602	98
Azimuth	515	477	93
Horizontal distance	473	470	99
Present tree status	613	606	99
Reconcile	51	51	100
Standing dead	58	58	100
Species	614	602	98
Genus	614	612	100
Live d.b.h.	455	353	78
Live d.b.h.: both diameter checks = 0	400	329	82
Live d.b.h.: both diameter checks >0	9	5	56
Live d.b.h.: mixed diameter checks	30	9	30
Sound dead d.b.h.	0	—	—
Decayed dead d.b.h.	9	9	100
Live rotten/missing cull	17	13	76
Dead rotten/missing cull	12	10	83
Number of d.r.c. stems	0	—	—
Diameter root collar	0	—	—
Total length	455	392	86
Live tree actual length	5	3	60
Dead tree actual length	13	12	92
Crown class	455	402	88
Compacted crown ratio	454	387	85
Uncompacted crown ratio	0	—	—
Cause of death	0	—	—
Mortality year	0	—	—
Decay class	0	58	57
Tree class	9	8	89
Tree grade	376	341	91
Board foot cull	147	113	77
Dieback incidence	147	108	73
Dieback severity	0	—	—
Utilization class	93	93	100
Abnormal termination	439	429	98
<b>Seedling variables</b>			
Species	389	351	90
Genus	389	379	97
Count	389	255	66

D.b.h. = diameter at breast height; d.r.c. = diameter at root collar.  
 — = no sample for the cell.



## Appendix B—Data Reliability

**Table B.4—Results of missing species, extra trees and seedlings, and missing invasive species blind checks for South Carolina, 2016**

Variable	Observations found by both	Observations found by just cruiser	Observations found by just QA
Missing/extra tree/seedling			
Trees	614	0	4
Seedlings	125	0	21
Invasive species			
Invasive species	24	4	14

QA = quality assurance.

**Table B.5—Results of invasive species cover and down woody materials blind checks for South Carolina, 2016**

Variable	Number of Observations	Number within Tolerance	Percent within Tolerance
Invasive species variable			
Invasive cover	24	23	96
Down woody materials variables			
Transect segments			
Existence of transect subsegments	54	54	100
Transect break point	2	2	100
Down woody materials duff/litter			
Duff/Litter method	50	48	96
Litter depth	50	29	58
Duff depth	50	33	66
Fine woody debris			
Segment matches	27	26	96
Small count	26	6	23
Medium count	26	10	38
Large count	26	14	54
Coarse woody debris			
Found by both crews	14	11	79
Condition	11	11	100
Horizontal distance	11	11	100
Decay class	11	10	91
Transect diameter	11	11	100
Length >3 feet	11	11	100
Hollow diameter	11	11	100
Residue piles			
Found by both crews	13	1	8
Condition	1	1	100
Begin distance	1	1	100
End distance	1	1	100
Compacted height	1	1	100
Decay class	1	0	0
Species	0	—	—

— = no sample for the cell.



### Sampling Error

Sampling error is associated with the natural and expected deviation of the sample from the true population mean. This deviation is susceptible to a mathematical evaluation of the probability of error. Sampling errors for State totals are based on one standard deviation. That is, there is a 68.27 percent probability that the confidence interval given for each sample estimate will cover the true population mean (table B.6).

The size of the sampling error generally increases as the size of the area examined decreases. In addition, as area or volume totals are stratified by forest type, species, diameter class, ownership, or other subunits, the sampling error may increase and be greatest for the smallest divisions. However, there may be instances where a smaller component does not have a proportionately larger sampling error. This can happen when the post-defined strata are more homogeneous than the larger strata, thereby having a smaller variance.

**Table B.6—Statistical reliability of forest land area, all-live volume, and growth, removals and mortality estimates for South Carolina, 2016**

Item	Sample estimate and 68.27-percent confidence interval		Sampling error percent
Forest land	<i>thousand acres</i>		
State	12,915.1	93.0	0.72
Southern Coastal Plain	3,431.4	52.8	1.54
Northern Coastal Plain	4,900.9	59.3	1.21
Piedmont	4,582.8	55.0	1.20
All-live volume on forest land	<i>million cubic feet</i>		
State	26,040.8	338.1	1.51
Softwoods	13,471.6	303.1	2.25
Hardwoods	12,569.3	338.1	2.69
Growth, removals and mortality	<i>million cubic feet</i>		
Net annual growth	1,308.9	25.0	1.91
Softwoods	961.5	24.5	2.55
Hardwoods	354.4	12.6	3.55
Annual removals	887.7	46.1	5.19
Softwoods	696.3	39.1	5.61
Hardwoods	191.4	19.8	10.37
Annual mortality	205.0	10.2	4.97
Softwoods	90.7	6.0	6.62
Hardwoods	114.3	8.1	7.09



For specific post-defined strata, the sampling error can be calculated using the following formula. Sampling errors obtained by this method are only approximations of reliability, because this process assumes constant variance across all subdivisions of totals.

$$SE_s = SE_t \frac{\sqrt{X_t}}{\sqrt{X_s}}$$

where

$SE_s$  = sampling error for subdivision of survey unit or State total

$SE_t$  = sampling error for survey unit or State total

$X_s$  = sum of values for the variable of interest (area or volume) for subdivision of survey unit or State

$X_t$  = total area or volume for survey unit or State

For example, the estimate of sampling error for softwood live-tree volume on forest land in the Southern Coastal Plain survey unit is computed as:

$$SE_s = 3.08 \left[ \frac{\sqrt{6,851,332,469}}{\sqrt{3,789,100,981}} \right] = 4.14$$

Thus, the estimated sampling error is 4.14 percent, and the resulting 68.27 percent confidence interval for softwood live-tree volume in the Southern Coastal Plain survey unit is 3,789.10 ± 156.93 million cubic feet.



**Table C.1—Area by survey unit and land status, South Carolina, 2016**

Unit	Total area	All forest	Unreserved			Reserved			Nonforest land	Census water
			Total	Timber-land	Unpro-ductive	Total	Produc-tive	Unpro-ductive		
<i>thousand acres</i>										
Southern Coastal Plain	5,515.9	3,434.6	3,414.1	3,414.1	0.0	20.5	20.5	0.0	1,743.5	337.7
Northern Coastal Plain	8,112.7	4,898.7	4,808.4	4,798.7	9.7	90.3	90.3	0.0	2,616.5	597.5
Piedmont	6,864.4	4,582.8	4,531.7	4,525.9	5.8	51.0	51.0	0.0	2,078.3	203.4
All survey units	20,493.0	12,916.1	12,754.2	12,738.7	15.5	161.8	161.8	0.0	6,438.3	1,138.6

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

**Table C.2—Area of forest land by ownership class and land status, South Carolina, 2016**

Ownership class	All forest land	Unreserved			Reserved		
		Total	Timber-land	Unpro-ductive	Total	Produc-tive	Unpro-ductive
<i>thousand acres</i>							
<b>U.S. Forest Service</b>							
National forest	609.2	586.3	583.5	2.8	22.9	22.9	0.0
Other Forest Service	3.8	3.8	3.8	0.0	0.0	0.0	0.0
Total	613.0	590.1	587.3	2.8	22.9	22.9	0.0
<b>Other Federal</b>							
National Park Service	35.3	0.0	0.0	0.0	35.3	35.3	0.0
U.S. Fish and Wildlife Service	74.4	0.0	0.0	0.0	74.4	74.4	0.0
Dept. of Defense/Dept. of Energy	323.6	317.8	311.6	6.2	5.8	5.8	0.0
Other Federal	4.6	4.6	4.6	0.0	0.0	0.0	0.0
Total	438.0	322.4	316.2	6.2	115.6	115.6	0.0
<b>State and local government</b>							
State	410.3	410.3	410.3	0.0	0.0	0.0	0.0
Local	171.1	147.7	147.7	0.0	23.3	23.3	0.0
Total	581.4	558.1	558.1	0.0	23.3	23.3	0.0
<b>Forest industry</b>							
Corporate	157.8	157.8	157.8	0.0	0.0	0.0	0.0
Individual	11.8	11.8	11.8	0.0	0.0	0.0	0.0
Total	169.6	169.6	169.6	0.0	0.0	0.0	0.0
<b>Nonindustrial private</b>							
Corporate	4,055.6	4,055.6	4,050.7	4.9	0.0	0.0	0.0
Conservation/natural resources organization	78.5	78.5	78.5	0.0	0.0	0.0	0.0
Unincorporated local partnership/association/club	100.7	100.7	100.7	0.0	0.0	0.0	0.0
Individual	6,879.2	6,879.2	6,877.7	1.5	0.0	0.0	0.0
Total	11,114.1	11,114.1	11,107.6	6.5	0.0	0.0	0.0
All classes	12,916.1	12,754.2	12,738.7	15.5	161.8	161.8	0.0

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.



## Appendix C—Supplemental Tables

**Table C.3—Area of forest land by forest-type group and ownership group, South Carolina, 2016**

Forest-type group	All ownerships	Ownership group				
		U.S. Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
<i>thousand acres</i>						
<b>Softwood types</b>						
White-red-jack pine	18.5	12.7	0.0	5.8	0.0	0.0
Longleaf-slash pine	554.4	28.0	87.1	79.4	6.8	353.1
Loblolly-shortleaf pine	5,585.8	329.9	163.3	116.5	92.4	4,883.7
Other eastern softwoods	27.9	0.0	0.0	4.3	0.0	23.7
<b>Total softwoods</b>	<b>6,186.7</b>	<b>370.7</b>	<b>250.4</b>	<b>206.0</b>	<b>99.2</b>	<b>5,260.4</b>
<b>Hardwood types</b>						
Oak-pine	1,503.3	55.8	38.0	69.5	3.5	1,336.5
Oak-hickory	2,775.6	84.2	43.4	144.4	8.3	2,495.3
Oak-gum-cypress	1,913.7	90.0	85.3	144.3	52.9	1,541.3
Elm-ash-cottonwood	388.2	9.4	17.7	15.7	5.7	339.6
Other hardwoods	4.9	1.0	0.0	0.0	0.0	3.9
Tropical hardwoods	1.5	0.0	1.5	0.0	0.0	0.0
Exotic hardwoods	26.0	0.0	1.6	0.0	0.0	24.3
<b>Total hardwoods</b>	<b>6,613.1</b>	<b>240.4</b>	<b>187.6</b>	<b>373.8</b>	<b>70.4</b>	<b>5,740.8</b>
Nonstocked	116.3	1.9	0.0	1.6	0.0	112.8
<b>All groups</b>	<b>12,916.1</b>	<b>613.0</b>	<b>438.0</b>	<b>581.4</b>	<b>169.6</b>	<b>11,114.1</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.



**Table C.4—Area of forest land by forest-type group and stand-size class, South Carolina, 2016**

Forest-type group	All classes	Stand-size class			Nonstocked
		Large diameter	Medium diameter	Small diameter	
<i>thousand acres</i>					
<b>Softwood types</b>					
White-red-jack pine	18.5	18.1	0.5	0.0	0.0
Longleaf-slash pine	554.4	238.0	200.0	116.4	0.0
Loblolly-shortleaf pine	5,585.8	3,190.1	1,549.0	846.7	0.0
Other eastern softwoods	27.9	9.1	6.5	12.4	0.0
<b>Total softwoods</b>	<b>6,186.7</b>	<b>3,455.3</b>	<b>1,755.9</b>	<b>975.5</b>	<b>0.0</b>
<b>Hardwood types</b>					
Oak-pine	1,503.3	740.7	373.8	388.7	0.0
Oak-hickory	2,775.6	1,399.7	538.2	837.7	0.0
Oak-gum-cypress	1,913.7	1,191.1	402.8	319.9	0.0
Elm-ash-cottonwood	388.2	227.0	49.2	111.9	0.0
Other hardwoods	4.9	0.0	1.5	3.3	0.0
Tropical hardwoods	1.5	1.5	0.0	0.0	0.0
Exotic hardwoods	26.0	5.8	13.9	6.2	0.0
<b>Total hardwoods</b>	<b>6,613.1</b>	<b>3,565.8</b>	<b>1,379.4</b>	<b>1,667.8</b>	<b>0.0</b>
Nonstocked	116.3	0.0	0.0	0.0	116.3
<b>All groups</b>	<b>12,916.1</b>	<b>7,021.1</b>	<b>3,135.4</b>	<b>2,643.3</b>	<b>116.3</b>

Numbers in rows and columns may not sum to totals due to rounding.  
 0.0 = no sample for the cell or a value of >0.0 but <0.05.



## Appendix C—Supplemental Tables

**Table C.5—Area of forest land by forest-type group and stand origin, South Carolina, 2016**

Forest-type group	Total	Stand origin	
		Natural stands	Artificial regeneration
<i>thousand acres</i>			
<b>Softwood types</b>			
White-red-jack pine	18.5	18.5	0.0
Longleaf-slash pine	554.4	316.2	238.2
Loblolly-shortleaf pine	5,585.8	2,825.0	2,760.7
Other eastern softwoods	27.9	25.8	2.2
<b>Total softwoods</b>	<b>6,186.7</b>	<b>3,185.5</b>	<b>3,001.1</b>
<b>Hardwood types</b>			
Oak-pine	1,503.3	1,332.7	170.5
Oak-hickory	2,775.6	2,728.9	46.7
Oak-gum-cypress	1,913.7	1,913.7	0.0
Elm-ash-cottonwood	388.2	388.2	0.0
Other hardwoods	4.9	4.9	0.0
Tropical hardwoods	1.5	1.5	0.0
Exotic hardwoods	26.0	24.3	1.6
<b>Total hardwoods</b>	<b>6,613.1</b>	<b>6,394.3</b>	<b>218.8</b>
<b>Nonstocked</b>	<b>116.3</b>	<b>106.0</b>	<b>10.3</b>
<b>All groups</b>	<b>12,916.1</b>	<b>9,685.8</b>	<b>3,230.3</b>

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value of >0.0 but <0.05.



**Table C.6—Area of forest land disturbed annually by forest-type group and disturbance class, South Carolina, 2012–16**

Forest-type group <sup>b</sup>	Disturbance class <sup>a</sup>							
	Insects	Disease	Weather	Fire	Domestic animals	Wild animals	Human	Other natural
	<i>thousand acres</i>							
<b>Softwood types</b>								
White-red-jack pine	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0
Longleaf-slash pine	0.0	0.0	2.7	23.2	0.0	0.0	8.5	0.0
Loblolly-shortleaf pine	6.4	11.1	19.2	105.7	0.7	1.1	7.0	7.2
Other eastern softwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>6.4</b>	<b>11.1</b>	<b>21.9</b>	<b>130.4</b>	<b>0.7</b>	<b>1.1</b>	<b>15.5</b>	<b>7.2</b>
<b>Hardwood types</b>								
Oak-pine	3.1	8.3	7.6	8.8	0.0	0.0	0.9	0.0
Oak-hickory	2.1	7.3	7.6	16.5	3.1	1.6	7.1	0.0
Oak-gum-cypress	1.2	21.4	7.3	6.5	0.0	4.2	0.9	0.0
Elm-ash-cottonwood	0.0	1.2	4.6	0.0	0.0	2.5	0.0	0.0
Other hardwoods	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exotic hardwoods	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
<b>Total hardwoods</b>	<b>6.4</b>	<b>38.2</b>	<b>27.0</b>	<b>32.7</b>	<b>3.1</b>	<b>8.3</b>	<b>8.8</b>	<b>0.0</b>
<b>Nonstocked</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>2.8</b>	<b>0.0</b>	<b>0.3</b>	<b>0.0</b>	<b>0.0</b>
<b>All groups</b>	<b>12.7</b>	<b>49.3</b>	<b>48.9</b>	<b>165.9</b>	<b>3.8</b>	<b>9.7</b>	<b>24.3</b>	<b>7.2</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.

<sup>b</sup>Based on past conditions.



## Appendix C—Supplemental Tables

**Table C.7—Area of forest land treated annually by forest-type group and treatment class (cutting), South Carolina, 2012–16**

Forest-type group <sup>b</sup>	Treatment class						
	Total treated	Cutting <sup>a</sup>					
		Final harvest	Partial harvest	Seed-tree/ shelterwood harvest	Commercial thinning	Timber stand improvement	Salvage cutting
	<i>thousand acres</i>						
<b>Softwood types</b>							
White-red-jack pine	0.3	0.0	0.3	0.0	0.0	0.0	0.0
Longleaf-slash pine	20.0	6.6	1.2	0.0	7.2	3.6	1.4
Loblolly-shortleaf pine	399.4	128.5	16.7	6.5	241.1	5.0	1.6
Other eastern softwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>419.7</b>	<b>135.1</b>	<b>18.1</b>	<b>6.5</b>	<b>248.3</b>	<b>8.6</b>	<b>3.0</b>
<b>Hardwood types</b>							
Oak-pine	34.9	17.7	5.9	2.0	8.2	0.0	1.1
Oak-hickory	44.8	23.9	13.4	0.0	7.5	0.0	0.0
Oak-gum-cypress	21.3	15.8	3.0	1.2	1.3	0.0	0.0
Elm-ash-cottonwood	1.4	0.3	0.0	0.8	0.3	0.0	0.0
Other hardwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exotic hardwoods	0.3	0.0	0.0	0.0	0.3	0.0	0.0
<b>Total hardwoods</b>	<b>102.8</b>	<b>57.7</b>	<b>22.2</b>	<b>4.1</b>	<b>17.6</b>	<b>0.0</b>	<b>1.1</b>
Nonstocked	0.6	0.6	0.0	0.0	0.0	0.0	0.0
<b>All groups</b>	<b>523.1</b>	<b>193.5</b>	<b>40.4</b>	<b>10.7</b>	<b>265.9</b>	<b>8.6</b>	<b>4.0</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.

<sup>b</sup>Based on past conditions.



Table C.8—Number of live trees on forest land by species group and diameter class, South Carolina, 2016

Species group	All classes	Diameter class (inches)														
		1.0–2.9	3.0–4.9	5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–24.9	25.0–28.9	29.0–32.9	33.0–36.9	37.0+
<i>million trees</i>																
<b>Softwood</b>																
Longleaf and slash pines	249.9	102.3	66.1	37.6	19.1	8.6	6.0	4.2	3.7	1.3	0.6	0.4	0.0	0.0	0.0	0.0
Loblolly and shortleaf pines	2,229.8	856.2	438.8	329.5	248.1	154.7	94.4	52.5	28.7	12.8	6.7	5.2	1.5	0.4	0.0	0.0
Other yellow pines	106.4	54.8	18.5	11.8	7.8	4.5	3.4	2.5	1.7	0.9	0.3	0.1	0.1	0.0	0.0	0.0
Eastern white and red pines	9.1	3.9	1.0	0.9	0.7	0.5	0.6	0.4	0.5	0.3	0.1	0.2	0.1	0.0	0.0	0.0
Eastern hemlock	5.0	2.6	0.7	0.4	0.4	0.4	0.3	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Cypress	52.2	19.7	8.3	4.7	4.1	4.7	3.6	2.8	1.9	1.2	0.5	0.6	0.1	0.1	0.0	0.0
Other eastern softwoods	201.3	136.4	35.1	16.9	7.4	3.4	1.0	0.6	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>2,853.7</b>	<b>1,175.9</b>	<b>568.5</b>	<b>401.8</b>	<b>287.6</b>	<b>176.7</b>	<b>109.3</b>	<b>63.1</b>	<b>36.8</b>	<b>16.7</b>	<b>8.3</b>	<b>6.5</b>	<b>1.9</b>	<b>0.5</b>	<b>0.0</b>	<b>0.0</b>
<b>Hardwood</b>																
Select white oaks	150.5	71.8	33.5	13.7	7.1	6.3	4.9	4.1	3.1	1.9	1.8	1.6	0.4	0.2	0.1	0.1
Select red oaks	32.2	16.0	3.0	3.8	2.0	1.7	1.2	0.9	0.9	0.6	0.7	0.7	0.3	0.3	0.0	0.1
Other white oaks	166.5	101.9	29.6	11.6	8.0	4.8	3.1	2.7	1.5	1.0	0.7	0.9	0.2	0.2	0.1	0.1
Other red oaks	1,110.3	743.7	179.0	73.5	39.0	24.0	17.7	11.0	7.8	5.1	3.2	3.9	1.3	0.8	0.1	0.2
Hickory	217.2	144.1	31.5	16.0	9.2	6.3	4.0	2.6	1.7	1.1	0.3	0.3	0.0	0.0	0.0	0.0
Yellow birch	1.4	0.4	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hard maple	44.1	38.2	4.1	1.1	0.3	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Soft maple	830.2	589.2	137.5	48.6	23.7	13.4	7.3	4.6	2.4	1.3	0.9	1.1	0.0	0.0	0.0	0.0
Beech	30.6	18.7	7.4	1.8	1.1	0.5	0.5	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Sweetgum	1,657.9	1,168.5	284.2	94.3	48.1	26.1	14.2	9.0	5.5	3.6	1.9	1.9	0.3	0.1	0.0	0.0
Tupelo and blackgum	382.9	208.8	75.6	32.4	20.7	14.8	11.2	8.7	4.6	2.9	1.6	1.0	0.2	0.0	0.1	0.0
Ash	183.1	126.8	33.3	9.7	5.1	2.8	2.0	1.3	0.8	0.7	0.4	0.2	0.0	0.0	0.0	0.0
Cottonwood and aspen	12.2	9.2	0.4	0.9	0.5	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0
Basswood	1.9	1.5	0.0	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow-poplar	164.6	95.1	24.5	12.7	9.1	6.3	4.2	3.4	3.0	2.1	1.4	1.8	0.8	0.2	0.2	0.0
Black walnut	1.8	0.0	0.4	0.4	0.3	0.3	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other eastern soft hardwoods	688.6	488.8	116.0	41.7	19.6	10.0	5.2	2.5	2.0	1.3	0.6	0.5	0.2	0.1	0.0	0.0
Other eastern hard hardwoods	402.2	321.5	58.0	15.4	4.9	1.5	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eastern noncommercial hardwoods	548.5	409.2	93.9	28.4	9.9	4.1	1.9	0.9	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total hardwoods</b>	<b>6,626.8</b>	<b>4,553.3</b>	<b>1,112.7</b>	<b>406.1</b>	<b>208.8</b>	<b>123.4</b>	<b>78.7</b>	<b>52.5</b>	<b>33.8</b>	<b>22.3</b>	<b>13.7</b>	<b>14.2</b>	<b>4.1</b>	<b>1.9</b>	<b>0.7</b>	<b>0.6</b>
<b>All species</b>	<b>9,480.6</b>	<b>5,729.2</b>	<b>1,681.3</b>	<b>807.9</b>	<b>496.5</b>	<b>300.0</b>	<b>188.0</b>	<b>115.6</b>	<b>70.6</b>	<b>39.0</b>	<b>22.0</b>	<b>20.6</b>	<b>6.0</b>	<b>2.5</b>	<b>0.8</b>	<b>0.6</b>

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value of >0.0 but <0.05.



## Appendix C—Supplemental Tables

**Table C.9—Net<sup>a</sup> volume of live trees on forest land by ownership class and land status, South Carolina, 2016**

Ownership class	All forest land	Unreserved			Reserved		
		Total	Timberland	Unproductive	Total	Productive	Unproductive
<i>million cubic feet</i>							
U.S. Forest Service							
National forest	1,760.0	1,705.4	1,702.5	2.8	54.7	54.7	0.0
Other Forest Service	11.2	11.2	11.2	0.0	0.0	0.0	0.0
Total	1,771.2	1,716.5	1,713.7	2.8	54.7	54.7	0.0
Other Federal							
National Park Service	102.6	0.0	0.0	0.0	102.6	102.6	0.0
U.S. Fish and Wildlife Service	224.9	0.0	0.0	0.0	224.9	224.9	0.0
Dept. of Defense/Dept. of Energy	990.8	959.6	959.6	0.0	31.3	31.3	0.0
Other Federal	5.9	5.9	5.9	0.0	0.0	0.0	0.0
Total	1,324.2	965.5	965.5	0.0	358.8	358.8	0.0
State and local government							
State	1,015.7	1,015.7	1,015.7	0.0	0.0	0.0	0.0
Local	482.8	366.2	366.2	0.0	116.6	116.6	0.0
Total	1,498.5	1,381.9	1,381.9	0.0	116.6	116.6	0.0
Forest industry							
Corporate	357.2	357.2	357.2	0.0	0.0	0.0	0.0
Individual	38.4	38.4	38.4	0.0	0.0	0.0	0.0
Total	395.6	395.6	395.6	0.0	0.0	0.0	0.0
Nonindustrial private							
Corporate	7,684.3	7,684.3	7,683.7	0.5	0.0	0.0	0.0
Conservation/natural resources organization	151.9	151.9	151.9	0.0	0.0	0.0	0.0
Unincorporated local partnership/association/club	168.9	168.9	168.9	0.0	0.0	0.0	0.0
Individual	13,046.4	13,046.4	13,046.4	0.0	0.0	0.0	0.0
Total	21,051.4	21,051.4	21,050.9	0.5	0.0	0.0	0.0
All classes	26,041.0	25,511.0	25,507.7	3.4	530.0	530.0	0.0

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Excludes rotten, missing, and form cull defects volume.



**Table C.10—Net<sup>a</sup> volume of live trees on forest land by forest-type group and stand-size class, South Carolina, 2016**

Forest-type group	All classes	Stand-size class			Nonstocked
		Large diameter	Medium diameter	Small diameter	
<i>million cubic feet</i>					
<b>Softwood types</b>					
White-red-jack pine	100.2	98.3	1.9	0.0	0.0
Longleaf-slash pine	734.4	513.5	193.9	26.9	0.0
Loblolly-shortleaf pine	11,376.6	8,883.6	2,312.7	180.2	0.0
Other eastern softwoods	23.7	14.4	5.4	3.9	0.0
<b>Total softwoods</b>	<b>12,234.8</b>	<b>9,509.8</b>	<b>2,514.0</b>	<b>211.0</b>	<b>0.0</b>
<b>Hardwood types</b>					
Oak-pine	2,658.1	1,998.4	528.7	131.0	0.0
Oak-hickory	5,119.4	4,210.1	714.4	194.9	0.0
Oak-gum-cypress	5,211.3	4,448.3	670.3	92.7	0.0
Elm-ash-cottonwood	787.2	725.1	51.4	10.6	0.0
Other hardwoods	0.6	0.0	0.4	0.2	0.0
Tropical hardwoods	4.4	4.4	0.0	0.0	0.0
Exotic hardwoods	18.6	8.7	7.9	2.0	0.0
<b>Total hardwoods</b>	<b>13,799.6</b>	<b>11,395.1</b>	<b>1,973.1</b>	<b>431.4</b>	<b>0.0</b>
Nonstocked	6.6	0.0	0.0	0.0	6.6
<b>All groups</b>	<b>26,041.0</b>	<b>20,904.9</b>	<b>4,487.0</b>	<b>642.4</b>	<b>6.6</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Excludes rotten, missing, and form cull defects volume.



## Appendix C—Supplemental Tables

**Table C.11—Net<sup>a</sup> volume of live trees on forest land by species group and ownership group, South Carolina, 2016**

Species group	All ownerships	Ownership group				
		U.S. Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
<i>million cubic feet</i>						
<b>Softwood</b>						
Longleaf and slash pines	862.7	50.7	179.4	105.6	3.5	523.4
Loblolly and shortleaf pines	11,343.0	950.1	489.2	290.6	189.2	9,423.9
Other yellow pines	456.8	31.4	14.7	31.5	0.1	379.2
Eastern white and red pines	119.8	50.2	0.0	36.1	0.0	33.5
Eastern hemlock	28.3	12.7	0.0	11.3	0.0	4.3
Cypress	506.7	29.9	34.7	64.4	23.1	354.7
Other eastern softwoods	154.5	8.0	5.6	10.7	0.5	129.8
<b>Total softwoods</b>	<b>13,471.8</b>	<b>1,132.9</b>	<b>723.6</b>	<b>550.2</b>	<b>216.5</b>	<b>10,848.8</b>
<b>Hardwood</b>						
Select white oaks	1,051.7	57.8	17.3	99.3	11.1	866.2
Select red oaks	423.4	22.1	11.2	32.1	1.5	356.5
Other white oaks	524.5	26.0	42.5	67.1	0.4	388.6
Other red oaks	2,756.5	94.6	134.0	174.0	32.4	2,321.5
Hickory	508.0	22.5	14.8	29.9	2.4	438.4
Yellow birch	1.1	0.0	0.0	1.1	0.0	0.0
Hard maple	12.9	1.1	0.0	1.7	0.0	10.1
Soft maple	970.7	71.9	36.0	112.5	8.3	742.0
Beech	55.5	7.8	0.0	5.2	0.0	42.6
Sweetgum	2,343.9	102.0	108.9	112.6	42.7	1,977.6
Tupelo and blackgum	1,374.4	107.5	91.2	120.8	59.8	995.0
Ash	303.7	10.1	34.9	32.4	2.9	223.3
Cottonwood and aspen	76.0	0.0	13.7	5.5	0.4	56.4
Basswood	4.4	0.9	0.0	0.0	0.0	3.5
Yellow-poplar	1,105.9	58.8	52.9	89.9	3.7	900.7
Black walnut	21.6	2.0	1.2	0.3	0.0	18.0
Other eastern soft hardwoods	755.3	29.3	29.4	35.9	9.9	650.8
Other eastern hard hardwoods	92.2	4.3	3.3	8.4	1.4	74.8
Eastern noncommercial hardwoods	187.5	19.6	9.4	19.7	2.1	136.7
<b>Total hardwoods</b>	<b>12,569.2</b>	<b>638.3</b>	<b>600.7</b>	<b>948.3</b>	<b>179.2</b>	<b>10,202.7</b>
<b>All species</b>	<b>26,041.0</b>	<b>1,771.2</b>	<b>1,324.2</b>	<b>1,498.5</b>	<b>395.6</b>	<b>21,051.4</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup> Excludes rotten, missing, and form cull defects volume.



Table C.12—Net<sup>a</sup> volume of live trees on forest land by species group and diameter class, South Carolina, 2016

Species group	All classes	Diameter class (inches)												
		5.0–6.9	7.0–8.9	9.0–10.9	11.0–12.9	13.0–14.9	15.0–16.9	17.0–18.9	19.0–20.9	21.0–24.9	25.0–28.9	29.0–32.9	33.0–36.9	37.0+
<i>million cubic feet</i>														
<b>Softwood</b>														
Longleaf and slash pines	862.7	90.1	113.1	99.0	128.6	132.3	154.0	71.6	43.3	30.6	0.0	0.0	0.0	0.0
Loblolly and shortleaf pines	11,343.0	855.0	1,597.8	1,933.0	1,954.2	1,608.5	1,239.9	743.0	511.3	550.1	241.5	84.7	10.3	13.9
Other yellow pines	456.8	36.8	56.4	62.0	69.2	73.4	69.4	48.8	22.0	9.2	9.6	0.0	0.0	0.0
Eastern white and red pines	119.8	2.7	4.7	6.3	12.1	11.2	20.3	14.5	5.6	20.0	14.8	4.5	3.1	0.0
Eastern hemlock	28.3	1.0	2.0	4.4	4.4	2.6	1.5	2.6	4.7	5.2	0.0	0.0	0.0	0.0
Cypress	506.7	15.6	29.8	62.8	71.9	81.1	72.1	59.9	30.9	47.8	18.7	16.1	0.0	0.0
Other eastern softwoods	154.5	39.6	39.1	31.2	15.4	13.4	5.8	7.0	0.0	0.0	3.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>13,471.8</b>	<b>1,040.8</b>	<b>1,842.9</b>	<b>2,198.7</b>	<b>2,255.9</b>	<b>1,922.5</b>	<b>1,562.9</b>	<b>947.3</b>	<b>617.8</b>	<b>662.9</b>	<b>287.5</b>	<b>105.3</b>	<b>13.4</b>	<b>13.9</b>
<b>Hardwood</b>														
Select white oaks	1,051.7	37.8	46.1	77.1	99.0	124.0	128.9	103.9	127.7	161.6	62.2	46.1	12.9	24.3
Select red oaks	423.4	12.5	15.1	22.3	22.6	27.0	37.5	27.7	45.0	65.5	46.7	59.3	0.0	42.1
Other white oaks	524.5	30.3	44.6	48.1	50.2	62.4	49.5	42.8	37.3	66.5	21.6	34.8	17.5	19.1
Other red oaks	2,756.5	211.7	247.2	269.8	318.5	286.5	286.2	250.5	196.4	317.4	161.1	122.2	33.3	55.8
Hickory	508.0	40.3	57.5	72.5	81.5	74.7	64.5	60.4	19.9	31.5	5.2	0.0	0.0	0.0
Yellow birch	1.1	0.4	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hard maple	12.9	2.5	1.2	1.4	4.2	0.3	1.5	1.8	0.0	0.0	0.0	0.0	0.0	0.0
Soft maple	970.7	150.4	151.4	148.8	125.6	115.9	81.8	57.2	54.2	78.1	4.6	0.0	2.7	0.0
Beech	55.5	5.2	6.4	6.3	9.5	3.5	3.0	12.0	4.1	3.9	1.6	0.0	0.0	0.0
Sweetgum	2,343.9	239.0	318.9	330.8	295.8	284.6	237.1	212.6	143.8	196.3	51.5	12.2	8.1	13.1
Tupelo and blackgum	1,374.4	89.7	136.3	175.2	211.6	235.3	168.8	136.6	96.9	78.7	22.6	0.0	17.1	5.5
Ash	303.7	29.1	35.4	35.0	38.4	37.2	30.7	39.9	25.7	18.7	5.4	0.0	8.3	0.0
Cottonwood and aspen	76.0	2.1	3.2	3.1	4.9	5.2	4.0	5.9	4.6	2.8	23.4	6.2	10.5	0.0
Basswood	4.4	0.2	0.8	1.3	1.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Yellow-poplar	1,105.9	39.3	66.5	87.4	88.7	104.0	127.2	123.7	105.0	174.0	110.7	34.9	44.5	0.0
Black walnut	21.6	1.1	2.2	3.2	1.1	1.8	3.8	2.0	0.6	0.9	4.8	0.0	0.0	0.0
Other eastern soft hardwoods	755.3	112.7	116.8	107.5	87.6	63.3	70.6	55.8	42.0	43.9	24.1	21.6	3.2	6.3
Other eastern hard hardwoods	92.2	34.7	25.6	14.8	8.4	6.2	0.0	0.2	0.0	2.2	0.0	0.0	0.0	0.0
Eastern noncommercial hardwoods	187.5	63.3	48.6	34.1	21.9	12.5	5.7	1.4	0.0	0.0	0.0	0.0	0.0	0.0
<b>Total hardwoods</b>	<b>12,569.2</b>	<b>1,102.4</b>	<b>1,323.8</b>	<b>1,438.7</b>	<b>1,471.8</b>	<b>1,444.4</b>	<b>1,301.5</b>	<b>1,134.5</b>	<b>903.1</b>	<b>1,242.0</b>	<b>545.6</b>	<b>337.3</b>	<b>158.0</b>	<b>166.1</b>
<b>All species</b>	<b>26,041.0</b>	<b>2,143.2</b>	<b>3,166.7</b>	<b>3,637.4</b>	<b>3,727.7</b>	<b>3,367.0</b>	<b>2,864.4</b>	<b>2,081.8</b>	<b>1,520.9</b>	<b>1,904.9</b>	<b>833.1</b>	<b>442.6</b>	<b>171.4</b>	<b>179.9</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Excludes rotten, missing, and form cull defects volume.



## Appendix C—Supplemental Tables

**Table C.13—Net<sup>a</sup> volume of live trees on forest land by forest-type group and stand origin, South Carolina, 2016**

Forest-type group	Total	Stand origin	
		Natural stands	Artificial regeneration
<i>million cubic feet</i>			
<b>Softwood types</b>			
White-red-jack pine	100.2	100.2	0.0
Longleaf-slash pine	734.4	521.9	212.5
Loblolly-shortleaf pine	11,376.6	6,285.4	5,091.2
Other eastern softwoods	23.7	23.5	0.2
Total softwoods	12,234.8	6,930.9	5,303.9
<b>Hardwood types</b>			
Oak-pine	2,658.1	2,533.2	125.0
Oak-hickory	5,119.4	5,081.6	37.8
Oak-gum-cypress	5,211.3	5,211.3	0.0
Elm-ash-cottonwood	787.2	787.2	0.0
Other hardwoods	0.6	0.6	0.0
Tropical hardwoods	4.4	4.4	0.0
Exotic hardwoods	18.6	17.0	1.6
Total hardwoods	13,799.6	13,635.2	164.4
Nonstocked	6.6	6.6	0.0
All groups	26,041.0	20,572.8	5,468.2

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Excludes rotten, missing, and form cull defects volume.



**Table C.14—Aboveground dry weight<sup>a</sup> of live trees on forest land by ownership class and land status, South Carolina, 2016**

Ownership class	All forest land	Unreserved			Reserved		
		Total	Timberland	Unproductive	Total	Productive	Unproductive
<i>thousand tons</i>							
<b>U.S. Forest Service</b>							
National forest	42,990.8	41,584.3	41,504.3	80.0	1,406.6	1,406.6	0.0
Other Forest Service	263.8	263.8	263.8	0.0	0.0	0.0	0.0
<b>Total</b>	<b>43,254.6</b>	<b>41,848.1</b>	<b>41,768.1</b>	<b>80.0</b>	<b>1,406.6</b>	<b>1,406.6</b>	<b>0.0</b>
<b>Other Federal</b>							
National Park Service	2,817.6	0.0	0.0	0.0	2,817.6	2,817.6	0.0
U.S. Fish and Wildlife Service	5,661.3	0.0	0.0	0.0	5,661.3	5,661.3	0.0
Dept. of Defense/Dept. of Energy	24,393.9	23,649.3	23,649.3	0.0	744.6	744.6	0.0
Other Federal	140.7	140.7	140.7	0.0	0.0	0.0	0.0
<b>Total</b>	<b>33,013.6</b>	<b>23,790.0</b>	<b>23,790.0</b>	<b>0.0</b>	<b>9,223.5</b>	<b>9,223.5</b>	<b>0.0</b>
<b>State and local government</b>							
State	26,202.9	26,202.9	26,202.9	0.0	0.0	0.0	0.0
Local	12,718.6	9,597.9	9,597.9	0.0	3,120.7	3,120.7	0.0
<b>Total</b>	<b>38,921.5</b>	<b>35,800.8</b>	<b>35,800.8</b>	<b>0.0</b>	<b>3,120.7</b>	<b>3,120.7</b>	<b>0.0</b>
<b>Forest industry</b>							
Corporate	8,833.6	8,833.6	8,833.6	0.0	0.0	0.0	0.0
Individual	947.3	947.3	947.3	0.0	0.0	0.0	0.0
<b>Total</b>	<b>9,780.9</b>	<b>9,780.9</b>	<b>9,780.9</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Nonindustrial private</b>							
Corporate	198,361.4	198,361.4	198,323.0	38.4	0.0	0.0	0.0
Conservation/natural resources organization	4,110.9	4,110.9	4,110.9	0.0	0.0	0.0	0.0
Unincorporated local partnership/association/club	4,797.8	4,797.8	4,797.8	0.0	0.0	0.0	0.0
Individual	348,466.0	348,466.0	348,466.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>555,736.2</b>	<b>555,736.2</b>	<b>555,697.7</b>	<b>38.4</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>All classes</b>	<b>680,706.8</b>	<b>666,956.0</b>	<b>666,837.6</b>	<b>118.4</b>	<b>13,750.8</b>	<b>13,750.8</b>	<b>0.0</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup> Calculations based on TREE\_REGIONAL\_BIOMASS.REGIONAL\_DRYBIOT.



## Appendix C—Supplemental Tables

**Table C.15—Total carbon<sup>a</sup> of live trees on forest land by ownership class and land status, South Carolina, 2016**

Ownership class	All forest land	Unreserved			Reserved		
		Total	Timberland	Unproductive	Total	Productive	Unproductive
<i>thousand tons</i>							
<b>U.S. Forest Service</b>							
National forest	21,495.4	20,792.1	20,752.2	40.0	703.3	703.3	0.0
Other Forest Service	131.9	131.9	131.9	0.0	0.0	0.0	0.0
<b>Total</b>	<b>21,627.3</b>	<b>20,924.0</b>	<b>20,884.1</b>	<b>40.0</b>	<b>703.3</b>	<b>703.3</b>	<b>0.0</b>
<b>Other Federal</b>							
National Park Service	1,408.8	0.0	0.0	0.0	1,408.8	1,408.8	0.0
U.S. Fish and Wildlife Service	2,830.7	0.0	0.0	0.0	2,830.7	2,830.7	0.0
Dept. of Defense/Dept. of Energy	12,196.9	11,824.7	11,824.7	0.0	372.3	372.3	0.0
Other Federal	70.4	70.4	70.4	0.0	0.0	0.0	0.0
<b>Total</b>	<b>16,506.8</b>	<b>11,895.0</b>	<b>11,895.0</b>	<b>0.0</b>	<b>4,611.8</b>	<b>4,611.8</b>	<b>0.0</b>
<b>State and local government</b>							
State	13,101.4	13,101.4	13,101.4	0.0	0.0	0.0	0.0
Local	6,359.3	4,799.0	4,799.0	0.0	1,560.3	1,560.3	0.0
<b>Total</b>	<b>19,460.7</b>	<b>17,900.4</b>	<b>17,900.4</b>	<b>0.0</b>	<b>1,560.3</b>	<b>1,560.3</b>	<b>0.0</b>
<b>Forest industry</b>							
Corporate	4,416.8	4,416.8	4,416.8	0.0	0.0	0.0	0.0
Individual	473.7	473.7	473.7	0.0	0.0	0.0	0.0
<b>Total</b>	<b>4,890.5</b>	<b>4,890.5</b>	<b>4,890.5</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>Nonindustrial private</b>							
Corporate	99,180.7	99,180.7	99,161.5	19.2	0.0	0.0	0.0
Conservation/natural resources organization	2,055.5	2,055.5	2,055.5	0.0	0.0	0.0	0.0
Unincorporated local partnership/association/club	2,398.9	2,398.9	2,398.9	0.0	0.0	0.0	0.0
Individual	174,233.0	174,233.0	174,233.0	0.0	0.0	0.0	0.0
<b>Total</b>	<b>277,868.1</b>	<b>277,868.1</b>	<b>277,848.9</b>	<b>19.2</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
<b>All classes</b>	<b>340,353.4</b>	<b>333,478.0</b>	<b>333,418.8</b>	<b>59.2</b>	<b>6,875.4</b>	<b>6,875.4</b>	<b>0.0</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Estimates of carbon calculated by multiplying aboveground dry tree biomass by 0.5. Calculations based on TREE\_REGIONAL\_BIOMASS.REGIONAL\_DRYBIOT.



**Table C.16—Average annual net growth of live trees by ownership class and land status, South Carolina, 2016 (2007–11 to 2012–16)**

Ownership class <sup>a</sup>	Land status	
	Timber-land	Forest land
	<i>million cubic feet per year</i>	
U.S. Forest Service		
National forest	51.8	52.9
Other Forest Service	1.6	1.6
Total	53.3	54.5
Other Federal		
National Park Service	0.0	1.0
U.S. Fish and Wildlife Service	0.0	3.9
Dept. of Defense/Dept. of Energy	19.3	19.7
Other Federal	0.2	0.2
Total	19.4	24.8
State and local government		
State	30.0	30.0
Local	12.1	11.3
Total	42.1	41.3
Forest industry		
Corporate	21.7	21.7
Individual	1.8	1.8
Total	23.6	23.6
Nonindustrial private		
Corporate	475.6	475.0
Conservation/natural resources organization	6.6	6.6
Unincorporated local partnership/association/club	5.1	5.1
Individual	678.6	678.1
Total	1,166.0	1,164.9
All classes	1,304.4	1,309.1

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



## Appendix C—Supplemental Tables

**Table C.17—Average annual net growth of live trees on forest land by forest-type group and stand-size class, South Carolina, 2016 (2007–11 to 2012–16)**

Forest-type group <sup>a</sup>	All classes	Stand-size class <sup>a</sup>			Nonstocked
		Large diameter	Medium diameter	Small diameter	
<i>million cubic feet per year</i>					
<b>Softwood types</b>					
White-red-jack pine	2.8	2.5	0.3	0.0	0.0
Longleaf-slash pine	37.2	12.3	13.0	11.9	0.0
Loblolly-shortleaf pine	833.9	347.4	374.6	111.9	0.0
Other eastern softwoods	0.9	0.1	0.3	0.5	0.0
<b>Total softwoods</b>	<b>874.7</b>	<b>362.3</b>	<b>388.2</b>	<b>124.2</b>	<b>0.0</b>
<b>Hardwood types</b>					
Oak-pine	121.5	55.9	38.0	27.6	0.0
Oak-hickory	139.6	73.1	35.9	30.6	0.0
Oak-gum-cypress	147.5	84.3	45.7	17.6	0.0
Elm-ash-cottonwood	22.0	12.8	4.7	4.4	0.0
Other hardwoods	0.0	0.0	0.0	0.0	0.0
Tropical hardwoods	-0.3	-0.3	0.0	0.0	0.0
Exotic hardwoods	1.0	0.3	0.2	0.5	0.0
<b>Total hardwoods</b>	<b>431.4</b>	<b>226.2</b>	<b>124.5</b>	<b>80.7</b>	<b>0.0</b>
Nonstocked	2.9	0.0	0.0	0.0	2.9
<b>All groups</b>	<b>1,309.1</b>	<b>588.5</b>	<b>512.7</b>	<b>204.9</b>	<b>2.9</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on past conditions.



**Table C.18—Average annual net growth of live trees on forest land by species group and ownership group, South Carolina, 2016 (2007–11 to 2012–16)**

Species group	All ownerships	Ownership group <sup>a</sup>				
		U.S. Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
<i>million cubic feet per year</i>						
<b>Softwood</b>						
Longleaf and slash pines	40.6	0.8	4.4	5.5	0.3	29.7
Loblolly and shortleaf pines	886.7	41.3	8.6	14.9	16.4	805.4
Other yellow pines	11.4	1.2	0.6	-0.8	0.0	10.4
Eastern white and red pines	3.9	1.2	0.0	1.0	0.0	1.6
Eastern hemlock	-2.0	0.3	0.0	-1.2	0.0	-1.2
Cypress	12.0	0.4	1.4	1.3	0.8	8.2
Other eastern softwoods	5.8	0.0	0.3	0.4	0.1	5.1
<b>Total softwoods</b>	<b>958.5</b>	<b>45.3</b>	<b>15.2</b>	<b>21.2</b>	<b>17.6</b>	<b>859.2</b>
<b>Hardwood</b>						
Select white oaks	30.5	1.4	0.4	2.2	0.5	26.0
Select red oaks	11.6	1.0	0.0	0.7	0.2	9.8
Other white oaks	10.8	0.4	1.0	1.5	0.0	7.9
Other red oaks	90.7	0.8	2.5	4.1	1.5	81.8
Hickory	10.0	-0.5	0.1	-1.1	-0.1	11.6
Yellow birch	0.1	0.0	0.0	0.1	0.0	0.0
Hard maple	0.2	0.0	0.0	0.0	0.0	0.2
Soft maple	30.9	1.5	0.8	3.8	0.1	24.7
Beech	2.1	0.2	0.0	0.2	0.0	1.6
Sweetgum	82.7	1.8	2.3	3.6	1.9	73.2
Tupelo and blackgum	22.3	1.2	1.3	3.1	0.8	15.9
Ash	6.2	-0.7	1.1	0.8	0.1	4.9
Cottonwood and aspen	1.4	0.0	0.3	0.2	0.0	0.8
Basswood	0.1	0.0	0.0	0.0	0.0	0.1
Yellow-poplar	28.6	0.7	0.4	1.7	0.0	25.7
Black walnut	0.6	0.0	0.0	0.0	0.0	0.5
Other eastern soft hardwoods	16.0	1.0	-0.3	-0.2	0.7	14.9
Other eastern hard hardwoods	1.2	0.1	0.1	-0.7	0.1	1.7
Eastern noncommercial hardwoods	4.7	0.4	-0.2	0.1	0.0	4.2
<b>Total hardwoods</b>	<b>350.6</b>	<b>9.2</b>	<b>9.6</b>	<b>20.1</b>	<b>5.9</b>	<b>305.7</b>
<b>All species</b>	<b>1,309.1</b>	<b>54.5</b>	<b>24.8</b>	<b>41.3</b>	<b>23.6</b>	<b>1,164.9</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



## Appendix C—Supplemental Tables

**Table C.19—Average annual mortality of live trees by ownership class and land status, South Carolina, 2016 (2007–11 to 2012–16)**

Ownership class <sup>a</sup>	Land status	
	Timber-land	Forest land
	<i>million cubic feet per year</i>	
U.S. Forest Service		
National forest	13.1	13.7
Other Forest Service	0.0	0.0
Total	13.2	13.8
Other Federal		
National Park Service	0.0	1.4
U.S. Fish and Wildlife Service	0.0	1.7
Dept. of Defense/Dept. of Energy	9.1	9.1
Total	9.1	12.3
State and local government		
State	15.2	15.2
Local	2.7	4.7
Total	17.9	19.9
Forest industry		
Corporate	2.3	2.3
Individual	0.2	0.2
Total	2.4	2.4
Nonindustrial private		
Corporate	58.7	58.7
Conservation/natural resources organization	0.7	0.7
Unincorporated local partnership/association/club	2.6	2.6
Individual	94.5	94.6
Total	156.5	156.6
All classes	199.2	205.0

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



**Table C.20—Average annual mortality of live trees on forest land by forest-type group and stand-size class, South Carolina, 2016 (2007–11 to 2012–16)**

Forest-type group <sup>a</sup>	All classes	Stand-size class <sup>a</sup>			Nonstocked
		Large diameter	Medium diameter	Small diameter	
<i>million cubic feet per year</i>					
<b>Softwood types</b>					
White-red-jack pine	0.5	0.4	0.2	0.0	0.0
Longleaf-slash pine	4.5	3.8	0.4	0.2	0.0
Loblolly-shortleaf pine	68.9	50.7	17.4	0.8	0.0
Other eastern softwoods	0.1	0.0	0.1	0.0	0.0
<b>Total softwoods</b>	<b>74.0</b>	<b>54.9</b>	<b>18.1</b>	<b>1.0</b>	<b>0.0</b>
<b>Hardwood types</b>					
Oak-pine	22.4	15.0	5.6	1.8	0.0
Oak-hickory	47.8	39.9	5.9	2.0	0.0
Oak-gum-cypress	47.5	39.5	6.9	1.1	0.0
Elm-ash-cottonwood	13.0	9.2	2.7	1.1	0.0
Other hardwoods	0.2	0.0	0.0	0.2	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0
Exotic hardwoods	0.1	0.0	0.1	0.0	0.0
<b>Total hardwoods</b>	<b>131.0</b>	<b>103.6</b>	<b>21.2</b>	<b>6.2</b>	<b>0.0</b>
Nonstocked	0.0	0.0	0.0	0.0	0.0
<b>All groups</b>	<b>205.0</b>	<b>158.5</b>	<b>39.3</b>	<b>7.2</b>	<b>0.0</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on past conditions.



## Appendix C—Supplemental Tables

**Table C.21—Average annual mortality of live trees on forest land by species group and ownership group, South Carolina, 2016 (2007–11 to 2012–16)**

Species group	All ownerships	Ownership group <sup>a</sup>				
		U.S. Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
<i>million cubic feet per year</i>						
<b>Softwood</b>						
Longleaf and slash pines	4.8	0.1	2.1	0.6	0.1	2.0
Loblolly and shortleaf pines	70.0	5.1	6.2	3.1	1.0	54.6
Other yellow pines	8.9	0.5	0.0	2.1	0.0	6.3
Eastern white and red pines	0.6	0.2	0.0	0.3	0.0	0.1
Eastern hemlock	2.7	0.1	0.0	1.3	0.0	1.3
Cypress	2.3	0.0	0.0	0.7	0.0	1.6
Other eastern softwoods	1.4	0.2	0.0	0.0	0.0	1.2
<b>Total softwoods</b>	<b>90.7</b>	<b>6.2</b>	<b>8.3</b>	<b>8.2</b>	<b>1.1</b>	<b>67.0</b>
<b>Hardwood</b>						
Select white oaks	4.4	0.3	0.0	0.0	0.0	4.1
Select red oaks	3.7	0.0	0.4	0.0	0.0	3.3
Other white oaks	2.9	0.1	0.0	0.5	0.0	2.2
Other red oaks	27.6	2.0	0.6	2.9	0.0	22.2
Hickory	5.0	1.1	0.2	1.9	0.0	1.9
Yellow birch	0.0	0.0	0.0	0.0	0.0	0.0
Hard maple	0.1	0.0	0.0	0.0	0.0	0.1
Soft maple	11.7	1.1	0.5	1.3	0.2	8.6
Beech	0.0	0.0	0.0	0.0	0.0	0.0
Sweetgum	13.8	0.5	0.2	0.3	0.0	12.7
Tupelo and blackgum	9.4	0.8	0.7	0.7	0.9	6.4
Ash	4.6	0.9	0.1	0.5	0.2	2.9
Cottonwood and aspen	1.5	0.0	0.0	0.0	0.0	1.5
Basswood	0.0	0.0	0.0	0.0	0.0	0.0
Yellow-poplar	5.2	0.1	0.1	0.0	0.0	5.0
Black walnut	0.2	0.0	0.0	0.0	0.0	0.2
Other eastern soft hardwoods	19.0	0.4	1.1	2.5	0.1	14.9
Other eastern hard hardwoods	2.2	0.1	0.1	0.9	0.0	1.1
Eastern noncommercial hardwoods	2.8	0.1	0.0	0.3	0.0	2.3
<b>Total hardwoods</b>	<b>114.3</b>	<b>7.5</b>	<b>4.1</b>	<b>11.8</b>	<b>1.4</b>	<b>89.5</b>
<b>All species</b>	<b>205.0</b>	<b>13.8</b>	<b>12.3</b>	<b>19.9</b>	<b>2.4</b>	<b>156.6</b>

Numbers in rows and columns may not sum to totals due to rounding.  
0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



**Table C.22—Average annual net removals of live trees by ownership class and land status, South Carolina, 2016 (2007–11 to 2012–16)**

Ownership class <sup>a</sup>	Land status	
	Timber-land	Forest land
	<i>million cubic feet per year</i>	
U.S. Forest Service		
National forest	13.8	13.8
Total	13.8	13.8
Other Federal		
U.S. Fish and Wildlife Service	0.0	0.9
Dept. of Defense/Dept. of Energy	15.4	15.4
Total	15.4	16.3
State and local government		
State	2.4	2.4
Local	3.9	3.9
Total	6.2	6.2
Forest industry		
Corporate	20.0	20.0
Total	20.0	20.0
Nonindustrial private		
Corporate	374.6	374.6
Conservation/natural resources organization	0.0	0.0
Unincorporated local partnership/association/club	4.6	4.6
Individual	452.4	452.4
Total	831.6	831.6
All classes	887.1	888.0

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



## Appendix C—Supplemental Tables

**Table C.23—Average annual removals of live trees on forest land by forest-type group and stand-size class, South Carolina, 2016 (2007–11 to 2012–16)**

Forest-type group <sup>a</sup>	All classes	Stand-size class <sup>a</sup>			Nonstocked
		Large diameter	Medium diameter	Small diameter	
<i>million cubic feet per year</i>					
<b>Softwood types</b>					
White-red-jack pine	0.2	0.0	0.2	0.0	0.0
Longleaf-slash pine	24.1	18.6	5.5	0.0	0.0
Loblolly-shortleaf pine	668.7	442.9	215.4	10.3	0.0
Other eastern softwoods	0.0	0.0	0.0	0.0	0.0
<b>Total softwoods</b>	<b>693.0</b>	<b>461.5</b>	<b>221.2</b>	<b>10.3</b>	<b>0.0</b>
<b>Hardwood types</b>					
Oak-pine	44.8	31.2	9.5	4.1	0.0
Oak-hickory	68.3	48.8	14.3	5.2	0.0
Oak-gum-cypress	74.4	64.2	8.7	1.5	0.0
Elm-ash-cottonwood	7.4	7.4	0.0	0.0	0.0
Other hardwoods	0.0	0.0	0.0	0.0	0.0
Tropical hardwoods	0.0	0.0	0.0	0.0	0.0
Exotic hardwoods	0.0	0.0	0.0	0.0	0.0
<b>Total hardwoods</b>	<b>194.9</b>	<b>151.6</b>	<b>32.4</b>	<b>10.9</b>	<b>0.0</b>
Nonstocked	0.1	0.0	0.0	0.0	0.1
<b>All groups</b>	<b>888.0</b>	<b>613.1</b>	<b>253.6</b>	<b>21.2</b>	<b>0.1</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on past conditions.



**Table C.24—Average annual removals of live trees on forest land by species group and ownership group, South Carolina, 2016 (2007–11 to 2012–16)**

Species group	All ownerships	Ownership group <sup>a</sup>				
		U.S. Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
<i>million cubic feet per year</i>						
<b>Softwood</b>						
Longleaf and slash pines	24.5	0.1	7.0	1.5	0.2	15.7
Loblolly and shortleaf pines	657.1	13.6	5.1	1.6	16.1	620.8
Other yellow pines	5.9	0.0	0.0	0.6	0.1	5.2
Eastern white and red pines	0.8	0.0	0.0	0.0	0.0	0.8
Eastern hemlock	0.0	0.0	0.0	0.0	0.0	0.0
Cypress	5.7	0.0	0.0	0.0	0.0	5.7
Other eastern softwoods	2.6	0.0	0.0	0.1	0.0	2.5
<b>Total softwoods</b>	<b>696.6</b>	<b>13.7</b>	<b>12.1</b>	<b>3.8</b>	<b>16.4</b>	<b>650.7</b>
<b>Hardwood</b>						
Select white oaks	14.4	0.0	0.0	0.0	0.0	14.4
Select red oaks	6.6	0.0	1.2	0.0	0.4	4.9
Other white oaks	5.5	0.0	2.0	0.0	0.0	3.5
Other red oaks	44.9	0.0	0.9	1.4	1.1	41.6
Hickory	3.5	0.0	0.0	0.0	0.2	3.3
Yellow birch	0.0	0.0	0.0	0.0	0.0	0.0
Hard maple	0.0	0.0	0.0	0.0	0.0	0.0
Soft maple	22.9	0.0	0.0	0.0	1.4	21.5
Beech	0.2	0.0	0.0	0.0	0.0	0.1
Sweetgum	45.4	0.1	0.0	0.2	0.5	44.6
Tupelo and blackgum	13.5	0.0	0.0	0.0	0.1	13.4
Ash	2.1	0.0	0.0	0.0	0.0	2.1
Cottonwood and aspen	0.0	0.0	0.0	0.0	0.0	0.0
Basswood	0.0	0.0	0.0	0.0	0.0	0.0
Yellow-poplar	16.3	0.0	0.0	0.7	0.0	15.7
Black walnut	0.2	0.0	0.0	0.0	0.0	0.2
Other eastern soft hardwoods	12.3	0.0	0.0	0.2	0.0	12.1
Other eastern hard hardwoods	1.7	0.0	0.0	0.0	0.0	1.7
Eastern noncommercial hardwoods	1.7	0.0	0.0	0.0	0.0	1.7
<b>Total hardwoods</b>	<b>191.4</b>	<b>0.2</b>	<b>4.2</b>	<b>2.4</b>	<b>3.6</b>	<b>181.0</b>
<b>All species</b>	<b>888.0</b>	<b>13.8</b>	<b>16.3</b>	<b>6.2</b>	<b>20.0</b>	<b>831.6</b>

Numbers in rows and columns may not sum to totals due to rounding.

0.0 = no sample for the cell or a value of >0.0 but <0.05.

<sup>a</sup>Based on current conditions.



## Appendix C—Supplemental Tables

**Table C.25—List of tree species  $\geq 1.0$  inch d.b.h. occurring in the FIA sample and number measured, South Carolina, 2012–16**

Common name	Scientific name	Number
<b>Softwoods</b>		
Loblolly pine	<i>Pinus taeda</i>	42,749
Longleaf pine	<i>Pinus palustris</i>	2,644
Eastern redcedar	<i>Juniperus virginiana</i>	1,674
Shortleaf pine	<i>Pinus echinata</i>	1,327
Virginia pine	<i>Pinus virginiana</i>	1,073
Baldcypress	<i>Taxodium distichum</i>	672
Slash pine	<i>Pinus elliotii</i>	620
Pond pine	<i>Pinus serotina</i>	407
Pondcypress	<i>Taxodium ascendens</i>	336
Eastern white pine	<i>Pinus strobus</i>	278
Eastern hemlock	<i>Tsuga canadensis</i>	131
Spruce pine	<i>Pinus glabra</i>	42
Pitch pine	<i>Pinus rigida</i>	26
Southern redcedar	<i>Juniperus virginiana</i>	10
Carolina hemlock	<i>Tsuga caroliniana</i>	2
<b>Hardwoods</b>		
Sweetgum	<i>Liquidambar styraciflua</i>	11,800
Red maple	<i>Acer rubrum</i>	6,472
Water oak	<i>Quercus nigra</i>	5,302
Swamp tupelo	<i>Nyssa biflora</i>	2,765
Yellow-poplar	<i>Liriodendron tulipifera</i>	1,979
White oak	<i>Quercus alba</i>	1,784
Laurel oak	<i>Quercus laurifolia</i>	1,729
Winged elm	<i>Ulmus alata</i>	1,275
Black cherry	<i>Prunus serotina</i>	1,225
Blackgum	<i>Nyssa sylvatica</i>	1,193
Green ash	<i>Fraxinus pennsylvanica</i>	1,091
Southern red oak	<i>Quercus falcata</i>	1,025
Sourwood	<i>Oxydendrum arboreum</i>	985
Mockernut hickory	<i>Carya alba</i>	874
American holly	<i>Ilex opaca</i>	860
Willow oak	<i>Quercus phellos</i>	848
Post oak	<i>Quercus stellata</i>	809
Flowering dogwood	<i>Cornus florida</i>	744
American hornbeam, musclewood	<i>Carpinus caroliniana</i>	734
Water tupelo	<i>Nyssa aquatica</i>	696
Redbay	<i>Persea borbonia</i>	634
Pignut hickory	<i>Carya glabra</i>	449
Turkey oak	<i>Quercus laevis</i>	431
Scarlet oak	<i>Quercus coccinea</i>	406
American elm	<i>Ulmus americana</i>	404
Sweetbay	<i>Magnolia virginiana</i>	337
Black willow	<i>Salix nigra</i>	329
Northern red oak	<i>Quercus rubra</i>	328

(Continued)



**Table C.25 (continued)—List of tree species  $\geq 1.0$  inch d.b.h. occurring in the FIA sample and number measured, South Carolina, 2012–16**

Common name	Scientific name	Number
Hardwoods (continued)		
Chestnut oak	<i>Quercus prinus</i>	310
Live oak	<i>Quercus virginiana</i>	299
Sugarberry	<i>Celtis laevigata</i>	299
Black oak	<i>Quercus velutina</i>	295
Common persimmon	<i>Diospyros virginiana</i>	285
Cherrybark oak	<i>Quercus pagoda</i>	239
Loblolly-bay	<i>Gordonia lasianthus</i>	238
American beech	<i>Fagus grandifolia</i>	233
River birch	<i>Betula nigra</i>	225
Dwarf post oak	<i>Quercus margarettiae</i>	200
Shagbark hickory	<i>Carya ovata</i>	187
Florida maple	<i>Acer barbatum</i>	181
Blackjack oak	<i>Quercus marilandica</i>	179
Slippery elm	<i>Ulmus rubra</i>	169
Swamp chestnut oak	<i>Quercus michauxii</i>	164
Eastern hophornbeam	<i>Ostrya virginiana</i>	163
Sand hickory	<i>Carya pallida</i>	157
American sycamore	<i>Platanus occidentalis</i>	155
White ash	<i>Fraxinus americana</i>	146
Chinaberry	<i>Melia azedarach</i>	127
Boxelder	<i>Acer negundo</i>	125
Chinese tallowtree	<i>Triadica sebifera</i>	117
Water-elm, planertree	<i>Planera aquatica</i>	113
Sassafras	<i>Sassafras albidum</i>	106
Red mulberry	<i>Morus rubra</i>	103
Bitternut hickory	<i>Carya cordiformis</i>	100
Bluejack oak	<i>Quercus incana</i>	89
Carolina ash	<i>Fraxinus caroliniana</i>	88
Eastern redbud	<i>Cercis canadensis</i>	87
Swamp cottonwood	<i>Populus heterophylla</i>	81
Water hickory	<i>Carya aquatica</i>	78
Overcup oak	<i>Quercus lyrata</i>	62
Hawthorn spp.	<i>Crataegus</i> spp.	56
Black walnut	<i>Juglans nigra</i>	51
Eastern cottonwood	<i>Populus deltoides</i>	50
Pawpaw	<i>Asimina triloba</i>	50
Pecan	<i>Carya illinoensis</i>	46
Black locust	<i>Robinia pseudoacacia</i>	43
Southern magnolia	<i>Magnolia grandiflora</i>	37
Ailanthus	<i>Ailanthus altissima</i>	33
Cabbage palmetto	<i>Sabal palmetto</i>	31
Sweet birch	<i>Betula lenta</i>	26
Hackberry	<i>Celtis occidentalis</i>	25
Mimosa, silktree	<i>Albizia julibrissin</i>	21

(Continued)



## Appendix C—Supplemental Tables

**Table C.25 (continued)—List of tree species  $\geq 1.0$  inch d.b.h. occurring in the FIA sample and number measured, South Carolina, 2012–16**

Common name	Scientific name	Number
Hardwoods (continued)		
Honeylocust	<i>Gleditsia triacanthos</i>	18
Cucumbertree	<i>Magnolia acuminata</i>	17
Carolina silverbell	<i>Halesia carolina</i>	15
American plum	<i>Prunus americana</i>	13
Mountain or Fraser magnolia	<i>Magnolia fraseri</i>	12
Carolina basswood	<i>Tilia americana</i>	11
Waterlocust	<i>Gleditsia aquatica</i>	10
Peach	<i>Prunus persica</i>	10
Other or unknown live tree	Tree unknown	10
Yellow birch	<i>Betula alleghaniensis</i>	6
Sugar maple	<i>Acer saccharum</i>	6
American basswood	<i>Tilia americana</i>	5
Serviceberry spp.	<i>Amelanchier</i> spp.	5
White basswood	<i>Tilia americana</i>	4
Paulownia, empress-tree	<i>Paulownia tomentosa</i>	4
Shellbark hickory	<i>Carya laciniosa</i>	3
Southern shagbark hickory	<i>Carya carolinae-septentrionalis</i>	3
Downy hawthorn	<i>Crataegus mollis</i>	3
Silverbell spp.	<i>Halesia</i> spp.	3
Chinkapin oak	<i>Quercus muehlenbergii</i>	2
Shumard oak	<i>Quercus shumardii</i>	2
Pumpkin ash	<i>Fraxinus profunda</i>	2
White mulberry	<i>Morus alba</i>	2
Willow spp.	<i>Salix</i> spp.	2
Unknown dead hardwood	<i>Tree broadleaf</i>	2
Swamp white oak	<i>Quercus bicolor</i>	1
Oglethorpe oak	<i>Quercus oglethorpensis</i>	1
Butternut	<i>Juglans cinerea</i>	1
Weeping willow	<i>Salix sepulcralis</i>	1
Oak spp.	<i>Quercus</i> spp.	1
Allegheny chinkapin	<i>Castanea pumila</i>	1
Southern crab apple	<i>Malus angustifolia</i>	1
Scrub oak	<i>Quercus ilicifolia</i>	1





**Brandeis, Thomas J.; Brandeis, Consuelo; Hartsell, Andrew J.** 2018. South Carolina's forests, 2016. Resour. Bull. SRS-215. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 74 p.

South Carolina's 12.9 million acres of forest cover 67 percent of the State. This forest land area has remained relatively stable for the past 15 years. Notable trends included timberland divestiture by forest industry, acquisition of that timberland by Timber Investment Management Organizations and Real Estate Investment Trusts, and a decrease in the average annual number of agricultural acres reverting to forest. Loblolly-shortleaf pine remains the predominant forest type followed by Oak-hickory forest. These forests hold slightly more than 26 billion cubic feet of wood volume and 636 million oven-dry tons of aboveground live-tree biomass. Softwood annual net growth and removals trended upwards while mortality declined from previously observed levels, giving a growth to removals ratio (a measure used to assess resource sustainability) of 1.4. Conversely, hardwood growth and removals were slightly down while their mortality increased, giving a growth to removals ratio of 1.8. Wildland forest fires were the most frequently recorded disturbance on forest land, followed by forest diseases and weather events. There was an average 15.5 million tons of down woody material carbon and 144.6 million tons on the forest floor in duff and litter. Chinaberry, Chinese/European privets, Japanese honeysuckle, Nepalese browntop, and Chinese or sericea lespedeza were the most commonly encountered nonnative invasive plants on forested plots.

**Keywords:** Components of change, FIA, forest inventory, forest survey, forest trends, South Carolina.



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**March 2018**

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Young longleaf pine (*Pinus palustris*) trees in South Carolina. (photo courtesy of Jeremy Rogers, U.S. Forest Service)



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