USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Southern Research Station | Resource Bulletin SRS-236 | June 2023

Georgia's Forests, 2019

Samuel G. Lambert, James Gray, Joseph M. McCollum,
Thomas J. Brandeis, and Mark Brown

About the Authors

Samuel G. Lambert is a Forester with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

James Gray is a Forester with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

Joseph M. McCollum is a Computer Scientist with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

Thomas J. Brandeis is a Research Forester with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

Mark Brown is a Forester with the U.S. Department of Agriculture, Forest Service, Southern Research Station, Forest Inventory and Analysis Research Work Unit, Knoxville, TN 37919.

Front cover: top left, rhododendron (*Rhododendron* spp.) in DeKalb County, GA (USDA Forest Service photo by Sam Lambert); top right, burned and thinned longleaf pine (*Pinus palustris*) in southern Georgia (Courtesy photo by Georgia Forestry Commission); center left, Georgia field crew on Cumberland Island National Seashore; from left to right: Ken Pierce (Georgia Forestry Commission [GFC]), Alex Ray (formerly GFC, now North Carolina Forest Service), and Robert Farmer (GFC) (Courtesy photo by Heather Gregg, Georgia Forestry Commission); bottom left, chinaberry tree (*Melia azedarach*), a nonnative invasive tree in Georgia (Courtesy photo by tmass); bottom right, bobwhite quail (*Colinus virginianus*). (Courtesy photo by Dave McGowen)
Back cover: top left, mirror image of swamp in the Okefenokee National Wildlife Refuge (Courtesy photo by Georgia Forestry Commission); top right, sericea lespedeza (*Lespedeza cuneata*), a nonnative invasive herb in Georgia (Courtesy photo by Dalgial); middle right, Moccasin Creek along Hemlock Falls Trail near Lake Burton, northern Georgia (USDA Forest Service photo by Sam Lambert); bottom left, dogwood (*Cornus florida* var. *rubra*) in Georgia (USDA Forest Service photo by Sam Lambert); bottom right, nepalese browntop (*Microstegium vimineum*), a nonnative invasive grass in Georgia. (Courtesy photo by James H. Miller & Ted Bodner, Southern Weed Science Society)

June 2023
https://doi.org/10.2737/SRS-RB-236

Forest Service
Research & Development
Southern Research Station
Resource Bulletin SRS-236

Southern Research Station
200 W.T. Weaver Blvd.
Asheville, NC 28804
www.fs.usda.gov/research/srs

Georgia's Forests, 2019

Samuel G. Lambert, James Gray, Joseph M. McCollum,
Thomas J. Brandeis, and Mark Brown

Planted loblolly pine (*Pinus taeda*) in Georgia. (Courtesy photo by Georgia Forestry Commission)

FOREWORD

The U.S. Department of Agriculture, Forest Service, 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. 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 multi-resource information needed to formulate sound forest policies, provide information for economic development, develop forest programs, and provide a scientific basis to monitor forest ecosystems. The 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, 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* (USDA 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://www.fia.fs.usda.gov/tools-data/index.php. Additional information about the FIA program can be obtained at https://www.fia.fs.usda.gov.

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

U.S. Department of Agriculture
Forest Service
Southern Research Station
Forest Inventory and Analysis
Research Work Unit
4700 Old Kingston Pike
Knoxville, TN 37919
Telephone: 865-862-2000
Burl Carraway
Program Manager

ACKNOWLEDGMENTS

The SRS FIA research work unit gratefully acknowledges the Georgia Forestry Commission (GFC) for their cooperation and input during this survey, as well as FIA field personnel, FIA Information Management, and SRS Technical Publications staff for all their dedication, hard work, and assistance. We would like to thank Jim Schiller, Greg Smith, Nathan Wheat, and Jeremy Rogers of the SRS FIA Quality Assurance/Quality Control staff; and SRS FIA foresters Jim Gray and Jason Cooper for the help with Timber Product Output; and David Dickinson and Dru Preston (GFC) for reviewing this manuscript. We also appreciate the cooperation of other public agencies and private landowners for providing access to measurement plots, including Bob Farmer, Ken Pierce, Chad Northcutt, Tim Karchner, Mark Freeman, Mark Barrett, Jon Ray, Keith Moss, Chad Sutton, Alex Gray, and Heather Gregg of the GFC.

Acknowlegements

Georgia field crew. From left to right: Nathan Wheat (USDA Forest Service), Robert Farmer (Georgia Forestry Commission [GFC]), Mark Freeman (GFC), Mark Barrett (GFC), Jonathan Ray (GFC), Ken Pierce (GFC), Keith Moss (GFC), David Dickinson (GFC Field Supervisor), Chad Northcutt (GFC), Heather Gregg (GFC), Chad Sutton (GFC), and Tim Karchner (GFC). (Courtesy photo by Georgia Forestry Commission)

CONTENTS

Contents

LIST OF FIGURES

LIST OF TABLES

List of Tables

HIGHLIGHTS

• Total land area for Georgia in 2019 is >38 million acres. There are 24.4 million acres of forest in Georgia. Sixty-four percent of the State is forested, while 33 percent is nonforest, and 3 percent is classified as census water. Ninety-eight percent of this forest land is considered timberland, that is, not reserved by legal statute and sufficiently productive to support sustainable harvesting of forest products.

• Among nonforest land, agricultural land is most prevalent. Ten percent of Georgia's surface area is cropland, with another 5 percent being pasture and 2 additional percent split among miscellaneous agricultural types. Roughly 3 percent of Georgia is developed due to rights-of-way, with another 11 percent otherwise developed. The remaining 1 percent of Georgia's surface area is wetland or beach.

• Forest ownership is changing as the divestiture of timberland by forest industry companies that own wood-processing facilities has continued, as has concurrent acquisition of these lands by other corporate owners, in particular Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). Due to the many ways that ownership information is recorded and stored in courthouses across the State, TIMO and REIT ownerships are often not readily identifiable in available public courthouse records, which further complicates the identification of these ownerships. Hopefully, future refinements in the collection of FIA ownership information will differentiate these two important categories and provide more insight into their role in forest ownership. Still, more than half (53 percent) of Georgia's forests belong to nonindustrial private landowners.

• Georgia's forests are a diverse mix of hardwood and softwood tree species typical of the South. Hardwood forests account for 54.5 percent (includes nonstocked, 1.3 percent) of the forested area versus 45.5 percent for softwood types. Loblolly-shortleaf pine is the most prevalent softwood forest-type group, consisting of 30.5 percent of all forest land. Oak-hickory is the most prevalent hardwood forest-type group, consisting of 26.4 percent of all forest land, followed by oak-gum-cypress and the mixed oak-pine forest-type groups.

• Pine plantations in 2019 account for 61 percent of all softwood forests. After decades of decreasing natural pine acreage and increasing plantation acreage, the balance between the two has stabilized at 6.8 and 4.2 million acres for planted and natural pine, respectively—slightly lower than 2014.

• Two land-use change trends stand out in Georgia from 2009 through 2019: the rate at which the State gained forest land acreage from converted agricultural land until 2012, which then decreased for the next 7 years, and the rate at which forest was lost to development, which decreased steadily until 2016 and has stayed relatively stable through 2019.

• The population of planted pine acres has been getting older. Two features are outstanding in the stand age distribution of planted pine timberland acreage. First is the relatively abrupt drop for all survey years in acreage >25 years old, which is the typical age at which plantations are harvested and replanted. Second, in more recent years, the number of acres >25 years old has been slightly increasing.

• The number of trees ≥1.0 inch diameter at breast height (d.b.h.) on Georgia's forest land has decreased by 1.0 billion from the 15.2 billion trees recorded in 2014 to 14.2 billion trees in 2019. The most numerous softwood species ≥1.0 inch d.b.h. were loblolly and shortleaf pines, while the most numerous hardwood species were sweetgum, red maple, water oak, swamp tupelo, and yellow-poplar.

• For trees ≥5.0 inches d.b.h., there were 24.1 billion cubic feet of volume in softwoods and 23.4 billion cubic feet in hardwoods, for a total of 47.5 billion cubic feet, which was 3.8 billion cubic feet higher than the 43.7 billion cubic feet present in 2014. Total wood volume on Georgia's timberland in 2019 was 46.5 billion cubic feet—only slightly lower than that on all forest land.

• Net growth, removals, and mortality volumes trended slightly upwards across the softwood resource, while hardwood species displayed increasing net growth with a slight increase in removals and a slight increase in mortality.

• Fire was the most frequently recorded disturbance in 2019 on forest land in Georgia, affecting an estimated 509,800 acres of forest land. This was a 11-percent decrease over the previous 2014 survey. The next most frequently recorded disturbance was disease, affecting an estimated 135,100 acres of forest land.

• Several tree species in Georgia have serious health issues. Redbay is affected by laurel wilt disease, with the number of live redbay trees ≥1.0 inches d.b.h. dropping by 56.1 percent between 2004 and 2019. Sassafras is also affected by laurel wilt disease and is starting to show an increase in mortality as well. Flowering dogwood is another species with a rather high rate of mortality, most likely due to factors including drought stress, dogwood anthracnose, and powdery mildew.

• The emerald ash borer is an exotic pest insect that rapidly spreads to infest native ash trees, threatening nearly 16.9 million ash trees ≥5 inches d.b.h. (growing stock) in Georgia in 2019. The future of Georgia's ash resource is uncertain; in areas where the emerald ash borer has been present for several years, mortality has exceeded 99 percent. In 2019, quarantine and education efforts targeting the spread of infested wood were still underway, with the aid of Federal grants.

• The hemlock woolly adelgid is another exotic pest insect that has affected the hemlock population in northern

Georgia since its introduction in 2002. Hemlocks have been a major component in northern Georgia's forests and play a keystone role in forest ecosystems. The potential loss of hemlocks throughout their range has been likened to the loss of the American chestnut in the last century.

- Japanese honeysuckle is the most prevalent invasive plant in Georgia forests, and it has been observed on 33 percent of all forested plots. Chinese/European privets are also prevalent and were encountered on 28 percent of forested plots while sericea lespedeza was observed on 8 percent of forested plots in the State.

- A diverse forest products industry in Georgia is made up of a variety of mills, ranging from small- to large-sized softwood and hardwood sawmills (including post/pole/piling, veneer, composite, bioenergy, and other miscellaneous mills) to very large pulp mills. There were 164 primary wood-using mills in 2013, 185 in 2015–2017, 190 in 2018, and 189 in 2019.

- Hurricane Michael, a Category 5 storm that made landfall on October 10, 2018, caused considerable damage in the States of Alabama, Florida, and Georgia. An assessment of forest resource damages was done using FIA plots and the National Oceanic and Atmospheric Administration's (NOAA) defined storm impact severity zones. Despite the nearly annual passage of damaging hurricanes like Michael along the Southeastern United States' coast, there were lessons to be learned from this most recent effort to assess their impacts on the region's forests. Fortunately, a network of permanent forest inventory and monitoring plots are in place upon which rapid assessments of the impacts of natural disasters like Hurricane Michael can be conducted. These are particularly important in the Southern States where forest resources are a vital part of Georgia's and the region's economy.

INTRODUCTION

Past forest inventory reports (Harper and others 2009) have emphasized the importance of Georgia's forest resources and their stability in recent years. These reports have revealed relatively constant forest and timberland area, steady or slightly increasing amounts of wood volume, and some disturbances, pests, or diseases that are threatening forest health. But these outward signs of stability can mask changes that occur within the resource that do not affect overall totals. This report will present a comprehensive overview of the state of the resource and focus on some of the dynamics behind the seemingly static numbers, such as gains and losses of forest land to other land uses that occur every year without changing total acreages, maturing of the planted pine resource over time, continual balancing of growth with natural mortality and harvest removals, and emergence of forest pests and diseases that are having serious impacts on Georgia's forests.

A general description of Georgia's forests is followed by an in-depth examination of its forest types in relation to its geography. Next, the report describes the dynamic nature of land-use change in the State, how economic factors are affecting the structure of the State's working pine plantations, and the net accrual of wood volume in the forest. Finally, the health of the forests is examined, with special focus on disturbances and nonnative invasive species that currently, or potentially will, negatively affect the forests' ability to deliver valuable ecosystem services to the people of Georgia.

AREA

Forest Land Area and Nonforest Land Uses

There are 38.0 million acres of land mass in the State of Georgia, including 24.4 million acres of forest across the five survey units (fig. 1). Sixty-four percent of the State is forested, while 33 percent is nonforest, and 3 percent is classified as census water (table 1). Ninety-eight percent of this forest land is considered timberland, that is, not reserved by legal statute and sufficiently productive to support sustainable harvesting of forest products. With the FIA survey units as reference, the northern portions of the North unit (Unit 5) along with most of the Central and Southeast units (Units 3 and 1, respectively) are dominated by forest cover, as at least 60 percent of the land area in most of these counties is in forest cover (figs. 2 and 3).

Among nonforest land, agricultural land is most prevalent. Ten percent of Georgia's land area is cropland, with another 5 percent being pasture and 2 additional percent split among miscellaneous agricultural types. Cropland is especially prevalent in the southern part of the State, with pastureland being prevalent in the northern two units. Roughly 3 percent of Georgia is developed due to rights-of-way, ranging from 2.7 percent in the

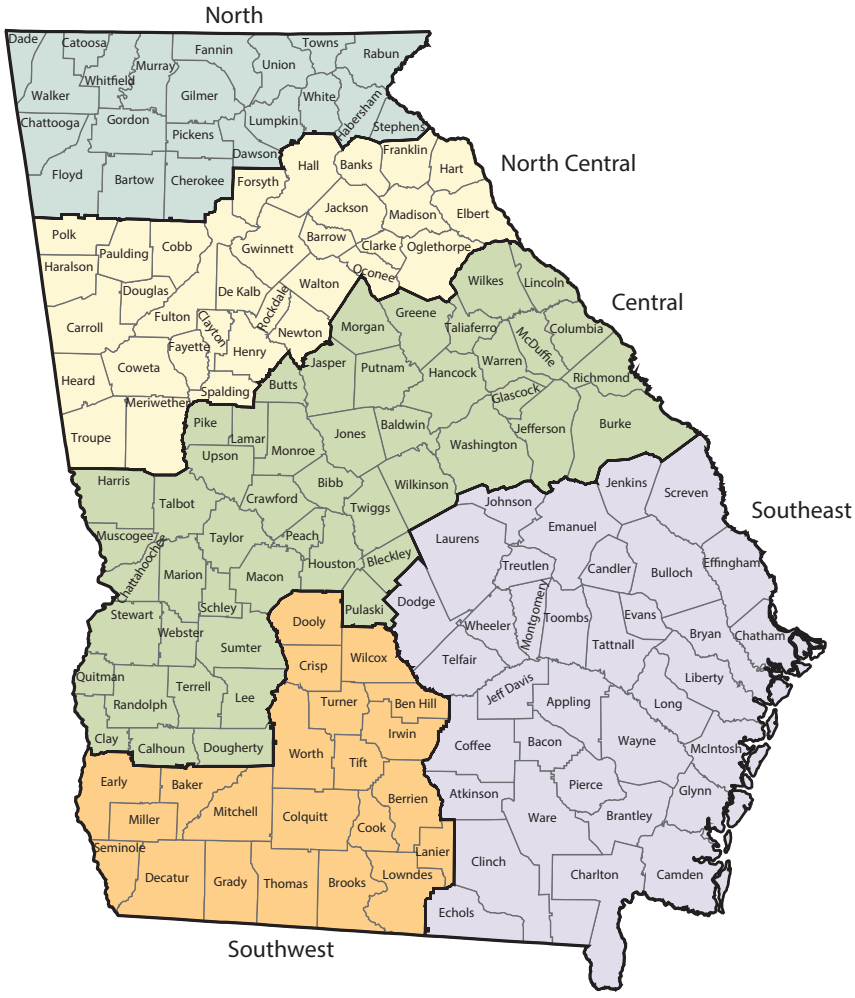

Figure 1—Counties and forest survey units, Georgia, 2019.

Table 1—Area by survey unit and land status, Georgia, 2019

Unit	Total area	All forest	Unreserved			Reserved			Nonforest land	Census water
			Total	Timberland	Unproductive	Total	Productive	Unproductive		
	thousand acres									
Southeast (Unit 1)	11,183.2	7,877.1	7,514.3	7,514.3	0.0	362.8	362.8	0.0	2,827.2	478.9
Southwest (Unit 2)	5,645.8	2,880.2	2,880.2	2,880.2	0.0	0.0	0.0	0.0	2,665.9	99.8
Central (Unit 3)	10,621.9	7,594.6	7,549.1	7,543.3	5.8	45.5	45.5	0.0	2,854.3	173.0
North Central (Unit 4)	6,309.2	3,144.7	3,144.7	3,144.7	0.0	0.0	0.0	0.0	3,030.4	134.1
North (Unit 5)	4,271.9	2,921.8	2,749.9	2,746.7	3.3	171.9	171.9	0.0	1,280.0	70.1
All survey units	38,031.9	24,418.2	23,838.2	23,829.1	9.1	580.1	580.1	0.0	12,657.7	956.0

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

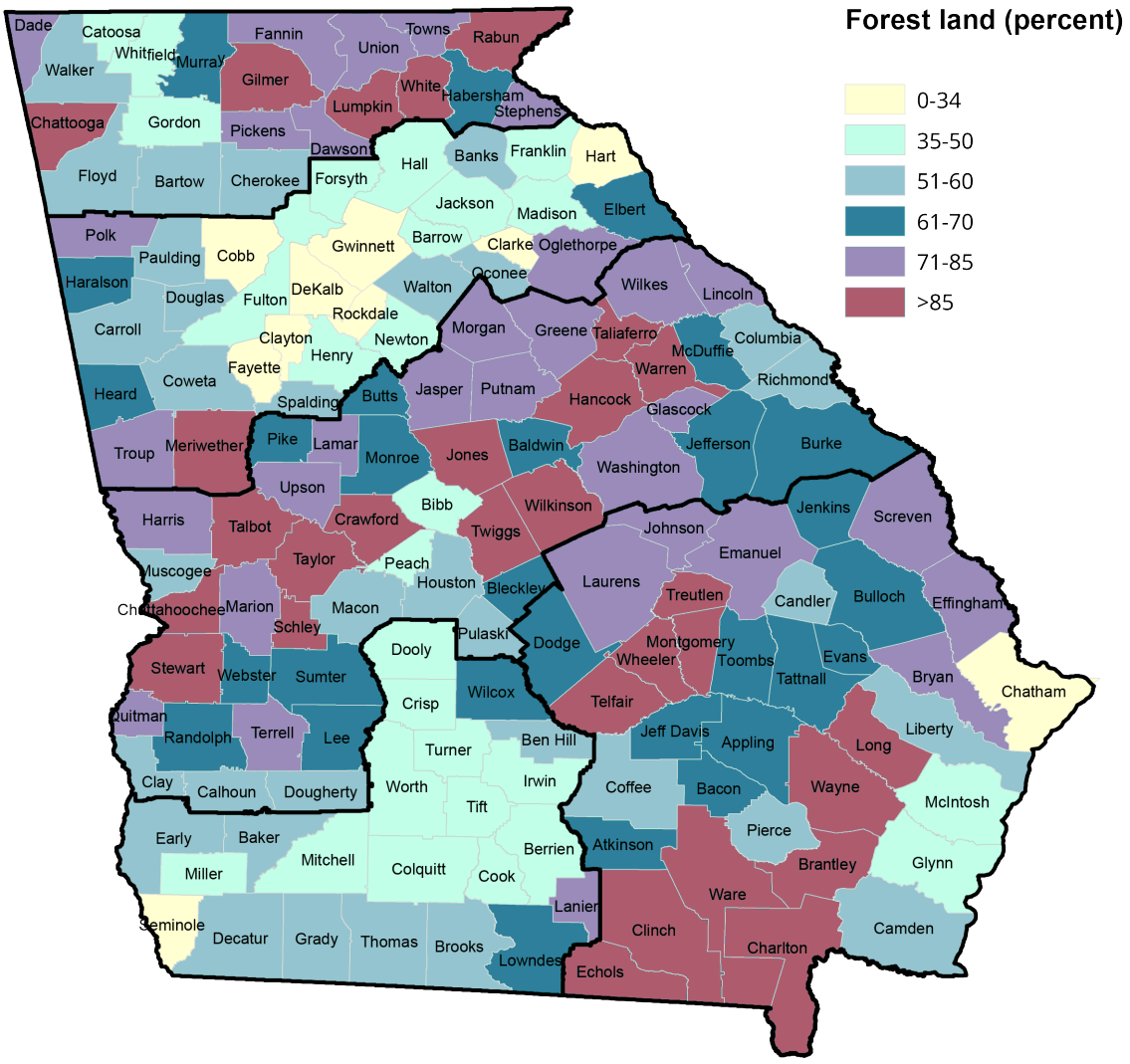

Figure 2—Percentage of counties in forest land, Georgia, 2019.

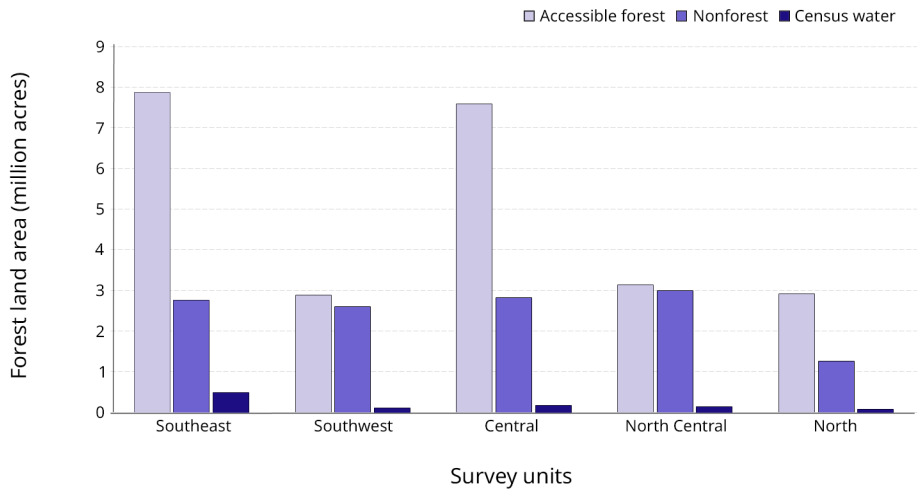

Figure 3—Forest land area by survey unit, Georgia, 2019.

Southeast unit (Unit 1) to 4.4 percent in the North Central unit (Unit 4). Another 11 percent is otherwise developed. The remaining 1 percent of Georgia's surface area is wetland or beach. This land cover type is concentrated in the Southeast unit (Unit 1).

Forest Ownership, Forest Types, and Stand Origins

Forest ownership

For more than 50 years, the U.S. Department of Agriculture, Forest Service, Southern Research Station's (SRS) Forest Inventory and Analysis (FIA) research work unit has reported ownership into four major groups: (1) national forest; (2) other Federal; (3) State and local, which collectively represent public ownership; and (4) private ownership, which is composed of nonindustrial private forest (NIPF) and forest industry lands (note: SRS FIA is mandated by Congress to protect private land ownership, so these two categories are combined under one group, private, for county estimates).

Forest ownership patterns have changed over time. As reported previously in Harper and others (2009) and Brandeis and others (2016), divestiture of timberland by traditional forest industry, defined as companies that own wood-processing facilities, has continued, as has concurrent acquisition of these lands by other corporate owners, in particular Timber Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs). Still, more than half (53 percent) of Georgia's forests belong to individual private landowners.

In the last inventory cycle (2019), forest industry acreage has increased in Georgia from 1.6 million acres to 1.8 million acres. The percentage of forest industry acreage is slightly up from 2014 but still lower than 2009 (fig. 4). With the merger of Plum Creek Timber and Weyerhaeuser in 2016, forest industry acres are increasing. Plum Creek is considered NIPF because it does not operate a mill, while Weyerhaeuser, which does have milling operations, is considered forest industry. SRS FIA divides forest industry (mill-owning) into two categories [(1) corporate and (2) individual], while NIPF ownership (no mill) is divided into four categories [(1) corporate, (2) conservation/natural resource organizations, (3) unincorporated local/clubs, and (4) individuals]. Acres in the NIPF

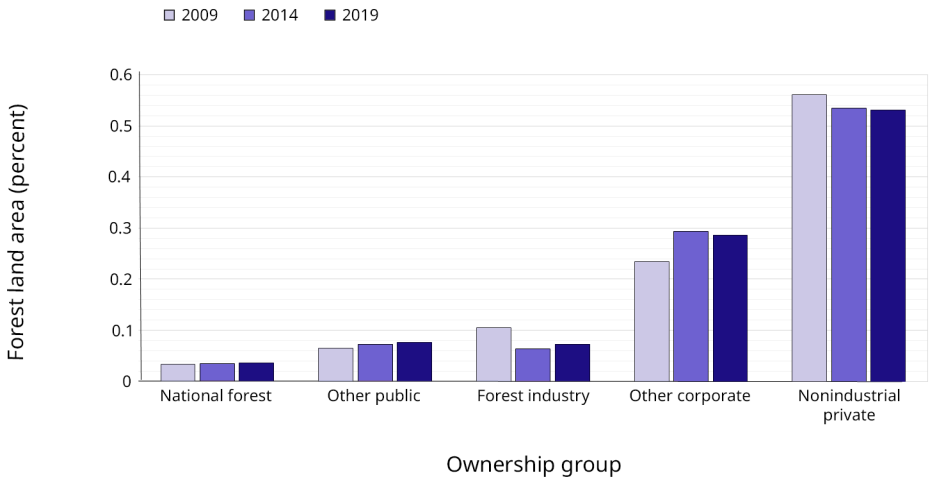

Figure 4—Percentage of forest land area by year and ownership group, Georgia, 2009–2019.

corporate category are often difficult for field crews to identify properly.

Other factors may be contributing to the difficulty in identifying NIPF corporate entities. Since the late 1990s, TIMOs and REITs have taken a leading role in land ownership. Currently, some of the TIMO and REIT acreage may still be in either the NIPF or forest industry categories, as a forest industry entity may retain its ownership designation even when under a REIT structure (Hickman 2007). To track the impact of these changes of ownerships on forest resources, it is essential that all ownerships are identified to their correct private category. During data collection for SRS FIA surveys, the TIMO and REIT investment groups have not been specifically identified as an ownership group and, therefore, are not listed and reported in the tables as an ownership category.

Due to the many ways that ownership information is recorded and stored in courthouses across the State, TIMO and REIT ownerships are often not readily identifiable in available public courthouse records, which further complicates the identification of these ownerships. Hopefully, future refinements in the collection of FIA ownership information will differentiate these two important categories and provide more insight into their role in forest ownership.

Forest types

Georgia's forests are a diverse mix of hardwood and softwood tree species typical of the U.S. South. Hardwood forests are the dominant type, accounting for 54.5 percent of the forested area versus 45.5 percent for softwood types.

Oak-hickory is the most prevalent hardwood forest-type group, consisting of 26.4 percent of all forest land (fig. 5). It is an upland hardwood forest-type group prevalent in the northern part of the State. Among oak-hickory forest types, mixed upland hardwoods are most prevalent. The second most common forest-type group among hardwoods is oak-gum-cypress at 13.3 percent statewide. It is a lowland hardwood forest-type group prevalent in the southern part of the State. After oak-gum-cypress comes the mixed oak-pine forest-type group. This is a mesic hardwood type spread across the State almost evenly at 11.4 percent. Oak-pine is the most common forest type within this group. After the oak-pine forest-type

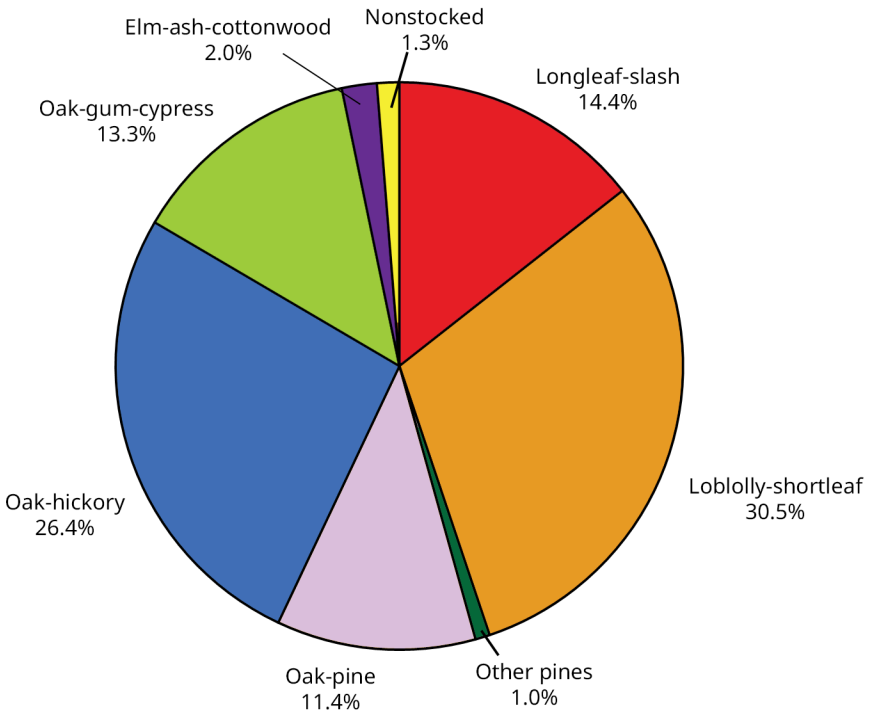

Figure 5—Percentage of forest land area by forest-type group, Georgia, 2019.

group comes another lowland forest-type group, elm-ash-cottonwood. At 2.0 percent statewide, it is most prevalent in the Piedmont, more so than oak-gum-cypress. It appears on meso-hydric sites. Minor hardwood types include other hardwoods, characterized by eastern hophornbeam (*Ostrya virginiana*) and peach (*Prunus persica*), as well as exotic hardwoods, characterized by chinaberry tree (*Melia azedarach*) and Chinese tallowtree (*Triadica sebifera*), and tropical hardwoods characterized by cabbage palmetto (*Sabal palmetto*).

Loblolly-shortleaf pine is the most prevalent softwood forest-type group, consisting of 30.5 percent of all forest land. This forest-type group comprises 95 percent loblolly pine (*Pinus taeda*), which is the upland softwood tree most prevalent in the Piedmont. After loblolly-shortleaf pine comes longleaf-slash pine, prevalent in the lowlands of the Coastal Plain. It consists of 14.4 percent of all forest land statewide and comprises 84 percent slash pine (*P. elliottii*). Minor softwoods include eastern white pine (*P. strobus*), appearing in the mountains, and eastern redcedar (*Juniperus virginiana*) throughout the State.

Finally, 1.3 percent of forest land is considered nonstocked. Nonstocked sites average <20 trees per acre and <20 seedlings per acre, compared to >600 trees and >1,400 seedlings per acre for stocked sites. However, field crews classify nonstocked sites into forest types. Nonstocked sites are disproportionately in the Coastal Plain, and disproportionately on meso-hydric sites. While the proportion of nonstocked hardwood and softwood stands mirrors that of stocked sites, nonstocked oak-gum-cypress stands were more commonly found than oak-hickory stands, and longleaf-slash pine stands were more common than loblolly-shortleaf pine on nonstocked sites. Also,

Table 2—Area and percentage of softwood stands by ownership group and stand origin on Georgia forests, 2019

	Ownership group	Total	Stand origin	
			Natural	Planted
thousand acres	**National forest**	152	114	38
	Other Federal	424	388	37
	State and local	325	171	155
	Private	10,141	3,604	6,537
	Total	11,043	4,276	6,767
percent	**National forest**	100	75	25
	Other Federal	100	92	8
	State and local	100	53	47
	Private	100	36	64
	Total	100	39	61

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

Coastal forest of planted longleaf pine (*Pinus palustris*), Unit 1, Georgia. (Courtesy photo by Georgia Forestry Commission)

most nonstocked sites are in transition after site preparation before planting or in the process of being changed to a nonforest land use (e.g., development, urban sprawl).

Pine forest stand origins and ownership

Currently, pine plantations account for 61 percent of all softwood forests (table 2). Sixty-four percent of the softwood forests controlled by private landowners are classified as planted. This differs greatly from forests owned by the Federal Government. Planted stands in national forests and other federally controlled lands represent only 25 percent and 8 percent of their forests, respectively. State and local lands are almost evenly split between natural and planted stands: roughly 47 percent of these forests are planted.

Another area of change in the recent past that now appears to be stabilizing is the balance between naturally regenerated pine timberlands and artificially regenerated (planted) ones. In 1972, there were roughly 9.3 million acres of natural pine stands and 2.8 million acres of pine plantations (fig. 6). These numbers have since largely reversed, such that in 2014 there were 4.1 million acres of natural pine stands and 6.9 million acres of planted pine. These trends have tapered off; as of 2019, these estimates are still at 6.8 and 4.2 million acres for planted and natural pine stands, respectively, slightly lower than in 2014.

Forest and Land Use by Survey Unit

Figure 7 represents the predominant forest-type groups by county and survey unit in Georgia. What follows is a survey of the land use, forest-type groups, and forest ownership of Georgia, unit by unit. In the maps shown in figures 8–12, the water layer is derived from TIGER 2019 (U.S. Census Bureau 2019). Water body names are also taken from TIGER (Topologically Integrated Geographic Encoding and Referencing system). Public land names are taken from the Protected Areas Database (U.S. DOI USGS GAP 2020). Otherwise, the maps are Thiessen expansions of FIA field plots.

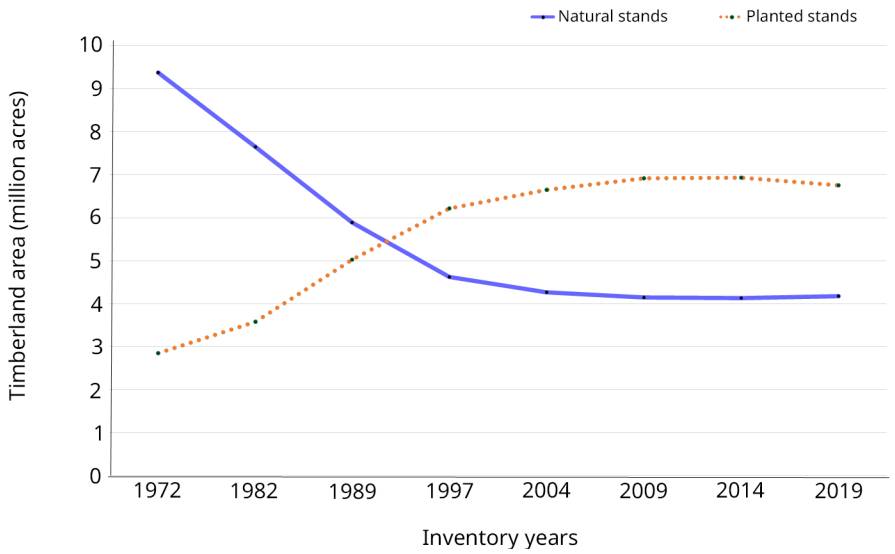

Figure 6—Natural and artificially regenerated (planted) softwood timberland area, Georgia, 1972–2019.

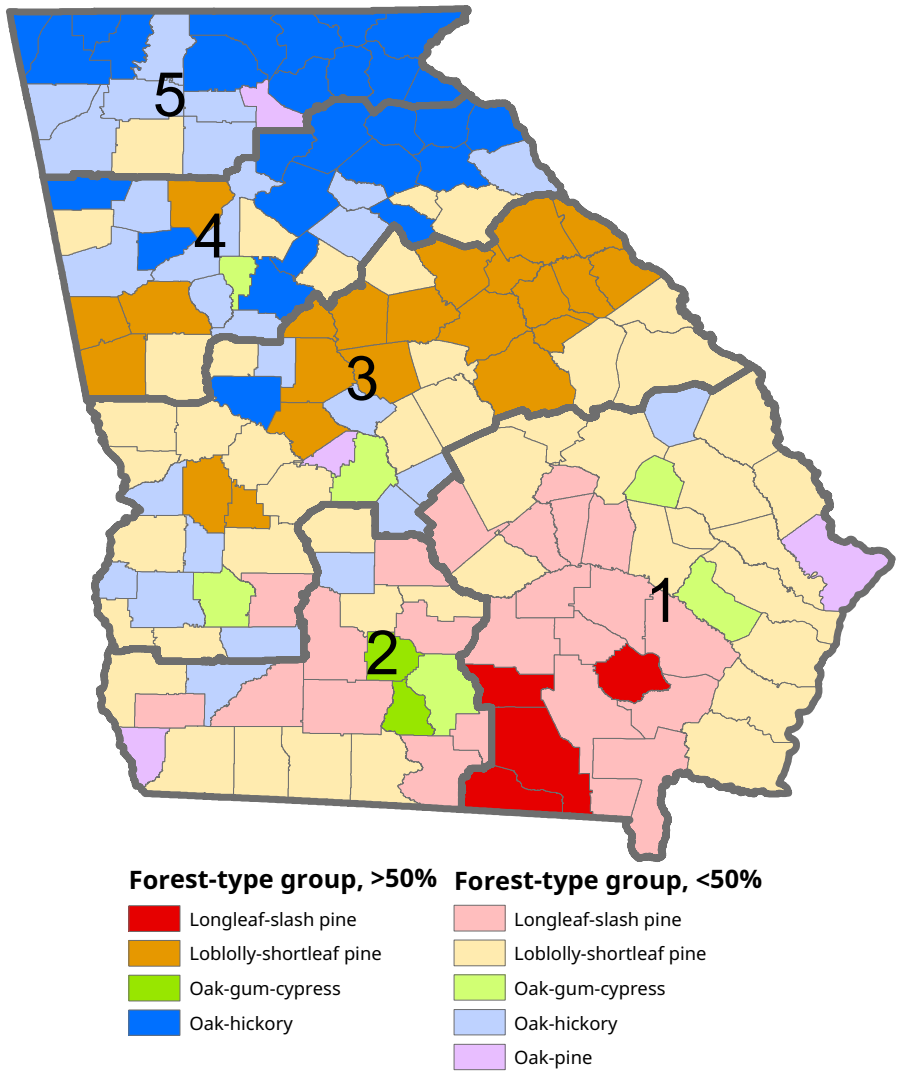

Figure 7—Percentage of forest-type group by county, Georgia, 2019. Numbered sections of the map represent forest survey units.

Southeast unit (Unit 1)

Georgia, as well as the Southeastern unit, begins at the Atlantic Ocean (fig. 8). To the west, the ocean turns to estuary and estuary turns to river. Tybee Island is the easternmost point of land in Georgia. It is the northernmost link within Georgia in a chain of islands called the Sea Islands. The chain begins in South Carolina and continues into Florida beyond Cumberland Island, Georgia's southernmost link in the chain. There is a narrow strip of beach on the ocean side of each of the islands. Beyond the beach are mudflats and herbaceous wetlands, although some forest is mixed in as well. The forest along the coast is largely on public lands.

Between the barrier islands and the mainland is a maze of streams, an ideal place for a fort (Fort Pulaski National Monument) or a pirate's hideout (Blackbeard Island National Wildlife Refuge). Rivers from the mainland empty into the maze, with wetlands along the riverbanks east of Interstate 95.

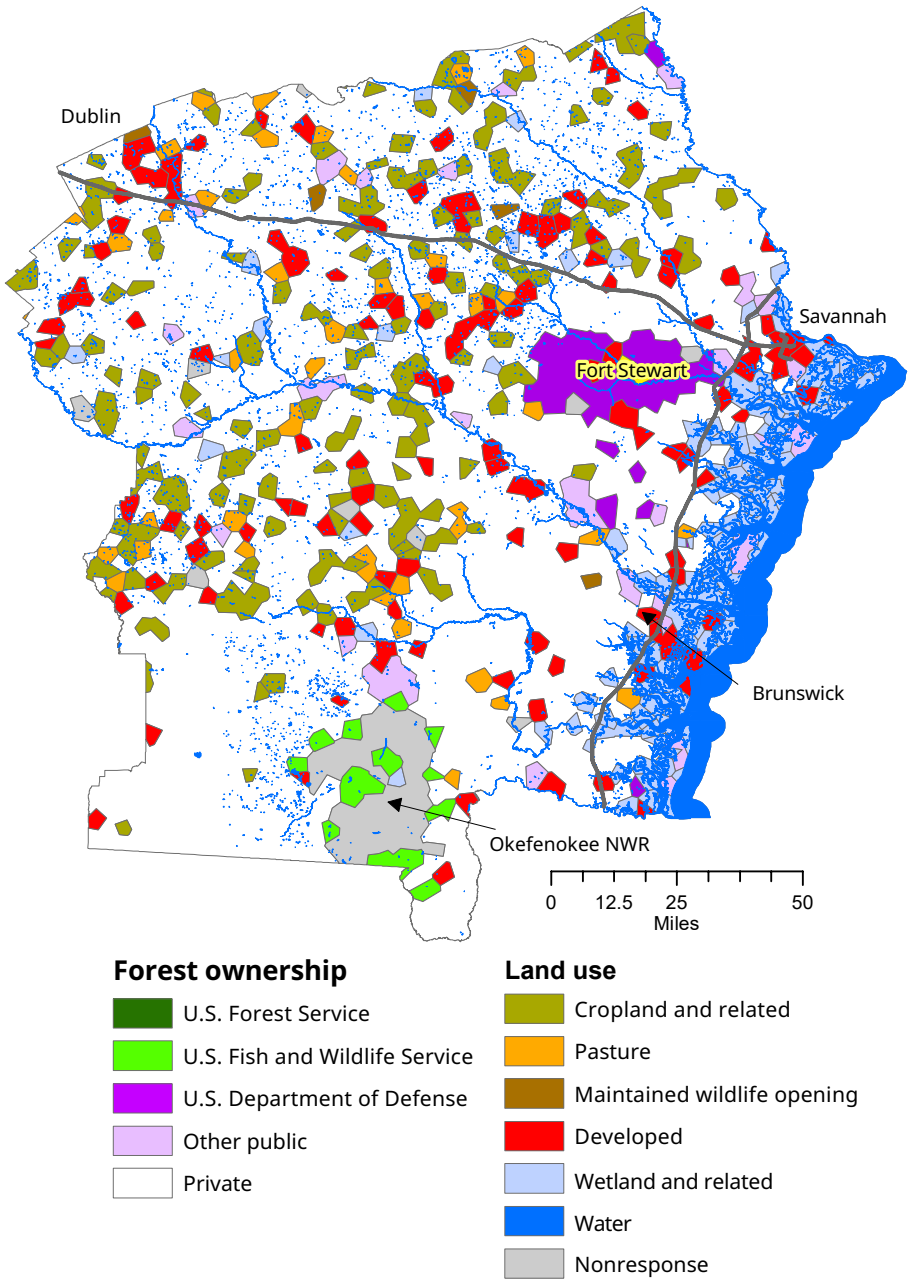

Figure 8—Forest ownership and land use, Southeast unit (Unit 1), 2019.

Along the coast, the loblolly-shortleaf pine forest-type group forms a majority of forested acres, with oak-pine edging that type out near Savannah, the unit's largest city. Near Savannah is the junction of Interstates 95 and 16.

Farther south on Interstate 95 is the Altamaha River, along which are several State-owned Wildlife Management Areas. Just across the Altamaha is a span of development stretching from Brunswick to St. Simons Island. West of Interstate 95, streams narrow considerably; wetlands are rarer, and the land becomes more forested.

Interstate 16 serves several communities across the northern part of the unit between Savannah and Dublin. The

loblolly-shortleaf pine forest-type group remains common in the northern part of the unit, but oak-gum-cypress and oak-hickory are mixed in as well.

To the southwest, the forest becomes thicker with the longleaf-slash pine forest-type group dominating. The Okefenokee National Wildlife Refuge is located here. With few roads, much of the refuge is difficult for FIA field crews to access. The swamp contains the headwaters of the St. Marys River, which flows east around the southernmost point of Georgia before emptying into the Atlantic Ocean. It also contains the headwaters of the Suwannee River, which winds west to the Gulf of Mexico. Just north of the refuge is the State-owned Dixon Memorial State Forest.

Southwest unit (Unit 2)

Heading west (fig. 9) into Unit 2, the longleaf-slash pine forest-type group remains most common, but there is a cluster of oak-gum-cypress in the east-central part of the unit.

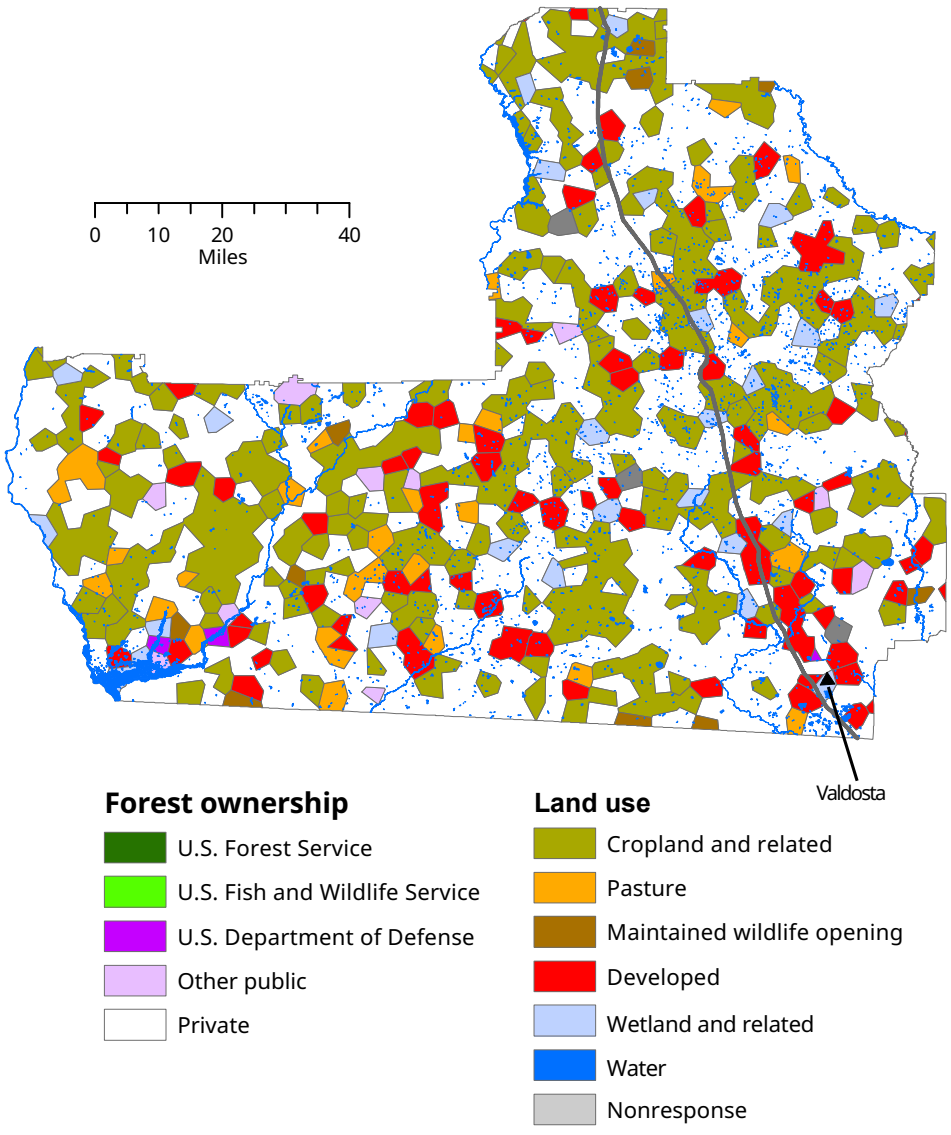

Figure 9—Forest ownership and land use, Southwest unit (Unit 2), 2019.

Loblolly-shortleaf pine edges out other forest types in the southern tier of counties west of the Withlacoochee River.

Unit 2 is the core of the agricultural belt. This unit contains multiple wildlife habitats for managing some of the best quail hunting in southern and central Georgia consisting of longleaf pine (*P. palustris*) timber with wiregrass understory, the native habitat to wild bobwhite quail (*Colinus virginianus*). Fifteen counties in southwestern Georgia (some in Unit 3) are at least one-third agricultural, with cropland being the leading subtype. Cotton and peanuts are the principal crops (USDA NASS 2019). The largest city in the unit is Valdosta.

At the southwestern corner of Georgia is Lake Seminole, into which the longest rivers in Georgia (the Chattahoochee and the Flint) empty. The Chattahoochee forms much of the boundary between Georgia and Alabama while the Flint flows from the northeast. There are several tracts of public land here ranging from Silver Lake Wildlife Management Area to Seminole State Park to U.S. Army Corps of Engineers land.

Central unit (Unit 3)

Between the Chattahoochee and the Flint (fig. 10), the forest become a patchwork of loblolly-shortleaf pine, oak-hickory, and oak-gum cypress forest-type groups. On the Chattahoochee is the Walter F. George Reservoir. Just south of

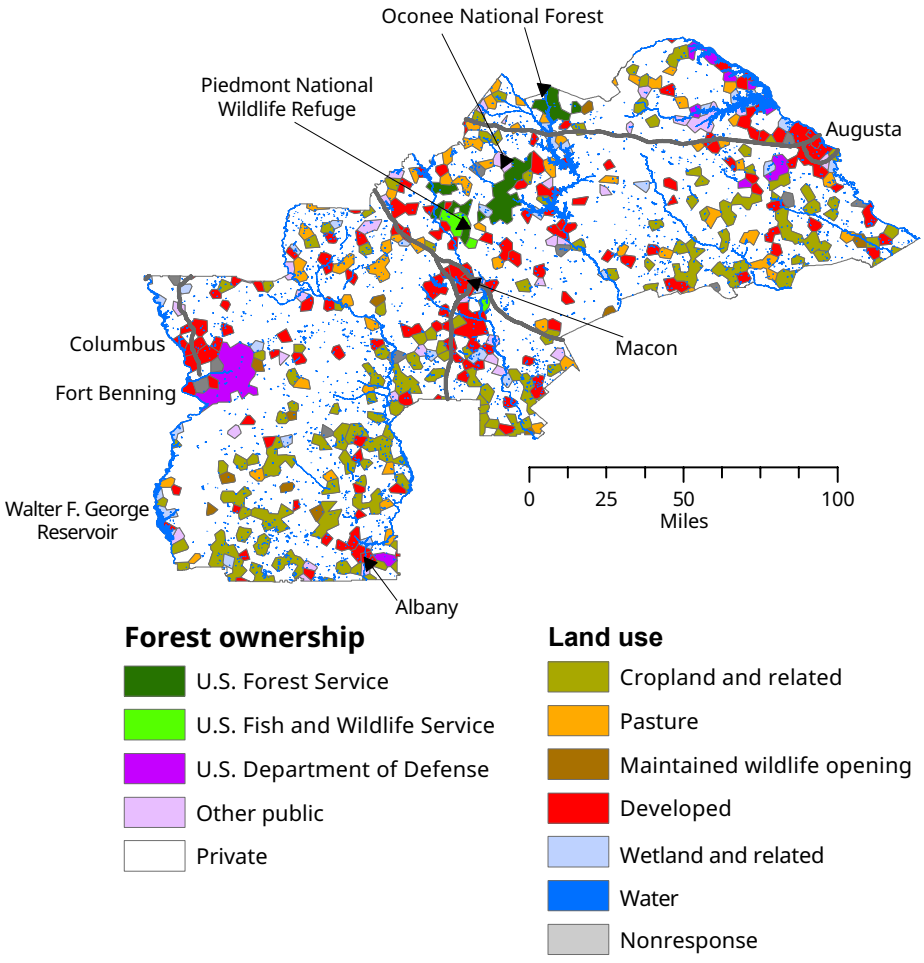

Figure 10—Forest ownership and land use, Central unit (Unit 3), 2019.

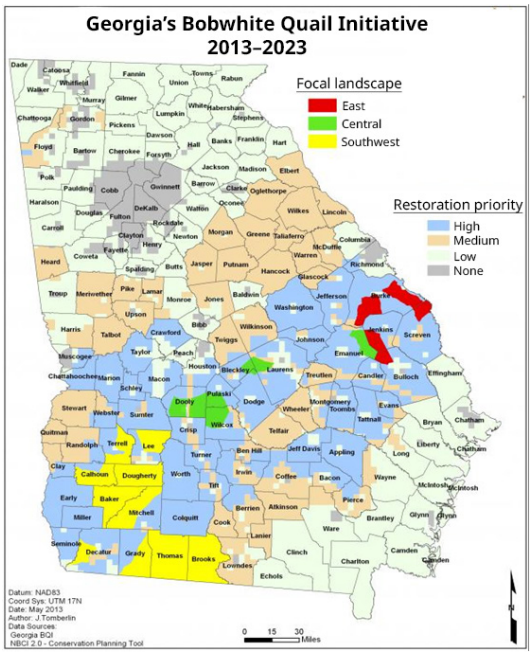

Figure 11—Restoration priority areas and focal landscapes for Georgia's bobwhite quail initiative 2013–2023.

Columbus (Unit 3's largest city) is Fort Benning. This unit, which also includes Albany, is highly involved in Georgia's Bobwhite Quail Initiative 2013–2023 and utilizes large wildlife habitats and pine plantations, which helps the quail population. This unit (including units 1–5) contains the highest levels of restoration priorities (fig. 11).

North of Columbus is Franklin Roosevelt State Park, the largest State park in Georgia (National Geographic Society 2018). This area is also home to Callaway Gardens and Warm Springs, which is a few miles to the northeast in Unit 3. Settlements arose on the rivers near the fall line: Columbus on the Chattahoochee, Macon on the Ocmulgee, Milledgeville on the Oconee, and Augusta on the Savannah.

There is a wall of forest across central Georgia, mostly the loblolly-shortleaf pine forest-type group, broken by development around Macon and Milledgeville. At Macon is the Ocmulgee Mounds National Historical Park. To the north is Piedmont National Wildlife Refuge. Farther east is the Oconee National Forest, and near Augusta is Fort Gordon.

North Central unit (Unit 4)

Per mile of highway, Georgia's busiest interstate is Interstate 285, Atlanta's Perimeter Parkway (Georgia Department of Transportation 2020), in Unit 4 (fig. 12). Next busiest is Interstate 85, which runs from Lake Hartwell to the Chattahoochee River, just south of West Point Lake. The first mile marker past Lake Hartwell is 179.

The eastern part of Unit 4 is the Poultry Belt. In the last 5 years, the Poultry Belt has shifted to the southeast, with Hall County slipping out of the top 10 of poultry-producing counties in the State and Wilkes County (in Unit 3) entering the top 12 (USDA NASS 2019).

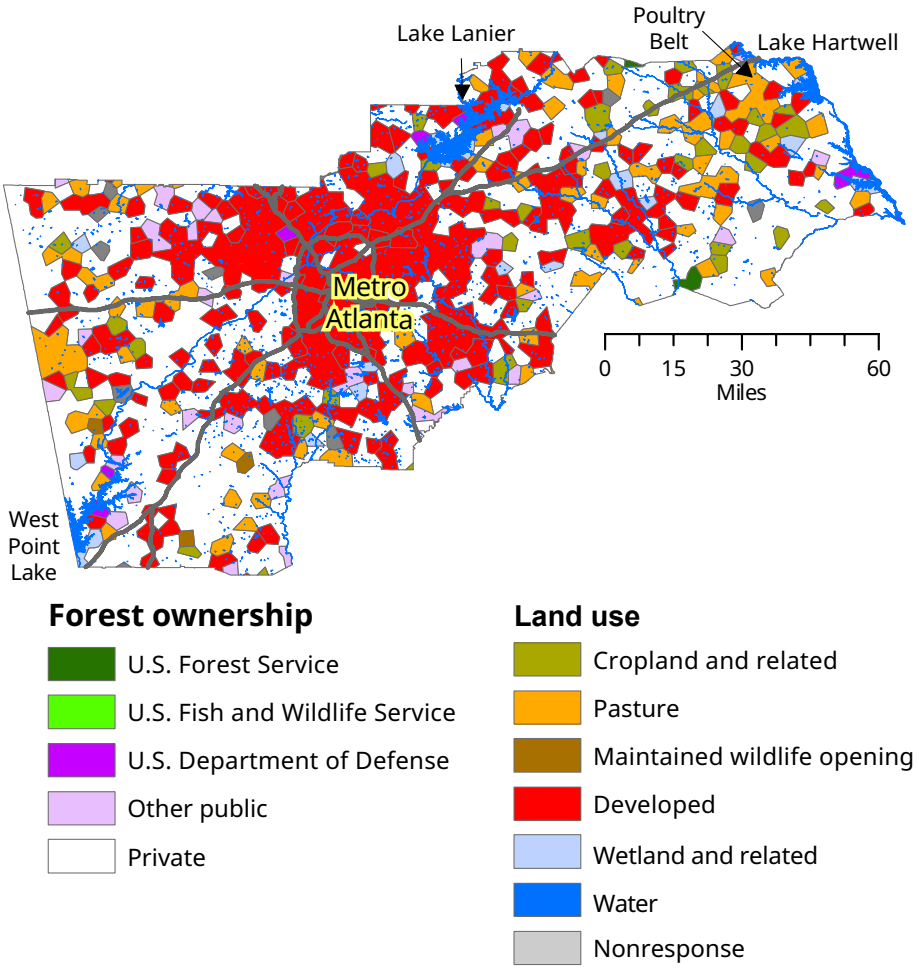

Figure 12—Forest ownership and land use, North Central unit (Unit 4), 2019.

The two busiest interstates cross northeast of Atlanta at the aptly named "Spaghetti Junction" (American Highway Users Alliance 2004) at exits 95A and 95B. Ten miles down the road, Interstates 75 and 85 merge. Atlanta's skyscrapers are in full view. The junction with Interstate 20 is near the Georgia State Capitol. Interstate 20 heads west through the middle of Unit 4. Across the Chattahoochee River is Cobb County, the least forested and most developed county in the State. Going west to the Alabama line, development thins, and the landscape becomes more forested in the oak-hickory forest-type group.

North unit (Unit 5)

North into Unit 5, the forest type transitions to the oak-hickory forest-type group. The largest city in the unit is Rome (fig. 13). North of the city is some of the Chattahoochee National Forest. From there, elevation increases to the northwest to Lookout Mountain, then dips slightly to the Tennessee-Alabama-Georgia tripoint, the westernmost point in Georgia. Nearby are several tracts of land managed by the U.S. Department of the Interior, National Park Service commemorating the Civil War battles.

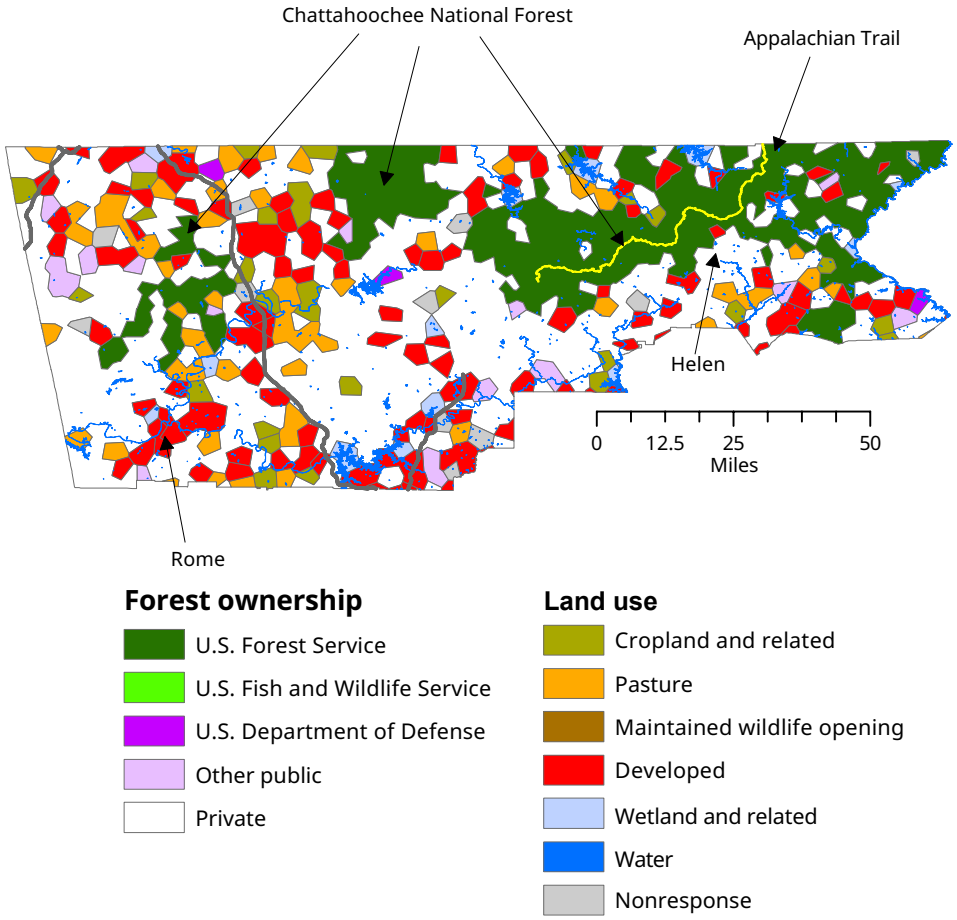

Figure 13—Forest ownership and land use, North unit (Unit 5), 2019.

To the east is a major part of the Chattahoochee National Forest. At the eastern end of that part of the national forest is Amicalola Falls State Park, home to the highest waterfall in Georgia. Officially, the Appalachian Trail begins at Springer Mountain (Towle 2021), although there are some feeder trails connecting to the main trail. For the most part, the trail follows the ridge of the mountains, but it misses Brasstown Bald (Georgia's highest point) (Cordell and others 1970) by several miles.

South of the trail is the city of Helen, located in White County, GA, along the Chattahoochee River. Helen is known for its German influence and gold, and just outside the town is the Sautee Nacoochee-Cherokee Indian Mound.

Like most of northern Georgia, Helen was home to the Cherokee Nation and other Native American tribes (pre-culture of the Cherokee) before the arrival of European settlers in the 1800s. The Chattahoochee National Forest is part of the Helen culture and encompasses the Blue Ridge, Chattooga River, and Conasauga Ranger Districts. The predominant vegetation is oak-pine and oak-hickory broadleaf forest.

The Chattahoochee River forms the southern half of the Alabama and Georgia border, as well as a portion of the Florida-Georgia border. It is a tributary of the Apalachicola River, a relatively short river formed by the confluence of the Chattahoochee and Flint rivers.

Points of interest along the Appalachian Trail are the headwaters of the Chattahoochee River as well as the Blood Mountain and Tray Mountain Wilderness Areas. The trail crosses into North Carolina in the Southern Nantahala Wilderness.

The northernmost point in Georgia is the tripoint of Georgia, North Carolina, and South Carolina, at the Chattooga River. The Chattooga flows into a chain of lakes—Tugaloo, Yonah, and Hartwell—before flowing into the Savannah River. Wide spots in the Savannah include Clark Hill Lake and Thurmond Lake. The Savannah bursts into several channels just northeast of the city of Savannah, each of which flow to estuaries on the Georgia coast.

Land-Use Change

Two land-use change trends stand out in Georgia from 2009 through 2019: the rate at which the State gained forest land acreage from converted agricultural land until 2012, which then decreased for the next 7 years, and the rate at which forest was lost to development, which has leveled out since 2016 (fig. 14). The latter trend may reflect the

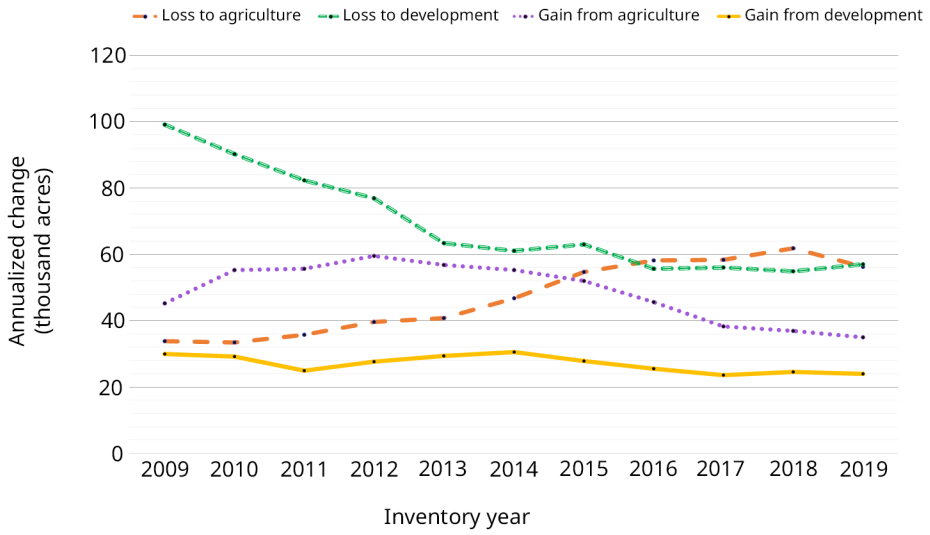

Figure 14—Annualized land-use change, Georgia, 2009–2019.

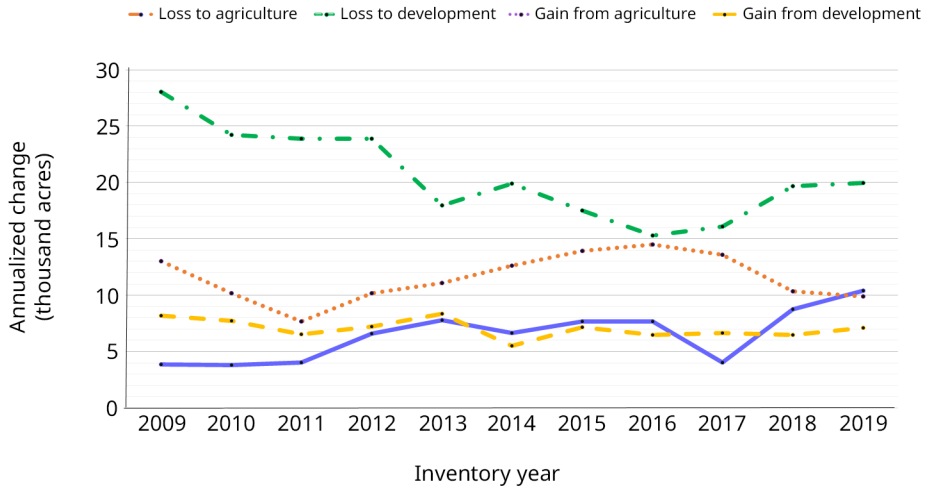

Figure 15—Annualized land-use change of planted loblolly-shortleaf pine forest land, Georgia, 2009–2019.

economic downturn experienced across the country beginning in 2008. Loss of forest land to development since 2009, however, represents change on plots that were forest 5 years previously in 2004 and were developed at some time in the intervening 5 years. Therefore, trends from 2009 onward reflect economic conditions but with some lag time and a degree of buffering, or muting, of the trends prior to the COVID-19 pandemic.

We can examine annualized land-use change focusing only on what was or became planted loblolly-shortleaf pine forest land (fig. 15). The decrease in the rate at which planted loblolly-shortleaf stands were established on former agricultural land from 2009 through 2019 is notable. The rate of decrease of planted pine establishment has slowed during the last 10 years through 2019. Gains in planted pine acres from development have remained at a stable, low rate. Losses to agriculture and development have remained relatively stable, with perhaps a slight indication of increased losses to agriculture in recent years.

Age Class Distribution

The rural landscape in the Southern United States has been dynamic, with forests and agricultural land expanding and contracting according to social and economic changes in the State, region, and country. The effects of this history on Georgia's forests can be seen when looking at forest stand ages. Figure 16 shows the distribution of stand age for all forest land in Georgia from 2009 through 2019. These data not only show what has gone on in the forest for the past 10 years, they also show the changes on the land for the past 100 years or more.

In a State with an active forest products sector and intensive pine plantation management, considerable forest acreage could be expected to be the age of the typical forest management rotation length or younger. This is seen more clearly by looking just at the stand age distribution for the State and by units of planted pine timberland acreage where two features are outstanding (fig. 17). First is the relatively abrupt drop for

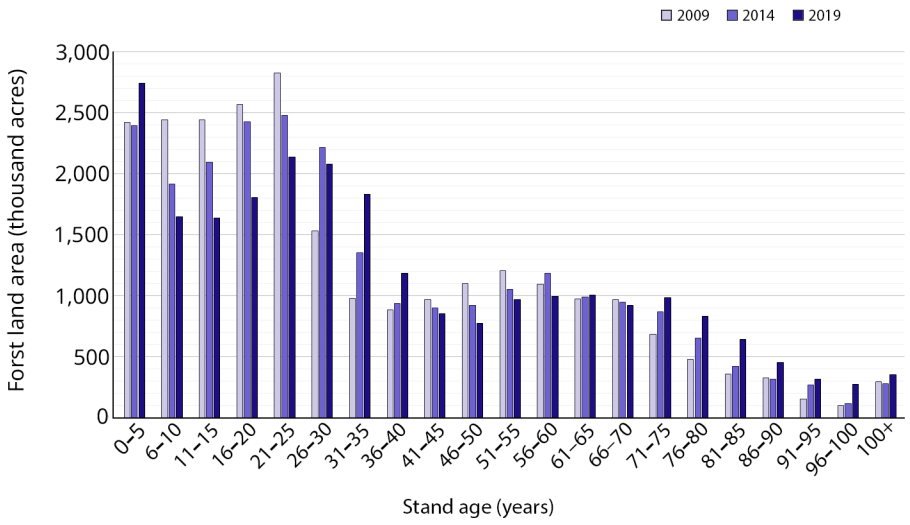

Figure 16—Distribution of forest land area by stand age, Georgia, 2009–2019.

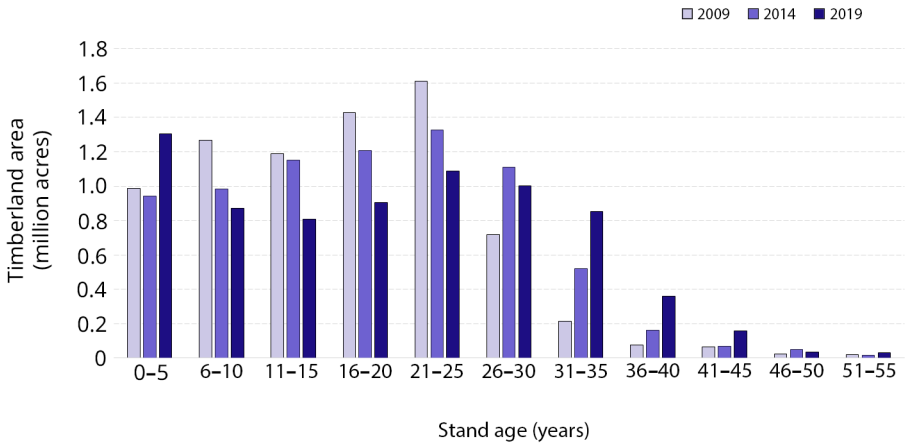

Figure 17—Distribution of planted pine timberland area by stand age, Georgia, 2009–2019.

all survey years in acreage >25 years old, which is the typical age at which plantations are harvested and replanted. Second, in more recent years, the number of acres >25 years old has been slightly increasing. Taking a more comprehensive look, the entire population of planted pine acres has been getting older, that is, the distribution curve has been shifting to the right over time such that the peak of the curve has moved from 21–25 years old in 2009 to 26–30 years in 2019. If the number of planted pine acres was stable for this time and all acres were harvested at the same age and then replanted, the distribution curve would have remained in place for all three time periods. Instead, the shift toward older stands almost certainly reflects two socioeconomic events from the past. First, one can speculate that the current plantation acreage largely originated in the late 1980s and early 1990s when natural pine stands were converted to managed, more highly productive plantations, often with the assistance of financial incentives from Conservation Reserve Programs as postulated by Harper and others (2009). Second, while total planted acreage has remained stable, acres that were clearcut and presumably replanted have decreased in recent years, possibly in response to changes in ownership and weakened markets prior to the COVID-19 pandemic. The evidence for a shift from final harvest to stand tending treatments can be seen in Harper (2012) and Brandeis and others (2016). Forest industry divestiture of their lands and their acquisition by TIMOs and REITs has been long documented (Brandeis and others 2016, Harper and others 2009). One could assume that TIMOs and REITs that do not own mills are not bound to harvest regularly by the needs to supply their wood-processing facilities as were the previous forest industry owners; therefore, they can refrain from harvesting their forests until timber products markets are their most favorable. The weakened markets experienced during the economic downturn of 2008 would not have been an economically favorable time for the landowners to harvest stands; therefore, many of Georgia's pine plantations continue to age and accumulate volume. Also, people's priorities have changed from timber income to wildlife and aesthetics, which has been shown in State stewardship plans where the landowner ranks five priorities to help SRS FIA write a stewardship that matches their desires for the land.

Looking back at the entire range of stand age distribution on forest land, there is an interesting peak in the 56–60-year-old category that precedes a steady decrease in forest that is >60 years old (fig. 16). There appears to be a cohort of forest acres that has been aging together, moving through time. This is probably not mostly planted pine because there are not many acres of planted pine timberland >40 years old shown in figure 17. These acres could be naturally regenerated forest or planted forest that has aged into a natural-appearing mix of conifers and hardwoods, established around 60 years ago in the mid-1950s. Larson and Spada's (1963) report on the 1961 timberland inventory of Georgia helps to explain this population peak. They reported a 21-percent gain in timberland since the preceding 25 years, an increase of 4.5 million acres, and that these new forests were established on cropland that had been idled or abandoned from the late 1930s to the early 1950s. After 1953, the rate of cropland abandonment dropped by 41 percent (Larson and Spada 1963). Therefore, this is another example of how the forests reflect the history of social and economic change in the State of Georgia.

NUMBER OF TREES, VOLUME, AND BIOMASS

Georgia's forest resources are considerable but slightly decreasing in the number of trees ≥1.0 inch diameter at breast height (d.b.h.). In 2019, there were 14.2 billion trees with d.b.h. ≥1.0 inch compared to 15.2 billion trees in 2014 (a decrease of 1.0 billion trees). The most numerous softwood species (d.b.h. ≥1.0 inch) were loblolly (*P. taeda*) and shortleaf (*P. echinata*) pines, while the most numerous hardwoods were sweetgum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), water oak (*Quercus nigra*), swamp tupelo (*Nyssa biflora*), and yellow-poplar (*Liriodendron tulipifera*). In trees with d.b.h. ≥5.0 inches, there were 24.1 billion cubic feet of wood volume in softwoods and 23.4 billion cubic feet in hardwoods, a total of 47.5 billion cubic feet, which is 3.8 billion more than the 43.7 billion cubic feet of volume in 2014. Total volume on timberland was 46.5 billion cubic feet—only slightly lower than that of forest land. As in other recent years, the loblolly and shortleaf pine species group (which consists primarily of loblolly pine in Georgia) had the greatest volume of any species group (table 3). The distribution of net volume on live trees by ownership class (fig. 18) reflects the distribution of forest acreage in figure 4.

While the numbers of most hardwood and softwood species are relatively stable or slightly up from the 2014 estimates in Brandeis and others (2016), net volume and forest biomass continues to increase (fig. 19). This can be attributed to the combination of steady or slightly increasing forest acreage and

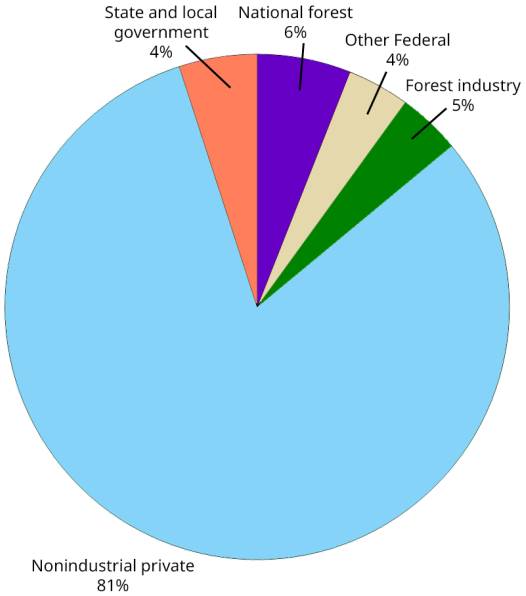

Figure 18—Percentage of net volume of live trees (≥5 inches d.b.h.) on forest land by ownership class, Georgia, 2019.

Table 3—Number of live trees,[a] net volume,[b] and aboveground green weight[a] on forest land by species group, Georgia, 2019

Species group		Number of live trees	Net volume	Aboveground green weight
		million trees	*million cubic feet*	*thousand tons*
Softwoods	Longleaf and slash pine	967.7	5,763.7	239,758.4
	Loblolly and shortleaf pine	2,451.9	15,901.1	602,659.7
	Other yellow pines	160.0	835.9	30,912.2
	Eastern white and red pine	59.2	517.6	13,876.7
	Eastern hemlock	10.3	57.1	2,183.3
	Cypress	215.0	945.3	39,521.3
	Other eastern softwoods	71.6	90.0	2,701.0
	Total softwoods	3,935.8	24,110.6	931,612.8
Hardwoods	Select white oaks	219.8	2,085.8	101,377.3
	Select red oaks	38.7	467.7	24,134.8
	Other white oaks	358.1	1,959.4	101,815.4
	Other red oaks	1,799.7	5,465.2	294,243.8
	Hickory	362.3	1,068.1	57,339.8
	Hard maple	69.3	44.0	2,591.3
	Soft maple	1,329.6	1,546.3	73,867.9
	Beech	48.5	109.4	4,722.3
	Sweetgum	2,116.6	2,998.9	136,092.2
	Tupelo and blackgum	991.0	2,155.8	105,905.4
	Ash	130.9	384.0	16,392.7
	Cottonwood and aspen	0.2	8.8	318.0
	Basswood	3.0	35.2	1,088.1
	Yellow-poplar	357.0	2,967.2	114,890.2
	Black walnut	5.9	31.3	1,335.4
	Other eastern soft hardwoods	989.4	1,130.1	55,103.2
	Other eastern hard hardwoods	490.8	171.2	13,046.2
	Eastern noncommercial hardwoods	969.4	815.7	44,852.0
	Total hardwoods	10,280.4	23,444.1	1,149,116.1
All species		14,216.2	47,554.7	2,080,728.9

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

[a] In trees with diameter at breast height (d.b.h.) ≥1 inch.

[b] In trees with d.b.h. ≥5 inches.

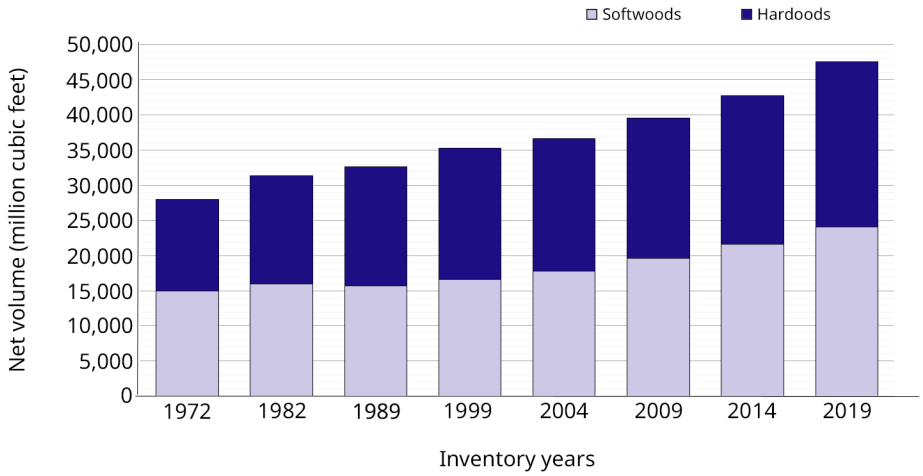

Figure 19—Net volume of live trees (≥5 inches d.b.h.) by major species group, Georgia, 1972–2019.

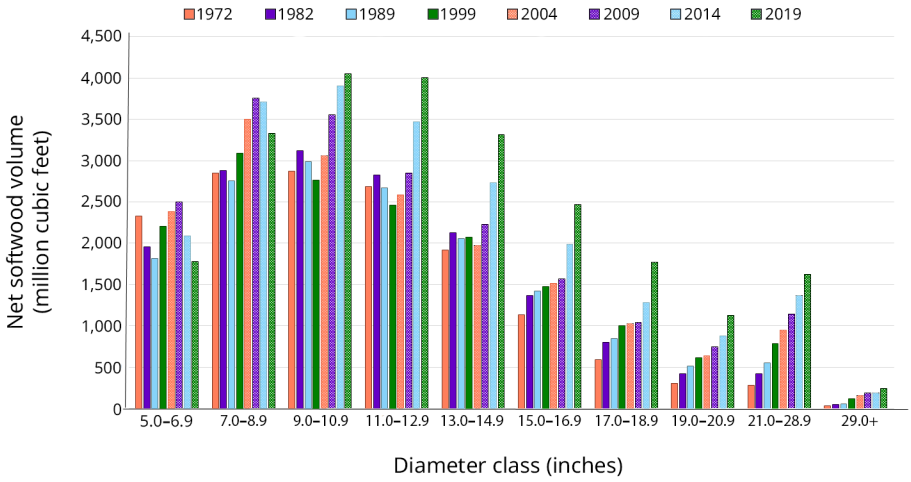

Figure 20—Net softwood volume of live trees (≥5 inches d.b.h.) by diameter class, Georgia, 1972–2019.

maturing stands. The evidence that older stands are becoming more prevalent seen previously in the example of stand age distribution of planted pine timberland is reinforced by the numbers of live trees, net volume, and biomass (table 3) and the gradual but steady increase in the proportion of volume in larger diameter stems in both softwoods (fig. 20) and hardwoods (fig. 21) from 1972 through 2019. The total numbers of live trees continue to decrease while net volume and biomass increase, indicating stands with fewer but larger trees. Evidence for this trend can also be seen in the increasing amounts of net volume found in the saw-log portions of both softwood and hardwood sawtimber trees (table 4) which has more than doubled (for both softwoods and hardwoods) since the 1970s.

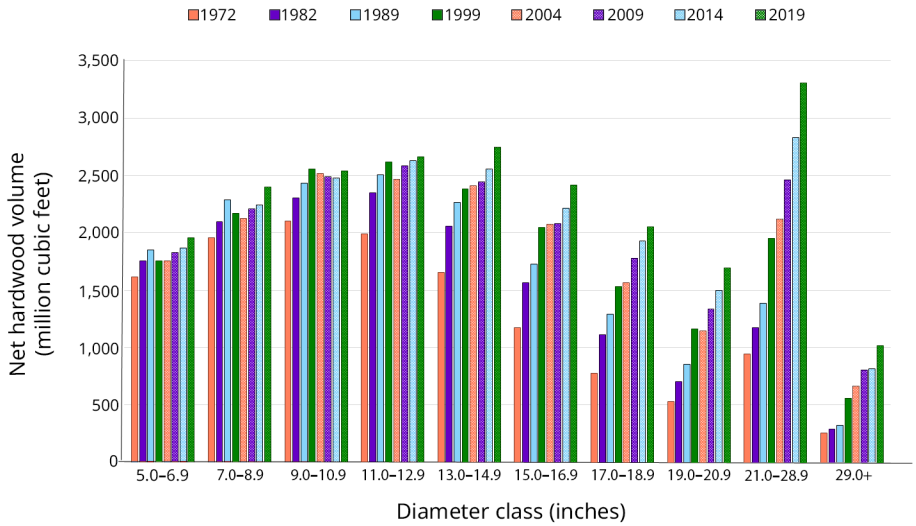

Figure 21—Net hardwood volume of live trees (≥5 inches d.b.h.) by diameter class, Georgia, 1972–2019.

Table 4—Net volume in the saw-log portion of sawtimber trees on timberland by inventory year and major species group, Georgia, 1972–2019

Year	Total	Species group	
		Softwoods	Hardwoods
	million cubic feet		
1972	13,806	8,710	5,095
1982	17,003	9,960	7,043
1989	17,948	9,978	7,970
1999	19,408	10,121	9,287
2004	19,583	10,541	9,042
2009	21,296	11,664	9,632
2014	23,318	13,666	9,651
2019	27,213	16,444	10,769

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

GROWTH, REMOVALS, AND MORTALITY

Forest land average annual net growth, removals, and mortality are calculated from plots measured during two consecutive inventories. For instance, estimates for the 2019 inventory are based on plots measured in the 2014 cycle that were remeasured during the 2019 cycle. Growth, removals, and mortality (GRM) estimates provide a measure of inventory change. As seen in figure 22, from 2009 through 2019, volumes of net GRM trended slightly upwards across the softwood resource, while hardwood species displayed increasing net growth with slight increase in removals and a slight increase in mortality.

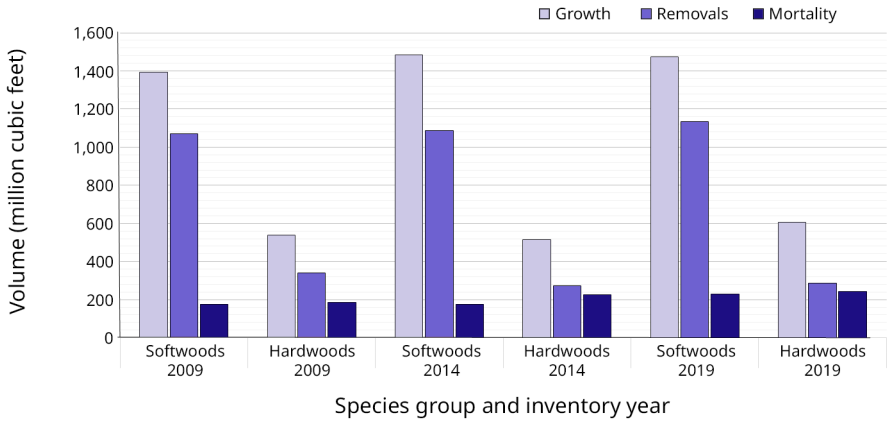

Figure 22—Average volume of net growth, removals, and mortality of live trees by major species group, Georgia, 2009–2019.

Examining GRM estimates by stand size and major species group, softwood net growth is increasing primarily within small- and large-diameter-size stands, with the 2019 net growth estimate for medium-diameter-size stands displaying a decrease compared to 2009 estimates (fig. 23). For hardwoods, the slight decrease in net growth observed between 2009 and 2014 changed to a slight increase from 2014 through 2019, with a slight change occurring within larger size hardwood stands. Looking at annual average removals by major species group and stand size across the 2009–2019 period (fig. 24), there is a slight increase in volume of softwood removals from small-diameter-size stands that is offset by a decrease in removals from medium- and large-diameter-size stands. The change in average annual hardwood removals resulted largely from declining removals from large-diameter stands as well, with small- and medium-diameter-size stands remaining stable throughout the 2009–2019 period. Figure 25 revealed an upward trend in mortality across both species groups with a larger share of mortality in hardwood forest lands. Increasing softwood mortality occurred mostly across large-diameter-size stands. Although mortality in small-diameter-size softwood stands

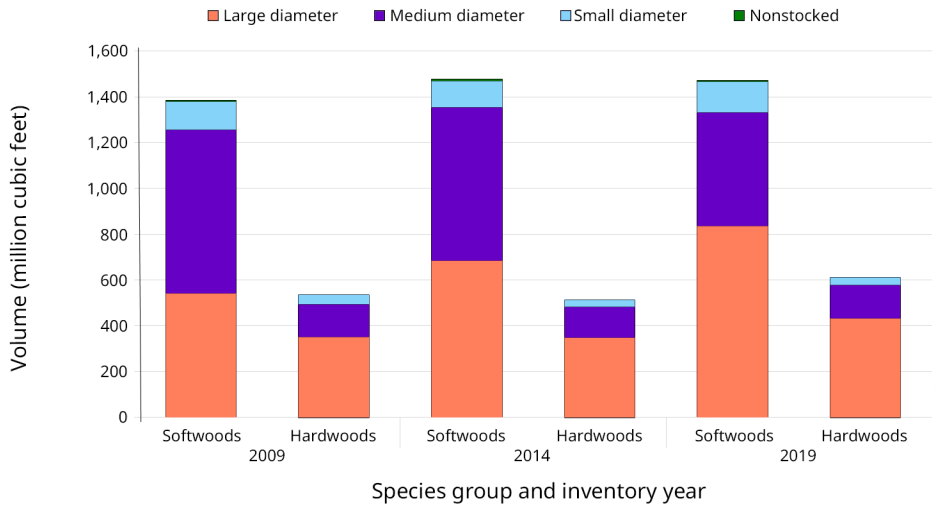

Figure 23—Average annual net growth of live trees by major species group and stand size, Georgia, 2009–2019.

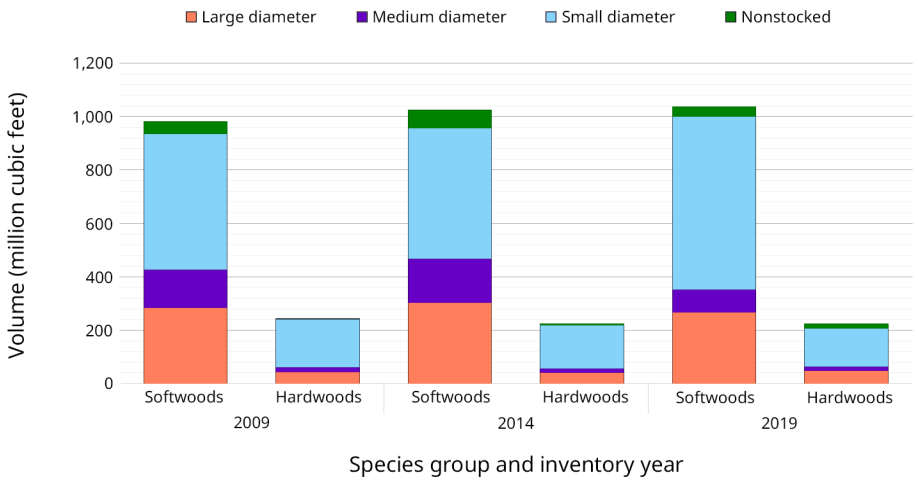

Figure 24—Average annual net removals of live trees by major species group and stand size, Georgia, 2009–2019.

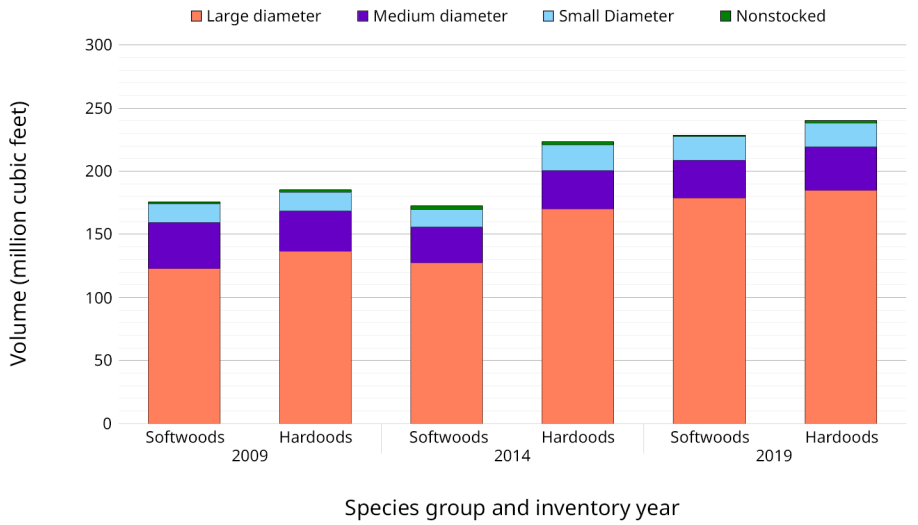

Figure 25—Average annual net mortality of live trees by major species group and stand size, Georgia, 2009–2019.

represents a minor portion of this species group's total mortality, 2019 data revealed an increase in mortality in this stand-size group compared to 2014 estimates. In hardwood stands, mortality increased across large- and medium-diameter-size stands, with small-diameter-size stands showing a slight increase in the volume lost to mortality between 2009 and 2019.

Treated Acres

A closer look at area of forest land undergoing a silvicultural treatment across the 2009–2019 period (fig. 26) revealed an increase in the area treated by a final harvest (clearcut), occurring mostly within the hardwood forest type. The acreage of forest land receiving partial harvests (partial, shelter, and salvage treatments) stayed relatively the same for softwoods and increased slightly for hardwoods since 2014. Acres of thinned forest land (including thinning and stand improvement treatments) stayed relatively unchanged for softwoods but increased substantially for hardwoods from 2014.

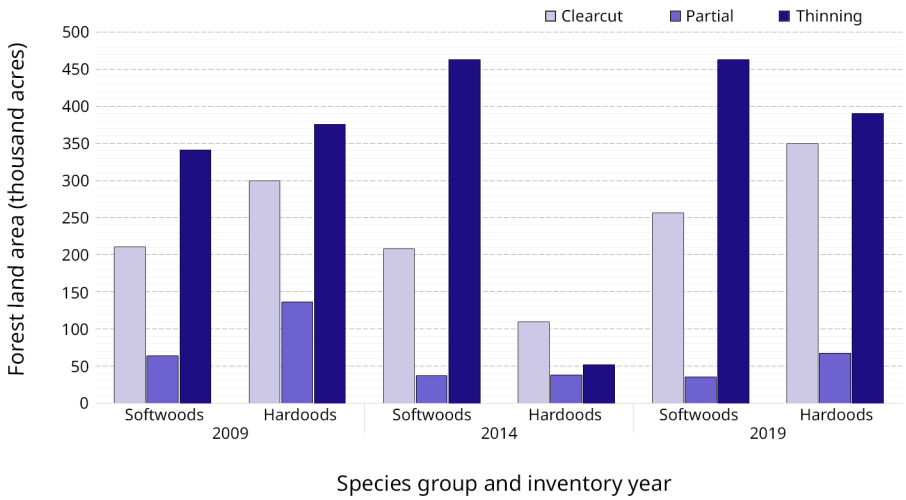

Figure 26—Average annual forest land acreage affected by cutting activity by major species group, Georgia, 2009–2019.

Alex Ray (formerly Georgia Forestry Commission, now North Carolina Forest Service) in a typical pine (*Pinus* spp.) plantation managed for bobwhite quail in northwestern Georgia. (Courtesy photo by Heather Gregg, Georgia Forestry Commission)

Volume, Growth, and Removals of the Planted Pine Resource

Net volume of all-live trees on forest land for 2019 was estimated at 47.6 billion cubic feet, spread relatively equally across softwood and hardwood species groups (table 5). Fifty-one percent of the net volume on softwood forest land originated from plantations, primarily of loblolly and shortleaf pine species. In contrast, plantation volume on hardwood forest lands accounted for about 1 percent of all hardwood volume. When looking at table 5, readers are reminded that FIA defines an area as planted or naturally regenerated, not whether the tree itself was planted. Consequently, volume in the hardwood species group could be classified as planted even if these hardwood trees naturally regenerated within pine plantations.

Examining the average annual volume of removals by species group and stand origin, softwoods represent close to 80 percent of all removals (table 6). Within softwoods, 56 percent of removals originated from planted forest land. Average annual growth follows a similar pattern with the majority of the average annual net volume of growth of pines found in plantation forests (table 7).

Table 5—Net volume of live trees on forest land by forest-type group and stand origin, Georgia, 2019

Forest-type group		Total	Stand origin	
			Natural	Planted
		million cubic feet		
Softwood types	White-red-jack pine	371.4	350.3	21.1
	Longleaf-slash pine	5,614.6	2,232.6	3,382
	Loblolly-shortleaf pine	15,572.7	8,076.3	7,496.4
	Other eastern softwoods	6.0	6.0	0.0
	Total softwoods	21,564.8	10,665.2	10,899.5
Hardwood types	Oak-pine	5,057.8	4,811.3	246.5
	Oak-hickory	12,731.8	12,646.5	85.3
	Oak-gum-cypress	7,401.5	7,400.5	1.0
	Elm-ash-cottonwood	686.8	651.5	35.2
	Other hardwoods	27.9	27.9	0.0
	Tropical hardwoods	16.6	16.6	0.0
	Exotic hardwoods	49.9	46.5	3.5
	Total hardwoods	25,972.4	25,600.8	371.5
Nonstocked		17.6	11.9	5.7
All groups		47,554.7	36,278	11,276.8

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

Table 6—Average annual removals of live trees on forest land by species group and stand origin, Georgia, 2014–2019

Species group		Total	Stand origin		
			Planted	Natural	Not available
		~~ *million cubic feet* ~~~~~~~~~~~~~~~			
Softwood	Longleaf and slash pine	332.0	197.5	100.0	34.5
	Loblolly and shortleaf pine	785.2	432.2	291.8	61.1
	Other yellow pines	10.7	1.6	8.4	0.7
	Eastern white and red pine	0.7	0.0	0.1	0.6
	Eastern hemlock	0.1	0.0	0.0	0.1
	Cypress	4.5	0.2	4.2	0.1
	Other eastern softwoods	1.2	0.7	0.2	0.3
	Total softwoods	1,134.4	632.2	404.8	97.3
Hardwood	Select white oaks	26.0	4.8	14.1	7.1
	Select red oaks	4.3	0.1	1.7	2.5
	Other white oaks	13.8	3.3	8.7	1.9
	Other red oaks	78.1	11.0	54.1	13.0
	Hickory	7.7	0.8	2.9	4.0
	Hard maple	0.5	0.0	0.2	0.3
	Soft maple	20.0	2.3	15.3	2.4
	Beech	0.4	0.0	0.4	0.0
	Sweetgum	48.6	7.3	30.8	10.5
	Tupelo and blackgum	29.4	1.0	26.3	2.1
	Ash	5.2	0.0	4.9	0.2
	Cottonwood and aspen	0.0	0.0	0.0	0.0
	Basswood	0.0	0.0	0.0	0.0
	Yellow-poplar	28.5	1.1	13.7	13.7
	Black walnut	0.2	0.0	0.1	0.2
	Other eastern soft hardwoods	13.9	3.0	8.1	2.9
	Other eastern hard hardwoods	1.6	0.2	0.7	0.7
	Eastern noncommercial hardwoods	9.0	0.7	6.1	2.1
	Total hardwoods	287.1	35.6	188.1	63.5
All species		1,421.5	667.8	592.9	160.8

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 7—Average annual net growth of live trees on forest land by species group and stand origin, Georgia, 2014–2019

Species group		Total	Stand origin		
			Planted	Natural	Not available
		~~ *million cubic feet* ~~~~~~~~~~~~~~			
Softwood	Longleaf and slash pine	388.9	291.8	92.5	4.6
	Loblolly and shortleaf pine	1,047.7	645.9	395.4	6.4
	Other yellow pines	13.6	2.3	11.3	0.0
	Eastern white and red pine	14.2	1.4	12.8	0.0
	Eastern hemlock	-0.9	0.0	-0.9	0.0
	Cypress	15.4	0.1	15.3	0.0
	Other eastern softwoods	3.6	0.4	3.2	0.0
	Total softwoods	1,482.5	941.8	529.6	11.0
Hardwood	Select white oaks	55.8	2.5	53.0	0.3
	Select red oaks	12.1	-0.1	12.1	0.2
	Other white oaks	43.9	1.8	42.0	0.1
	Other red oaks	156.0	14.1	141.4	0.5
	Hickory	17.4	0.7	17.1	-0.4
	Hard maple	1.4	0.1	1.1	0.2
	Soft maple	38.2	2.0	35.9	0.4
	Beech	3.2	0.1	3.2	0.0
	Sweetgum	96.9	9.0	87.2	0.6
	Tupelo and blackgum	38.8	0.8	38.0	0.1
	Ash	5.8	0.5	5.3	0.0
	Cottonwood and aspen	0.2	0.0	0.2	0.0
	Basswood	0.8	0.1	0.7	0.0
	Yellow-poplar	86.6	2.6	84.1	-0.1
	Black walnut	0.8	0.1	0.8	0.0
	Other eastern soft hardwoods	29.9	3.6	26.3	0.0
	Other eastern hard hardwoods	3.2	0.1	3.0	0.0
	Eastern noncommercial hardwoods	21.2	1.0	20.2	0.1
	Total hardwoods	612.4	39.0	571.5	1.8
All species		2,094.9	980.8	1,101.2	12.9

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.

DISTURBANCE AND FOREST HEALTH INDICATORS

Disturbance

Many forest disturbances are naturally occurring and affect small areas of forest land. Disturbance may or may not be detrimental to forest land and in some cases can result in a more resilient ecosystem or increased species richness. Fire is a disturbance that benefits forest ecosystems by burning residual fuel and spurring new growth from different species of plant life, including trees. Fire (from all causes including weather, prescribed burn, arson, etc.) was the most frequently recorded disturbance on forest land in Georgia during the 2019 survey. It affected an estimated 509,800 acres of forest land (table 8). This was a decrease over the previous survey when fire affected an estimated 572,600 acres of forest land per year. The next most frequently recorded disturbance was disease, affecting an estimated 135,100 acres of forest land per year, the majority of which was recorded in softwood forest-type groups.

Table 8—Area of forest land disturbed annually by forest-type group and disturbance class, Georgia, 2019

Forest-type group[b]		Disturbance class[a]							
		Insects	Disease	Weather	Fire	Domestic animals	Wild animals	Human	Other natural
		~~ *thousand acres* ~~~~~~~~~~~~~~~~~~~~~~~~							
Softwood types	White-red-jack pine	5.6	0.7	0.0	1.8	0.0	0.0	0.0	0.0
	Longleaf-slash pine	5.9	44.7	22.0	138.6	3.5	0.0	23.4	0.0
	Loblolly-shortleaf pine	39.2	45.7	13.7	204.2	7.5	0.3	11.3	5.9
	Other eastern softwoods	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
	Total softwoods	50.6	91.2	35.8	345.7	10.9	0.3	34.6	5.9
Hardwood types	Oak-pine	17.6	9.0	10.0	55.1	3.9	3.2	11.9	1.0
	Oak-hickory	38.9	26.1	19.8	74.1	17.3	4.5	12.2	1.4
	Oak-gum-cypress	3.2	7.3	26.3	31.2	7.9	15.9	1.2	1.1
	Elm-ash-cottonwood	0.0	0.0	1.7	0.9	0.0	4.3	0.4	0.0
	Other hardwoods	0.4	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	0.9
	Exotic hardwoods	0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0
	Total hardwoods	60.1	42.5	57.7	161.4	29.2	27.9	26.4	4.3
Nonstocked		0.0	1.4	0.8	2.7	0.4	1.0	0.0	0.2
All groups		110.7	135.1	94.3	509.8	40.5	29.2	61.0	10.5

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.
[a] Based on current conditions.
[b] Based on past conditions.

Carbon

The forests of Georgia sequester approximately 1.7 billion short tons of carbon (table 9). Over 48 percent of this was in forest soil (fig. 27). These forest carbon estimates were derived using the component ratio method described in Woodall and others (2011). Standing dead trees are an important part of the forest, both for carbon and for wildlife. Many wildlife species rely on standing dead trees during some or all their life cycle. The number of standing dead trees ≥5.0 inches d.b.h. in forests of Georgia increased from 162.9 million in the 2014 survey to 179 million in the 2019 survey, a slight percent increase (table 10).

Table 9—Carbon pool on forest land by forest-type group and carbon pool groups, Georgia, 2019

Forest-type group		Carbon pool								
		Aboveground trees	Belowground trees	Standing dead trees	Aboveground understory	Belowground understory	Down dead material	Forest floor litter	Soil organic matter	Total
		thousand short tons								
Softwood	White-red-jack pine	3,232.2	689.8	256.6	89.3	9.9	395.2	475.8	1,726.3	6,875.0
	Longleaf-slash pine	67,843.0	14,871.6	2,203.3	5,171.6	574.6	9,240.1	15,440.4	156,589.6	271,934.2
	Loblolly-shortleaf pine	167,343.4	36,515.9	6,529.8	10,471.7	1,163.5	22,600.0	33,374.7	219,466.9	497,465.8
	Other eastern softwoods	90.1	18.8	1.9	12.2	1.4	14.3	56.4	125.7	320.8
	Total softwoods	238,508.7	52,096.1	8,991.5	15,744.8	1,749.4	32,249.5	49,347.3	377,908.4	776,595.8
Hardwood	Oak-pine	60,590.3	12,333.6	3,257.4	3,713.6	412.6	6,142.0	11,925.1	68,877.9	167,252.4
	Oak-hickory	160,861.8	30,972.1	7,788.7	8,190.8	910.1	15,805.5	18,398.9	118,168.8	361,096.8
	Oak-gum-cypress	85,620.8	16,930.7	2,943.9	2,085.5	231.7	8,866.9	9,085.7	207,492.1	333,257.3
	Elm-ash-cottonwood	8,022.3	1,551.1	506.4	323.7	36.0	1,014.5	1,173.5	18,859.9	31,487.3
	Other hardwoods	386.7	74.4	64.0	40.4	4.5	40.0	71.1	1,942.8	2,623.9
	Tropical hardwoods	211.5	40.8	11.6	2.7	0.3	34.9	14.7	335.9	652.2
	Exotic hardwoods	745.6	146.4	37.0	52.9	5.9	121.8	147.7	5,374.0	6,631.3
	Total hardwoods	316,439.2	62,049.2	14,608.9	14,409.7	1,601.1	32,025.6	40,816.6	421,051.2	903,001.3
Nonstocked		656.1	92.8	90.6	501.5	55.7	47.8	373.0	11,921.4	13,738.9
All groups		555,604.0	114,238.0	23,691.1	30,655.9	3,406.2	64,322.8	90,537.0	810,881.0	1,693,336.0

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

Table 10—Number of standing dead trees on forest land by forest-type group and diameter class, Georgia, 2019

Forest-type group		Diameter class										
		Total	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+
		number of trees										
Softwood	White-red-jack pine	1,952,715	937,642	411,213	295,925	108,937	102,587	12,423	46,618	24,845	12,526	0
	Longleaf-slash pine	18,980,307	8,096,852	4,814,944	3,013,972	1,909,287	501,461	288,885	139,960	110,835	104,109	0
	Loblolly-shortleaf pine	52,195,120	23,924,654	12,888,421	7,369,070	4,021,698	2,137,793	796,533	533,365	227,149	153,749	142,687
	Other eastern softwoods	39,262	39,262	0	0	0	0	0	0	0	0	0
	Total softwoods	73,167,404	32,998,410	18,114,578	10,678,967	6,039,922	2,741,841	1,097,841	719,943	362,829	270,384	142,687
Hardwood	Oak-pine	22,582,765	8,350,870	4,837,670	3,850,529	2,259,548	1,095,235	1,127,878	452,872	242,733	330,727	34,703
	Oak-hickory	50,590,109	20,271,529	11,168,898	6,429,727	4,501,106	3,229,553	1,902,032	1,009,090	589,705	1,369,311	119,158
	Oak-gum-cypress	27,617,994	10,327,295	5,804,802	4,927,819	2,855,228	1,490,871	921,433	425,681	252,124	354,396	258,345
	Elm-ash-cottonwood	3,330,830	1,658,933	854,895	242,009	173,755	35,121	105,400	0	82,247	143,313	35,157
	Other hardwoods	235,166	147,486	12,526	25,051	0	0	0	12,526	12,526	25,051	0
	Tropical hardwoods	231,209	38,535	38,535	0	115,605	38,535	0	0	0	0	0
	Exotic hardwoods	615,104	436,113	109,585	34,703	34,703	0	0	0	0	0	0
	Total hardwoods	105,203,177	41,230,761	22,826,911	15,509,838	9,939,945	5,889,315	4,056,743	1,900,169	1,179,335	2,222,798	447,363
Nonstocked		622,118	329,280	73,736	37,179	71,672	0	0	0	73,696	0	36,556
All groups		178,992,699	74,558,451	41,015,225	26,225,984	16,051,539	8,631,156	5,154,584	2,620,112	1,615,860	2,493,182	626,606

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

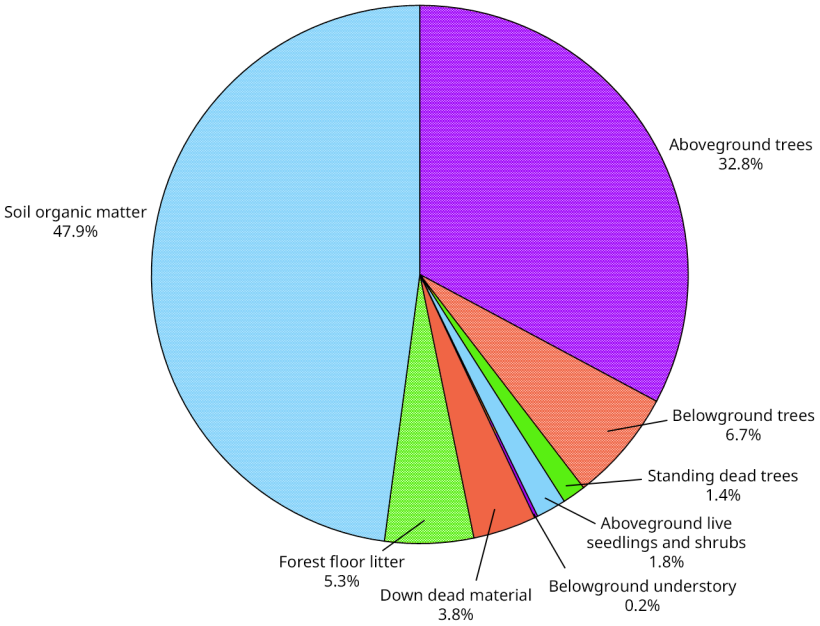

Figure 27—Percentage of forest carbon in the aboveground and belowground portions of live and dead trees (d.b.h. ≥1.0 inch), seedlings and shrubs (d.b.h. <1.0 inch), coarse woody debris, forest floor litter, and soil organic matter, Georgia, 2019.

Species of Concern

The top ten tree diseases in Georgia and their associated fungal pathogens (based on frequency) are thousand cankers disease (*Geosmithia morbida*), dogwood anthracnose (*Discula destructiva*), laurel wilt disease (*Raffaelea lauricola*), apple scab (*Venturia inaequalis*), cedar-apple rusts (*Gymnosporangium juniperi-virginianae*), Diplodia tip blight (*Sphaeropsis sapinea*), Dothistroma needle blight of pines (*Dothistroma septosporum*), oak wilt (*Ceratocystis fagacearum*), powdery mildew (*Golovinomyces orontii*), and Photinia leaf spot (*Entomosporium* spp.). Some of the damaging tree insects in Georgia are redbay ambrosia beetle (*Xyleborus glabratus*), Asian longhorned beetle (*Anoplophora glabripennis*), emerald ash borer (*Agrilus planipennis*), hemlock wooly adelgid (*Adelges tsugae*), Mediterranean pine engraver (*Orthotomicus erosus*), pine shoot beetle (*Tomicus* spp.), and walnut twig beetle (*Pityophthorus juglandis*), to name a few.

Various tree species in Georgia have serious health issues. These include, but are not limited to, redbay (*Persea borbonia*); sassafras (*Sassafras albidum*); flowering dogwood (*Cornus florida*); various species of ash (*Fraxinus* spp.) including green ash (*F. pennsylvanica*), white ash (*F. americana*), and black ash (*F. nigra*); and Carolina hemlock (*Tsuga caroliniana*) and eastern hemlock (*T. canadensis*). All of these are under threat from either a disease or an insect or both.

Redbay, a small tree native to the Southeastern United States is affected by laurel wilt disease. This disease is caused by a fungus (*Raffaelea lauricola*) that is spread by the redbay ambrosia beetle (*Xyleborus glabratus*). Both this disease and its vector were introduced from Asia. In 2004, there were an estimated 248.5 million live redbay trees ≥1.0 inch d.b.h. As of the 2019 survey, that number dropped to 109.0 million, a 56.1-percent decrease in 15 years.

Flowering dogwood is another species with a rather high rate of mortality. This is most likely due to a number of factors, including drought stress, dogwood anthracnose (Discula destructiva), and powdery mildew (Erysiphe pulchra and possibly other species). Between 2004 and 2019, the number of live dogwood trees ≥1.0 inch d.b.h. declined from 526.3 million to 189.2 million, a 64-percent decrease. And between 2014 and 2019, the number of live dogwood trees ≥1.0 inch d.b.h. declined from 307.4 million to 189.2 million, a 38-percent decrease. Declines in dogwood have been noted in other States, particularly Virginia (Rose 2013).

The emerald ash borer (fig. 28) is an exotic pest insect in the family Buprestidae (metallic wood boring beetles). First found in the Eastern United States near Detroit, MI, in 2002, the beetle has rapidly spread to infest native ash trees in 26 States by 2019. The insect's larval stage feeds within the phloem, rapidly girdling even healthy trees and killing them in as little as 3 years (fig. 29).

Figure 28— Emerald ash borer (*Agrilus planipennis*) adult. (Courtesy photo by moneycue_canada, Adobe Stock)

Figure 29—Typical serpentine larval galleries of the emerald ash borer (*Agrilus planipennis*). (Courtesy photo by Elena Berd, Adobe Stock)

While the overall economic importance of ash is greater in other parts of the United States, primarily in the Midwestern and Northern States, ash is still a valuable resource in Georgia. As of 2019, Georgia's forests contained nearly 16.9 million ash trees ≥5 inches d.b.h. Green ash is often a major component of forests in low-lying areas. Ash wood is relatively strong and resistant to shock, and is used for manufacturing handles, oars, baseball bats, and furniture. Seeds provide mast for wildlife, and trees provide harborage and nesting sites for a variety of birds. More than 40 arthropod species in North America feed exclusively on ash. Green ash is also widely used as a landscape tree. The Georgia Forestry Commission estimates that Georgia's urban and community forests contain nearly 3 million ash trees with a value >$700 million.

As of October 2019, 26 Georgia counties were under Federal quarantine for emerald ash borer. It was first detected in DeKalb and Fulton Counties in July of 2013. One notable tree threatened by the borer is the "Battle of Decatur" white ash on the campus of Agnes Scott College, a tree that survived that battle

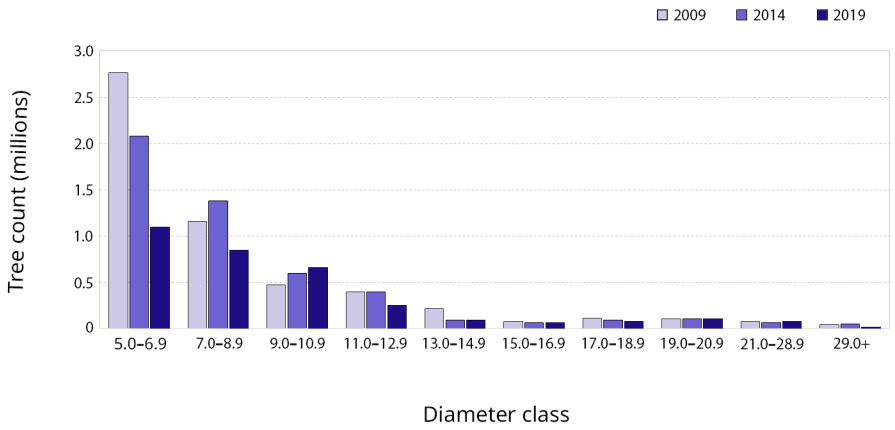

Figure 30—Number of hemlock (*Tsuga* spp.) trees (≥5 inches d.b.h.) and diameter class, Georgia, 2009–2019.

in 1864 but will likely not survive the onslaught of this pest without chemical treatment (Brandeis and others 2015). There are four Champion Trees in the genus Fraxinus in Georgia, representing green ash, white ash, and Carolina ash (F. caroliniana). One Champion Tree is in the 2019 quarantine area (Fulton County), and all are susceptible to the emerald ash borer. The future of Georgia's ash resource is uncertain; in areas where the emerald ash borer has been present for several years, mortality can exceed 99 percent. A study demonstrated that regeneration essentially ceases as ash mortality approaches 100 percent, suggesting that viable seeds do not remain in the soil for an extended period of time (Klooster and others 2014). Current management efforts include slowing the spread of the borer, biological control, and prophylactic insecticidal treatment for high-value trees, as well as investigations into mechanisms of resistance. The speed with which emerald ash borer kills healthy trees suggests that even with a successful combination of control and restoration efforts, its effects will be significant and widespread.

Hemlocks have been a major component in Southern Appalachian forests and play a keystone role in forest ecosystems of northern Georgia (Unit 5), where they are some of the largest and most common trees. They cool mountain streams and provide habitat for many other species, including shaded habitat that is favorable to many native amphibians, fish, and invertebrates, as well as critical nesting sites for many bird species. They are shade tolerant, common in cool coves as well as north-facing slopes and rock outcrops and streams. Their aesthetic value is significant, yet impossible to quantify. Different factors impact the health of hemlocks in the South; they are declining rapidly, and Georgia is no exception (fig. 30). The hemlock woolly adelgid, an invasive insect pest, has been a threat to Carolina hemlock and eastern hemlock in Georgia and throughout their range in the United States. The pest gets its name from the white woolly coating that surrounds and protects the nymphs while they feast on hemlock trees in the winter (fig. 31). The pest as a concern was previously reported in *Forests of North Carolina, 2012* (Brown and others 2014). The potential loss of hemlocks throughout

Figure 31—Hemlock woolly adelgid (*Adelges tsugae*). (Courtesy photo by ondreicka, Adobe Stock)

their range has been likened to the loss of the American chestnut (*Castanea dentata*) in the last century. Unfortunately, there is no other tree species that can adequately fill the functional niche of hemlocks.

Nonnative Invasive Plants

Many nonnative invasive plants have been recognized as problematic because they may compete with or even displace native species, in addition to changing the characteristics of forest soils and potentially altering a site's biodiversity. It is important, therefore, to continually monitor and track their occurrence and spread to gauge their potential impact on forest resources. Table 11 lists by frequency those invasive species of trees, shrubs, vines, grasses, and herbs encountered on FIA survey plots in Georgia during the 2019 survey period.

The most frequently encountered invasive tree was chinaberry tree, which was encountered on 288 plots (4 percent of all forested plots sampled). An import from Asia, chinaberry tree is an escaped ornamental with brightly colored fall foliage and berries that are poisonous to both humans and livestock. The second most recorded tree was silk tree or mimosa (*Albizia julibrissin*), encountered on 154 plots. Silk tree, like chinaberry tree, was also imported for ornamental use from Asia, but the tree's ability to form dense colonies from root sprouts harms wildlife that are dependent on native vegetation (Miller and others 2010). Chinese tallowtree was the third most encountered invasive tree, recorded on 132 plots. Chinese tallowtree has earned a reputation as a rapidly spreading invader along the Southern U.S. coast and has been the focus of recent research. The tree can displace native species, change soil chemistry, and transform community structure (Battaglia and others 2009). Fan (2015) estimates that >1.5 million ha of U.S. forest land could be infested by Chinese tallowtree by 2023 and identified the oak-gum-cypress forest type as one susceptible ecological community.

Table 11—Regionally recognized nonnative invasive plants identified on forest survey plots by common name, scientific name, and number and percentage of plots, Georgia, 2019

	Common name	Scientific name	Count	Percent
Trees	Chinaberry tree	*Melia azedarach*	288	4.36
	Silk tree, mimosa	*Albizia julibrissin*	154	2.33
	Chinese tallowtree	*Triadica sebifera*	132	2.00
	Callery pear	*Pyrus calleryana*	120	1.82
	Hardy orange	*Poncirus trifoliata*	32	0.48
	Princess tree	*Paulownia tomentosa*	25	0.38
	Tree of heaven	*Ailanthus altissima*	15	0.23
	Camphor tree	*Cinnamomum camphora*	13	0.20
	Chinese parasol tree	*Firmiana simplex*	3	0.05
	Tungoil tree	*Vernicia fordii*	3	0.05
Shrubs	Chinese/European privet	*Ligustrum* spp.	1,875	28.42
	Nonnative rose	*Rosa* spp.	124	1.88
	Sacred bamboo	*Nandina domestica*	124	1.88
	Autumn olive, oleaster	*Elaeagnus* spp.	122	1.85
	Thorny olive	*Elaeagnus pungens*	81	1.23
	Japanese privet	*Ligustrum japonicum*	45	0.68
	Beale's barberry	*Mahonia bealei*	36	0.55
	Burning bush	*Euonymus alatus*	1	0.02
Vines	Japanese honeysuckle	*Lonicera japonica*	2,207	33.45
	Japanese climbing fern	*Lygodium japonicum*	339	5.14
	Kudzu	*Pueraria montana* var. *lobata*	60	0.91
	Ivy	*Hedera* spp.	43	0.65
	Wisteria	*Wisteria* spp.	41	0.62
	Periwinkle	*Vinca* spp.	10	0.15
	Honeysuckle	*Lonicera* spp.	10	0.15
	Winter creeper	*Euonymus fortunei*	2	0.03
	Hen's eyes	*Ardisia crenata*	1	0.02
	Amur peppervine	*Ampelopsis brevipedunculata*	1	0.02
Grasses	Nepalese browntop	*Microstegium vimineum*	267	4.05
	Bamboo	*Bambusa* spp.	7	0.11
	Tall fescue	*Schedonorus arundinaceus*	5	0.08
	Lilyturf	*Liriope* spp.	3	0.05
	Cogongrass	*Imperata cylindrica*	1	0.02
Herbs	Sericea lespedeza	*Lespedeza cuneata*	537	8.14
	Lespedeza	*Lespedeza* spp.	57	0.86

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

The most frequently encountered invasive shrubs were Chinese/European privets (*Ligustrum* spp.), which were encountered on 1,875 plots, a full 28 percent of all forested plots sampled, and the second most invasive plant collected by FIA on forests in Georgia. These aggressively spreading shrubs, introduced for use as hedgerows, are ubiquitous in the forests of the Southeastern United States. Although deer browse the shrubs, the plants form dense thickets along the forest edge and in the understory of forests, displacing native vegetation important to other wildlife. The second most recorded shrubs were nonnative roses (*Rosa* spp.), on 124 plots.

The most frequently encountered invasive vine, and the overall most frequently recorded invasive plant across all monitored species in Georgia, was Japanese honeysuckle (*Lonicera japonica*). This aggressive invader was detected on 2,207 forested plots in Georgia—33 percent of all forested plots sampled in the State. Japanese honeysuckle is widely recognized for its fragrant flowers in the summer and has been intentionally planted in many areas for deer browse and ornamental use. However, the plant is extremely persistent and difficult to eradicate once established, and it grows rapidly in response to disturbance in the forest canopy. The rapid growth response can result in the shading of developing seedlings and small saplings in the understory, hampering successful regeneration of tree species, and even preventing afforestation of new sites (Nickelson and others 2015). The next most common vine detected on Georgia forests was Japanese climbing fern (*Lygodium japonicum*) on 339, or 5 percent, of plots sampled. This increasingly problematic vine, if left unchecked, can shade out entire trees and produce a thick groundcover that prevents native plants from germinating.

The most frequently detected invasive grass was Nepalese browntop (*Microstegium vimineum*), with occurrences on 267 or 4 percent of forested plots. While this grass is fairly small and unnoticeable in a shady understory, it rapidly expands with exposure to sunlight and has the ability to grow over and hamper tree regeneration in the understory (Oswalt and others 2007). Bamboo (*Bambusa* spp.) was the second most recorded grass but was only encountered on seven forested plots in Georgia.

Sericea lespedeza (*Lespedeza cuneata*) was the most encountered invasive herb on forested plots, with detections on 537 plots (8 percent). Other lespedezas made up the remainder of invasive herb observations (57) on forested plots.

TIMBER PRODUCT OUTPUT AND UTILIZATION

Timber Products

A diverse forest products industry in Georgia is made up of a variety of mills, ranging from small-to large-sized softwood and hardwood sawmills (including post/pole/piling, veneer, composite, bioenergy, and other miscellaneous mills) to very large pulp mills (fig. 32). In 2013, there were 164 primary wood-using mills, 185 in 2015–2017, 190 in 2018, and 189 in 2019. Since 2013, the total number of sawmills, pulpwood mills, and other primary wood-processing plants distributed across the State has moderately increased.

This section presents estimates from industry surveys conducted in 2013, 2015, 2017, 2018, and 2019 used to determine the output for timber

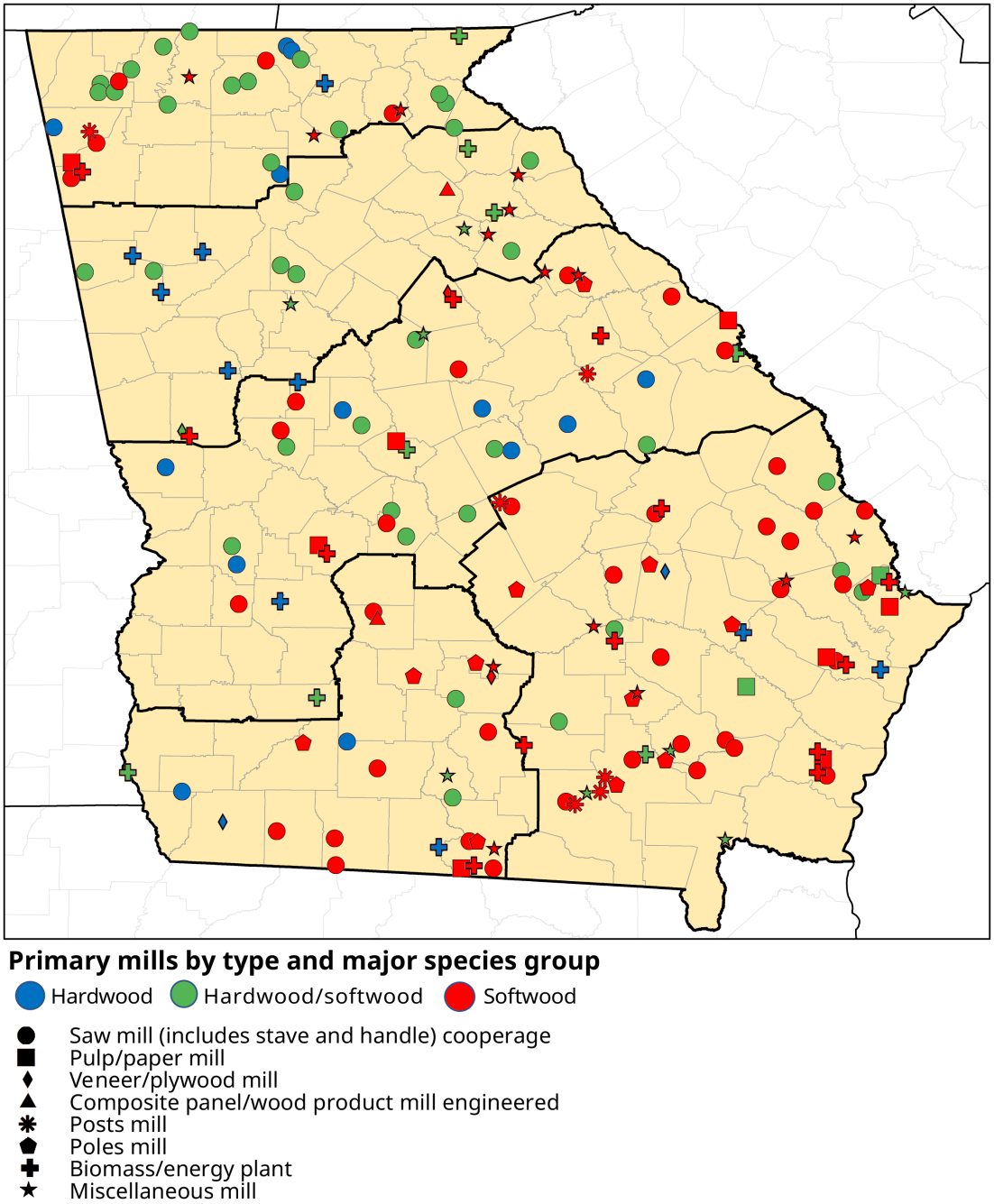

Figure 32—Primary mills by type and major species group and forest survey unit, Georgia, 2019.

products and plant byproducts. Data used for this section were compiled from the Timber Product Output (TPO) Toolkit-TPO Interactive Reporting Tool. TPO Data Download can be found at https://www.fia.fs.usda.gov/program-features/tpo/ (USDA Forest Service 2021).

Estimates of TPO and plant residues were obtained from canvass surveys (questionnaires) in 2013, 2015, and 2017, which were sent to all primary wood-using mills in the State. The 2018 and 2019 estimates were obtained through surveys using a sample design where all mills using >10,000 million cubic feet of roundwood are 100-percent

sampled, and mills using <10,000 million cubic feet of roundwood are 40-percent sampled from a population of five of more mills by mill type. The surveys are used to determine the types and amount of roundwood or timber (i.e., saw logs, pulpwood, plywood and veneer, poles, etc.) received by each mill, the county of origin, the species used, and how the mills disposed of the bark and wood residues produced. Personnel from the SRS and the Georgia Forestry Commission conduct the canvass surveys every 2 years and the sample surveys annually. These data, along with the harvest and utilization study, are used to augment the annual inventory of all-live timber removals to derive the proportions that are used for timber products. Individual TPO studies, or industry surveys, are necessary to track trends and capture changes in product output levels.

In 2013, volume harvested and delivered for products (including residential fuelwood) from all sources totaled 1.3 billion cubic feet (44.5 million green tons) (table 12). Output volumes moderately increased in 2015 to 1.4 billion cubic feet (48.4 million green tons) then slightly declined in 2017 to 1.4 billion cubic feet (47.9 million green tons). Output volumes slightly increased in 2018 and 2019 to 1.4 billion cubic feet each or 49.2 million and 50.4 million green tons, respectively. Volume harvested for softwood products in 2013 totaled 1.0 billion cubic feet (36.5 million green tons) and accounted for 83 percent of the total industrial product volume, while the volume increased in 2015 to 1.2 billion cubic feet (40.0 million green tons). In 2017, there was a slight increase from the 2015 output softwood volume totals to 1.2 billion cubic feet (40.2 million green tons). Volume harvested for softwood products increased in 2018 and 2019 to 1.2 billion cubic feet each or 41.8 million and 42.0 million green tons, respectively. The percentage of softwood roundwood harvested increased to a high of 86 percent in 2018. Volume of total roundwood harvested for products increased over the report period for softwood roundwood. Hardwood output volume showed more volatility for the report period but trended upward overall, from 163.4 million cubic feet (6.0 million green tons) in 2013 to 196.6 million cubic feet (7.2 million green tons) in 2019.

The total number of sawmills remained relatively stable at 95 to 99 between 2013 and 2019, and there was no change from 2017 through 2019 with 98 sawmills. Saw-log output increased from 364.0 million cubic feet in 2013 to 478.9 million cubic feet in 2018 with a slight decrease (5.1 million cubic feet) to 473.8 million cubic feet in 2019. Saw-log output increased 30 percent over the 2013–2019 report period and 53 percent from 2009 through 2019. At 407.1 million cubic feet (14.2 million green tons), softwoods accounted for 86 percent of saw-log output volume while hardwood saw-log output volume totaled 66.7 million cubic feet (2.5 million green tons) in 2019.

Pulpwood production in 2013 totaled 607.9 million cubic feet (21.5 million green tons) and ranged from a high of 618.3 million cubic feet (21.8 million green tons) in 2015 to a low of 590.3 million cubic feet (20.8 million green tons) in 2018. Over the 2013–2019 report period, the amount of roundwood used for pulp generally decreased. During the report period, pulpwood was the leading product produced in the State. The 12 pulp mills in the 2019 survey accounted for 42 percent of the 1.4 billion cubic feet total product output. In 2013, softwood pulpwood production totaled 508.1 million cubic feet (17.8 million green tons) with a peak of 524.4 million cubic

Table 12—Output of industrial roundwood products by product, major species group, and year, Georgia, 2019

Product	Species group	2013	2015	2017	2018	2019	2013	2015	2017	2018	2019
		~~ *thousand cubic feet* ~~~~~~~~~~~~~~					~~~~~~~~~~~~~~~~~~~~ *green tons* ~~~~~~~~~~~~~~~~~~~~				
Saw logs	Softwood	310,022	357,898	384,816	430,231	407,097	10,804,227	12,470,430	13,411,819	14,987,132	14,163,179
	Hardwood	53,997	61,454	65,713	48,703	66,710	2,018,004	2,296,675	2,457,977	1,819,720	2,493,703
	Total	364,019	419,352	450,529	478,934	473,807	12,822,231	14,767,105	15,869,796	16,806,852	16,656,882
Veneer logs	Softwood	40,494	41,936	36,077	36,077	40,221	1,408,242	1,458,382	1,254,616	1,254,616	1,398,742
	Hardwood	2,761	2,764	2,783	2,903	2,348	106,267	106,188	106,900	111,248	89,843
	Total	43,255	44,700	38,860	38,980	42,569	1,514,509	1,564,570	1,361,516	1,365,864	1,488,585
Pulpwood	Softwood	508,127	524,401	503,249	505,511	508,926	17,839,124	18,409,956	17,664,578	17,747,853	17,864,032
	Hardwood	99,809	93,907	91,133	84,821	87,444	3,631,961	3,418,192	3,316,819	3,083,991	3,179,731
	Total	607,936	618,308	594,382	590,332	596,370	21,471,085	21,828,148	20,981,397	20,831,844	21,043,763
Composite panel	Softwood	74,166	85,665	89,144	105,467	85,706	2,586,908	2,988,157	3,109,617	3,677,474	2,989,830
	Hardwood	4	170	416	508	1,212	160	6,338	15,577	19,150	45,301
	Total	74,170	85,835	89,560	105,975	86,918	2,587,068	2,994,495	3,125,194	3,696,624	3,035,131
Bioenergy/ fuelwood	Softwood	76,487	92,283	92,003	84,643	113,803	2,682,022	3,235,910	3,226,073	2,967,998	3,990,496
	Hardwood	5,774	25,775	12,624	29,770	37,140	214,150	955,903	468,175	1,104,070	1,377,394
	Total	82,261	118,058	104,627	114,413	150,943	2,896,172	4,191,813	3,694,248	4,072,068	5,367,890
Poles, posts, pilings	Softwood	24,908	33,232	34,020	22,327	22,497	728,065	965,338	987,922	660,735	653,358
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	24,908	33,232	34,020	22,327	22,497	728,065	965,338	987,922	660,735	653,358
Miscelleneous[a]	Softwood	11,621	14,597	16,153	14,355	25,753	406,722	510,891	565,339	502,429	901,338
	Hardwood	1,033	1,173	2,059	1,130	1,702	38,751	43,979	77,212	42,375	63,833
	Total	12,654	15,770	18,212	15,485	27,455	445,473	554,870	642,551	544,804	965,171
Total (Industrial)	Softwood	1,045,825	1,150,012	1,155,462	1,198,611	1,204,003	36,455,310	40,039,064	40,219,964	41,798,237	41,960,975
	Hardwood	163,378	185,243	174,728	167,835	196,556	6,009,293	6,827,275	6,442,660	6,180,554	7,249,805
	Total	1,209,203	1,335,255	1,330,190	1,366,446	1,400,559	42,464,603	46,866,339	46,662,624	47,978,791	49,210,780
Residential fuelwood[b]	Undifferntiated	53,200	39,976	32,072	32,072	32,072	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
	Total	53,200	39,976	32,072	32,072	32,072	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
Total	Softwood	1,045,825	1,150,012	1,155,462	1,198,611	1,204,003	36,455,310	40,039,064	40,219,964	41,798,237	41,960,975
	Hardwood	163,378	185,243	174,728	167,835	196,556	6,009,293	6,827,275	6,442,660	6,180,554	7,249,805
	Undifferntiated	53,200	39,976	32,072	32,072	32,072	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
	Total	1,262,403	1,375,231	1,362,262	1,398,518	1,432,631	44,459,603	48,365,439	47,865,324	49,181,491	50,413,480

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

[a] Includes mulch, shavings, and other miscellaneous products.

[b] Residential fuelwood volume from the latest U.S. Department of Energy estimates.

feet (18.4 million green tons) in 2015. However, in 2017, 2018, and 2019, softwood pulpwood production decreased to levels similar to 2013 from 503.2 million cubic feet (17.7 million green tons), to 505.5 million cubic feet (17.7 million green tons), and to 508.9 million cubic feet (17.9 million green tons), respectively. The proportion of softwood roundwood used for pulpwood production was stable for the 2013–2019 report period, ranging from 83 to 85 percent. Hardwood pulpwood production in 2013 totaled 99.8 million cubic feet (3.6 million green tons) and generally decreased during the 2013–2019 period. Hardwood pulpwood production decreased 12 percent from 2013 to 87.4 million cubic feet (3.2 million green tons) in 2019.

Volume harvested for veneer products in 2013 totaled 43.3 million cubic feet (1.5 million green tons). Veneer production was relatively flat during the 2013–2019 period, from a high of 44.7 million cubic feet in 2015 to a low of 38.9 million cubic feet in 2017. In 2019, volume harvested for veneer dropped 2 percent from 2013 and increased 9 percent from the previous year's totals to 42.6 million cubic feet (1.5 million green tons) and accounted for 3 percent of total roundwood products for the State.

Volume harvested for composite panel products in 2013 totaled 74.2 million cubic feet (2.6 million green tons) and generally increased from 2013 through 2019. The peak year for composite panel production was 2018 at 106.0 million cubic feet (3.7 million green tons). In 2019, volume harvested for composite panels increased 17 percent from 2013 totals to 86.9 million cubic feet (3.0 million green tons) and accounted for 6 percent of total roundwood products for the State.

Volume harvested for poles, posts, and pilings in 2013 totaled 24.9 million cubic feet (728,000 green tons), or 2 percent of the State's total product output. For the 2013–2019 report period, posts, poles, and pilings product volume increased to a peak of 34.0 million cubic feet

Pine (*Pinus* spp.) logs are loaded and ready for transport to a mill. (USDA Forest Service photo)

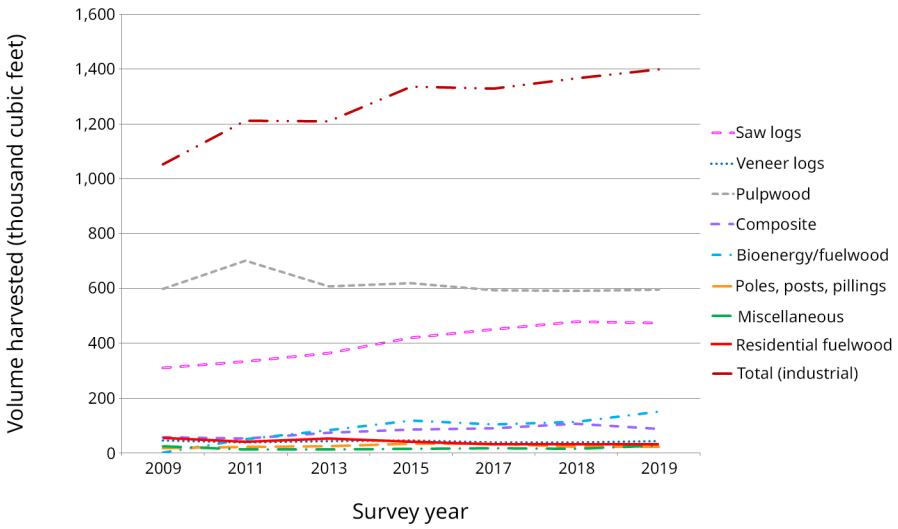

Figure 33—Volume harvested by roundwood products, Georgia, 2009–2019.

(988,000 green tons) in 2017 and then decreased 34 percent to 22.3 million cubic feet (661,000 green tons) in 2018. The volume harvested for poles, posts, and pilings decreased 10 percent over the 2013–2019 period and increased 23 percent from 2009 through 2019. In 2019, volume harvested for posts, poles, and pilings was 22.5 million cubic feet (653,000 green tons) and accounted for 2 percent of total roundwood products for the State.

Volume used for bioenergy and commercial fuelwood totaled 82.3 million cubic feet (2.9 million green tons) and accounted for 7 percent of total product output in 2013. Bioenergy and commercial fuelwood production generally increased over the 2013–2019 report period, peaking in 2019 at 150.9 million cubic feet (5.4 million green tons) and 11 percent of total roundwood product output. Use of roundwood for bioenergy and commercial fuelwood production increased 83 percent from 2013 through 2019.

Volume harvested for other miscellaneous roundwood products including mulch and shavings totaled 12.7 million cubic feet (445,000 green tons) and accounted for 1 percent of total roundwood product output in 2013. Miscellaneous product production generally increased from 2013 through 2019, peaking in 2019 at 27.5 million cubic feet (965,000 green tons) and 2 percent of total roundwood product output; it increased 117 percent from 2013 through 2019 but only 14 percent from 2009 through 2019 (fig. 33).

Mill Residue

Mill or plant residues are defined as wood material generated in the production of timber products from roundwood at primary manufacturing plants. This material falls into three main categories: (1) coarse residues or material such as slabs, edgings, trim, veneer cores and ends, which are suitable for chipping; (2) fine residues or material such as sawdust, shavings, and veneer residue, which are not suitable for chipping; and (3) bark, which is used mainly for industrial fuel.

For many years, most mill residue produced in Georgia has been utilized either for primary products such as pulp and bioenergy or in secondary products such as mulch and animal bedding, or as fuel at wood product mills.

Tables 13A and 13B depicts the volume of mill residue by roundwood and residue type. Data on mill residue production and disposal generated from the 2013 through 2019 forest industry surveys indicated 361.8 million cubic feet of wood and bark residue was generated from primary processors in 2013. This total gradually increased each year to 436.6 million cubic feet in 2019. The most recent survey in 2019 shows sawmills generated most of the mill residue produced totaling 318.4 million cubic feet. In 2019, bark accounted for 135.0 million cubic feet (31 percent), coarse residues accounted for 172.6 million cubic feet (40 percent), and sawdust and shavings accounted for 129.0 million cubic feet (29 percent) of mill residue produced. Residue totals show the largest increase, 12 percent, for all residue types from 2013 through 2015. Overall roundwood residue increased 21 percent from the 2013 total of 361.8 million cubic feet to 436.6 million cubic feet in 2019 (fig. 34).

In 2013, nearly 180.5 million cubic feet, or 50 percent, of mill residue produced was used for industrial fuel either at pulp mills for boiler fuel or at sawmills for dry kiln operations, pellets, or residential fuelwood (table 14). From 2015 through 2017, this total decreased 3 percent to 219.2 million cubic feet. From 2013 through 2019, this total increased 35 percent to 243.5 million cubic feet. Bark and fine residues, at 109.0 and 110.6 million cubic feet, respectively, accounted for 90 percent of mill residue utilized for industrial fuel in 2019, which was just below the average of 91 percent for 2013–2019. In 2019, 81 percent of bark residue produced was utilized for fuel, with the remainder of the utilized bark going for miscellaneous and fiber products. Mill residue produced in Georgia from 2013 through 2019 was predominately used for industrial fuel. During 2013, 2015, 2017, 2018, and 2019, 91, 77, 82, 75, and 76 percent of the coarse residue produced was utilized for fiber products, respectively. Bark and wood residues not utilized accounted for <1 percent of all residues produced in the 2013–2019 report period (fig. 35).

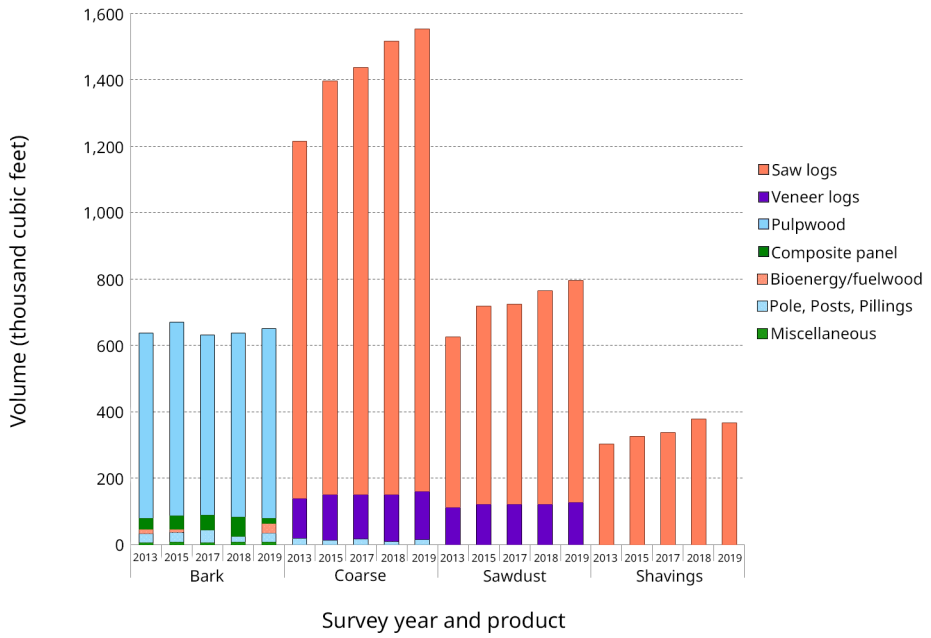

Figure 34—Volume of mill residue by roundwood and residue type, Georgia, 2013–2019.

Table 13A—Primary mill residue volume by roundwood type, major species group, and residue type, Georgia, 2013–2019

Roundwood type and species group		Residue type														
		All types					Bark					Coarse				
		2013	2015	2017	2018	2019	2013	2015	2017	2018	2019	2013	2015	2017	2018	2019
		thousand cubic feet														
Saw logs	Softwood	214,971	245,375	251,384	279,966	275,050	30,244	34,830	36,637	39,651	39,037	104,203	120,002	123,090	136,614	134,497
	Hardwood	36,150	41,050	42,907	31,173	43,383	6,610	7,500	7,769	5,709	7,927	17,344	19,681	20,654	14,978	20,798
	Total	251,121	286,425	294,291	311,139	318,433	36,854	42,330	44,406	45,360	46,964	121,547	139,683	143,744	151,592	155,295
Veneer logs	Softwood	25,769	28,126	28,126	28,126	31,052	3,594	3,922	3,922	3,922	4,330	12,381	13,514	13,514	13,514	14,920
	Hardwood	3,306	3,478	3,553	3,413	2,366	533	560	572	550	381	1,397	1,470	1,502	1,442	1,000
	Total	29,075	31,604	31,679	31,539	33,418	4,127	4,482	4,494	4,472	4,711	13,778	14,984	15,016	14,956	15,920
Pulpwood	Softwood	54,017	57,211	53,912	54,825	55,535	54,017	57,211	53,912	54,825	55,535	0	0	0	0	0
	Hardwood	9,755	9,753	9,254	8,844	9,474	9,755	9,753	9,254	8,844	9,474	0	0	0	0	0
	Total	63,772	66,964	63,166	63,669	65,009	63,772	66,964	63,166	63,669	65,009	0	0	0	0	0
Composite panel	Softwood	7,771	8,642	8,666	8,218	7,629	7,771	8,642	8,666	8,218	7,629	0	0	0	0	0
	Hardwood	0	41	73	63	158	0	41	73	63	158	0	0	0	0	0
	Total	7,771	8,683	8,739	8,281	7,787	7,771	8,683	8,739	8,281	7,787	0	0	0	0	0
Bioenergy/ fuelwood	Softwood	4,563	4,263	4,008	0	6,381	4,563	4,263	4,008	0	6,381	0	0	0	0	0
	Hardwood	0	307	39	0	0	0	307	39	0	0	0	0	0	0	0
	Total	4,563	4,570	4,047	0	6,381	4,563	4,570	4,047	0	6,381	0	0	0	0	0
Poles, posts, pilings	Softwood	4,979	4,841	6,214	3,399	4,933	3,162	3,593	4,438	2,473	3,507	1,817	1,248	1,776	926	1,426
	Hardwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	4,979	4,841	6,214	3,399	4,933	3,162	3,593	4,438	2,473	3,507	1,817	1,248	1,776	926	1,426
Miscellaneous[a]	Softwood	474	710	514	779	688	474	710	514	779	688	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	474	710	514	779	688	474	710	514	779	688	0	0	0	0	0
Total	Softwood	312,544	349,168	352,824	375,313	381,268	103,825	113,171	112,097	109,868	117,107	118,401	134,764	138,380	151,054	150,843
	Hardwood	49,211	54,629	55,826	43,493	55,381	16,898	18,161	17,707	15,166	17,940	18,741	21,151	22,156	16,420	21,798
	Total	361,755	403,797	408,650	418,806	436,649	120,723	131,332	129,804	125,034	135,047	137,142	155,915	160,536	167,474	172,641

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

[a] Includes mulch, shavings, and other miscellaneous products.

Table 13B—Primary mill residue volume by roundwood type, major species group, and residue type, Georgia, 2013–2019

Roundwood type and species group		Residue type									
		Sawdust					Shavings				
		2013	2015	2017	2018	2019	2013	2015	2017	2018	2019
		~~ *thousand cubic feet* ~~~~~~~~~~~~~~~~~~~~~~~~~~									
Saw logs	Softwood	50,332	57,963	57,972	65,987	64,965	30,192	32,580	33,685	37,714	36,551
	Hardwood	12,139	13,773	14,447	10,484	14,557	57	96	37	2	101
	Total	62,471	71,736	72,419	76,471	79,522	30,249	32,676	33,722	37,716	36,652
Veneer logs	Softwood	9,794	10,690	10,690	10,690	11,802	0	0	0	0	0
	Hardwood	1,376	1,448	1,479	1,421	985	0	0	0	0	0
	Total	11,170	12,138	12,169	12,111	12,787	0	0	0	0	0
Pulpwood	Softwood	0	0	0	0	0	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Composite panel	Softwood	0	0	0	0	0	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Bioenergy/ fuelwood	Softwood	0	0	0	0	0	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Poles, posts, pilings	Softwood	0	0	0	0	0	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Miscellaneous[a]	Softwood	0	0	0	0	0	0	0	0	0	0
	Hardwood	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0
Total	Softwood	60,126	68,653	68,662	76,677	76,767	30,192	32,580	33,685	37,714	36,551
	Hardwood	13,515	15,221	15,926	11,905	15,542	57	96	37	2	101
	Total	73,641	83,874	84,588	88,582	92,309	30,249	32,676	33,722	37,716	36,652

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

[a] Includes mulch, shavings, and other miscellaneous products.

Table 14—Volume of residue disposal at primary wood-using plants by product, major species group, and residue type, Georgia, 2013–2019

Product and species group		Residue type																			
		All types					Bark					Coarse					Fines (sawdust and shavings)				
		2013	2015	2017	2018	2019	2013	2015	2017	2018	2019	2013	2015	2017	2018	2019	2013	2015	2017	2018	2019
		thousand cubic feet																			
Fiber products	Softwood	128,243	117,108	120,265	124,575	125,970	0	2,078	1	0	28	107,973	101,425	111,928	116,329	117,317	20,270	13,605	8,336	8,246	8,625
	Hardwood	18,196	19,393	20,255	9,128	14,600	31	29	29	0	595	17,279	19,364	20,226	9,128	14,005	886	0	0	0	0
	Total	146,439	136,501	140,520	133,703	140,570	31	2,107	30	0	623	125,252	120,789	132,154	125,457	131,322	21,156	13,605	8,336	8,246	8,625
Industrial fuel	Softwood	153,117	194,207	187,686	203,173	212,284	82,990	92,732	87,114	87,100	93,926	9,281	22,669	15,564	21,679	21,816	60,846	78,806	85,008	94,394	96,542
	Hardwood	27,333	31,478	31,513	25,933	31,193	15,020	17,012	16,044	13,507	15,094	732	1,153	857	1,558	2,034	11,581	13,313	14,612	10,868	14,065
	Total	180,450	225,685	219,199	229,106	243,477	98,010	109,744	103,158	100,607	109,020	10,013	23,822	16,421	23,237	23,850	72,427	92,119	99,620	105,262	110,607
Miscellaneous	Softwood	30,931	37,785	44,825	45,255	40,705	20,585	18,340	24,975	22,769	23,153	1,146	10,628	10,864	13,045	11,710	9,200	8,817	8,986	9,441	5,842
	Hardwood	3,207	3,159	3,470	7,922	9,588	1,843	1,101	1,630	1,659	2,251	727	626	1,062	5,735	5,759	637	1,432	778	528	1,578
	Total	34,138	40,944	48,295	53,177	50,293	22,428	19,441	26,605	24,428	25,404	1,873	11,254	11,926	18,780	17,469	9,837	10,249	9,764	9,969	7,420
Not used	Softwood	252	66	49	2,309	2,309	249	20	7	0	0	1	42	24	0	0	2	4	18	2,309	2,309
	Hardwood	476	601	589	510	0	5	19	5	0	0	3	9	12	0	0	468	573	572	510	0
	Total	728	667	638	2,819	2,309	254	39	12	0	0	4	51	36	0	0	470	577	590	2,819	2,309
All products	Softwood	312,543	349,166	352,825	375,312	381,268	103,824	113,170	112,097	109,869	117,107	118,401	134,764	138,380	151,053	150,843	90,318	101,232	102,348	114,390	113,318
	Hardwood	49,212	54,631	55,827	43,493	55,381	16,899	18,161	17,708	15,166	17,940	18,741	21,152	22,157	16,421	21,798	13,572	15,318	15,962	11,906	15,643
	Total	361,755	403,797	408,652	418,805	436,649	120,723	131,331	129,805	125,035	135,047	137,142	155,916	160,537	167,474	172,641	103,890	116,550	118,310	126,296	128,961

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

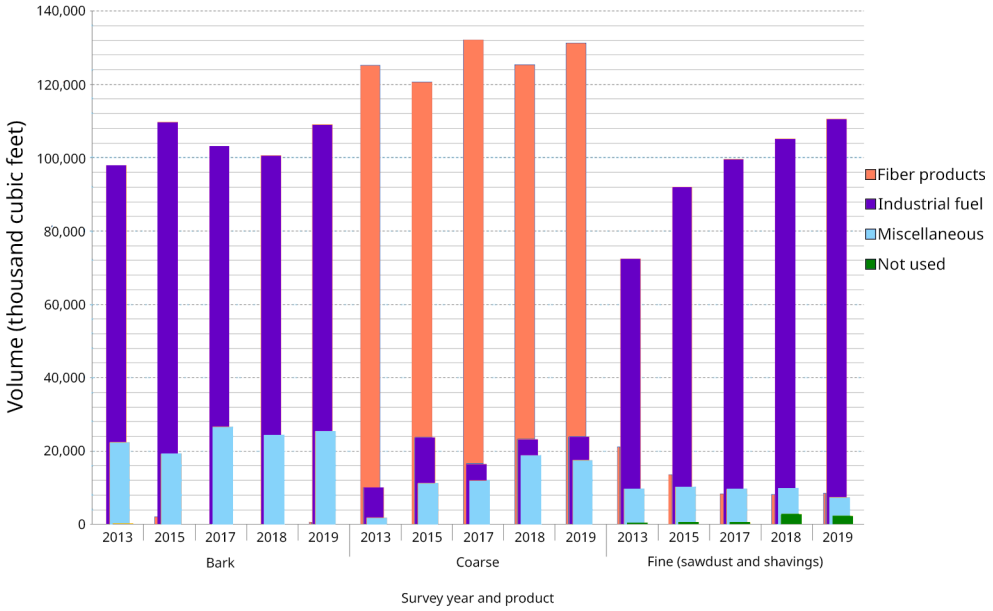

Figure 35—Volume of mill residue disposal by product, Georgia, 2013–2019.

Table 15—Volume of timber removals in cubic feet by year, major species group, removals class, and source, Georgia, 2013–2019

Year	Species group	Roundwood products			Logging residues			Other removals			All removals		
		Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources
		thousand cubic feet											
2013	Softwood	912,424	133,401	1,045,825	34,177	102,055	136,232	5,143	15,357	20,500	951,744	250,813	1,202,557
	Hardwood	154,159	9,220	163,379	20,067	49,351	69,418	7,412	18,229	25,641	181,638	76,800	258,438
	Total	1,066,583	142,621	1,209,204	54,244	151,406	205,650	12,555	33,586	46,141	1,133,382	327,613	1,460,995
2015	Softwood	1,022,545	127,467	1,150,012	40,806	111,452	152,258	5,074	13,858	18,932	1,068,425	252,777	1,321,202
	Hardwood	180,809	4,434	185,243	24,250	52,976	77,226	9,555	20,875	30,430	214,614	78,285	292,899
	Total	1,203,354	131,901	1,335,255	65,056	164,428	229,484	14,629	34,733	49,362	1,283,039	331,062	1,614,101
2017	Softwood	1,030,020	125,440	1,155,460	42,098	114,979	157,077	4,863	13,283	18,146	1,076,981	253,702	1,330,683
	Hardwood	171,337	3,391	174,728	24,024	52,482	76,506	8,651	18,898	27,549	204,012	74,771	278,783
	Total	1,201,357	128,831	1,330,188	66,122	167,461	233,583	13,514	32,181	45,695	1,280,993	328,473	1,609,466
2018	Softwood	1,076,611	122,000	1,198,611	43,729	119,435	163,164	4,071	11,118	15,189	1,124,411	252,553	1,376,964
	Hardwood	163,072	4,763	167,835	23,462	51,256	74,718	9,413	20,564	29,977	195,947	76,583	272,530
	Total	1,239,683	126,763	1,366,446	67,191	170,691	237,882	13,484	31,682	45,166	1,320,358	329,136	1,649,494
2019	Softwood	1,064,188	139,814	1,204,002	44,062	120,346	164,408	4,142	11,313	15,455	1,112,392	271,473	1,383,865
	Hardwood	190,543	6,014	196,557	24,647	53,844	78,491	7,906	17,271	25,177	223,096	77,129	300,225
	Total	1,254,731	145,828	1,400,559	68,709	174,190	242,899	12,048	28,584	40,632	1,335,488	348,602	1,684,090

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

Land-Use Removals

Land use removals (land clearing or set-aside forest land), or removal volume attributed to land-use change, accounted for 2 to 3 percent of total removals for each year surveyed 2013–2019 (tables 15 and 16). The volume of land-use removals was relatively stable during the report period, ranging from 40.6 million cubic feet in 2019 to 49.4 million cubic feet in 2015. The nonmerchantable (nongrowing stock) portion of live trees accounted for 70–73 percent of land-use change removals for the entire reporting period of 2013–2019. The hardwood species group accounted for 56 to 66 percent of the land-use change removals from 2013 through 2019.

Logging Residue

The merchantable (growing stock) portions of trees cut and left onsite are underutilized removals by FIA merchantability standards, while the nonmerchantable (nongrowing stock) portions of trees (part of the 1-foot stump or volume in tops <4 inches in diameter) used for products are considered overutilized removals by FIA merchantability standards. Underutilization and overutilization factors used to determine average annual logging residue estimates used in this section were derived from estimates in the Georgia harvest and utilization studies conducted from 2013 through 2019. Logging residue has

Table 16—Volume of timber removals in green tons by year, major species group, removals classs, and source, Georgia, 2013–2019

Year	Species group	Roundwood products			Logging residues			Other removals			All removals		
		Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources	Growing stock	Nongrowing stock	All sources
		green tons											
2013	Softwood	31,778,529	4,676,781	36,455,310	2,384,332	7,119,869	9,504,201	358,782	1,071,362	1,430,144	34,521,643	12,868,012	47,389,655
	Hardwood	5,672,402	336,892	6,009,294	1,514,245	3,723,914	5,238,159	559,326	1,375,526	1,934,852	7,745,973	5,436,332	13,182,305
	Total	37,450,931	5,013,673	42,464,604	3,898,577	10,843,783	14,742,360	918,108	2,446,888	3,364,996	42,267,616	18,304,344	60,571,960
2015	Softwood	35,572,439	4,466,626	40,039,065	2,846,843	7,775,465	10,622,308	353,967	966,776	1,320,743	38,773,249	13,208,867	51,982,116
	Hardwood	6,663,541	163,733	6,827,274	1,829,825	3,997,446	5,827,271	721,031	1,575,169	2,296,200	9,214,397	5,736,348	14,950,745
	Total	42,235,980	4,630,359	46,866,339	4,676,668	11,772,911	16,449,579	1,074,998	2,541,945	3,616,943	47,987,646	18,945,215	66,932,861
2017	Softwood	35,824,993	4,394,971	40,219,964	2,936,933	8,021,525	10,958,458	339,300	926,716	1,266,016	39,101,226	13,343,212	52,444,438
	Hardwood	6,317,513	125,147	6,442,660	1,812,757	3,960,159	5,772,916	652,750	1,426,002	2,078,752	8,783,020	5,511,308	14,294,328
	Total	42,142,506	4,520,118	46,662,624	4,749,690	11,981,684	16,731,374	992,050	2,352,718	3,344,768	47,884,246	18,854,520	66,738,766
2018	Softwood	37,522,449	4,275,787	41,798,236	3,050,750	8,332,387	11,383,137	283,991	775,652	1,059,643	40,857,190	13,383,826	54,241,016
	Hardwood	6,004,484	176,070	6,180,554	1,770,421	3,867,671	5,638,092	710,298	1,551,721	2,262,019	8,485,203	5,595,462	14,080,665
	Total	43,526,933	4,451,857	47,978,790	4,821,171	12,200,058	17,021,229	994,289	2,327,373	3,321,662	49,342,393	18,979,288	68,321,681
2019	Softwood	37,061,003	4,899,972	41,960,975	3,074,015	8,395,931	11,469,946	288,960	789,224	1,078,184	40,423,978	14,085,127	54,509,105
	Hardwood	7,027,306	222,500	7,249,806	1,859,809	4,062,950	5,922,759	596,550	1,303,226	1,899,776	9,483,665	5,588,676	15,072,341
	Total	44,088,309	5,122,472	49,210,781	4,933,824	12,458,881	17,392,705	885,510	2,092,450	2,977,960	49,907,643	19,673,803	69,581,446

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

been considered a possible source for bioenergy and other timber products during recent years. It is important to keep in mind that logging residue, traditionally, has not had a marketable value. Retrieval of logging residue is a matter of economics and markets. If markets are available and a willingness to pay a reasonable price exists, then more total tree volume (including what has been left as logging residues) is utilized for products.

Woody material typically left on a logging site includes: whole trees, ≥5 inches d.b.h., or portions of the merchantable boles of severed trees broken and left during the felling operation (merchantable); small trees, <5 inches d.b.h., damaged or killed during harvesting operations (nonmerchantable); and residual stump portions, tops, and limbs or forks not utilized because of insufficient size or quality to fit on the trailers (nonmerchantable). This wood material left on the site is known as merchantable and nonmerchantable logging residues.

FIA calculates the merchantable portion of logging residue in a two-stage process. First, for those plots that were classified as timberland during the previous inventory and stayed in timberland for the current inventory cycle, FIA field crews identify the volume of whole trees cut and not utilized during the remeasurement phase of the inventory. A removal volume is derived for trees that are classified in this category. Second, underutilization factors derived from felled-tree utilization studies are applied to the volume classified as utilized by field crews for the remainder of the merchantable portion of logging residue.

The total removal volume is made up of volume from the merchantable and nonmerchantable portions of removal trees. Overutilization factors from the utilization studies were used to determine how much of the nonmerchantable portion of removals was used for timber products. The nonmerchantable volume is calculated for the land-use change removal estimate and added to the merchantable volume for a total land-use change removal volume. With the nonmerchantable portion of timber products and land-use change values calculated and subtracted from total nonmerchantable removals volume, the remainder is the volume of nonmerchantable logging residues.

The logging residue volume in Georgia for 2013 totaled 205.7 million cubic feet. It has since consistently increased to 229.5 million cubic feet in 2015, 233.6 million cubic feet in 2017, 237.9 million cubic feet in 2018, and 242.9 million cubic feet in 2019. This volume accounted for <15 percent of total timber removals for the previously stated survey years. During 2013, logging residue from the merchantable portion of all-live removals totaled 54.2 million cubic feet, or 26 percent of total logging residue. Logging residue from the merchantable portion of all-live tree removals gradually increased each year of the reporting period from 65.1 million cubic feet (28 percent of total logging residue) in 2015 to 66.1 million cubic feet (28 percent of total logging residue) in 2017, to 67.2 million cubic feet (28 percent of total logging residue) in 2018, to 68.7 million cubic feet (28 percent of total logging residue) in 2019. The merchantable portion of logging residue for both softwood and

hardwood combined accounted for about 4 percent of total live removals for those survey periods. For softwoods, the merchantable portion of logging residue accounted for 3 percent of the total softwood all-live tree removals for the 2013–2019 surveys. The merchantable portion of hardwood logging residue proportion remained stable at 29 to 31 percent for 2013, 2015, 2017, 2018, and 2019 (20.1, 24.3, 24.0, 23.5, and 24.6 million cubic feet, respectively). Nonmerchantable sources (such as the residual stump, forks, tops, and limbs) accounted for 151.4 million cubic feet, or 74 percent of total logging residue in 2013. This percentage declined to 72 percent for each year from 2015 through 2019, and the amount produced increased to 164.4 million cubic feet in 2015, 167.5 million cubic feet in 2017, 170.7 million cubic feet in 2018, and 174.2 million cubic feet in 2019.

OVERVIEW OF HURRICANE MICHAEL

Hurricane Michael, a Category 5 storm that made landfall on October 10, 2018, caused considerable damage in the States of Alabama, Florida, and Georgia. An assessment of forest resource damages was done using the FIA program's permanent forest inventory plot network and the National Oceanic and Atmospheric Administration's (NOAA) defined storm damage severity zones (fig. 36). This section summarizes some of the study's findings, which can be found in Brandeis and others (2022).

Hurricane Michael left forest stands within the impacted zones with a mix of live, standing dead, broken, and windthrown trees. (USDA Forest Service photo by Jason Cooper)

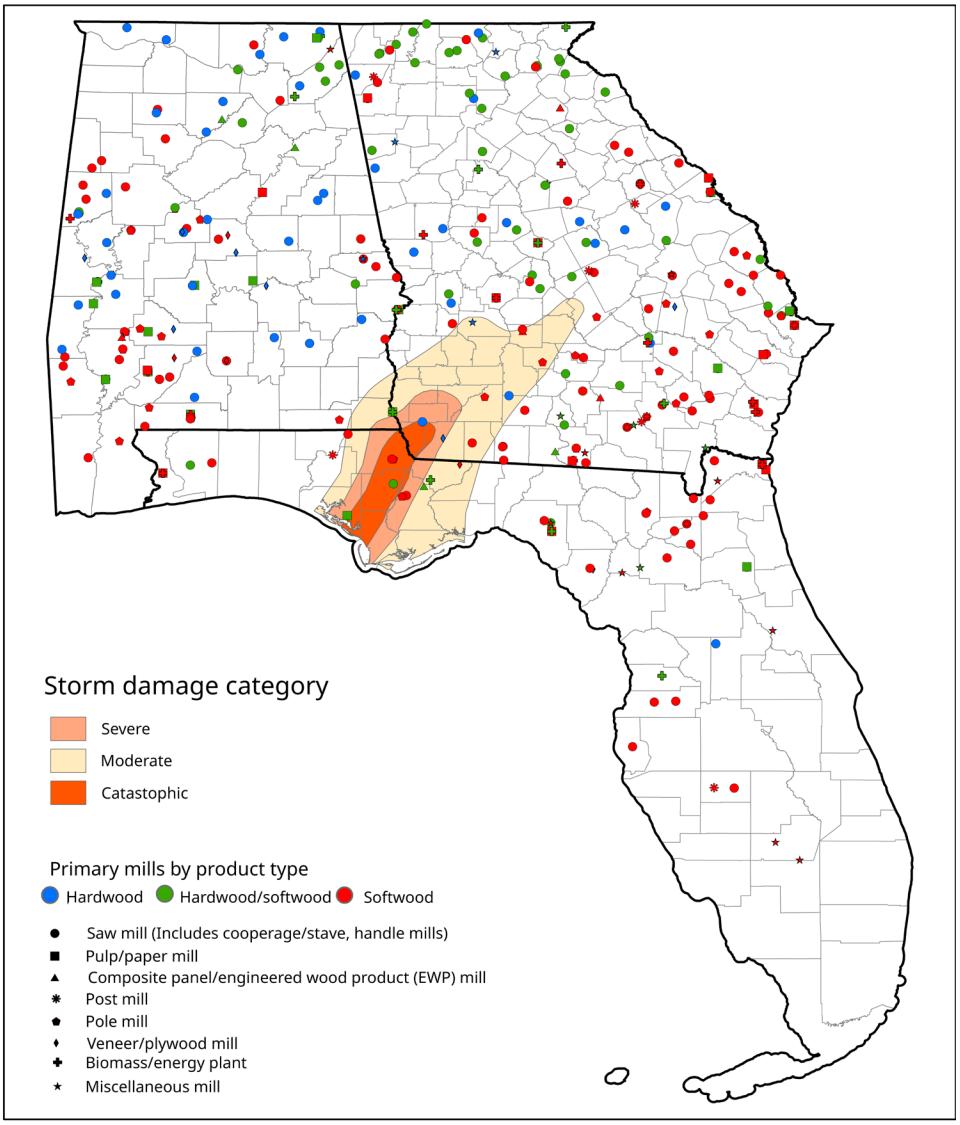

Figure 36—National Oceanic and Atmospheric Administration's Hurricane Michael damage severity zones in the States of Alabama, Florida, and Georgia and the Forest Inventory and Analysis (FIA) plots measured as part of the damage assessment.

There were 6.17 million acres of forest land with 10.01 billion cubic feet of timber within the entire impacted zone, of which 2.27 million acres and 3.61 billion cubic feet were in the State of Georgia (Brandeis and others 2022). In Georgia, 2.45 billion cubic feet remained alive after the hurricane, 503.57 million cubic feet were standing dead, and 651.45 million cubic feet were utilized (table 17). This represents a total of 68.0 percent of live-tree volume surviving across the entire impacted zone, with survival decreasing from 70.6 percent in moderately impacted areas to 34.3 percent in the catastrophically impacted areas. The percentage of utilized tree volume across all severity zones was 18.1 percent, with higher utilization rates in the catastrophic zone (60.2 percent). Over the entire impacted area in Georgia, more volume per acre was left alive (1,081.12 cubic feet per acre) than left standing dead (222.03 cubic feet per acre) or utilized (287.23 cubic feet per acre) (table 18).

Table 17—Volume in trees (d.b.h. ≥5 inches) left alive, standing dead, and utilized in Georgia by NOAA-defined damage severity zones for Hurricane Michael

Damage severity zone	Post-hurricane status			
	Live	Standing dead	Utilized	Total
	~~ *million cubic feet* ~~~~~~			
Moderate	2,404.1	488.1	512.7	3,404.8
Severe	19.1	10.9	88.1	118.2
Catastrophic	28.8	4.6	50.6	84.1
Total	2,452.0	503.6	651.4	3,607.1

Numbers in rows and columns may not sum to totals due to rounding.
d.b.h. = diameter at breast height; NOAA = National Oceanic and Atmospheric Administration.

Table 18—Volume per acre in trees (d.b.h. ≥5 inches) left alive, standing dead, and utilized in Georgia within NOAA-defined damage severity zones for Hurricane Michael

Damage severity zone	Post-hurricane status			
	Live	Standing dead	Utilized	Zone subtotal
	~~ *cubic feet per acre* ~~~~~~			
Moderate	1,176.5	238.9	250.9	1,666.2
Severe	141.6	80.7	651.9	874.1
Catastrophic	322.3	51.4	566.2	939.9
Average	1,081.1	222.0	287.2	1,590.4

Numbers in rows and columns may not sum to totals due to rounding.
d.b.h. = diameter at breast height; NOAA = National Oceanic and Atmospheric Administration.

Table 19—Volume in trees (d.b.h. ≥5 inches) left alive, standing dead, and utilized in Georgia by NOAA-defined damage severity zones for Hurricane Michael

Damage severity zone	Major species group	Post-hurricane status			
		Live	Standing dead	Utilized	Species group subtotal
		~~ *million cubic feet* ~~~~~~~~~~~~~~~~~~~~			
Moderate	**Pine**	1,252.08	182.76	382.89	1,817.74
	Other softwood	287.09	5.02	0.00	292.11
	Hard hardwood	412.24	132.52	120.21	664.96
	Soft hardwood	452.68	167.76	9.58	630.03
	Zone subtotal	2,404.09	488.07	512.68	3,404.84
Severe	**Pine**	18.09	6.43	76.30	100.82
	Other softwood	0.00	0.00	0.00	0.00
	Hard hardwood	0.24	0.00	5.59	5.83
	Soft hardwood	0.81	4.48	6.24	11.53
	Zone subtotal	19.14	10.91	88.13	118.17
Catastrophic	**Pine**	0.00	0.00	50.64	50.64
	Other softwood	0.00	0.00	0.00	0.00
	Hard hardwood	3.09	3.64	0.00	6.72
	Soft hardwood	25.74	0.96	0.00	26.69
	Zone subtotal	28.82	4.60	50.64	84.05
	State subtotal	2,452.05	503.57	651.45	3,607.07

Numbers in rows and columns may not sum to totals due to rounding.
d.b.h. = diameter at breast height; NOAA = National Oceanic and Atmospheric Administration.

Pines showed decreasing amounts of live volume remaining in the forest with increasing damage severity, ranging from 68.9 percent in the moderate damage zone to zero remaining live pine volume on the sampled FIA plots in the catastrophic damage zone (table 19). Utilized volume per acre for pines increased with increasing damage severity, indicating active salvage logging activity, particularly in the severe and catastrophically impacted zones, probably focused on pine plantations (table 20). One can only speculate, though, as to how much of the volume recorded was truly utilized and how much was cut down and piled for burning or disposal later.

The relatively small sample of trees in the other softwoods species group in Georgia makes drawing conclusions on these species difficult, although impacts across the entire Hurricane Michael impact zone were lower on this species group than on others (Brandeis and others 2022). Impacts on trees in the hard and soft hardwood groups in the moderate damage zone were comparable to that observed in pines. Where there was severe and catastrophic damage in Georgia, hardwood utilization rates on a per-acre basis were comparable to softwood utilization, indicating active salvage logging at rates that were higher than those observed in Florida and Alabama (Brandeis and others 2022).

Table 20—Volume per acre in trees (d.b.h. ≥5 inches) left alive, standing dead, and utilized in Georgia by NOAA-defined damage severity zones for Hurricane Michael

Damage severity zone	Major species group	Post-hurricane status			
		Live	Standing dead	Utilized	Species group subtotal
		~~ *cubic feet per acre* ~~~~~~~~~~~~~~~~~~			
Moderate	Pine	612.7	89.4	187.4	889.6
	Other softwood	140.5	2.5	0.0	143.0
	Hard hardwood	201.7	64.9	58.8	325.4
	Soft hardwood	221.5	82.1	4.7	308.3
	Zone average	1,176.5	238.9	250.9	1,666.2
Severe	Pine	133.8	47.6	564.3	745.7
	Other softwood	0.0	0.0	0.0	0.0
	Hard hardwood	1.8	0.0	0.0	43.1
	Soft hardwood	6.0	33.1	46.2	85.3
	Zone average	141.6	80.7	651.9	874.1
Catastrophic	Pine	0.0	0.0	566.2	566.2
	Other softwood	0.0	0.0	0.0	0.0
	Hard hardwood	34.5	40.7	0.0	75.2
	Soft hardwood	287.8	10.7	0.0	298.5
	Zone average	322.3	51.4	566.2	939.9
	State average	1,081.1	222.0	287.2	1,590.4

Due to averaging in each zone, the State average will not total.
d.b.h. = diameter at breast height; NOAA = National Oceanic and Atmospheric Administration.

Figure 37 is a map of primary mills by major forest-type group, mill type, storm damage categories, and buffer zones (50, 100, and 150 miles). This map shows the proximity of these primary mills in the affected area. Table 21 provides mill counts for Georgia and Florida. In Georgia, there were 11 mills in the damage zones, 5 of which were softwood mills (all in the moderate damage zone); 4 hardwood mills (1 in the catastrophic damage zone, 1 in the severe damage zone, and 2 in the moderate damage zone); and 2 combined softwood/hardwood mills (both in the moderate damage zone). Reference figure 32 for types of mills.

The amounts of down woody material (DWM) found on the forest floor on plots in Alabama, Florida, and Georgia remeasured after the passage of

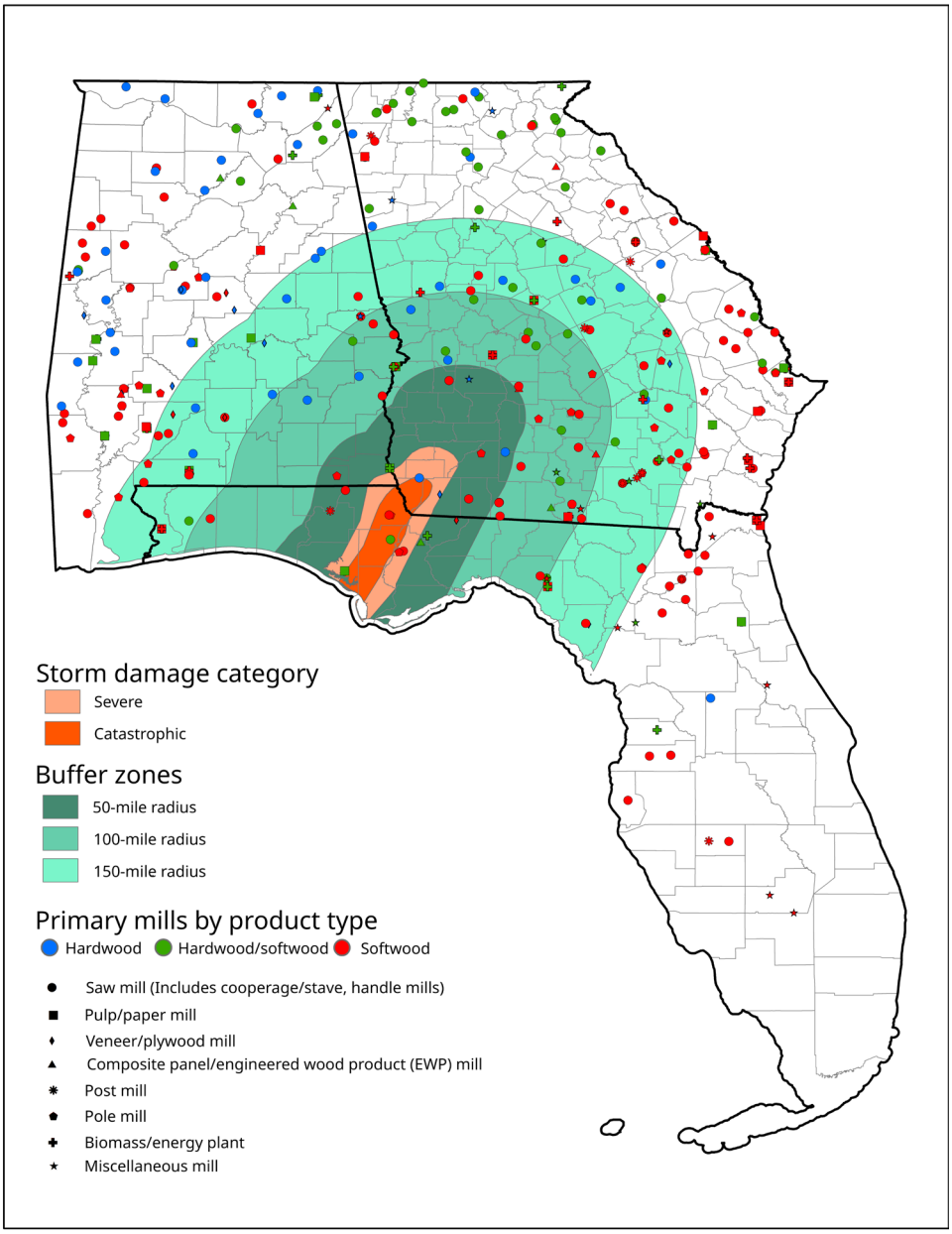

Figure 37—Mills in the Hurricane Michael damage zone categories, primary mill and product type, State, and major species group (courtesy of TPO, SRS FIA, USDA Forest Service).

Hurricane Michael were considerably (over four times) higher than that found prior to the hurricane, most notably for coarse woody debris and piles (Brandeis and others 2022). In Georgia, FIA estimated there to be 14.50 million short tons (or 1.23 billion cubic feet in terms of volume) of DWM deposited after to the passage of Hurricane Michael. It is probable that the large numbers of trees broken or uprooted by the storm plus post-hurricane salvage logging and site cleanup, which created numerous piles of logs and branches, is at least part of the reason for these higher amounts of DWM. Periodic depositions of such large amounts of DWM will have important consequences for forest management and carbon cycling across coastal forest ecosystems in the Southern United States.

Last, Hurricane Michael was the strongest hurricanes (in terms of wind) this century to make landfall in the continental United States (Bevin and others 2019) and was devastating to the forest resources in southwestern Georgia. SRS FIA is currently investigating new protocols and tools to assist in the evaluation of future catastrophic events with help from Georgia and other States.

Table 21—Mill count of primary mills by State, NOAA-defined damage severity zone[a] for Hurricane Michael, major forest-type group, and mill type

		Total	Saw mill			Veneer mill			Pulp mill			Composite panel			Poles, posts, pilings			Miscellaneous		
			Cat.	Sev.	Mod.	Cat.	Sev.	Mod.	Cat.	Sev.	Mod.	Cat.	Sev.	Mod.	Cat.	Sev.	Mod.	Cat.	Sev.	Mod.
Florida	Softwood	8	1	1	1	0	0	1	0	0	0	0	0	0	1	2	0	0	1	0
	Hardwood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Combined	4	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
	Total	12	2	1	1	0	0	1	0	1	0	0	0	1	1	2	0	0	1	1
Georgia	Softwood	5	0	0	2	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0
	Hardwood	4	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	Combined	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
	Total	11	1	0	3	0	1	0	0	0	1	0	0	1	0	0	2	0	0	2
Total	Softwood	13	1	1	3	0	0	1	0	0	0	0	0	1	1	2	2	0	1	0
	Hardwood	4	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	Combined	6	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	2
	Total	23	3	1	4	0	1	1	0	1	1	0	0	2	1	2	2	0	1	3

Source: U.S. Department of Agriculture, Forest Service, Southern Research Station, Timber Product Output.
NOAA = National Oceanic and Atmospheric Administration.
[a] Damage serverity zones are catastropic (Cat.), severe (Sev.), and moderate (Mod.).

LITERATURE CITED

American Highway Users Alliance. 2004. Unclogging America's arteries: effective relief for highway bottlenecks, 1999–2004. Washington, DC. https://www.highways.org/wp-content/uploads/2004/04/bottleneck2004.pdf. [Date accessed: October 24, 2022].

Battaglia, L.L.; Denslow, J.S.; Inczauskis, J.R.; Baer, S.G. 2009. Effects of native vegetation on invasion success of Chinese tallow in a floating marsh ecosystem. Journal of Ecology. 97: 239–246. https://doi.org/10.1111/j.1365-2745.2008.01471.x.

Bechtold, W.A.; Patterson, P.L., eds. 2005. The enhanced Forest Inventory and Analysis program—national sampling design and estimation procedures. Gen. Tech. Rep. SRS-80. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 85 p.

Bevin, J.L., II; Berg, R.; Hagen, A. 2019. Hurricane Michael, 7–11 October 2018. National Hurricane Center Tropical Cyclone Report AL142018. Miami, FL: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. 86 p.

Brandeis, T.; Turner, J.; Baeza Castro, A. [and others]. 2022. Assessing forest resource damage following natural disasters using national forest inventory plots: a case study of Hurricane Michael. Res. Pap. SRS-65. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 30 p. https://doi.org/10.2737/SRS-RP-65.

Brandeis, T.J.; McCollum, J.; Hartsell, A. [and others]. 2016. Georgia's forests, 2014. Resour. Bull. SRS-209. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 78 p.

Brown, M.J.; Vogt, J.T.; New, B.D. 2014. Forests of North Carolina, 2012. Resource Update FS-13. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 4 p.

Cordell, H.K.; James, G.A.; Griffith, R.F. 1970. Estimating recreation use at visitor information centers. Res. Pap. SE-69. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 8 p.

Fan, Z. 2015. Invasibility of major forest types by non-native Chinese tallow in east Texas. In: Holley, A.G.; Connor, K.F.; Haywood, J.D., eds. Proceedings of the 17th biennial southern silvicultural research conference. e–Gen. Tech. Rep. SRS-203. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 283–285.

Georgia Department of Transportation. 2020. Interstate mileage report – 2020. http://www.dot.ga.gov/DriveSmart/Data/Documents/400%20Series/438/438_Report_2020.pdf. [Date accessed: December 8, 2022].

Harper, R.A. 2012. Georgia, 2011—Forest Inventory and Analysis factsheet. e-Science Update SRS-053. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 5 p.

Harper, R.A.; McClure, N.D.; Johnson, T.G. [and others]. 2009. Georgia's forests, 2004. Resour. Bull. SRS-149. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 78 p.

Hickman, C. 2007. TIMOs and REITs. http://thetimberlandblog.blogspot.com/2007/05/timos-and-reits.html. [Date accessed: July 12, 2013].

Klooster, W.S.; Herms, D.A.; Knight, K.S. [and others]. 2014. Ash (*Fraxinus* spp.) mortality, regeneration, and seed bank dynamics in mixed hardwood forests following invasion by emerald ash borer (*Agrilus planipennis*). Biological Invasions. 16: 859–873. https://doi.org/10.1007/s10530-013-0543-7.

Larson, R.W.; Spada, B. 1963. Georgia's timber. Resour. Bull. SE-1. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 39 p.

Miller, J.H.; Chambliss, E.B.; Loewenstein, N.J. 2010. A field guide for the identification of invasive plants in southern forests. Gen. Tech. Rep. SRS-119. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 126 p. https://doi.org/10.2737/SRS-GTR-119.

National Geographic Society. 2018. National Geographic guide to State parks of the United States. 5th ed. Washington, DC. 480 p.

Nickelson, J.B.; Holzmueller, E.J.; Groninger, J.W.; Lesmeister, D.B. 2015. Previous land use and invasive species impacts on long-term afforestation success. Forests. 6: 3123–3135. https://doi.org/10.3390/f6093123.

Oswalt, C.M.; Oswalt, S.N.; Clatterbuck, W.K. 2007. Effects of *Microstegium vimineum* (Trin.) A. Camus on native woody species density and diversity in a productive mixed-hardwood forest in Tennessee. Forest Ecology and Management. 242(2–3): 727–732.

Rose, A.K. 2013. Virginia's forests, 2011. Resour. Bull. SRS-197. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 92 p.

Towle, R. 2021. WhiteBlaze pages 2021. A complete Appalachian Trail guidebook. https://www.whiteblazepages.com/images/2021%20WhiteBlaze%20Pages-printable-SAMPLE.pdf. [Date accessed: December 8, 2022].

U.S. Census Bureau. 2019. 2019 TIGER/Line Shapefiles. [Machine-readable data files]. https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.2019.html#list-tab-2WACYN8LDK61B29LS8. [Date accessed: May 2022].

U.S. Department of Agriculture (USDA), Forest Service. 1992. Forest Service resource inventories: an overview. Washington, DC: U.S. Department of Agriculture, Forest Service, Forest Inventory, Economics, and Recreation Research. 39 p.

Literature Cited

U.S. Department of Agriculture (USDA), Forest Service. 2012. Forest Inventory and Analysis national core field guide. Volume 1: field data collection procedures for Phase 2 plots. Version 4.01. Washington, DC. 300 p. https://www.fia.fs.usda.gov/library/field-guides-methods-proc/index.php. [Date accessed: December 8, 2022].

U.S. Department of Agriculture (USDA), Forest Service. 2014. Forest Inventory and Analysis national core field guide. Volume 1: field data collection procedures for Phase 2 plots. Version 6.11. Washington, DC. 305 p.

U.S. Department of Agriculture (USDA), Forest Service. 2021. TPO toolkit-TPO data download. https://usfs-public.app.box.com/s/y4ziirdb9v7zardus0cuajh7ziy9b2id. [Date accessed: November 5, 2021].

U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS). 2019. 2017 Census of Agriculture. Complete data available at www.nass.usda.gov/AgCensus. [Date accessed: June 2022].

U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2016. The PLANTS database. National Plant Data Team, Greensboro, NC. https://plants.usda.gov. [Date accessed: December 8, 2022].

U.S. Department of the Interior (DOI), U.S. Geological Survey (USGS), Gap Analysis Project (GAP). 2020. Protected Areas Database of the United States (PAD-US) 2.1. https://doi.org/10.5066/P92QM3NT.

Woodall, C.W.; Heath, L.S.; Domke, G.M.; Nichols, M.C. 2011. Methods and equations for estimating aboveground volume, biomass, and carbon for trees in the U.S. forest inventory, 2010. Gen. Tech. Rep. NRS-88. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 30 p.

GLOSSARY

Note: Timber Product Output definitions are indicated by an asterisk (*).

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 ≥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 ≥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 ≥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 ≥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 include 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 ≥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 ≥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.

***Board foot**—A unit of measure applied to lumber that is 1-foot long, 1-foot wide, and 1-inch thick (or its equivalent) and associated with roundwood as to its potential yield of such products.

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

*Byproducts—Primary wood products, e.g., pulp chips, animal bedding, and fuelwood, recycled from mill residues.

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 ≥3 inches and a length of ≥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.

***Composite panel—**Roundwood products manufactured into chips, wafers, strands, flakes, shavings, or sawdust and then reconstituted into a variety of panel and engineered lumber products.

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.

***Consumption—**The quantity of a commodity, such as pulpwood, utilized by a particular mill or group of mills.

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 1.0–4.9 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.

***Diameter inside bark (d.i.b.)**—Diameter measured at any point on a tree or log that excludes the bark.

Diameter at root collar (d.r.c.)—Diameter measured at the root collar or at the natural ground line, whichever is higher, outside the bark. Measure tree stems only, not branches.

Diameter outside bark (d.o.b.)—Diameters are measured outside the bark at 4.5 feet above the ground on the uphill side of the tree. This location, called diameter at breast height or d.b.h., is above most butt swell and brush. It is also at a comfortable arm position for most people.

Disturbance—Natural or human-caused disruption that is ≥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 remeasured plots only, those disturbances that have occurred since the previous inventory are recognized.

Diversion—See: Components of change.

***Domestic fuelwood**—The volume of roundwood harvested to produce heat for residential settings.

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 fuel bed; fuel loading on the microplot; and residue piles are also measured as part of the DWM indicator for FIA.

***Drain**—The volume of roundwood removed from any geographic area where timber is grown.

Dry weight—The oven-dry weight of biomass.

***Exports**—The volume of domestic roundwood utilized by mills outside the State where timber was cut.

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

***Fiber products**—Byproducts used in the manufacture of pulp, paper, paperboard, and composite products, such as chipboard.

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 form 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.)

Longleaf-slash pine—Forests in which longleaf pine, slash pine, or other southern yellow pines, except loblolly or shortleaf 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 as 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 removals**—The growing-stock volume removed from poletimber and sawtimber trees in the timberland inventory. (Note: Includes volume removed for roundwood products, logging residues, and other removals.)

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.

***Growing-stock volume**—The cubic-foot volume of sound wood in growing-stock trees at least 5.0 inches d.b.h. from a 1-foot stump to a minimum 4.0-inch top d.o.b. of the central stem.

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 ≤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.

***Imports**—The volume of domestic roundwood delivered to a mill or group of mills in a specific State but harvested outside that State.

***Industrial fuelwood**—A roundwood product, with or without bark, used to generate energy at a manufacturing facility such as a wood-using mill.

***Industrial roundwood products**—Any primary use of the main stem of a tree, such as saw logs, pulpwood, veneer logs, intended to be processed into primary wood products such as lumber, wood pulp, and sheathing at primary wood-using mills.

***International 1/4-inch rule**—A log rule or formula for estimating the board-foot volume of logs, allowing 1/2 inch of taper for each 4-foot length. The rule appears in a number of forms that allow for kerf. In the form used by FIA, a 1/4 inch of kerf is assumed. This rule is used as the U.S. Forest Service standard log rule in the Eastern United States.

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 ≥1.0 acre in size and ≤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 ≥1.0 acre in size and ≥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 United States, or other reasons.

Large-diameter trees—Softwoods ≥9.0 inches d.b.h. and hardwoods ≥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.).

***Log**—8-foot (2.4-m) or longer tree segment suitable for processing into lumber, veneer, or other wood products.

***Logging residues**—The unused portions of trees cut or destroyed during harvest and left in the forest.

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., Resources 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.

***Merchantable portion**—The 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. The portion of a woodland species tree from the d.r.c. measurement to the 1.5-inch diameters of all the qualifying stems.

***Merchantable volume**—Solid-wood volume in the merchantable portion of live trees.

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.

***Noncommercial species**—Tree species of typically small size, poor form, or inferior quality that normally do not develop into trees suitable for industrial wood products.

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 ≥120 feet wide, and clearings, etc., ≥1.0 acre in size, to qualify as nonforest land.

***Nongrowing-stock sources**—The net volume removed from the nongrowing-stock portions of poletimber and sawtimber trees (stumps, tops, limbs, cull sections of central stem) and from any portion of a rough, rotten, sapling, dead, or nonforest tree.

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 products**—A miscellaneous category of roundwood products, e.g., cooperage, excelsior, shingles, and mill residue byproducts (charcoal, bedding, mulch, etc.).

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.

***Other sources**—See: Nongrowing-stock sources.

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 U.S. 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 P2+—A subset of Phase 2 plots where additional attributes related to down woody material are measured.

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

***Plant byproducts**—Plant residues that are recovered and recycled during the manufacturing process into useful products, such as pulp chips, bark mulch, fuel, etc.

***Plant residues**—Wood material generated in the production of timber products at primary manufacturing plants.

Bark.

Coarse residues—Material, such as slabs, edgings, trim, veneer cores and ends, which is suitable for chipping.

Fine residues—Material, such as sawdust, shavings, and veneer residue, which is not suitable for chipping.

Poletimber-size 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.

***Posts, poles, and pilings**—Roundwood products milled (cut or peeled) into standard sizes (lengths and circumferences) to be put in the ground to provide vertical and lateral support in buildings, foundations, utility lines, and fences. May also include nonindustrial (unmilled) products.

***Primary wood-using plants**—Industries that convert roundwood products (saw logs, veneer logs, pulpwood, etc.) into primary wood products, such as lumber, veneer or sheathing, and wood pulp.

Private land—See: Ownership.

***Production**—The total volume of known roundwood harvested from land within a State, regardless of where it is consumed. Production is the sum of timber harvested and used within a State, and all roundwood exported to other States.

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.

***Pulpwood**—A roundwood product that will be reduced to individual wood fibers by chemical or mechanical means. The fibers are used to make a

broad generic group of pulp products that includes paper products, as well as fiberboard, insulating board, and paperboard.

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.

***Receipts**—The quantity or volume of industrial roundwood received at a mill or by a group of mills in a State, regardless of the geographic source. Volume of roundwood receipts is equal to the volume of roundwood retained in a State plus roundwood imported from other States.

***Red oaks**—Quercus species in the subgenus Erythrobalanus. Among other characteristics, red oaks have leaves with bristles at the tips of the lobes and leaf apex, and their acorns require two growing seasons to mature. FIA divides the red oaks into two categories:

Select red oaks—Cherrybark, Shumard, and northern red oaks.

Other red oaks—All other red oak species.

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.

***Retained**—Roundwood volume harvested from and processed by mills within the same State.

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

***Rotten trees**—Live timber species (excludes nonsaw-log species) that do not contain at least one 12-foot saw log or two noncontiguous 8-foot merchantable logs now or prospectively, primarily because of rotten cull. Less than 1/3 of its gross board-foot volume meets size, soundness, and grade requirements and <1/2 of the total board-foot cull is due to form board-foot cull.

***Rough trees**—Live timber species (excludes nonsaw-log species) that do not contain at least one 12-foot saw log or two noncontiguous 8-foot merchantable logs now or prospectively, primarily because of roughness or poor form. Less than 1/3 of its gross board-foot volume meets size, soundness, and grade requirements and <1/2 of the total board-foot cull is rotten or unsound.

***Roundwood products**—Any primary product, such as lumber, veneer, composite panels, poles, pilings,

pulp, or fuelwood that is produced from roundwood.

Roundwood logs—Logs or other round sections cut from trees for industrial manufacture or consumer uses.

Roundwood chipped—Any timber cut primarily for industrial manufacture, delivered to nonpulpmills, chipped, and then sold to pulpmills for use as fiber. Includes tops, whole trees, and pulpwood sticks.

***Salvable dead trees**—Standing or downed dead trees that were formerly growing stock and considered merchantable. Trees must be at least 5.0 inches d.b.h. to qualify.

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

***Saw log**—A roundwood product, usually ≥8 feet in length, processed into a variety of sawn products such as lumber, cants, pallets, railroad ties, and timbers.

***Saw-log portion**—That portion of the main stem of a timber species tree of large-diameter size from a 1-foot stump to a minimum top d.o.b. 7.0 inches for softwoods and 9.0 inches for hardwoods (equivalent 6.0 inches d.i.b. for softwoods, 8.0 inches d.i.b. for hardwoods).

***Saw-log top**—The point on the bole of sawtimber trees above which a conventional saw log cannot be produced. The minimum saw-log top is 7.0 inches d.o.b. for softwoods and 9.0 inches d.o.b. for hardwoods for FIA standards.

***Sawtimber-size trees**—Softwood timber species ≥9.0 inches d.b.h., and hardwood timber species ≥11.0 inches d.b.h. Now referred to as large-diameter trees.

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 1.0–4.9 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.

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

Planted—Planted or artificially seeded.

Natural—No evidence of artificial regeneration.

***Standard cord**—A unit of measure applied to roundwood, usually bolts or split wood. It is a stack of wood 4 feet high, 4 feet wide, and 8 feet long encompassing 128 cubic feet of wood, bark, and air space. This usually translates to approximately 75.0 to 81.0 cubic feet of solid wood for pulpwood, because pulpwood is more uniform.

***Standard unit—**A unit measure applied to roundwood timber products. Board feet (International 1/4-inch rule) are the standard unit used for saw logs and veneer; cords are used for pulpwood, composite panel, and fuelwood; hundred pieces for poles; thousand pieces for posts; and thousand cubic feet for all other miscellaneous forest products.

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-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 (1/24 acre), primarily used to sample trees ≥5.0 inches 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.

***Timber product output—**A unit measure applied to roundwood timber products. Board feet (International

1/4-inch rule) are the standard unit used for saw logs and veneer; cords are used for pulpwood, composite panel, and fuelwood; hundred pieces for poles; thousand pieces for posts; and thousand cubic feet for all other miscellaneous forest products.

***Timber products—**Roundwood products and byproducts.

***Timber removals—**The total volume of trees removed from the timberland inventory by harvesting, cultural operations such as stand improvement, land clearing, or changes in land use. (Note: Includes roundwood products, logging residues, and other removals.)

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.

***Upper stem portion**—The part of the main stem of sawtimber trees above the saw-log top and the minimum top diameter of 4.0 inches outside bark, or to the point where the main stem breaks into limbs.

***Utilization studies**—Studies conducted on active logging operations to develop factors for merchantable portions of trees left in the woods (logging residues), logging damage, and utilization of the unmerchantable portion of growing-stock trees and nongrowing-stock trees.

***Veneer log**—A roundwood product either rotary cut, sliced, stamped, or sawn into a variety of veneer products such as plywood, finished panels, veneer sheets, or sheathing.

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.

***Weight**—A unit of measure for mill residues, expressed as oven-dry tons (2,000 oven-dry pounds).

***White oaks**—Quercus species in the subgenus Leucobalanus. Among other characteristics, white oaks have leaves lacking bristles on the lobes or leaf apex, and their acorns require one growing season to mature. FIA divides the white oaks into two categories:

Select white oaks—White, swamp chestnut, swamp white, chinkapin, Durand, and bur oaks.

Other white oaks—All other white oak species.

Metric equivalents

1 acre = 4046.87 m^2 or 0.404687 ha

1 cubic foot = 0.028317 m^3

1 inch = 2.54 cm or 0.0254 m

Breast height (4.5 feet) = 1.4 m above the ground

1 square foot = 929.03 cm^2 or 0.0929 m^2

1 square foot of basal area per acre = 0.229568 m^2/ha

1 cubic foot per acre = 0.0699722 m^3/ha

1 pound = 0.454 kg

1 ton = 0.908 metric ton

APPENDIX A—INVENTORY METHODS

The Georgia 2019 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 survey plots by Forest Inventory and Analysis (FIA) field personnel. Phase 2+ (P2+, formerly identified as 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 (fig. A.1). The diagram in figure A.1 shows the transects on each subplot (P2+); only the Pacific Northwest FIA region (fig. A.2) uses the macroplot. 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 P2+ hexagon, 20 percent per subcycle. P2 and P2+ 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.

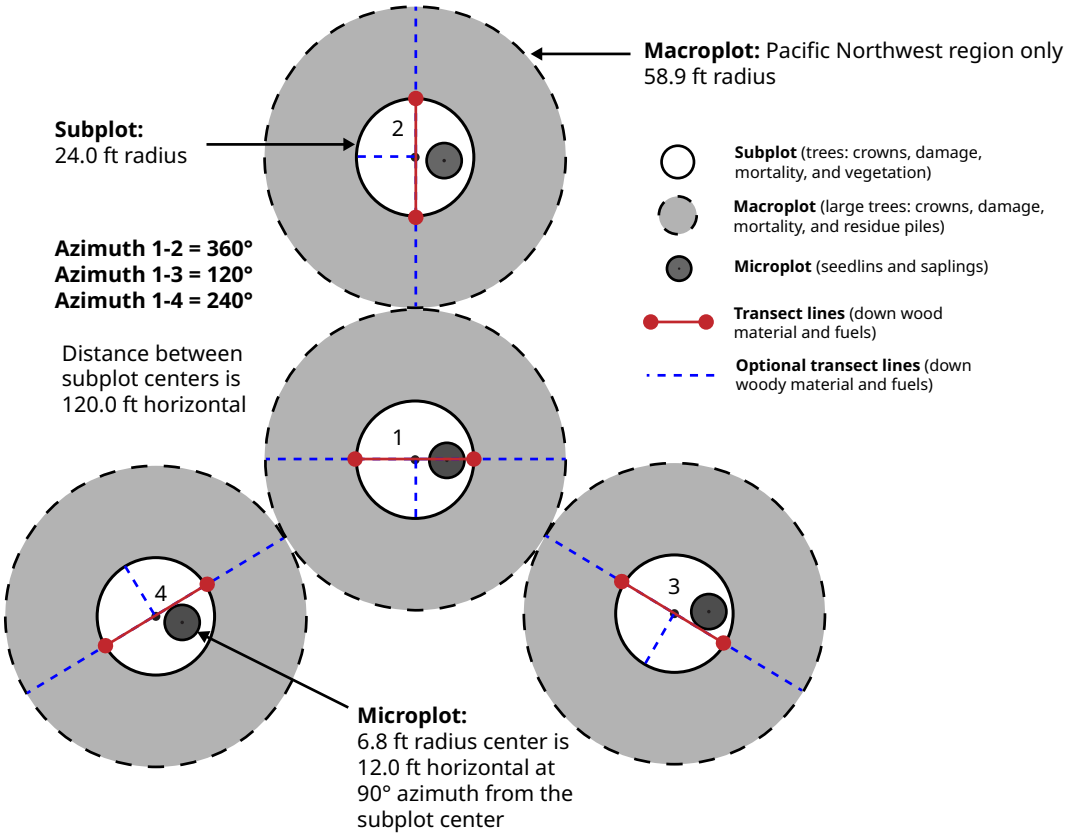

Figure A.1—Annual inventory fixed-plot design (the Phase 2 [P2] plot).

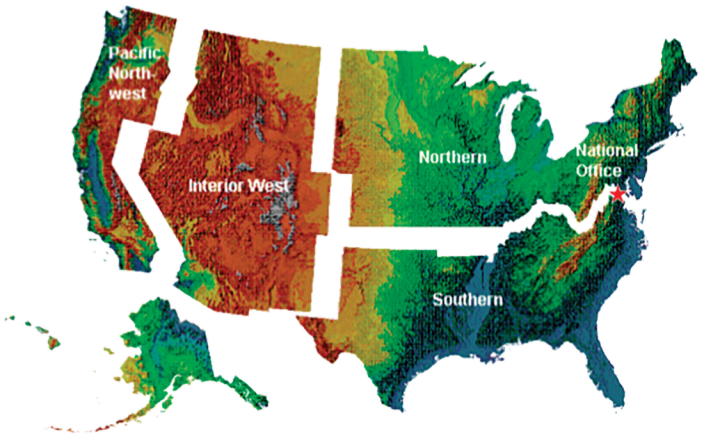

Figure A.2—National Forest Inventory and Analysis regions.

After field measurements are completed, a cycle (5 years) of data is available for the 5-year report. The 2019 inventory accounted for a total of 4,701 plots where 2,713 were forested across the State. There were 931, 558, 541, 429, and 477 plots measured in the Southeast, Southwest, Central, North Central, and North units, respectively. A total of 2,721 plots measured for the 2014 inventory were remeasured during the 2019 inventory. The remeasured plots were used to calculate estimates of growth, removals, and mortality, commonly referred to as GRM.

Note: These data were accessed and compiled from the FIA database (FIADB) in October, November, and December 2021 and February 2022. Publicly available data from the FIADB are regularly updated when data collection or processing anomalies are found and corrected. Additionally, new data are added on a regular basis which may be reflected by small changes in the past or current estimates.

Phase 1

For the 2019 inventory of Georgia, 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 of the U.S. Department of Agriculture, Forest Service, will not agree exactly with the statistical estimate of national forest land derived by FIA. 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 ≥5.0 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 1.0–4.9 inches d.b.h. and seedlings (<1.0 inch d.b.h.) are measured in these microplots (USDA 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: (1) land use, (2) forest type, (3) stand size, (4) ownership, (5) stand density, (6) regeneration status, and (7) reserved status. A new condition is defined and mapped each time one of these variables changes during plot measurement.

Phase 2+

Data on forest health variables (P2+) are collected on about 1/16 of the P2 survey plots. P2+ data are coarse descriptions and are meant to be used as general indicators of overall forest health over large geographic areas. P2+ 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 Georgia 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.

APPENDIX B—DATA RELIABILITY

A relative standard of accuracy has been incorporated into the forest survey. 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 postsurvey 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 Core Field Guide (USDA Forest Service 2012). 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.

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.

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. 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 Central survey unit is computed as:

$$SE_S = 2.01\% \left[\frac{\sqrt{12,795,915,772}}{\sqrt{6,855,051,565}} \right] = 2.75\%$$

Thus, the estimated sampling error is 2.75 percent, and the resulting 68.27-percent confidence interval for softwood live-tree volume in the Central survey unit is 6,855.05 ± 188.25 million cubic feet.

APPENDIX C—SUPPLEMENTAL TABLES

Table C.1—Area by survey unit and land status, Georgia, 2019

Unit	Total area	All forest	Land status						Nonforest land	Census water
			Unreserved			Reserved				
			Total	Timberland	Unproductive	Total	Productive	Unproductive		
	thousand acres									
Southeast (Unit 1)	11,183.2	7,877.1	7,514.3	7,514.3	0.0	362.8	362.8	0.0	2,827.2	478.9
Southwest (Unit 2)	5,645.8	2,880.2	2,880.2	2,880.2	0.0	0.0	0.0	0.0	2,665.9	99.8
Central (Unit 3)	10,621.9	7,594.6	7,549.1	7,543.3	5.8	45.5	45.5	0.0	2,854.3	173.0
North Central (Unit 4)	6,309.2	3,144.7	3,144.7	3,144.7	0.0	0.0	0.0	0.0	3,030.4	134.1
North (Unit 5)	4,271.9	2,921.8	2,749.9	2,746.7	3.3	171.9	171.9	0.0	1,280.0	70.1
All survey units	38,031.9	24,418.2	23,838.2	23,829.1	9.1	580.1	580.1	0.0	12,657.7	956.0

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.

Table C.2—Area of forest land by ownership class and land status, Georgia, 2019

Ownership class		All forest land	Unreserved			Reserved		
			Total	Timberland	Unproductive	Total	Productive	Unproductive
		thousand acres						
USDA Forest Service	National forest	865.9	704.9	704.9	0.0	161.1	161.1	0.0
	Total	865.9	704.9	704.9	0.0	161.1	161.1	0.0
Other Federal	National Park Service	33.0	0.0	0.0	0.0	33.0	33.0	0.0
	U.S. Fish and Wildlife Service	386.1	0.0	0.0	0.0	386.1	386.1	0.0
	Dept. of Defense/ Dept. of Energy	545.0	545.0	545.0	0.0	0.0	0.0	0.0
	Other Federal	26.7	26.7	26.7	0.0	0.0	0.0	0.0
	Total	990.7	571.7	571.7	0.0	419.0	419.0	0.0
State and local government	State	483.3	483.3	483.3	0.0	0.0	0.0	0.0
	Local	371.7	371.7	371.7	0.0	0.0	0.0	0.0
	Total	855.0	855.0	855.0	0.0	0.0	0.0	0.0
Forest industry	Corporate	1,403.5	1,403.5	1,403.5	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	11.9	11.9	11.9	0.0	0.0	0.0	0.0
	Total	1,415.4	1,415.4	1,415.4	0.0	0.0	0.0	0.0
Nonindustrial private	Corporate	7,025.0	7,025.0	7,025.0	0.0	0.0	0.0	0.0
	Conservation/ natural resources organization	62.6	62.6	62.6	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	221.7	221.7	221.7	0.0	0.0	0.0	0.0
	Individual	12,982.0	12,982.0	12,972.9	9.1	0.0	0.0	0.0
	Total	20,291.2	20,291.2	20,282.1	9.1	0.0	0.0	0.0
All classes		24,418.2	23,838.2	23,829.1	9.1	580.1	580.1	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.

Table C.3—Area of forest land by forest-type group and ownership group, Georgia, 2019

Forest-type group		All ownerships	USDA Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
		~~ *thousand acres* ~~~~~~					
Softwood types	White-red-jack pine	81.4	37.6	0.0	0.0	0.0	43.8
	Longleaf-slash pine	3,516.2	5.9	227.4	101.8	446.6	2,734.5
	Loblolly-shortleaf pine	7,435.7	108.8	195.3	223.7	508.6	6,399.4
	Other eastern softwoods	9.6	0.0	1.5	0.0	0.0	8.1
	Total softwoods	11,042.9	152.3	424.1	325.5	955.2	9,185.7
Hardwood types	Oak-pine	2,771.5	144.0	117.5	122.8	103.2	2,284.0
	Oak-hickory	6,452.7	556.5	127.2	248.9	45.1	5,475.0
	Oak-gum-cypress	3,244.9	1.9	266.3	107.9	253.9	2,614.8
	Elm-ash-cottonwood	487.1	4.0	4.4	36.4	21.7	420.7
	Other hardwoods	27.8	7.3	0.0	0.0	0.0	20.5
	Tropical hardwoods	4.8	0.0	0.0	4.8	0.0	0.0
	Exotic hardwoods	76.8	0.0	0.0	5.8	0.0	71.1
	Total hardwoods	13,065.6	713.6	515.4	526.6	424.0	10,886.1
Nonstocked		309.7	0.0	51.2	2.9	36.2	219.4
All groups		24,418.2	865.9	990.7	855.0	1,415.4	20,291.2

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.

Table C.4—Area of forest land by forest-type group and stand-size class, Georgia, 2019

Forest-type group		All classes	Stand-size class			
			Large diameter	Medium diameter	Small diameter	Nonstocked
		thousand acres				
Softwood types	White-red-jack pine	81.4	63.0	14.1	4.3	0.0
	Longleaf-slash pine	3,516.2	1,719.4	1,114.8	681.9	0.0
	Loblolly-shortleaf pine	7,435.7	4,427.0	1,805.8	1,202.9	0.0
	Other eastern softwoods	9.6	0.0	9.6	0.0	0.0
	Total softwoods	11,042.9	6,209.4	2,944.4	1,889.1	0.0
Hardwood types	Oak-pine	2,771.5	1,436.9	521.8	812.8	0.0
	Oak-hickory	6,452.7	3,692.4	1,039.8	1,720.5	0.0
	Oak-gum-cypress	3,244.9	1,708.8	745.2	790.9	0.0
	Elm-ash-cottonwood	487.1	245.0	96.4	145.7	0.0
	Other hardwoods	27.8	4.7	1.0	22.1	0.0
	Tropical hardwoods	4.8	4.8	0.0	0.0	0.0
	Exotic hardwoods	76.8	2.4	28.5	45.9	0.0
	Total hardwoods	13,065.6	7,095.1	2,432.7	3,537.9	0.0
Nonstocked		309.7	0.0	0.0	0.0	309.7
All groups		24,418.2	13,304.5	5,377.1	5,427.0	309.7

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.5—Area of forest land by forest-type group and stand origin, Georgia, 2019

Forest-type group		Total	Stand origin	
			Natural stands	Artificial regeneration
		~~ *thousand acres* ~~~~~~~~~~~~		
Softwood types	White-red-jack pine	81.4	76.4	5.0
	Longleaf-slash pine	3,516.2	1,033.0	2,483.1
	Loblolly-shortleaf pine	7,435.7	3,157.1	4,278.7
	Other eastern softwoods	9.6	9.6	0.0
	Total softwoods	11,042.9	4,276.1	6,766.8
Hardwood types	Oak-pine	2,771.5	2,304.4	467.1
	Oak-hickory	6,452.7	6,213.7	239.0
	Oak-gum-cypress	3,244.9	3,239.0	5.9
	Elm-ash-cottonwood	487.1	460.7	26.4
	Other hardwoods	27.8	27.8	0.0
	Tropical hardwoods	4.8	4.8	0.0
	Exotic hardwoods	76.8	67.6	9.2
	Total hardwoods	13,065.6	12,318.0	747.6
Nonstocked		309.7	241.7	68.0
All groups		24,418.2	16,835.9	7,582.4

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 timberland disturbed annually by forest-type group and disturbance class, Georgia, 2019

Forest-type group[b]		Disturbance class[a]							
		Insects	Disease	Weather	Fire	Domestic animals	Wild animals	Human	Other natural
		~~ *thousand acres* ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~							
Softwood types	White-red-jack pine	4.8	0.3	0.0	1.1	0.0	0.0	0.0	0.0
	Longleaf-slash pine	5.9	44.7	22.0	134.5	3.5	0.0	23.4	0.0
	Loblolly-shortleaf pine	38.7	45.7	13.7	199.5	7.5	0.3	10.7	5.9
	Other eastern softwoods	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
	Total softwoods	49.4	90.8	35.8	336.2	10.9	0.3	34.1	5.9
Hardwood types	Oak-pine	15.3	9.0	10.0	48.7	3.9	3.2	11.9	1.0
	Oak-hickory	31.7	19.6	19.8	69.2	17.3	4.5	12.2	1.4
	Oak-gum-cypress	3.2	6.3	25.2	11.6	7.9	15.9	1.2	1.1
	Elm-ash-cottonwood	0.0	0.0	1.7	0.9	0.0	4.3	0.4	0.0
	Other hardwoods	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	0.9
	Exotic hardwoods	0.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0
	Total hardwoods	50.2	34.9	56.6	130.3	29.2	27.9	26.4	4.3
Nonstocked		0.0	1.4	0.8	2.7	0.4	1.0	0.0	0.2
All groups		99.6	127.1	93.2	469.2	40.5	29.2	60.5	10.5

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.
[a] Based on current conditions.
[b] Based on past conditions.

Table C.7—Area of timberland treated annually by forest-type group and treatment class (cutting), Georgia, 2019

Forest-type group[b]		Treatment class						
			Cutting[a]					
		Total treated	Final harvest	Partial harvest	Seed-tree/ shelterwood harvest	Commercial thinning	Timber stand improvement	Salvage cutting
		~~ *thousand acres* ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
Softwood types	White-red-jack pine	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Longleaf-slash pine	190.2	92.3	2.0	2.5	88.2	1.1	4.1
	Loblolly-shortleaf pine	450.4	163.5	9.3	8.8	255.8	4.3	8.6
	Other eastern softwoods	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total softwoods	640.6	255.9	11.4	11.3	344.0	5.4	12.7
Hardwood types	Oak-pine	52.7	24.4	4.5	0.8	21.0	2.0	0.0
	Oak-hickory	69.2	39.7	13.3	0.1	13.9	2.1	0.1
	Oak-gum-cypress	39.7	26.4	10.0	0.8	1.9	0.0	0.5
	Elm-ash-cottonwood	1.6	0.0	1.0	0.2	0.3	0.0	0.0
	Other hardwoods	0.5	0.5	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	0.8	0.8	0.0	0.0	0.0	0.0	0.0
	Total hardwoods	164.4	91.7	28.8	2.0	37.1	4.2	0.6
Nonstocked		2.9	2.6	0.2	0.0	0.0	0.0	0.0
All groups		807.9	350.2	40.4	13.3	381.2	9.6	13.3

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.
[a] Based on current conditions.
[b] Based on past conditions.

Table C.8—Number of live trees on forest land by species group and diameter class, Georgia, 2019

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+
		million trees															
Softwood	Longleaf and slash pines	967.7	223.2	193.8	221.5	157.5	81.6	44.6	23.3	10.8	6.0	3.0	1.9	0.4	0.1	0.0	0.0
	Loblolly and shortleaf pines	2,451.9	779.2	503.1	382.0	302.0	205.8	128.9	72.5	38.7	20.2	9.9	7.5	1.8	0.5	0.0	0.1
	Other yellow pines	160.0	73.7	33.3	16.3	12.2	9.2	6.6	3.9	2.5	1.3	0.4	0.4	0.2	0.0	0.0	0.0
	Eastern white and red pines	59.2	28.6	11.1	5.9	3.7	2.6	1.7	1.4	1.0	0.8	0.6	1.2	0.5	0.2	0.0	0.0
	Eastern hemlock	10.3	3.4	2.5	1.9	1.1	0.7	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
	Cypress	215.0	103.1	45.7	24.8	13.5	9.5	7.0	4.6	2.8	1.8	0.9	0.8	0.2	0.0	0.1	0.1
	Other eastern softwoods	71.6	47.2	11.4	7.2	2.8	1.3	0.7	0.5	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0
	Total softwoods	3,935.8	1,258.4	800.8	659.6	492.9	310.6	189.8	106.2	56.3	30.3	15.0	11.8	3.0	0.8	0.2	0.2
Hardwood	Select white oaks	219.8	92.5	37.5	23.8	16.4	12.0	10.4	9.0	6.2	5.0	3.1	2.8	0.8	0.2	0.1	0.0
	Select red oaks	38.7	19.2	5.2	3.0	2.5	1.8	1.3	1.6	1.0	0.9	0.8	0.9	0.3	0.2	0.0	0.1
	Other white oaks	358.1	190.2	64.3	28.1	19.2	15.7	11.4	10.7	6.6	4.1	2.8	2.4	1.4	0.6	0.4	0.3
	Other red oaks	1,799.7	1,170.9	292.7	123.6	69.9	43.2	29.1	23.3	16.2	10.8	6.9	7.7	3.2	1.2	0.5	0.3
	Hickory	362.3	232.4	54.2	27.4	16.9	10.6	7.3	5.9	2.9	2.1	1.4	0.8	0.2	0.1	0.1	0.0
	Hard maple	69.3	54.1	9.1	3.2	1.2	0.6	0.6	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Soft maple	1,329.6	941.1	222.1	79.9	38.1	20.1	11.7	7.0	4.5	2.2	1.3	1.2	0.4	0.1	0.0	0.0
	Beech	48.5	30.4	10.2	3.3	2.1	0.7	0.3	0.5	0.2	0.3	0.1	0.3	0.0	0.0	0.0	0.0
	Sweetgum	2,116.6	1,459.9	384.5	128.0	64.6	31.8	20.7	11.2	6.8	4.1	2.1	2.1	0.7	0.1	0.0	0.0
	Tupelo and blackgum	991.0	599.7	184.1	85.7	48.6	29.4	18.7	11.5	6.8	3.4	1.6	1.6	0.0	0.0	0.0	0.0
	Ash	130.9	85.3	21.1	10.0	5.4	2.9	1.5	1.5	1.0	1.1	0.5	0.6	0.1	0.0	0.0	0.0
	Cottonwood and aspen	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Basswood	3.0	0.9	0.6	0.4	0.2	0.2	0.3	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
	Yellow-poplar	357.0	171.4	62.8	36.3	23.2	17.1	12.7	10.1	7.1	5.0	4.5	4.4	1.6	0.5	0.2	0.0
	Black walnut	5.9	2.7	0.9	0.5	0.5	0.4	0.3	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Other eastern soft hardwoods	989.4	670.6	181.6	68.2	33.6	16.4	8.3	4.7	2.7	1.3	0.8	0.8	0.3	0.1	0.0	0.0
	Other eastern hard hardwoods	490.8	378.1	78.9	22.0	7.0	2.6	1.2	0.6	0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0
	Eastern noncommercial hardwoods	969.4	663.3	173.0	68.9	33.9	14.8	7.7	4.5	1.7	1.0	0.4	0.3	0.1	0.0	0.0	0.0
	Total hardwoods	10,280.4	6,762.7	1,782.8	712.4	383.4	220.3	143.4	102.3	64.3	41.6	26.7	26.0	9.1	3.1	1.4	0.8
All species		14,216.2	8,021.1	2,583.7	1,372.0	876.3	530.9	333.2	208.4	120.6	71.9	41.7	37.8	12.1	3.9	1.6	1.0

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.

Table C.9—Net[a] volume of live trees on forest land by ownership class and land status, Georgia, 2019

Ownership class		All forest land	Unreserved			Reserved		
			Total	Timberland	Unproductive	Total	Productive	Unproductive
		million cubic feet						
USDA Forest Service	National forest	2,904.3	2,285.2	2,285.2	0.0	619.1	619.1	0.0
	Total	2,904.3	2,285.2	2,285.2	0.0	619.1	619.1	0.0
Other Federal	National Park Service	59.7	0.0	0.0	0.0	59.7	59.7	0.0
	U.S. Fish and Wildlife Service	387.9	0.0	0.0	0.0	387.9	387.9	0.0
	Dept. of Defense/ Dept. of Energy	1,352.8	1,352.8	1,352.8	0.0	0.0	0.0	0.0
	Other Federal	54.3	54.3	54.3	0.0	0.0	0.0	0.0
	Total	1,854.6	1,407.0	1,407.0	0.0	447.6	447.6	0.0
State and local government	State	1,218.1	1,218.1	1,218.1	0.0	0.0	0.0	0.0
	Local	864.7	864.7	864.7	0.0	0.0	0.0	0.0
	Total	2,082.8	2,082.8	2,082.8	0.0	0.0	0.0	0.0
Forest industry	Corporate	1,928.5	1,928.5	1,928.5	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	33.2	33.2	33.2	0.0	0.0	0.0	0.0
	Total	1,961.8	1,961.8	1,961.8	0.0	0.0	0.0	0.0
Nonindustrial private	Corporate	12,028.7	12,028.7	12,028.7	0.0	0.0	0.0	0.0
	Conservation/ natural resources organization	75.3	75.3	75.3	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	456.4	456.4	456.4	0.0	0.0	0.0	0.0
	Individual	26,190.9	26,190.9	26,190.4	0.5	0.0	0.0	0.0
	Total	38,751.2	38,751.2	38,750.7	0.5	0.0	0.0	0.0
All classes		47,554.7	46,488.0	46,487.5	0.5	1,066.7	1,066.7	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.
[a] Excludes rotten, missing, and form cull defects volume.

Table C.10—Net[a] volume of live trees on forest land by forest-type group and stand-size class, Georgia, 2019

Forest-type group		All classes	Stand-size class			
			Large diameter	Medium diameter	Small diameter	Nonstocked
		million cubic feet				
Softwood types	White-red-jack pine	371.4	350.2	17.6	3.6	0.0
	Longleaf-slash pine	5,614.6	4,115.5	1,428.7	70.4	0.0
	Loblolly-shortleaf pine	15,572.7	12,642.6	2,731.3	198.7	0.0
	Other eastern softwoods	6.0	0.0	6.0	0.0	0.0
	Total softwoods	21,564.8	17,108.3	4,183.7	272.8	0.0
Hardwood types	Oak-pine	5,057.8	4,148.3	680.6	228.9	0.0
	Oak-hickory	12,731.8	10,964.0	1,392.0	375.8	0.0
	Oak-gum-cypress	7,401.5	6,030.3	1,174.1	197.1	0.0
	Elm-ash-cottonwood	686.8	549.6	102.8	34.4	0.0
	Other hardwoods	27.9	19.8	1.3	6.8	0.0
	Tropical hardwoods	16.6	16.6	0.0	0.0	0.0
	Exotic hardwoods	49.9	1.8	30.9	17.2	0.0
	Total hardwoods	25,972.4	21,730.5	3,381.7	860.2	0.0
Nonstocked		17.6	0.0	0.0	0.0	17.6
All groups		47,554.7	38,838.8	7,565.4	1,133.0	17.6

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.
[a] Excludes rotten, missing, and form cull defects volume.

Table C.11—Net[a] volume of live trees on forest land by species group and ownership group, Georgia, 2019

Species group		All ownerships	Ownership group				
			USDA Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
		million cubic feet					
Softwood	Longleaf and slash pines	5,763.7	0.1	493.0	212.7	528.8	4,529.0
	Loblolly and shortleaf pines	15,901.1	379.9	516.7	667.6	768.7	13,568.2
	Other yellow pines	835.9	134.5	17.6	22.2	14.9	646.7
	Eastern white and red pines	517.6	364.6	0.0	2.1	0.0	150.9
	Eastern hemlock	57.1	42.4	0.0	0.8	0.0	13.9
	Cypress	945.3	0.0	94.8	62.8	78.6	709.0
	Other eastern softwoods	90.0	0.9	4.1	4.8	1.8	78.3
	Total softwoods	24,110.6	922.4	1,126.3	973.0	1,392.9	19,696.1
Hardwood	Select white oaks	2,085.8	196.7	43.3	89.5	4.7	1,751.6
	Select red oaks	467.7	95.7	8.2	35.8	4.0	323.9
	Other white oaks	1,959.4	506.6	58.0	147.2	22.4	1,225.2
	Other red oaks	5,465.2	311.9	190.2	254.6	137.2	4,571.2
	Hickory	1,068.1	97.5	18.6	56.0	11.0	885.0
	Hard maple	44.0	3.1	4.2	1.6	0.0	35.1
	Soft maple	1,546.3	176.6	38.7	53.6	60.9	1,216.6
	Beech	109.4	3.4	1.3	5.2	0.0	99.5
	Sweetgum	2,998.9	33.5	95.2	127.5	88.9	2,653.8
	Tupelo and blackgum	2,155.8	53.0	117.6	76.4	110.3	1,798.6
	Ash	384.0	13.9	7.7	31.2	19.4	311.7
	Cottonwood and aspen	8.8	0.0	1.7	0.0	5.2	1.9
	Basswood	35.2	13.7	0.0	0.0	0.0	21.5
	Yellow-poplar	2,967.2	306.5	46.6	87.0	18.4	2,508.7
	Black walnut	31.3	0.4	0.2	0.9	0.9	28.9
	Other eastern soft hardwoods	1,130.1	40.0	62.6	87.9	42.4	897.2
	Other eastern hard hardwoods	171.2	46.9	5.4	4.8	2.7	111.5
	Eastern noncommercial hardwoods	815.7	82.8	28.8	50.5	40.5	613.1
	Total hardwoods	23,444.1	1,982.0	728.3	1,109.7	568.9	19,055.2
All species		47,554.7	2,904.3	1,854.6	2,082.8	1,961.8	38,751.2

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.
[a] Excludes rotten, missing, and form cull defects volume.

Table C.12—Net[a] volume of live trees on forest land by species group and diameter class, Georgia, 2019

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+
		million cubic feet													
Softwood	Longleaf and slash pines	5,763.7	589.4	1,048.9	1,074.2	965.2	746.5	488.3	346.4	228.7	201.6	51.5	23.0	0.0	0.0
	Loblolly and shortleaf pines	15,901.1	1,045.1	2,089.8	2,748.8	2,770.9	2,305.6	1,752.1	1,220.1	776.7	796.1	265.3	103.5	6.8	20.3
	Other yellow pines	835.9	54.2	96.2	132.3	146.3	123.9	108.6	74.1	31.6	42.1	26.6	0.0	0.0	0.0
	Eastern white and red pines	517.6	18.1	24.7	31.4	32.5	38.5	36.6	44.4	41.5	122.3	74.4	43.6	0.0	9.7
	Eastern hemlock	57.1	4.4	6.2	7.2	5.0	2.5	2.0	5.6	6.5	5.0	3.4	0.0	9.4	0.0
	Cypress	945.3	79.3	95.9	114.1	131.7	127.2	105.4	92.9	58.1	70.3	26.3	6.2	20.0	17.9
	Other eastern softwoods	90.0	17.9	15.6	12.7	10.4	10.5	9.1	6.1	7.7	0.0	0.0	0.0	0.0	0.0
	Total softwoods	24,110.6	1,808.3	3,377.2	4,120.9	4,062.1	3,354.6	2,502.1	1,789.6	1,150.8	1,237.3	447.5	176.3	36.1	47.8
Hardwood	Select white oaks	2,085.8	71.3	116.1	156.2	219.8	274.6	265.6	284.6	229.4	291.4	105.2	44.4	15.1	12.2
	Select red oaks	467.7	9.9	19.3	23.7	26.8	46.3	39.0	50.7	59.4	82.8	39.8	26.7	13.0	30.3
	Other white oaks	1,959.4	77.4	118.4	177.1	200.5	276.5	234.3	187.9	164.6	180.3	142.6	76.9	54.6	68.3
	Other red oaks	5,465.2	371.3	454.7	504.6	538.8	618.0	596.1	514.2	434.5	654.7	377.2	202.7	114.7	83.8
	Hickory	1,068.1	70.3	106.8	125.3	143.1	172.2	119.9	111.4	95.0	67.5	25.7	9.6	16.3	5.0
	Hard maple	44.0	8.8	6.9	6.9	10.6	2.7	3.4	3.9	0.9	0.0	0.0	0.0	0.0	0.0
	Soft maple	1,546.3	239.3	238.1	220.0	197.5	171.8	149.6	94.1	73.8	94.9	42.8	19.0	5.5	0.0
	Beech	109.4	8.9	13.8	9.7	6.2	11.7	7.5	14.2	9.6	15.6	4.2	0.0	8.0	0.0
	Sweetgum	2,998.9	332.7	431.5	412.8	445.2	356.6	303.9	235.4	157.0	210.3	101.1	12.3	0.0	0.0
	Tupelo and blackgum	2,155.8	232.3	305.9	340.1	348.0	300.4	253.9	156.7	95.7	111.9	4.1	6.9	0.0	0.0
	Ash	384.0	29.9	37.6	38.9	30.7	44.2	43.2	58.3	27.7	56.4	11.0	6.0	0.0	0.0
	Cottonwood and aspen	8.8	0.0	0.4	0.6	0.0	0.0	2.7	0.0	0.0	0.0	0.0	5.2	0.0	0.0
	Basswood	35.2	1.5	1.6	2.5	5.6	3.5	1.9	3.9	8.7	1.0	5.0	0.0	0.0	0.0
	Yellow-poplar	2,967.2	119.0	174.1	233.3	273.8	322.9	318.1	297.2	343.9	454.3	243.6	111.8	58.3	17.0
	Black walnut	31.3	1.5	2.6	4.5	5.5	4.0	6.8	1.7	2.0	2.7	0.0	0.0	0.0	0.0
	Other eastern soft hardwoods	1,130.1	188.5	201.2	172.7	139.8	117.1	89.7	59.0	42.8	64.6	31.5	13.1	9.9	0.0
	Other eastern hard hardwoods	171.2	52.5	39.1	26.7	21.3	14.4	6.8	3.2	2.0	5.3	0.0	0.0	0.0	0.0
	Eastern noncommercial hardwoods	815.7	176.7	187.3	146.6	114.2	82.4	37.3	35.8	16.5	14.9	4.1	0.0	0.0	0.0
	Total hardwoods	23,444.1	1,991.7	2,455.3	2,602.1	2,727.2	2,819.3	2,479.6	2,112.1	1,763.6	2,308.7	1,138.1	534.5	295.4	216.6
All species		47,554.7	3,800.0	5,832.5	6,722.9	6,789.2	6,173.9	4,981.7	3,901.7	2,914.4	3,546.0	1,585.7	710.8	331.5	264.4

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.
[a] Excludes rotten, missing, and form cull defects volume.

Table C.13—Net[a] volume of live trees on forest land by forest-type group and stand origin, Georgia, 2019

Forest-type group		Total	Stand origin	
			Natural stands	Artificial regeneration
		~~ *million cubic feet* ~~~~~~~~~~~~~~		
Softwood types	White-red-jack pine	371.4	350.2	21.1
	Longleaf-slash pine	5,614.6	2,232.6	3,382.0
	Loblolly-shortleaf pine	15,572.7	8,076.3	7,496.4
	Other eastern softwoods	6.0	6.0	0.0
	Total softwoods	21,564.7	10,665.1	10,899.5
Hardwood types	Oak-pine	5,057.8	4,811.2	246.5
	Oak-hickory	12,731.8	12,646.5	85.0
	Oak-gum-cypress	7,401.5	7,400.5	1.0
	Elm-ash-cottonwood	686.8	651.5	35.2
	Other hardwoods	27.9	27.9	0.0
	Tropical hardwoods	16.6	16.6	0.0
	Exotic hardwoods	49.9	46.5	3.5
	Total hardwoods	25,972.3	25,600.7	371.2
Nonstocked		17.7	10.1	7.6
All groups		47,554.7	35,258.5	11,229.0

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.
[a] Excludes rotten, missing, and form cull defects volume.

Table C.14—Aboveground dry weight[a] of live trees on forest land by ownership class and land status, Georgia, 2019

Ownership class		All forest land	Unreserved			Reserved		
			Total	Timberland	Unproductive	Total	Productive	Unproductive
		thousand tons						
USDA Forest Service	National forest	73,121.5	57,518.0	57,518.0	0.0	15,603.5	15,603.5	0.0
	Total	73,121.5	57,518.0	57,518.0	0.0	15,603.5	15,603.5	0.0
Other Federal	National Park Service	1,811.6	0.0	0.0	0.0	1,811.6	1,811.6	0.0
	U.S. Fish and Wildlife Service	10,412.8	0.0	0.0	0.0	10,412.8	10,412.8	0.0
	Dept. of Defense/ Dept. of Energy	32,741.6	32,741.6	32,741.6	0.0	0.0	0.0	0.0
	Other Federal	1,392.8	1,392.8	1,392.8	0.0	0.0	0.0	0.0
	Total	46,358.8	34,134.4	34,134.4	0.0	12,224.3	12,224.3	0.0
State and local government	State	31,723.1	31,723.1	31,723.1	0.0	0.0	0.0	0.0
	Local	22,687.9	22,687.9	22,687.9	0.0	0.0	0.0	0.0
	Total	54,411.1	54,411.1	54,411.1	0.0	0.0	0.0	0.0
Forest industry	Corporate	51,247.0	51,247.0	51,247.0	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	801.4	801.4	801.4	0.0	0.0	0.0	0.0
	Total	52,048.5	52,048.5	52,048.5	0.0	0.0	0.0	0.0
Nonindustrial private	Corporate	311,621.1	311,621.1	311,621.1	0.0	0.0	0.0	0.0
	Conservation/ natural resources organization	2,212.5	2,212.5	2,212.5	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	11,874.3	11,874.3	11,874.3	0.0	0.0	0.0	0.0
	Individual	681,369.7	681,369.7	681,291.9	77.8	0.0	0.0	0.0
	Total	1,007,077.5	1,007,077.5	1,006,999.7	77.8	0.0	0.0	0.0
All classes		1,233,017.2	1,205,189.4	1,205,111.7	77.8	27,827.8	27,827.8	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.
[a] Calculations based on TREE_REGIONAL_BIOMASS.REGIONAL_DRYBIOT.

Table C.15—Total carbon[a] of live trees on forest land by ownership class and land status, Georgia, 2019

Ownership class		All forest land	Unreserved			Reserved		
			Total	Timberland	Unproductive	Total	Productive	Unproductive
		thousand tons						
USDA Forest Service	National forest	36,560.7	28,759.0	28,759.0	0.0	7,801.7	7,801.7	0.0
	Total	36,560.7	28,759.0	28,759.0	0.0	7,801.7	7,801.7	0.0
Other Federal	National Park Service	905.8	0.0	0.0	0.0	905.8	905.8	0.0
	U.S. Fish and Wildlife Service	5,206.4	0.0	0.0	0.0	5,206.4	5,206.4	0.0
	Dept. of Defense/ Dept. of Energy	16,370.8	16,370.8	16,370.8	0.0	0.0	0.0	0.0
	Other Federal	696.4	696.4	696.4	0.0	0.0	0.0	0.0
	Total	23,179.4	17,067.2	17,067.2	0.0	6,112.2	6,112.2	0.0
State and local government	State	15,861.6	15,861.6	15,861.6	0.0	0.0	0.0	0.0
	Local	11,344.0	11,344.0	11,344.0	0.0	0.0	0.0	0.0
	Total	27,205.5	27,205.5	27,205.5	0.0	0.0	0.0	0.0
Forest industry	Corporate	25,623.5	25,623.5	25,623.5	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	400.7	400.7	400.7	0.0	0.0	0.0	0.0
	Total	26,024.2	26,024.2	26,024.2	0.0	0.0	0.0	0.0
Nonindustrial private	Corporate	155,810.5	155,810.5	155,810.5	0.0	0.0	0.0	0.0
	Conservation/ natural resources organization	1,106.2	1,106.2	1,106.2	0.0	0.0	0.0	0.0
	Unincorporated local partnership/ association/club	5,937.1	5,937.1	5,937.1	0.0	0.0	0.0	0.0
	Individual	340,684.8	340,684.8	340,646.0	38.9	0.0	0.0	0.0
	Total	503,538.7	503,538.7	503,499.9	38.9	0.0	0.0	0.0
All classes		616,508.6	602,594.7	602,555.8	38.9	13,913.9	13,913.9	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.
[a] 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, Georgia, 2019

Ownership class[a]		Timberland	Forest land
		million cubic feet per year	
USDA Forest Service	National forest	41.5	50.8
	Total	41.5	50.8
Other Federal	National Park Service	0.0	-0.7
	U.S. Fish and Wildlife Service	0.1	6.8
	Dept. of Defense/ Dept. of Energy	25.3	25.3
	Other Federal	1.8	1.8
	Total	27.1	33.2
State and local government	State	24.7	24.7
	Local	30.6	30.6
	Total	55.3	55.3
Forest industry	Corporate	186.6	186.6
	Unincorporated partnership/association/club	2.9	2.9
	Individual	2.3	2.3
	Total	191.7	191.7
Nonindustrial private	Corporate	588.0	588.0
	Conservation/natural resources organization	2.8	2.8
	Unincorporated partnership/association/club	19.7	19.7
	Individual	1,153.3	1,153.4
	Total	1,763.9	1,763.9
All classes		2,079.5	2,094.9

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.
[a] Based on current conditions.

Table C.17—Average annual net growth of live trees on forest land by forest-type group and stand-size class, Georgia, 2019

Forest-type group[a]		All classes	Stand-size class[a]			
			Large diameter	Medium diameter	Small diameter	Nonstocked
		million cubic feet per year				
Softwood types	White-red-jack pine	7.6	6.3	0.9	0.4	0.0
	Longleaf-slash pine	372.8	113.9	183.5	75.4	0.0
	Loblolly-shortleaf pine	984.6	426.8	430.2	127.6	0.0
	Other eastern softwoods	0.4	0.0	0.4	0.1	0.0
	Total softwoods	1,365.4	547.0	615.0	203.4	0.0
Hardwood types	Oak-pine	194.4	88.8	57.9	47.7	0.0
	Oak-hickory	327.8	195.3	66.3	66.2	0.0
	Oak-gum-cypress	177.0	97.6	49.2	30.2	0.0
	Elm-ash-cottonwood	24.4	8.5	9.1	6.8	0.0
	Other hardwoods	1.0	0.2	0.0	0.8	0.0
	Tropical hardwoods	0.2	0.2	0.0	0.0	0.0
	Exotic hardwoods	2.9	0.0	0.7	2.2	0.0
	Total hardwoods	727.7	390.7	183.1	153.8	0.0
Nonstocked		1.8	0.0	0.0	0.0	1.8
All groups		2,094.9	937.7	798.1	357.2	1.8

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.
[a] Based on past conditions.

Table C.18—Average annual net growth of live trees on forest land by species group and ownership group, Georgia, 2019

Species group		All ownerships	Ownership group[a]				
			USDA Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
		million cubic feet per year					
Softwood	Longleaf and slash pines	388.9	0.0	10.0	10.1	56.8	312.0
	Loblolly and shortleaf pines	1,047.7	6.5	13.7	28.0	82.9	916.6
	Other yellow pines	13.6	-0.2	0.2	0.3	1.0	12.2
	Eastern white and red pines	14.2	8.9	0.0	-0.4	0.0	5.7
	Eastern hemlock	-0.9	-1.0	0.0	0.0	0.0	0.1
	Cypress	15.4	0.0	1.8	1.3	0.7	11.6
	Other eastern softwoods	3.6	0.0	0.0	0.1	0.1	3.3
	Total softwoods	1,482.5	14.3	25.8	39.4	141.4	1,261.6
Hardwood	Select white oaks	55.8	4.6	1.2	2.4	0.1	47.5
	Select red oaks	12.1	1.0	0.2	1.4	0.2	9.3
	Other white oaks	43.9	10.7	0.6	2.4	0.4	29.8
	Other red oaks	156.0	4.6	2.0	2.8	5.3	141.3
	Hickory	17.4	0.8	0.1	0.3	0.4	15.9
	Hard maple	1.4	-0.1	0.1	0.1	0.0	1.2
	Soft maple	38.2	3.6	0.7	1.5	2.8	29.7
	Beech	3.2	0.1	0.1	0.0	0.0	3.1
	Sweetgum	96.9	0.7	1.6	2.2	4.1	88.4
	Tupelo and blackgum	38.8	1.1	1.4	1.2	2.9	32.2
	Ash	5.8	0.2	-0.1	-1.8	0.8	6.8
	Cottonwood and aspen	0.2	0.0	0.1	0.0	0.1	0.0
	Basswood	0.8	0.5	0.0	0.0	0.0	0.3
	Yellow-poplar	86.6	6.4	1.1	1.4	1.0	76.7
	Black walnut	0.8	0.0	0.0	0.0	0.0	0.8
	Other eastern soft hardwoods	29.9	0.7	-0.7	1.1	1.4	27.4
	Other eastern hard hardwoods	3.2	0.4	0.1	-0.1	-0.1	2.8
	Eastern noncommercial hardwoods	21.2	1.3	-1.2	1.0	1.9	18.2
	Total hardwoods	612.4	36.5	7.4	15.9	21.3	531.3
All species		2,094.9	50.8	33.2	55.3	162.7	1,792.9

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.
[a] Based on current conditions.

Table C.19—Average annual mortality of live trees by ownership class and land status, Georgia, 2019

Ownership class[a]		Timberland	Forest land
		million cubic feet per year	
USDA Forest Service	National forest	25.5	32.1
	Total	25.5	32.1
Other Federal	National Park Service	0.0	1.6
	U.S. Fish and Wildlife Service	0.0	6.3
	Dept. of Defense/ Dept. of Energy	16.4	16.4
	Other Federal	0.2	0.2
	Total	16.6	24.5
State and local government	State	18.1	18.1
	Local	13.3	13.3
	Total	31.4	31.4
Forest industry	Corporate	15.8	15.8
	Unincorporated partnership/association/club	0.4	0.4
	Total	16.2	16.2
Nonindustrial private	Corporate	113.4	113.4
	Conservation/natural resources organization	1.3	1.3
	Unincorporated partnership/association/club	4.2	4.2
	Individual	262.3	262.3
	Total	381.2	381.2
All classes		471.0	485.5

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.
[a] Based on current conditions.

Table C.20—Average annual mortality of live trees on forest land by forest-type group and stand-size class, Georgia, 2019

Forest-type group[a]		All classes	Stand-size class[a]			
			Large diameter	Medium diameter	Small diameter	Nonstocked
		~~ *million cubic feet per year* ~~~~~~~~~~~~~~~~~~~				
Softwood types	White-red-jack pine	3.0	2.9	0.1	0.0	0.0
	Longleaf-slash pine	41.0	26.6	13.1	1.3	0.0
	Loblolly-shortleaf pine	151.2	111.8	35.4	4.0	0.0
	Other eastern softwoods	0.0	0.0	0.0	0.0	0.0
	Total softwoods	195.2	141.4	48.6	5.3	0.0
Hardwood types	Oak-pine	63.3	49.9	11.3	2.1	0.0
	Oak-hickory	121.5	101.1	16.3	4.0	0.0
	Oak-gum-cypress	91.6	71.3	17.3	3.0	0.0
	Elm-ash-cottonwood	11.7	8.1	1.9	1.7	0.0
	Other hardwoods	0.1	0.1	0.0	0.0	0.0
	Tropical hardwoods	0.0	0.0	0.0	0.0	0.0
	Exotic hardwoods	0.9	0.0	0.3	0.6	0.0
	Total hardwoods	289.1	230.5	47.2	11.4	0.0
Nonstocked		1.2	0.0	0.0	0.0	1.2
All groups		485.5	371.8	95.7	16.7	1.2

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.
[a] Based on past conditions.

Table C.21—Average annual mortality of live trees on forest land by species group and ownership group, Georgia, 2019

Species group		All ownerships	Ownership group[a]				
			USDA Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
		~~ *million cubic feet per year* ~~~~~~~~~~~~~~~~~~~~~~					
Softwood	Longleaf and slash pines	46.0	0.0	4.9	2.5	3.8	34.9
	Loblolly and shortleaf pines	157.1	8.6	6.0	8.7	4.1	129.7
	Other yellow pines	18.2	4.3	0.3	0.3	0.2	13.2
	Eastern white and red pines	4.4	3.2	0.0	0.5	0.0	0.7
	Eastern hemlock	2.1	1.9	0.0	0.0	0.0	0.2
	Cypress	5.8	0.0	0.4	0.0	1.8	3.6
	Other eastern softwoods	1.2	0.0	0.2	0.1	0.0	1.0
	Total softwoods	234.9	18.0	11.7	12.1	9.8	183.2
Hardwood	Select white oaks	8.9	0.6	0.0	0.1	0.0	8.3
	Select red oaks	4.8	1.3	0.1	0.0	0.0	3.4
	Other white oaks	9.8	1.7	0.4	0.6	0.2	6.8
	Other red oaks	79.5	4.3	3.1	7.6	1.6	62.9
	Hickory	9.6	1.3	0.3	0.8	0.0	7.1
	Hard maple	0.2	0.1	0.0	0.0	0.0	0.1
	Soft maple	24.3	1.2	0.5	0.3	1.1	21.2
	Beech	0.0	0.0	0.0	0.0	0.0	0.0
	Sweetgum	25.9	0.5	1.0	2.5	0.8	21.1
	Tupelo and blackgum	14.3	0.2	1.3	0.8	0.5	11.5
	Ash	7.6	0.2	0.3	2.9	0.1	4.2
	Cottonwood and aspen	0.2	0.0	0.0	0.0	0.0	0.2
	Basswood	0.2	0.0	0.0	0.0	0.0	0.2
	Yellow-poplar	24.2	0.9	0.9	1.3	0.4	20.8
	Black walnut	0.5	0.0	0.0	0.0	0.0	0.5
	Other eastern soft hardwoods	27.9	0.5	3.2	1.9	1.2	21.1
	Other eastern hard hardwoods	2.8	0.6	0.0	0.2	0.1	1.8
	Eastern noncommercial hardwoods	9.9	0.7	1.7	0.5	0.2	6.8
	Total hardwoods	250.6	14.1	12.8	19.3	6.3	198.0
All species		485.5	32.1	24.5	31.4	16.2	381.2

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.
[a] Based on current conditions.

Table C.22—Average annual net removals of live trees by ownership class and land status, Georgia, 2019

Ownership class[a]		Timberland	Forest land
		million cubic feet per year	
USDA Forest Service	National forest	3.2	3.2
	Total	3.2	3.2
Other Federal	U.S. Fish and Wildlife Service	0.3	1.2
	Dept. of Defense/ Dept. of Energy	20.9	20.9
	Other Federal	0.6	0.6
	Total	21.8	22.8
State and local government	State	7.2	7.2
	Local	16.4	16.4
	Total	23.5	23.5
Forest industry	Corporate	124.1	124.1
	Unincorporated partnership/association/club	0.1	0.1
	Total	124.2	124.2
Nonindustrial private	Corporate	532.9	532.9
	Conservation/natural resources organization	4.4	4.4
	Unincorporated partnership/association/club	9.8	9.8
	Individual	700.7	700.7
	Total	1,247.8	1,247.8
All classes		1,420.6	1,421.5

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.
[a] Based on current conditions.

Table C.23—Average annual removals of live trees on forest land by forest-type group and stand-size class, Georgia, 2019

Forest-type group[a]		All classes	Stand-size class[a]			
			Large diameter	Medium diameter	Small diameter	Nonstocked
		~~ *million cubic feet per year* ~~~~~~~~~~~~~~~~~~~~				
Softwood types	White-red-jack pine	0.0	0.0	0.0	0.0	0.0
	Longleaf-slash pine	330.0	174.7	152.4	2.8	0.0
	Loblolly-shortleaf pine	783.9	497.6	274.3	12.0	0.0
	Other eastern softwoods	0.3	0.0	0.0	0.3	0.0
	Total softwoods	1,114.2	672.3	426.7	15.1	0.0
Hardwood types	Oak-pine	80.6	54.7	21.9	4.1	0.0
	Oak-hickory	119.3	94.2	16.8	8.3	0.0
	Oak-gum-cypress	98.2	80.3	16.2	1.8	0.0
	Elm-ash-cottonwood	7.6	7.3	0.1	0.2	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	1.2	0.4	0.3	0.5	0.0
	Total hardwoods	307.0	236.9	55.2	14.8	0.0
Nonstocked		0.4	0.0	0.0	0.0	0.4
All groups		1,421.5	909.3	481.9	29.9	0.4

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.
[a]Based on past conditions.

Table C.24—Average annual removals of live trees on forest land by species group and ownership group, Georgia, 2019

Species group		All ownerships	Ownership group[a]				
			USDA Forest Service	Other Federal	State and local government	Forest industry	Nonindustrial private
		~~ *million cubic feet per year* ~~~~~~~~~~~~~~~~~~~~~~					
Softwood	Longleaf and slash pines	332.0	0.0	5.0	5.1	54.7	267.1
	Loblolly and shortleaf pines	785.2	1.4	15.8	13.5	65.4	689.1
	Other yellow pines	10.7	0.0	0.0	0.0	0.2	10.5
	Eastern white and red pines	0.7	0.3	0.0	0.0	0.0	0.4
	Eastern hemlock	0.1	0.0	0.0	0.0	0.0	0.1
	Cypress	4.5	0.0	0.0	0.0	0.1	4.5
	Other eastern softwoods	1.2	0.0	0.0	0.1	0.0	1.2
	Total softwoods	1,134.4	1.7	20.8	18.7	120.4	972.8
Hardwood	Select white oaks	26.0	0.0	0.0	0.4	0.0	25.5
	Select red oaks	4.3	0.5	0.0	1.4	0.0	2.4
	Other white oaks	13.8	0.1	0.1	0.0	0.2	13.4
	Other red oaks	78.1	0.1	0.6	0.7	1.6	75.2
	Hickory	7.7	0.0	0.0	0.0	0.0	7.6
	Hard maple	0.5	0.0	0.0	0.0	0.0	0.5
	Soft maple	20.0	0.1	0.0	0.3	0.5	19.1
	Beech	0.4	0.0	0.0	0.0	0.0	0.4
	Sweetgum	48.6	0.5	0.8	1.0	0.5	45.7
	Tupelo and blackgum	29.4	0.0	0.0	0.3	0.3	28.8
	Ash	5.2	0.0	0.0	0.0	0.0	5.1
	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	28.5	0.0	0.0	0.2	0.0	28.3
	Black walnut	0.2	0.0	0.0	0.0	0.0	0.2
	Other eastern soft hardwoods	13.9	0.1	0.2	0.1	0.4	13.1
	Other eastern hard hardwoods	1.6	0.0	0.1	0.3	0.0	1.2
	Eastern noncommercial hardwoods	9.0	0.0	0.0	0.1	0.3	8.6
	Total hardwoods	287.1	1.5	2.0	4.8	3.8	275.0
All species		1,421.5	3.2	22.8	23.5	124.2	1,247.8

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.
[a] Based on current conditions.

Table C.25—List of tree species ≥1.0 inch d.b.h. occurring in the FIA survey plots and number measured, Georgia, 2019

	Common name	Scientific name	Trees measured
			number
Softwoods	Atlantic white-cedar	*Chamaecyparis thyoides*	2
	Eastern redcedar	*Juniperus virginiana*	2,148
	Southern redcedar	*J. virginiana* var. *silicicola*	6
	Sand pine	*Pinus clausa*	327
	Shortleaf pine	*P. echinata*	8,019
	Slash pine	*P. elliottii*	80,716
	Spruce pine	*P. glabra*	367
	Longleaf pine	*P. palustris*	8,062
	Table Mountain pine	*P. pungens*	22
	Pitch pine	*P. rigida*	250
	Pond pine	*P. serotina*	931
	Eastern white pine	*P. strobus*	3,695
	Loblolly pine	*P. taeda*	201,351
	Virginia pine	*P. virginiana*	7,398
	Pondcypress	*Taxodium ascendens*	8,120
	Baldcypress	*T. distichum*	1,534
	Eastern hemlock	*Tsuga canadensis*	1,167
	Carolina hemlock	*T. caroliniana*	10
Hardwoods	Florida maple	*Acer barbatum*	1,353
	Chalk maple	*A. leucoderme*	55
	Boxelder	*A. negundo*	747
	Black maple	*A. nigrum*	13
	Striped maple	*A. pensylvanicum*	1
	Red maple	*A. rubrum*	37,682
	Silver maple	*A. saccharinum*	76
	Sugar maple	*A. saccharum*	43
	Mountain maple	*A. spicatum*	2
	Yellow buckeye	*Aesculus flava*	48
	Ailanthus	*Ailanthus altissima*	39
	Silktree, mimosa	*Albizia julibrissin*	139
	Serviceberry	*Amelanchier* spp.	262
	Pawpaw	*Asimina triloba*	14
	Yellow birch	*Betula alleghaniensis*	70
	Sweet birch	*B. lenta*	708
	River birch	*B. nigra*	895
	American hornbeam	*Carpinus caroliniana*	2,339

Table C.25—List of tree species ≥1.0 inch d.b.h. occurring in the FIA survey plots and number measured, Georgia, 2019 (continued)

	Common name	Scientific name	Trees measured
			number
	Mockernut hickory	*Carya alba*	4,921
	Water hickory	*C. aquatica*	355
	Bitternut hickory	*C. cordiformis*	195
	Pignut hickory	*C. glabra*	7,442
	Pecan	*C. illinoinensis*	404
	Shellbark hickory	*C. laciniosa*	52
	Nutmeg hickory	*C. myristiciformis*	5
	Red hickory	*C. ovalis*	433
	Shagbark hickory	*C. ovata*	365
	Sand hickory	*C. pallida*	255
	American chestnut	*Castanea dentata*	22
	Southern catalpa	*Catalpa bignonioides*	33
	Sugarberry	*Celtis laevigata*	1,010
	Hackberry	*C. occidentalis*	251
	Eastern redbud	*Cercis canadensis*	712
	Camphortree	*Cinnamomum camphora*	11
	Flowering dogwood	*Cornus florida*	6,033
Hardwoods *(continued)*	Hawthorn	*Crataegus* spp.	442
	Cockspur hawthorn	*C. crus-galli*	5
	Downy hawthorn	*C. mollis*	101
	Common persimmon	*Diospyros virginiana*	1,949
	American beech	*Fagus grandifolia*	72
	Other palms	Family *Arecaceae*	5
	White ash	*Fraxinus americana*	192
	Carolina ash	*F. caroliniana*	37
	Green ash	*F. pennsylvanica*	4,677
	Waterlocust	*Gleditsia aquatica*	23
	Honeylocust	*G. triacanthos*	44
	Loblolly-bay	*Gordonia lasianthus*	3,352
	Carolina silverbell	*Halesia carolina*	277
	Two-wing silverbell	*H. diptera*	1
	Silverbell	*Halesia* spp.	57
	American holly	*Ilex opaca*	2,212
	Butternut	*Juglans cinerea*	19
	Black walnut	*J. nigra*	317
	Sweetgum	*Liquidambar styraciflua*	55,730

Table C.25—List of tree species ≥1.0 inch d.b.h. occurring in the FIA survey plots and number measured, Georgia, 2019 (continued)

	Common name	Scientific name	Trees measured
			number
	Yellow-poplar	*Liriodendron tulipifera*	20,382
	Osage-orange	*Maclura pomifera*	5
	Cucumbertree	*Magnolia acuminata*	88
	Mountain or Fraser magnolia	*M. fraseri*	106
	Southern magnolia	*M. grandiflora*	843
	Bigleaf magnolia	*M. macrophylla*	26
	Sweetbay	*M. virginiana*	6,737
	Apple	*Malus* spp.	30
	Southern crab apple	*M. angustifolia*	263
	Sweet crab apple	*M. coronaria*	3
	Chinaberry	*Melia azedarach*	1,569
	White mulberry	*Morus alba*	52
	Red mulberry	*M. rubra*	553
	Water tupelo	*Nyssa aquatica*	2,319
	Swamp tupelo	*N. biflora*	31,309
	Ogeechee tupelo	*N. ogeche*	1,329
	Blackgum	*N. sylvatica*	7,099
Hardwoods *(continued)*	Eastern hophornbeam	*Ostrya virginiana*	1,464
	Sourwood	*Oxydendrum arboreum*	10,169
	Princess tree	*Paulownia tomentosa*	68
	Redbay	*Persea borbonia*	1,967
	Planertree, water-elm	*Planera aquatica*	27
	American sycamore	*Platanus occidentalis*	767
	Eastern cottonwood	*Populus deltoides*	30
	American plum	*Prunus americana*	184
	Pin cherry	*P. pensylvanica*	8
	Peach	*P. persica*	75
	Black cherry	*P. serotina*	7,890
	Chokecherry	*P. virginiana*	12
	White oak	*Quercus alba*	14,237
	Swamp white oak	*Q. bicolor*	12
	Scarlet oak	*Q. coccinea*	4,749
	Southern red oak	*Q. falcata*	8,364
	Bluejack oak	*Q. incana*	283
	Turkey oak	*Q. laevis*	1,186
	Laurel oak	*Q. laurifolia*	13,941

Table C.25—List of tree species ≥1.0 inch d.b.h. occurring in the FIA survey plots and number measured, Georgia, 2019 (continued)

	Common name	Scientific name	Trees measured
			number
Hardwoods *(continued)*	Overcup oak	*Q. lyrata*	639
	Dwarf post oak	*Q. margarettiae*	1,317
	Blackjack oak	*Q. marilandica*	617
	Swamp chestnut oak	*Q. michauxii*	526
	Dwarf live oak	*Q. minima*	11
	Chinkapin oak	*Q. muehlenbergii*	10
	Water oak	*Q. nigra*	32,136
	Oglethorpe oak	*Q. oglethorpensis*	2
	Cherrybark oak	*Q. pagoda*	399
	Willow oak	*Q. phellos*	1,599
	Chestnut oak	*Q. prinus*	9,537
	Northern red oak	*Q. rubra*	1,918
	Shumard oak	*Q. shumardii*	49
	Durand oak	*Q. sinuata* var. *sinuata*	26
	Post oak	*Q. stellata*	4,692
	Texas red oak	*Q. texana*	5
	Black oak	*Q. velutina*	2,620
	Live oak	*Q. virginiana*	3,070
	Black locust	*Robinia pseudoacacia*	436
	Cabbage palmetto	*Sabal palmetto*	230
	Black willow	*Salix nigra*	2,132
	Sassafras	*Sassafras albidum*	816
	American basswood	*Tilia americana*	158
	Carolina basswood	*T. americana* var. *caroliniana*	18
	White basswood	*T. americana* var. *heterophylla*	80
	Unknown hardwood, broadleaf	Unknown	52
	Chinese tallowtree	*Triadica sebifera*	467
	Winged elm	*Ulmus alata*	5,833
	American elm	*U. americana*	1,274
	Slippery elm	*U. rubra*	742

d.b.h. = diameter at breast height; FIA = Forest Inventory and Analysis.
Nomenclature based on USDA NRCS (2016).

Table C.26—Output of industrial roundwood products in cubic feet by product, major species group, and year, Georgia, 2009–2019

Product	Species group	2009	2011	2013	2015	2017	2018	2019
		~~ *thousand cubic feet* ~~~~~~~~~~~~~~~~~~~~~~~~						
Saw logs	Softwood	266,169	277,899	310,022	357,898	384,816	430,231	407,097
	Hardwood	43,310	56,462	53,997	61,454	65,713	48,703	66,710
	Total	309,479	334,361	364,019	419,352	450,529	478,934	473,807
Veneer logs	Softwood	42,145	35,525	40,494	41,936	36,077	36,077	40,221
	Hardwood	3,279	3,618	2,761	2,764	2,783	2,903	2,348
	Total	45,424	39,143	43,255	44,700	38,860	38,980	42,569
Pulpwood	Softwood	503,176	586,478	508,127	524,401	503,249	505,511	508,926
	Hardwood	94,244	114,708	99,809	93,907	91,133	84,821	87,444
	Total	597,420	701,186	607,936	618,308	594,382	590,332	596,370
Composite panel	Softwood	57,522	50,547	74,166	85,665	89,144	105,467	85,706
	Hardwood	370	946	4	170	416	508	1,212
	Total	57,892	51,493	74,170	85,835	89,560	105,975	86,918
Bioenergy/fuelwood	Softwood	0	44,949	76,487	92,283	92,003	84,643	113,803
	Hardwood	0	4,189	5,774	25,775	12,624	29,770	37,140
	Total	0	49,138	82,261	118,058	104,627	114,413	150,943
Poles, posts, pilings	Softwood	18,363	22,234	24,908	33,232	34,020	22,327	22,497
	Hardwood	0	0	0	0	0	0	0
	Total	18,363	22,234	24,908	33,232	34,020	22,327	22,497
Other industrial[a]	Softwood	21,192	12,405	11,621	14,597	16,153	14,355	25,753
	Hardwood	2,917	917	1,033	1,173	2,059	1,130	1,702
	Total	24,109	13,322	12,654	15,770	18,212	15,485	27,455
Total (industrial)	Softwood	908,567	1,030,037	1,045,825	1,150,012	1,155,462	1,198,611	1,204,003
	Hardwood	144,120	180,840	163,378	185,243	174,728	167,835	196,556
	Total	1,052,687	1,210,877	1,209,203	1,335,255	1,330,190	1,366,446	1,400,559
Residential fuelwood[b]	Undifferentiated	55,792	41,268	53,200	39,976	32,072	32,072	32,072
	Total	55,792	41,268	53,200	39,976	32,072	32,072	32,072
Total	Softwood	908,567	1,030,037	1,045,825	1,150,012	1,155,462	1,198,611	1,204,003
	Hardwood	144,120	180,840	163,378	185,243	174,728	167,835	196,556
	Undifferentiated	55,792	41,268	53,200	39,976	32,072	32,072	32,072
	Total	1,108,479	1,252,145	1,262,403	1,375,231	1,362,262	1,398,518	1,432,631

Numbers in rows and columns may not sum to totals due to rounding.
0 = no sample for the cell or a value of >0.0 but <0.05.
[a] Includes poles, posts, and other miscellaneous products.
[b] Residential fuelwood volume from the latest U.S. Department of Energy estimates.

Table C.27—Output of industrial roundwood products in green tons, by product, major species group, and year, Georgia, 2009–2019

Product	Species group	2009	2011	2013	2015	2017	2018	2019
		~~ *green tons* ~~~~~~						
Saw logs	Softwood	8,499,844	9,696,798	10,804,227	12,470,430	13,411,819	14,987,132	14,163,179
	Hardwood	1,620,647	2,109,935	2,018,004	2,296,675	2,457,977	1,819,720	2,493,703
	Total	10,120,491	11,806,733	12,822,231	14,767,105	15,869,796	16,806,852	16,656,882
Veneer logs	Softwood	1,441,140	1,235,434	1,408,242	1,458,382	1,254,616	1,254,616	1,398,742
	Hardwood	127,286	139,273	106,267	106,188	106,900	111,248	89,843
	Total	1,568,426	1,374,707	1,514,509	1,564,570	1,361,516	1,365,864	1,488,585
Pulpwood	Softwood	18,716,095	20,595,875	17,839,124	18,409,956	17,664,578	17,747,853	17,864,032
	Hardwood	3,521,048	4,167,035	3,631,961	3,418,192	3,316,819	3,083,991	3,179,731
	Total	22,237,143	24,762,910	21,471,085	21,828,148	20,981,397	20,831,844	21,043,763
Composite panel	Softwood	2,140,147	1,762,770	2,586,908	2,988,157	3,109,617	3,677,474	2,989,830
	Hardwood	14,028	35,325	160	6,338	15,577	19,150	45,301
	Total	2,154,175	1,798,095	2,587,068	2,994,495	3,125,194	3,696,624	3,035,131
Bioenergy/ fuelwood	Softwood	0	1,576,135	2,682,022	3,235,910	3,226,073	2,967,998	3,990,496
	Hardwood	0	155,370	214,150	955,903	468,175	1,104,070	1,377,394
	Total	0	1,731,505	2,896,172	4,191,813	3,694,248	4,072,068	5,367,890
Poles, posts, pilings	Softwood	642,705	649,329	728,065	965,338	987,922	660,735	653,358
	Hardwood	0	0	0	0	0	0	0
	Total	642,705	649,329	728,065	965,338	987,922	660,735	653,358
Other industrial[a]	Softwood	741,720	434,165	406,722	510,891	565,339	502,429	901,338
	Hardwood	109,388	34,375	38,751	43,979	77,212	42,375	63,833
	Total	851,108	468,540	445,473	554,870	642,551	544,804	965,171
Total (industrial)	Softwood	32,181,651	35,950,506	36,455,310	40,039,064	40,219,964	41,798,237	41,960,975
	Hardwood	5,392,397	6,641,313	6,009,293	6,827,275	6,442,660	6,180,554	7,249,805
	Total	37,574,048	42,591,819	42,464,603	46,866,339	46,662,624	47,978,791	49,210,780
Residential fuelwood[b]	Undifferentiated	2,077,633	1,547,550	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
	Total	2,077,633	1,547,550	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
Total	Softwood	32,181,651	35,950,506	36,455,310	40,039,064	40,219,964	41,798,237	41,960,975
	Hardwood	5,392,397	6,641,313	6,009,293	6,827,275	6,442,660	6,180,554	7,249,805
	Undifferentiated	2,077,633	1,547,550	1,995,000	1,499,100	1,202,700	1,202,700	1,202,700
	Total	39,651,681	44,139,369	44,459,603	48,365,439	47,865,324	49,181,491	50,413,480

Numbers in rows and columns may not sum to totals due to rounding.
0 = no sample for the cell or a value of >0.0 but <0.05.
[a] Includes poles, posts, and other miscellaneous products.
[b] Residential fuelwood volume from the latest U.S. Department of Energy estimates.

Lambert, S.G.; Gray, J.; McCollum, J.M.; Brandeis, T.J.; Brown, M. 2023. Georgia's Forests, 2019. Resour. Bull. SRS-236. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 109 p. https://doi.org/10.2737/SRS-RB-236.

Georgia's 24.4 million acres of forest are a diverse mix of hardwood and softwood tree species typical of the South. Hardwood forests account for 54.5 percent of the forested area (which includes 1.3 percent in nonstocked) versus 45.5 percent for softwood types. Georgia's forest resources are considerable and slightly decreasing from 2014 in terms of the number of trees ≥1.0 inch diameter at breast height. The rate at which the State gained forest land acreage from converted agricultural land increased until 2012 and then decreased slightly from 59.5 thousand acres to 34.9 thousand acres. The rate at which forest was lost to development decreased steadily since 2009 and has stayed relatively stable through 2019. There were 24.1 billion cubic feet of wood volume in softwoods and 23.4 billion cubic feet in hardwoods, for a total of 47.5 billion cubic feet. Several tree species in Georgia have serious health issues. Redbay and sassafras are affected by laurel wilt disease. Flowering dogwood shows a high rate of mortality, most likely due to several factors such as anthracnose. The emerald ash borer threatens native ash trees, and hemlocks are under attack from the hemlock woolly adelgid. Japanese honeysuckle is the most prevalent invasive nonnative plant in Georgia forests, followed by Chinese/European privets. Despite these threats to forest health, Georgia still has one of the strongest and most successful forestry programs in the South.

KEYWORDS: Components of change, forest inventory, FIA, forest survey, forest trends, Georgia.

www.fs.usda.gov/research/srs