GEORGIA FORESTRY COMMISSION

GEORGIA
Statewide Assessment of Forest Resources

2010

Georgia Statewide Assessment of Forest Resources

April 2010

Produced by

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Abbreviations:

ACP	Atlantic Coastal Plain Priority Area
APHIS	Animal and Plant Health Inspection Service
ATV	All Terrain Vehicle
BMP	Best Management Practice
BR	Blue Ridge Priority Area
CARS	Community Accomplishment Reporting System
CCX	Chicago Climate Exchange
CLEAR	Center for Land Use Education and Research
CUVA	Conservation Use Valuation Act
CWCS	Comprehensive Wildlife Conservation Strategy
CWPP	Community Wildfire Protection Plan
DNR	Georgia Department of Natural Resources
EGCP	East Gulf Coastal Plain Priority Area
EPA	United States Environmental Protection Agency
EPD	Georgia Department of Natural Resources Environmental Protection Division
FIA	Forest Inventory and Analysis
FL	Fall Line Priority Area
FLPA	Forest Land Protection Act
GAP	Gap Analysis Program
GFC	Georgia Forestry Commission
GHG	Greenhouse Gas
GIS	Geographic Information System
GLCP	Georgia Land Conservation Partnership
GLUT	Georgia Land Use Trends
GOAL	Greater Okefenokee Association of Landowners
GUFC	Georgia Urban Forest Council
HUC	Hydrologic Unit Code
HWA	Hemlock Woolly Adelgid
LFT	Land Fragmentation Tool
LOC	Level of Concern
LRB	Large River Bottomlands Priority Area
NARSAL	Natural Resources Spatial Analysis Laboratory
NASF	National Association of State Foresters
NBCI	National Bobwhite Conservation Initiative
NRCS	Natural Resources Conservation Service
NWOS	National Woodland Owner Survey
RC&D	Resource Conservation and Development
REIT	Real Estate Investment Trust
RV	Ridge and Valley Priority Area
SCFP	Sustainable Community Forestry Program
SGSF	Southern Group of State Foresters
SPB	Southern Pine Beetle
SWAP	State Wildlife Action Plan
SWRA	Southern Wildfire Risk Assessment
TIMO	Timber Management Investment Organization
TMDL	Total Maximum Daily Load
UGA	The University of Georgia
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WFSI	Wildfire Susceptibility Index
WRD	Georgia Department of Natural Resources Wildlife Resources Division
WUI	Wildland Urban Interface

Georgia Statewide Assessment of Forest Resources

A comprehensive analysis of forest-related conditions, trends, threats and opportunities

2010

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Executive Summary

Georgia's 24 million acres of forest land are a rich and renewable resource that provide a myriad of benefits to citizens across the state. Yet challenges to the land and the professionals who manage it abound. In this Statewide Assessment of Forest Resources, the Georgia Forestry Commission, partners and other stakeholders address the conditions and issues at hand today, and prioritize concerns for the near and distant future.

Georgia's current forest conditions link the land to a vivid history of species diversity, resource exploitation and appreciation. Today, forests with stands of varying ages account for 67 percent of the state's total land area. Forests thrive in six physiographic ecoregions and grow almost 56 percent more wood than is being harvested, producing 96 percent more cubic feet of wood than 50 years ago. The majority of Georgia forests are privately owned by individuals and corporations, with public lands accounting for just 10 percent. According to the *Sustainable Forest Management in Georgia* report, prepared for the Georgia General Assembly in July of 2008, and on which some of the findings of this Assessment are based, these forest lands are being sustainably managed to meet the numerous needs of our state today.

Georgia Benefits from its Forests

A variety of benefits are provided to Georgia from its healthy, sustainable forests. Of primary importance is the $28.7 billion economic impact the forest industry has on the state. The industry is the state's second largest employer, with compensation exceeding $6.5 billion and payments to landowners of about $14.5 million. It generates an estimated $539 million per year in revenues for the state budget.

Forest-based recreation contributes to the state's economic growth and tourism industry. Georgia leads the nation in nonresident hunters, and resident sportsmen spend more than $1.8 billion annually. Anglers spend $569 million each year.

Importantly, Georgia's forests impact the state's ability to provide its citizens with vital nature services. Georgia's abundant water resources within 14 major river basins and multiple groundwater aquifer systems are enhanced by the healthy forest systems around and above them. Many of Georgia's 44,056 miles of perennial streams, 23,906 miles of intermittent streams and 603 miles of ditches and canals begin or flow through forest lands. Forests afford value through filtration and stormwater management services, reducing costs to water authorities. Georgia forests also improve air quality, with metro Atlanta trees removing some 19 million pounds of pollutants, a $47 million value, in 1996 alone. Trees help moderate the heat island effect caused by pavement and buildings, create energy savings through shading and sequester atmospheric carbon, which benefits human health and may benefit Georgia landowners through emerging reimbursement systems.

Georgia is beginning to benefit from the state's emerging bioenergy industry. Residues from timber harvesting exceeded 7.4 million tons (oven dry weight) in 2007, and a recently performed forest biomass assessment based on forest inventory data gathered between 1995 and 2005 showed that on average 18.1 million tons (oven dry weight) of biomass are available annually in Georgia. This growing opportunity for new markets from previously unutilized and low value forest biomass will add to the economic impacts of Georgia's forest industry.

Additional benefits to Georgia from its healthy forests include enhanced wildlife habitats and plentiful aesthetic and education opportunities.

Leading Threats and Pressing Issues

Forest issues ranked most critical by the public and identified in the 2008 *Sustainable Forest Management in Georgia* report include a number of threats which present significant challenges to forest managers, landowners and civic leaders. They are interrelated and often complex. Conservation was a highly ranked public concern that affects and is interwoven with every issue; it is not individually analyzed in this report.

Water quality is the public's primary issue of concern. Urbanization and nonpoint sources of pollution are the greatest threats to Georgia's water quality. Urbanization removes acreage from forest cover, resulting in increased storm runoff and intensified streamflow that causes stream bank erosion, sedimentation and flooding. Currently, more than 6,000 miles of streams do not meet state water quality standards due to nonpoint sources of pollution. Magnifying the threat is the problem that Georgia does not have systems in place that measure stream and aquifer water output or pollution capacities, making water projections impossible to gauge. Specific regional water priority issues are detailed in this report.

The urbanization of Georgia is a serious threat that could undermine forest sustainability in decades to come. Georgia is home to four of the nation's fastest growing counties and the state's population is projected to increase by an additional 46 percent in the next 20 years. From 2001-2005, Georgia's canopy cover declined by a total of 398,330 acres and impervious surfaces increased by 106 acres a day. Much of this growth occurred in metro Atlanta, though the Savannah, Columbus and Macon areas reflected significant changes as well. Population increases and the loss of tree cover to impervious surfaces impact every forest benefit. Proactive management tools and technical support systems are needed to adequately protect Georgia's forest resources.

Forest fragmentation and parcelization are additional challenges caused by urbanization. These phenomena are created when forests are converted to other land uses and when the number of forest landowners increase, but the land parcels shrink in size. Contributing factors include urban sprawl, inheritance issues, tax implications, timber land divestitures, investment concerns or other financial pressures. Taxation issues also play a part as land values rise but income from forest uses does not. The global recession and economic pressures of global competition have compounded these issues. Likewise, these situations can lead to a decreased value for forest management, and an increased occurrence of water quality degradation, wildlife disruption and forest pest incidence.

Urbanization and resulting forest land losses place extraordinary stresses on wildlife and biodiversity. While some species have adapted to changes brought on by growth, others are in need of more careful management to prevent further declines in habitat loss. Georgia ranks fifth in the nation in number of species extinctions and eighth for species at risk. A system of public and private conservation strategies, including expansion of the Georgia Land Conservation Program and the State Wildlife Action Plan, support this goal.

Air quality and carbon sequestration are additional opportunities. Urbanization affects Georgia's tree canopy, diminishing forestry's ability to provide clean air nature services. Georgia's new Carbon Sequestration Registry is being developed to assist landowners with garnering new income from timberland while air quality is positively impacted by the sequestration of carbon emissions statewide.

Urbanization puts more lives and property at risk from wildfire and reduces options for proper fire management, including prescribed burning. Tactics and strategies for fire management and suppression are compromised in the wildland urban interface, where access challenges, liability and logistics can complicate response. Some 12,000 Georgia communities are rated by the Southern Wildfire Risk Assessment at high or very high risk of wildfire. In addition, air quality regulations, resident fears and misunderstandings about prescribed burning and smoke effects can hinder the effective use of this forest management tool.

Economics and changing markets must be considered in order to increase the value of forests and forest products for continued industry growth. Traditional forest product markets have declined, but forest growth exceeds removals and is available to supply local and global markets. Bioenergy markets are believed to hold great potential for Georgia.

Significant forest pests threaten Georgia, including the southern pine beetle, hemlock woolly adelgid, redbay ambrosia beetle, annosum root disease, gypsy moth, *Sirex noctilio* woodwasp, emerald ash borer and Asian longhorned beetle. The highest priority invasive plant in Georgia is cogongrass, listed as the seventh most noxious weed in the world. Chinese privet, kudzu, Japanese climbing fern and Chinese tallowtree continue to threaten native plants. Trees that are weakened by pests and disease are at added risk of wildfire. Legislative support and regulation are needed to prevent the spread of these destructive threats.

Unusual weather events and the potential for climate change also threaten Georgia's forests. Thousands of trees are lost annually to wind, ice, flooding, drought and lightning, with damages exceeding $10 million every year, not including future liability problems. These occurrences can affect the incidence of wildfire in Georgia's forests and are predicted to intensify challenges for wildland fire managers.

Georgia's diverse landscape and population centers contribute to the definition of six priority resource areas from the Blue Ridge Mountains to the East Gulf Coastal Plain. The priority areas were determined by evaluating percent coverage of core forest areas greater than 250 contiguous acres. These core areas are large enough to be managed to provide for critical ecosystem services. The 12-digit Hydrologic Unit Codes (HUCs) were selected as a bounding area because they, for the most part, represent a consistent area of approximately 45km^2. Areas that were represented by 30 percent or greater coverage of a HUC by core area forests were selected. Watersheds were then merged and six priority areas were defined. They include: Blue Ridge, Ridge and Valley, Fall Line, Large River Bottomlands, Atlantic Coastal Plain and East Gulf Coastal Plain. The Assessment details the predominant forest issues contained in each distinct region.

The Georgia Statewide Assessment of Forest Resources is a comprehensive and thorough analysis of one of the nation's most abundant and productive expanses of natural splendor. The prudent use of the assessment tool can ensure that this valuable resource is sustained for every future generation.

Introduction

The *Georgia Statewide Assessment of Forest Resources* was developed under the leadership of the Georgia Forestry Commission (GFC) in accordance with national direction issued jointly by the U.S. Forest Service (USFS) and the National Association of State Foresters (NASF).

Statewide assessments are a key component of the USFS State and Private Forestry (S&PF) Redesign

Initiative that was launched in 2008. These assessments will provide a science-based foundation to assist state forestry agencies and their partners in: 1) identifying the areas of greatest need and opportunity for forests across their states, and 2) developing a long-term strategy to address them.

By working collaboratively with partners to identify and address priorities, S&PF funds will be invested in landscape areas where they will make the most significant difference for both the state and the nation.

2008 Farm Bill Requirements

In accordance with the 2008 Farm Bill, all states must complete a State Assessment and Resource Strategy by June 2010 in order to continue to receive funding under the Cooperative Forestry Assistance Act (CFAA). The three consensus-based national priorities with accompanying strategic objectives are:

Conserve working forest landscapes.

- Identify and conserve high-priority forest ecosystems and landscapes.
- Actively and sustainably manage forests.

Protect forests from harm.

- Restore fire-adapted lands and reduce risk of wildfire impacts.
- Identify, manage and reduce threats to forest and ecosystem health.

Enhance public benefits from trees and forests.

- Protect and enhance water quality and quantity.
- Improve air quality and conserve energy.
- Assist communities in planning for and reducing wildfire risks.
- Maintain and enhance the economic benefits and values of trees and forests.
- Protect, conserve and enhance wildlife and fish habitat.
- Connect people to trees and forests.
- Manage and restore trees and forests to mitigate and adapt to global climate change.

The 2008 Farm Bill calls for three components in the assessment and planning that identify priority forest landscapes and the work needed to address forest management priorities: Statewide Assessment of Forest Resources, Statewide Forest Resources Strategy and Annual Report on Use of Funds.

Statewide Assessment of Forest Resources

To ensure that federal and state resources are being focused on landscape areas with the greatest opportunity to address shared management priorities and achieve measurable outcomes, the Georgia Forestry Commission has collaborated with key partners and stakeholders. The result is a comprehensive analysis of the forest-related conditions, trends, threats and opportunities found on all forest ownerships within the state.

Georgia's Assessment is the product of work with the Forest Stewardship Coordinating Committee, Georgia Department of Natural Resources' Environmental Protection Division and Wildlife Resources Division, Georgia Soil and Water Conservation Commission, Georgia Urban Forest Council, National Wildlife Refugees, Natural Resource Conservation Service, State Technical Committee, U.S. Forest Service and other natural resource entities.

The cornerstone of the Assessment is the *Sustainable Forest Management in Georgia* report. In 2007, the Georgia General Assembly enacted into law Senate Bill 176. It requires the Georgia Forestry Commission (GFC) to submit a report to the General Assembly every five years which summarizes the sustainability of the state's forests. Specifically, the bill requests verification of *"the ability of forest resources in this state to meet the needs of the present without compromising the ability to meet the needs of future generations."* The report, submitted to the General Assembly on July 1, 2008, highlights the current forest resource conditions, along with the challenges and opportunities being faced by Georgia's forest managers and owners. It concludes that while Georgia's forests are being sustainably managed for the numerous needs of the state today, their future viability will be determined by specific actions of state leaders and the forestry community.

To gather further information relevant to key state issues and national themes, the GFC conducted a public survey. Top Georgia issues ranked in order of importance include: Water Quality, Urban Sprawl, Conservation, Taxes, Biodiversity, Forest Health, Air Quality, Fire Management, Fragmentation/Parcelization and Changing Markets. In addition, GFC contracted with the University of Georgia College of Agriculture and Environmental Sciences to develop geospatial data layers for use in identifying priority forest landscapes. This geospatial data, together with issues identified in the 2008 *Sustainable Forest Management in Georgia* report, laid the foundation for developing an Assessment that accomplishes the following:

- Identifies forest-related benefits and services consistent with the 2008 Farm Bill national priorities.
- Delineates priority rural and urban forest landscape areas to be addressed by the Statewide Forest Resources Strategy.
- Identifies areas of regional priority through work with adjoining states.
- Incorporates and complements existing statewide plans and assessments including the *Comprehensive Statewide Water Management Plan, A Comprehensive Wildlife Conservation Strategy for Georgia, Community Wildfire Protection Plans, The Five-Year Plan for Georgia's Urban and Community Forest 2007-2011, the Georgia Invasive Species Strategy* and the *Southern Wildfire Risk Assessment*, and addresses existing S&PF program planning requirements.

This Assessment serves as the basis for development of the Statewide Forest Resources Strategy.

Forest Resource Conditions

Distribution and Abundance of Forests

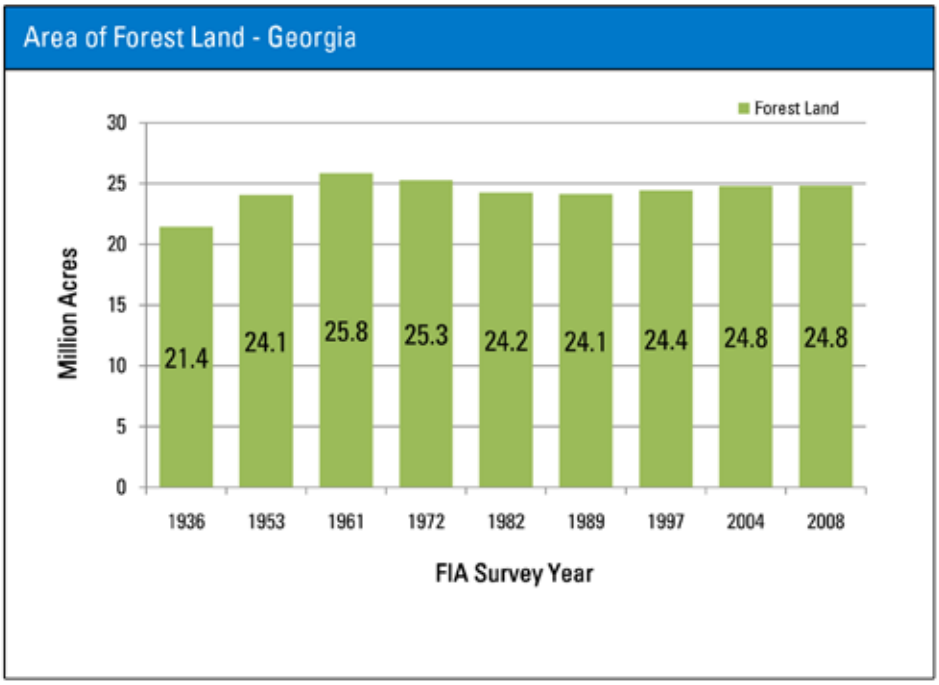
Since the beginning of recorded history, Georgia has been distinguished by its forest land bounty. William Bartram, one of the first naturalist-botanists, explored this region in the mid-1770s. He found forests of different ages interspersed with expansive savannas, swamps and river bottomlands filled with a rich diversity of broad-leaved species.

It was not until the 1880s that large scale commercial logging practices began to alter the appearance of Georgia's landscape. By the late 1920s, most of the virgin stands in Georgia had been cut over. By 1930, heavy removals forced increased taxes on the remaining timber, which in turn caused its rapid liquidation.

Georgia's forest land acreage has remained relatively stable since that time and timber volumes are at an all time high.

The number of forest land acres in Georgia has stabilized at approximately 24 million acres, or 67 percent of our total land area, as demonstrated by the Forest Inventory and Analysis reports compiled since 1936 (Figure 1).

However, it is the current trend toward shrinking parcel size per landowner (Figure 2 on following page) that can be expected to impact the quality, quantity and availability of our forest resources into the future.



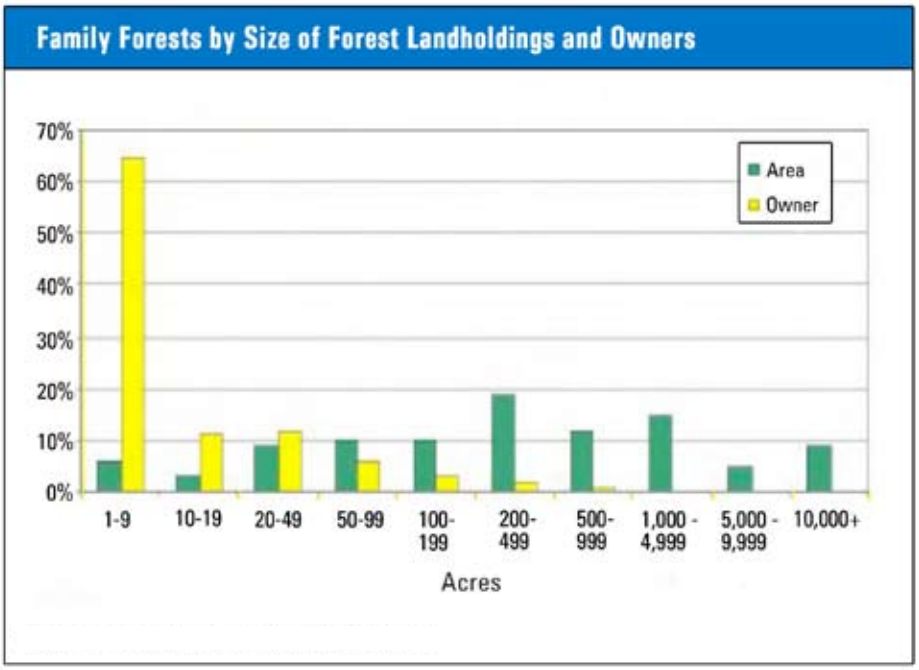
Source: U.S. Forest Service, FIA and the Georgia Forestry Commission, 2008

Figure 1

Historical Growth, Harvesting and Reforestation

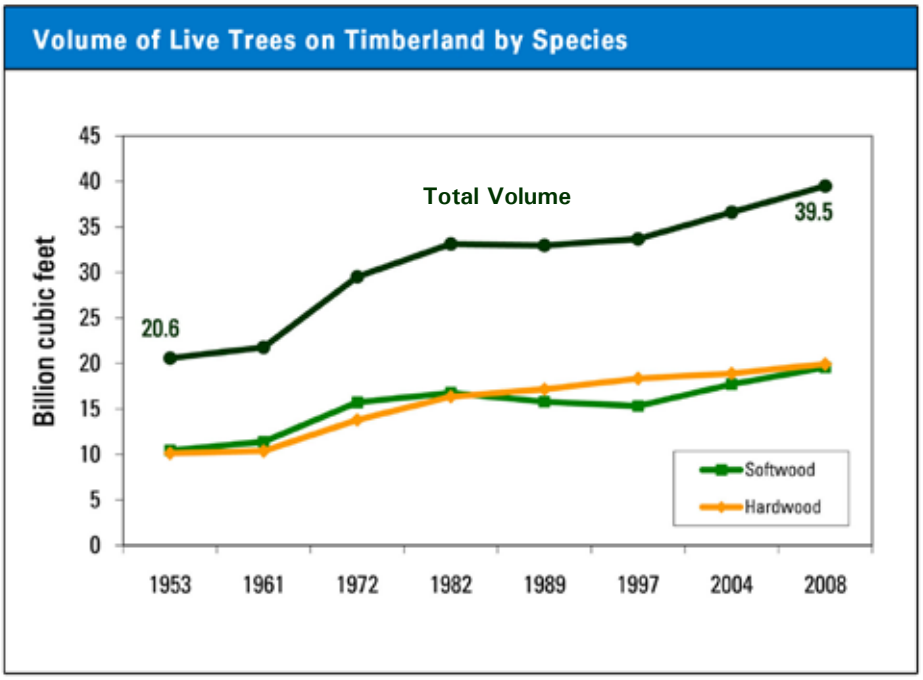
Georgia's forests are currently growing almost 56 percent more wood than is being harvested on an annual basis. Timber volumes have been increasing since 1953, which means that today we have 96 percent more cubic feet of wood growing in Georgia than we did 50 years ago (Figure 3).

Tree planting after harvest has been a major contributor to increasing timber volumes, and federal tree planting cost-share programs have positively influenced replanting.



Source: U.S. Forest Service National Woodland Owner Survey, 2006

Figure 2



Source: U.S. Forest Service, FIA and the Georgia Forestry Commission, 2008

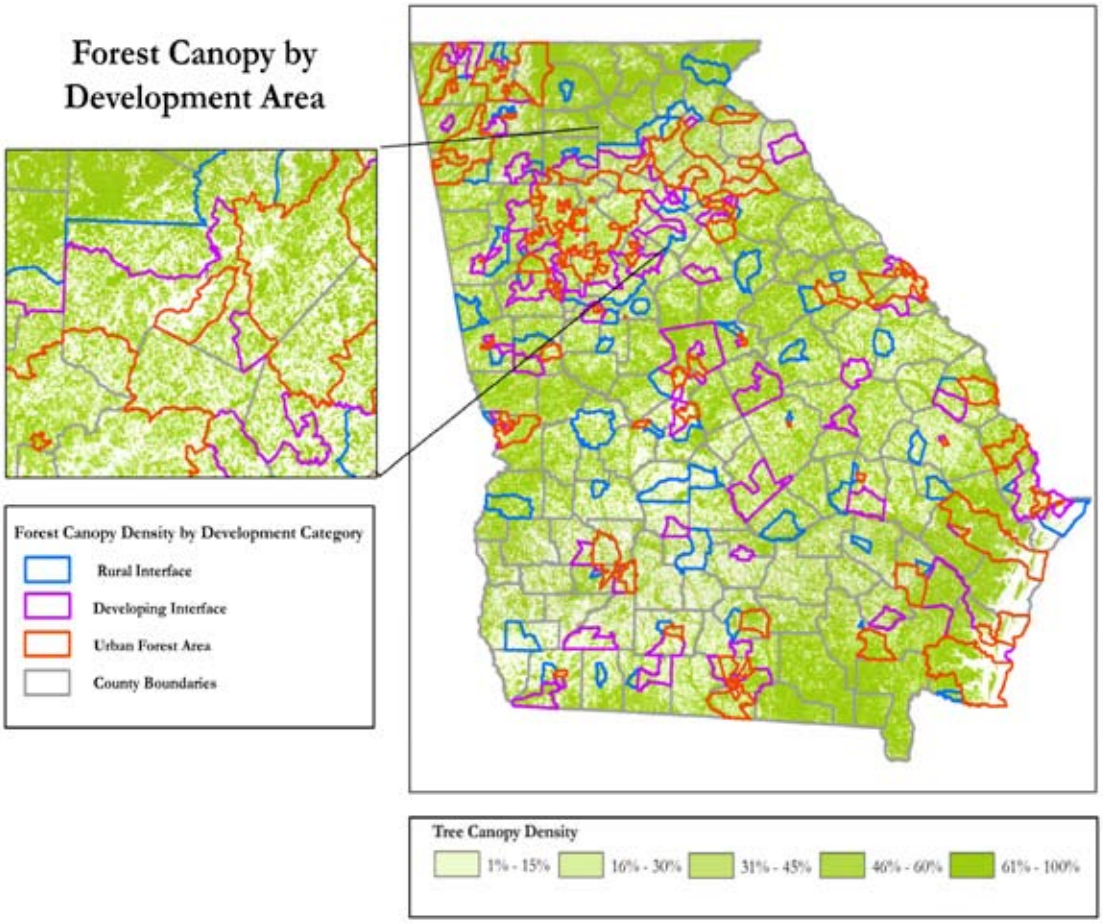
Figure 3

The urban and community forest includes all trees, vegetation, watersheds and wildlife in urban areas, developed areas or communities. State and local government highway rights-of-way, open greenspaces, undeveloped forests, interface areas where urban and rural conditions meet, parks and private and commercial lands are all part of the community forest (GUFC Five-Year Plan Committee 2004).

Urban land comprises 8.76 percent of the land area of Georgia. Another 9.07 percent is classified as wildland-urban interface (WUI) area. Of the WUI area, 6.07 percent is being directly impacted by urban pressures (Developing Interface) and another 3.0 percent has a growing population density of over 150 people per square mile (Rural Interface). More than 60 percent of all Georgia's citizens live in either urban or wildland-urban interface areas.

Between 1990 and 2000, urban area increased 32.7 percent. Urban area in Georgia is projected to increase to 14.3 percent by 2050, based on the average urban growth pattern of the 1990s (Nowak and Walton 2005). Statewide, urban or community land in Georgia has an estimated 293.1 million trees (Nowak and Greenfield 2009).

Forest canopy distribution varies widely depending upon land use type (Figure 4). Much of the most dense community forest canopy lies in the Developing Interface areas, while urban development patterns have reduced the available canopy percent in more dense population areas. Rural Interface areas show a lower average canopy density than Developing Interface areas, mostly due to their proximity to agricultural lands, row crops and pastures.

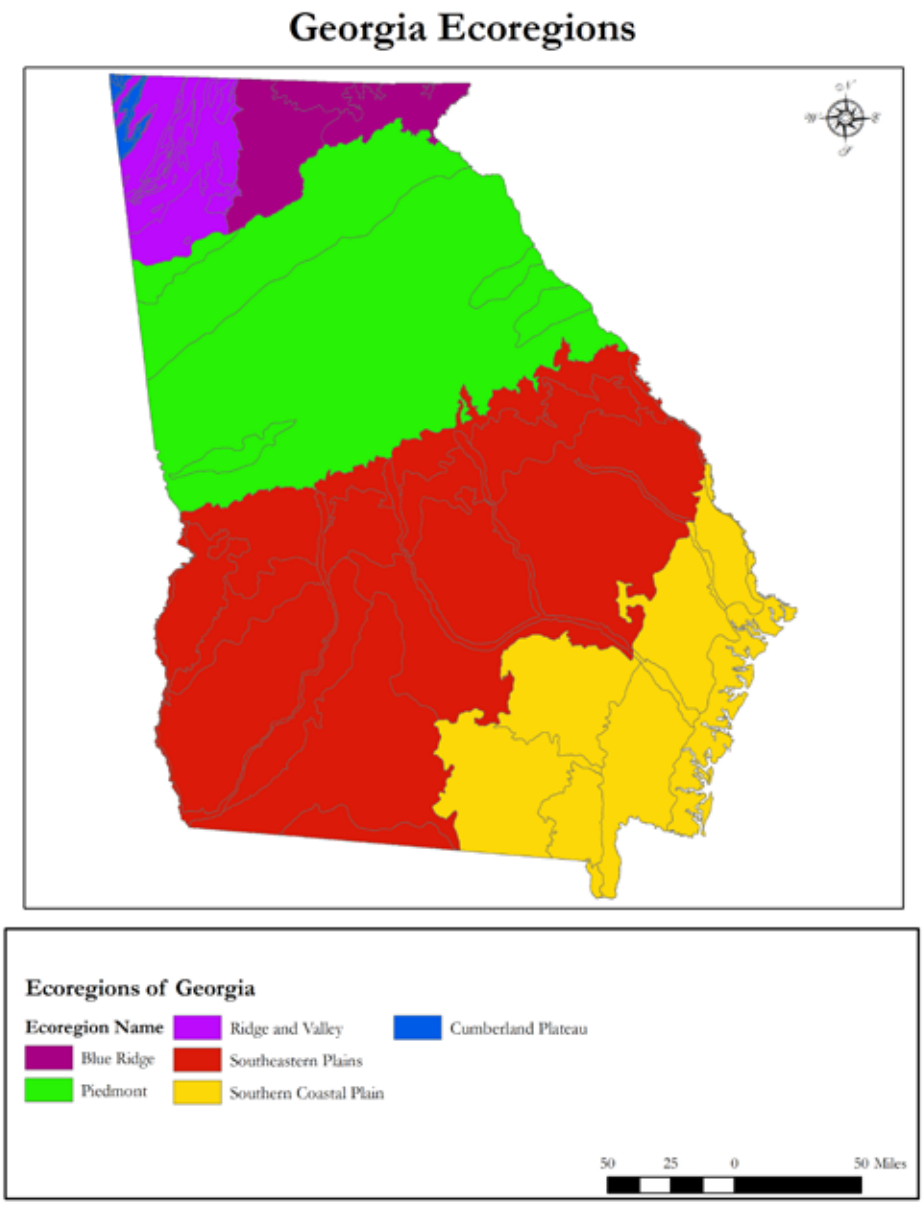


Sources: Department of Commerce. Census Bureau. Geography Division. 2000 Census Tracts. http://www.census.gov
Natural Resources Spatial Analysis Laboratory (NARSAL). 2010. University of Georgia. Athens, GA. Unpublished data.

Figure 4

The six physiographic ecoregions of Georgia are the Southern Coastal Plain, Southeastern Coastal Plains, Piedmont, Blue Ridge, Ridge and Valley and Cumberland Plateau (Figure 5).

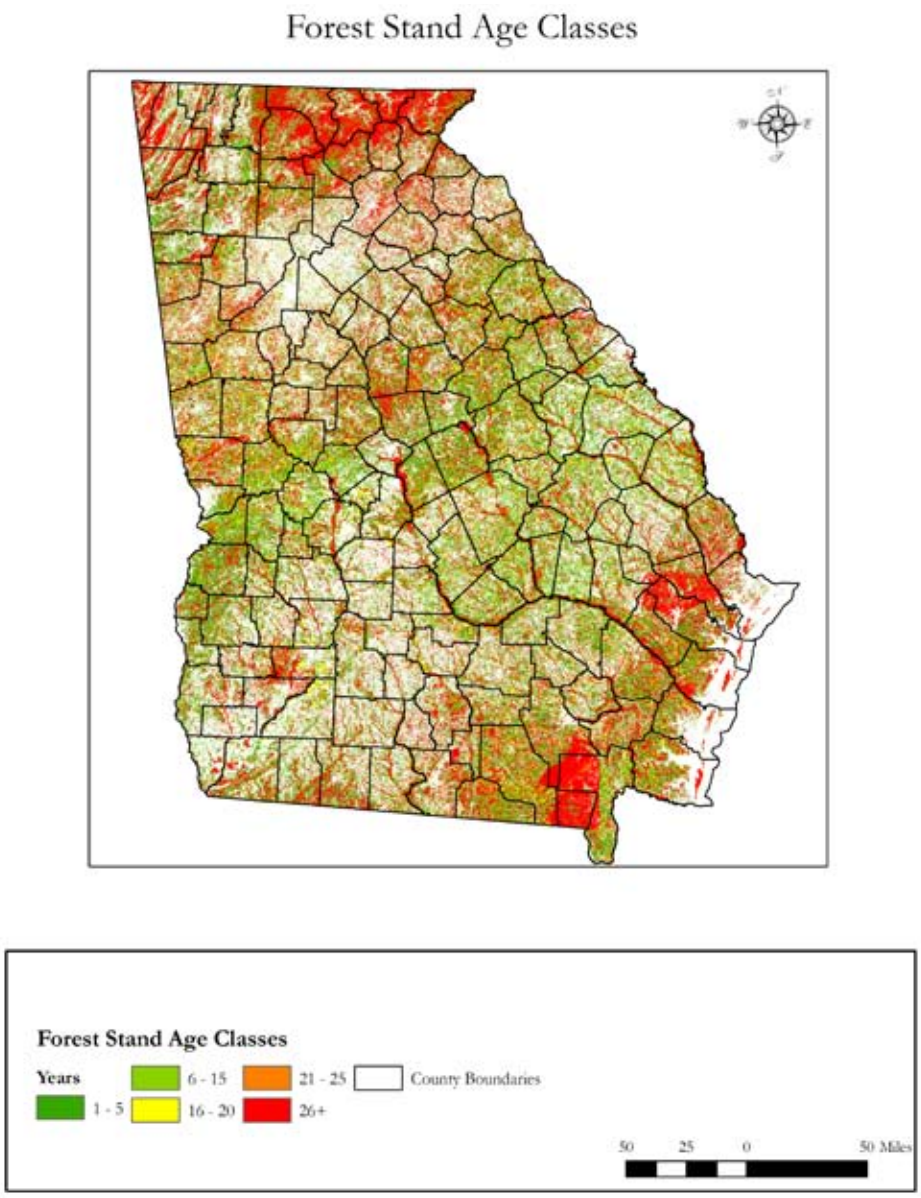
The Southern Coastal Plain and Southeastern Plains, collectively referred to in this report as the Coastal Plain, are comprised mostly of loblolly, slash and longleaf pine and lowland hardwoods. The Piedmont is comprised mostly of loblolly pine, loblolly pine-hardwood mix, with small percentages of shortleaf pine, upland hardwoods and lowland hardwoods. The Blue Ridge has a majority of upland hardwood types with small percentages of white pine and hemlock types. The Ridge and Valley region varies between upland hardwoods on the ridges to mostly loblolly pine and Virginia pine in the valleys and lower slopes. The Cumberland Plateau, which only includes Dade County in extreme northwest Georgia, is comprised mostly of upland hardwoods, with some loblolly pine and Virginia pine.



Source: Griffith, G.E., J.M. Omernik, J.A. Comstock, S. Lawrence, G. Martin, A. Goddard, V.J. Hulcher, and T. Foster. 2001. Ecoregions of Alabama and Georgia (color poster with map, descriptive text, summary tables, and photographs). Reston, Virginia: U.S. Geological Survey (map scale 1:1,700,000).

Figure 5

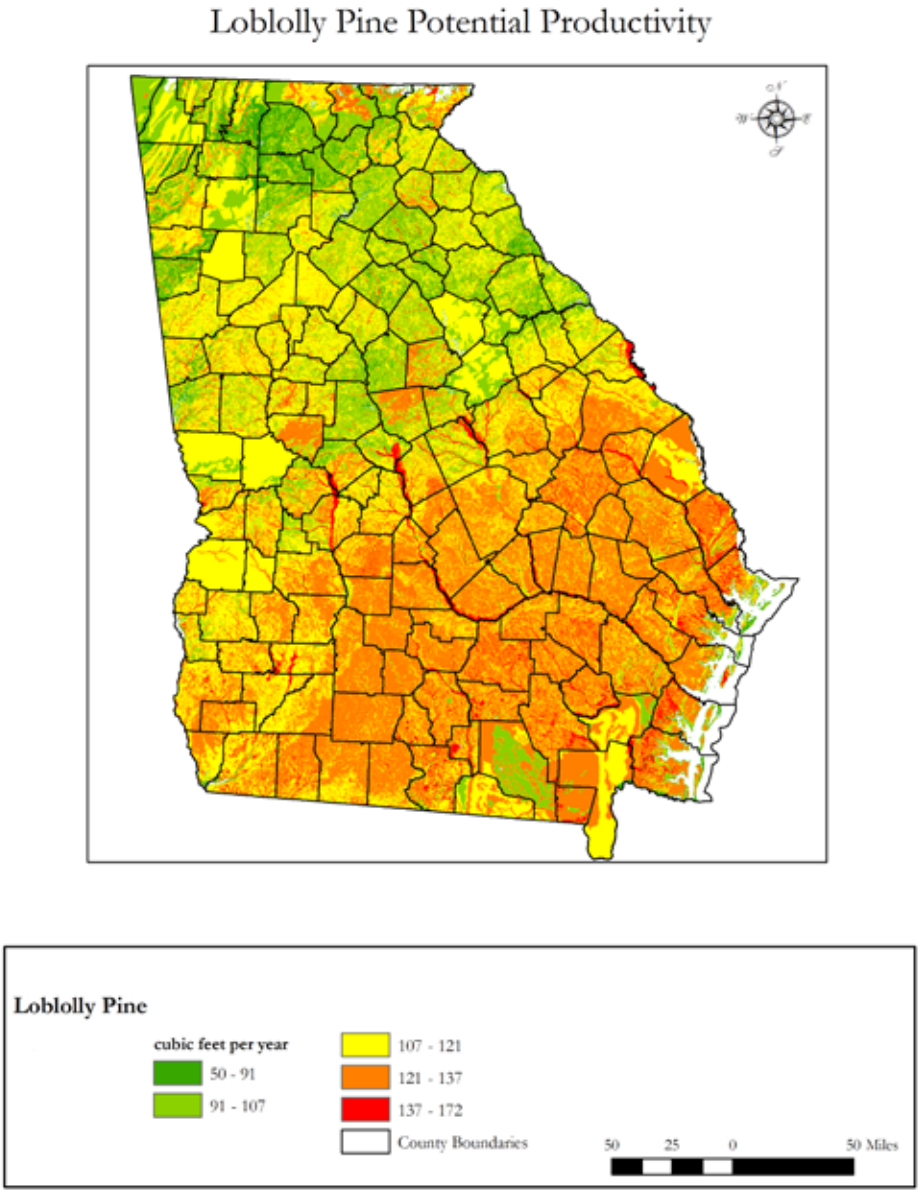
Stand ages vary across the state (Figure 6), with most of the oldest stands located in the northeastern mountainous terrain (owned primarily by the USFS) and the floodplains and lowlands across the state. Pine stands across the state tend to average lower in age than hardwood stands, mostly due to the increased probability of active forest management, including harvesting. The older hardwood stands often occur on steep slopes, land that is difficult to access due to lack of roads, and floodplains/swamps where logging is difficult, except perhaps in the driest conditions. Also, publicly owned lands, on which harvesting is very limited, tend to have older stands.



Source: Natural Resources Spatial Analysis Laboratory (NARSAL). 2010. University of Georgia. Athens, GA. (Unpublished data)

Figure 6

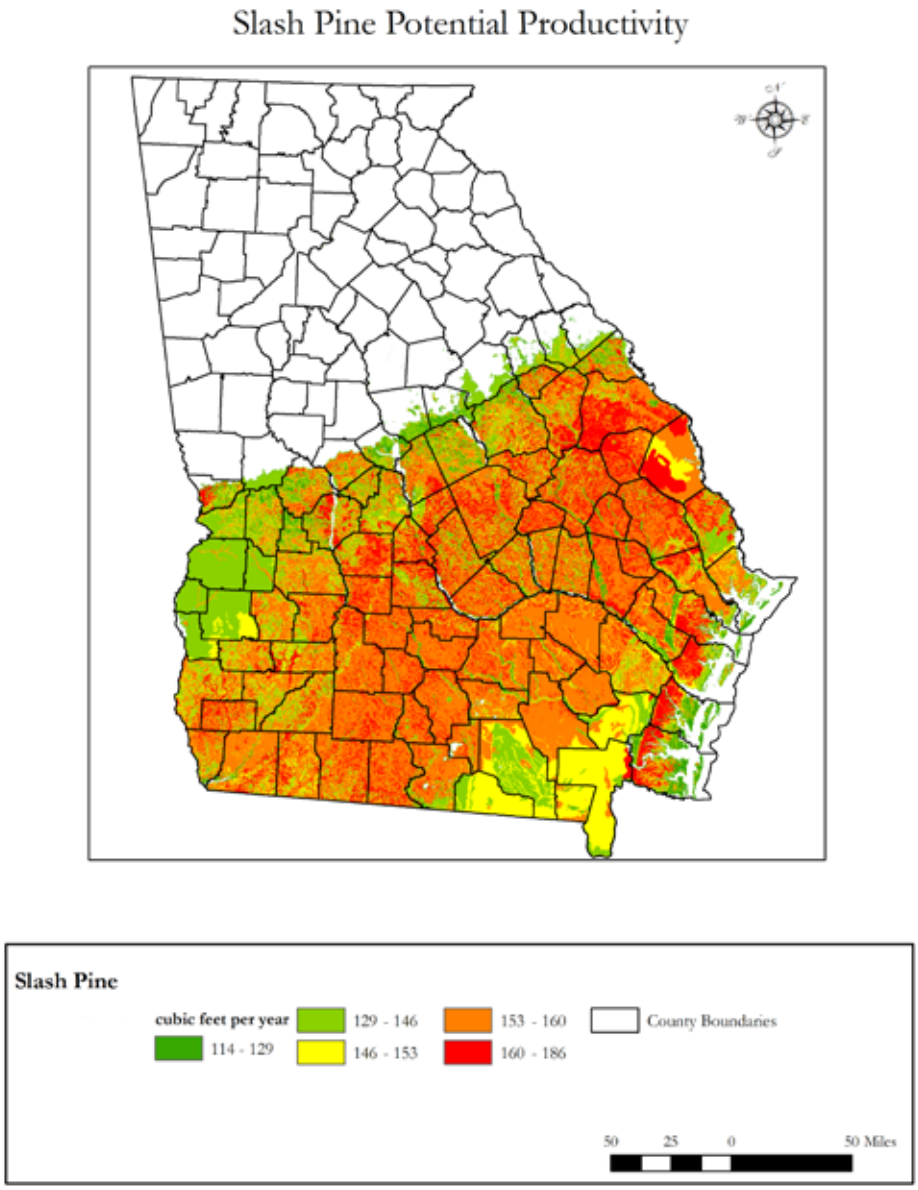
Soil productivity across Georgia varies significantly between lowlands and uplands and between the north and south halves of the state (Figure 7). Average productivity for loblolly pine in the northern half of the state ranges from 91-120 cubic feet of wood produced per acre per year. In the southern half of the state, averages are 120-137 cubic feet, with areas along waterways ranging from 137 to 172 cubic feet.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 7

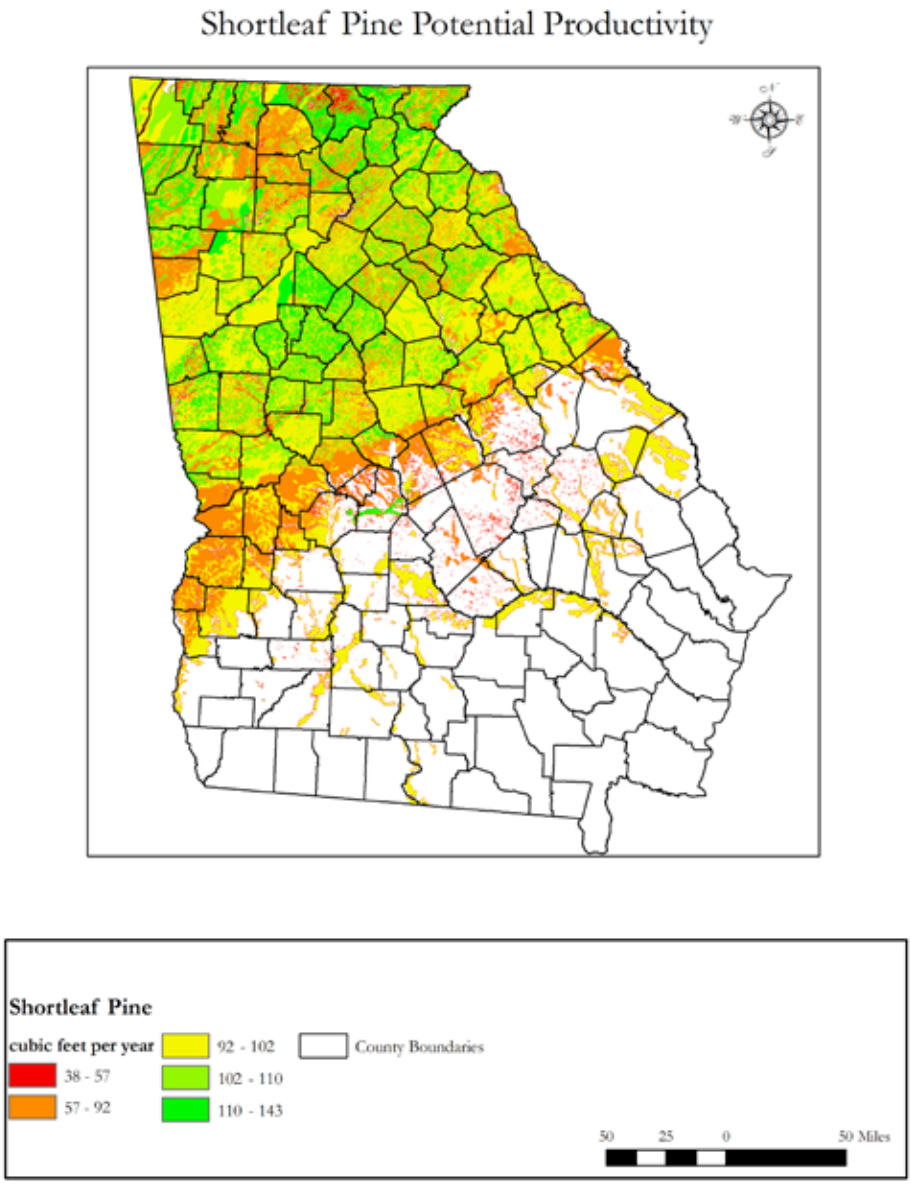
Slash pine is mostly limited to the Coastal Plain and mimics the productivity of loblolly pine in the southern part of the state (Figure 8).



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 8

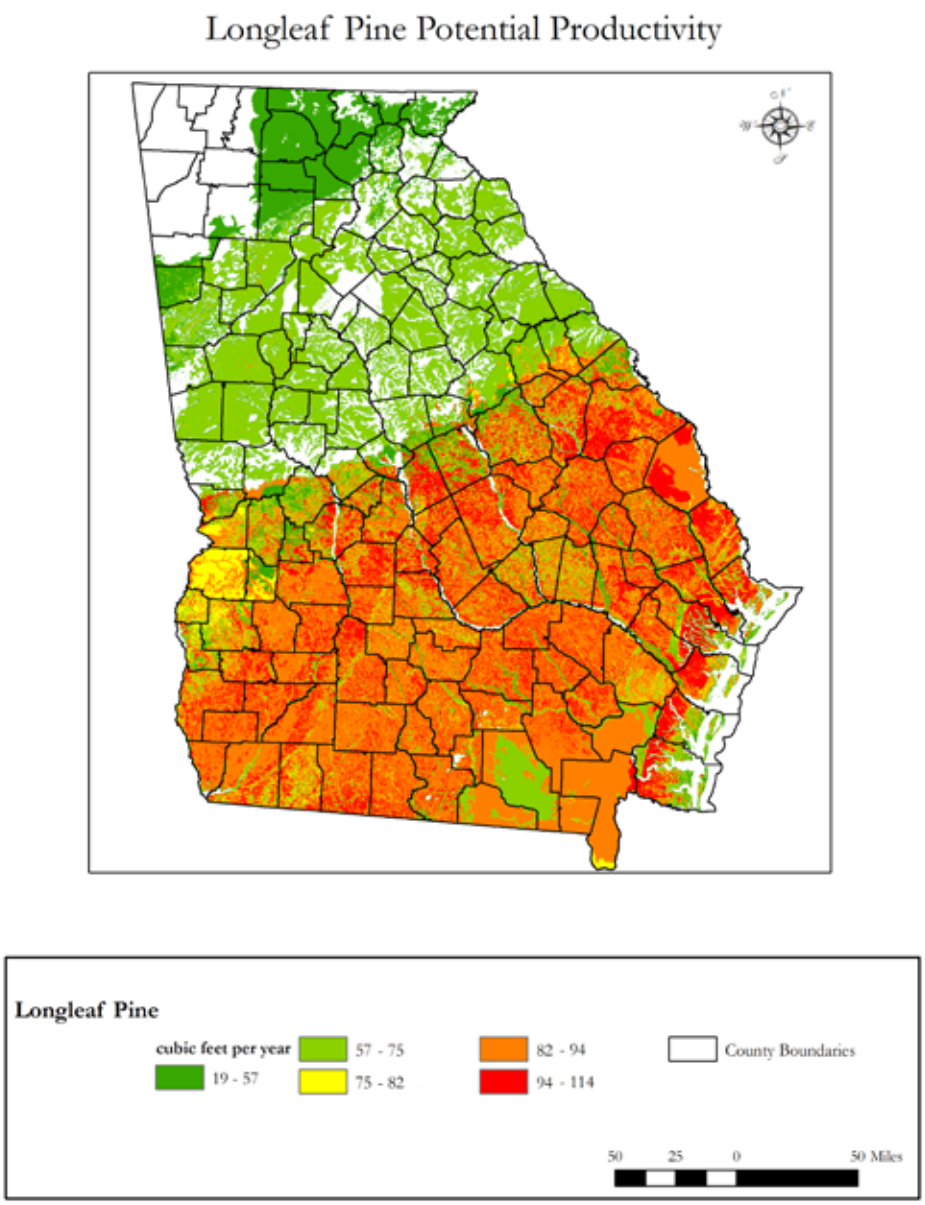
Shortleaf pine is found mostly in the northern part of the state, with most of the higher productivity sites located in northwest Georgia (Figure 9). The average productivity for shortleaf ranges from 92–110 cubic feet of wood produced per acre per year, with best productivities ranging from 110–143 cubic feet.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 9

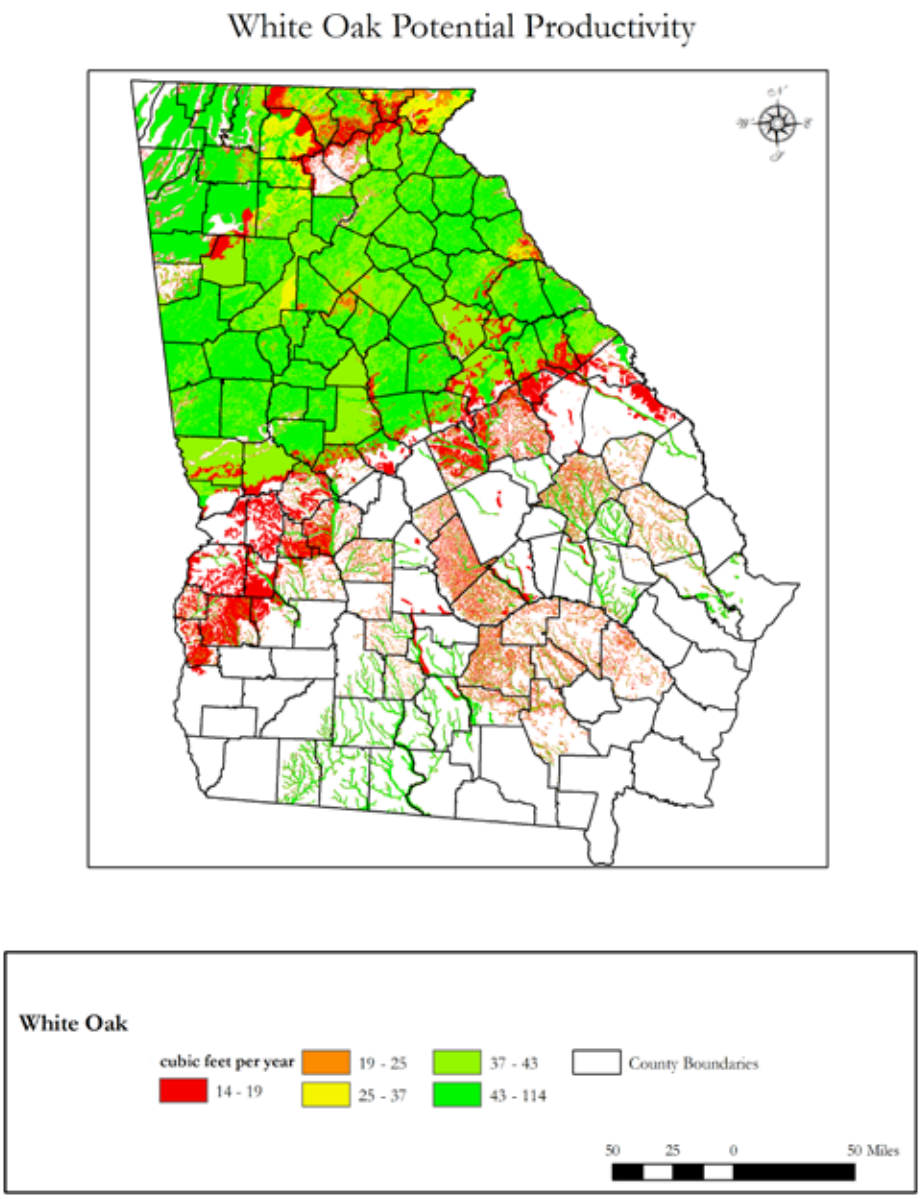
The better soil productivities for longleaf pine occur in the southern half of the state (Figure 10). The average productivity for longleaf in south Georgia ranges from 82–94 cubic feet of wood produced per acre per year, with better longleaf sites ranging from 94–114 cubic feet. Although longleaf occurs naturally in northwest Georgia, data was unavailable for the productivity map.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 10

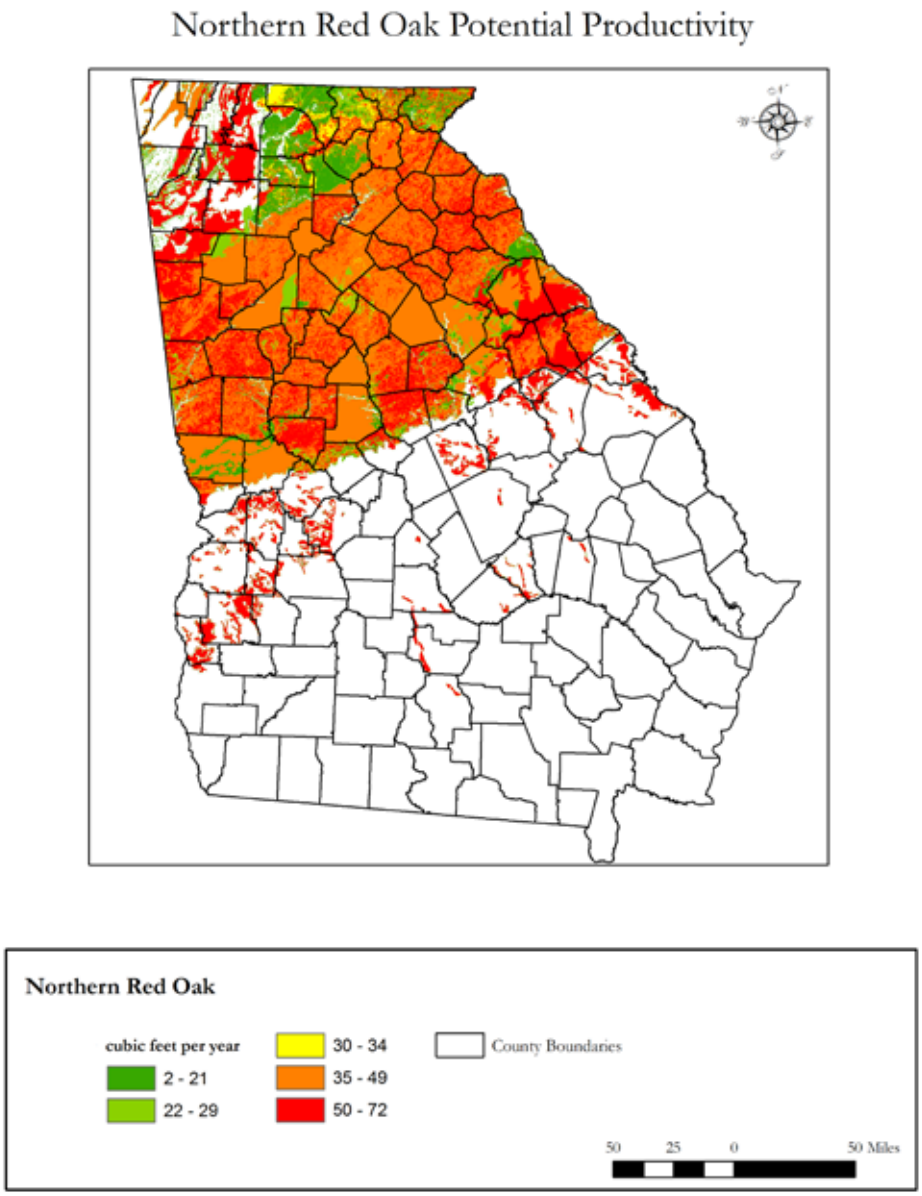
The better soil productivities for white oak occur in the northern half of the state (Figure 11). The best sites for white oak are found in the Ridge and Valley region in northwest Georgia. The productivity for white oak in north Georgia ranges from 43–114 cubic feet of wood produced per acre per year.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 11

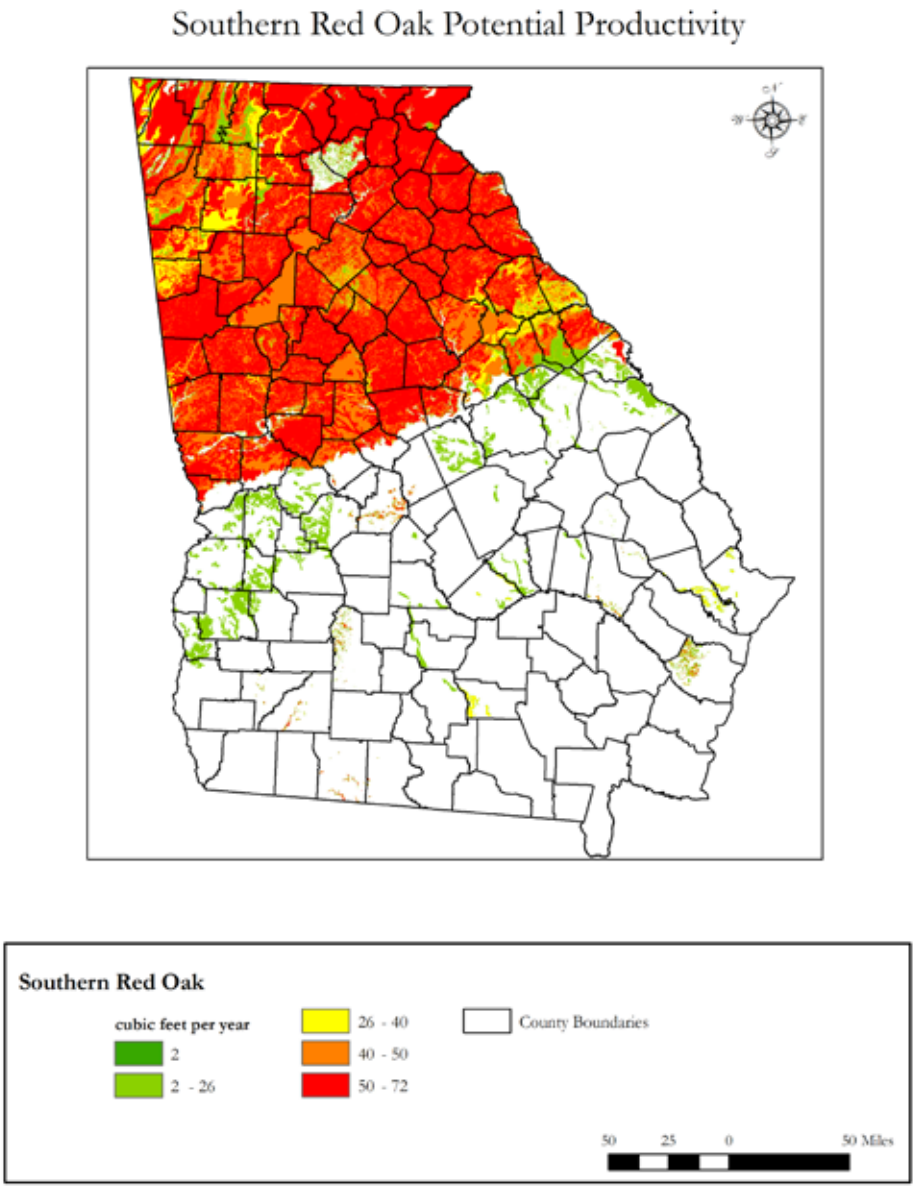
Northern red oak productivities are much like the white oaks', with the northern half of the state being best for productivity (Figure 12). The average productivity for northern red oak in north Georgia ranges from 35–49 cubic feet of wood produced per acre per year, with better northern red oak sites ranging from 50–72 cubic feet of wood produced.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 12

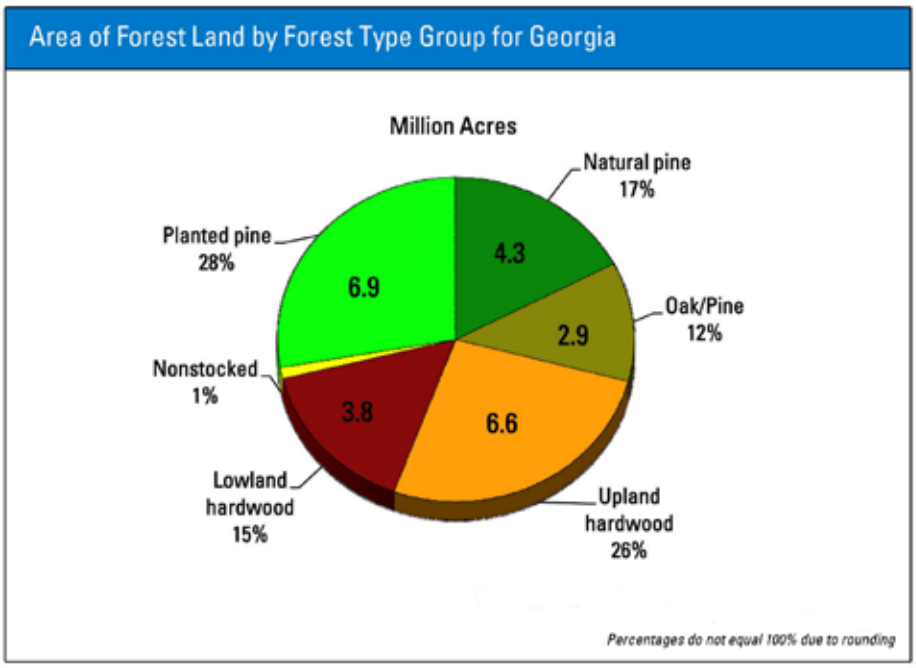
Southern red oak also grows best in the northern part of the state, but the preeminent locations are found on drier mountain sites (Figure 13). Concentrations of good sites are located in the Blue Ridge and Ridge and Valley regions. The average productivity for southern red oak in north Georgia ranges from 40–72 cubic feet of wood produced per acre per year.



Sources: Soil Survey Staff. 2010. Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/

Figure 13

Hardwood forest types comprise 41 percent of Georgia's 24.8 million acres of forest land. Softwood (mostly pine) occupies 45 percent and mixed oak/pine accounts for 12 percent. One percent of the forested area is nonstocked, i.e. recently harvested land that has not yet seeded or been planted with seedlings (Figure 14).



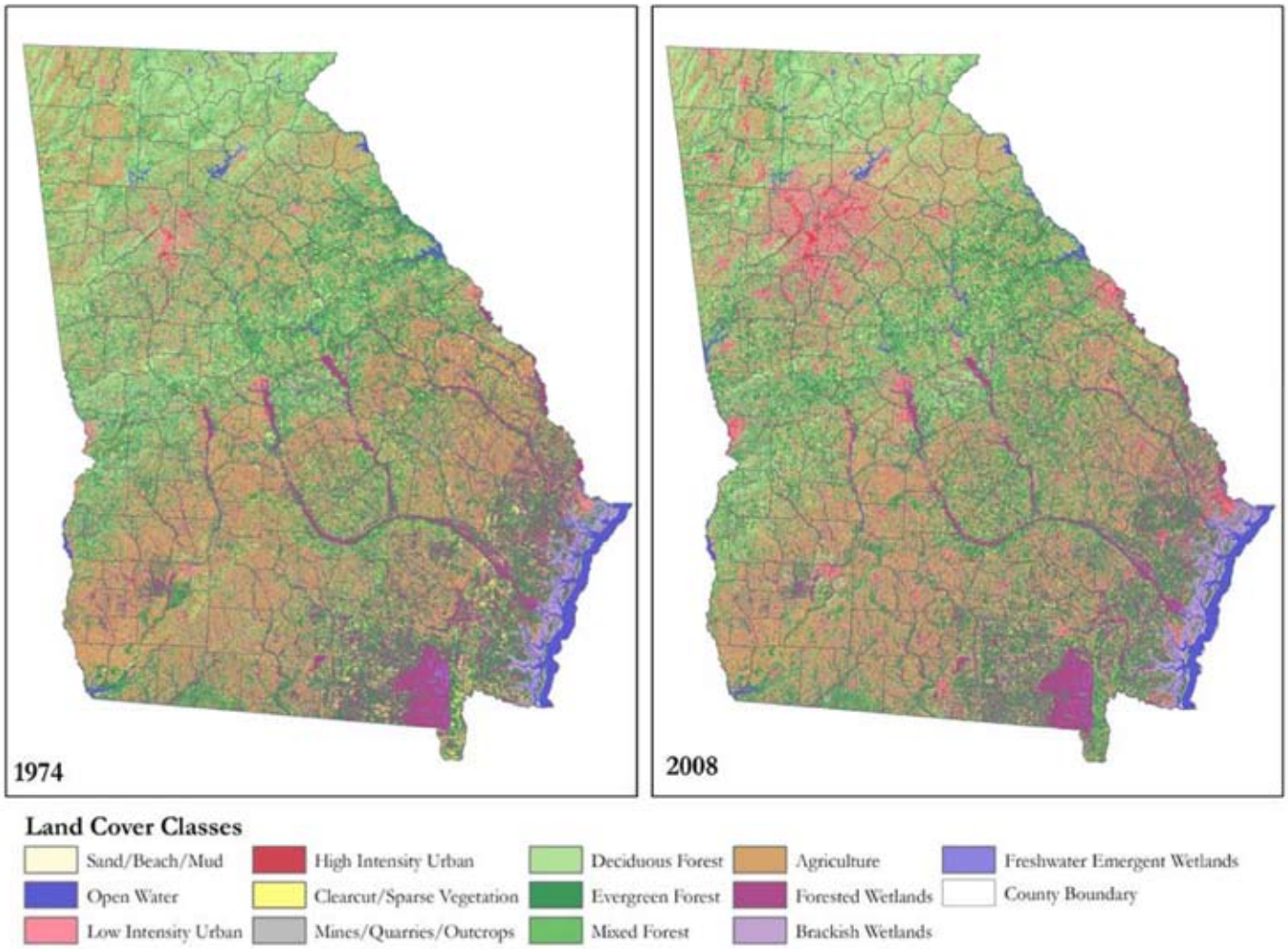
Source: U.S. Forest Service, FIA and the Georgia Forestry Commission, 2008

Figure 14

Forest Cover Trends

Comparing the 2008 forest cover map to the 1974 map (Figure 15) shows significant increases in areas affected by high intensity urban land uses. Major areas of change are Atlanta, Augusta, Savannah and areas of the Chattanooga suburbs in north Georgia.

Land Cover Change

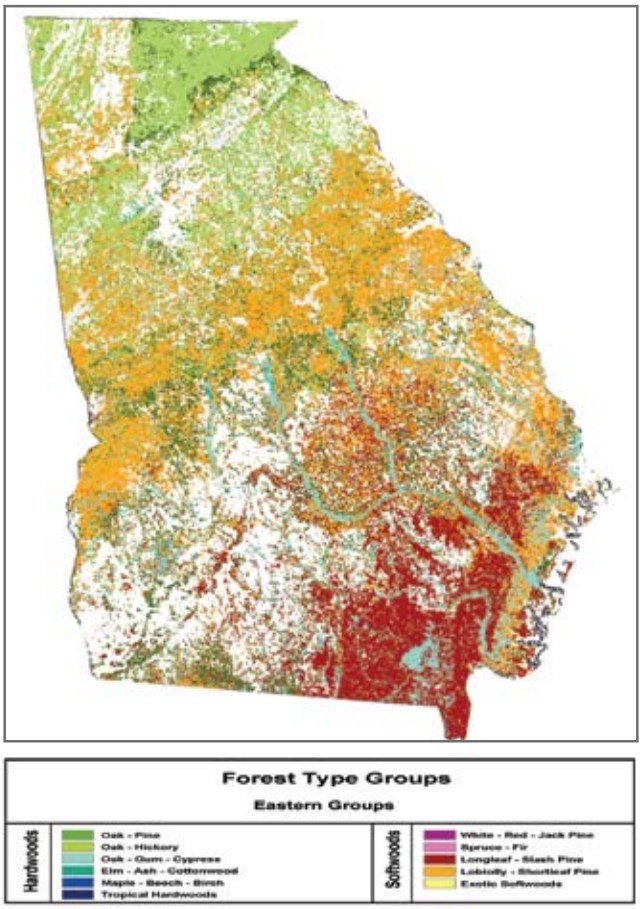


Source: Natural Resources Spatial Analysis Laboratory (NARSAL). 2010. University of Georgia. Athens, GA. (Unpublished data)

Figure 15

Comparing the 2008 forest cover map with the 1941 map (Figures 16 and 17) shows some significant differences. One is the prevalence of the shortleaf pine component in the Piedmont in 1941 compared to 2008. Today it is rarely more than a minor component in any pine forest type with loblolly pine being by far the major pine species in the Piedmont. Historically, shortleaf pine appears to have been a major component of many upland hardwood types even into the Blue Ridge. Today, Virginia and loblolly pine are the more common components of these upland hardwood stands with more pure stands of upland hardwood becoming common as the pine component died out. Longleaf pine in the Coastal Plain was more prevalent in 1941 than it is today. Now, slash and loblolly (planted) pine are the predominant pine species in the Coastal Plain. Georgia and several other southern states are collaborating to reintroduce longleaf pine throughout its natural range.

Georgia Land Cover 2008



Source: U. S. Forest Service, FIA 2008

Figure 16

Georgia Land Cover 1941

Source: U. S. Forest Service, FIA 1941

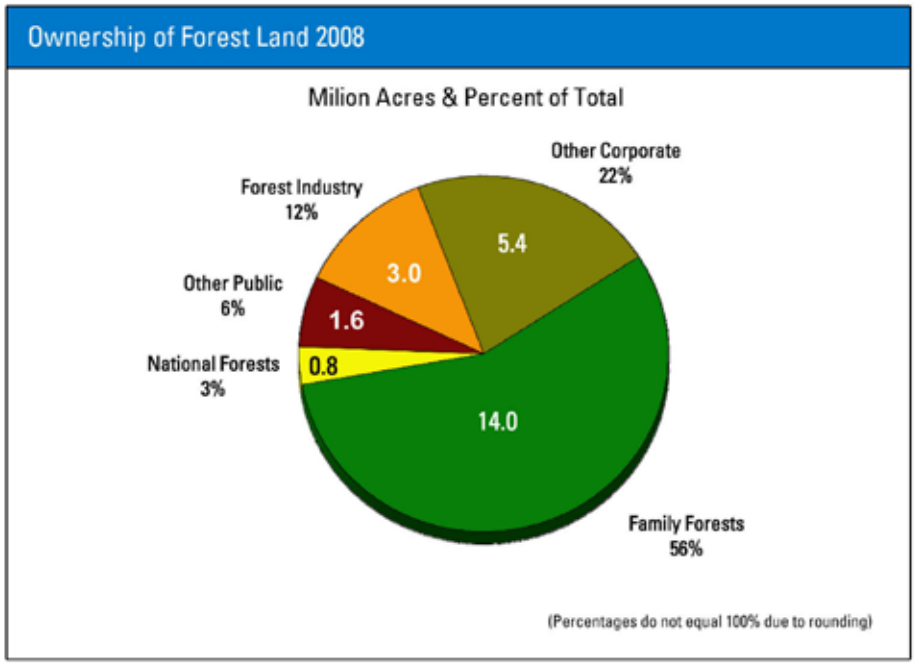
Figure 17

Trees and forests come in a variety of forms, from forest stands to park groves, to urban trees. Every tree has the natural ability to affect air currents, cool the air and shade the ground. However, older, larger trees maximize these benefits. A mature, continuous canopy is more beneficial than separate ornamental trees. More trees and forest area, large canopy trees, soil design and urban forest management are necessary to maximize the environmental, social, economic, energy and health benefits of trees.

In the urban forest, a single tree may be as important as a patch of forest remnant. Since trees are responsible for keeping much of our ecological system working to provide the goods and services that benefit society, enough trees must be planted and maintained, even in highly urbanized areas, to create a forest. The sum of the effects of a continuous tree canopy provides the real benefit, and is the desired outcome (Urban 2000).

An increasing share of southern forests are now held in smaller parcels, measured at 50 acres or less (Wear and Greis 2002). This forest fragmentation is an issue of concern throughout the state of Georgia.

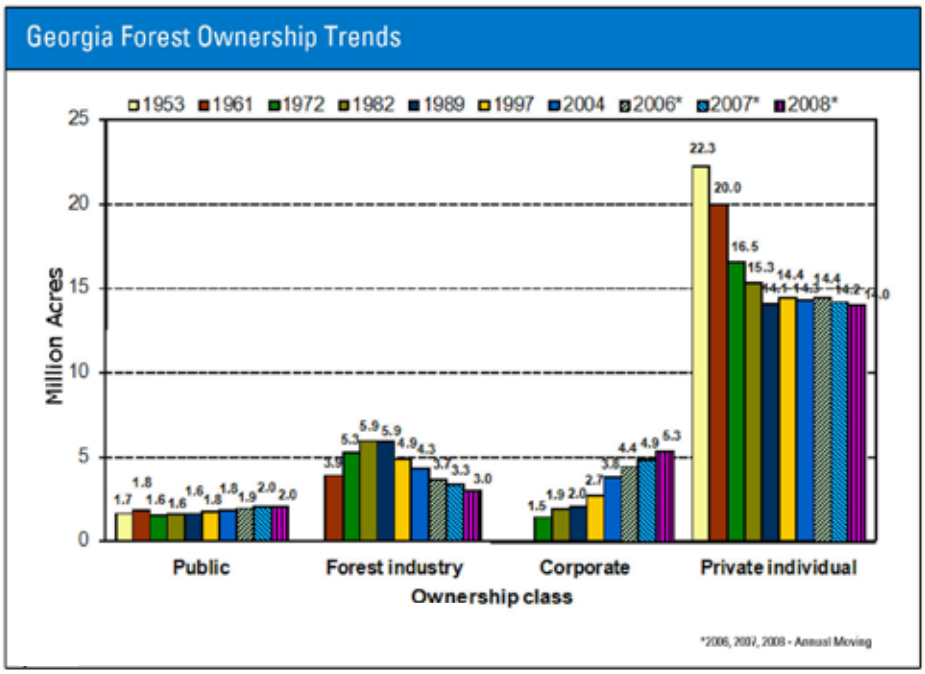
Georgia leads the nation in forest land acreage that is privately owned. Only nine percent are public lands, including state and national forests, military reservations, parks, and other federal, state and local government lands (Figure 18).



Source: U. S. Forest Service, FIA and Georgia Forestry Commission 2008

Figure 18

Some of the forest ownership trends since the 1950s are shown in the graph below (Figure 19). One obvious trend is a shift of private individual forest land ownership to private corporate ownership. Another trend is a drop in forest industry forest land acreage since 1989, which reduces Georgia's forest industry ownership in Georgia by about one-half. Public ownership has remained fairly stable.



Source: R. Harper, U.S. Forest Service, FIA and the Georgia Forestry Commission

Figure 19

General Management Objectives of Family Forest Landowners in Georgia

Georgia landowners have many reasons to own forest land, but when surveyed by the U.S. Forest Service through the National Woodland Owner Survey (NWOS) regarding their reasons for owning forest land, the landowners' answers correlated closely with their size of forest tract owned.

As shown in Table 1, owners of the smaller acreages (<500 acres) of forest land gave reasons of being part of a home, passing on to heirs, enjoying the beauty of the forest and land investment as their primary reasons for ownership. Those who owned 500 or more acres listed timber production as their number one reason for ownership and enjoying the beauty of the forest and passing the land on to heirs (and vice versa for 1000+ acres) as their second and third reasons.

The results of the NWOS Survey support the belief that private landowners are more likely to actively manage their forest land if they own larger tracts. In the interest of preserving the wise management of forest land in Georgia, an important factor is discouraging rather than encouraging the subdivision of large tracts. Selling and/or subdividing often occur(s) as a result of large tax costs passed on to heirs when a forest landowner passes away. The inheritance tax is, therefore, a strong barrier to sound, healthy, sustainable forest management. Large forest land tracts are critical to maintaining the forest product supply chain and for sustaining product revenues that benefit the citizens of Georgia over foreign suppliers.

The continued sustainability of Georgia's forests falls largely on individuals and corporations. These landowner groups are facing new challenges that will determine the future of Georgia's forests. State and local tax structures and struggling forest product markets will have a major impact on these landowner decision makers.

	Rank	Acreage Owned		
		10-100	100-500	1000+
Reasons for Owning Forest Land	1st	Part of home	To pass on to heirs	Timber production
	2nd	To pass on to heirs	To enjoy beauty/scenery	To pass on to heirs
	3rd	To enjoy beauty/scenery	Land investment	To enjoy beauty/scenery

Source: Butler et al. 2010

Table 1

Urban forest ownership entities include public, city and county, residential, rights-of-way, industrial, recreational, commercial and institutional land, to name a few. The urban forest is a patchwork of land uses extending from the urban core, through suburbs, to the wildland urban interface. The forest canopy within those areas is a widely varying mix that ranges from heavily-forested backyards and riparian buffers to sparsely-canopied parking lots and newly-built subdivisions. Much of the forest is fractured into unconnected patches less than 10 acres in size. This small size results in greatly decreased levels of forest benefits that are realized from an integrated, connected forest landscape. This canopy is further overlaid with a complex set of ownerships, values, goals and attitudes towards tree planting, management and conservation. Urban forest growing conditions are very different from natural forest processes. Management also becomes more difficult when an increasing amount of human influences are applied.

Georgia's 24.8 million acres of forest land, containing vast supplies of renewable raw materials, sustains an important economic engine for the state. A 2009 report provides the following economic impact data for Georgia's forest industry (Riall 2009a).

- Total economic activity supported by the forest industry in Georgia is more than $28.7 billion. This includes the multiplier effect of recirculated dollars brought into the economy by the forest industry sectors and federal payments to landowners of about $14.5 million. More than 128,000 people are employed by the industry with compensation that exceeds $6.5 billion.
  - This employment represents about 3.1 percent and 3.0 percent of total Georgia employment, in wages and salaries, respectively.
  - Between 2007 and 2008, output decreased slightly, and the number of jobs and compensation decreased nine percent and three percent, respectively. Trends in these economic indicators for 2001-2008 are reflected in Figure 20 (McClure 2009a).
- Georgia's forest industry directly employed 57,812 in all industry sectors combined, paid an annual compensation of more than $3.1 billion, and had estimated total revenue of almost $18.3 billion.
  - The pulp and paper sector continues to dominate the forest industry by producing 59 percent of the total industry output, providing 36 percent of total industry jobs and 50 percent of total industry compensation.

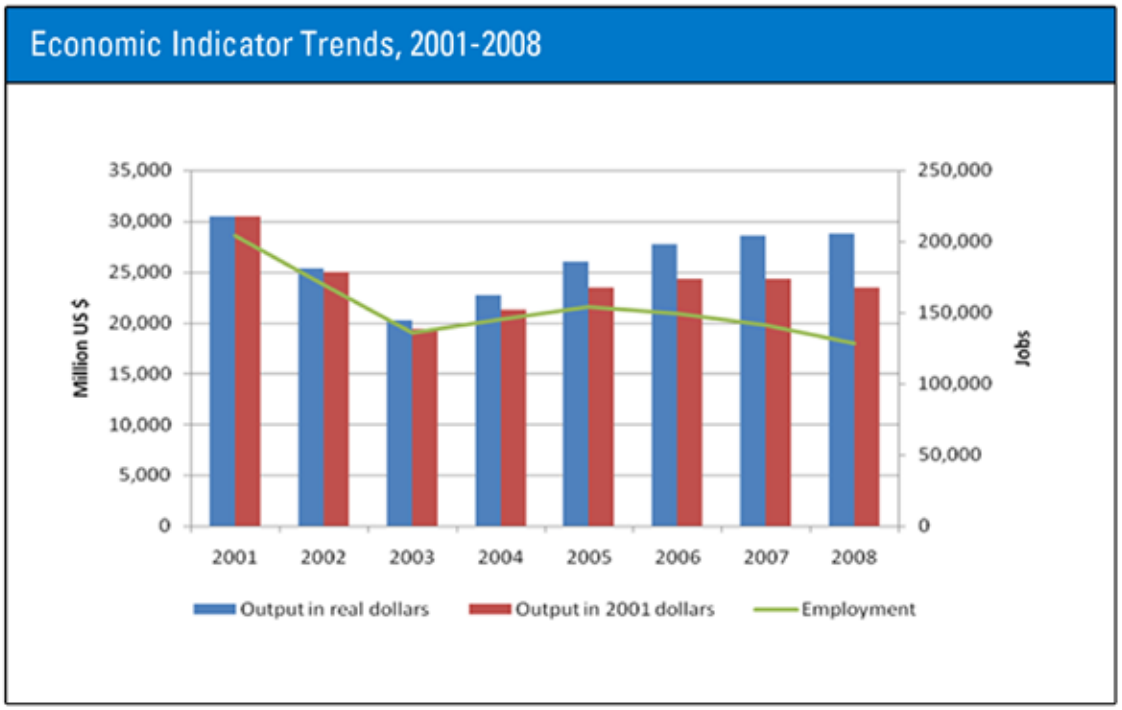


Figure 20

- Compared to 2007, output decreased slightly and employment and compensation declined 10 percent and 8 percent, respectively; economic activity of forest industry sectors, 2007-2008 are shown in Table 2 (Riall 2009b).

- The forest industry is the second largest industry sector in Georgia based upon wages and salaries (behind food processing), and the third largest based upon employment (behind food processing and textiles).

- The forest industry generates an estimated $539 million per year in revenues for the state budget. When the costs of providing state services to Georgia's households and companies associated with that activity are deducted from these revenues, net annual state revenues are more than $206 million.

- The rural economies of 47 counties are moderately to critically dependent on the forest industry based on both employment and income. Figures 21 and 22 show the levels of economic dependence of counties based on these factors (Riall 2009c&d).

Economic Activity of Forest Industry Sectors, 2007-2008

	Output	
Forest Industry Sector	**2007**	**2008**
Forestry Management, Logging, and Misc. Forest Products	$1,806,862,272	$1,698,173,50
Lumber and Wood Preservation	$2,099,945,996	$1,732,113,02
Veneer, Plywood, Reconstituted, and Engineered Wood	$1,321,714,784	$961,215,87
Prefabricated Wood Buildings and Manufactured Housing	$523,282,896	$426,574,81
Pulp and Paper Products	$10,131,473,013	$10,855,959,29
Woodworking and Paper Industries Machinery	$60,710,076	$67,305,68
Wooden Furniture and Cabinets	$1,197,442,044	$1,058,247,48
Windows and Doors	$516,655,904	$720,966,46
Containers, Showcases, Partitions, and Shelving	$624,186,992	$654,329,04
Custom Architectural and Miscellaneous Wood Products	$176,638,616	$95,202,31
Total	$18,458,912,593	$18,270,087,48

Table 2

Figure 21

Figure 22

In addition to federal payments via various cost-share programs, Georgia's 500,000 timber owners received an average of $577 million per year in timber harvest income from 2000 to 2007. Statewide timber sale values totaled $4.6 billion during this period. In 2006, as reported on the 2007 tax digest, timber was harvested on 3,129,223 acres with an assessed value of $564,231,554. Table 3 shows the timber revenue generated from these timber sales (Graham 2009).

2006 Timber Revenue Reported on 2007 Tax Digests

County	Acres	Assessed Value	State Revenue	County Revenue	School Revenue	Total Revenue
Totals	3,129,223	$ 564,231,554	$ 141,057	$ 6,468,265	$ 8,056,465	$ 14,665,787

Table 3

Public Benefits from Forest Resources

Jobs and Economic Activity - Recreation

Forest-based recreation provides excellent opportunities for economic growth and tourism in Georgia.

As an example, Georgia led the nation in nonresident hunters in 2006 with approximately 136,000 participants. Georgia sportsmen spend more than $1.8 billion annually, which contributes to 31,000 jobs. Investment in public outdoor recreation, public-private partnerships and promotion of private recreational opportunities will continue to provide strong economic benefits to Georgia in the future.

Anglers currently spend approximately $569 million each year on fishing in Georgia. The total economic effect of angling is approximately $1.5 billion. There are 10,649 jobs related to sport fishing, which generate $15 million in state income taxes and $19 million in state sales taxes.

The new Go Fish Georgia program is a $30 million initiative that is intended to boost economic development in many small towns and establish Georgia as a national fishing destination.

Trees generate income by creating jobs, boosting property values and attracting educated workers. A single, large 40-year old tree pays back taxpayers and homeowners nearly $200 per year just in its cleansing and cooling effect on the air, water and land. A large front-yard tree adds almost one percent to the sales price of a single family home, and property values of homes adjacent to parks and open spaces are typically about 8 percent to 20 perent higher than comparable properties elsewhere (McPherson 2006).

Tourism and urban forests share a vital link. In Savannah, magnificent live oaks and many other trees line the streets and city squares. Research shows that trees are a significant amenity in cities, and are often part of the reason visitors choose to spend time in a specific location. Trees provide many important benefits to visitors. For example, shady streets in business districts encourage people to linger and shop longer, and studies show people spend up to 10 percent more money when shopping on tree-lined streets. In addition, trees create inviting, beautiful places to enjoy, and give people lasting memories to take home.

Trees benefit employers, too. Workers without a view of nature from their desks reported 23 percent more instances of illnesses. They also reported higher levels of frustration and irritability. Those who have views of nature reported better overall health, greater enthusiasm for their jobs, less frustration and feelings of higher life satisfaction (Kaplan and Kaplan 1989).

Of the 506 Georgia cities and counties measured in the U.S. Forest Service's Community Accomplishment Reporting System (CARS) in 2009, a total of 94 communities in Georgia have made investments in their urban forest by hiring a consulting urban forester or certified arborist to assist in planning for and managing community trees, creating a wealth of green jobs in the state at tree nurseries and in arboriculture.

With an array of employment options, a temperate climate and a diverse landscape, Georgia offers residents and visitors a myriad of opportunities for a rich quality of life. It is no wonder that Georgia had 16 of the fastest growing counties in the United States between 2000 and 2006 (U.S. Census Bureau). Fourteen counties were within a 50-mile radius of Atlanta and the remaining two were near Savannah.

Georgia has abundant water resources within 14 major river basins and multiple groundwater aquifer systems. Many of the state's 44,056 miles of perennial streams, 23,906 miles of intermittent streams and 603 miles of ditches and canals begin or flow through forest lands.

Forests provide remarkable benefits for Georgia's water resources. They help supply clean water for aquatic habitat, safe drinking water and recreational activities.

Forested buffers protect biological diversity by stabilizing stream temperatures and providing food and habitat to aquatic ecosystems. Additionally, they protect water quality by reducing the amount of sediment, nutrients and other pollutants that enter streams and lakes.

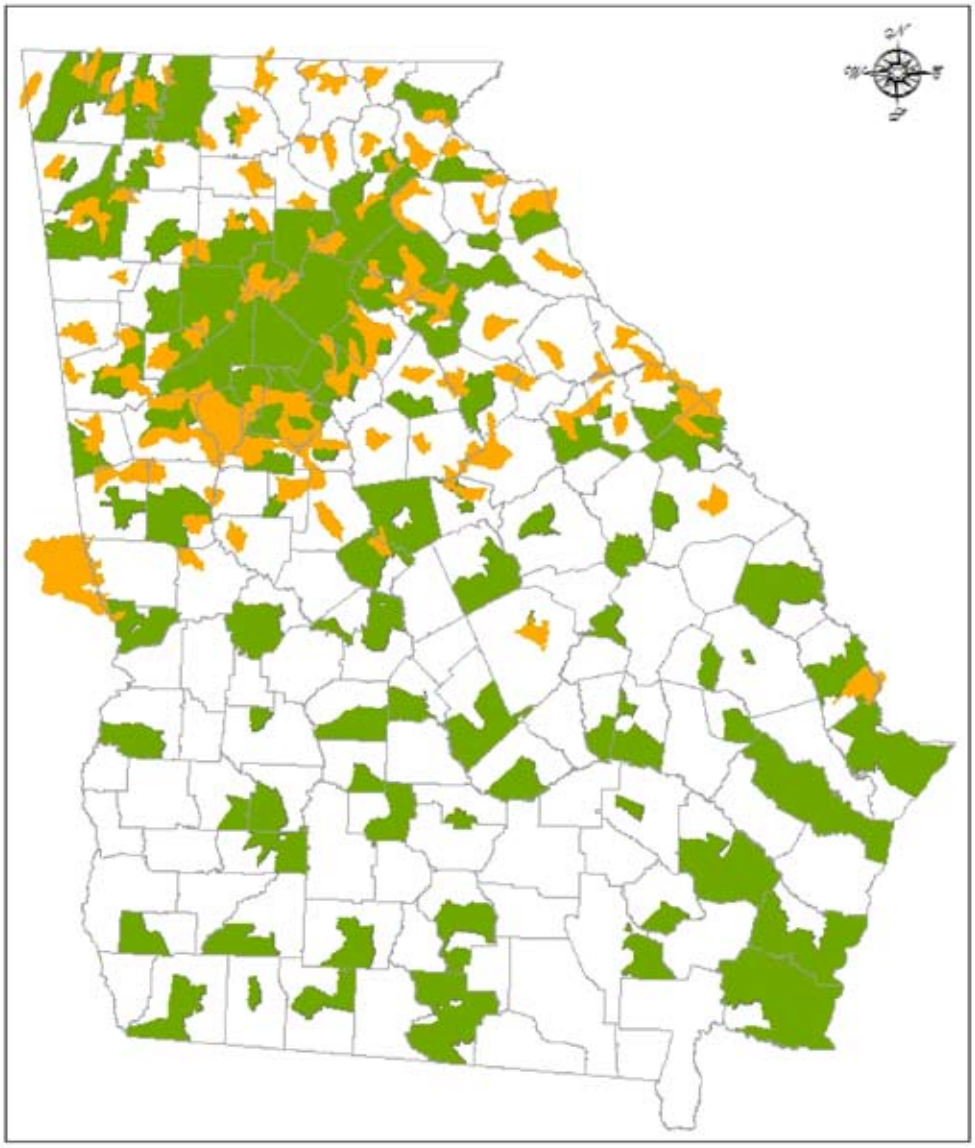
Studies have shown that riparian forests and wetlands can trap more than 80 percent of sediment and nutrients, as well as reduce peak flood periods by 50 percent (Cooper et al. 1987). This is an important benefit to the 134 water supply reservoirs that provide many Georgians with a clean source of water (Figure 23 on following page).

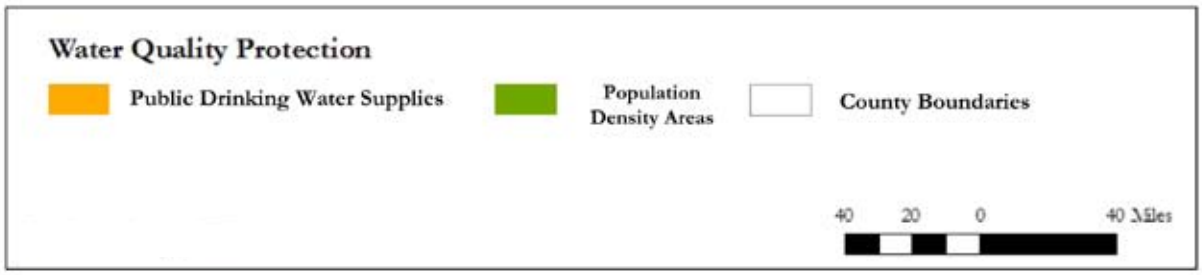
From an economic standpoint, communities that utilize this important function of trees and canopy cover may spend less money developing additional stormwater management infrastructure. In Atlanta, for instance, the stormwater retention capacity of the urban forest has been calculated at about $85.9 million a year (American Forests, 2001).

- Infiltration rates for forested areas are 10 to 15 times greater than for equivalent areas of turf and grass.
- During a heavy rain, a healthy forest can absorb as much as 20,000 gallons of water in an hour.

The future of Georgia will depend on the clean fresh water that flows through the sustainable forest lands in the state.

Areas of Population Density and Public Drinking Supplies





Sources: Georgia Department of Natural Resources, Environmental Protection Division, 2009. Unpublished data. Department of Commerce. Census Bureau. Geography Division. 2000 Census Tracts. http://www.census.gov

Figure 23

Public Benefits from Forest Resources

Wildlife Habitat and Natural Heritage

Georgia boasts a tremendously diverse natural heritage - ranking sixth among all states in overall biological diversity. The state's rich forest resource reflects an important part of our natural heritage that directly shaped the lives and cultures of earlier residents, and provides essential wildlife habitat and recreation opportunities of immense value to our state's residents and visitors.

Habitat diversity begets wildlife diversity, and many of Georgia's distinct habitat types are forests. Additionally, forest cover is essential to the health of many aquatic habitats by providing shade and structure. Forest structure, species composition and other criteria determine which wildlife species find a particular site suitable. Mature upland and bottomland hardwood forests with well-developed canopy, mid-story, shrub layer and ground cover, and open, frequently burned pine woods with diverse ground cover provide the most value to the greatest diversity of wildlife species. Some species, such as black bears and great-horned owls are large, charismatic and easily detectable. Others, such as salamanders and shrews, are secretive and small, but no less important.

The "value" of wildlife to society is difficult to measure, but most citizens agree that having wildlife on the landscape contributes significantly to the quality of life. Additionally, wildlife is very important to the many people who enjoy hunting, fishing, nature photography, birding and other activities that depend upon healthy populations of wild plants and animals. In 2006, 35 percent, or 2.4 million, of Georgia residents age 16 and older took part in wildlife-related recreation, spending more than $3.5 billion. (U.S. Department of the Interior 2007).

Georgia has 182 primary forest products manufacturers with 94 sawmills, 11 veneer and panel product mills, 12 pulp mills and 65 mills that produce other miscellaneous products from logs. Forty-seven primary mills export products to world markets. Of Georgia's 159 counties, 85 counties have at least one primary mill; 74 counties have none. In addition to the primary mills, approximately 1,500 secondary manufacturers provide further processing to Georgia's wood products (Willard 2009).

Following is a summary of the most recent mill production data available for Georgia's primary forest products manufacturers:

- In 2007, Georgia led the 13 southern states in the production of four roundwood products (Johnson et al. 2009):
  - All Products – 15 percent of the region's total.
  - Pulpwood – 17 percent of the region's total.
  - Composite Panels – 25 percent of the region's total.
  - Poles and Posts – 30 percent of the region's total.
  - Softwoods were the dominant species group in these rankings, as shown in Table 4 (Johnson et al. 2009).

- In 2008, Georgia had three of the top 10 U.S. hardwood mills – #1, #2 and #6; and eight of the top 100 U.S. softwood mills – #27, #49, #63, #66, #72, #79, #88, #98 (Abbott and Donnell 2009).

- In 2008, Georgia continued to be a leader in pulpwood production, roundwood production and number of pulp mills and pulping capacity. Of the 13 states in the southern region (Johnson et al. 2010):
  - Georgia ranked second in the number of pulp mills: 12 out of 86 total mills.

Volume of Roundwood Products, Georgia vs. Southern Region, 2007

State, year, and species group	All Products	Product						
		Saw Logs	Veneer Logs	Pulpwood	Composite Panels	Poles & Posts	Other Misc.	Domestic Fuelwood
Georgia 2007		*thousand cubic feet*		Rank in ( )				
Softwood	1,042,696 (1)	352,142 (2)	57,684 (5)	507,960 (1)	95,415 (1)	16,001 (1)	9,105 (2)	4,389 (2)
Hardwood	209,141 (7)	59,543 (7)	5,804 (4)	102,767 (4)	2,786 (5)	0 (4)	609 (5)	37,632 (2)
Total	1,251,837 (1)	411,685 (2)	63,488 (5)	610,727 (1)	98,201 (1)	16,001 (1)	9,714 (4)	42,021 (2)
GA's % of Southern Region Total	15	12	9	17	25	30	20	13
Total Southern States								
Softwood	6,120,474	2,524,468	654,897	2,449,972	365,800	53,571	38,076	33,690
Hardwood	2,413,316	922,992	65,826	1,102,558	27,292	308	11,548	282,792
Total	8,533,790	3,447,460	720,723	3,552,530	393,092	53,879	49,624	316,482

Table 4

- Georgia ranked first in pulping capacity: 21,015 tons/24 hours; 17 percent of the South's total.
- Georgia ranked first in pulpwood production for all species combined; first in softwood production and fourth in hardwood production.
  - Georgia had 30,776,207 green tons of pulpwood production; a 10 percent increase since 2007.
  - Georgia ranked first in pulpwood production from wood sourced within the state at 25,109,614 green tons.
  - Georgia ranked first in roundwood production for all species combined - a 12 percent increase since 2007; first in softwood production; and fourth in hardwood production.
  - The two most productive Georgia counties averaged 840,000 green tons of roundwood pulpwood production; the top-leading seven counties produced 18 percent of the state's total as shown in Table 5 (Johnson et al. 2010).

Top 7 Roundwood Pulpwood Producing Counties in Georgia, 2008

County Ranking	Georgia County	All Species	Softwood	Hardwood
		green tons		
1	Clinch	841,811	729,038	112,773
2	Charlton	837,135	826,629	10,506
3	Burke	664,968	538,604	126,364
4	Wayne	565,087	525,120	39,967
5	Emanuel	561,432	496,895	64,537
6	Camden	548,532	525,239	23,293
7	Appling	543,272	494,667	48,605
Total		4,562,237	4,136,192	426,045
% of State Total		18%	20%	11%
State Total		25,109,614	21,225,245	3,884,369

Table 5

Exports from Georgia to World Markets 2006-2008

	2006	2008
	thousands ($USD)	
All Merchandise	$20,113,252	$27,513,962
Paper	$1,803,722	$2,775,256
Wood Products	$172,624	$173,165

Table 6

Georgia forest products continue to be an important export commodity to world markets. In 2008, exports from Georgia's paper and wood products sectors to world markets accounted for 11 percent of the total export valuation from Georgia, or $3 billion; a $1 billion increase since 2006, as shown in Table 6 (U.S. Department of Commerce 2009).

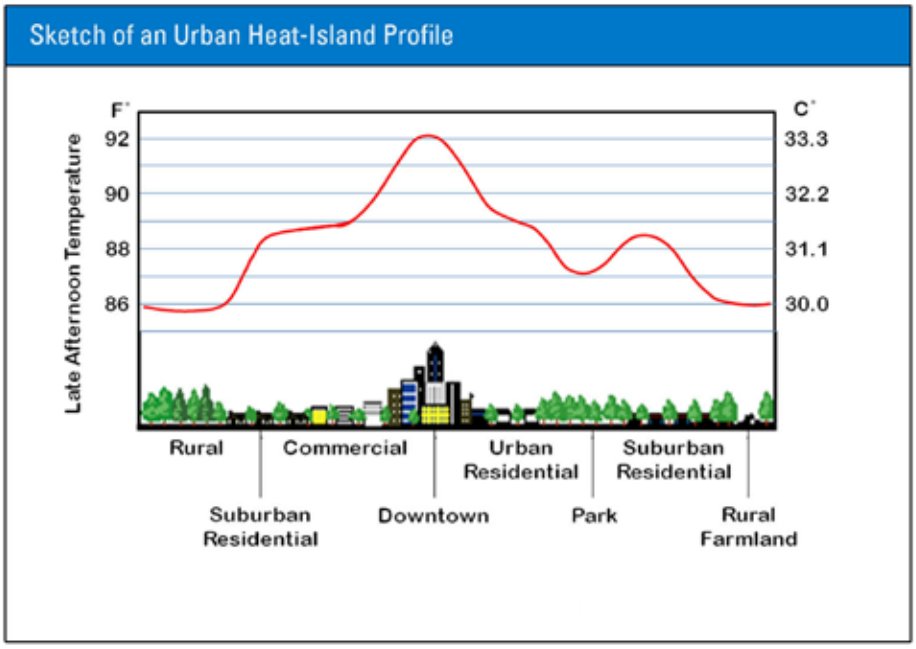
Georgia's forest industry is well-positioned to capture increased market share in emerging countries for traditional products such as lumber and panel products as well as new bioenergy products such as wood pellets. This is largely due to the proximity of the Port of Savannah, the fastest growing port in the U.S. and the fourth largest port in the U.S. In 2008 and 2009, wood products (including wood pulp, paper and paperboard, and logs and lumber) were the top export product category from the Port of Savannah. From 2004-2008, wood pulp was the top export commodity from Savannah (Brown 2009).

Having forests in the places where people live, work and play improves quality of life. Studies show contact with nature can lower blood pressure, speed recovery from surgery and lower self-reported stress. For children, inner-city children in particular, trees and parks provide a safe, inviting environment in which to play and explore. That opportunity is vital, considering children who have contact with nature score higher on tests of concentration and self-discipline. Children who play regularly in natural environments show more advanced motor skills, including coordination, balance and agility. When children play in natural environments, their play is more diverse with imaginative and creative play that fosters language and collaborative skills. Nature buffers the impact of life's stresses on children and helps them deal with adversity (Georgia Urban Forest Council 2006).

Trees soothe our psyche, instill us with peace and restore our spirits. Scientific studies have shown links between contact with trees and nature and psychological and societal well-being. People with green views from their windows are more likely to know their neighbors and report a stronger sense of community (Georgia Urban Forest Council 2005a).

Trees improve air quality by removing nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3) and particulate matter measuring 10 microns or less (PM10). This role is especially valuable in 27 Georgia counties and cities including Atlanta, Athens, Augusta, Columbus and Macon that are designated as non-attainment areas (not in compliance for air quality standards as monitored by the U.S. Environmental Protection Agency).

In the Atlanta metro area, trees removed 19 million pounds of pollutants, valued at $47 million in 1996. Tree cover as it existed in 1974 would have removed 30 million pounds of pollutants, valued at $75.5 million (American Forests 2001).



Source: Adapted from Heat Island Group, LBNL, *http://eetd.lbl.gov/heatisland*

Figure 24

Trees help moderate the heat island effect caused by pavement and buildings in commercial areas. On warm summer days, the air in urban areas can be 6-8°F hotter than it is in surrounding areas (Figure 24). Scientists call these cities "urban heat islands." The higher temperatures in urban heat islands increase air conditioning usage and raise pollution levels. Causes of the "heat island effect" include dark surfaces that absorb more heat from the sun and less vegetation that would provide shade and cool the air (Akbari 2000).

As the higher heat creates more pollution, the pollution continues to trap more heat. Twelve percent of Atlanta's air pollution is thought to be the direct result of the urban heat island effect (Galveston-Houston Association for Smog Prevention 1999).

By reducing air pollution, trees do more than save money in pollution mitigation efforts; they save money in health care costs. The American Lung Association estimates that ozone-associated health care costs Americans about $50 billion annually. Much of that expense can be traced to asthma, which is the leading cause of chronic illness in Georgia. Trees can also lure us off our couches into the outdoors, inviting us to become more active. Trees create a more attractive and comfortable environment for outdoor recreation. This could prove to be a huge benefit, considering health care costs associated with obesity have risen to $100 billion, per year, nationwide (Georgia Urban Forest Council 2005b).

Energy savings provided by trees can be significant. Nationwide, it is estimated that planting trees and using more light colored surfaces (roofs and pavement) could annually save up to 40 billion kilowatts of electricity and the attendant pollution produced by the necessary power generation (Galveston-Houston Association for Smog Prevention 1999). Three properly-placed trees can save the average household between $100 and $250 in energy costs or about 30 percent on air conditioning costs every year.

Avoided Carbon

Reducing energy use also decreases the amount of carbon pollution produced by utility companies. A CITYgreen calculation (that multiplied the amount of kilowatt hours of electricity conserved as a result of direct shading of trees by the fuel mix profile of Georgia's electricity production) revealed that Atlanta eliminates about 658,000 tons of carbon emission annually as a result of direct shading (American Forests 2002).

Trees and forests store carbon in roots, trunks and limbs. This helps to remove atmospheric carbon, a by-product of burning fossil fuels, and thus reduces pollution. Carbon accounts for about half the dry weight of most trees. The carbon-related function of trees is measured in two ways: the total amount stored, which becomes greater as the tree ages, and the rate at which carbon is stored (called sequestration), which is faster in young trees and then slows as the tree matures. This stored carbon has the potential to be saved for a long period of time in both living trees and solid wood products.

In addition, carbon sequestration is an emerging ecological market opportunity for forest owners. In 2008, Georgia's forests grew a net plus 546 million cubic feet (Miles 2009) of green wood and sequestered approximately 15 million metric tons of carbon dioxide (CO_2). Carbon sequestered through forest growth offsets more than eight percent of all CO_2 emissions from energy production in Georgia annually (U.S. EPA 2009). The utilization of the trees removed from Georgia forests each year results in the storage of an additional 22.5 million metric tons of CO_2 or an additional 12 percent of annual energy emissions (U.S. Forest Service 2009a). The sale of "carbon credits" may provide a potential opportunity for new income to Georgia landowners.

Companies are seeking opportunities in the commercialization of bioenergy, or the conversion of forest biomass into energy, which will benefit both forest landowners and forest industries.

Georgia's current abundance of forest resources has been identified as having tremendous potential in this arena.

The continued development of a bioenergy industry will generate additional products from the forest, including electricity, motor fuel and biochemicals such as solvents and adhesives. Landowners will realize financial benefits from previously unmarketable forest materials utilized from their lands. As the value of biomass for energy applications becomes more defined, the market for small diameter trees can be expected to improve and landowners will have an additional incentive to plant trees.

Equipment manufacturers have begun designing and manufacturing specialized tools for harvesting and gathering forest biomass and loggers are testing methods to efficiently harvest biomass. The forest management practices of landowners and investment by loggers will be influenced by local bioenergy markets, just as they have been by other forest products manufacturing facilities.

Georgia's sustainable forests produce an abundance of surplus forest biomass that can be converted to energy. A large potential exists to capture a portion of biomass resources that is currently not utilized.

In 2004, a harvest and utilization study was conducted which found that 14 percent of total softwood volume and 26 percent of total hardwood volume were left in the woods after harvest (Bentley and Harper 2007). In 2008, the study was repeated and found that 12 percent of total softwood volume and 22 percent of total hardwood volume were left in the woods after harvest.

Residues from timber harvesting exceeded 7.4 million tons (oven dry weight) in 2007 (U.S. Forest Service 2007). A recently performed forestry biomass assessment based on forest inventory data gathered between 1995 and 2005 showed that on average, 9.1 million tons (oven dry weight) of biomass is available each year from residues in Georgia. This amount increases to 18.7 million tons (oven dry weight) when considering the excess growth of merchantable timber. (McClure 2009b). This figure does not include biomass currently being used by other industries.

Various policies established at the federal, state and local levels have been developed recently to encourage the use of renewable energy products, including biomass. For example, Georgia has established state income tax credits for the purchase of equipment to build renewable energy production facilities. In addition, the 2008 Farm Bill contains the Biomass Crop Assistance Program and other provisions to encourage biomass production for energy use. Policies are also being developed to limit biomass use because of concerns about long term sustainability and unintended consequences of incentive-based regulation. An example of a policy limiting biomass use is the Energy Independence and Security Act of 2007, which requires all biomass harvest locations to be mapped and documented by liquid biofuel producers and does not allow any "merchantable-sized" trees from naturally regenerated forests to be used to produce liquid biofuels. Georgia can supply significant biomass amounts from trees on the seven million acres of planted forests and from logging residues on all forests. However, this policy will certainly have some effect on the availability of biomass for liquid fuel production.

Recent groundbreakings, announcements and openings of new bioenergy facilities are evidence of a growing opportunity for new markets for previously unutilized and low value forest biomass.

The development of a forest resource-based bioenergy industry will add to the economic impacts of Georgia's forest industry. New industries will create jobs and investment for rural Georgia communities, while providing critical tax revenue for the state. Georgia currently imports 100 percent of its oil, gasoline, diesel fuel, natural gas and coal from foreign countries and other states. The development of a forest bioenergy industry would allow Georgia's energy dollars to stay in the local economy.

Multitrade Biomass, LLC has converted an idle textile mill in Rabun County into a bioelectricity generating plant and is using wood chips to fuel the steam boiler. Two large 100 megawatt bioelectricity plants have recently been announced by Oglethorpe Power, and the first in Warren County is expected to be functioning in 2014. Yellow Pine Energy Company, LLC, will build a 110 megawatt plant in Clay County, and is expected to be operational in 2012. Georgia Power is planning to convert Plant Mitchell near Albany from coal to wood fuel. In total,

there have been announcements for 11 bioelectricity plants in Georgia totaling 700 megawatts of power production.

The manufacturing of compressed wood pellets, briquettes and fire logs for "carbon neutral" electricity and heat production is another market that is gaining momentum in Georgia. Four facilities are producing wood pellets and/or briquettes and fire logs, and several more companies have announced plans to build more. These compressed wood products, made from sawdust, are used domestically for heat, or are exported to European countries, where mandates exist to decrease carbon emissions from fossil fuels.

Biomass is a renewable source of energy that can provide liquid transportation fuels and potentially could replace 30 percent of U.S. petroleum use (Perlack et al. 2005).

A significant event in the history of Georgia's forest industry occurred in November of 2007, when Range Fuels broke ground in Treutlen County, near Soperton, for the world's first commercial scale cellulosic fuel factory, converting non-merchantable trees and harvesting residues into ethanol and methanol. The plant's first phase will produce nine million gallons of ethanol and methanol per year. The final stage of the facility is expected to produce 100 million gallons per year, potentially utilizing one million oven-dry tons of wood biomass annually.

In 2011, Georgia BioMass will begin operations as a wood pellet production plant and is expected to produce 750,000 tons of wood products annually. It will create 75 jobs and represents a $150 million investment in Georgia.

Threats to Forest Resources

There are many challenges at hand for Georgia's currently thriving forest system and the people who manage it. Major threats to Georgia's forests include urbanization, ownership changes, forest pests, invasive plants, wildfire and limitations on the use of prescribed fire.

Unprecedented population growth and the urbanization of our state lead the list of forces that could undermine forest sustainability in decades to come. Georgia experienced rapid population growth in the late '90s, becoming the fastest growing state in the South. Four counties in the metropolitan Atlanta area ranked among the top 10 fastest growing counties in the U.S. Over the next two decades, between 2010 and 2030, the state's population is projected to grow by an additional 4.6 million people. According to the current projection, Georgia's population will increase 46 percent, from 10.1 to 14.7 million people by the year 2030 (Governor's Office of Planning and Budget 2010). Effects of this rapid growth include declining air and water quality and increased need for stormwater management resources. Partly, as a result of the loss of tree cover, some communities are currently not able to meet clean air and water standards. Increasing population threatens to accelerate this trend.

Canopy Loss - Impervious Surface Gain

GFC-funded studies by the University of Georgia's Natural Resources Spatial Analysis Laboratory (NARSAL) determined that approximately 54 acres of canopy cover were lost in the Atlanta region each day from 1991-2001. Simultaneously, approximately 28 acres of impervious surfaces (e.g. roads, buildings, etc.) were added daily. Updating this information to 2005 showed a slight decrease in canopy loss, but impervious surface additions increased to approximately 55 acres daily.

In a similar statewide analysis, NARSAL determined that from 2001-2005, Georgia's canopy cover declined by a total of 398,330 acres, or 273 acres per day. Although canopy loss in rural areas often reflects ongoing forestry activities, in urban areas it frequently indicates development. Accordingly, impervious surfaces increased by a total of 154,134 acres, or 106 acres per day.

One half of the state's increase in impervious surface occurred in metro Atlanta. The data shows for every one acre of tree canopy lost, there was an increase of one acre of impervious surface in the 16-county Atlanta metro region between 1991 and 2005. The Savannah area also experienced tremendous growth pressures. Tree canopy decreased by 28 percent in Bryan, Chatham and Effingham counties between 1991 and 2005, while impervious surfaces increased by 272 percent. The trends are similar in Columbus, which lost eight percent of tree cover and increased in impervious surfaces by 71 percent. The Macon area lost 10 percent of tree cover and increased in impervious surfaces by 41 percent. Whitfield County gained four percent in tree cover and also increased in impervious surfaces by 78 percent. Glynn County lost eight percent of tree cover and increased in impervious surfaces by 66 percent and Camden County lost five percent of tree cover and increased 71 percent in impervious surfaces.

The impact of urbanization extends beyond Georgia's major metropolitan areas. The Upper Oconee and Etowah watersheds are two of the top 15 watersheds in the country projected to experience housing density increases on more than 200,000 acres of their surface area (Stein et al. 2005).

Urbanization and Water

Conversion of forest land to urban use is the greatest threat to the sustainability of Georgia's water quantity and quality. Urbanization effectively and permanently removes acreage from forest cover, resulting in increased storm runoff and increased streamflow that causes streambank erosion, sedimentation and flooding.

Further effects of forest cover loss include higher levels of pollutants and increased water temperatures that degrade fish and wildlife habitat. Development in the wildland-urban interface often occurs in the headwaters of streams and rivers that are home to many of Georgia's endemic species which are vulnerable to environmental changes and pollutants.

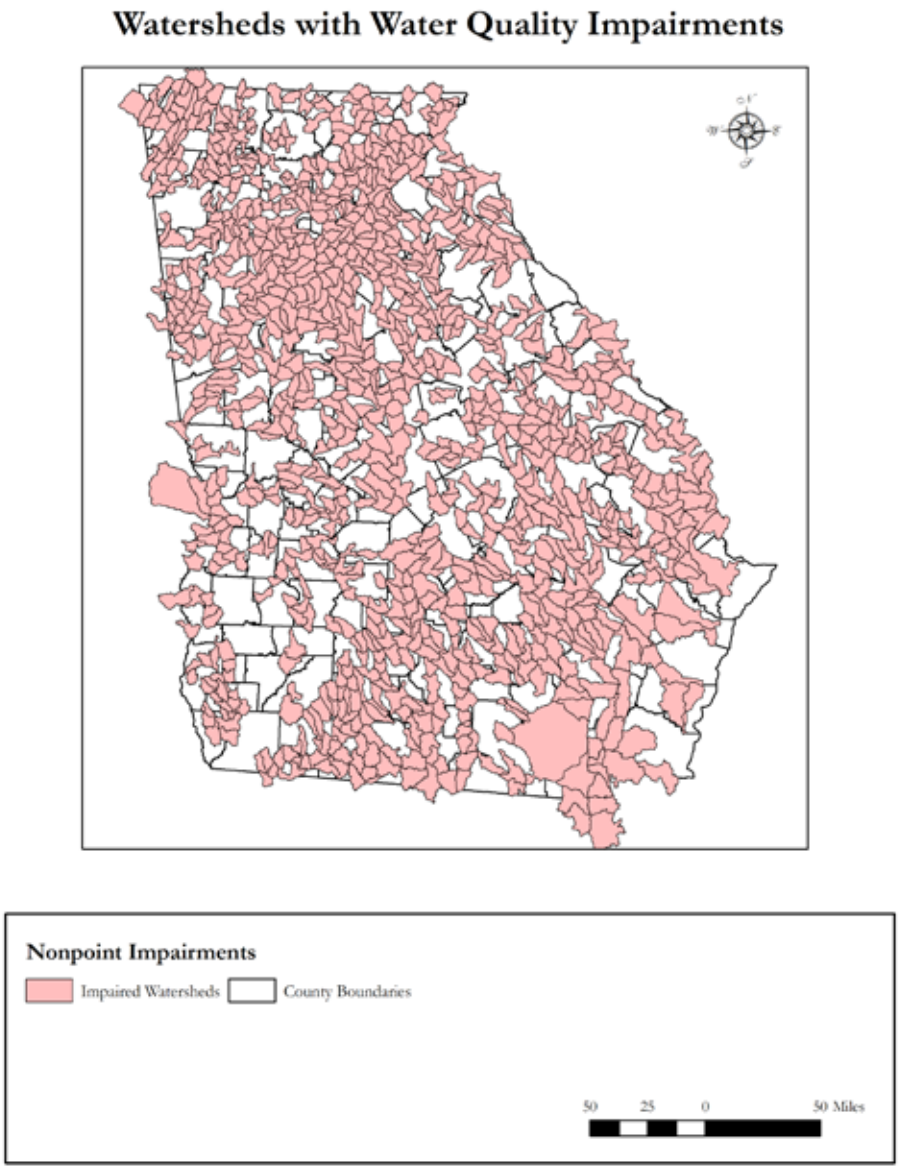
There are inconsistent standards for managing riparian management zones among land users. For example, state law requires developers to maintain only a 25-foot undisturbed management zone along most streams, regardless of the pitch of slopes that are perpendicular to the stream. Forestry operators, however, recognize a 40-foot minimum management zone, which can increase to 100 feet, depending on the slope or whether the stream is identified by DNR as a mountain trout stream.

Critical Water Projection Data Needed

Regarding quantities of water available for the state's growing needs, Georgia does not have precise measurements of how much water is available from its streams and aquifers. Calculations are also unavailable for how many waterborne pollutants Georgia streams and rivers can safely assimilate. No reliable forecasts have been made concerning how much water the state will need, or how much wastewater will be discharged, as the state continues to grow. Accurate information is needed on water quantity as well as water quality for effective planning and management. Georgia must determine how much water can be removed from rivers, lakes and aquifers without causing unacceptable negative impacts and determine how much wastewater and stormwater streams can handle before water quality begins to degrade.

In addition to urban pressures, the Georgia Comprehensive Statewide Water Management Plan (Georgia DNR 2008)states that there are over 6,000 miles of streams that do not meet state water quality standards because of non-point sources of pollution. Nonpoint sources include forestry activities. It has been estimated that seven to ten thousand forestry operations are conducted on some 790,000 acres per year statewide. Other nonpoint sources include agriculture, past practices of constructing canals and ditches and poor county road maintenance. These have contributed to impaired streams and wetland losses (Figure 25).

Declining budgets have affected state and local regulatory agencies' abilities to effectively address water quality and quantity issues.



Source: Georgia Department of Natural Resources, Environmental Protection Division 2008.

Figure 25

Urbanization and Biodiversity
Most of Georgia's native plants and animals depend upon healthy forest habitats for survival. High quality forest habitat is being lost to development and conversion to other uses to meet the desires of our growing population and changing society. Contributing factors include urban sprawl, tax laws and economic factors that encourage parcelization and development, global competition for forest products, intensifying forest management practices and widespread corporate divestiture of timberlands.

Forest habitats in decline include mature bottomland hardwoods and cypress-gum wetlands (U.S. Forest Service 2008). Imbedded within forests are small patches of special habitats such as bogs, rock outcrops, caves and prairie remnants that are essential for numerous localized and rare species.

Wildlife Species' Ups and Downs
Examples of high priority large-patch or "matrix" habitats that support substantial numbers of wildlife species include upland hardwood and pine-hardwood forests, pine woodlands and savannas, bottomland hardwood forests, river swamps, and depressional wetlands (Georgia Department of Natural Resources 2005; Comer et al. 2005;Van De Genachte and Cammack 2002). Often embedded within large-patch habitats are small-patch natural communities such as bogs, rock outcrops, caves and prairie remnants that represent essential habitat for many localized or rare species. Both "matrix" and small-patch habitats are impacted by habitat fragmentation and disruption of natural ecological processes such as fire and flooding.

Over time, some species have successfully adapted to extensive landscape changes resulting from residential and commercial development, agriculture, intensive forestry, stream impoundment, pollution and additional factors that have accompanied human population growth and a high rate of natural resource consumption.

However, other species are less adaptable and are in need of careful management to prevent further declines in the face of extensive habitat loss. For example, populations of the northern bobwhite, Bachman's sparrow, redcockaded woodpecker, prairie warbler and many others that once occupied the extensive and highly diverse longleaf pine savannas of the coastal plain, characterized by open forest canopy with herbaceous ground cover maintained through frequent fire, have all decreased as their habitats have dwindled.

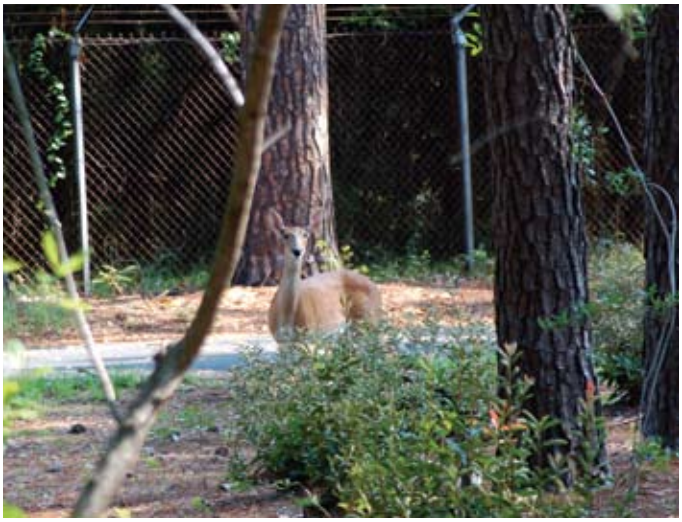


Photo courtesy of Melissa McGraw

Many aquatic organisms have declined as a result of impoundments, siltation, pollution and competition from exotic species. Georgia ranks eighth among all states in the number of species at risk and fifth in the number of extinctions.

Also, the growing wildland-urban interface compounds other problems, including conflicts between wildlife and humans, pets and livestock. Of particular concern is the increasing number of wildlife and car collisions. With the deer population hovering around 1.2 million statewide, and continued urbanization and development, there are an estimated 50,000 deer-car collisions annually in Georgia.

Urbanization and Wildfire

Urbanization places more lives and property at risk from wildfire and reduces options for proper fire management. The most important function/work management challenge for forestry professionals is to ensure public safety by providing fire prevention services through prescribed fire as well as wildfire suppression. The sustainability of Georgia's forest is dependent on attention to both of these critical services.

Urbanization makes wildfire management complex. Tactics and strategy, roles and responsibilities, coordination of responders, media relations, liability, planning, logistics, finances and firefighter safety become more difficult to manage in the wildland-urban interface (WUI). Preparation of forest rangers and cooperators for WUI wildfires requires additional, intensive training at considerable expense.

Prescribed Burning Challenges

Increasing urbanization challenges Georgia's ability to maintain or increase the million-acre prescribed fire program. This program is GFC's best fire prevention tool for mitigating wildfire threat. As Georgia's population increases, it takes extra time and effort to consider how every prescribed fire impacts communities. Prescribed fire managers are trained to minimize smoke impacts on the public and to communicate fire projects to neighboring communities. Planning and execution of prescribed fires become increasingly complex, requiring critical decisions and better trained practitioners. However, extra precautions increase costs and reduce the cost/benefit ratio of prescribed burning. Although the threat of wildfire may be reduced for communities through prescribed fire, few communities have been motivated to help alleviate costs for this practice that ensures forest health and reduces wildfire risk.

Apprehension about fire and smoke increases with urbanization. Air quality has become a major concern in Georgia, and prescribed fire has been targeted as one of many sources of harmful emissions. Drift smoke from prescribed fire and wildfires concerns urban dwellers. An important mission is to help Georgians understand the life sustaining properties of healthy forests, and the natural role that fire plays in ecosystems.

Another issue caused by the pressure of urbanization is forest fragmentation and parcelization. Parcelization results when the number of forest landowners increases, but the forest land is held in smaller parcels, measured at 50 acres or less (Wear and Greis 2002). The shrinking size of forest land parcels results in less efficient management units, which contributes to cost increases and resource management difficulties. In addition, increasing numbers of people result in a decreased implementation of sound forestry practices. At approximately 45 people per square mile, there is a 50:50 probability that forestry will be practiced. At 150 people per square mile, forestry practice applications approach zero (Wear 1999).

Fragmentation is the division of contiguous forest areas into smaller, isolated pieces or less contiguous tracts due to development, conversion to agriculture, the divestiture of forest land by the forest industry and other human activities.

Though fragmentation and parcelization may not result in forest canopy loss, in many cases the resources on the tract become unavailable to forestry markets. They may also cause adverse changes in water quality and quantity and impede the management of fire and forest pests.

Both fragmentation and parcelization may disrupt wildlife corridors and migration routes of many wildlife species. Those species requiring large, undisturbed expanses may decline.

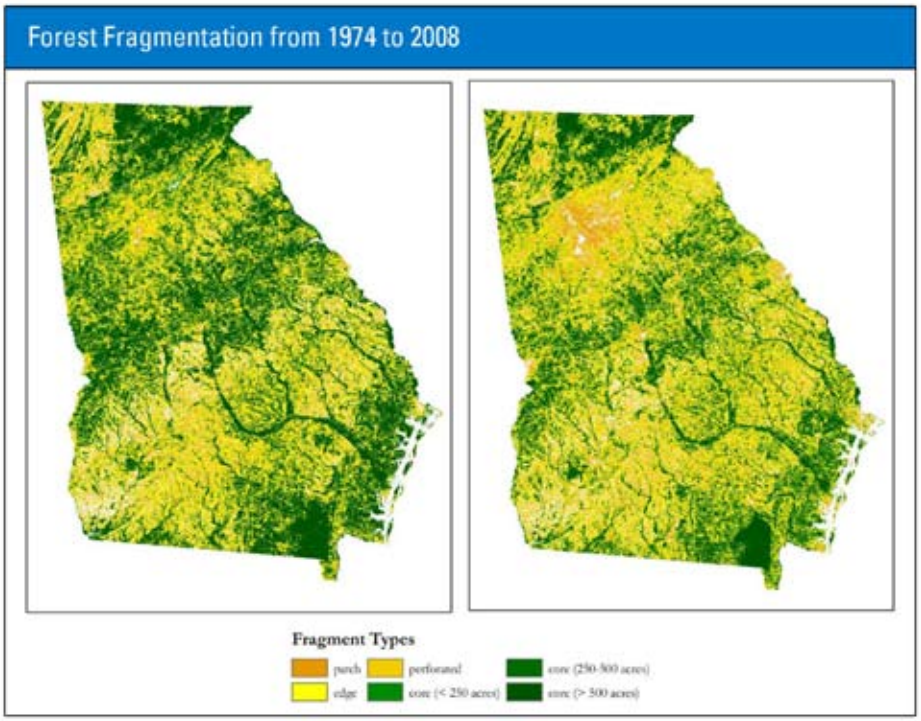
Georgia forest fragmentation trends over the past 34 years were evaluated by a comparison of four classes of forest areas defined in terms of the type of fragmentation present:

- Core – interior forest pixels that are not degraded from "edge effects."
- Perforated – forest along the inside edge of a small forest perforation.
- Edge – forest along the outside edge of a forest patch.
- Patch – small fragments of forest that are entirely degraded by "edge effects."

Results showed forest core areas greater than 500 acres have decreased by more than 20 percent (Figure 26).

This core size represents large, contiguous forest area available to provide abundant amounts of key ecosystem services including wood and fiber production, water quality and quantity protection and biodiversity. Some of this loss is accounted for in the increase in developed area across the state, but the biggest reduction in large core areas is in fragmentation due to the changes in land ownership and priorities of these land owners over time. Much of the loss of large patches can be accounted for in the increase in area of smaller core patches and increases in edge, patch and perforated patches (Table 7).

In addition to urban sprawl, a major contributing factor to fragmentation and parcelization is taxation. Property tax burdens often result in the sale of land to pay taxes. When this occurs, the land is more prone to be subdivided. Highest and best use land valuation tax assessments are causing massive divestitures of forest products company lands to timber investment management organizations and real estate investment trusts. These divestitures are resulting in more rapid turnover in forest ownership and increased potential for fragmentation and parcelization.



Source: Natural Resources Spatial Analysis Laboratory (NARSAL), University of Georgia, Athens, GA (Unpublished data)

Figure 26

Percent total forest for each category of fragment

Patch Type/Year	1974	1984	1991	1998	2001	2005	2008
Patch	3.1	3.9	5.3	4.6	6	6	4.6
Edge	25.1	25.8	29.3	28.5	33	33.2	30.2
Perforated	10.7	15	18.8	17.1	12.4	12.8	15.6
Core (<250 ac)	5	5.6	9.8	9.4	11.9	12.1	11.2
Core (250 - 500 ac)	1.8	2.1	4.2	4.3	6.1	6	5.8
Core (>500 ac)	54.4	47.7	32.7	36.1	30.6	29.9	32.6

Source: Natural Resources Spatial Analysis Laboratory (NARSAL), University of Georgia, Athens, GA (Unpublished data)

Table 7

A significant challenge for the forest industry in Georgia is increased market competitiveness on a global scale. While globalization provides an opportunity for local companies to expand through increased exports, it also exposes them to competition from both domestic and international markets. For example, southern lumber markets have been negatively impacted by subsidized lumber from Canada and other countries. Low-cost finished wood products are now flooding U.S. markets because of lower production costs in overseas factories. The result for Georgia has been a loss of some paper industries and slow reaction by solid wood manufacturing companies to analyze opportunities in foreign markets.

Another component of globalization is the difference in currency values. These values vary between countries, and over time, result in unpredictable and highly variable market demands for wood pulp and other products.

Several recent changes in forest product markets have resulted in lower forest product values and decreased tree planting rates. Many changes, however, present the opportunity for positive impacts, which will be addressed in the "Strategic Issues" section of this Assessment. Market changes that have negatively impacted forestry include globalization of business, product substitution, the general economic recession and increased interest in certified wood products.

Product Substitution

New methods and materials have offset the use of many traditional forest products, including paper products and building products. The replacement of paper bags with plastic by many retail companies was the first notable trend in forest product substitution. More recent substitutions include aluminum construction studs, plastic pallets, electronic file storage, online newspapers and electronic mail. Although construction continues to be the largest market for wood, the percentage of lumber and wood panels used per square foot of floor space in residential construction has decreased 27 and 19 percent, respectively, since 1986 (McKeever 2009).

Economic Recession

The major impact to the forest industry of the global economic recession of 2007-09 was a significant reduction in construction activities and the use of wood building products. Private residential housing starts in the U. S. dropped from 1,716,000 in 2005 to 622,000 in 2008-a 64 percent decrease (U.S. Census Bureau 2009). The slowing economy also decreased the demand for manufactured goods, and thus the demand for wood and paper-based shipping products. Further declines in output are anticipated for 2009, due in part to depressed economic activity as reported by housing starts and pine lumber shipments.

From 1989 to 2007, Georgia lost 63 primary forest products manufacturers: during this period 38 mills came into existence and 101 mills closed for a net loss of 63 mills (Johnson et al. 1994-2009). The depressed housing and construction market has caused several dimensional lumber mills and engineered wood products mills to reduce output by 25 to 50 percent or shut down operations altogether. These mill shutdowns have a domino effect on the economy, including the loss of logging jobs and fewer markets for timber growers.

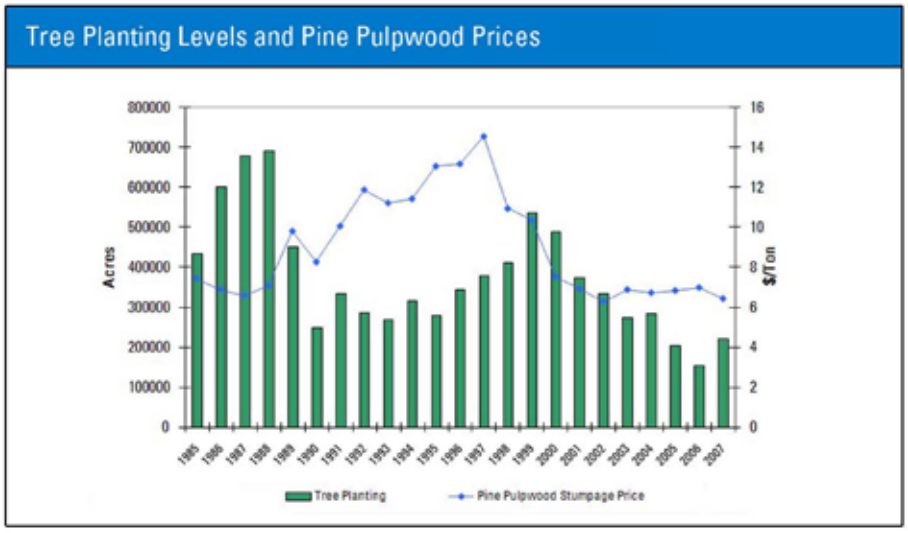
Certified Wood Products

The use of products that have been "certified" as friendly to the environment has also increased, due to green building standards, government regulation and pressure on product retailers from environmental groups. The certification trend began as a concern about poor logging practices and negative social impacts in developing countries' tropical forests. Demand for certified wood products now dominates the furniture industry and is quickly growing in the building industry, where it is a cornerstone of the "green" building movement.

While the use of wood originating from well managed forests is prudent, participation in certification programs is costly and has only been slowly adopted by small non-industrial forest landowners in Georgia. Georgia currently has 2.5 million acres in the Sustainable Forests Initiative, 1.3 million acres in the Tree Farm program and 7,000 acres of forest land under Forest Stewardship Council certification (Georgia Forestry Commission 2009). Most Georgia forest product mills do not track chain of custody from these forests for their products. In addition, some green building standards do not accept all certification systems. Georgia landowners and forest product manufacturers may not have access to certified product markets, unless increases in the adoption of these systems occur.

Tree planting has declined recently, likely due to decreased prices (Figure 27) paid to landowners for timber. If prices increase, tree planting is expected to increase. If reduced tree planting begins to lower timber volumes, then tree planting incentive programs may be warranted. The high peaks recorded in tree planting have coincided with federal tree planting cost-share programs.

An increasing amount of forest land is being left idle. This is partly due to low or poor markets that are too weak to drive the investment in reforestation after a timber harvest. Tree seedling costs are reasonable at this time, but the loss of industry nurseries will impact the availability of seedlings, leading to higher prices for those seedlings. Genetic research is also diminishing. Such research is critical to the improved productivity of commercially important tree species.



Sources: Georgia Forestry Commission and Timber Mart South 2007.

Figure 27

Forest pests can drastically alter the forest ecosystem, eliminate important resources and inflict great economic losses. Georgia's forests are under threat from numerous native and nonnative insects, diseases and other decimating agents such as invasive plants. Some of these agents are capable of causing widespread mortality while others affect forests by degrading tree value and form, decreasing growth rates or lowering ecosystem diversity. In the past 25 years, there has been a large increase of introduced pests due to the global economy and shipping of goods. Some non-native pests are already in Georgia, while others are in North America and will eventually reach Georgia either through natural spread or human-assisted movement.

International commerce has created the most common pathway for the introduction of non-native pests on North America. These insects are frequently found in cargo that has been crated or packaged with solid wood packing material (SWPM). This material is usually constructed of poor quality wood, often from trees damaged or killed by pests. Bark inclusions increase the likelihood of the presence of insects, and boards with bark attached can be hidden in middle layers of products such as wooden spools, pallets, or wooden pieces attached directly to the cargo. There are phytosanitary rules regarding SWPM to ensure the wood is either heat or chemically treated, but it is virtually impossible to check all material entering the country. Furthermore, once the SWPM is certified and stamped, it can be reused repeatedly and stored outdoors where pests can invade the wood before it is used again.

Pest Rankings

Pests are ranked into two categories based upon the level of monetary or ecological damage they are capable of inflicting on Georgia's forests. This listing was developed by the Assessment committee's Forest Health team. Pests regulated by USDA APHIS and/or Georgia Department of Agriculture are included.

Category one pests (Table 8) are currently found in Georgia and have the capability to cause severe monetary losses, ecological damage or both.

Common name	*Latin name*
Southern pine beetle	*Dendroctonus frontalis*
Ips bark beetles (4, 5, & 6 spined)	*Ips avulsus, Ips grandicollis, Ips calligraphus*
Black turpentine bark beetle	*Dendroctonus terebrans*
Hemlock woolly adelgid	*Adelges tsugae*
Laurel wilt disease	*Raffaelea lauricola*
Redbay ambrosia beetle	*Xyleborus glabratus*
Annosum root disease	*Heterobasidion annosum*
Pitch canker disease	*Fusarium circinatum*

Table 8

Table 9 shows pests not considered naturalized in Georgia, but of adequate risk level to warrant early detection and appropriate suppression actions.

Category two pests (Table 10) may pose significant damage to Georgia's forests but not to the monetary or ecological extent of those in category one. None of these species are currently considered naturalized within Georgia.

Common name	***Latin name***
Gypsy moth (European and Asian)	*Lymantria dispar & Lymantria dispar dispar*
Sirex woodwasp	*Sirex noctilio*
Emerald ash borer	*Agrilus planipennis*
Asian longhorned beetle	*Anoplophora glabripennis*

Table 9

Common name	***Latin name***
Light brown apple moth	*Epiphyas postvittana*
Siberian silk moth	*Dendrolimus sibiricus*
Rosy (or pink) gypsy moth	*Lymantria mathura*
Nun moth	*Lymantria monacha*
Pine shoot beetle	*Tomicus piniperda*
Banded elm bark beetle	*Scolytus schevyrewi*
Sudden oak death	*Phytophthora ramorum*
Thousand cankers disease	*Geosmithia spp (undescribed species)*
Walnut twig beetle	*Pityophthorus juglandis*

Table 10

Significant Forest Pests

Southern Pine Beetle

The southern pine beetle is the most destructive forest pest in Georgia. It attacks and kills all pine species in Georgia. Historical financial losses from this species surpass all other forest pests combined.

The southern pine beetle is a native insect with a history that stretches back to the 1700s, when early settlers to America noted widespread mortality of southern yellow pines. Although a tremendous amount of research has been conducted over the past 50 years, no effective control measures have been developed for trees that have been attacked. Beetle populations tend to be cyclical. Epidemic levels can last for two to three years and can occur every five to fifteen years, depending on the region of Georgia, environmental factors and overall health of the area's pine forests. Historical outbreaks are shown in Figure 28.

Stands of overstocked pines that have poor vigor and health suffer much greater levels of damage following pine beetle attack. Lack of forest management practices that control stand density and promote vigor further endangers Georgia's pine forests. Southern pine beetle threat for Georgia is based upon stand density, site factors, pine species and other information.

For more information on SPB:
http://www.gfc.state.ga.us/Forest-Management/PineBarkBeetles.cfm

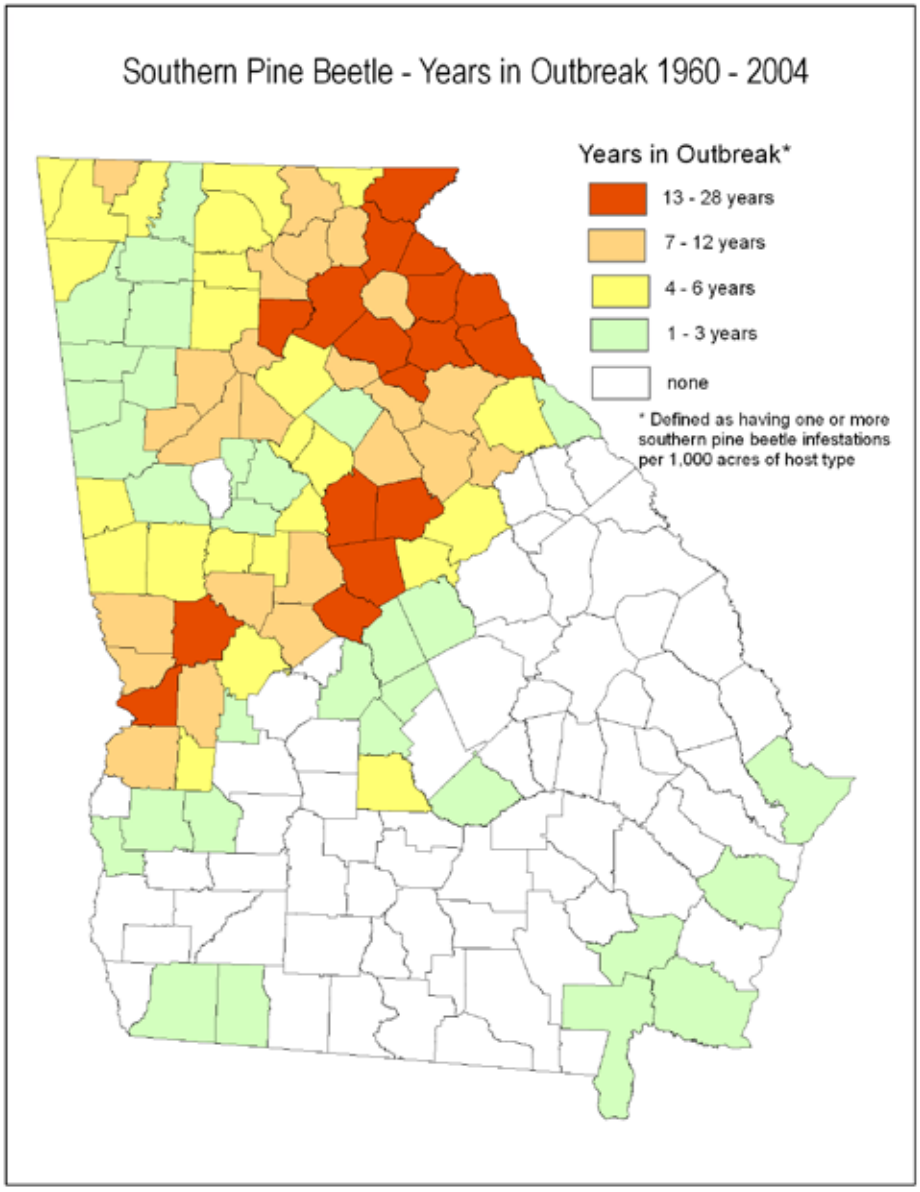
http://www.srs.fs.usda.gov/idip/spb_ii/what_r_spb.html

http://www.barkbeetles.org/spb/

http://web2.ento.vt.edu/servlet/sf/spbicc/biblioSearch.html

http://web2.ento.vt.edu/servlet/sf/spbicc/index.html

http://www.fs.fed.us/foresthealth/technology/nidrm_spb.shtml



Source: Georgia Forestry Commission

Figure 28

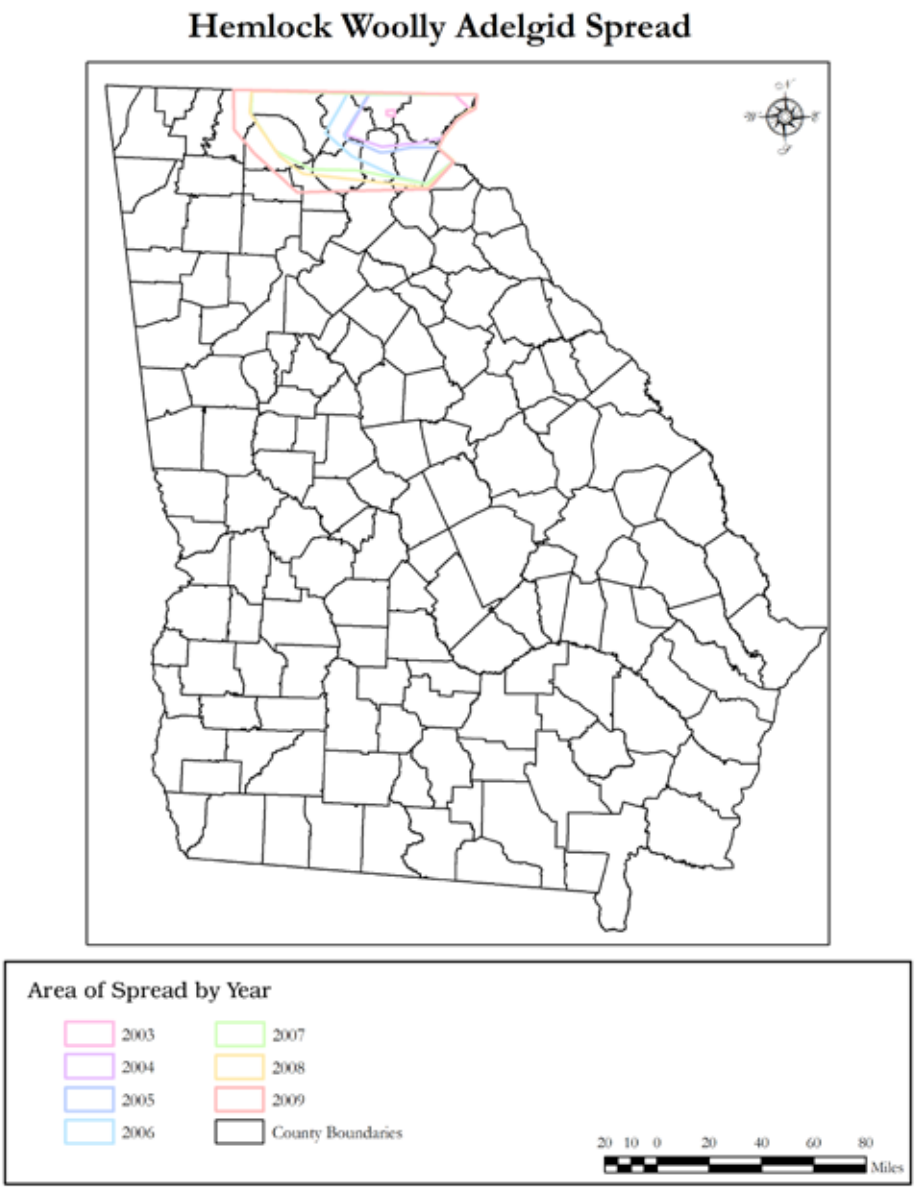
Hemlock Woolly Adelgid

The hemlock woolly adelgid (HWA) is a serious pest of eastern and Carolina hemlock trees in Georgia. It is an aphid-like insect that feeds on the sap of hemlock trees. The adelgid is dispersed by wind, birds and human activity and is spreading at an alarming rate.

HWA was accidentally introduced into Virginia in the 1950s. The insect is native to Japan, China and the United States' Pacific Northwest. HWA was first discovered in Georgia in 2003 near the Ellicott Rock area of Rabun County and can now be found in almost all Georgia's mountain counties where native hemlock occurs (Figure 29). All ages and sizes of hemlocks can be attacked. HWA causes damage to the tree by feeding at the base of needles, causing them to desiccate and drop. This inhibits the trees' ability to produce new growth. Trees that have been infested for a couple of years will show signs of decline. Unhealthy hemlocks will appear a dull green to gray color and exhibit branch dieback. Tree death can occur after as few as four years of infestation.

For more information on HWA:
http://www.gatrees.org/ForestManagement/HemlockWoollyAdelgid.cfm

http://na.fs.fed.us/fhp/hwa/



Source: Georgia Forestry Commission and U. S. Forest Service

Figure 29

Laurel Wilt Disease (and redbay ambrosia beetle)

Laurel wilt, a new disease of redbay (*Persea borbonia*) and other plant species in the family *Lauraceae*, is causing widespread mortality in the coastal regions of South Carolina, Georgia and Florida. The disease is caused by a fungus (*Raffaelea lauricola*) that is introduced by an exotic insect, the redbay ambrosia beetle. The redbay ambrosia beetle is native to Asia and is the twelfth new species of ambrosia beetle introduced into the U.S. since 1990. Redbay trees grow in the Coastal Plain region from eastern Texas to Virginia.

The beetle was first discovered in the spring of 2002 when three adult specimens were trapped at Savannah's Port Wentworth. The beetle likely entered the country in solid wood packing material with cargo that was imported from Asia. Redbay trees began dying in Georgia and South Carolina near the Savannah area in 2003. By early 2005, officials with the Georgia Forestry Commission, South Carolina Forestry Commission and U.S. Forest Service began to suspect the recently discovered ambrosia beetle was associated with this mortality. Research since 2005 has found that the mortality is caused by a pathogenic fungus carried by the redbay ambrosia beetle. The fungus is believed to be transmitted to healthy redbay trees when they are attacked by the beetle, resulting in a wilt disease.

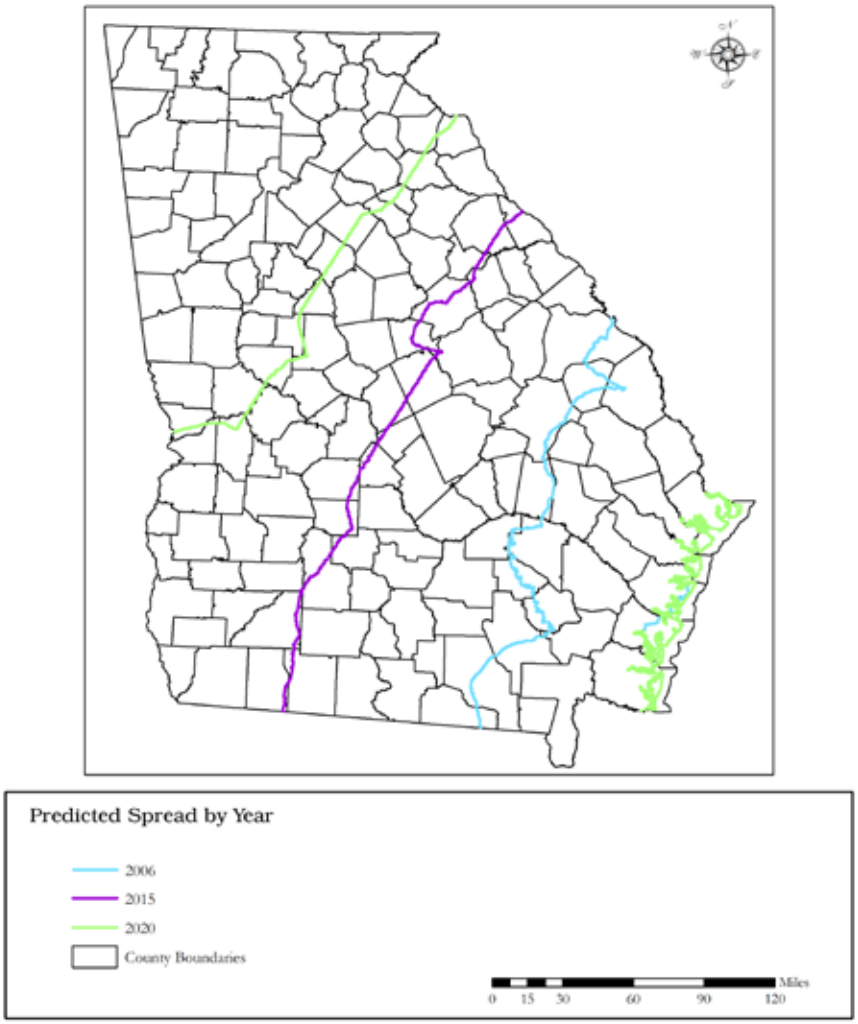
The disease has also been discovered in individual plants of the federally endangered pondberry (*Lindera melissifolia*), the threatened pondspice (*Litsea aestivalis*), sassafras (*Sassafras albidum*) and avocado (*Persea americana*). Although redbay is a Coastal Plain species, sassafras can be found westward to the Mississippi River in the U.S. and northward to Canada. There is concern that if sassafras can serve as a suitable solo host, the disease may spread to a large portion of North America. Southern Mexico and Central America have many species within the Lauraceae family, and host-testing on some of them has revealed a susceptibility to the pathogen, prompting concern about potential impacts to the forests there as well. The primary agricultural crop threatened is avocado, and a great deal of research into the situation is ongoing in south Florida.

Georgia now has over seven million acres that are confirmed with laurel wilt (Figure 30), and the disease is moving northward in South Carolina, southward in Florida and inland at an alarming rate. A GFC survey indicates that natural spread is about 15 miles per year, but movement of infested firewood, wood chips and logs is believed to be a major factor in spreading the disease into new locations incontiguous with the main area of infestation.

For more information on laurel wilt:
http://www.gatrees.org/ForestManagement/LaurelWilt.cfm

http://www.fs.fed.us/r8/foresthealth/laurelwilt/index.shtml

Laurel Wilt Predicted Spread



Source: U. S. Forest Service and Georgia Forestry Commission

Figure 30

Annosum Root Disease

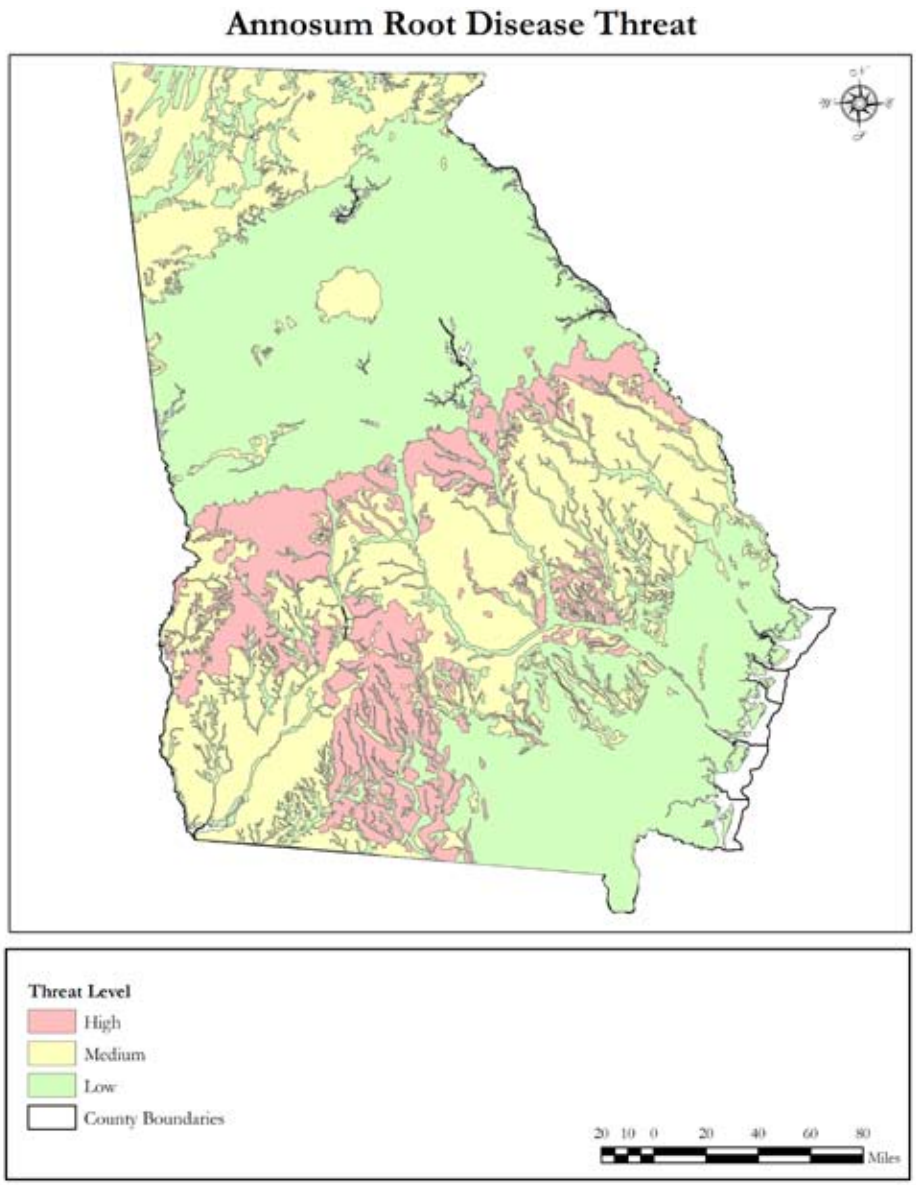
Annosum root disease, caused by *Heterobasidion annosum*, can be a serious problem in pine plantations that have been thinned one or more times. All southern pines are susceptible, but loblolly, slash and white pine are the most vulnerable. *H. annosum* causes decay in the root system, making the trees subject to butt rot, windthrow, decreased growth and death. Bark beetles can become established in diseased trees and spread to healthy ones, leading to greater losses.

The fungus usually enters a healthy stand by infecting freshly cut stump surfaces. Airborne basidiospores of the fungus land on a stump's surface, germinate and colonize the stump and its root system. The fungus then spreads to adjacent trees by root grafts or contacts, causing root disease and a decline in tree health. When two or more main lateral roots are killed, tree death usually occurs. Damage within a stand can range from single trees to pockets of dead trees scattered throughout the entire stand. If the damage is widespread, *Ips* and black turpentine bark beetles often cause further mortality by attacking the weakened trees.

Damage has not occurred on a significant scale throughout the state, but is concentrated in areas along the Fall Line and southward, particularly where sandy soils are found (Figure 31). Tree decline and death can occur from soon after the harvest up to seven years hence, with peak mortality occurring from two to five years following harvest. Georgia began to experience significant losses from annosum root disease in 2004, due in part to thinnings that began on CRP plantings throughout the state in the late 1980s. Thinnings of loblolly and slash pine CRP plantings, combined with drought, have created conditions favorable for annosum root disease.

For more information on annosum root disease in:
http://www.gatrees.org/ForestManagement/AnnosumRoot.cfm

http://www.fs.fed.us/r8/foresthealth/forestpests/diseases/annosus.shtml



Source: U. S. Forest Service

Figure 31

Pests Not Naturalized in Georgia

Gypsy Moth

The gypsy moth (Figure 32), a federally regulated pest, is a serious forest pest capable of causing severe damage to hardwood trees, especially oaks. This damage is inflicted as the gypsy moth larvae defoliate entire stands of trees. Defoliation during the spring causes severe stress on trees and can cause mortality in unhealthy individuals, but multiple years of defoliation will cause mortality in healthy stands.

Figure 32

Gypsy moths were brought into Massachusetts in the late 1800s, with the intent to farm the moths for silk produced by the larvae. It wasn't long before the moths escaped captivity and moved into the surrounding woodlands. Many northeastern states (Virginia northward and west to Illinois) now have established populations. The natural spread of gypsy moths occurs as newly hatched larvae spin long silk threads and ride on the breeze. Active populations in Tennessee and North Carolina threaten Georgia's borders.

Georgia has had several widespread outbreaks in the past which required suppression treatments. It is likely that egg masses attached to incoming cargo brought them from infested areas to Georgia. To date, only European strain moths have been caught in Georgia and they pose a lower threat because the females can't fly. The Asian strain of the same species, however, does have flight-capable females which allows for much greater spread potential and are of higher priority. All moths caught within a 20 mile radius of a port of entry (Atlanta airport or shipping ports at Savannah and Brunswick) are genetically tested to ensure they are not the Asian strain.

While there are currently no known gypsy moth infestations in Georgia, the threat is always present. This is due to the number of visitors and new residents who move to our state from areas of the northeast where the insect is naturalized. Egg masses and live moths can be transported on vehicles, outdoor furniture, firewood or goods such as stone or rock. Through the vigilant use of detection trapping and suppression, gypsy moths are part of a pest success story because they haven't spread as predicted, and can be reasonably controlled where they occur.

For more information on gypsy moths:
http://www.gatrees.org/ForestManagement/GypsyMoth.cfm

http://www.fs.fed.us/foresthealth/management/fhm-invasives-gm.shtml

http://www.aphis.usda.gov/plant_health/plant_pest_info/gypsy_moth/index.shtml

Sirex Noctilio Woodwasp

A non-native woodwasp, *Sirex noctilio* (Figure 33), was detected in New York in 2005 and likely entered a port via solid wood packing material in cargo. This federally regulated pest is native to Europe and Asia, and has now been introduced into every continent. It has the potential to kill many species of pines. In Georgia, all pine species could be impacted, including several that have tremendous commercial importance. Loblolly and slash are Georgia's most abundant pine species and are rated as extremely susceptible to this pest. Even minor damage could result in enormous economic losses.

This is a large insect (1–1½ inches in length) that is a strong flyer, capable of traveling almost 50 miles in one season. It now infests a sizable portion of New York and has migrated southward into Pennsylvania and northward into Canada.

Figure 33

Part of the insect's life cycle involves creating egg niches and laying eggs in trees. They also inject a symbiotic fungus and toxic mucus into the tree. The larvae feed upon the fungus, but the mucus spreads within the water conductive tissue of the tree and clogs this pathway. When a critical level of this vascular tissue can no longer function, moisture stress occurs in the tree and death soon follows. Furthermore, larvae tunnel through the wood as they feed upon the fungus (not the wood), and these large holes can mechanically disrupt the water conductive tissue.

Sirex has accounted for huge losses of loblolly and slash plantations elsewhere in the world, but it is uncertain what damage will occur if it invades the southern U.S. Several species of native woodwasps are found in the southeastern U.S., including two species within the *Sirex* genus that do not kill the host trees. In other parts of the world, it has been observed that weakened, stressed stands (such as overstocked plantations) have been more vulnerable to *Sirex noctilio* than thinned, vigorous stands. Trapping surveys are underway in several southeastern states, including Georgia, but no *Sirex noctilio* has been detected to date.

A biological control agent (nematode that sterilizes the adults) developed in Australia was shown to successfully suppress outbreaks. This nematode is being tested in New York, and may be introduced in quantity at some point in the future in the United States.

For more information on Sirex:
http://www.gatrees.org/ForestManagement/SirexWoodwasp.cfm

http://www.aphis.usda.gov/plant_health/plant_pest_info/sirex/index.shtml

Emerald Ash Borer

This insect was first detected in Detroit, Michigan and was thought to have arrived within solid wood-packing material from Asia. It attacks and kills all members of the *Fraxinus* genera of North America and has now spread through most of the upper midwestern states and as far south as Kentucky and Virginia.

The emerald ash borer (Figure 34) is a buprestid and has an extended life cycle (two years) in which to develop from egg to adult. This non-native insect

Figure 34

appears to have no significant natural enemies in the U.S and is a federally regulated pest. Huge suppression efforts which involved removing infested trees along with some healthy ash trees around the infested ones, have proven unsuccessful. Part of the reason for this is that detecting infested trees is virtually impossible until advanced stages of attack are reache**d.** At this point, some of the insects have developed and emerged. Furthermore, the trapping methods used to determine the presence of this species have not proven effective. Systemic insecticides have been proven effective when applied to individual, high-value trees, but these are relatively short-lived, expensive, and repeat applications are necessary.

Although ash is not a tremendously significant species within the rural landscapes of Georgia (FIA indicates about 60,000 acres where ash occurs), the impacts on urban forests may be more significant because green ash is widely used as a street tree.

For more information on the emerald ash borer:
http://www.emeraldashborer.info/index.cfm

http://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/index.shtml

http://ashalert.osu.edu/

Asian Longhorned Beetle

This Asian species (Figure 35) was first detected in New York City in the 1990s and is believed to have come into the country via solid wood packing material at the port of entry. It attacks several species of deciduous trees, and members of *Aceraceae* family are the preferred hosts. This federally regulated pest has since been found in Chicago, Illinois and Worcester, Massachusetts and has directly killed over 10,000 trees in these urban forests.

Figure 35

No trapping method has been proven successful in detecting this pest, but vigilant inspections of trees in these areas and prompt tree removals have been successful in minimizing spread and mortality. Several maple species are very common throughout Georgia, and improved varieties planted in urban areas would be at high risk for damage if this species were to be introduced. USDA APHIS funds the GFC to conduct annual surveys of warehouses which receive cargo from Asian countries where the insect occurs.

For more information on Asian longhorned beetles:
http://www.aphis.usda.gov/plant_health/plant_pest_info/asian_lhb/index.shtml

Invasive Plants

Non-native invasive plants have plagued the U.S. since early settlement times and continue at an accelerated pace today. Most of these plants do not readily colonize and invade natural areas, but a small number do spread. Some of these have proven to be very aggressive at invading natural habitats and out-competing Georgia's native flora. Ecosystem disruption has been known to occur, which affects forest health and diversity.

Rank	Species or Genera	Acres
1	Non-native Privet	347,346
2	Non-native Lespedeza	58,391
3	Kudzu	26,669
4	Chinaberry	23,057
5	Japanese Climbing Fern	9,225
6	Tallowtree	7,204
7	Non-native Roses	5,799
8	Non-native Olives	5,158
9	Chinese/Japanese Wisteria	5,045
10	Napalese Browntop	4,061
11	Mimosa	3,567
12	Cogongrass	200
	Total	**495,722**

Table 11

Forest inventory and analysis measures many non-native species. The listing below (Table 11) shows the 12 highest priority species/genera for the forests of Georgia, and the estimated acres each has infested. These are known as Georgia's "Dirty Dozen" invasive species.

As listed, non-native privet is the most widespread priority species, found throughout Georgia. Most of the other species occur at varying levels regionally and tend to more aggressively disrupt native flora populations in certain ecosystems than others.

For more information on invasive plants:

http://www.gainvasives.org/

http://www.gatrees.org/ForestManagement/documents/InvasivePlantsofGeorgiasForests0309.pdf

http://www.gaeppc.org/

http://www.fs.fed.us/invasivespecies/

http://www.invasivespecies.org/fedweeds.html

http://www.invasivespeciesinfo.gov/unitedstates/ga.shtml

Cogongrass

Cogongrass, *Imperata cylindrica,* is considered the seventh worst weed in the world. It is listed as a federal noxious weed and is the number one priority invasive plant species in Georgia. Cogongrass (Figure 36) was first introduced into the United States near Grand Bay, Alabama in 1911 via seed packing material in shipping containers from Japan. This grass suppresses and eliminates natural vegetation, thereby significantly reducing tree and plant regeneration, wildlife habitat, forage and ecological diversity.

Figure 36

Cogongrass has spread through more than one million acres in Alabama, Mississippi and Florida and is moving into other southeastern states. In Georgia, there were 53 known cogongrass spots in 2006. As of February 2010, a total of 347 spots had been identified in 38 counties. While cogongrass infestations are being found primarily in south Georgia, the weed is capable of growing throughout the state (Figure 37).

For more information on cogongrass:

http://www.gatrees.org/ForestManagement/Cogongrass.cfm

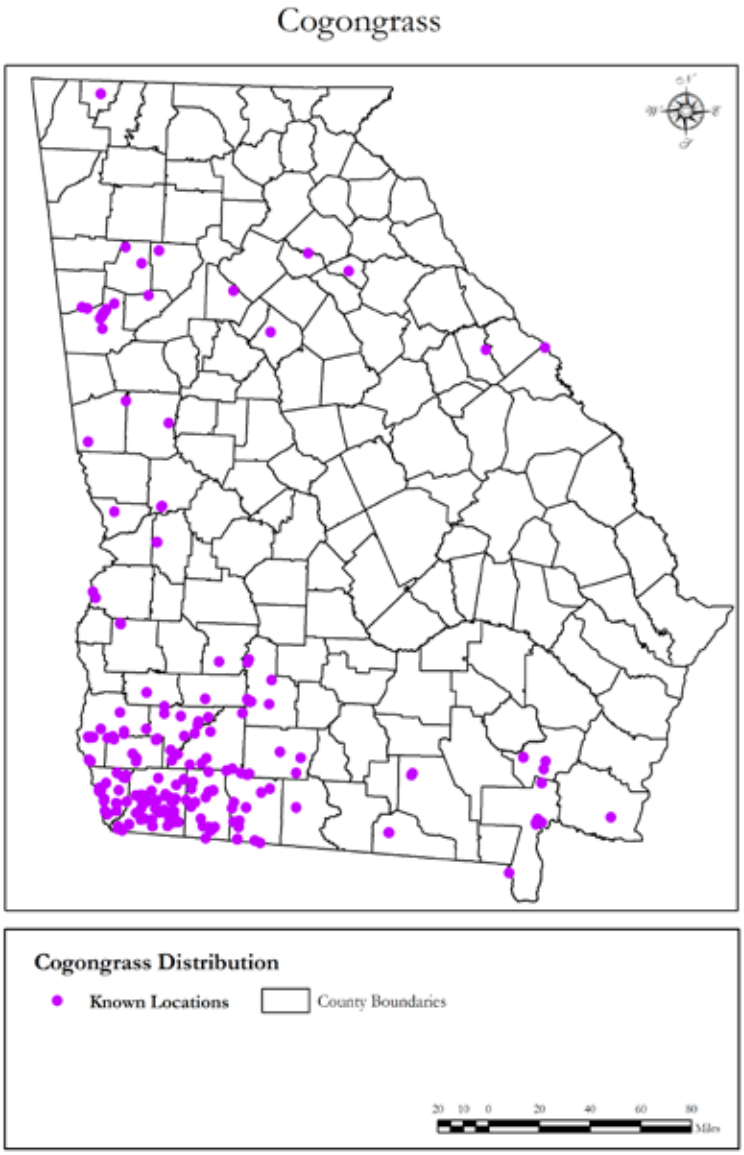
www.gaeppc.org/

http://www.gainvasives.org/

http://www.gatrees.org/ForestManagement/documents/InvasivePlantsofGeorgiasForests0309.pdf

http://www.gaeppc.org/

http://www.cogongrass.org/



Source: Georgia Forestry Commission

Figure 37

Threats to Forest Resources

Wildfire

Every year, Georgia experiences nearly 8,000 wildfires that burn approximately 60,000 acres. These wildfires can either totally destroy a forest or weaken the trees, which can perpetuate insects and diseases affecting the value of the forest and the timber it produces. Forest landowners suffer environmental and aesthetic losses as well as economic losses.

Georgia has experienced unprecedented growth and development across the state over the last decade. It is in the area where development meets native vegetation, the Wildland Urban Interface (WUI), that the greatest risk to public safety and property from wildfire exists. It is the combination of homes and wildland fuels that creates volatile burning conditions which may have catastrophic results. The Southern Wildfire Risk Assessment identifies nearly 12,000 Georgia communities, with more than 5,000 rated "high" or "very high" for wildfire risk. Georgia ranks second in the region in acres of WUI with nine million acres, or about 25 percent of Georgia's land area classified as WUI.

Fire is a natural part of Georgia's landscape and must be managed for a positive influence on forest sustainability. A combination of wildfire suppression, prevention and mitigation has been Georgia's management strategy for nearly eight decades and is essential for public safety and protection of property. Wildfires can destroy millions of acres of forest land and threaten lives and property if left unchecked. The need for an effective fire management program was emphasized by wildfire's destruction in 2007. Over 9,500 fires burned more 504,000 acres, resulting in timber losses totaling more than $58 million. Assessing specific risks of fire throughout Georgia is addressed in this report's "Strategic Issues" section.

Thousands of shade and street trees are lost every year to wind, ice, flooding, drought and lightning. Estimates of property value loss in Georgia from this type of tree damage exceeds $10 million annually (GUFC Committee 2000). This value does not include future liability problems. Georgia records 50 to 70 thunderstorm days per year. Each storm can cause extensive damage to trees along its path. Historic, rare and specimen trees, especially where landscapes are designed around them, are especially valuable. These trees can become major aesthetic, financial and social losses as a result of storms (Coder 1995).

Weather phenomena can affect wildfire threats to thousands of acres of Georgia's forests each year. The Brookings Institution Center for Public Policy Education report on The Mega-Fire Phenomenon, approved by the National Fire and Aviation Executive Board, suggests that changing land conditions combined with increasing urbanization contribute to unusually large wildfires. Evidence indicates that we may be expecting, through climate change, more intense weather phenomena that will out-challenge wildland fire managers. Georgia is not exempt from catastrophic fire, as evidenced by the 2007 Georgia Bay Complex that consumed 560,000 acres in Georgia and Florida and directly threatened several communities. Threats to the forest from wildfire are increasing, not decreasing. Specific strategies must be implemented that affect the condition of the landscape, increase resistance of communities to wildfire and prepare fire managers to address changing weather phenomena.

Impacts from climate change are a threat to southern forests. Paleontological data demonstrates that southern forest ecosystems have adapted to gradual changes in climate for millions of years (Iverson and Prasad 2001; Karl et al. 2009). Historically, these climate shifts occurred slowly, over hundreds or thousands of years, giving forest communities time to successfully adapt to changes in temperature, growing season length, moisture availability and other variables. However, mounting evidence suggests that the current warming trend is occurring more rapidly than previous climate shifts (Karl et al. 2009).

As dynamic biological systems, forests will be impacted by global climate change, although quantitative predictions are problematic due to scientific limitations and the complexity of the processes involved. Furthermore, climate change impacts to forests are not likely to be uniform across the U.S; some regions/forest types may be more negatively impacted than others.

Despite these obstacles, the current state of knowledge is sufficient to develop a qualitative assessment of the most likely ecological and economic impacts of climate change on southeastern forests:

Ecological Impacts

- *Increased vulnerability to pests, pathogens, and natural disturbance*. Some current models indicate that average temperatures will increase in all seasons. This means a longer growing season, which may increase reproductive success for insect pests and allow for more frequent and intense outbreaks. Fewer days with temperatures below freezing will increase the survival rate of overwintering insects. Higher temperatures may also result in lower moisture availability due to increased evapotranspiration, leading to overall drying conditions. Both of these factors will result in higher mortality of trees and increased wildfire risk.
- *Productive, dry sites may become more vulnerable*. Pine plantations established on dry sites could become highly vulnerable to the effects of climate change. Although current models differ on how precipitation will respond to climate change, much of the southeast is likely to experience longer and more frequent droughts. Coupled with higher temperatures, increased photosynthesis and lower moisture availability, these dry sites could become more susceptible to mortality from pests, pathogens and fire. Drought is currently one of the primary stress factors which contributes to insect and disease outbreaks in the South, and recent historical (long-term) droughts are directly correlated to certain outbreaks.
- *Changes in forest productivity*. Higher concentrations of atmospheric carbon dioxide may have a "carbon fertilization" effect on some forest communities, but the end result of this effect on net primary productivity is uncertain (Körner 1993). Forests' capacity to sequester additional carbon may be significantly reduced by other limiting factors and ecosystem interactions.
- *Changes in forest species composition*. More drought-hardy species may be able to better compete in the pine forests of Georgia. *Quercus* species may become a larger component of today's pine forests (Iverson and Prasad 2001).

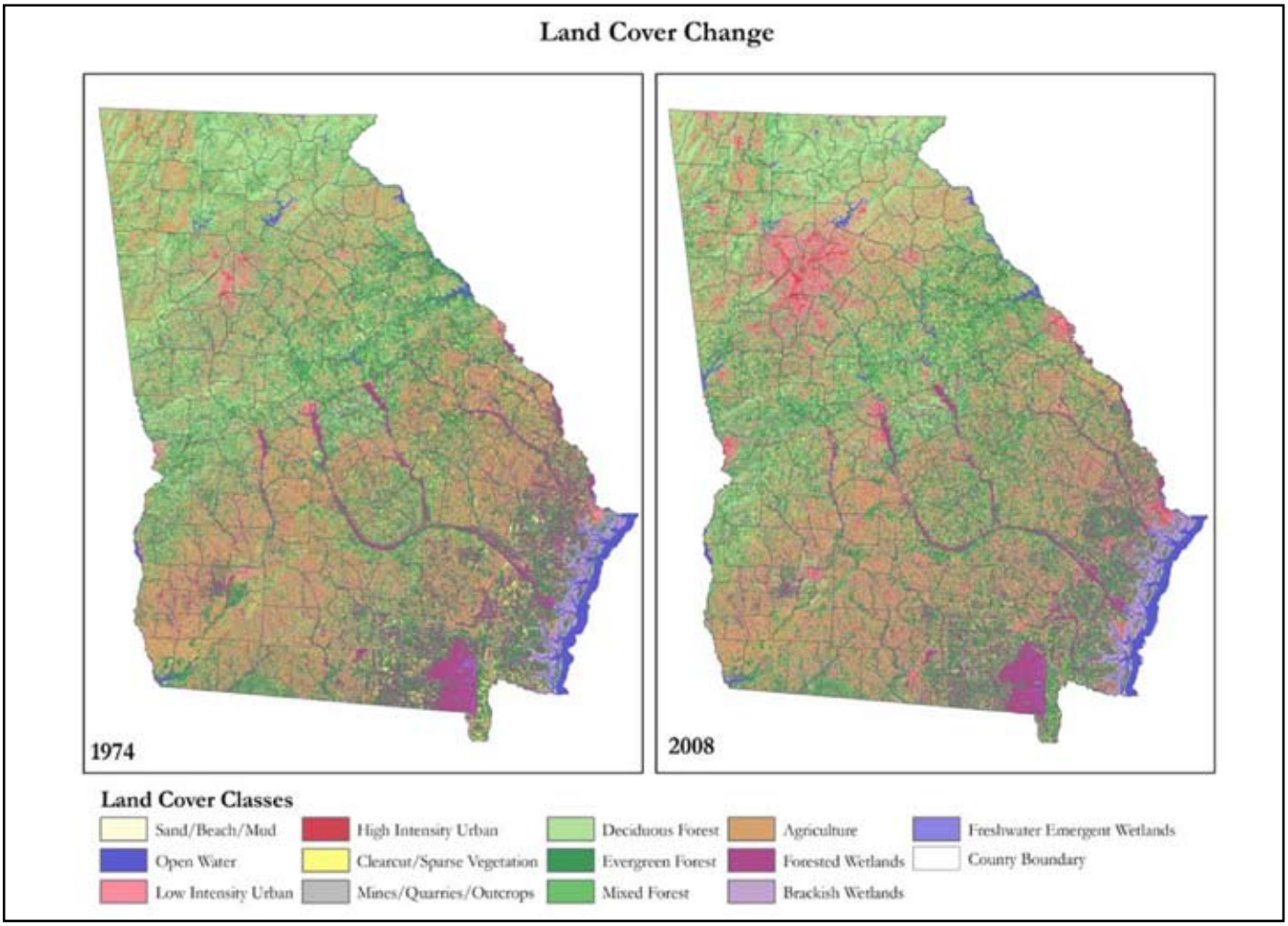
- *Expansion/contraction of species range.* In general, ranges could move northward and up slope for all species, including Georgia's primary timber producing species.
- *Invasive species.* More frequent disturbance, higher mortality and expanding ranges could intensify invasive species spread.

Economic Impacts

- *Southern forest owners could become vulnerable to climate change effects.* The southeastern U.S. holds the largest share of timber investment capital, and our most productive species are highly susceptible to the potential drying effects of climate change. Expansion of the range for southern pine species means that states north of Georgia may be able to gain market share and productivity (Shugart, Sedjo and Sohngen 2003).

To identify areas of Georgia where GFC and partners should look first to protect, conserve and enhance Georgia's forest resources, changes in land cover was used as the basis. Land use change due to urbanization and changes in land ownership patterns have impacted not just the types of forest land in Georgia but also the spatial orientation of forest lands. As part of the resource assessment and the priority area identification, changes to the spatial distribution of forest patches throughout the state of Georgia were evaluated. Globally, forest fragmentation has been identified as a key measure of environmental quality and the ability of the forest to provide critical ecosystem services. These services include protection of water quality and quantity, air quality protection, biodiversity protection and carbon sequestration.

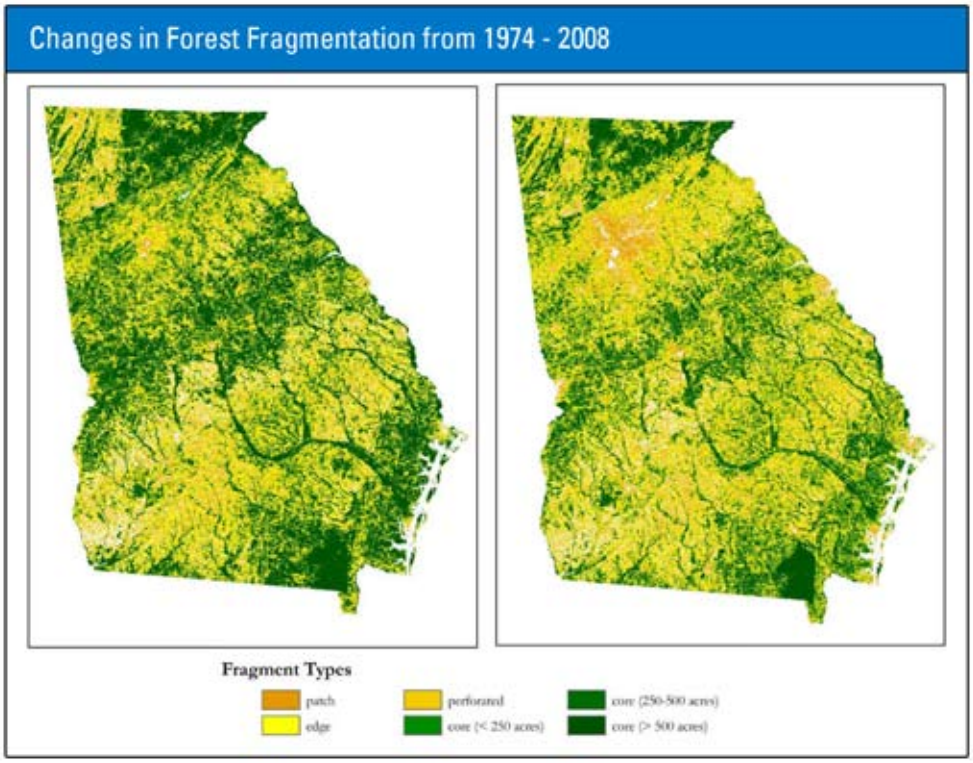
By comparing changes in forest patches over time on land cover maps from Landsat satellite images, areas that still have large contiguous forest available to provide abundant amounts of key ecosystem services were identified. Land cover maps from 1974 to 2008 were used to generate forest fragmentation patterns (Figure 38).



Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 38

Forest patches greater than 250 acres make up the core forest areas (Figure 39). These core areas are at a size large enough to be managed for critical ecosystem services. The smaller patches can still be managed for forest activities but have a higher probability of being impacted by the land use activities that are surrounding them. Thus, as compared to land cover (forest cover), the ability of forests to perform ecosystem services was measured. While forest cover can be maintained in Georgia, fragmentation and changes to patch sizes as well as exposure to edges and non-forest activities such as development influence how well these patches can provide critical services.



Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 39

Georgia's priority resource areas were selected by evaluating percent coverage of core forest areas by using a bounding area that was relatively similar in size across the state. County boundaries and census tracts are highly variable in size and were therefore excluded from the selection. The 12-digit Hydrologic Unit Codes (HUCs) were selected as this unit because they, for the most part, represent a consistent area of approximately 45km^2. Percent forest cover was calculated for core patches ranging from 25 to 50 percent forest area coverage of the watersheds (Table 12). Further description of methods and results for determining priority areas is included in Appendix A.

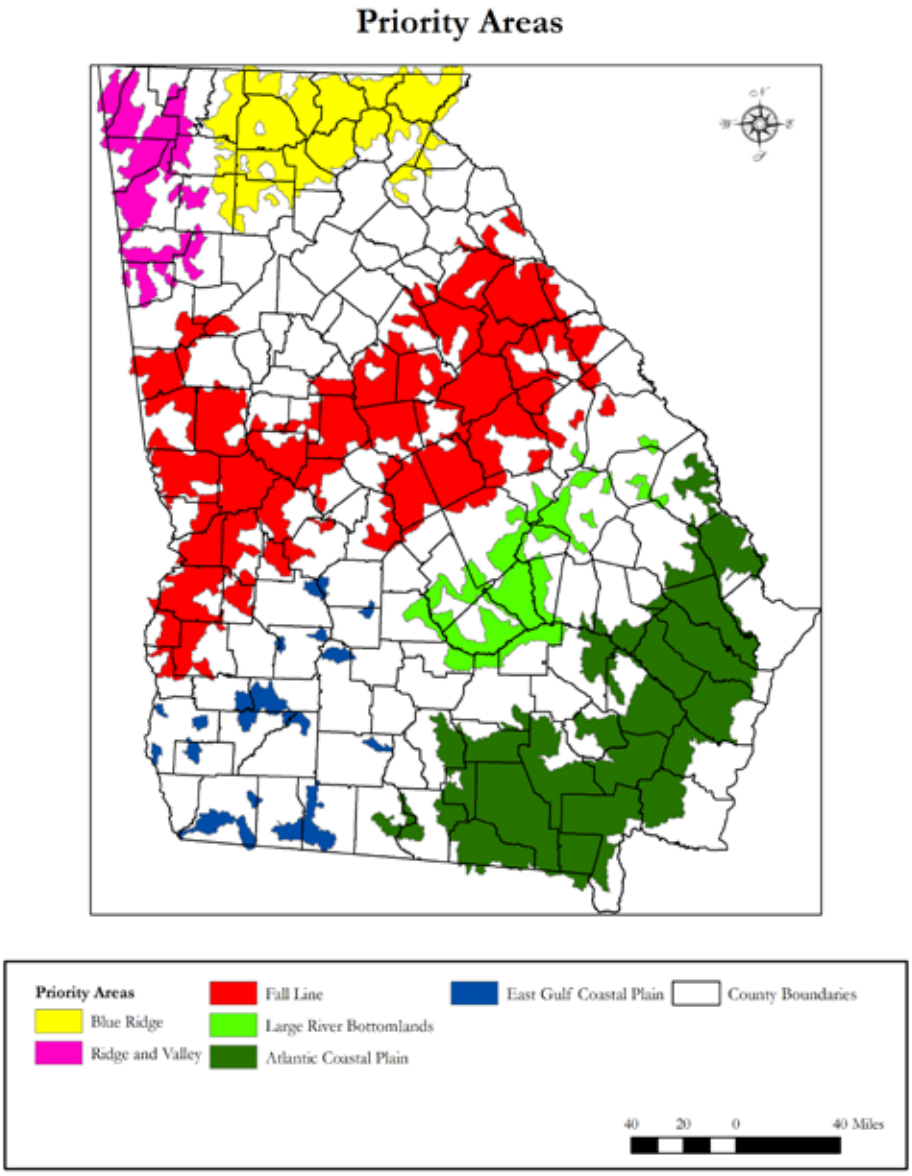
Percentage of Watersheds in Georgia

Percentage of Watersheds in Georgia under different scenarios of percent forest core area coverage

Percent of Watershed Area in large forest patches	Percent of 12 – digit HUC's included
25%	48%
30%	37%
40%	21%
50%	10%

Table 12

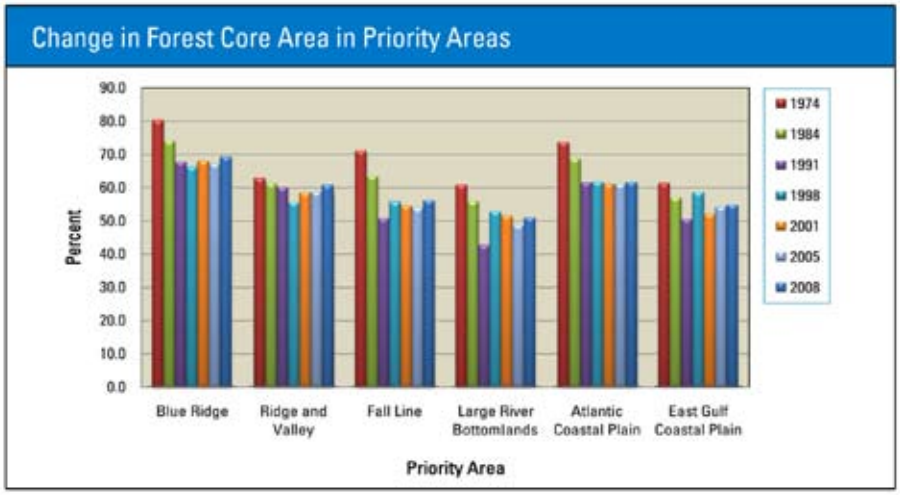
Priority areas that were represented by 30 percent or greater coverage of a HUC by core area forests were selected. Watersheds were then merged and six priority area boundaries were defined as Blue Ridge, Ridge and Valley, Fall Line, Large River Bottomlands, Atlantic Coastal Plain and East Gulf Coastal Plain (Figure 40).



Source: Natural Resources Spatial Analysis Laboratory (NARSAL). 2010. University of Georgia. Athens, GA. (Unpublished data)

Figure 40

Analysis of changes in forest core area over time in each of the six priority areas reveals that the total amount of core area in each group has stayed consistent and stable over the past 34 years, which is very different from the surrounding areas of the state (Figure 41).



Source: Natural Resources Spatial Analysis Laboratory (NARSAL). 2010. University of Georgia. Athens, GA. (Unpublished data)

Figure 41

Priority Area Descriptions

Blue Ridge

The Blue Ridge makes up the mountain area of northeast Georgia. The Chattahoochee National Forest plays an important role in maintaining the large core areas. Additionally, there are numerous public lands maintained by Georgia DNR and GFC as well as multiple lands held in private conservation easements by a number of land trusts. There is considerable pressure from population growth in this region for retirement and second homes. The proximity to metro-Atlanta has made this area a key recreational area in the southeast U.S. In addition to recreational amenities, the area is a critical source of drinking water for the metro-Atlanta region. The Blue Ridge is the headwaters of the watersheds of both Lake Allatoona and Lake Lanier. Additional fragmentation of forests in this area has major implications for the condition of the area's water supply.

Ridge and Valley

The Ridge and Valley makes up the mountain area of northwest Georgia and is bound by the I-75 corridor between Atlanta and Chattanooga. Forests are found along the slopes and tops of the ridges and there is still extensive agriculture in the valleys. The area is under considerable development pressure because of the corridor that connects Chattanooga with Atlanta, sometimes referred to as "Chattlanta." This corridor is a key industrial area in the state and produces much of the carpet sold in the United States. Major cities such as Dalton and Cartersville are found along this corridor.

Fall Line

The Fall Line area is represented by a gradient of three distinct ecoregions: the lower Piedmont, the Fall Line and the upper Coastal Plain. This area has been a key source of natural resources in Georgia. The unique geology of the area, which includes many discontinuities from an ancient shore line to large sand dune areas, provides the recharge zone for the Floridian aquifer.

Large River Bottomlands

The geomorphology of the Coastal Plain has allowed for the development of large floodplains and wetlands associated with the river systems. Many of these rivers are blackwater and have unique flora and fauna associated with them. The upland areas between floodplains are a mix of piney flatwoods and wetlands. These areas have been important sources of forest products since colonial times, from naval stores and timber to fiber for paper production. The area also sustains one of the last large populations of black bear in the state of Georgia.

Atlantic Coastal Plain

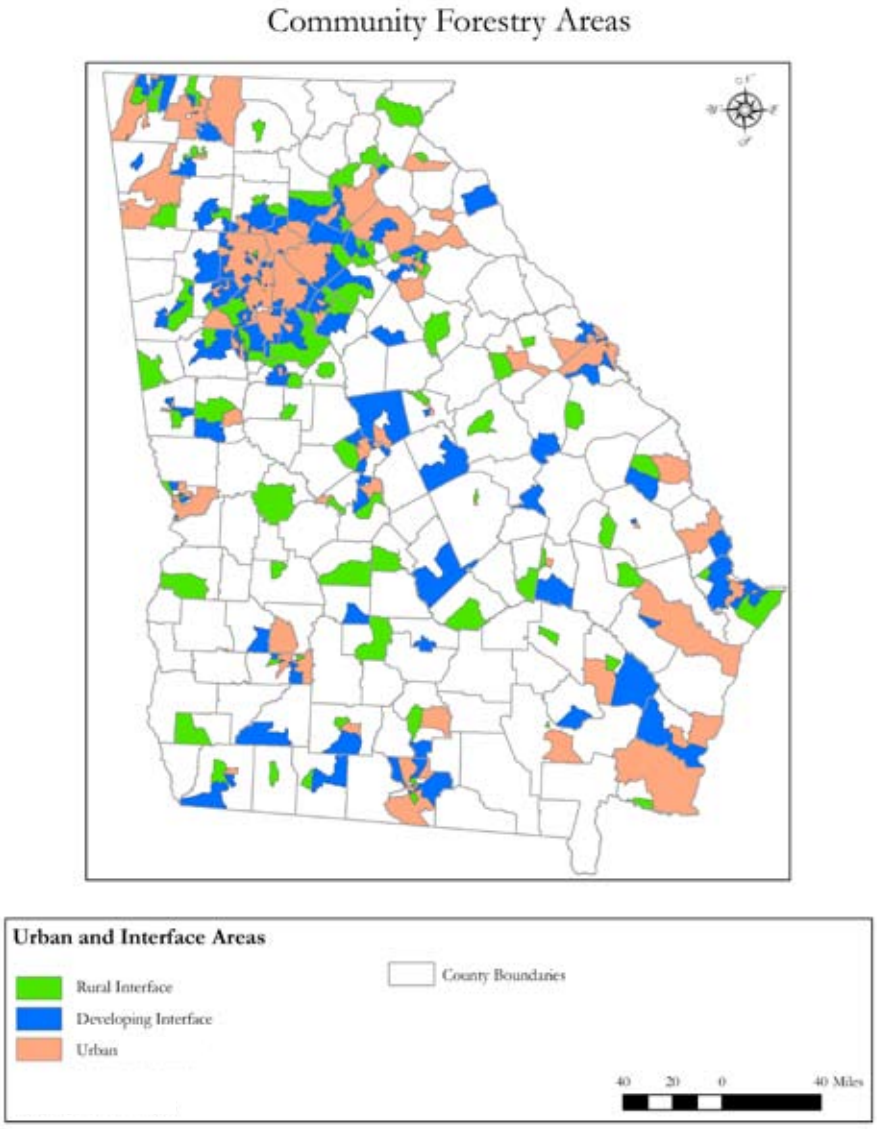
Many of the forests in this area are intensively managed for fiber production. Much of the land was formerly owned by industrial timber companies that have a number of fiber facilities along the coast. With the divestiture of forest lands by large industrial land owners, the ownership patterns have changed in this area. In addition, development pressures coming from coastal counties have led to conversion of these lands from forest products to real estate holdings for potential development. The Atlantic coastal forests have many key wetland areas, both associated with the large river bottomlands as well as many types of isolated wetlands. These play a critical role in maintaining high biodiversity in this region.

East Gulf Coastal Plain

The East Gulf Coastal Plain is the most fragmented of the priority areas. The area is the major producer for commodity crops in Georgia and has a large and shallow aquifer that is used for irrigation of row crops. Forest lands in this region are found along wetland and floodplain corridors. There are large tracts of land that are currently being managed for quail and other hunting opportunities. The fragmentation provides an opportunity for expanding and connecting large tracts of forest land by restoring areas that were natural longleaf pine savannas.

Urban Forestry Priority Areas

To address urban forestry issues, a different data set was selected to identify priority areas. An analysis of population and canopy cover resulted in the identification of three areas: Urban Priority Area, Developing Interface Priority Area and Rural Interface Priority Area (Figure 42).



Source: Department of Commerce, Census Bureau, Geography Division. 2000 Census Tracts. *http://www.census.gov*

Figure 42

The Urban Priority Area is characterized by population greater than 1000 residents per square mile. Average tree canopy cover is 30 percent in urban areas in Georgia. In general, minimum canopy coverage percentage recommendations set by the U.S. Forest Service and other agencies and nonprofit organizations across the nation range from 25 to 50 percent, depending on land use type.

The Developing Interface Priority Area is characterized by population of 300 to 1000 residents per square mile. These areas are typically located next to Urban Priority Areas and are impacted by rapid development pressures. Average tree canopy cover is 74 percent in these areas in Georgia.

The Rural Interface Priority Area is characterized by population of 150 to 300 residents per square mile. A total of 21.7 million acres across the county are projected to shift from rural or exurban to urban by 2030 (Stein et al. 2005). This interface area is typically located between the Developing Interface Priority Area and the rural hinterlands. The Upper Oconee and the Etowah watershed are two of the top 15 watersheds in the country projected to experience housing density increases on more than 200,000 acres of their surface area (Stein et al. 2005).

Urban and Interface Priority Areas

	Rural Interface	Developing Interface	Urban	State Totals
Population / sq. mi*.	150-300	300-1000	> 1000	---
Area in Acres	83,876	229,465	372,017	685,358
Canopy Coverage (%)	47	74	31	----
State Area (%)	3.00	6.07	8.76	17.83
Population by Category*	563,808	1,633,882	3,797,576	5,995,266
State Population (%)*	7	20	46	73

* 2000 census

Source: Department of Commerce, Census Bureau, Geography Division. 2000 Census Tracts. *http://www.census.gov*

Table 13

Information about each of the three priority areas for the Sustainable Community Forestry Program is shown in Table 13.

The three urban forestry priority areas will be redefined when the 2010 Census information is available.

Regional Priority Areas
Opportunities to collaborate with neighboring states on common issues include the following:

Alabama-Georgia-Florida Longleaf Pine Corridor
The development of a longleaf pine corridor from Ft. Benning, Georgia to Eglin Air Force Base, Florida via Ft. Rucker, Alabama would protect, conserve and restore longleaf pine ecosystems that are critical habitat for many threatened and endangered species.

Okefenokee National Wildlife Refuge
The recent 564,000 acre Georgia Bay Complex wildfire offers unique opportunities to promote wildfire mitigation efforts in the southeast Georgia and north Florida region. Partners in the area include the well-organized and nationally known GOAL landowner association, which includes the USFWS Okefenokee National Wildlife Refuge, several forest products companies, private landowners and six rural communities. The Refuge itself is a fire dependent ecosystem. Fuel reduction practices that benefit this ecosystem include firewise practices, community wildfire preparedness plans and coordinated preparedness measures. Providing education and alternative management options for affected landowners could have a pronounced effect on future management in the area and be used as a national model. Forest management options include the use of prescribed burning and planting of fire-resistant longleaf pine within the buffer area.

Water quality and quantity
The Apalachicola-Chattahoochee-Flint River Basin lawsuit may lead to regional plans to protect the flow and quality of rivers from Georgia into Alabama and Florida. Water quality standards and flow continue to be debated in federal and state courts, which may lead to more regulation affecting private landowners. The Alabama-Coosa-Tallapoosa River Basins may also lead to regional plans to protect flow and quality of rivers from Georgia into Alabama. The Savannah River is a subject of continuing negotiations between South Carolina and Georgia regarding water flow and water quality.

Non-native invasive species
Three top multi-state efforts to protect forest health include: cogongrass eradication in the south Georgia, north Florida and eastern Alabama areas; hemlock woolly adelgid monitoring and treatment in north Georgia, North Carolina and Tennessee; and laurel wilt monitoring in South Carolina.

Strategic Issues

Overview

The following issues were identified by stakeholders and key partners during the development of the 2008 *Sustainable Forest Management in Georgia* report. At the beginning of this Assessment process, these issues were placed in a survey on the GFC website for public comment and ranking. The issues are presented in order of their importance as determined by the public survey (Appendix), and will be carried forward into the Resource Strategy. These findings are the basis for Georgia's goals, objectives and strategies.

Issue Description

Protecting, conserving and en-hancing water quality and quantity produced by forests was the highest rated priority issue in GFC's public stakeholder survey for the Forest Resource Assessment. This could have been influenced by recent droughts that left many cities and its citizens located above the Fall Line with restrictions on water use. In addition, the tri-state water wars with Alabama and Florida regarding the Apalachicola, Chattahoochee, Flint River lawsuit as well as the Alabama, Coosa, Tallapoosa River lawsuit has brought attention to Georgia's water woes. Judge Magnuson's recent ruling that Georgia does not have legal rights to Lake Lanier places the state in a perilous position. This water source is critical to the water supply and recreational needs of Atlantans as well as citizens downstream. If Judge Magnuson's ruling stands and Lake Lanier can no longer be used as a water source for Georgia, more water supply reservoirs must be constructed. Georgia currently has 134 existing water supply reservoir/watersheds that supply millions of Georgians their daily water. Construction of additional reservoirs will result in loss of forest cover and place restrictions on land uses upstream. State legislation regarding the need for more water supply watersheds is currently being debated.

The loss of forest land to urbanization is the greatest threat to Georgia's water quality. Removal of forest cover results in increased storm runoff and increased streamflow that causes erosion, sedimentation and flooding.

Many of Georgia's streams, particularly those in rapidly developing areas of the state, have insufficient stream buffers (Meyer et al. 2005). A recent assessment of riparian buffers along the upper reaches of the Toccoa River revealed that half of the buffers on private land were less than 25 ft. in width (K. Owers, personal communication). Streams with narrow vegetated buffers are at higher risk of water quality impairment resulting from land-disturbing activities, introduction of toxic chemicals or excess nutrients and thermal impacts from lack of shading. Intact riparian habitats are needed for all streams, but especially for those that support exceptional diversity or rare aquatic species (Ambrose, 1999). Breaches of these stream buffers can be minimized through careful placement of roads, bridges, utility corridors and livestock crossings. Access to streams by all-terrain vehicles and livestock should be limited to maintain water quality.

The Georgia Comprehensive Statewide Water Management Plan states that more than 6,000 miles of streams do not meet state water quality standards because of nonpoint sources of pollution, to which forestry activities may contribute (The Water Council 2008). It is estimated that between 7,000 and 10,000 timber harvesting operations are conducted annually.

The U.S. Environmental Protection Agency (EPA) was sued in federal court for not requiring the Georgia Environmental Protection Division (EPD) to set Total Maximum Daily Load (TMDL) limits on these and other impaired streams that would bring them back to their designated uses. TMDLs and their implementation plans have now been developed for the majority of these streams.

In addition, the effects of agricultural practices, old canals and ditches and poor county road maintenance have resulted in legacy sedimentation, impaired streams and wetland losses.

There are many opportunities for GFC and key organizations to enhance the role forests play in improving Georgia's water quality and quantity.

Potential Agency and Organization Roles

- GFC will continue the state leadership role in BMP development, education, implementation and monitoring.
- Through EPA Section 319 and USFS competitive grants, GFC will continue to seek assistance in water quality education. BMP education efforts will be expanded through partnerships with Tree Farm, Trout Unlimited, Riverkeeper and other fisheries and recreation associations. Leveraging more funds with these groups and others is needed to direct more support to excellent but under-funded state programs.
- GFC will further expand BMP education by working with the Board of Registration for Foresters to support BMP education and implementation among professional foresters and with non-SFI wood mills to educate their producers about BMPs.
- GFC will work with state, federal and local government agencies to provide input and implement regional strategies identified in the Georgia Comprehensive Statewide Water Management Plan.
- As NRCS develops Rapid Watershed Assessments (Coosawattee, Ocmul-gee, Upper Oconee, Satilla, Little River and Spring Creek), GFC will help identify forestry and agriculture needs for improvement to the watersheds and gain funding for cost-share assistance to landowners.
- GFC will partner with RC&Ds and county road departments to implement Better Back Road BMPs and to identify and rectify stream crossings that are a continuing source of sediment.
- GFC and DNR will provide information on high priority streams to commercial and non-profit mitigation bankers to encourage restoration and enhancement of vegetated buffers and provide financial incentives to private landowners to fence livestock out of streams.
- GFC and DNR will work with local governments and developers to ensure protection of stream buffers when development plans are considered.
- DNR will work with ATV manufacturers to develop and disseminate messages discouraging ATV use in and adjacent to streams.

Issue-Specific Priority Areas

Water quality priority areas shown on the maps below were defined by analyzing the following GIS data layers:

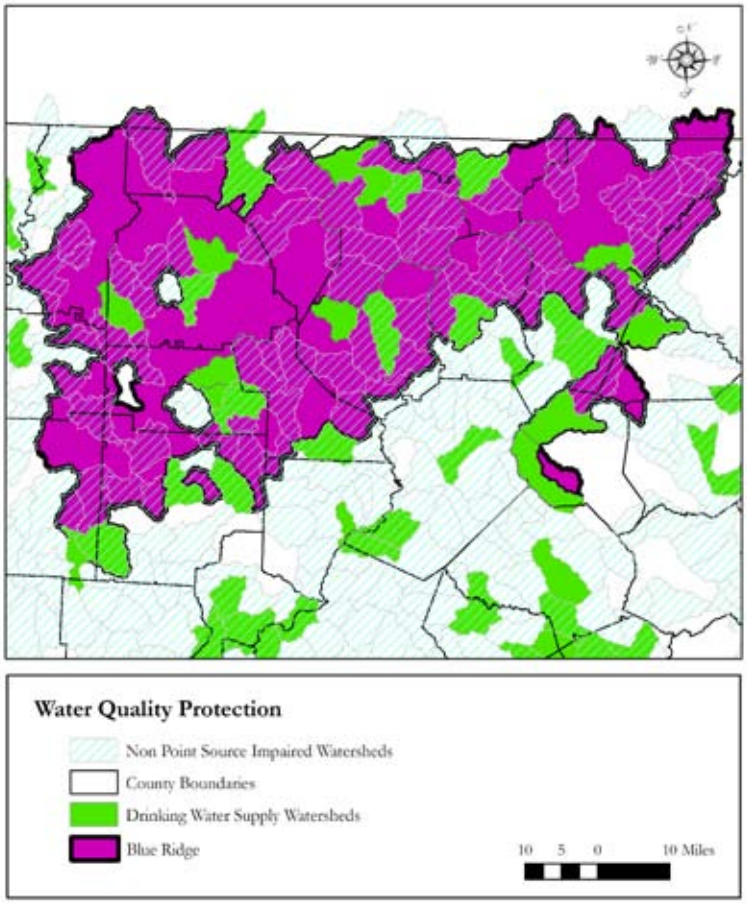
- The 2008 305(b) 303(d) list of impaired stream segments from EPD. (There are 459 sediment or dissolved oxygen impaired stream segments that have been identified, of which 272 segments affecting 2,716 miles of stream are listed for federal TMDL reductions.)
- Public drinking water supply watersheds
- Trout streams
- Endangered aquatic species
- Wetlands
- Lands adjacent to federal or state protected areas
- Intact riparian areas
- Percent forest cover
- Soils (hydric and erodibility)
- Slope
- Potential mitigation bank sites
- Connectivity

Blue Ridge Priority Area

Within this area (Figure 43), 16 public drinking water supply intakes/ watersheds are located within forests adjacent to predominately USFS lands. In addition, there are approximately 20 biota (sediment)-impaired stream segments caused by nonpoint sources of pollution. Of these, 11 have federally-mandated TMDL reductions listed in state implementation plans. Numerous high quality trout streams are also located here.

The GFC received a USFS redesign grant in 2009 to improve water quality conditions in the Georgia Appalachian area; She Creek and Chechero Creek watersheds were selected. These two streams were identified by the EPA as impaired because of sediment. This watershed is surrounded by USFS land and has many private landowners, a golf resort community and a Boy Scout camp.

Blue Ridge Watershed Protection Priority Area

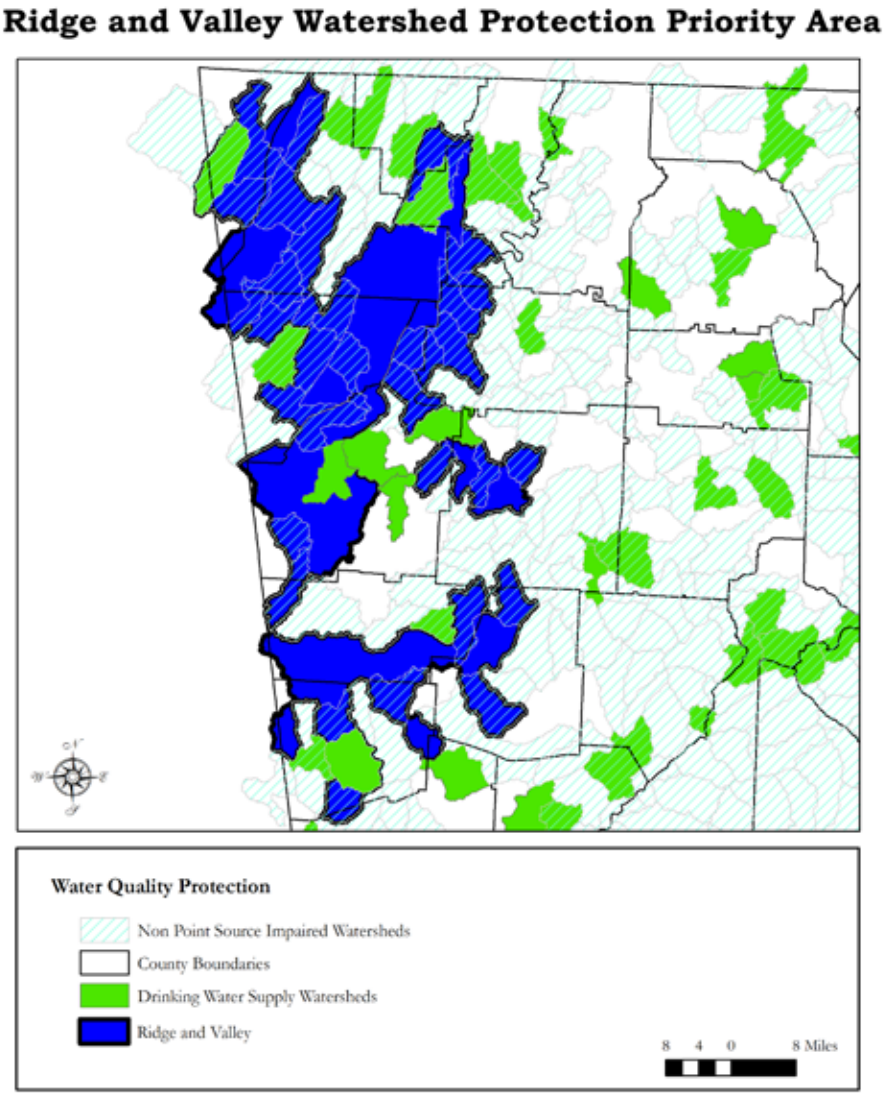


Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 43

Ridge and Valley Priority Area

This area (Figure 44) contains four public drinking water supply intakes/ watersheds and approximately 18 biota (sediment)-impaired stream segments caused by nonpoint sources of pollution. Of these, three have federally-mandated TMDL reductions. Numerous high quality trout streams are also located here.

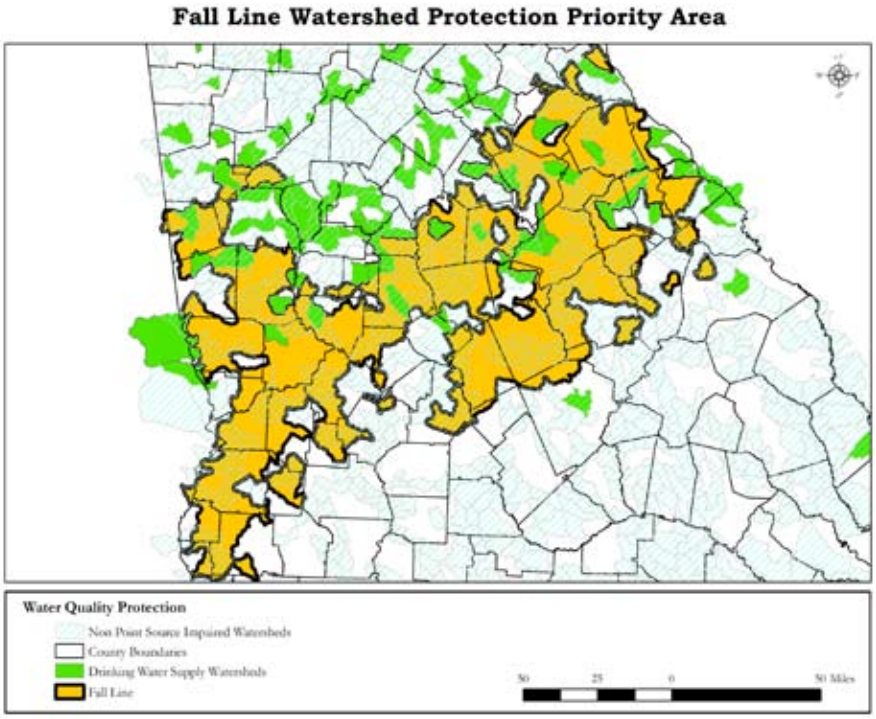


Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 44

Fall Line Priority Area

This area, (Figure 45), contains 23 public drinking water supply intakes/ watersheds and approximately 62 biota (sediment)-impaired stream segments caused by nonpoint sources of pollution. Of these, 18 have federally-mandated TMDL reductions. There are also numerous high quality streams in the area.

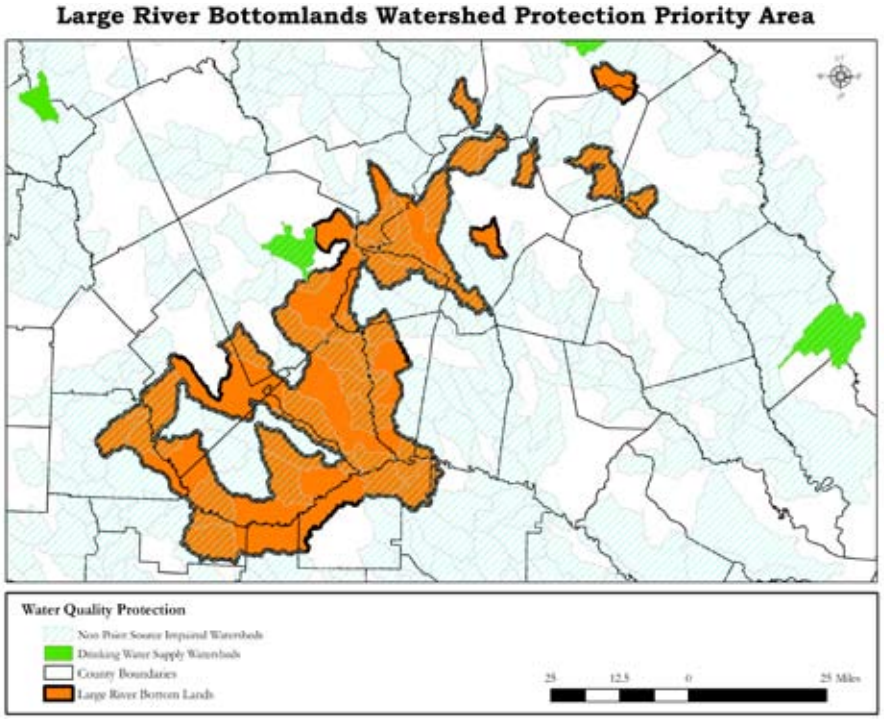


Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 45

Large River Bottomlands Priority Area

This area, (Figure 46), contains no public drinking water supply intakes/watersheds, but contains impaired stream segments from various pollutants. There are 10 biota (sediment)-impaired stream segments caused by nonpoint sources of pollution, of which five have federally-mandated TMDL reductions. There are also numerous high quality river corridors and associated floodplains and wetlands in the area that warrant protection.

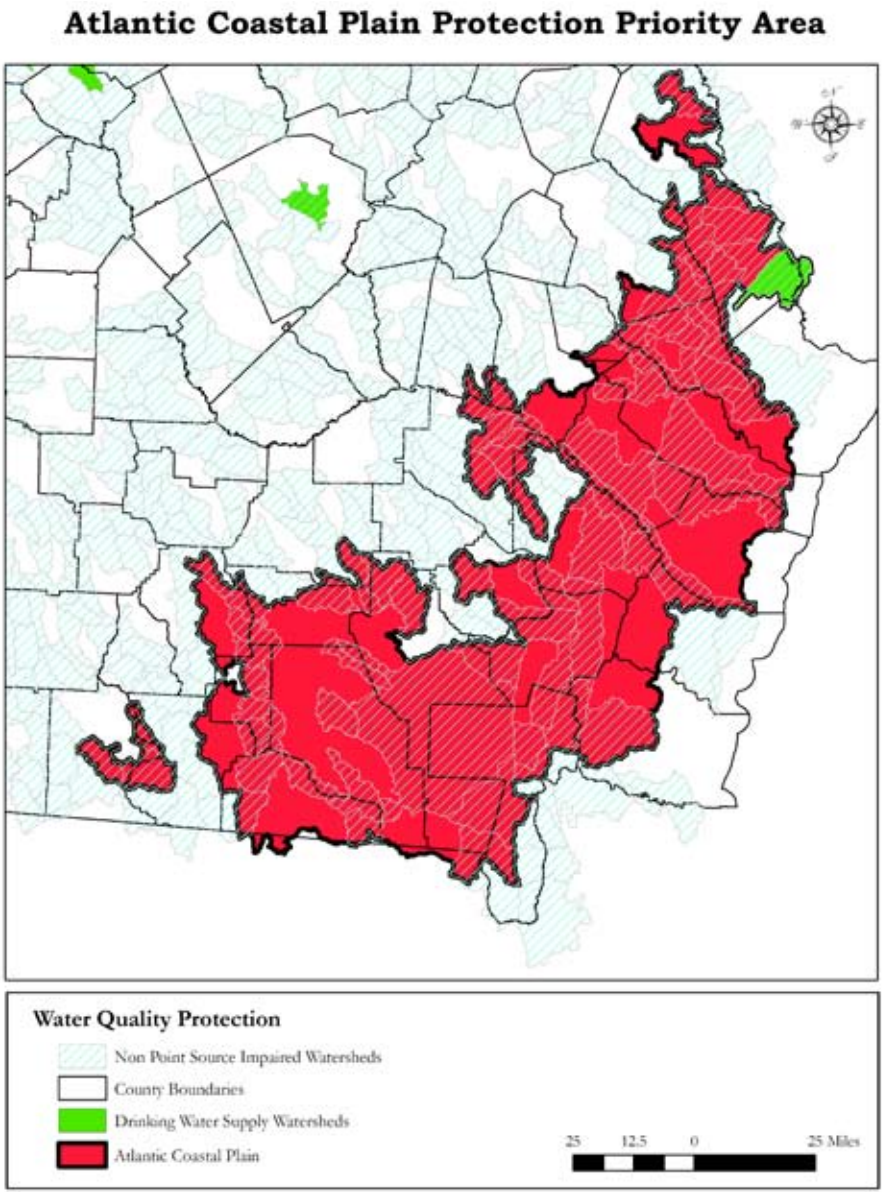


Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 46

Atlantic Coastal Plain Priority Area

This area, (Figure 47), contains one public drinking water supply intake/ watershed and contains two biota (sediment)-impaired stream segments caused by nonpoint sources of pollution, and both have federally-mandated TMDL reductions. There are also seven dissolved oxygen-impaired stream segments and all of them are listed for federal TMDL reductions. There are numerous high quality river corridors, floodplains, wetlands and streams in the area that need to be protected.

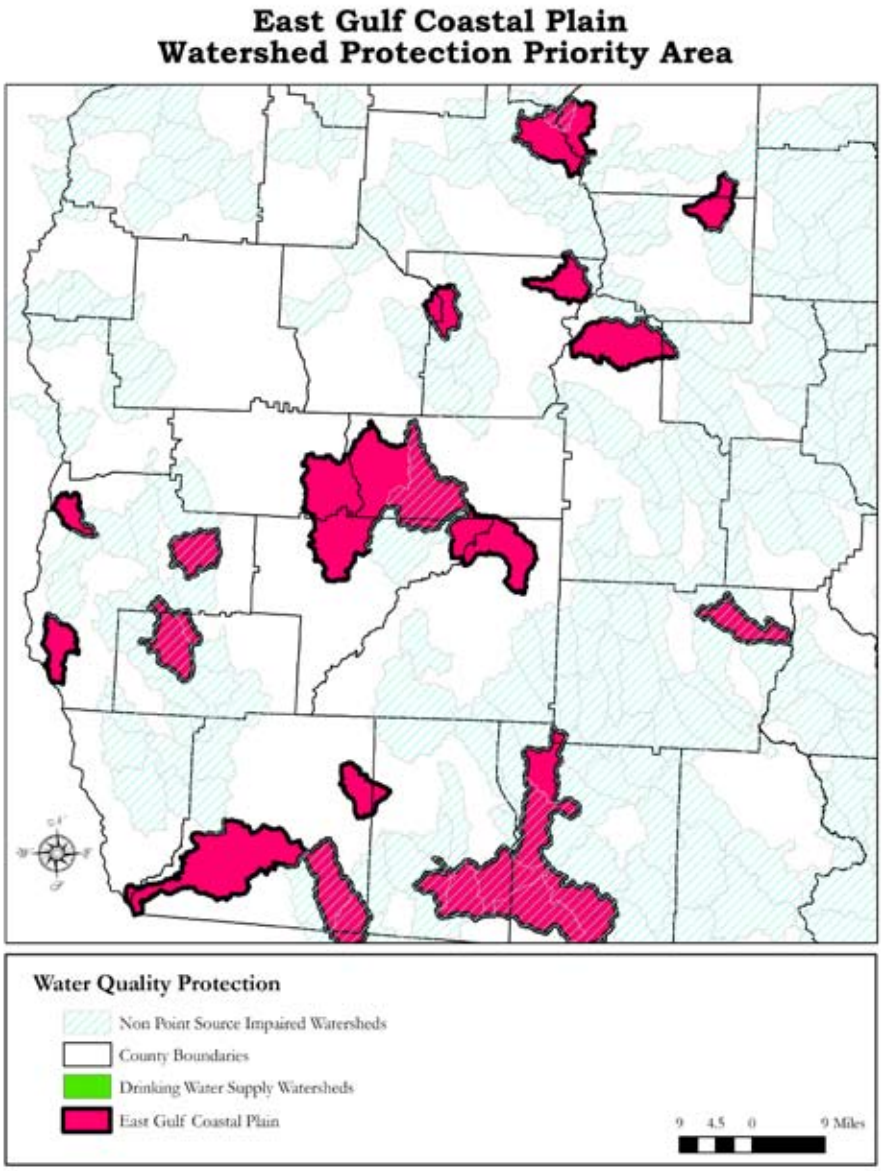


Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 47

East Gulf Coastal Plain Priority Area

This area, (Figure 48), contains no public drinking water supply intake/ watersheds, but according to the EPD there are approximately 60 impaired stream segments from various causes. There is only one dissolved oxygen-impaired stream segment which is listed for federal TMDL reduction. There are numerous high quality river corridors and streams in the area that need protection. Riparian buffer enhancements could help mitigate or minimize pollutant inputs.



Source: Georgia Department of Natural Resources, Environmental Protection Division, 2009 (Unpublished data)

Figure 48

Issue Description

Urban sprawl was ranked the second most important forest resource issue by public stakeholders. GFC-funded studies by the University of Georgia's Natural Resources Spatial Analysis Laboratory (NARSAL) determined that approximately 54 acres of canopy cover were lost in the Atlanta region each day from 1991-2001, while approximately 28 acres of impervious surfaces (e.g. roads, buildings, etc.) were added daily. Updating this information to 2005 showed a slight decrease in canopy loss but impervious surface additions increased to approximately 55 acres daily.

In a similar statewide analysis, NARSAL determined that from 2001- 2005, Georgia's canopy cover declined by a total of 398,330 acres, or 273 acres per day. Although canopy loss in rural areas often reflects ongoing forestry activities, in urban areas it often indicates development. Accordingly, impervious surfaces increased by about 154,134 acres, or 106 acres per day.

These changes effectively and permanently remove this acreage from forest cover. The effects of forest cover loss on water quality and quantity are huge. Trees act as natural water filters and help significantly slow the movement of storm water, which lowers total runoff volume, soil erosion and flooding. Infiltration rates for forested areas are 10 to 15 times greater than for equivalent areas of turf and grass. During a heavy rain, a healthy forest can absorb as much as 20,000 gallons of water in an hour. Many municipalities are now charging businesses and homeowners a "storm water utility" fee based on the amount of impervious surface at their location.

Air quality and local climate are also negatively affected by loss of forest cover. In exchange for providing oxygen, trees absorb carbon dioxide produced from the combustion of various fuels. Trees remove or trap lung-damaging dust, ash, pollen and smoke from the air, in addition to providing shade for people and conserving energy. In the Atlanta metro area, trees removed 19 million pounds of pollutants, valued at $47 million in 1996. Tree cover as it existed in 1974 would have removed 30 million pounds of pollutants, valued at $75.5 million (American Forests 2001).

Loss of forest cover affects the health of communities. Trees enhance community economic stability by attracting businesses and tourists. Studies have found a correlation between community forests and the average amount of physical activity exerted by neighborhood residents. People are more inclined to get outdoors and exercise when their surroundings are greener. Logically, greater physical activity leads to fewer cases of obesity, which in turn may help reduce other health problems such as heart disease and diabetes.

Urbanization increases apprehen-sion about fire. Air quality has become a major concern in Georgia, and prescribed fire has been targeted as one of many sources of harmful emissions. Drift smoke from prescribed fire and wildfires concerns urban dwellers. An important challenge is to help Georgians understand the life sustaining properties of healthy forests, and the natural role that fire plays in ecosystems.

Urban sprawl places lives and property at risk from wildfire and reduces options for proper fire management. More than half of Georgia homes are located in the Wildland Urban Interface. The greatest fire management challenge for forestry professionals is to ensure public safety by providing fire prevention services in the form of prescribed fire as well as wildfire suppression. The sustainability of Georgia's forest is dependent on attention to both prescribed fire and wildfire suppression.

Forest conservation is a special priority north of the Fall Line, along the coast and in counties with the highest growth projections. Key lands for acquisition should be identified and prioritized in these rapidly-growing areas. According to a telephone survey conducted by The Statewide Comprehensive Outdoor Recreation Plan (SCORP), 88 percent of Georgians support public funding for investment in outdoor recreation.

As Georgia becomes more urbanized, it will become more challenging to sustain a connection between urban populations and our natural resources. Our forest land, parks and nature-based recreation will provide critically important connections to the environment and promote a conservation ethic.

Additionally, our schools should have access to natural areas for education. Schools must provide balanced interpretation, education and outdoor recreation programs to promote healthy lifestyles and knowledge of our natural resources.

Potential Agency and Organization Roles

- GFC will initiate updated tree canopy loss and impervious surface studies and help build local capacity to manage tree canopy.

- GFC will identify areas of opportunity within community watersheds to connect forest patches to improve the water and air quality function of forest canopy, identify appropriate mechanisms, and facilitate discussions to link patches with landowners, local governments and conservation-minded non-profit organizations.

- The Georgia Urban Forest Council and GFC will utilize grant and corporate funds to plant trees in communities to assist in job creation, help stimulate the economy and restore ecosystems impacted by growth and urbanization.

- GFC and DNR will promote forest canopy benefits in riparian buffers and demonstrate impacts of canopy loss in interface watersheds.

- GFC will continue to promote the Changing Roles training within GFC and with other state partners.

- The Georgia Forestry Association, GFC and University of Georgia Warnell School of Forestry and Natural Resources will expand the Project Learning Tree program to educate youth on forest conservation.

Issue-Specific Priority Areas

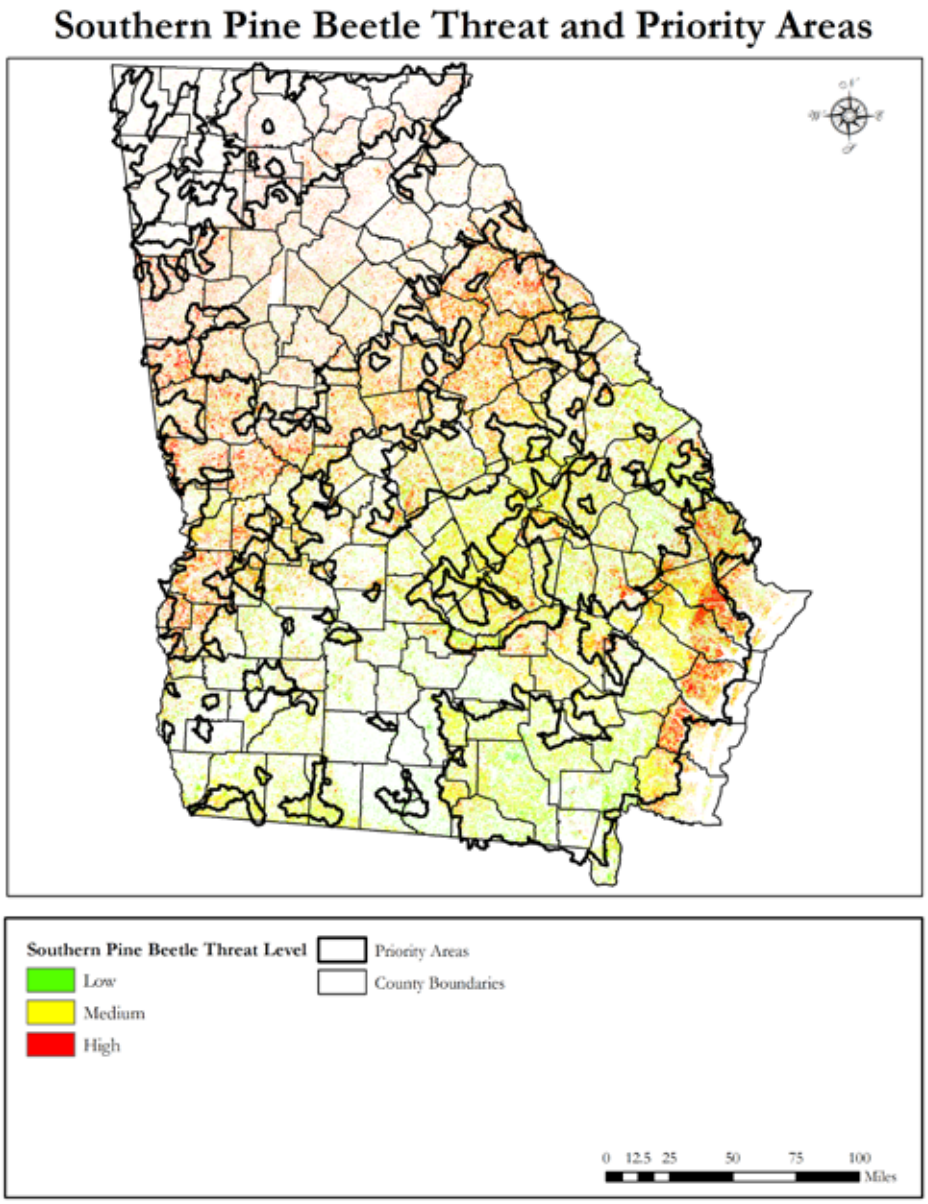
Areas of focus to address the urbanization issue include metropolitan Atlanta, north Georgia and the coast. These areas have the greatest population density as well as population growth. Federal and corporate grant funds will be used to focus on high-profile projects in these areas. Potential projects include establishment of model stormwater management demonstration sites and ecosystem restoration. Watershed planning work in north Georgia's Blue Ridge and Ridge and Valley priority areas will target opportunities to enhance the water and air quality function of forest canopy.

Issue Description

Healthy forests are essential for air and water quality, habitat, environmental cooling, recreation and the multitude of forest products from which Georgians benefit. History shows that a decimating agent such as the chestnut blight in the early 1900s can drastically alter the forest ecosystem and eliminate important resources.

The southern pine beetle (SPB) and other pine bark beetles continue to represent the biggest threat to pine timber in Georgia (Figure 49).

Annosum root disease is another serious problem that results in decreased growth and death of trees in pine plantations.



Source: USFS and Georgia Forestry Commission

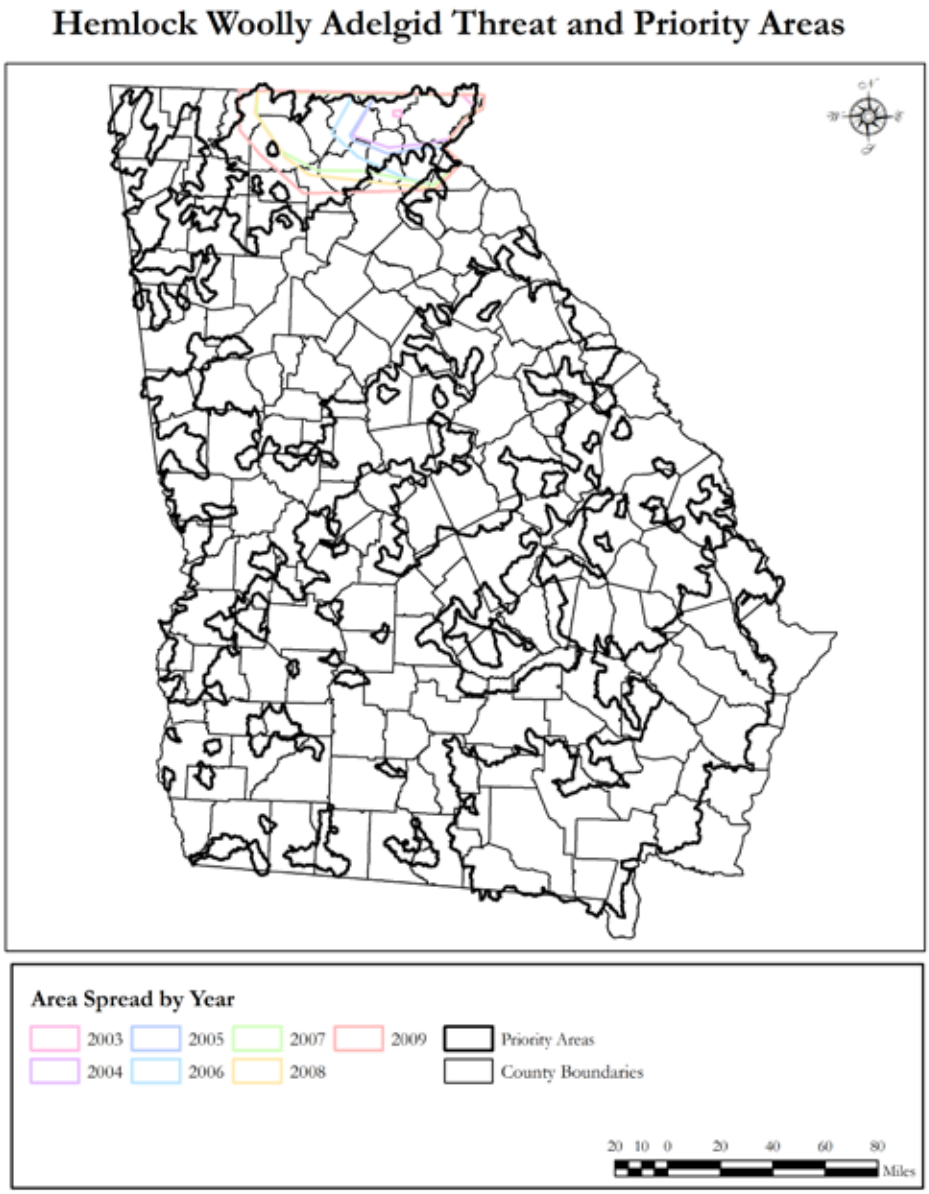
Figure 49

In today's global market, the potential is very real for insects and disease organisms to find their way into Georgia and cause widespread damage. For example, the hemlock woolly adelgid, imported from Japan, was detected in Georgia in 2002, and has now spread throughout most of the native hemlock range. It has the potential to nearly eliminate hemlocks in north Georgia and drastically alter the ecosystems in the area (Figure 50).

The redbay ambrosia beetle was first detected near Savannah in 2002 and is associated with a laurel wilt disease that is killing redbay and sassafras trees across almost six million acres of forest in the Coastal Plain region (Figure 51).

Invasive plants such as cogongrass are finding their way into the state. Cogongrass, which destroys wildlife habitat is spreading aggressively in Georgia (Figure 52). It overcomes native grasses and herbaceous browse. In addition, it burns extremely hot, increasing the threat of wildfires.

Other established invasive plants such as kudzu, Chinese privet, Japanese climbing fern and Chinese tallowtree continue to displace native plants.



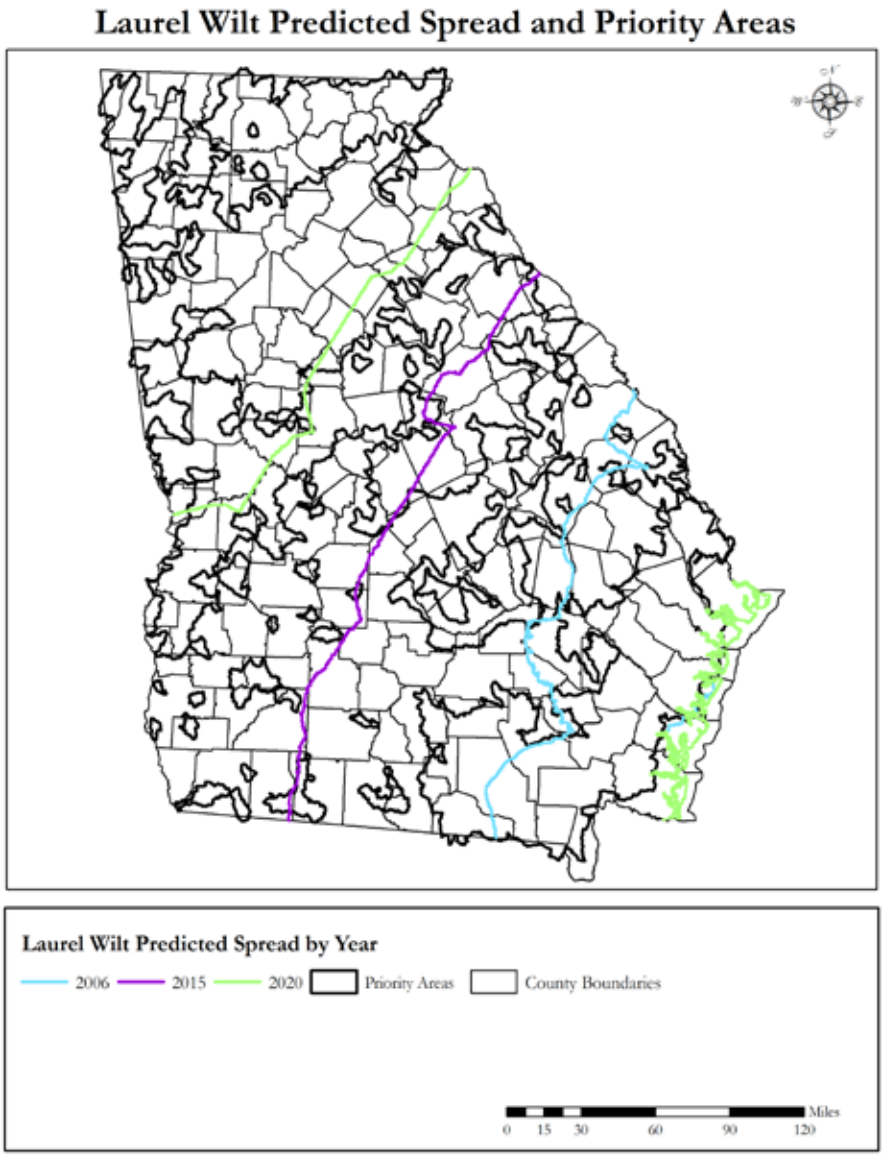
Source: USFS and Georgia Forestry Commission

Figure 50

Legislative support and regulation to prevent the introduction and spread of non-native exotic plants, animals and pathogens is needed. In addition, interagency cooperation on invasive species management can be improved through the implementation of a statewide Invasive Species Management Plan and establishment of a state Invasive Species Council.

Potential Agency and Organization Roles

- GFC will continue to monitor native forest health issues and aggressively monitor for new insects, diseases and invasive plants in the forest, urban landscapes and at points of entry so that solutions can be undertaken while problems are small and the chances of eradication or control are greatest.
- The Georgia Invasive Species Task Force will work collaboratively within the scope of the Georgia Department of Agriculture, Georgia Department of Natural Resources, Georgia Forestry Commission and University of Georgia to monitor for invasive species and take suppression actions when possible. USDA APHIS has regulatory authorities within Georgia and internationally and will be included in any pest-specific action that is planned or implemented. Full descriptions of authorities of these agencies are included in Appendix A.
- GFC is working collectively with six southern region state forestry agencies to detect and minimize the spread of cogongrass.

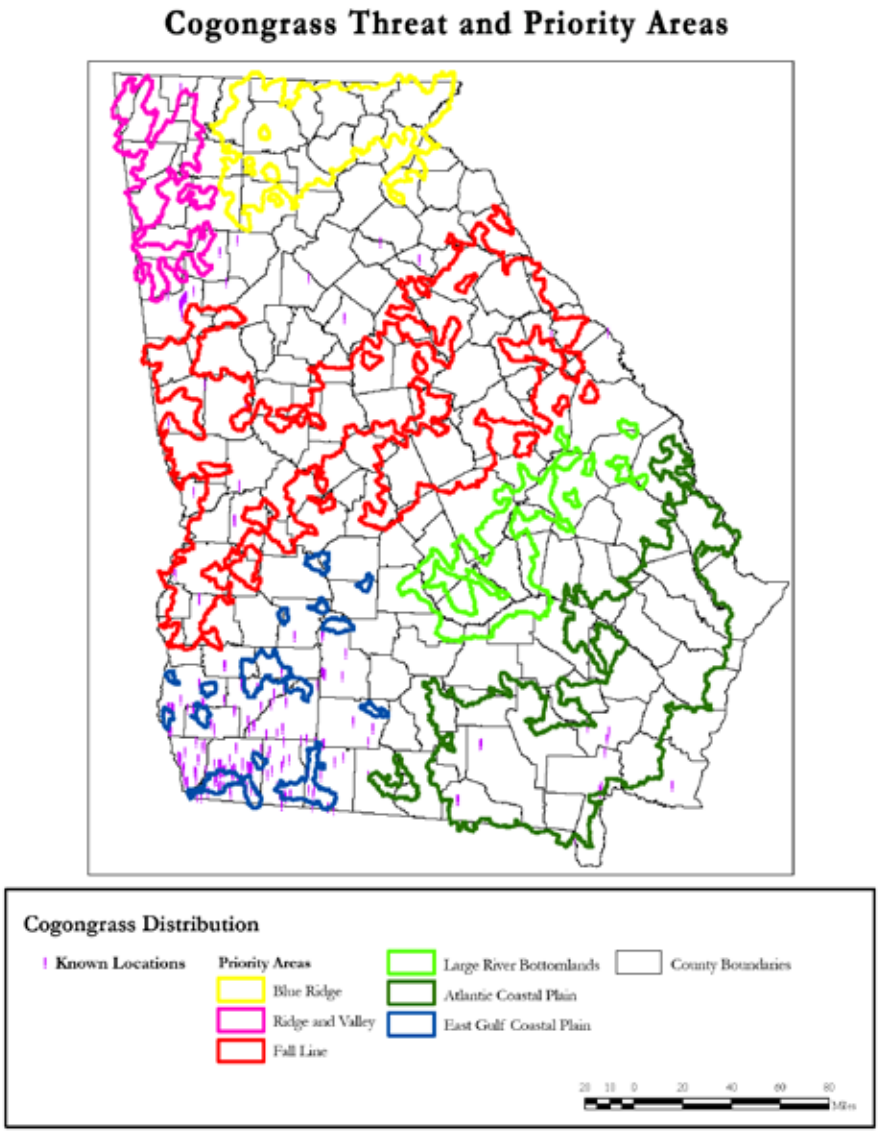


Source: USFS and Georgia Forestry Commission

Figure 51

Issue-Specific Priority Areas

Southern pine beetle work will be focused in the Fall Line priority area (Figure 49). HWA efforts will be conducted in the Blue Ridge priority area (Figure 50). The Atlantic Coastal Plain will be the area of focus for laurel wilt (Figure 51). The East Gulf Coastal Plain and Atlantic Coastal Plain will be the priority areas for cogongrass prevention and eradication efforts (Figure 52).



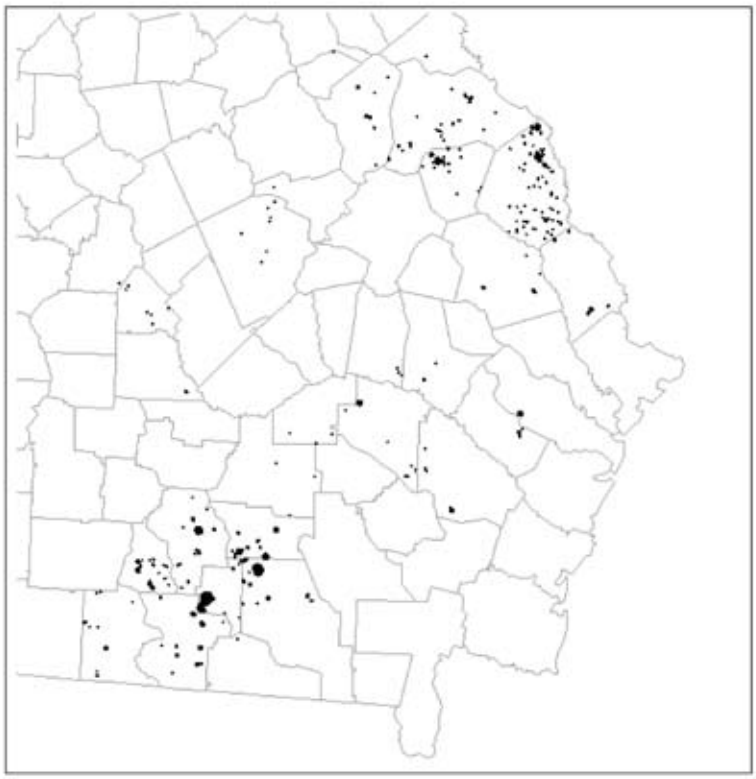
Source: USFS and Georgia Forestry Commission

Figure 52

Issue Description

Georgia's rich biodiversity is threatened by several factors, including loss of isolated wetlands and mature bottomland hardwood forests, impacts to headwater streams and riparian buffers resulting from development and other land disturbing activities and habitat degradation caused by invasive exotic species. Many of Georgia's rare or declining species depend upon fire-maintained habitats or sensitive karst environments. The lack of prescribed fire in fire-dependent ecosystems and lack of protection for many karst environments further endangers these species (Georgia Department of Natural Resources 2005).

Distribution of Carolina Bays in Georgia



Source: VanDeGenachte and Cammack 2002

Figure 53

The drastic loss of pine savanna, resulting primarily from conversion to other land use types and reduction in fire, has contributed to the severe decline of numerous wildlife species that rely fully or in part on these habitats to meet their life requisites. Northern bobwhite (Georgia's state gamebird) serves as one example of a species in conservation need that is largely dependent on pine savanna restoration. Georgia's bobwhite population has declined by over 70 percent since 1966.

Protection of isolated wetlands

Isolated wetlands comprise an important group of habitats for wildlife, including more than 45 Georgia species of conservation concern (Comer et al. 2005). Studies of the extent and condition of isolated wetlands indicate a consistent trend toward degradation and loss. A recent assessment of Carolina bays in Georgia (Figure 53) indicated that the majority of the smaller bays showed evidence of hydrologic alterations or other forms of degradation (Van De Genachte and Cammack 2002). Other examples of important isolated wetlands include solution pits on granite outcrops, shallow depressions in pine flatwoods, sagponds, limesinks and sandhill ponds. Depression wetlands that have direct connections to groundwater may be significantly affected by excessive groundwater withdrawal to a point at which the hydroperiod is diminished or even eliminated. Other isolated wetlands have been impacted by introduction of predatory fish, excessive inputs of sediments or nutrients, conversion to agricultural uses or ditching and draining.

Maintenance of mature bottomland forest habitats

Bottomland forests and associated cypress-gum swamps are important habitats for a variety of wildlife groups, including neotropical migratory birds, bats, waterfowl, wild turkey, game mammals, reptiles and amphibians. This general habitat type includes linear or small-patch communities such as canebrakes, floodplain pools, riparian forests and hardwood and pine-dominated hammocks. Though present in every region of the state, bottomland hardwood forests and cypress-gum swamps are most prevalent in the Coastal Plain (Figure 54). Maintenance of mature, intact and contiguous bottomland forests is important for conservation of Georgia's wildlife diversity. In particular, old-growth canopy trees, snags, large woody debris and diverse midstory and understory vegetation are important elements to maintain in these forests.

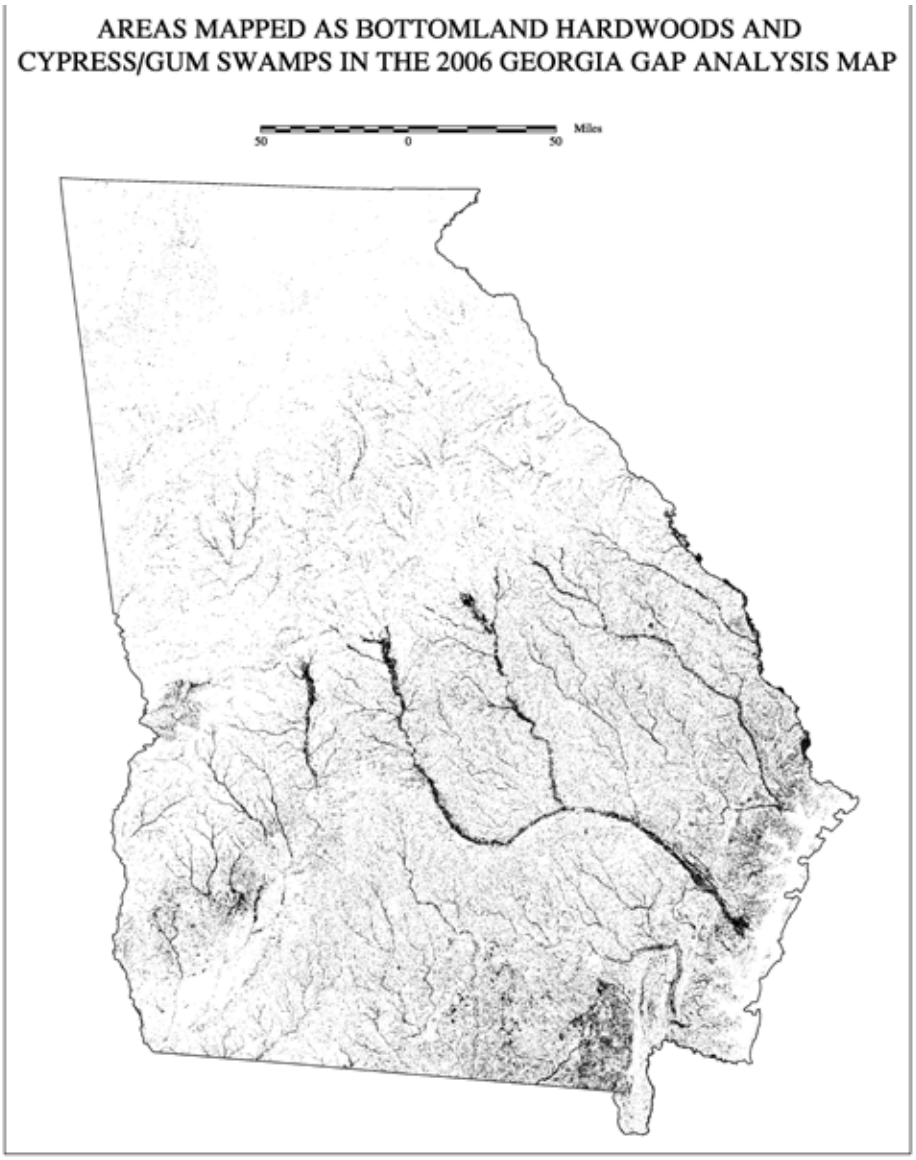
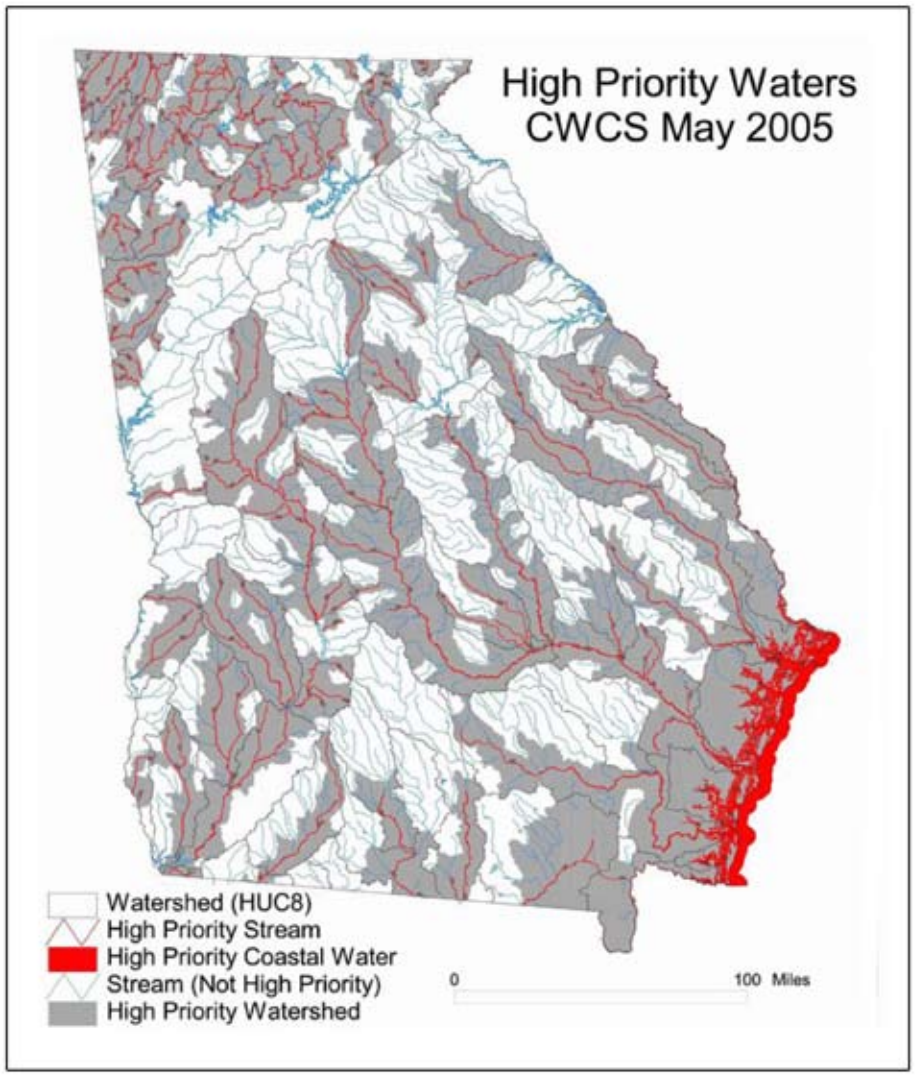


Figure 54

Protection of headwater streams

Headwater streams are found in the uppermost reaches of watersheds and may have flowing water for only a portion of the year. They account for the majority of stream miles in a given watershed, and are important for a wide variety of species, including several species of conservation concern (Meyer et al. 2003; Georgia Department of Natural Resources 2005). Headwater streams are also important for maintenance of water quality and aquatic wildlife habitat in the higher-order perennial streams which they feed (Ohio Environmental Protection Agency 2002).

Intermittent/ephemeral streams and associated seepage zones are often overlooked when streams and wetlands are mapped. In addition, they have received less research emphasis than perennial streams (Meyer et al. 2003). In areas where development pressures are high or agricultural uses are prevalent, many of these habitats may be adversely affected by land-disturbing activities or piping of streams (DeMeo et al. 2005). While important in every watershed in the state, protection of headwater streams is most critical in those watersheds that have been identified as high priority for conservation of aquatic biodiversity (Figure 55).



Source: Georgia Department of Natural Resources 2005

Figure 55

Protection of karst environments
Caves, limesinks, sagponds and springs represent some of the most sensitive natural habitats in Georgia. These karst environments harbor many of this state's rarest and most imperiled species and are susceptible to impacts from a wide variety of land uses, including agricultural and forestry practices and commercial and residential development. Groundwater withdrawals, impoundments and conversion of surrounding vegetation can significantly impact karst environments (Georgia Department of Natural Resources 2005). Protection of caves and other karst environments is essential for maintenance of Georgia's biological diversity and water quality. There are more than 600 documented caves in Georgia, and the vast majority of these are located on private land. Only a small percentage of Georgia's caves have received biological surveys.

Restoration and management of fire-maintained communities
Many of Georgia's rare or declining species depend on habitats that are maintained by fire. These habitats are declining in extent and condition due to fire suppression and/or lack of prescribed fires. Among the impediments to wider application of prescribed fire programs are smoke management problems, restrictions on burning due to non-attainment of air quality standards in metropolitan areas, reluctance of landowners to use prescribed fire due to concerns about liability, lack of understanding of the role of fire in some natural environments and a lack of technical expertise with regard to the application of prescribed fire in some habitats.

Restoration and management of pine savanna habitats
Open canopy forests with diverse grass-forb-shrub groundcover characterize pine savanna. Prior to European settlement, this habitat type dominated as much as three-fourths of the Southeastern Coastal Plain landscape (Platt 1999). These forests were predominately two-layered with an overstory of widely-spaced pines and an herbaceous ground cover that was maintained by frequent fire (Frost, 1998). It has been estimated that pine savanna covered as much as 17,000 square miles of Georgia's Coastal Plain (Wharton 1978). Additionally, pine and oak-pine savanna occurred on xeric ridges of the Ridge and Valley and Piedmont physiographic provinces.

Functional pine savanna now comprises less than five percent of the southeastern Coastal Plain (Platt 1999). This drastic loss, resulting primarily from conversion to other land use types and reduction in fire, has contributed to the severe decline of numerous wildlife species that rely fully or in part on savanna habitats to meet their life requisites. Georgia's SWAP identifies 20 high priority animals (Table 14) and 56 plants (Table 15 on following page) associated with pine savanna that are in need of conservation attention.

Georgia SWAP High Priority Animals of Pine Savannas	
Bachman's Sparrow	Florida Worm Lizard
Brown-headed Nuthatch	Mimic Glass Lizard
Red-cockaded Woodpecker	Eastern Diamondback Rattlesnake
Northern Bobwhite	Southern Hognose Snake
Southeastern American Kestrel	Eastern Indigo Snake
Loggerhead Shrike	Florida Pine Snake
Southeastern Pocket Gopher	Florida Crowned Snake
Sherman's Fox Squirrel	Flatwoods Salamander
Northern Yellow Bat	Striped Newt
Gopher Tortoise	Gopher Frog

Source: Georgia Department of Natural Resources 2005

Table 14

Georgia SWAP High Priority Plants of Pine Woodlands & Savannas	
Chapman Three-awn Grass	Ohoopee Bumelia
Georgia Aster	Florida Ladies-tresses
Sandhill Milkvetch	Giant Spiral Ladies-tresses
Purple Honeycomb Head	Pineland Dropseed
Hairy Rattleweed	Wire-leaf Dropseed
Indian Grave Mountain Wild Basil	Tallahassee Hedge-nettle
Many-flowered Grass-pink	Pickering's Morning-glory
Oklahoma grasspink	Dwarf Goats Rue
Catesby's bindweed	Carolina Redtop
Sandhill Awned Moss	Evergreen Low Bush Blueberry
Long-Awned Split Sedge	Pineland Barbara Buttons
Lavender Lady flatwoods	Trailing Milkvine
Florida Senna	Savanna Cowbane
Virginia Thistle	Inland Rugel's Nailwort
Florida Orange-grass	Rugel's Nailwort
Florida Finger Grass	Yellow Nailwort
Creeping Morning-glory	Dixie Mountain Breadroot
Michaux Orchid	Grit Beardtongue
Blazing Star	Trailing Bean-vine
Harper Grooved Flax	Sandhill Golden-aster
Carolina Birdfoot-trefoil	Pineland Plantain
Chaffseed	Southern White Fringed Orchid
Hooded Pitcherplant	Yellow Fringeless Orchid
Parrot Pitcherplant	Wild Coco
Lowland Purple Pitcherplant	Georgia Beakrush
Sweet Pitcherplant	Spotted Beakrush
Creeping bluestem	Yellow Flytrap
White Sunnybell	Whitetop Pitcherplant

Source: Georgia Department of Natural Resources 2005

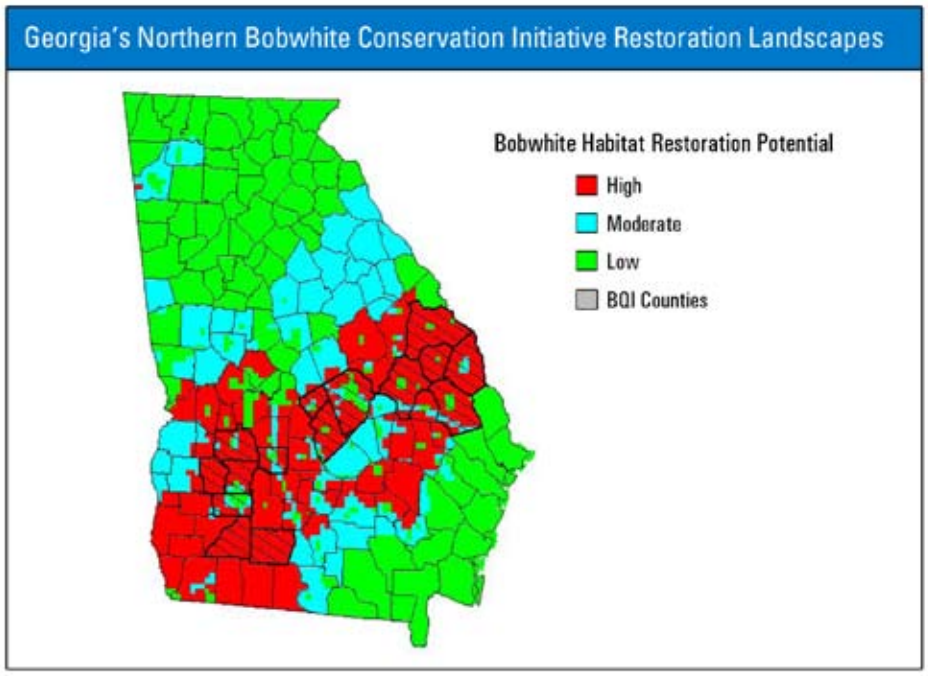
Table 15

The northern bobwhite (Georgia's state gamebird) serves as one example of a species in conservation need that is largely dependent on pine savanna restoration. Georgia's bobwhite population has declined by 4.44 percent annually since 1966 (Sauer et al. 2008). Research has shown that closed-canopy pine stands provide poor quality habitat for bobwhites and may also serve as ecological sinks, thereby negatively impacting bobwhite populations on adjacent grassland habitats.

Restoration of this habitat type, especially longleaf pine savanna, is a high priority in a variety of conservation plans developed by federal, state and non-governmental conservation organizations. Examples include: America's Longleaf Initiative; Georgia DNR's State Wildlife Action Plan (SWAP) and Bobwhite Quail Initiative; Northern Bobwhite Conservation Initiative (NBCI); Partners in Flight North American Landbird Conservation Plan and Partners in Amphibian and Reptile Conservation - Habitat Management Guidelines for Amphibians and Reptiles of the Southeastern United States.

Portions of 61 Georgia counties have been identified as high priority for bobwhite restoration (Figure 56). Within these counties, there are 378,965 acres of longleaf and 4,387,159 acres of loblolly slash pine that might potentially be restored to functional pine savanna (Forest Service 2009). If achieved, this could contribute as much as 50 percent toward Georgia's NBCI recovery goals. Additionally, there are over three million acres of harvested cropland, a portion of which might be restored to longleaf pine.

GEORGIA'S NORTHERN BOBWHITE CONSERVATION INITIATIVE RESTORATION LANDSCAPES



Source: Georgia Department of Natural Resources, Wildlife Resources Division 2009.

Figure 56

Potential Agency and Organization Roles

- Conservation organizations and GFC will identify and protect significant wetland habitats through fee-simple acquisition or conservation easements.
- DNR and GFC will work to provide technical guidance and direct financial and other incentives to private landowners to encourage the protection, restoration and management of these important wetlands.
- DNR will conduct surveys and mapping of priority sites, develop management plans for state lands and implement landowner incentive programs and conservation easements.
- GFC will provide delivery of landowner incentive programs, forest stewardship plans and monitoring of BMPs.
- NRCS will administer federal incentive programs.
- DNR will place greater emphasis on accurate mapping and delineation of headwater streams so that these can be protected with vegetated buffers.
- DNR will conduct surveys to document the diversity of cave organisms and establish conservation priorities for springs, limesinks and other karst features.

- The Interagency Burn Team will facilitate application of prescribed fire on ecologically sensitive sites that harbor rare species.

- The Georgia Prescribed Fire Council will promote the use of prescribed fire.

- GFC will advise landowners with intact natural savanna habitats, particularly longleaf pine systems, on the natural values of these systems and encourage management that retains these values.

- Georgia DNR will continue the NBCI implementation effort with the collaboration of GFC, Georgia Soil and Water Conservation Commission, Georgia State Council Quail Unlimited, U.S. Army, Georgia State Farm Service Agency, University of Georgia Warnell School of Forestry and Natural Resources, Georgia Association of Conservation District Supervisors, Georgia Natural Resources Conservation Service, Tall Timbers Research Station – Albany Quail Project, Quail Forever, U.S. Forest Service and the U.S. Fish and Wildlife Service.

Issue-Specific Priority Areas

Isolated wetlands are found throughout the state, but especially in the Cumberland Plateau, Ridge and Valley, Atlantic Coastal Plain and East Gulf Coastal Plain. Bottomland hardwoods and headwater streams are found throughout the state. Areas of focus for the protection of karst environments include the Ridge and Valley and East Gulf Coastal Plain priority areas. The priority areas for restoration and management of pine savanna habitats are the East Gulf Coastal Plain and Atlantic Coastal Plain.

Issue Description

Private forest lands have enormous potential to provide climate benefits through carbon sequestration. In addition to their ability to sequester carbon, forests provide numerous benefits to society, including water quality and quantity services, flood control, aesthetics, recreation and wildlife habitat. Historically, these societal benefits have been taken for granted, with no dollar value placed on their environmental contributions. Monetizing forest carbon through private forest landowner participation in these markets provides an opportunity for a measure of compensation for the provision of a societal benefit. Since most of the land in the South is in private ownership, landowners able to generate additional revenue from carbon markets may be more likely to maintain their forest lands, resisting the pressure to develop their lands.

The emerging market for carbon offsets continues to generate significant interest from private forest landowners looking to maximize the financial potential of their forest assets. Generally, a forest offset project is defined as a series of prescribed management actions implemented on particular area of land that result in an increase in removals of carbon dioxide from the atmosphere (sequestration) or a reduction or avoidance of greenhouse gas emissions. Some examples of forest offset activities include planting trees, protecting forests from conversion, modifying forest species composition and increasing tree stocking levels. Forest offset projects that are successful in reducing or avoiding carbon emissions generate carbon credits, which can be sold to entities who wish to mitigate or "offset" their greenhouse gas (GHG) emissions.

Unfortunately, the opportunities for NIPF landowners to participate in this new market continue to be limited due to significant opportunity costs, high uncertainty and the persistent fact that carbon credits are a relatively low-value commodity. The future opportunities for privately-owned forests in any forthcoming regulatory framework are difficult to predict.

Lack of uniform standards for forestry projects, along with an absence of federal policy on GHG emissions, means that landowners must today contend with significant uncertainty when evaluating the economic viability of forest carbon. Those who develop offset projects on their forest properties face significant long term contractual obligations and legal liability, with no guarantees regarding the long-term market viability of a project developed in accordance to an established pre-compliance standard. Large-scale investment in forest offsets in the future will require a national regulatory policy that effectively places a market price on GHG emissions and a clear, practical and economically-feasible national standard for the development and implementation of forest-based offsets within this regulatory framework.

The GFC and The University of Georgia Warnell School of Forestry and Natural Resources have developed carbon accumulation tables for Georgia and an online carbon sequestration registry. This registry will list and document forestry projects that are managed to sequester carbon.

The registry gives Georgia landowners the opportunity to certify that their forests meet specific standards required by emitters seeking carbon credits

for sale. The services associated with the registry will be adjusted with the dynamics of the carbon market and the changing compliance standards.

Those landowners who wish to develop projects may use the registry as a marketing tool, and registry staff members actively pursue market opportunities for registered projects. There are currently a number of landowners participating in carbon offset projects, mainly through the Chicago Climate Exchange (CCX).

In addition to the carbon sequestration benefit, trees remove or trap lung-damaging dust, ash, pollen and other air pollutants. By reducing air pollution, they save money in pollution mitigation efforts and health care costs (Georgia Urban Forest Council 2005b). To sustain air quality, communities must set goals to minimize the loss of trees while maximizing their benefits.

Potential Agency and Organization Roles

- GFC staff worked with the Southern Group of State Foresters (SGSF) to develop a guiding principles paper that focuses on carbon offsets from a southeast regional perspective and will work to promote the principles.
- The GFC and Oglethorpe Power Corporation are partnering on a reforestation project in a state forest. This project will result in carbon offsets produced from the tree planting on sites devastated by the 2007 wildfires in south Georgia.
- GFC staff members continue to monitor developments on a national scale concerning climate change legislation so that Georgia's landowners will be well positioned to participate in carbon markets.
- GFC will identify air quality benefits of community forests related to public health.
- The Georgia Urban Forest Council and GFC will utilize grant and corporate funds to plant trees in communities.

Issue-Specific Priority Areas Focus areas for reducing greenhouse gases by increasing carbon sequestration are in the Blue Ridge, Ridge and Valley and East Gulf Coastal Plain. Urban priority areas will be targeted for community tree planting projects.

Issue Description

One of the founding missions of the Georgia Forestry Commission was the protection of forest resources from wildfire. Today, about two-thirds of Georgia's land area, or 24.8 million acres of forest land, is protected by the Georgia Forestry Commission. Timber is the highest valued crop in Georgia, with a total economic impact of $28.7 billion. Georgia averages approximately 8,000 wildfires per year that burn 40,000 acres. In addition to that annual loss of or damage to forest land, a major threat is posed by the potential loss of life and property. Georgia currently loses approximately 150 homes valued at $4.5 million and 200 outbuildings valued at $2.4 million to wildfire each year. The GFC Fire Management program saves approximately 1800 structures (homes and outbuildings) valued at $162 million annually through direct wildfire suppression efforts. Urbanization, increasing levels of forest fuels and restrictions that reduce prescribed burning are escalating forest wildfire threats.

Mitigating the effects of wildfires is an integral part of GFC's Fire Management program. Suppression alone cannot limit the effects of wildfire, because fire is a volatile force of nature. Fuel reduction programs are essential to providing protection from wildfires. Pressure from urbanization, air quality controls and public acceptance has placed challenges on the GFC to provide acceptable mitigation programs. Limitations on GFC's ability to administer low cost applications, such as prescribed burning, hinder the ability to provide affordable protection for Georgia's citizens.

The recent Southern Wildfire Risk Assessment determined that 25 percent of Georgia, or about nine million acres, is designated as Wildland Urban Interface. The SWRA also determined that 5,000 of Georgia's communities are ranked as "high" or "very high" for wildland fire risk. Mitigation program limitations have compelled the Fire Management program to provide more public education about the risk from wildfires and the need for more fire prevention. Most fire causes can be traced to human involvement. Preventing man-made fires from starting is a continuing challenge and GFC is dedicated to finding programs that help reduce this cause of fire. All fires are not preventable, so we must also ensure that we have good wildfire protection programs in place when fires do occur. Wildfire protection can be addressed at the county level, at the community level and for the individual homeowner.

As the U.S. economy has faltered over the past several years, GFC's workforce has diminished. It has been necessary to develop several partnerships with state and federal agencies, as well as land management organizations. GFC continues to be the lead agency in wildland fire, but depends on its many partners to help accomplish the overall mission. Partnerships are also used to ensure the smooth transmission of programs such as wildland fire suppression, prescribed burning and air quality. In order to maintain superior performance and protection, it is necessary for these partnerships to grow and expand.

A strategy must be implemented to affect the condition of the landscape, increase safeguarding of communities from wildfire and prepare fire managers to address conditions caused by changing weather phenomena.

Potential Agency and Organization Roles

The most important mission of the Fire Management program is fire suppression. GFC is mandated by the state of Georgia to suppress wildfires. However, the downturn in the economy and reductions in state budgets have strained personnel and resources. To continue the protection of lives, property and forests, GFC will:

- Increase GFC Forest Ranger training as experienced work force retirements increase.
- Provide basic training on wildland firefighting to structural firefighters through the Georgia Fire Academy.
- Increase firefighting equipment refurbishing options.
- Incorporate technological advances in communications and weather predictive systems.
- Participate in the Firefighter Program to acquire better quality equipment.
- Administer Volunteer Fire Assistance grants for small fire departments to help with purchase of training and equipment and the Helping Hands program to provide for low cost personal protective gear to fire departments and other fire suppression cooperators.
- Issue authorizations for outdoor burning through the GFC Permit System.
- Provide pre-suppression firebreak plowing and burning assistance to landowners.
- Conduct forest fuels reduction burning assistance to landowners.
- Provide National Incident Management System training for Georgia.
- Promote prescribed burning and certify burn practitioners through the Certified Prescribed Fire Manager program.
- Provide local county governments with a comprehensive Community Wildfire Protection Plan (CWPP).
- Using the Firewise USA program, introduce Firewise concepts to at-risk homeowners.
- Continue to develop and implement innovative Fire Prevention programs.
- Continue the Redesign Grant.

Issue-Specific Priority Areas

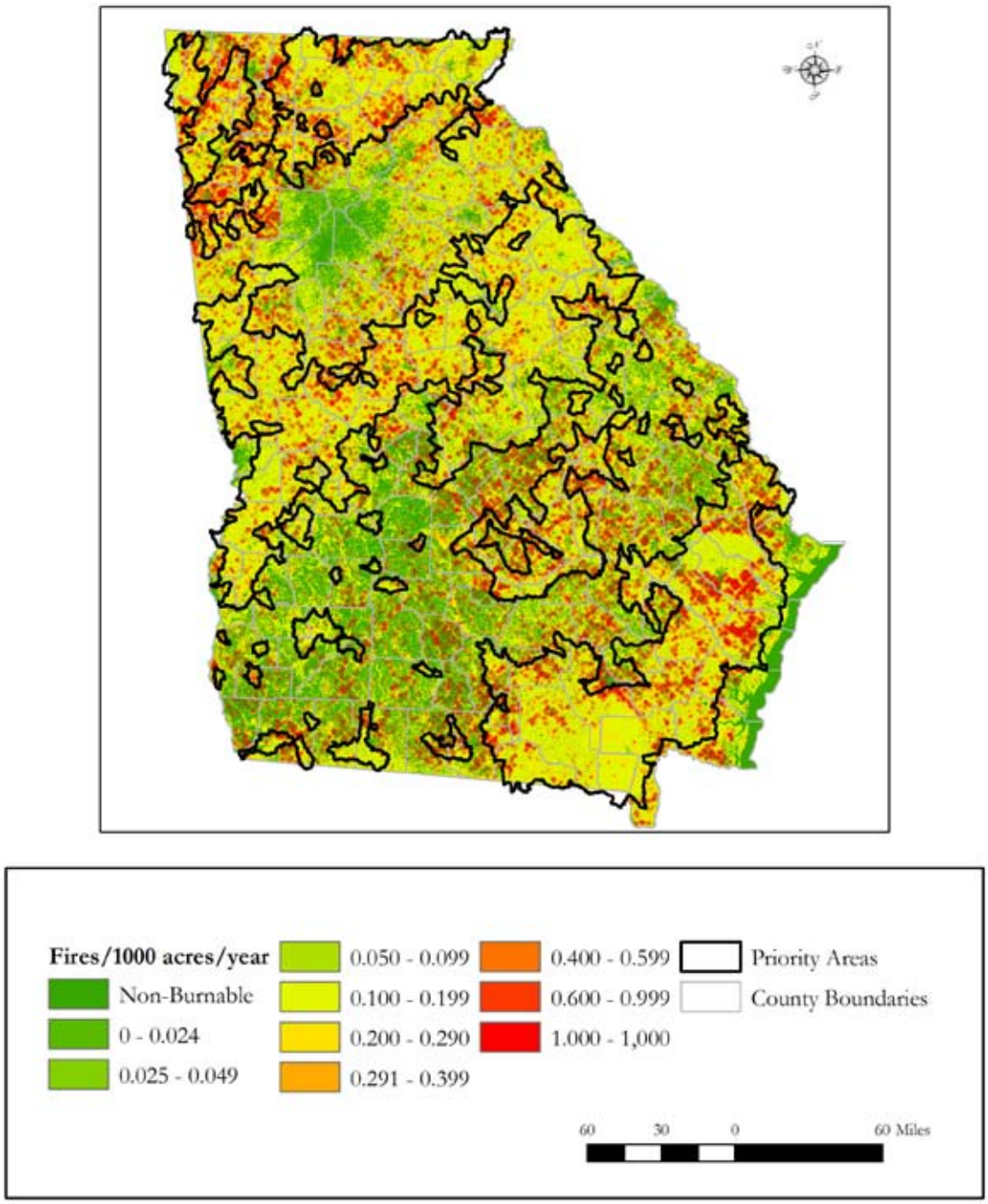
To identify Fire Management program-specific priority areas, the GFC utilized the Southern Wildfire Risk Assessment (SWRA). Maps of forest fuels, historical wildfire occurrence, values at risk from wildfires and communities at risk were used to develop the wildfire susceptibility index (WFSI) and levels of concern (LOC), which measure wildfire risk. These SWRA products are the main tools used in assigning priority to GFC Fire Management programs including CWPPs, fire prevention and mitigation efforts.

Of Georgia's 12,000 communities, more than 5,000 are rated "high" or "very high" for wildland fire risk. Because the greatest risks occur in WUI areas and fall on the edges of Georgia's priority areas, the SWRA priority areas are set within each county.

An overlay of the statewide fire occurrence map with Georgia's priority areas (Figure 57 on the following page) identifies the Blue Ridge, Ridge and Valley and the Atlantic Coastal Plain as priority areas on which to focus fire suppression efforts.

The Community Protection Grant identifies priority areas for prescribed burning near USFS property. Overlays of this data on Georgia's priority areas identify the Blue Ridge, Ridge and Valley and the Fall Line as primary targets for prescribed burning. The Okefenokee (GOAL) grant targets areas in and around the Okefenokee Swamp within the Atlantic Coastal Plain area. Wildlife management programs such as the Bobwhite Quail Initiative have identified the East Gulf Coastal Plain and Large River Bottomlands as priority areas for prescribed burning in longleaf pine ecosystems.

Fire Occurence Areas



Source: Georgia Forestry Commission 1997-2002 and Southern Wildfire Risk Assessment 2008.

Figure 57

Issue Description

The future of Georgia's forests is imperiled by increasing forest fragmentation and parcelization. Parcelization results when the number of forest landowners increases, but the forest land is held in smaller parcels, measured at 50 acres or less (Wear and Greis 2002). Though parcelization may not result in forest canopy loss, in many cases resources on the tract become unavailable to markets.

Forest fragmentation is the division of contiguous forest stands into smaller, isolated pieces or less contiguous tracts due to development, conversion to agriculture, the divestiture of forest land by the forest industry and other human activities.

Both fragmentation and parcelization may disrupt wildlife corridors and migration routes of many wildlife species. Those species requiring large, undisturbed expanses may decline. They may also cause adverse changes in water quality and quantity and impede the management of fire and forest pests. Fragmentation and parcelization result in less efficient management units, which contribute to cost increases and resource management difficulties.

Fragmentation has been identified as a key measure of environmental quality, and representative of a forest's ability to provide critical ecosystem services. These services include protection of water quality and quantity, air quality protection, biodiversity protection and carbon sequestration.

Contributing Factors

A primary factor contributing to forest fragmentation and parcelization is changing ownership patterns. The majority of Georgia's productive forest lands are in private ownership. These private landowners are facing increased pressure to convert their forest lands to other uses. Urbanization pressures, taxation and mass divestitures of forest industry land are leading concerns.

A major urbanization factor is leapfrog development sprawl, a discontinuous pattern of urbanization with patches of developed lands that are widely separated from each other and from the boundaries of recognized urbanized areas. Such sprawl isolates forest patches, drives up the highest and best use value and ensures their conversion to development.

Several taxation issues affect forest land ownership and the forest industry in Georgia. However, none is more critical to the future of Georgia's forests than property taxes. Georgia's ad valorem tax system was created during a time when the wealth and profits of the state came out of the production of the land – when cotton was still king in the 1800s. As times have changed and Georgia has become increasingly urban, the tax structure has remained the same. As a result, forest land valuations for tax purposes are inconsistent across Georgia and "highest and best use" land valuation threatens forest sustainability.

Non-industrial private landowners throughout Georgia are reporting dramatic increases in local property taxes. Many have been hit with a doubling, tripling or more of ad valorem tax liability just in the past few years. In this environment, a growing number of landowners simply cannot grow trees fast enough or sell them at a price high enough to pay the current property taxes levied on the land. When owners of large tracts die, their heirs may be left with enormous tax bills, often leading to the sale of some or all of the land in order to pay taxes. When this occurs, the land is more prone to be subdivided.

Traditional forest products companies have also been impacted by highest and best use tax assessment resulting in divestitures to timber investment management organizations (TIMOs) and real estate investment trusts (REITS). One result of greater TIMO and REIT involvement is a more rapid turnover in forest ownership and an increased potential for subsequent parcelization into smaller-sized properties (Wear et al. 2007).

In addition, landowners must pay severance taxes on timber. For many, owning forests and timber land has become a poor business decision. Studies show that for every $1.00 in ad valorem tax generated by Georgia's timber lands, those same lands receive less than $0.50 return in services.

In 1991, the General Assembly passed the Conservation Use Valuation Assessment Act (CUVA). It provides for a reduction in property tax assessments and is available only to private individuals who own forest land not exceeding 2,000 acres. Lands belonging to forest industry companies are not eligible. As a result, many companies divested their lands. CUVA properties are assessed according to soil type, productivity and a reduced fair market value factor. Landowners are required to place their property in 10-year covenants, severely restricting the use of the property. If a covenant is breached, stiff penalties must be paid. Each county tax assessor's office administers the program independently, so application requirements may vary among counties. Generally, a minimum of 10 acres is required for enrollment, but some counties have recently increased the minimum acreage to 25 acres. No more than 2,000 acres can be enrolled in CUVA by any one non-industrial, private landowner.

Because of the mass divestitures of forest industry land, in November 2008, Georgians overwhelmingly voted for a Constitutional Amendment that provides relief for property taxation of Georgia's forests over 2,000 acres. Through the Forest Land Protection Act (FLPA), large tracts of privately or corporately owned forest lands may be eligible for reduced property tax.

Landowners can apply for FLPA valuation of their property if they meet eligibility requirements and sign a conservation agreement to keep the land in a qualified use for 15 years. Landowners receive a reduced ad valorem tax rate for property enrolled in FLPA. Eligible tracts must be used for subsistence or commercial production of trees, timber or other wood and wood fiber products; and the value of any residences on the property are excluded. Properties must be a minimum of 200 acres, but unlike CUVA, there is no maximum acreage cap.

Forest land designated for conservation use may include land that has been certified as environmentally sensitive property by the Department of Natural Resources. It may also be property that is kept in accordance with a recognized sustainable forestry certification program. The property may have compatible secondary uses such as the promotion, preservation or management of wildlife habitat, carbon sequestration or mitigation and conservation banking that results in the restoration or conservation of wetlands and other natural resources.

Opportunities are to provide landowners with incentives to retain manageable tracts of forest land that can compete with the financial returns of converting or selling forest land for other purposes. Some of these incentives could be in tax relief and in the development and support of markets to increase the financial investment value of forest resources. Maintaining incentives and smart public policy to allow lands to remain in forest cover will provide both environmental and economic benefits for Georgians in the future.

Georgia's forests are a valuable natural resource and economic engine for our state. Forest landowners should be given every opportunity to hold their property for the benefits of forest sustainability and the security and enjoyment of future generations.

Potential Agency/Organization Roles

There is still much that needs to be done to address the inequity that exists across Georgia in the application of ad valorem taxes:

- GFC will continue to educate landowners about CUVA and FLPA opportunities and educate local tax assessors about how to adequately evaluate the properties enrolled in these programs.
- GFC will work with the Department of Revenue as it reviews and enhances statewide regulations.
- GFA will use its advocacy role to educate state legislators about the need for ad valorem tax reform in the state and about inequitable tax impacts on forest landowners and the forest industry.

Issue-Specific Priority Areas

The large forest land base and economic dependence on forestry makes south Georgia counties a priority. Many rural counties throughout south Georgia rely almost entirely on ad valorem taxes for their budgets.

Issue Description

Georgia's forests sustain a huge economic engine for the state. In 2008, the forest industry brought more than $28.7 billion to Georgia's economy and employed more than 128,000 people. It is the second largest industry in Georgia based upon wages and salaries, and the third largest based upon employment. In order to develop appropriate strategies for improving the environmental, social and economic benefits related to forests in Georgia, it is necessary to combine the "Economics" and "Changing Markets" issues. The overall objective is to increase the value of forests and forest products. Strategies must address both the changing market threats and the opportunities created by changing markets. The threats have been identified as globalization, product substitution, economic recession and demands for certified wood products.

More markets for existing forest product types leads to competition and increased stumpage. New forest products, such as bioenergy and various types of engineered wood products, create additional markets for many forest resources that have not been utilized in traditional forest industries. Increased stumpage values and the creation of additional markets for new products provide more incentives for forest management and reforestation.

Potential positive impacts can be obtained through the opportunities of: developing new forest bioenergy facilities, attracting other new forest product manufacturing firms, developing international trade in forest products and carbon offsets through sequestration in forests.

Potential Agency and Organization Roles

- The GFC plans to positively impact forest values by increasing the quantity and per-unit value of forest products delivered to manufacturing facilities in the state. This will be done by attracting new bioenergy and traditional mill development, facilitating certified wood product manufacturing and assisting companies with identifying new international markets.
- GFC will educate and encourage landowners about forest carbon offset projects.
- GFC will work with GFA and other partners to promote incentives and public policy that allow lands to remain in forest cover and provide both environmental and economic benefits for Georgians in the future.

Issue-Specific Priority Areas

The Economics and Changing Markets strategic issue is important for the entire state. However, this issue should be applied with more focus in the Fall Line forests and the Atlantic Coastal Plain.

Appendix

Assessment Process Overview

The *Georgia Statewide Assessment of Forest Resources* was developed under the leadership of the Georgia Forestry Commission (GFC) in accordance with national direction issued jointly by the U.S. Forest Service (USFS) and the National Association of State Foresters (NASF).

The cornerstone of the Assessment is the 2008 Sustainable Forest Management in Georgia report. In 2007, the Georgia General Assembly enacted into law Senate Bill 176. It requires the GFC to submit a report to the General Assembly every five years which summarizes the sustainability of the state's forests. Specifically, the bill requests verification of "the ability of forest resources in this state to meet the needs of the present without compromising the ability to meet the needs of future generations." The report, submitted to the General Assembly on July 1, 2008, highlights the current forest resource conditions, along with the challenges and opportunities being faced by Georgia's forest managers and owners. It concludes that while Georgia's forests are being sustainably managed for the numerous needs of the state today, their future viability will be determined by specific actions of state leaders and the forestry community. Forest issues identified by stakeholders and key partners in the report served as the basis for this Assessment's development.

Public and Partner Involvement

At the beginning of the Assessment process, the GFC conducted a public survey to gather further information relevant to key state issues and the national priorities. The Georgia Forest Stewardship Steering Committee met several times to discuss relevant strategic issues and offer content to the Strategy. The committee has also functioned as a key reviewer of the Assessment and Strategy. Issues were placed in a survey on the GFC website for public comment and ranking. The issues, presented in order of their importance as determined by the public, include: Water Quality, Urban Sprawl, Conservation, Taxes, Biodiversity, Forest Health, Air Quality, Fire Management, Fragmentation/ Parcelization and Changing Markets (Table A1 on following page).

These issues encompass a number of threats which present significant challenges to forest managers, landowners and civic leaders. They are interrelated and often complex. Conservation was a highly ranked public concern that affects and is interwoven with every issue; it is not individually analyzed in this report. Likewise, taxation was included as a contributing factor to the fragmentation and parcelization issue.

GFC contracted with the University of Georgia College of Agriculture and Environmental Sciences to develop geospatial data layers for use in identifying priority forest landscapes. This geospatial data, together with issues identified in the 2008 *Sustainable Forest Management in Georgia* report, laid the foundation for developing the Assessment.

The Georgia Forestry Commission coordinated with the State Forest Stewardship Coordinating Committee, State Technical Committee, Georgia Urban Forest Council, Georgia Statewide Water Management Plan Interagency Coordinating Committee, Invasive Species Task Force, U.S. Forest Service and The University of Georgia Warnell School of Forestry and Natural Resources to develop the Assessment

Public Stakeholder Survey Results 144 Respondents													
Issue	Rankings	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	Total	
	Weight	10	9	8	7	6	5	4	3	2	1		
Urban Sprawl	# Votes	41	28	7	6	11	5	4	9	16	17	144	
	Subtotal	410	252	56	42	66	25	16	27	32	17	943	2nd
Parcelization	# Votes	11	13	11	11	23	11	14	13	16	21	144	
	Subtotal	110	117	88	77	138	55	56	39	32	21	733	9th
Taxes	# votes	35	11	18	8	14	8	12	8	15	15	144	
	Subtotal	350	99	144	56	84	40	48	24	30	15	890	4th
Economics	# Votes	13	16	11	13	11	9	17	13	16	25	144	
	Subtotal	130	144	88	91	66	45	68	39	32	25	728	10th
Water	# Votes	32	12	17	23	18	10	15	8	5	4	144	
	Subtotal	320	108	136	161	128	50	60	24	10	4	1001	1st
Air	# Votes	12	15	13	7	19	21	11	17	17	12	144	
	Subtotal	120	135	104	49	144	105	44	51	34	12	798	7th
Biodiversity	# Votes	15	10	17	21	16	13	12	19	9	12	144	
	Subtotal	150	90	136	147	96	65	48	57	18	12	819	5th
Fire Management	# Votes	13	17	12	11	12	15	15	20	14	15	144	
	Subtotal	130	153	96	77	72	75	60	60	48	15	786	8th
Forest Health	# Votes	21	16	14	6	14	15	14	19	14	11	144	
	Subtotal	210	144	112	42	84	75	56	57	28	11	819	5th
Conservation	# Votes	28	20	19	12	12	12	14	5	3	19	144	
	Subtotal	280	180	152	84	72	60	56	15	6	19	924	3rd

Table A1

and identify opportunities for program coordination and integration. The participation of these and other key partners from natural resource and related entities ensures that Georgia's Assessment and Strategy integrates, builds upon and complements other natural resource plans.

Primary Data Sources

Dr. Elizabeth Kramer of the University of Georgia College of Agriculture and Environmental Sciences developed the geospatial data layers for use in priority resource area identification. The following is Dr. Kramer's report on the data sources, methods and results of the priority area identification process.

Introduction

Land use change due to urbanization and changes in land ownership patterns have impacted not just the types of forest land in Georgia but also the spatial orientation of forest lands. As part of the resource assessment and the priority area identification, changes to the spatial distribution of forest patches throughout the state of Georgia were evaluated. Globally, forest fragmentation has been identified as a key measure of environmental quality and representative of providing critical ecosystem services. These services include protection of water quality and quantity, air quality protection, biodiversity protection and carbon sequestration.

Over time, many different metrics have been developed to assess the spatial distribution of forests extent and intactness of forest areas. Numerous reviews and tools are available to assess patch level metrics; these tools include measures of internal and external fragmentation, changes in patch areas and numbers as well as changes in shape such as perimeter measures (Vogt et al. 2007). There are limits to the use of these tools when working in areas with large numbers of small patches. Newer techniques allow for large area pixel-level mapping to identify patches and landscape morphology (Vogt et al. 2007 and Soille 2003). These techniques use methods in morphological image processing to map edge types and produce metrics of patch dynamics. By comparing changes in forest patches, over time areas that still have large contiguous forest available to provide abundant amounts of key ecosystem services can be prioritized.

Methods

Land Cover Data

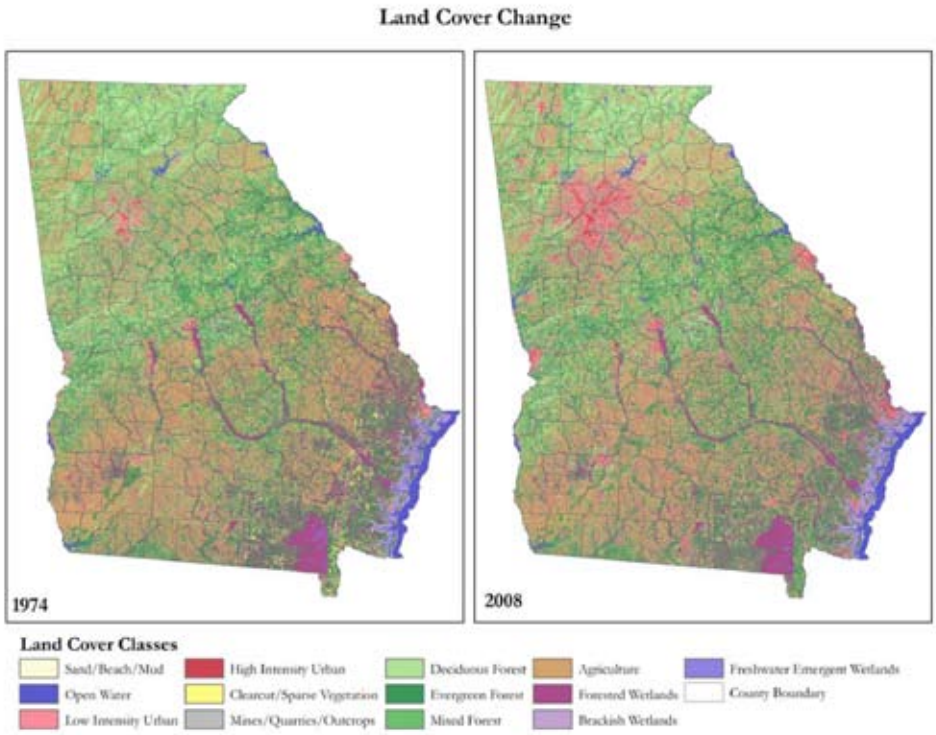
Data from the Georgia Land Use Trends Program (GLUT) was used for the analysis. GLUT is a series of land cover maps produced from Landsat satellite images. The earlier maps 1974 and 1985 were derived from Landsat MSS data the rest of the maps (1991, 1998, 2001, 2005 and 2008) were derived from higher resolution Landsat TM images. The GLUT program tracks 13 land cover classes over time: 1) mud/sand/beaches; 2) open water; 3) Low Intensity Urban; 4) High Intensity Urban; 5) Clearcut/Sparse Vegetation; 6) Mines/Quarries/Outcrops; 7) Deciduous Forest; 8) Evergreen Forest; 9) Mixed Forest; 10) Agriculture; 11) Forested Wetlands; 12) Brackish Wetlands/Marshes; and 13) Freshwater Emergent Wetlands. All classes are reported at a 60 meter pixel resolution. For this analysis, the forest fragmentation results for the 2008 land cover map product was the focus.

Figure A1 shows the land cover maps from 1974 to 2008. These basemaps were used to generate forest fragmentation patterns.

The Landscape Fragmentation Tool (LFT), developed by the Center for Land Use Education and Research (CLEAR) at the University of Connecticut, was used to analyze forest fragmentation in Georgia (http://clear.uconn.edu/projects/landscape/forestfrag/index.htm). The GLUT land cover is reclassified into three classes: forest, non-forest and water. For this study, an edge-width of 100 meters was used. The edge width distance is defined as the width over which non-forest land covers can degrade the function of forest land cover. This edge-width helps to define the output of forest types core, perforated, edge and patch (described below).

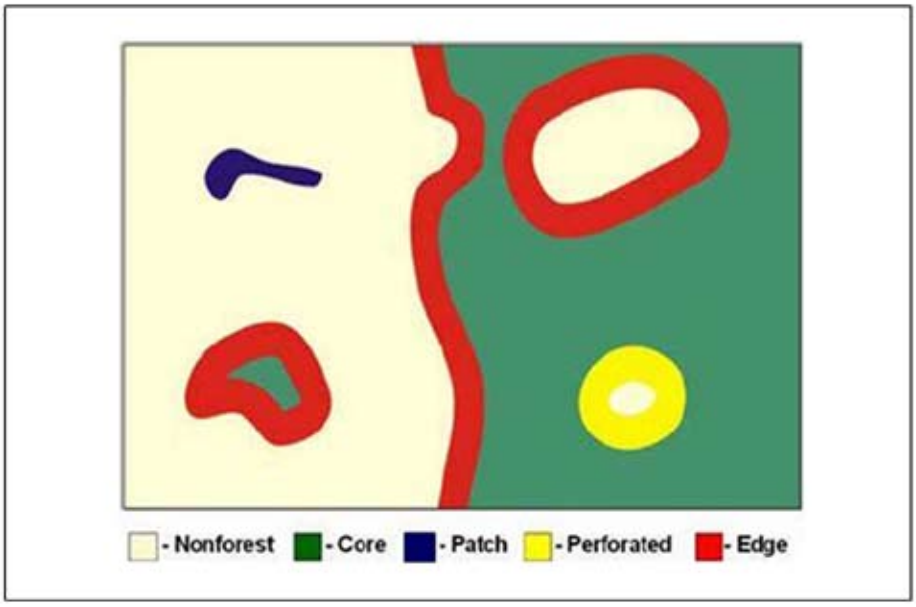
Four classes of forest are identified in terms of the type of fragmentation present (Figure A2):

- Core – interior forest pixels that are not degraded from "edge effects."
- Perforated – forest along the inside edge of a small forest perforation.
- Edge – forest along the outside edge of a forest patch.
- Patch – small fragments of forest that are entirely degraded by "edge effects."



Source: Natural Resources Spatial Analysis Laboratory (NARSAL), University of Georgia, Athens, GA (Unpublished data)

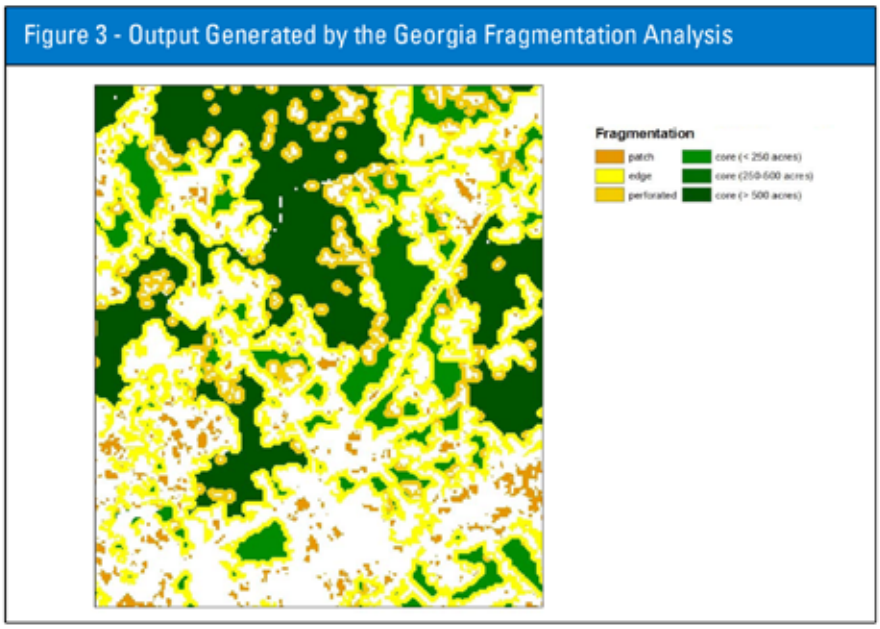
Figure A1



Land Cover maps from the Georgia Land Use Trends Program. These maps were used as the basis for identify forest priority areas.

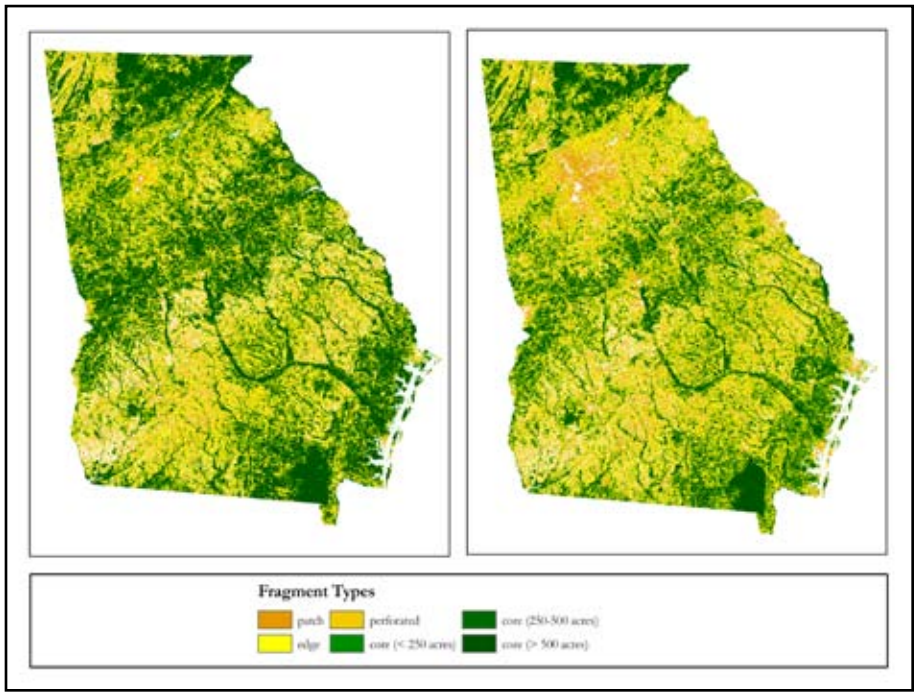
Figure A2

Figure A3 shows an example of output from the fragmentation analysis. Figure A4 shows results of the analysis for land cover data from 1974 and 2008. All forest patches are shown in the output. Smaller brown patches are isolated from larger, continuous forest areas. Patches that make up areas greater than 250 acres account for the core forest areas, which are represented in green. These core areas are large enough to be managed for critical ecosystem services. The smaller patches can still be managed for forest activities, but have a higher probability of being impacted by the land use activities surrounding them. Thus, as compared to land cover (forest cover), the ability of forests to perform ecosystem services was measured. Forest cover in Georgia can be maintained, but fragmentation, changes to patch sizes and exposure to edges and non-forest activities such as development will influence how well these patches can provide critical services.



Zoom-in from output generated by the Georgia fragmentation analysis.

Figure A3



Example of what the analysis output represents. Patch forests are those that have beyond 100m and isolated from other forest areas (graphic from Parent and Hurd, 2007, CLEAR website)

Figure A4

Results

Tables A2 and A3 show the changes in forest patch types from year to year. Table A2 represents percent of each patch type that makes up the total forest cover for each year. Table A3 shows the area for each patch type and the associated changes of forest cover in hectares by year. The largest core patch areas show the greatest loss from 1974 to 2008. Some of this loss is accounted for in the increase in developed area across the state, but the biggest reduction in large core areas is in fragmentation due to the changes in land ownership.

Percent of Total Forest for each category of Forest Fragment

Patch Type/Year	1974	1984	1991	1998	2001	2005	2008
Patch	3.1	3.9	5.3	4.6	6	6	4.6
Edge	25.1	25.8	29.3	28.5	33	33.2	30.2
Perforated	10.7	15	18.8	17.1	12.4	12.8	15.6
Core (<250 ac)	5	5.6	9.8	9.4	11.9	12.1	11.2
Core (250 - 500 ac)	1.8	2.1	4.2	4.3	6.1	6	5.8
Core (>500 ac)	54.4	47.7	32.7	36.1	30.6	29.9	32.6

Table A2

Area Calculations for Each Forest Patch Type by Year in Hectares

Patch Type/Year	1974	1984	1991	1998	2001	2005	2008
Patch	303,382	375,395	488,839	439,715	542,254	525,620	423,223
Edge	2,449,703	2,466,886	2,708,876	2,702,797	2,958,621	2,908,445	2,808,893
Perforated	1,044,019	1,431,043	1,736,004	1,622,216	1,111,501	1,124,170	1,444,865
Core (<250 ac)	485,052	536,150	903,314	894,462	1,070,844	1,061,836	1,043,223
Core (250 - 500 ac)	178,647	197,388	387,483	405,002	543,272	523,778	543,238
Core (>500 ac)	5,312,877	4,560,511	3,029,118	3,423,220	2,741,252	2,624,371	3,024,918
Total Forest	9,775,655	9,569,358	9,255,624	9,489,410	8,969,745	8,770,225	9,290,368

Table A3

Much of the loss of large patches can be accounted for by the increase in area of smaller core patches and increases in edge, patch and perforated patches. Figures A5, A6 and A7 represent the changes in forest patches over time as calculated from the GLUT land cover maps.

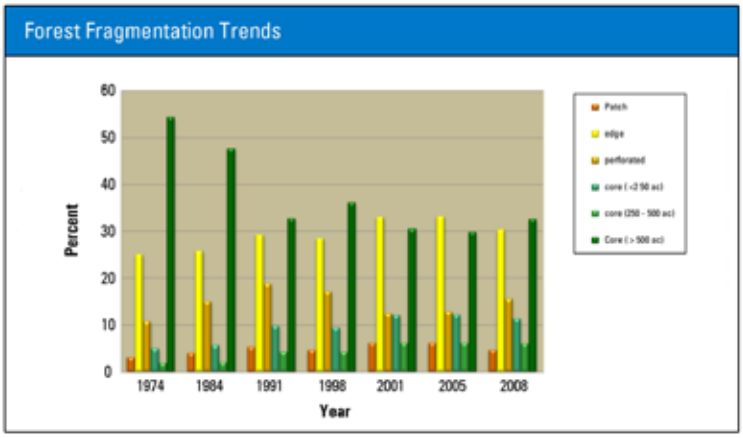


Figure A5

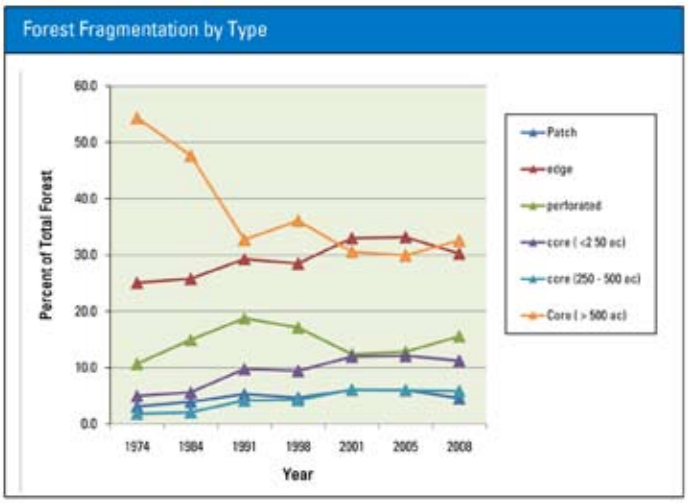


Figure A6

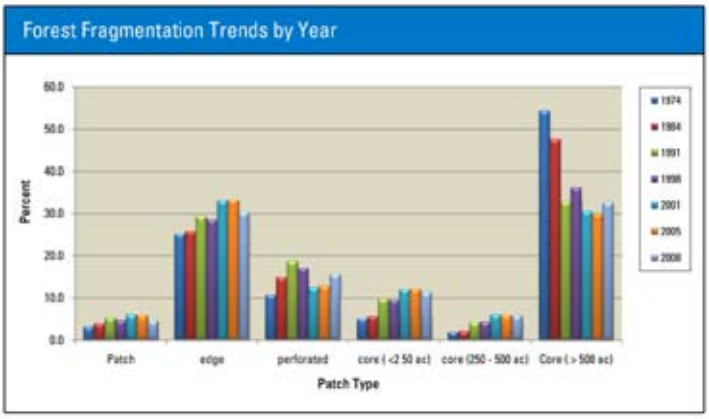


Figure A7

Integration of Other Plans and Assessments

Wildlife

Probably the greatest tool available for guiding efforts to sustain overall forest wildlife in Georgia is the "State Wildlife Action Plan" (SWAP). This document, entitled *A Comprehensive Wildlife Conservation Strategy for Georgia*, was completed by the Wildlife Resources Division of DNR in 2005 with the help of many private and public stakeholders.

The SWAP focuses on those species and habitats believed to be most in need of conservation attention because of population declines and continuing threats. It lists 296 high priority animal species and 323 plants, along with a number of forest and non-forest habitat types.

It addresses the extent and condition of essential habitat types, as well as habitat problems and conservation opportunities. It also addresses research, surveys, monitoring and habitat restoration needs, and provides an evaluation of existing conservation policies and programs. In addition, the SWAP outlines partnership opportunities and prioritizes the implementation of specific conservation actions.

Of a list of 25 "problem categories" for high priority species and habitats, developed within the strategy and used in an overall assessment, four have direct ties to forest management activities: altered fire regimes, conversion of natural forests to agricultural and silvicultural uses, forestry practices not meeting the standards of Best Management Practices and invasive/alien species. There are opportunities to address these problems and enhance sustainability.

Strategies from the State Wildlife Action Plan were incorporated into the *Georgia Statewide Assessment of Forest Resources*.

Water

The Georgia Comprehensive Statewide Water Management Plan of January, 2008, prepared by the Georgia Environmental Protection Division (Georgia DNR 2008) in cooperation with recommendations from the Water Council, stated that of all its natural resources, none is more important to the future of Georgia than water. Meeting future water challenges will require a more proactive and comprehensive approach. The plan can be viewed: http://www.georgiawaterplanning.org/pages/more_information/state_water_plan.php.

During the development of the *Georgia Statewide Assessment of Forest Resources*, the Water Management Plan was used to identify public water supply watersheds and impaired streams on which to focus monitoring efforts.

The Georgia Comprehensive Statewide Water Management Plan was developed with input provided by basin advisory committees, a statewide advisory committee and technical advisory committees. Potential water policies and management practices relating to regional concerns were discussed at numerous town hall meetings held across the state. Hundreds of individuals representing agriculture, forestry and business interests, local governments, water authorities, nonprofit agencies, trade associations and others provided input. It was recognized that water resources and water needs vary widely by region, and future growth and development will occur differently in each region. What emerged was a blueprint that, when executed, will guide future decisions about water management across the state. It provides a flexible framework for regional water planning and allows for these regional differences while also providing statewide policies and management practices to support regional planning. The plan hinges on regional forecasts of future needs and will identify the management practices to be implemented, following state policy and guidance, to ensure that the anticipated demands can be met. When developed and approved, the state must partner with the various users in the region to implement the plans. This plan will guide the stewardship of Georgia's precious water resources to ensure that they continue to support growth and prosperity statewide while maintaining healthy natural systems. The plan addresses the following elements:

- An integrated water policy
- Water quantity and water quality policies
- A water resource assessment
- Establishing water quantity and water quality management practices
- Water demand and water return management practices
- A water supply management policy
- Enhanced water quality standards and monitoring practices
- Enhanced pollution management practices
- Regional water planning

Going forward, GFC will provide forestry information to the Regional Councils to guide future water quality and quantity policy issues.

Forest Stewardship

Georgia's Forest Stewardship Plan was an important resource used by the State Forest Stewardship Coordinating Committee during the development of the Statewide Assessment of Forest Resources. The committee coordinates the Forest Stewardship Program and provides advice and recommendations to the State Forester concerning implementation of the Forest Legacy Program. The assistance and recommendations provided by the group during the development of the Assessment ensured a product focused on the interrelatedness of the multiple benefits and needs of Georgia's forests.

Fire Management

The *Prescribed Fire In Georgia: A Strategic Plan 2008-2020*, was developed in 2008 by 40 professionals from Georgia and Florida with over 500 years of combined experience. The three-day "Fire Summit" at the Tall Timbers Research Station and Land Conservancy produced a strategic plan with goals and objectives that reflect the highest priorities based on the current and projected status for prescribed burning. Goals and objectives from this plan were incorporated into the *Georgia Statewide Assessment of Forest Resources*. To view the document, visit http://www.gatrees.org/ForestFire/documents/PrescribedFireinGAStrategicPlan2008-20.pdf.

The Southern Wildfire Risk Assessment was used to identify the potential for serious wildfires within Georgia and to provide information that will help prioritize areas where mitigation options may be desirable. The models utilized ensure that the assessment results are consistent, comparable and repeatable using the Southern Fire Risk Assessment System (SFRAS) software application.

The published results utilize data layers including maps of forest fuels, historical wildfire occurrence, values at risk from wildfires and communities at risk to develop the two main product outputs. These are wildfire susceptibility index (WFSI) and levels of concern (LOC) for damage from wildfires. The WFSI integrates the probability of an acre igniting and the expected final fire size based on the rate of spread in four weather percentile categories into a single measure of wildland fire susceptibility. The WFSI is used for determining the probability of an acre burning. This index is used to identify areas that have the highest probability of a fire ignition during periods of high fire danger. WFSI and Fire Effects Index were used to calculate the LOC. With this measure, level of risk at any location across the state can be identified. These SWRA products are the primary tools used in assigning priority to GFC Fire Management programs including CWPPs, fire prevention and mitigation efforts.

Forest Health

The Georgia Department of Natural Resources headed an effort in 2008 and 2009 to bring many stakeholders together to formulate The Georgia Invasive Species Strategy. The Committee identified needs and existing efforts for response to or detection of invasive species problems within the state. As part of this process, the committee identified 51 invasive or potentially invasive plant species, 107 animal species and 30 disease-causing organisms. Based on this information, the committee set goals and objectives and proposed strategies for action. The goal of this effort is to prevent and control the introduction of invasive species into Georgia and minimize the further spread and impacts of existing invasive species populations on native species, environmental quality, human health and the economy. The Strategy endeavors to do this through eight objectives:

1. Coordinate local, state, regional, federal and international activities and programs pertaining to invasive species in Georgia.
2. Control and manage the introduction and spread of invasive species in Georgia through education and outreach.
3. Prevent the establishment of invasive species populations in Georgia through early detection and rapid response programs.
4. Control or eradicate established invasive species in Georgia through cooperative management activities designed to minimize impacts to non-target species.
5. Monitor the distribution and impacts of invasive species in Georgia to determine management priorities.
6. Identify and implement needed research on impacts and control of invasive species in Georgia.
7. Prevent the introduction and spread of invasive species in Georgia through legislative and regulatory efforts.
8. Secure adequate long-term funding for invasive species programs in Georgia.

There are 40 actions in the Strategy to address these objectives. Some of the first actions are anticipated to be the development of new educational materials relating to invasive species, funding of a statewide invasive species coordinator and development of a rapid response plan to control or eradicate priority invasive species populations and coordinate responses with full partner participation.

The purpose of the Georgia Invasive Species Strategy is to coordinate support for all state invasive species efforts through collaboration and full communication among agencies and organizations. Not only does such a planning effort improve the effectiveness of field actions, it can also increase funding opportunities for the proposed actions. Cooperation among the committee members (drawn from 15 state entities, seven federal agencies and nine non-governmental organizations) was central to the development of the strategy, and will be critical to its execution. The document is available at: http://www.georgiawildlife.com/sites/default/files/uploads/legacy_assets/Documents/GeorgiaInvasiveSpeciesStrategy.pdf.

Breakdown of Agencies/Authorities for the Georgia Invasive Species Task Force

Agency	Jurisdictional Authority
1. Georgia Department of Agriculture	Agricultural Pests
2. Georgia Department of Natural Resources	Aquatic Pests
3. Georgia Forestry Commission	Forest Pests
4. The University of Georgia	Education, Outreach and Research

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912-287-4915
Counties: Atkinson, Bacon, Berrien, Brantley, Camden, Charlton, Clinch, Coffee, Echols, Glynn, Lanier, Lowndes, Pierce, Ware and Wayne

District 9 - Camilla
3561 Hwy 112
Camilla, GA 31730
229-522-3580
Counties: Baker, Brooks, Calhoun, Clay, Colquitt, Cook, Decatur, Early, Grady, Miller, Mitchell, Seminole, Thomas, Tift, Turner and Worth

District 10 - Statesboro
18899 US Hwy 301 North
Statesboro, GA 30461
912-681-0490
Counties: North Bryan, South Bryan, Bulloch, Candler, Chatham, Effingham, Emanuel, Evans, Jenkins, Liberty, Long, McIntosh, Screven and Tattnall