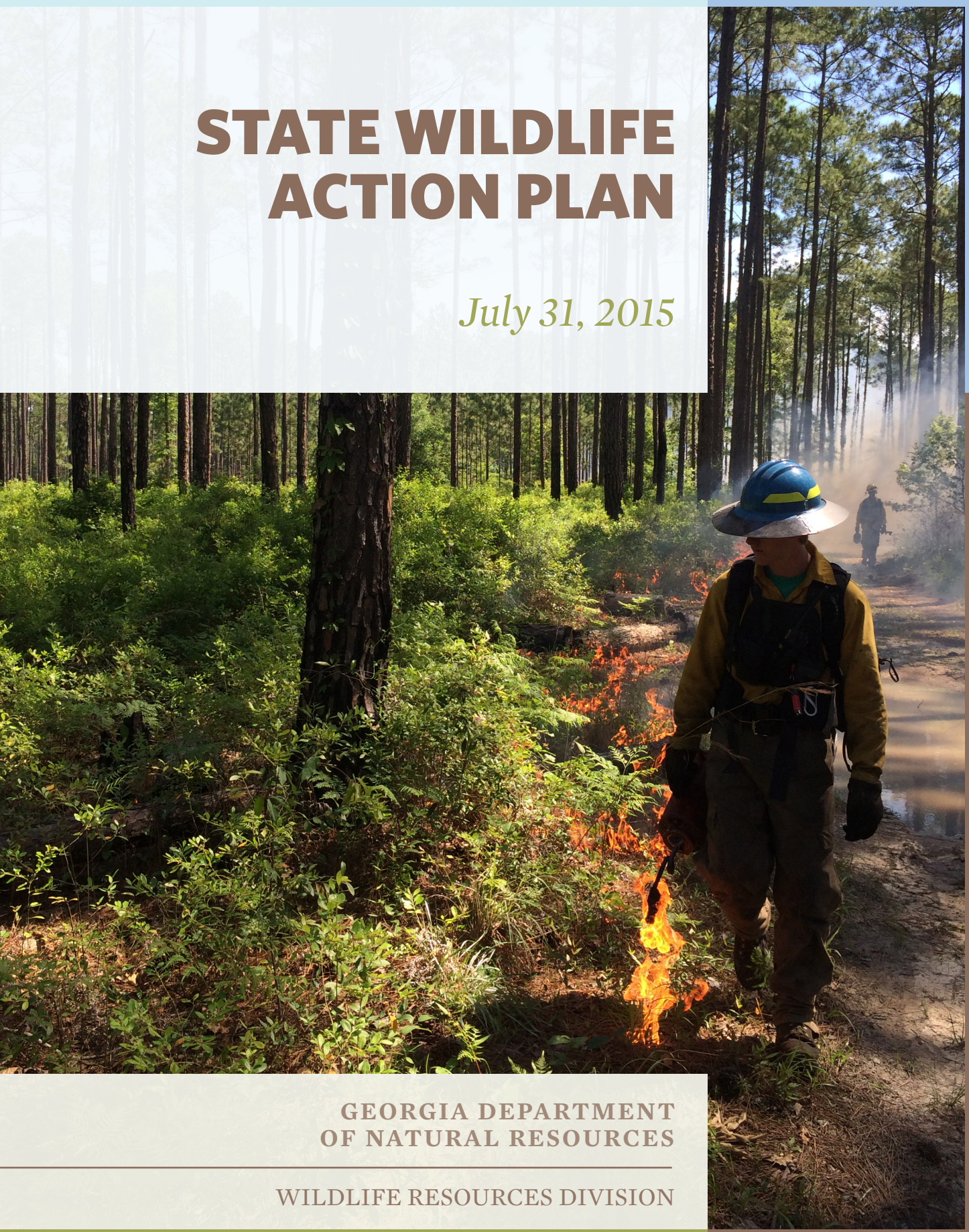
STATE WILDLIFE ACTION PLAN

July 31, 2015



GEORGIA DEPARTMENT
OF NATURAL RESOURCES

WILDLIFE RESOURCES DIVISION

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Executive Summary

In 2013 the Wildlife Resources Division (WRD) of the Georgia Department of Natural Resources (DNR) began a process to revise the Comprehensive Wildlife Conservation Strategy developed in 2005. Support for this revision effort came from a federal grant to WRD through the State Wildlife Grants program; matching funds were provided through Georgia's Nongame Wildlife Conservation Fund. The goal of the Comprehensive Wildlife Conservation Strategy, now known as the State Wildlife Action Plan (SWAP), is to conserve Georgia's animals, plants, and natural habitats through proactive measures emphasizing voluntary and incentive-based programs on private lands, habitat restoration and management by public agencies and private conservation organizations, rare species survey and recovery efforts, and environmental education and public outreach activities.

The best available wildlife data were used to review and revise the SWAP. The review process included an assessment of habitats required by these species, as well as problems affecting these habitats. This process included an evaluation of research and survey needs, habitat restoration needs, and monitoring needs. It also included an assessment of existing programs and policies for wildlife conservation in Georgia and recommendations for improvements in these areas. Coordination with other organizations that manage land or administer conservation programs in Georgia was a key component of this effort.

The SWAP revision process involved staff within DNR, representatives of private and public conservation organizations and land managers and owners in Georgia. An advisory committee composed of representatives of various agencies, organizations, and land management groups provided project oversight. Technical teams addressed specific components of the revised SWAP; these teams included DNR staff and representatives of other agencies and organizations. Input from the advisory committee, stakeholders, representatives of other conservation organizations, consulting biologists, academic researchers, and the public was used in the revision process. Educational materials were developed to inform the public about the project's goals and milestones. These materials were posted on the DNR website and distributed to the public.

Components of this review and revision included the following: 1) updating databases on rare species and natural communities; 2) reassessing high priority species and habitats; 3) identifying high priority research, survey, and monitoring needs; 4) conducting surveys for rare species on public and private lands; 5) updating databases of conservation lands and high priority watersheds and landscapes; 6) identifying conservation, education, and habitat protection needs for priority species and habitats; 7) collaborating with state and federal agencies on state and regional conservation plans; 8) consulting with private conservation organizations, corporate land managers, and other groups on local conservation plans; 9) reviewing existing laws, rules, and policies for wildlife conservation; and 10) communicating with stakeholder groups and the general public.

Four technical teams focused on biodiversity database development and use, ecosystem/habitat mapping, education, and outreach and communications, respectively. The database enhancements team reviewed current sources and uses of biological

diversity data. This team developed specific recommendations for exchange and application of biodiversity information, including improved Web-based access to rare species/natural community information and methods for more efficient incorporation of field data on the status of species and natural communities. The ecosystem/habitat mapping team reviewed existing GIS datasets and mapping efforts in the state and region and developed recommendations for future mapping and assessment projects to support wildlife conservation. The environmental education team developed recommendations for improvements in wildlife-related education programs in Georgia. The outreach and communications team reviewed the findings of the education team and other technical teams and outlined methods for improving outreach to the general public as well as in-reach to members of the conservation community.

Six technical teams focused on the following groups of species: birds, amphibians and reptiles, mammals, fishes and aquatic invertebrates, terrestrial invertebrates, and plants. Although conservation efforts for plants could not be addressed under this grant, a parallel conservation planning process was undertaken, funded in part through a federal grant to the Wildlife Resources Division, with matching funds provided from the Nongame Wildlife Conservation Fund. These technical teams consulted numerous data sources and used a variety of criteria to revise the lists of high priority species for Georgia; this group of species includes critically imperiled species, habitat indicator species known to be in decline, species endemic to Georgia, and rare or uncommon species in need of further research to determine conservation objectives.

The habitat restoration technical team reviewed the efforts of DNR and other agencies and organizations involved in habitat management and restoration over the past decade. This team documented the progress made by these conservation partners and outlined goals for future habitat restoration management efforts. These recommendations included expansion of prescribed fire programs, management of invasive species, and restoration of natural communities on public and private lands. The monitoring technical team assessed needs for monitoring programs to support habitat and species conservation and developed recommendations for implementing or expanding monitoring programs and coordinating these programs among conservation organizations.

The climate change adaptation technical team reviewed current data sources and research efforts related to climate change impacts on species and habitats in Georgia and the Southeast. This group outlined key concepts to consider in undertaking conservation efforts for high priority species and habitats in a changing landscape and identified information needs and survey and monitoring efforts that can help inform these efforts in the years to come.

Results of the various biological and ecological assessments undertaken in this planning effort are presented in this document. Many of the details of these analyses can be found in the appendices that follow the main report. Ranges of distribution, habitat associations, conservation needs, and research priorities for high priority animals and plants are described in this report and in the appendices. Similarly, high priority habitats are defined for each ecoregion and management needs for these habitats are discussed.

In this document, conservation goals are defined broadly, while discussions of strategies and partnerships more specifically address the objectives that must be met to achieve these goals. Conservation goals, strategies and partnerships are identified for each of the five ecological regions of the state in Section IV of this report. In addition, statewide wildlife conservation themes and strategies are addressed in Section V. Lists of specific high priority conservation actions were also developed. These conservation actions were first identified by the technical teams, advisory committee, and other stakeholders and included specific programs for improvements in habitat protection, conservation of high priority habitats and species, research and surveys, and environmental education and public outreach. These identified conservation actions were then evaluated using a set of seven ranking criteria. The complete set of prioritized conservation actions can be found in the Conservation Actions table in Section VI of this report. Summaries of existing programs and resources for habitat protection and recommendations to increase capacity for wildlife conservation in Georgia are provided in Section V of this document. The following goals represent important conservation themes in this document:

- Maintain viable populations of all high-priority species and functional examples of all high priority habitats through voluntary land protection and incentive-based habitat management programs on private lands and habitat protection and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Facilitate restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic enhancements, and vegetation restoration.
- Conduct statewide assessments of rare natural communities and habitats that support species of conservation concern and complete a statewide habitat mapping effort to inform future land conservation efforts.
- Improve efforts to protect vulnerable and ecologically important habitats such as isolated wetlands, headwater streams, and caves.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, and working cooperatively on early detection and rapid response protocols.
- Minimize impacts from development and other activities on high-priority species and habitats by improving environmental review procedures and facilitating training for and compliance with best management practices.
- Update the state protected species list and work with conservation partners to improve management of these species and their habitats.
- Conduct targeted field inventories of neglected taxonomic groups, including invertebrates and nonvascular plants.
- Continue efforts to recover federally listed species through implementation of recovery plans, and restore populations of other high priority species.
- Work with other states and with the U.S. Fish & Wildlife Service to assess species proposed for federal listing and engage in proactive programs to conserve these species so as to preclude the need for federal listing.

- Establish a consistent source of state funding for land protection to support wildlife conservation, and increase availability and use of federal funds for land acquisition and management.
- Continue efforts to monitor land use changes statewide and in each ecoregion, and use predictive models to assess impacts to high priority species and habitats.
- Monitor high priority species and habitats as well as the results of conservation actions and share monitoring results to inform adaptive management programs.

Monitoring needs for species, habitats, and conservation programs are addressed in Appendix J as well as in the Conservation Actions table in Section VI. Monitoring programs are acknowledged as critical components of adaptive management efforts in wildlife conservation, and specific recommendations are provided to improve existing monitoring programs. In addition, partnerships with other organizations involved in monitoring efforts are recommended. The approach taken in this planning effort was to identify the types of data to be collected and relevant performance indicators for every high priority conservation action as a first step to development of monitoring programs.

Several projects undertaken as components of this planning effort represent efforts to develop new analytical tools and methods that can inform future conservation plans at various geographic scales. The fishes and aquatic invertebrates technical team completed a GIS-informed analysis of priority watersheds based on mapped occurrences of high priority species. Highest priority watersheds were identified based on the potential contribution of conservation efforts to populations of rare or declining species. This approach will serve as a model for assessments of other priority conservation areas in the future. This technical team also conducted a statewide assessment of watershed condition based on land use, existing impacts, and other factors. This report can be found in Appendix F.

One of the results of discussions in the database enhancements team was the development of a new online mapping tool that provides information on the distribution of species of conservation concern in Georgia using a variety of alternative mapping units, including counties, watersheds, ecoregions, hexagons, and quarter-quads (1/4 of a 1:24000 topographic map). This online mapping tool is based on current information in the Biotics database managed by WRD and will be expanded and updated as new information is incorporated into the database. The mapping units are color-coded to indicate the range of dates of the occurrence data. The goal of this project is to depict the current known range areas of these high priority species as well as areas of historic occurrence where surveys may be needed to confirm their continued existence.

One of the goals articulated in the 2005 SWAP was the development of a new natural community classification system that will serve as a standard for habitat mapping on conservation lands. A three-year mapping effort focused on the 11-county coastal region of Georgia served as the pilot effort for this mapping approach. The new classification system is based on ecological systems and vegetation alliances described by NatureServe and the Natural Heritage Network. One of the highest priority goals identified in this SWAP revision is the expansion of this mapping approach statewide to provide a detailed

map of ecological systems that will inform conservation efforts at a variety of scales. WRD staff also collaborated with a group of volunteers working on a detailed guide to Georgia's natural communities. This document, which was published by The University of Georgia Press in 2013 as "The Natural Communities of Georgia", was based on the NatureServe ecosystem classification and written for a broad audience including teachers, science students, and practicing biologists. We hope that this document will facilitate surveys of natural communities across the state and increase public awareness of Georgia's ecological and biological diversity.

This revised SWAP reflects an assessment of wildlife conservation needs and programs to address those needs based on data available in 2013-2015. Our understanding of the conservation needs of Georgia's species and habitats is likely to change based on the result of additional surveys, results of monitoring efforts associated with management efforts, or new trends in land uses. In addition, the development of new analytical techniques, funding programs, or legislative mandates may result in a need to reassess some of the conservation priorities described in this document.

The intent of the Wildlife Resources Division is to begin a formal process of reviewing the current wildlife conservation strategy within the next ten years and to adopt revisions to the strategy as deemed necessary based on this review. In order to do this, we propose to reconvene the technical teams and advisory committee and hold meetings to assess and address changing conservation needs for species and habitats in Georgia. The proposed procedure for this review is outlined in Section VII of this document.

The changes that are occurring in the Georgia landscape as a result of population growth and increasing development pressures present daunting challenges to those involved in wildlife conservation. The trend of increasing fragmentation and degradation of natural habitats is likely to continue in the coming decades, driven by local, national, and global economic and demographic factors. In addition, changing climatic conditions, emerging wildlife diseases, and introductions of invasive species will exacerbate problems affecting the viability of native species.

The following elements are critical for conservation of Georgia's natural heritage: (1) increased emphasis on field research focused on the identification and assessment of species, biotic communities, and ecosystems; (2) greater commitment of resources to identify and protect those habitats that contribute most significantly to biodiversity; (3) further development and funding of conservation programs that emphasize public-private partnerships for broad-scale conservation of "working landscapes"; (4) greater emphasis on land use planning to minimize impacts of future developments on natural habitats; and (5) increased collaboration between researchers and educators to heighten public awareness of the magnitude and significance of biodiversity decline in the state. The Department of Natural Resources will continue to work with a wide array of public agencies, private conservation organizations, research institutions, sportsmen's groups, educators, local governments, and landowners in the coming years to address these critical elements of wildlife conservation.

I. Introduction and Purpose

A Plan to Protect Georgia's Biological Diversity

This document represents the latest iteration of a conservation planning effort that began officially in December of 2002, but which builds upon many years of research and data accumulation by staff of the Georgia Department of Natural Resources (DNR) and other organizations. In 2000 the Wildlife Resources Division, Nongame Wildlife & Natural Heritage Section produced a document entitled "Georgia's Wildlife Diversity: An Overview". This unpublished technical report provided a summary of the biological diversity of the state and described some of the problems affecting this biological diversity within each physiographic province. It also gave examples of important habitats and landscape features, provided summaries of laws and regulations pertaining to wildlife in Georgia, and described some of the essential components of wildlife conservation (e.g., monitoring, habitat management, and land protection). Information from this report, as well as data from more recent analyses of wildlife diversity patterns and threats by DNR and other cooperating agencies and organizations, was later incorporated into "A Comprehensive Wildlife Conservation Strategy for Georgia", which is now known as Georgia's State Wildlife Action Plan (SWAP).

Funding for the current revision of Georgia's SWAP came from the State Wildlife Grants Program administered by the U.S. Fish & Wildlife Service; matching nonfederal funds came from the Nongame Wildlife Conservation Fund administered by the Wildlife Resources Division (WRD).

The goal of this effort was to develop an updated wildlife conservation strategy based upon the best currently available data on the distribution and abundance of wildlife species in the state, particularly rare and declining species. The strategy assesses the extent and condition of habitats required by these species, as well as existing and potential problems and conservation opportunities for these habitats. Further, this SWAP addresses research and survey needs, habitat restoration needs, and monitoring needs. It also includes an evaluation of existing programs for wildlife conservation in Georgia. Existing and potential partnerships are outlined, and priorities for implementing specific conservation actions are provided.

Coordination with other agencies and organizations that manage land or administer conservation programs in Georgia was a key component of this effort. The planning team included Georgia DNR staff as well as representatives of private and public research, education, and conservation organizations and land managing entities in Georgia. An advisory committee composed of representatives of various agencies, organizations, and land managing groups provided general oversight for the project. Technical teams were formed to address specific components of the conservation strategy; these teams included DNR staff as well as representatives of other agencies and organizations. Input from the advisory committee, technical teams, other stakeholders, and the general public was used in the development of the revised conservation strategy

The goal of the revised SWAP is to provide an informational and strategic framework that will support the conservation of Georgia's biological diversity over the next 5 to 10 years. While this revision builds on the work of previous planning efforts, it attempts to define a set of prioritized conservation strategies that may be applied locally and statewide to achieve the goal of maintaining Georgia's diversity of native species and natural habitats.

The purpose of this document is to outline objectives and partnerships for wildlife conservation in Georgia. It is a broadly focused strategy that indicates areas in which resources should be concentrated and emphasis placed to facilitate the conservation of Georgia's animals, plants, and natural communities. Where data are currently lacking to provide a clear picture of conservation objectives, research priorities to provide needed data are indicated. Where the data are sufficient to provide direction for species and habitat protection, restoration, or management, these recommendations are stated.

This document is not intended to be a conservation blueprint or statewide land use plan. It is not intended as an assessment or critique of land management practices by any segment of society. We acknowledge that nearly every activity by humans on the Georgia landscape has positive or negative impacts on wildlife populations and their habitats. The purpose of developing this strategy is to provide information that may help minimize negative impacts and maximize positive impacts in a changing landscape. Finally, the emphasis of this document is not on development of new regulations, but on more effective implementation of existing regulations and development of new cooperative relationships to protect and maintain habitats for native wildlife species.

Essential Elements of a State Wildlife Action Plan

In enacting the authorizing legislation for the State Wildlife Grants program, Congress provided guidance on the essential elements that comprise a Comprehensive Wildlife Conservation Strategy (State Wildlife Action Plan). These elements are as follows:

(1) Information on the distribution and abundance of species of wildlife, including low and declining populations as the State fish and wildlife agency deems appropriate, that are indicative of the diversity and health of the State's wildlife; and,

(2) Descriptions of locations and relative condition of key habitats and community types essential to conservation of species identified in (1); and,

(3) Descriptions of problems which may adversely affect species identified in (1) or their habitats, and priority research and survey efforts needed to identify factors which may assist in restoration and improved conservation of these species and habitats; and,

(4) Descriptions of conservation actions proposed to conserve the identified species and habitats and priorities for implementing such actions; and,

(5) Proposed plans for monitoring species identified in (1) and their habitats, for monitoring the effectiveness of the conservation actions proposed in (4), and for adapting these conservation actions to respond appropriately to new information or changing conditions; and,

(6) Descriptions of procedures to review the strategy at intervals not to exceed ten years; and,

(7) Plans for coordinating the development, implementation, review, and revision of the plan with Federal, State, and local agencies and Indian tribes that manage significant land and water areas within the State or administer programs that significantly affect the conservation of identified species and habitats; and

(8) Broad public participation in the development and implementation of the conservation strategy.

Species of Greatest Conservation Need

Congress further directed that the strategies must identify and be focused on "species in greatest need of conservation," yet address the "full array of wildlife" and wildlife-related issues. No definition of "species of greatest conservation need" was provided in the authorizing legislation; instead, the task of defining and identifying these species was left to each state wildlife agency working in collaboration with its conservation partners. The purpose of focusing on species of greatest conservation need is to ensure that those most imperiled species are adequately addressed in the conservation strategy.

The directive to emphasize species of greatest conservation need is not meant to imply that these species are of greater intrinsic value than other species. The ultimate goal of a SWAP is to protect and maintain the full complement of species native to a state or region. While many species of wildlife (particularly generalists, species adapted to a wide range of conditions and habitats) are able to maintain viable populations in spite of significant land use changes, other species (particularly those species adapted to a narrow range of habitat conditions) are becoming increasingly imperiled due to loss or degradation of natural habitats, direct mortality from human activities, and other factors. It is intuitively logical that in developing a set of conservation strategies to maintain the whole of Georgia's natural heritage, one should prioritize conservation actions based upon an objective assessment of need.

Species that are globally imperiled and clearly threatened with extinction are an obvious choice for conservation action. However, there are many other species that are experiencing significant population declines in Georgia. The directive to address the "full array of wildlife" requires that the agency consider these species as well, to ensure that the conservation strategy meets the dual objectives of "keeping common species common" as well as preventing or minimizing further extirpations or extinctions of the state's most imperiled species.

The approach taken in this planning effort has been to define species of greatest conservation need based on a number of factors, including global and state rarity rankings, population and habitat trends, range of occurrence, number of protected populations, and importance of Georgia efforts to the global conservation of the species. Some species that are not globally imperiled but are considered indicators of habitat quality over a large area or region were included as well. Finally, rare or uncommon species for which additional research is needed in order to develop specific conservation strategies were included, since one of the required elements of the planning process is identification of high-priority research and survey needs. The term used in this document for this more inclusive group is "high priority species". A discussion of the procedures used in selecting these species can be found in the "Approach and Methods" section.

Scales of Biological Diversity

In general terms, diversity means variety or heterogeneity within some defined group or area. Biological diversity can be expressed at several scales of concern, from subcellular to global. For example, genetic diversity refers to the variety of genes or genotypes within a species, population, or subpopulation. This diversity is often measured or indicated by laboratory research methods such as electrophoresis. Individual populations within a species may exhibit high or low levels of genetic diversity. The amount of genetic diversity within a population is a reflection of various biological and physical environmental factors operating over time on the genetic resources of that population (e.g., spontaneous mutations, interbreeding, isolation, habitat variability). The level of genetic diversity within a population is often reflected in variability in form or function (e.g., body structure, metabolism, blood type, leaf shape, hair color or disease resistance) and may have important implications for the capability of that population to sustain itself through time.

Another type of biological diversity is expressed in terms of the number of species in a given habitat. This has been referred to as "alpha diversity" by some researchers. The simplest type of alpha diversity is known as "species richness", and is based on presence/absence data. Species richness is simply the number of species observed within a given habitat. Other measures of within-habitat diversity are based on formulae that take into account the relative abundance of different species within the habitat. These diversity indices require counts of individuals within species, and are often used for purposes of comparison across habitat types within certain taxonomic groups.

A great deal of ecological research has been devoted to investigation of the patterns of species richness, and development of theories to explain why some habitats support great numbers of species, while other support relatively few. Some of the factors that are important in determining alpha diversity include successional stage of the habitat, structural complexity in the habitat, climatic stability, nutrient availability, degree of isolation from other similar habitats, variability of natural disturbance patterns, competition, predation and parasitism. As with most things in nature, it is difficult to detect the relative importance of these various factors for a given habitat.

A third type of diversity, known as "beta diversity", refers to the amount of biological diversity across habitats within a given region or landscape. Beta diversity is a reflection of the variety of habitats within the landscape, which in turn is indicative of the heterogeneity of topography, soils, climate, geology, disturbance patterns, etc. in the region. Regions with more complex environmental gradients typically have greater beta diversity, even though the alpha diversity values for each habitat may be relatively low.

In this document, we are mostly concerned with beta diversity, that is, the diversity of wildlife species across the entire Georgia landscape. However, reference is made at various points to habitats that are particularly rich in species ("alpha diversity"). It is important to keep in mind that the diversity of life forms represented in a particular habitat depends on many factors. Nevertheless, conservation planners agree that the best approach to maintaining biological diversity over a broad region is maintenance of the full suite of natural communities on which native species depend.

Wildlife Diversity Databases

Our knowledge of species diversity patterns in Georgia and elsewhere is based on a long history of field studies and taxonomic research. Occurrence data for species are derived from a variety of sources, including natural history museums, herbaria, published scientific literature, and reports prepared by field researchers. In each state, natural heritage programs compile and analyze data on species and natural communities to develop a picture of biological diversity. An international network of natural heritage programs known as NatureServe provides a standardized data framework for assessing the global distribution of these species and natural communities.

The Nongame Conservation Section (NCS) of WRD develops and maintains information on animal and plant species and the natural communities they comprise within the state of Georgia. The NCS staff maintains manual and digital files on approximately 750 plant species and 500 animal species, including 318 state-protected species. The section's databases currently include over 11,500 documented occurrences of rare species and significant natural communities in Georgia. The NCS staff also maintains digital landcover databases as well as a GIS database of conservation lands.

Database management programs developed and maintained by NatureServe are used within WRD and throughout the United States by natural heritage programs to manage diversity data and to generate detailed, site-specific information. Significant natural communities and plant and animal species of special concern are termed "elements of biodiversity", and one of the central data features of WRD biodiversity databases is the element occurrence record. These records contain information on occurrences of rare species or natural communities at particular sites, including location, size, and condition of the population or community and date of observation.

Rarity ranks are used to characterize elements and to facilitate conservation planning. These ranks are assigned after reviewing pertinent status information at the state level and globally. Rarity ranks are based on a scale of 1 to 5; the higher the number, the more secure that species is thought to be at the state (or global) level. Therefore, an S1 species

is considered very rare or imperiled in the state, while an S5 species is considered common and secure. A species with a rarity rank of G5 S1 is globally secure but occurs in very small numbers in the state. Thus it is not of global conservation concern, but may be considered a priority for conservation within the state, depending on other factors. This ranking system helps to assure that conservation efforts are directed to those species needing the most help in order to maintain biological diversity in a state or region. More detailed information on global rarity ranks and state rarity ranks can be found at the following website: http://www.natureserve.org/explorer/ranking.htm.

II. Approach and Methods

The guidelines for development and revision of the SWAP stipulate that state wildlife agency will conduct a comprehensive review and revision of the plan at least once within a ten-year period. Thus, while the current strategy is based upon the best available information and analyses, we recognize that it is part of an iterative process that allows adaptation to changing conditions and newly identified conservation needs. The general approach taken in this planning effort was to emphasize activities that would help build an infrastructure to ensure more efficient and effective conservation planning in the future. Emphasis was placed on updating and expanding the biodiversity databases and conservation lands databases maintained by WRD and taking advantage of existing information networks, monitoring programs, and land conservation programs wherever possible. The objective was to build capacity for consistency in conservation efforts and to take advantage of methodologies that would facilitate development of broader-scale (e.g., regional or national) wildlife conservation strategies. Information from assessments completed by DNR, The Nature Conservancy, Partners in Flight, Partners in Amphibian and Reptile Conservation, and other organizations was utilized in the current SWAP revision effort, and an effort was made to share information on approaches and products with neighboring states in the Southeast.

At the same time, some novel analytical approaches and methods were utilized to explore new ways of identifying and addressing conservation priorities for species and habitats in Georgia. Examples include the development of new interactive online maps depicting historic and recent occurrences of species of conservation concern using a variety of mapping units; a GIS-informed statewide prioritization of HUC 10 watersheds based on occurrences of high priority aquatic species and associated assessments of watershed condition and threats; and a draft "Georgia Greenway Opportunities" map based on multiple data layers, including public and private conservation lands, natural and semi-natural vegetation, models of landscape diversity and connectivity, and species-based habitat connectivity models.

Organizational Structure

The primary responsibility for revising the State Wildlife Action Plan was assigned to the Nongame Conservation Section of WRD. Early in the process a SWAP Revision Advisory Committee was established. The purpose of this committee was to provide general guidance and direction for the revision of the conservation strategy. An attempt was made to include representatives from all major conservation agencies and organizations operating within the state, as well as many of the major land-managing entities. The advisory committee met periodically throughout the course of the revision effort and provided feedback to the project staff on the objectives, methods, and products of the planning effort.

Representation on the committee changed during the course of the planning effort due to staff changes in the participating organizations and identification of additional organizations that could facilitate the planning process. Individuals serving as members

of the Steering Committee and other participants in Steering Committee meetings are listed below:

State Wildlife Action Plan Revision Advisory Committee

Joanne Baggs, USDA Forest Service, Chattahoochee-Oconee National Forest
Leah Barnett, Georgia Conservancy
Carolyn Belcher, DNR, Coastal Resources Division
Liz Caldwell, USDA Forest Service, Chattahoochee-Oconee National Forest
Fuller Callaway, Georgia Environmental Finance Authority
Jim Candler, Georgia Power Company
Dr. Ron Carroll, University of Georgia, Odum School of Ecology (retired)
Becky Champion, Georgia DNR, Environmental Protection Division
Kyla Cheynet, Plum Creek Timber Company
Deron Davis, The Nature Conservancy
Shaw Davis, USFWS, Savannah National Wildlife Refuge
Sim Davidson, Georgia DNR, Parks, Recreation, and Historic Sites Division
Glenn Dowling, Georgia River Network
Carrie Fowler, Georgia State Soil & Water Conservation Commission
Laurie Fowler, University of Georgia, River Basin Center
Susan Gibson, US Department of Defense
Dr. Robin Goodloe, USFWS, Ecological Services
Jane Griess, USFWS, Savannah Coastal Refuges Complex
Deborah Harris, USFWS, Ecological Services
Wade Harrison, The Nature Conservancy
David Hedeen, Georgia Department of Transportation
Dr. Don Imm, USFWS, Ecological Services
Betty Jewett, USDA Forest Service, Chattahoochee-Oconee National Forest
Carolyn Johnson, USFWS, Piedmont National Wildlife Refuge
Mike Joyce, USDA Forest Service, Chattahoochee-Oconee National Forest
Jan MacKinnon, Georgia DNR, Coastal Resources Division
Steve McWilliams, Georgia Forestry Association
Hans Neuhauser, Georgia Land Conservation Center
Brian Nichols, Georgia DNR, Parks, Recreation, and Historic Sites Division
Tim Pinion, National Park Service, Southeast Region
Tom Putnam, Langdale Industries
Gina Rogers, Georgia Wildlife Federation
Brandon Rutledge, Joseph W. Jones Ecological Research Center
Jenny Cruse-Sanders, Atlanta Botanical Garden
Andrew Schock, Conservation Fund
Curt Soper, Trust for Public Land
Gary White, Georgia Forestry Commission
Marshall Williams, US Department of Defense

Others attending the advisory committee meetings:

John Bowers, Georgia DNR, Wildlife Resources Division
John Doresky, USFWS, Ecological Services
Brent Dykes, Georgia Soil and Water Conservation Commission
Sara Gottlieb, The Nature Conservancy
Patti Lanford, Georgia DNR, Wildlife Resources Division
Chris Manganiello, Georgia River Network
Jared Teutsch, The Nature Conservancy

Technical teams were formed to address various components of the plan. These technical teams were chaired by WRD staff members and included representation from a wide variety of organizations and agencies. These teams and their leaders are listed below:

State Wildlife Action Plan Revision Technical Team Leaders

Birds: Todd Schneider, Tim Keyes
Mammals: Jim Ozier, Trina Morris
Fishes and Aquatic Invertebrates: Brett Albanese, Jason Wisniewski, Andrew Gascho Landis
Aquatic Habitat: Brett Albanese
Reptiles and Amphibians: John Jensen
Plants: Tom Patrick, Mincy Moffett
Terrestrial Invertebrates: Matt Elliott
Ecological Systems/Habitat Mapping: Jason Lee, Chris Canalos
Habitat Restoration: Shan Cammack, Eamonn Leonard
Monitoring: Lisa Kruse, Jacob Thompson
Database Support and Enhancements: Greg Krakow, Anna Yellin
Outreach and Communications: Rick Lavender
Education: Linda May
Climate Change Adaptation: Jon Ambrose, Mary Pfaffko

Complete lists of technical team members can be found in appendices B through O and in the Acknowledgements section.

Public Involvement

Throughout the planning period the current SWAP was available for review, and the public was notified of the timeline for revision of the document. Questions about the current SWAP and the revision process were answered by email and telephone. The public review draft of the SWAP was posted on the WRD website on June 1, 2015 and was accompanied by news releases. Announcements about the availability of the SWAP were included in the WRD e-newsletter and in other agency publications. In addition, other conservation organizations such as the Georgia Land Conservation Center and Georgia Forestry Association posted notices or articles about the draft SWAP document. Public meetings were held to solicit public input on the draft plan.

The public review period for the draft SWAP was June 1, 2015 through July 15, 2015. All verbal and written comments were recorded and reviewed, and this public input was used to develop the final draft of the SWAP.

Other Presentations and Meetings

During the course of the planning period five meetings of the advisory committee were held. In addition, presentations were given at meetings of public agencies, private conservation groups, civic groups, and academic institutions. Examples include the Georgia Wildlife Federation, Forestry for Wildlife Partnership, University of Georgia River Basin Center. These presentations focused on the goals and objectives of the SWAP revision process and the conservation programs implemented under the original SWAP. In addition, presentations on the SWAP revision were provided to the Georgia DNR Board.

Coordination with Other Agencies and Organizations

Development of the conservation strategy was accomplished through coordination with a variety of public wildlife agencies, private conservation organizations, and corporate land managers operating in Georgia. This coordination was ensured by inclusion of representatives of these agencies and organizations on the advisory committee and technical teams. Below is a list of agencies and organizations that provided input in the revision of the plan. A complete list can be found in the Acknowledgements section.

Federal agencies:
National Park Service
Natural Resources Conservation Service
Tennessee Valley Authority
U.S. Department of Defense
U.S. Geological Survey
U.S. Fish & Wildlife Service
U.S. Forest Service
U.S. Geological Survey

State agencies:
Coastal Resources Division, Georgia DNR
Environmental Protection Division, Georgia DNR
Florida Fish and Wildlife Commission
Georgia Department of Transportation
Georgia Environmental Finance Authority
Georgia Forestry Commission
Georgia Soil & Water Conservation Commission
Law Enforcement Division, Georgia DNR
Parks, Recreation, and Historic Resources Division, Georgia DNR
Wildlife Resources Division, Georgia DNR

Private conservation organizations:
Altamaha Riverkeeper
Animals A-Z
Atlanta Audubon Society
Association of Fish & Wildlife Agencies
Captain Planet Foundation
Conservation Fund
Defenders of Wildlife
Georgia Botanical Society
Georgia Conservancy
Georgia Forestry Association
Georgia Land Conservation Center
Georgia Native Plant Society
Georgia Ornithological Society
Georgia Plant Conservation Alliance
Georgia River Network
Georgia Wildlife Federation
Habitat for Bats
Land Trust for the Little Tennessee
Little St. Simons Island
National Wildlife Federation
NatureServe
North American Land Trust
St. Catherines Island Foundation
The Nature Conservancy

Corporate landowners:
Georgia Power Company
International Paper
Langdale Industries
Plum Creek Timber Company

Environmental consultants:
CCR Environmental
Conservation Fisheries, Inc.
Dinkins Biological Consulting
Eco-Tech Consultants
Ecological Solutions, Inc.
Golder Associates, Inc.

Academic / research institutions:
Abraham Baldwin Agricultural College
Alabama Aquatic Biodiversity Center
Alabama Natural Heritage Program
Appalachian State University
Atlanta Botanical Garden

Auburn University
Avian Research and Conservation Institute
Berry College
Clayton State University
Clemson University
Columbus State University
Cumberland Island Museum
Dalton State College
Florida State University
Georgia College and State University
Georgia Highlands College
Georgia Sea Turtle Center
Columbus State University
Georgia College & State University
Georgia Southern University
Georgia Southwestern University
Georgia State University
Gordon State College
Joseph W. Jones Ecological Research Center
Kennesaw State University
LaGrange College
Lanier Museum of Natural History
Mississippi State University
New York Botanical Garden
North Alabama University
North Georgia College
North Carolina Natural Heritage Program
Piedmont College
Reinhardt College
Roanoke College
Savannah-Ogeechee Canal Museum
Savannah State University
Skidaway Institute of Oceanography
South Georgia College
State Botanical Garden of Georgia
Tall Timbers Research Station
The University of Georgia
Tennessee Aquarium Research Institute
Tennessee Natural Heritage Program
Tennessee Technological University
University of California at Los Angeles
University of Florida
Valdosta State University
Virginia Tech University
Young Harris College
Zoo Atlanta

In addition, WRD staff interacted with representatives of wildlife agencies and conservation organizations from other states through regional and national meetings. These included annual meetings of the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) and the Association of Fish and Wildlife Agencies (AFWA), annual meetings of the Wildlife Diversity Program Managers working group coordinated by AFWA, and national meetings of SWAP coordinators. In addition, staff participated in numerous webinars organized by AFWA focused on revision and implementation of SWAPs and assisted with the development of "Best Management Practices for State Wildlife Action Plans: Voluntary Guidance to States for Revision and Implementation" (AFWA, 2012).

At these meetings, SWAP coordinators shared information on designation of high priority species and habitats, identification of problems affecting wildlife, opportunities for collaboration with other agencies and organizations, and techniques for encouraging public involvement. Within the SEAFWA Wildlife Action Plans committee meetings, efforts were made to share information and approaches with other southeastern states to promote greater consistency in the plans of adjacent states. These efforts have been only partially successful to date due to varying administrative responsibilities, interagency relationships, and planning mechanisms of different state wildlife agencies as well as time constraints on the planning and revision process. However, representatives of the southeastern state wildlife agencies are continuing discussions in this area with a goal of achieving greater consistency across state boundaries, allowing for development of regional conservation strategies for high priority species and habitats. In addition, the recent establishment of Landscape Conservation Cooperatives by the U.S. Fish and Wildlife Service provides a foundational framework for interagency cooperation in landscape-scale conservation. Three Landscape Conservation Cooperatives intersect Georgia's boundaries: The South Atlantic, the Appalachian, and the Gulf Coastal Plain and Ozarks.

Because Georgia has no federally recognized Indian tribes or tribal lands, there was no opportunity for coordination with federally recognized tribal governments. The State of Georgia officially recognizes three tribes (the Georgia Tribe of Eastern Cherokee, the Lower Muscogee Creek Tribe, and the Cherokee of Georgia), but these tribes do not manage significant areas of land or water within the state.

Coordination with Other Planning Efforts in Georgia

State Planning Efforts

The SWAP revision effort was initiated shortly before an internal WRD planning effort, namely the update of the Wildlife Resources Division Strategic Plan. In addition, WRD staff had previously been involved in the development of the State Forest Action Plan coordinated by the Georgia Forestry Commission. In 2012, the Open Space Institute initiated a study to identify areas in which state wildlife and forestry agencies could expand collaborative efforts on common conservation goals. Staff of WRD and the

Georgia Forestry Commission staff identified three areas in which further collaboration would be mutually beneficial: Implementation of prescribe fire programs, control of invasive species, and restoration of longleaf pine forests and savannas. In 2007 through 2009, WRD staff coordinated the development of the Georgia Invasive Species Strategy with assistance from 30+ state and federal agencies and private conservation and education organizations, and in 2009 joined with the Georgia Forestry Commission, Georgia Department of Agriculture, and University of Georgia to formally establish the Georgia Invasive Species Task Force. More recently, WRD and other organizations collaborated in the development of a Cooperative Invasive Species Management Area in the coastal region of Georgia and in the expansion of the Interagency Burn Team. All of these efforts provided opportunities to share information and improve coordination of agency functions that contribute to wildlife conservation efforts in Georgia.

Federal Agency Planning Efforts

The SWAP revision effort provided opportunities to share information and ideas with individuals involved in various conservation efforts at the federal level. These included U.S. Forest Service staff in the Chattahoochee-Oconee National Forests; staff of the National Park Service involved in development of NPS site management and monitoring plans and biodiversity databases; staff of the U.S. Fish & Wildlife Service involved in revision of management plans for the Savannah Coastal Complex, Okefenokee/Banks Lake, Piedmont, and Bond Swamp National Wildlife Refuges; U.S. Fish & Wildlife Service staff involved in listed species recovery efforts, assessments of species petitioned for federal listing, and environmental project reviews; and Department of Defense staff involved in management of lands at Ft. Stewart, Ft. Gordon, Ft. Benning, Robins Air Force Base, Moody Air Force Base, Albany Marine Corps Logistics Base, and Kings Bay Naval Base as well as efforts to protect buffer lands adjacent to these bases. In addition, information from studies funded by the U.S. Geological Survey and the U.S. Environmental Protection Agency was consulted in the revision of the SWAP.

Other Planning Efforts

Before and during the course of the SWAP revision WRD staff met periodically to discuss ways to more effectively incorporate conservation objectives for rare species and significant natural communities into management plans for Division-managed lands. Annual work plans were developed for Wildlife Management Areas and Natural Areas. WRD biologists also provided technical assistance to the Parks, Recreation, and Historic Sites Division to facilitate development of habitat restoration and management plans for state parks. These efforts continued throughout the course of the project period.

Identification of Priorities, Problems and Actions

High Priority Species

Six of the technical teams were focused on taxonomic groups – birds, amphibians and reptiles, mammals, fishes and aquatic invertebrates, terrestrial invertebrates, and plants.

Although conservation efforts for plants could not be addressed under the State Wildlife Grant, a parallel conservation planning process was undertaken. This effort was funded in part through a federal Cooperative Endangered Species grant to the Wildlife Resources Division, with matching funds provided from the Nongame Wildlife Conservation Fund.

Members of the species technical teams are listed in the individual technical team reports in the appendices and in the Acknowledgements. Over 250 individuals were contacted and invited to participate on the technical teams. The majority of these individuals accepted the invitation and provided assistance and expertise.

The species technical teams were provided lists of uncommon or rare species from databases maintained by the Nongame Conservation Section of WRD ("Special Concern Species"). All animals and plants designated as High Priority Species in the 2005 SWAP were included on the initial species lists. The "Special Concern Species" list includes species currently protected by state or federal law as well as those species considered imperiled at the state or global level with no formal protection under state or federal law. In recognition of the fact that many species in the lesser-known taxonomic groups have not received adequate attention, other globally imperiled (G1 and G2) species of terrestrial invertebrates, aquatic invertebrates, and nonvascular plants were added to the list. The technical teams evaluated these and other species to revise the lists of High Priority Species. Factors considered in these assessments included global and state rarity, range in Georgia, endemism, threats, population trends, and importance of Georgia efforts to conservation of the species. These technical teams also identified research, management, and monitoring needs for these species of conservation need.

In order to make this assessment an exercise that would improve the quality of the WRD biodiversity databases, an effort was made to use existing criteria found within the Biotics database management system used by the Nongame Conservation Section. Fields and field descriptions were exported from this database, and some additional criteria were added to augment the assessment. These were populated as spreadsheets and relational databases. Guidance was provided to the technical teams as to the important criteria for selecting high priority species, but the decision to include or exclude species was up to each team. The technical teams also developed recommendations for revisions to the list of state-protected species.

Population sizes and recovery objectives for all Georgia species protected under the federal Endangered Species Act were considered in the assessments. In addition, the technical teams included federal Candidate species and species that have been petitioned for listing as Endangered or Threatened under the Act. However, these species were not automatically afforded higher priority in the planning process due to their status as federally listed, candidate, or petitioned species. Instead, the emphasis of this process was on selection of highest priority taxa based on the factors listed above. The technical teams also developed specific recommendations for changes to state and global rarity ranks and state protected status as part of this assessment process. Further review and assessments will be undertaken for all species for which changes in state protected status have been recommended.

A revised list of 349 high-priority animal plant species and 292 high-priority plant species was developed as a result of this process. The current animal list includes 40 birds, 25 mammals, 17 amphibians, 18 reptiles, 78 fishes, 57 mollusks (freshwater mussels and gastropods), 24 crayfishes, 7 aquatic insects or other invertebrates, and 83 terrestrial invertebrates (see Table 1). Each list was reviewed by the technical teams and by other experts and formed the core group of species upon which components of the revised conservation strategy were based. The complete lists of high priority animals and plants are found in Appendix A. High priority species identified for each ecoregion are listed in Section IV (Conservation Landscape Assessments and Conservation Strategies), along with descriptions of their range and habitat in Georgia.

Table 1. Number of High Priority Species in 2005 and 2015 SWAP

High Priority Species	2005	2015
Birds	33	40
Mammals	23	25
Reptiles	22	18
Amphibians	22	17
Fishes	74	78
Mollusks	75	57
Aquatic Arthropods	47	31
Terrestrial Arthropods	0	83
Plants	323	292
Total	619	641

Marine Species Not Addressed in This Strategy

Several marine species and species groups occurring in Georgia waters are covered by federal or multi-state agency conservation plans. The following list includes the administrative organization and the Georgia species that are covered under these plans:

Atlantic States Marine Fisheries Commission (effective in Georgia's territorial waters)
- American Eel
- Atlantic Croaker
- Atlantic Menhaden
- Atlantic Sturgeon
- Bluefish
- Horseshoe Crab
- Red Drum
- Shad and River Herring

Spanish Mackerel
Spiny Dogfish and Coastal Sharks
Spot
Spotted Seatrout
Weakfish

Management plans for these species can be found at http://www.asmfc.org/

South Atlantic Fishery Management Council (effective in Exclusive Economic Zone)
Calico Scallop
Coral
Coastal Migratory Pelagics (king and Spanish mackerel, cobia)
Dolphin-Wahoo
Golden Crab
Sargassum
Shrimp (penaeid and rock)
Snapper-Grouper
Spiny Lobster

Management plans for these species can be found at http://www.safmc.net/library/

United States Secretary of Commerce (effective in Exclusive Economic Zone)
Atlantic tunas
Billfish
Sharks

Management plans for these species can be found at http://www.nmfs.noaa.gov/sfa/hms/

Specific conservation priorities for these species are not addressed in this strategy, since their needs are addressed in plans developed under the direction and auspices of the aforementioned organizations. Ongoing efforts by DNR to conserve shad and red drum constitute conservation priorities that are not specifically addressed in this document. The Coastal Resources Division of Georgia DNR is the primary state agency responsible for management of marine fisheries and shellfish populations.

High Priority Habitats

In this planning effort, habitats were addressed using two separate approaches. The brief habitat descriptions developed by the species technical teams were used to develop lists of high priority habitats for each ecoregion. These habitat types generally have non-technical names and correspond to habitats or groups of similar natural communities. In some cases, these high-priority habitats represent groups of small-patch habitats or edaphically controlled communities that are not easily mapped. The high priority habitat types identified for each ecological region are listed in Section IV of this report.

The land cover types used for the Georgia Gap Analysis Program (GAP) represent a statewide GIS land cover dataset derived primarily from 1998 satellite imagery with augmentation from aerial photographs and other sources. This 44-class dataset has great value for broad-scale mapping and assessment of vegetation types and land use changes,

but cannot be used to address the quantity or condition of most small-patch habitats. The GAP land cover types do not adequately address the variety of Georgia's aquatic systems, but do work well for mapping and assessment many of the large-patch terrestrial habitats. Similarly, the NLCD dataset is current as of 2011, but includes only 15 land cover classes in Georgia. We used the 2006 and 2011 NLCD datasets to update general patterns of land use change in Georgia.

One of the long-term goals related to this wildlife conservation strategy is revision of the natural community classification system used by WRD and its conservation partners. During the course of this planning and revision effort WRD staff worked with other individuals involved in development of a new natural community classification system based on the ecological systems classification system used by NatureServe and the international network of natural heritage programs. This effort led to the publication of "The Natural Communities of Georgia" by the University of Georgia Press in 2013. In coming years the classification will be field tested to assess its utility for habitat mapping at a local level. It is hoped that this revised natural community system will become the standard for habitat mapping on state lands as well as the basis for education and outreach activities relating to natural habitats in Georgia. A document linking the natural community types identified in "The Natural Communities of Georgia" with the high priority habitat types used in this document can be found online at: http://georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/natural_communities_thumbnail_accounts.pdf

The emphasis of this wildlife conservation strategy is on protection, restoration, and maintenance of natural habitats. We acknowledge that data on abundance and condition of these natural habitats are not sufficient to assign quantitative scores or values for most habitat types. In addition, the correspondence of these habitats to mapped units derived from satellite imagery is often problematic, as is a strict correlation of high priority species with a particular habitat type (this is especially true for those species that have received little attention from field researchers to date). However, we can state generally that conserving viable examples of all representative natural habitats in a given ecoregion will provide the greatest benefits for the widest variety of native species. The approach taken in this planning effort was to describe the general location and condition of high priority habitats, with the recognition that much more field inventory and mapping work must be done in the coming years in order to provide a more accurate picture of the specific status of most of these habitats in a given ecoregion. Increased emphasis on statewide assessments of rare or declining natural communities is one of the highest priority conservation actions identified in this strategy.

While this strategy emphasizes conservation of natural habitats, we recognize that many habitats that are heavily influenced by human activities (e.g., agricultural fields, pine plantations, suburban forests) provide benefits for native wildlife, including some high priority species. These habitats may provide nesting sites, foraging areas, or migration corridors for wide ranging species. In addition, they often provide a landscape context or matrix that is compatible with protection of embedded natural habitats, especially if care is taken to limit impacts from human activities on these natural habitats. There are many

opportunities to provide benefits to native species and natural habitats by modifying management of these human-altered systems. For example, minor modifications of field border management practices can provide significant benefits for birds that require early successional habitat. These issues are discussed in more detail in Section V.

As noted above, one of the goals articulated in the 2005 SWAP was the development of a new natural community classification system that will serve as a standard for habitat mapping on public lands. Since the completion of the original SWAP, the WRD staff has been using the NatureServe classification system to map habitats on state-owned natural areas. A three-year mapping effort focused on the 11-county coastal region of Georgia served as the pilot effort for implementation of this mapping approach at a larger scale. One of the highest priority goals identified in this SWAP revision is the expansion of this mapping approach statewide to provide a detailed map of ecological systems that will inform conservation efforts at a variety of scales. This project will involve a significant investment of staff, funds, and other resources, but will result in an unprecedented level of understanding of Georgia's ecosystems and natural habitats.

Problems Affecting Species and Habitats

One of the tasks of the technical teams was to identify problems affecting high priority species and their habitats. There are several different approaches noted in the literature, but most rely on identification of "stresses" and/or "sources of stress" in the environment (Salafsky et al., 2003). For example, a stress might be excess sediment in streams that chokes out mussel beds and interferes with fish reproduction. The source of this stress might be any number of activities, including road construction or maintenance, residential development, lack of stream buffers adjacent to agricultural fields, or any other type of land disturbing activity that is accompanied by inadequate sediment control.

It is important to note that these problems may be historic, current, or potential. For example, conversion of natural forest stands to traditional agricultural uses in Georgia represents an impact that is mostly historic. Little conversion to agricultural uses is occurring today, and in fact many agricultural lands have been converted to forestry or residential uses in recent decades. However, it is important to mention that wildlife populations have been impacted by these past land uses in the context of a long-range conservation plan that considers potential for recovery of these species. Similarly, the impacts of past land practices on soils and vegetation greatly influence our consideration of the potential restoration of natural communities.

The plan must also take into account predicted patterns of land use changes in Georgia. Most people recognize that the primary long-term threat to wildlife populations in Georgia and elsewhere is loss of habitat due to development pressures. This development pressure is fueled by a tremendous increase in the state's human population.

In order to assess the historic, current, and potential impacts of various sources of stress on high priority species and habitats, a list of 25 general problem categories was developed. This list was derived from several different assessment approaches found in

the scientific literature. The technical teams were asked to assign each high priority species to one or more of these general problem categories, which in turn correspond to sources of stress. For some of the high priority species, especially those that represent priorities for future research, no problem category could be assigned. The 25 general problem categories used in this assessment are listed below.

1. Acidified Rainfall and Other Atmospheric Pollution
Includes acid deposition from the atmosphere (both wet and dry) and other air-borne pollutants or nutrients. Acidified rainfall generally has a pH lower than 5.5. It is typically, but not exclusively, related to aerosols, volatile compounds, and semi-liquid pollutants. Impacts include acidifying aquatic systems, impairing plants' ability to evaporate water and exchange gases, and nutrient leaching and toxic accumulation in soil.

2. Altered Fire Regimes
Includes fire exclusion, fire suppression, alteration of habitats through unnatural timing, frequency, or intensity of prescribed burns, and other incompatible fire management practices. Fire regimes are affected by altered community composition (e.g., increase of non-pyric species such as oak) and habitat fragmentation. Fire is an important ecological process that drives many of the terrestrial habitats in Georgia.

3. Altered Hydrology
Includes construction and use of ditches, levees, dikes, and drainage tiles, flow diversion, dredging, channelization, filling of wetlands and headwater streams, destabilization of stream banks or channels, head-cutting, and other alterations to stream morphology or hydrologic regimes. Results in degradation or destruction of aquatic and wetland habitats.

4. Altered Water Quality
Includes various forms of point and non-point source pollution, such as herbicides, pesticides, sediments, nutrient loading, and thermal modifications that directly impact water quality. Sources are quite varied and include wastewater discharges, excessive soil disturbance near streams, increased impermeable surface area resulting from development, and loss of vegetation in riparian buffers.

5. Commercial/Industrial Development
Includes development of structures and infrastructure (buildings, utilities, driveways and roads) for commercial or industrial purposes, usually in an urban setting. Impacts may include direct habitat destruction, fragmentation, altered thermal regimes, and indirect pollution sources that alter water quality.

6. Conversion to Agriculture or Silviculture
Includes the conversion of natural habitats to anthropogenic habitats managed for agricultural crops, pasture, horticulture, or monospecies silviculture. Usually involves removal of native vegetation, site preparation, and planting of off-site or nonnative species. Results in habitat destruction or fragmentation and may impact water quality.

7. Dam and Impoundment Construction
Includes the construction of dams and impoundments (from agricultural ponds to large reservoirs) that directly affect stream flows and fragment aquatic habitat. Results in impacts to the impounded portion of the stream as well as habitats above and below the dam.

8. Development of Roads or Utilities
Includes construction of new roads (interstate highways, state highways, and county roads) and utility right-of-ways (e.g., electrical transmission lines, water/sewer, gas pipelines) that result in habitat destruction or fragmentation and creation of new avenues for invasion by exotic species.

9. Disease
Includes fatal or debilitating disorders resulting from infections, poisons, pathogenic microorganisms, or parasites. The most serious impacts generally result from introduced vectors or pathogens (e.g., sudden oak death, white nose syndrome, hemlock wooly adelgid, chestnut blight). Impacts can be devastating to the species directly attacked as well as natural communities.

10. Excessive Groundwater and Surface Water Withdrawal
Includes direct groundwater and surface water withdrawals for agricultural, industrial, and municipal water supplies. Excessive withdrawal can result in lowered water tables, diminished local aquifer discharges, and reductions in water available to sustain stream base flows, spring discharges, isolated wetlands, karst environments, and seepage communities.

11. Excessive Herbivory
Involves high, generally unsustainable rates of herbivory that intensively affect species or entire natural communities. Usually attributed to the impacts of herbivorous species that are either non-native or native but have been released from typical natural population limiters (e.g., white-tailed deer in areas of limited hunting).

12. Excessive Predation
Includes impacts to animal populations caused by predators that extensively and intensively impact the demographics of either a select species or entire species assemblages. These predators may either be non-native species or native species that are released from typical natural population limiters.

13. Global Warming/Climate Change
Defined as consistent, directed change in climatic conditions at regional scales. Such changes may include increases or decreases in average temperatures, changes in the distribution, frequency, or timing of precipitation, changes in the frequency and intensity of storm events, and changes in sea levels.

14. Illegal Dumping
Includes all forms of illegal dumping of by-products, ranging from household trash to light industrial waste, to chemical toxins, as well as the impacts resulting from the movement of these wastes from the original site of dumping. Effects on high-priority habitats may range from minor to serious (e.g. dumping in an ephemeral pool on a granite outcrop).

15. Incompatible Agricultural Practices
Includes agricultural practices that impact the environment well outside the actual agricultural operation through releases of excess nutrients, toxins, or sediments. Includes practices that degrade stream or wetland habitat quality.

16. Incompatible Fisheries Practices
Includes harvest or management of fish or shellfish by methods that are destructive to native species or aquatic habitats. Includes forms of harvest that result in heavy rates of by-catch, losses of reproductively critical age classes, or increased mortality of imperiled species.

17. Incompatible Forestry Practices
Involves poor forestry BMP implementation and site management activities that result in altered structure and composition of adjacent natural habitats or degraded stream or wetland habitats.

18. Incompatible Mining/Mineral Extraction
Includes extraction of minerals, oil, or gas or similar activities that result in the disturbance or destruction of natural habitats as well as secondary impacts such as sedimentation or releases of toxins. Impacts may include increased sediment loads, downstream scouring, habitat destruction and disturbance, fragmentation, and creation of migration routes for invasive exotic species.

19. Incompatible Road/Utility Management
Includes management of roads or utility corridors that results in excessive releases of sediment or provides access for non-native species, as well as vegetation management practices that are environmentally "unfriendly" (e.g. indiscriminant use of herbicides).

20. Industrial/Municipal Pollution
Includes toxins and air-borne pollutants, thermally altered effluent, and other point source pollutants derived from industrial/commercial land uses in an urban or suburban setting. Involves direct impacts in the form of chemical or thermal stresses to species or natural communities.

21. Invasive/Alien Species
Includes exotic species as well as native species that have become invasive due to past habitat alterations (e.g. hardwood encroachment of longleaf pine habitats following fire suppression). Impacts include competition, hybridization, and predation as well as long-

term alterations of ecological systems and processes (e.g. hydrologic changes, changes in soil attributes, altered fire regimes).

22. Poaching or Commercial Collecting
Includes commercial exploitation, poaching, and unscrupulous or excessive collecting of animals or plants by individual or corporate operators. Impacts may include mortality of individuals, population declines, and changes in community composition.

23. Residential Development
Includes primary and secondary home construction as well as development of associated infrastructure (e.g. subdivision roads and driveways, sewer and stormwater utilities). Impacts may include habitat destruction, disturbance, fragmentation, and introduction of invasive species.

24. Unmanaged Recreation
Includes recreational overuse, particularly by ATVs (all terrain vehicles), but also hiking, biking, caving, horseback riding, rock climbing, and boating (or use of jet skis) in sensitive areas or at rates considered unsustainable in the environments where they occur. Impacts may include habitat destruction and disturbance as well as impaired water quality.

25. Vehicle-Induced Mortality
Includes mortality of animals resulting from collisions with automobiles, boats, or other vehicles. Also includes impacts to plants resulting from vehicular traffic along roadsides, trails, or waterways.

Database and Information Needs

The Database Enhancements technical team included representatives from WRD, U.S. Fish & Wildlife Service, U.S. Forest Service, National Park Service, Georgia Department of Transportation and the University System of Georgia, as well as biological consultants. This group met to discuss ways in which the biodiversity databases maintained by WRD and other conservation partners could be used more effectively for wildlife conservation. Specific items discussed in these meetings included providing financial and technical support for acquisition of LiDAR data, developing better access to rare species location data for conservation planners, researchers, biological consultants and the general public, providing funding for field surveys, and developing Web-based templates for submission of species or habitat data to WRD.

The need to provide protection for site-specific data on rare species or sensitive natural habitats was a recurring theme in these discussions. Participants discussed methods for ensuring the protection of these data as well as the rights of private property owners under provisions of Georgia's Open Records Act. The group also discussed implementation of standards for documenting the types of data produced and maintained by each organization (i.e., metadata standards). A summary of recommendations from

this team is provided in Section V of this document (Statewide Wildlife Conservation Themes and Strategies).

Some funds from this planning project were used to upgrade the database management system for biodiversity data used by WRD and to provide training to WRD staff in the use of this system, known as Biotics 5. In addition, members of the Nongame Conservation Section added hundreds of new occurrence records for rare species, developed natural habitat descriptions, and updated information on rarity for all high priority species.

GIS Support and Mapping

Wildlife Resources Division staff provided GIS and mapping support for this project. WRD staff continued efforts to build data layers for conservation lands and sites in Georgia. These data layers included polygons representing ecologically significant sites (e.g., high priority watersheds and streams) identified from field research and previous conservation planning projects. Information on land cover developed by the Natural Resources Spatial Analysis Laboratory at the University of Georgia was used in an ecoregion-based analysis of land use trends in the original SWAP. Data from the Georgia Land Use Trends project (Natural Resources Spatial Analysis Laboratory, 2001) were used to assess land use changes from 1974 to 1998 in each ecoregion. This change detection was based on an 18-class land cover dataset derived from Landsat Thematic Mapper imagery. Maps and statistics on land cover for each of four reference years (1974, 1985, 1992, and 1998) were developed for each ecoregion. For this revision, we updated information on land use changes in each of the ecoregions using 2006 and 2011 data from the National Land Cover Database (www.mrlc.gov). Summaries of these land use trends are noted in Section IV.

Another pilot project was undertaken with NARSAL to identify potentially important conservation areas in the state for the original SWAP. This project used land cover data in combination with information on documented and predicted occurrences of rare species. The objective of this project was to complement the expert-driven approach to identification of important habitats and sites with a broad-scale assessment of existing natural habitat facilitated by GIS.

Land cover data for a "natural vegetation subset" of the 44-class statewide data layer were used to identify areas of the state with significant acreage of natural vegetation. A computer program known as FRAGSTATS was used to categorize and rank these patches of natural vegetation based on size, shape, contiguity, and proximity. Species-habitat models developed for the Georgia GAP project as well as documented occurrences of rare species from the WRD databases were also used to prioritize the patches. One product of this project was a map of "potential conservation areas", areas that may represent important sites or regions for wildlife conservation emphasis (Figure 1).

In this revision, we used GIS tools and the Biotics database to update maps of high priority watersheds using a new approach outlined in detail in Appendix We also

updated the map of "potential conservation areas" using a combination of landcover and conservation land coverages, connectivity models, and expert opinion to develop a draft "Georgia Greenway Map". In addition, WRD staff developed a new tool that provides online maps of species of conservation concern. These maps can be found on the WRD website at the following address:
http://georgiawildlife.com/about_rare_species_range_maps

Education and Outreach

The Environmental Education technical team included members of DNR's Wildlife Resources Division, Environmental Protection Division, Pollution Prevention Assistance Division, and Parks, Recreation and Historic Sites Division as well as a representative of the Georgia Wildlife Federation. This team was charged with development of environmental education objectives related to the SWAP. Specifically, this group was asked to:

- Identify and describe existing educational programs and sources of information relating to wildlife conservation in Georgia.
- Assess the effectiveness of existing environmental education programs in promoting wildlife conservation statewide and develop recommendations for improving the effectiveness of existing programs.
- Develop recommendations for future programs or areas of emphasis in environmental education and identify major resource needs (funding, staff, facilities, etc.).
- Suggest ways to overcome existing resource limitations.

The Education Technical Team report can be found in Appendix K.

The Outreach and Communications Team addressed needs for both outreach and inreach to further goals of the SWAP. Linking an assessment of communications methods and priorities by various conservation organizations with objectives outlined by the Education Team, the Outreach and Communications Team report identified opportunities for facilitating understanding of SWAP goals by partner organizations and the public. This report can be found in Appendix L.

High Priority Conservation Actions

Technical team leaders, Advisory Committee members, and other stakeholders contributed draft recommendations for high priority land protection, habitat restoration, rare species recovery, research, survey, database development, and education efforts. For each high priority conservation action, target habitats or species, watersheds, and ecoregions were listed as appropriate (many of the recommended actions were statewide in scope). In addition, information on lead organizations, potential partners, performance measures and funding sources was compiled. This draft list was provided to the

Advisory Committee for review and comment, and was revised based on the committee's input. Each conservation action on the list was evaluated and assigned an importance score using the following seven criteria:

1) *Providing Multiple Benefits for High Priority Species/Habitats*
   The conservation action provides direct, measurable benefits for several high priority species and/or globally rare natural communities.
   (Rating =1 to 3; Weight: = 2)

2) *Addressing Un(der)funded Needs:*
   The conservation action represents a significant improvement or advance in wildlife conservation in that it provides support for a conservation effort that is not addressed by other funding sources, programs, or organizations.
   (Rating =1 to 3; Weight = 1)

3) *Overall Importance of Georgia Efforts*
   The conservation action addresses wildlife conservation needs that are unique to Georgia (e.g., endemic species) or for which Georgia serves a key role geographically or strategically.
   (Rating =1 to 3; Weight = 3)

4) *Timeliness or Urgency*
   The conservation action addresses a problem that is particularly urgent. If this specific action is not implemented or continued in the next ten years, Georgia will experience a significant loss of biological diversity or habitat quality.
   (Rating =1 to 3; Weight = 3)

5) *Connections with Other Conservation Actions*
   The conservation action serves as a critical component that enables or facilitates one to several other important conservation measures. Without this component, other efforts will be crippled or made ineffectual.
   (Rating =1 to 3; Weight = 2)

6) *Building Public Support for Wildlife Conservation*
   The conservation action is likely to increase overall public support for wildlife conservation. The benefits of the action will be readily apparent to the public, or the project itself will focus on increasing public support for conservation.
   (Rating =1 to 3; Weight = 2)

7) *Probability of Success*
   The conservation action is likely to succeed because it employs tested methodologies, has strong support from stakeholders, and has clearly identified and readily achievable objectives.
   (Rating =1 to 3; Weight = 2)

In this rating system, the score assigned to a particular conservation action indicates the relative contribution or significance of that action for a particular criterion (1 = Low; 2 = Medium; 3 = High). The weight is a multiplier of the rating and indicates the relative contribution of that criterion to the total score (maximum total score = 45 points).

Numeric scores totaled for all criteria were used to assign each conservation action to one of three levels of priority: Very High (41-45 points); High (36-40 points); and Medium (27-35 points). The complete table of prioritized conservation actions is found in Section VI. Highest priority conservation actions identified for each ecoregion are summarized in Section IV (Conservation Landscape Assessments and Conservation Strategies), and highest priority conservation actions for the state as a whole are discussed in Section V (Statewide Conservation Themes and Strategies).

High Priority Conservation Areas

In the original SWAP, the Fishes and Aquatic Invertebrates technical team identified 212 high priority watersheds in Georgia. These watersheds represented important sites for at least one high priority aquatic species or contained examples of high quality aquatic communities. Information used in this analysis included rare species occurrence data in biodiversity databases maintained by WRD and other organizations, recommendations provided by participants in CWCS stakeholder meetings, data from the WRD Stream Assessment Team, and information from a previous aquatic assessment completed by The Nature Conservancy (Smith et al 2002).

The 2015 revision of Georgia's State Wildlife Action Plan provided an opportunity to update and improve the existing high priority waters dataset. U.S Geological Survey Hydrologic Unit Code 10 digit watersheds (HUC10) were chosen for the identification of high priority watersheds. Based on species occurrence data, land cover, and expert knowledge, the Fishes and Aquatic Invertebrates Species Technical Team identified 165 high priority watersheds to protect the best known populations of 168 high priority aquatic species. These watersheds were then prioritized by calculating a Global Significance Score (GSS), which was based upon the number of species identified in each watershed as well as the global rarity of each species. Watersheds with the highest GSS clustered in the Coosa and Tennessee drainages of northwest Georgia, but also occurred in the Tallapoosa, Chattahoochee, Flint, and Savannah drainages. Watersheds with high and moderate GSS occurred in all of Georgia's five ecological regions and 14 major drainages, except the Satilla. An additional 56 watersheds were designated as "significant" high priority watersheds, but were not further prioritized. These watersheds contained important habitat for coastal or anadromous species, recent occurrences or critical habitat for a federally listed species, or occurred in a region of the state where high priority watersheds were poorly represented.

The team also conducted a GIS assessment of all of Georgia's HUC 10 watersheds (n = 366) to characterize the degree of protection, existing condition, recent landcover trends, and future threats. Existing conservation lands are concentrated in the Blue Ridge of northeast Georgia, but there are significant parcels of protected land scattered throughout

the state. Important patterns affecting watershed condition include high forest in northeast Georgia, high row crop agriculture in southwest Georgia, and extensive development within and fringing the Metro Atlanta area and along the I-75 corridor. The density of impoundments varies across watersheds, but impacts aquatic connectivity in almost every watershed in the state. Trends in land cover changes between 2001 and 2011 include significant declines in forest cover in the Piedmont and Southeastern Plains, little change in row crop agriculture, and increases in developed landcover in urban areas throughout the state. Urban growth models predict that extensive urbanization will occur throughout the Piedmont and Blue Ridge provinces and at scattered locations throughout the state between now and 2050.

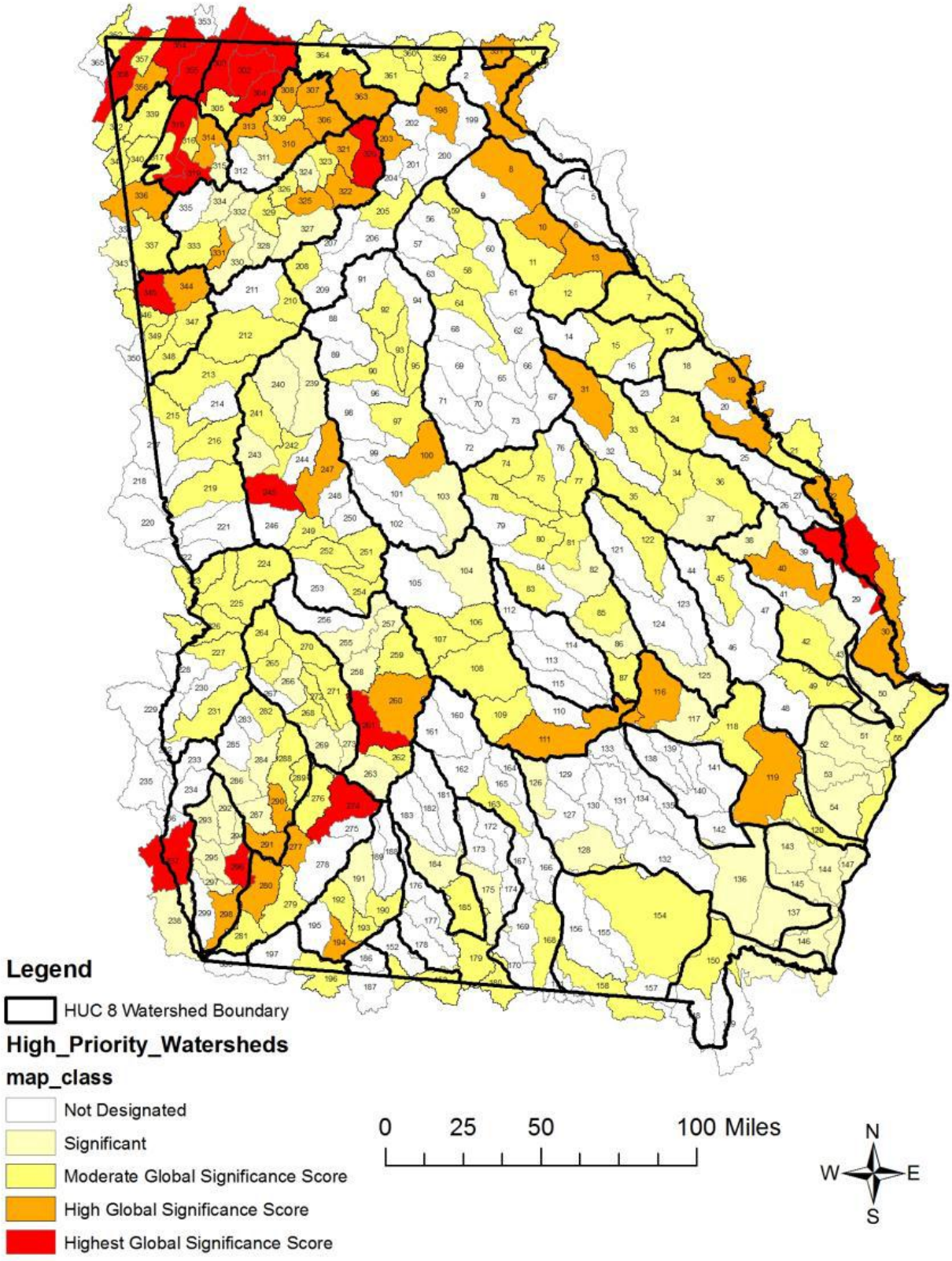

Figure1. High priority watersheds identified during the 2015 revision of Georgia's State Wildlife Action Plan.

Many of the other high priority conservation areas mentioned in this document were identified previously through a series of ecoregion-based conservation planning projects coordinated by The Nature Conservancy with assistance from WRD and other organizations. These are listed and described briefly for each ecoregion in Section IV of this document. Some of these sites correspond to or contain existing conservation lands, while others represent lands with no formal protection. While the general locations of these sites are mentioned in this document, no attempt has been made to depict the boundaries for these priority conservation areas in this document, for two reasons. First, the draft boundaries for many of these priority conservation areas represent an initial attempt to delineate major landforms or hydrologic features of biological significance, and we recognize that additional work needs to be done to refine these preliminary delineations to a level that could be considered "conservation site boundaries." Secondly, some of these high priority areas represent specific sensitive habitats whose precise locations should not be made part of a publicly accessible document.

In the 2005 SWAP another approach to delineation of high priority conservation areas involved the aforementioned GIS-informed pilot project completed by NARSAL and WRD. A set of potential "conservation opportunity areas" based on analyses of the size and configuration of natural vegetation patches was derived from 1998 Georgia GAP land cover data and documented and predicted occurrences of species of conservation concern. A prioritization scheme was devised to sort these conservation opportunity areas into general categories of significance using combinations of these three factors.

Original values for three GIS layers were recoded for each of three data layers before combining these to produce the final potential conservation opportunity area layer. The three data layers used in this prioritization scheme included core area of natural vegetation patches, weighted density of rare species (plant and animal) occurrences, and predicted occurrences of terrestrial vertebrate species of conservation concern. The use of these three factors together provided a mechanism for ranking patches of natural vegetation based on combinations of size, predicted value for species of conservation need, and documented value for species of conservation need. Finally, the prioritized patches identified from this analysis were mapped along with existing conservation lands. The resulting map is shown in Figure 2.

The 2005 map of potential conservation opportunity areas has been employed in a wide variety of conservation planning projects and has been useful in the context of identifying relatively large patches of natural habitat. Together with the maps of high priority streams and watersheds, the conservation opportunity areas dataset was used to prioritize properties for a regional conservation effort in Northwest Georgia coordinated by the Open Space Institute. The Northwest Georgia Land Protection Fund was established to protect ecologically significant landscapes through the efforts of local land conservation partners. With support from two private foundations, this fund provided $1,696,000 in grants from 2007 through 2010, helping land trusts protect 5,255 acres with a full market value of $23,323,000 (Open Space Institute, 2012).

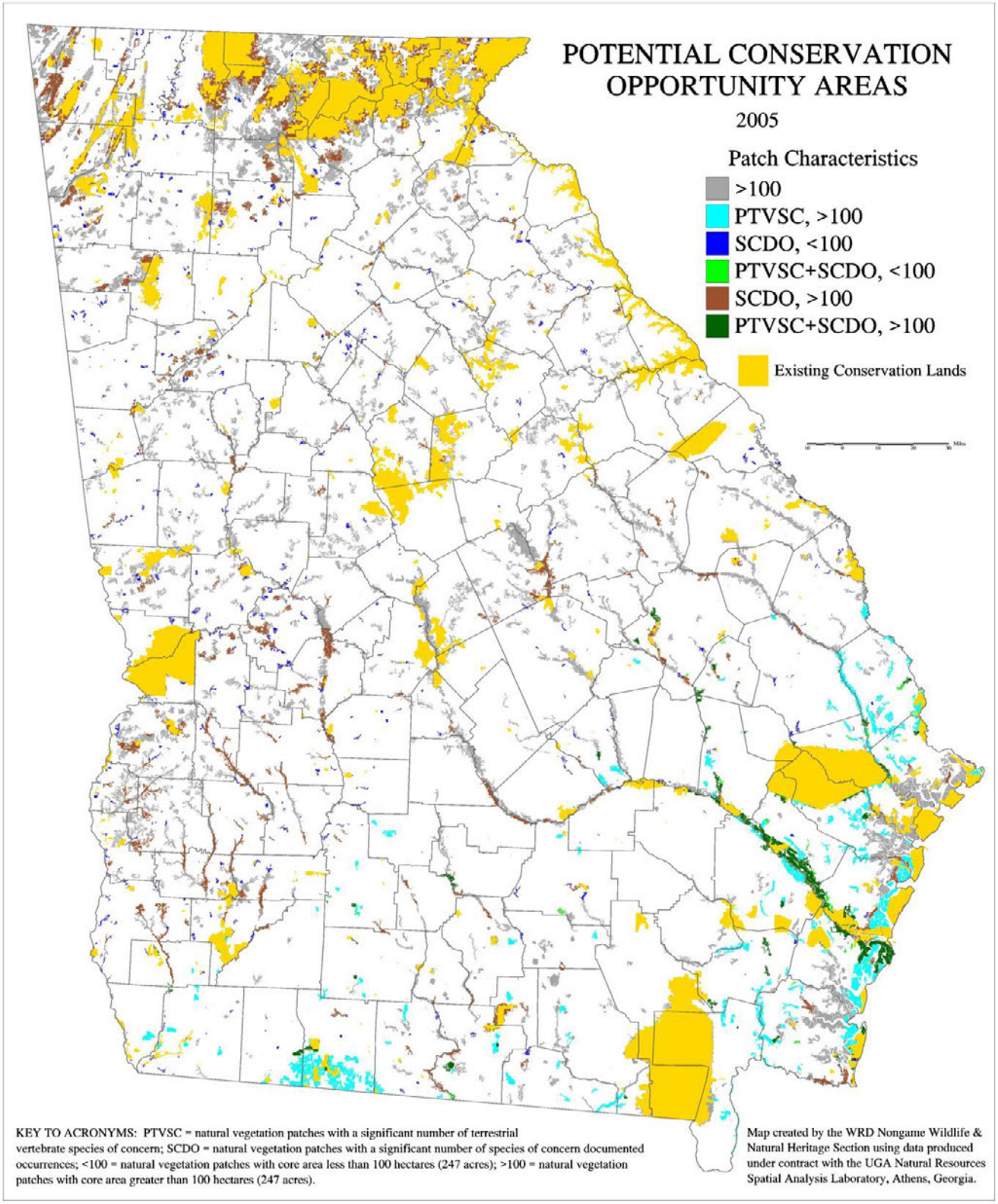

Figure 2. Potential conservation opportunity areas map from 2005 SWAP.

In 2006 staff of Georgia DNR modified the potential conservation opportunity areas map to highlight six large landscapes that represented priorities for land conservation by the agency. Over the past nine years this map has been used to prioritize land conservation projects involving fee-simple acquisitions by Georgia DNR. The "six priority areas" map was developed based on expert opinion as well as mapped locations of rare species and natural communities (Figure 3).

From 2008 through 2010, DNR staff conducted a field-based habitat mapping project focused on the 11-county coastal region of Georgia. Using digital aerial photography, soils, topography, and other data, they completed a comprehensive map of natural, semi-natural, and anthropogenic habitats using NatureServe associations, alliances, and ecological systems. The resulting dataset has been widely applied in planning efforts by conservation organizations, private landowners, and local governments, serving as the foundation for the Coastal Georgia Land Conservation Initiative coordinated by the Georgia Conservancy, Association County Commissioners of Georgia, and Georgia DNR
http://www.georgiaconservancy.org/coast/cglci.html
http://www.georgiawildlife.org/node/267

In this current revision of the SWAP, the ecosystem/habitat mapping technical team utilized a mapping approach that incorporated data from the Southeast Resilient Landscapes Project conducted by The Nature Conservancy, models of habitat connectivity, and other data to develop a draft "Georgia Greenways" map (Figure 4). This map includes large patches of natural habitat as well as areas that could be conserved or restored to provide for greater habitat connectivity within the Georgia landscape. More information on this mapping approach is found in the habitat/ecosystem mapping team report in Appendix N.

While useful as broad-scale depictions of biologically significant areas, the delineated high priority streams, watersheds, and other conservation areas are not intended to represent a "conservation blueprint" for Georgia. Each of these approaches to delineation of high priority conservation areas has its own limitations, and these maps should be considered aids to conservation planning rather than conservation plans. For example, limiting future conservation activities to designated high priority watersheds would ignore the very real need to address opportunities for habitat improvements in the remaining waters of Georgia. Similarly, the potential conservation opportunity areas delineated in this project are based on analyses of existing natural vegetation, and therefore ignore many habitats that represent important restoration or enhancement opportunities. Further, in no instance should these maps be seen as an attempt to limit, expand, or define regulatory authority of the Georgia Department of Natural Resources or any other agency. While many of the high priority conservation areas mentioned in this document are considered deserving of special emphasis for habitat protection, we do not mean to imply that other areas should be ignored or considered unworthy of protection, or that state or federal laws protecting wildlife should be applied unevenly over the Georgia landscape.

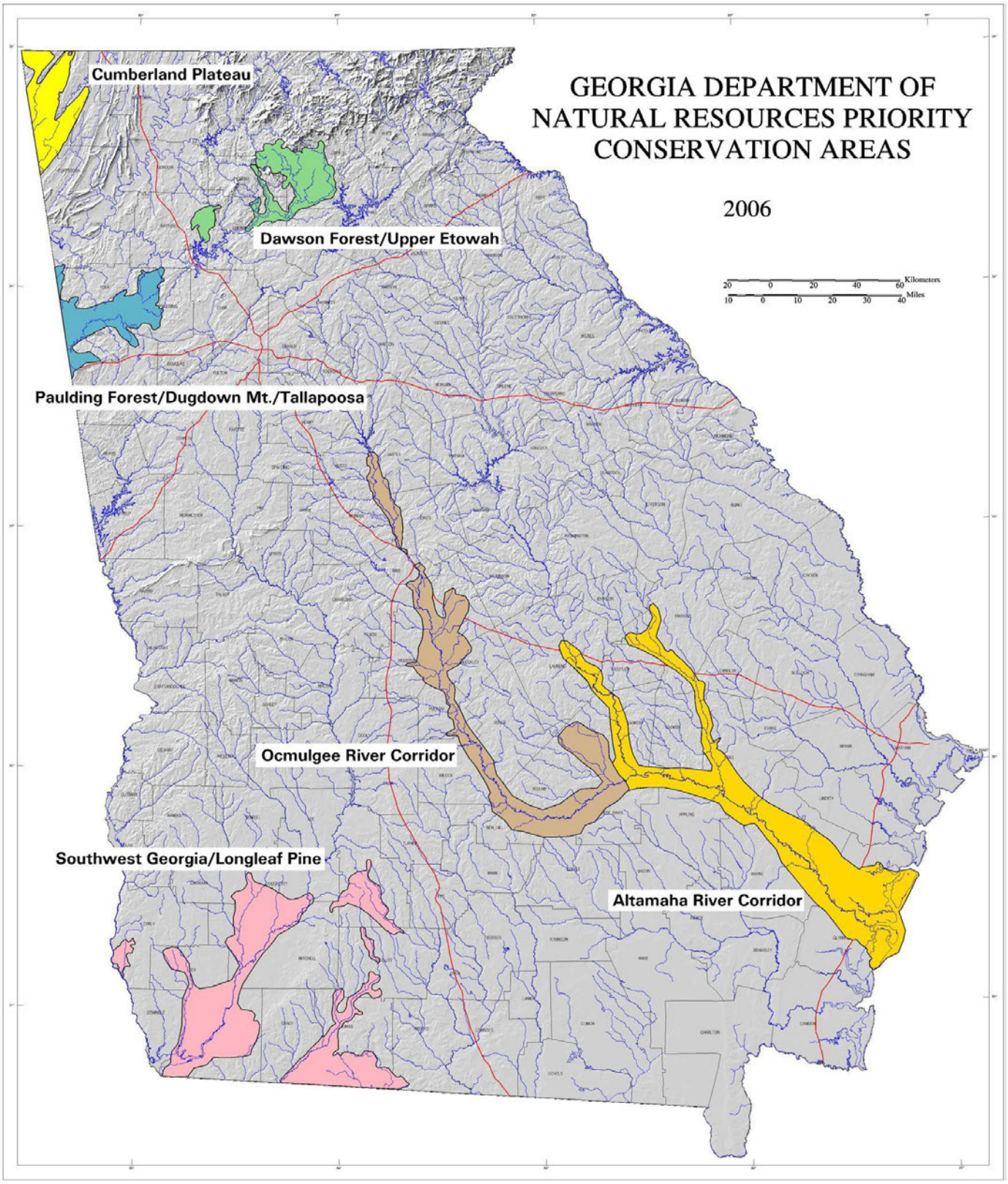

Figure 3. Georgia DNR Priority Conservation Areas Map

The depiction of high priority conservation areas in this document represents the compilation and assessment of large volumes of biological and ecological data. However, it must be acknowledged that any such delineation of biologically important areas inevitably reflects the quality and quantity of data available at a given point in time. Given the large number of high priority species for which additional field research has been identified as a conservation emphasis, the picture of high priority conservation areas must be considered subject to change. We expect to be able to provide a clearer and more precise picture of the most biologically significant areas of Georgia in coming years as implementation of this conservation strategy continues.

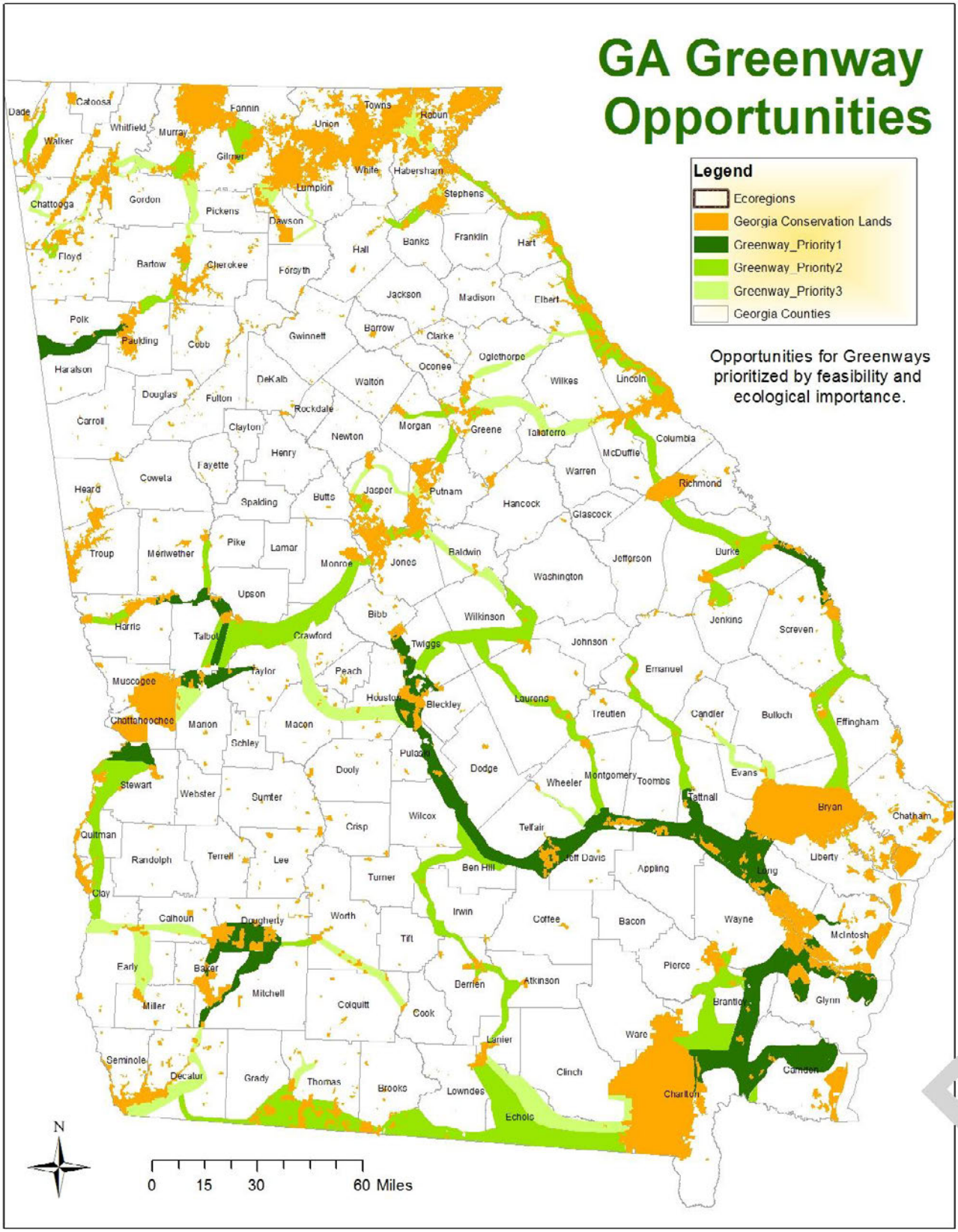

Figure 4. Draft Georgia Greenway Opportunities Map

Review and Revision

The first draft of the SWAP revision was submitted to the SWAP Revision Advisory Committee in May 2015. Comments and recommendations from the advisory committee were addressed and a public review draft was developed. This public review draft was posted on the WRD website on June 1, 2015 and its availability was publicized through email notices and statewide news releases. The public comment period for this draft of the strategy extended from June 1, 2015 to July 20, 2015.

III. State Overview- Ecological Framework

Physiography

The variety of species and natural communities found in Georgia is in part reflective of its physiographic diversity. The boundaries of Georgia include portions of five physiographic provinces. Each physiographic province has its own distinctive representative habitats and landforms (Clark and Zisa 1976), and the history of human land use and resulting impacts on species and habitats vary by province.

The Cumberland (Appalachian) Plateau in extreme northwest Georgia is composed of nearly flat-topped mountains capped with sandstone, with the valleys between them underlain by limestone. Escarpments on the margins of the mountains drop more than 1000 feet to the valley floor, and are breached by numerous streams that have their sources on top of the upland and reach the valley through deep notches in the cliffs. This province supports forests dominated by chestnut oak and white oak, with shortleaf and Virginia pine also present.

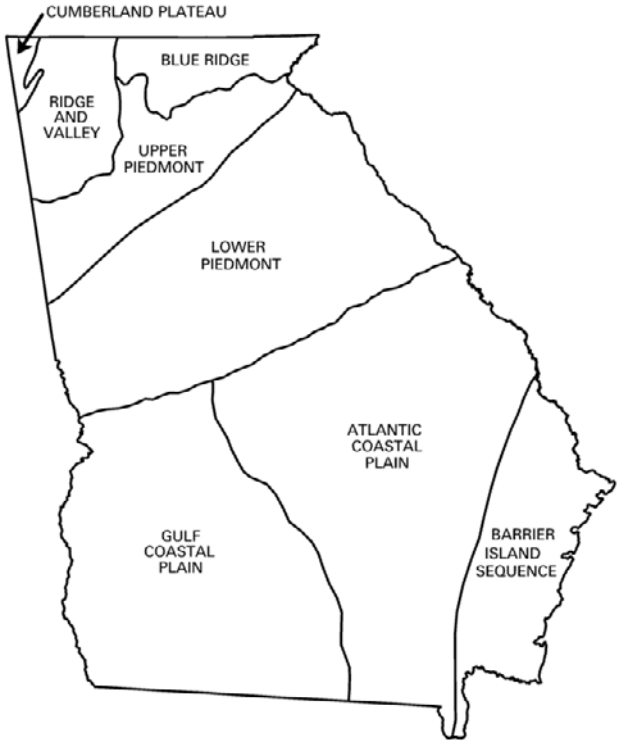

Figure 5. Georgia Physiographic Provinces and Districts

To the south and east of the Cumberland Plateau lies the Ridge and Valley Province, characterized by the low, linear, parallel ridges of the Chickamauga Valley district and the more prominent, narrow ridges of the Armuchee district. Farther east, the Great Valley district is typically broad and open with a few scattered ridges and hills, underlain with shales and limestone, as are the valleys between the linear ridges to the west. The relatively flat, fertile valleys are dominated by agriculture, such that the province is only about 65% forested. These range from mesic forests to those composed of dry-tolerant species. Longleaf pine is found at its northernmost extent in Georgia on some of the ridges in this district, and other examples of coastal plain biota can be found in the valley of the Coosa River and its tributaries (Wharton 1978).

The Blue Ridge Province is characterized by the rounded, eroded crystalline rock masses of the Blue Ridge and Cohutta mountains with dendritic drainage patterns, contrasting with the linear, steep-sided elevations of the Ridge and Valley Province with its trellis drainage patterns. Forests account for more than 90% of the landcover in this province, a higher percentage than any other Georgia physiographic province. Examples of forest

types found in this province include broadleaf deciduous cove forests on moist, cool north-facing slopes, the stunted oak forests of the ridges, and the oak-hickory forests that comprise the bulk of the Appalachian slope forests. Agriculture and other land uses are limited primarily to the flat floodplains of creeks and rivers in this province.

While containing slightly higher percentages of forested landcover than the Ridge and Valley Province, the forests of the Piedmont are more fragmented, as agricultural land uses are more or less evenly distributed throughout a matrix of second-growth and industrial forests. Urban land uses reach their greatest extent in the Upper Piedmont. Although this province is characterized by gently rolling topography throughout, some areas of high relief are found in the Upper Piedmont, on slopes associated with river valleys, and in the Fall Line area of transition to the upper Coastal Plain, where the metamorphic rock of the Piedmont gives way to sedimentary rock and sandy soils. Rivers and creeks in this transitional area are characterized by shoals and rapids.

South of the Fall Line, streams open into the wide floodplains characteristic of the Gulf and Atlantic Coastal Plains. In the former, upland forested landcover decreases to 38%, as nearly half of the province is in agricultural and other open landcover types. Bottomland forests associated with the broad, meandering streams of these provinces provide contiguous wildlife habitat to a greater extent than do the streams traversing the Piedmont in narrower floodplains. The Atlantic Coastal Plain province contains a higher percentage of wetlands than the Gulf Coastal Plain, due in part due to the presence of the Okefenokee Swamp in the former and the relative lack of surface waters in the karst-influenced lower Flint River basin. Broadleaf evergreen forests are found in areas not converted to pine monoculture, although remnants of the original longleaf pine matrix are few and widely separated.

The lowest elevations in the state and highest percentage of wetlands are found in that part of the Atlantic Coastal Plain known as the Barrier Island Sequence. This district is composed of the barrier and marsh islands, the extensive saltwater and brackish marshes, and the low-lying forests immediately to the west. Only the Cumberland Plateau and the Blue Ridge provinces have a lower percentage of non-forested landcover types, as many of the soils of the Barrier Island Sequence are too wet for agriculture. In addition to bottomland hardwoods along the rivers flowing to the marsh, and the extensive industrial pinelands, maritime forest types can be found on the barrier islands and on upland bluffs in this district. The terraces of ancient shorelines account for most of the topographic relief in this otherwise flat and lowlying district.

Geology

Georgia is divided into five major geologic provinces (Georgia Geological Survey 1976). These provinces are the Cumberland Plateau, Valley and Ridge, Blue Ridge, Piedmont, and Coastal Plain. Because of their geological similarity, the Cumberland Plateau and the Valley and Ridge provinces are considered together in this summary, as are the Blue Ridge and the Piedmont provinces. The Cumberland Plateau and Valley and Ridge provinces, in northwest Georgia, are composed of folded and faulted Paleozoic sedimentary rocks. The Blue Ridge and Piedmont provinces, in the northeast and upper-

central part of the state are composed of Precambrian to Paleozoic igneous and metamorphic rocks. The Coastal Plain Province, in South Georgia, is composed of Cretaceous to Holocene sediments.

Cumberland Plateau and Valley and Ridge Provinces

The Cumberland Plateau and Valley and Ridge Provinces of northwest Georgia are composed of folded sedimentary rocks that range in age from Cambrian to Early Pennsylvanian (approximately 570 to 326 million years ago) (Georgia Geologic Survey 1976, Patchen et al 1984). They are predominantly composed of ridge-capped cherts and sandstones alternating with valleys underlain with carbonates (limestone and dolostone), shales and slates. These strata are strongly folded and locally cut by relatively shallow thrust faults in the Valley and Ridge, and only gently folded with little faulting in the Cumberland Plateau. Fold axes in the area have varied orientations, but they generally trend northeast to southwest as evidenced by the trends of major ridge lines. Thrust fault surfaces generally dip at relatively shallow angles to the southeast. The major episode of faulting and folding occurred late in the Paleozoic Era (approximately 286 million years ago) at which time the Paleozoic strata were overthrust by igneous and metamorphic rocks of the Blue Ridge Province along the Great Smoky-Cartersville fault.

Blue Ridge and Piedmont Provinces

The Blue Ridge and Piedmont provinces are composed of igneous and metamorphic rocks: gneisses, amphibolites, schists, phyllites, slates, quartzites, and granites of Late-Precambrian to Pennsylvanian age (approximately 1,100 to 305 million years ago) (Higgins 1986, Georgia Geologic Survey 1976). These rocks were intensely folded and faulted during at least three episodes of mountain building during the Paleozoic Era. During these episodes older sedimentary, volcanic, and plutonic igneous rocks were highly compressed, very tightly folded, thrust-faulted, intruded by several pulses of magma, and metamorphosed at high pressure and temperature several miles below the surface of the earth. At the peaks of these metamorphic episodes, some of these rocks were partially melted. The axes of folded layers generally trend northeast-southwest and metamorphic layering is almost invariably inclined at low angles to the southeast. As in the Valley and Ridge, these features reflect a predominant compression from southeast to northwest during metamorphism.

Fine-grained metamorphic rocks, especially slate and phyllite, are most typically found along the western flank of the Blue Ridge and at the eastern portion of the Piedmont Province. Tectonically sheared rocks (e.g., mylonite, phyllonite, and button schist) are locally well-developed along the major faults and shear zones within these Provinces (especially the Brevard, Towaliga, and Goat Rock faults). Elsewhere, coarser grained rocks such as gneiss, schist, and amphibolite, as well as granite and gabbro, are more typically encountered.

Locally, there are narrow vertical dikes of diabase (a dark grey, fine-grained, intrusive, igneous rock) of probable Jurassic age (190 to 170 million years ago) (Higgins 1986).

These represent the youngest rocks of these provinces as they cut across all the other metamorphic and igneous rocks. These dikes are generally basaltic in composition and almost invariably trend in a northwest-southeast direction (roughly perpendicular to the regional trend of the metamorphic layering). Individual dikes are rarely more than a few tens of feet wide but can be traced for tens of miles. They represent the intrusion by mafic magma into the rock of the region as a result of tensional rifting of the crust during the Mesozoic Era (245 to 66 million years ago) (Palmer 1983). Much of the bedrock in this area is blanketed with a thick residual clay mantle (saprolite). Quaternary to Recent alluvium is common along the major drainage basins.

Coastal Plain Province

The Coastal Plain Province occupies the southern three-fifths of the State and is composed of poorly consolidated sediments (predominantly clays, sands, and marls). Sediments exposed at the surface range in age from Late Cretaceous to Holocene (approximately 97 million years ago to the present day) (Georgia Geologic Survey 1976, Huddlestun et al 1988). Older rocks, including possible Jurassic sediments, Triassic basin fills, and Paleozoic sediments of African origin occur in the deep subsurface (Huddlestun et al 1988). The sediments of the Coastal Plain are essentially undeformed and dip very gently toward the coast to the south and southeast. These sediments form a wedge with the thin edge of the wedge at the Fall Line and the thick edge at the Atlantic Ocean.

There are four broad subareas of the Georgia Coastal Plain. Within each of these subareas, sediments are generally similar but differ markedly from adjacent areas of the Coastal Plain. These are the Fall Line Hills area, The Dougherty Plain area, Coastal Georgia, and the large intervening region that may be called the Altamaha Upland area. The Fall Line Hills, Dougherty Plain, and Coastal Georgia geologic areas approximately correspond to the Fall Line Hills, the Dougherty Plain, and the Barrier Island Sequence physiographic districts, respectively. The Altamaha Upland geologic area approximates the combined Tifton Upland and Vidalia Upland physiographic districts.

The Fall Line Hills area is predominantly underlain by soft, unconsolidated sands and clays that are of late Cretaceous and Early Tertiary age. Because the Fall Line Hills area lies adjacent to the more uplifted Piedmont, this sequence of sediments is the most deeply dissected region in the Georgia Coastal Plain. West of the Flint River, Cretaceous and early Tertiary sediments consist mostly of nearshore marine sands and grey clays. However, east of the Flint River these same deposits become more coarsely sandy (and locally gravelly) and the clay consists predominantly of kaolins. The kaolinitic sediments east of the Flint River were originally deposited by rivers, and they consist of channel-fill deposits and floodplain deposits along a narrow Cretaceous and early Tertiary Coastal Plain.

In southwestern Georgia the Dougherty Plain is underlain by limestones of middle Tertiary age (mostly upper Eocene and Oligocene limestones). These limestones were deposited when sea levels were unusually high and the Piedmont was deeply eroded into

a low-lying, undulating plain. At that time, the shoreline of the Atlantic Ocean and Gulf of Mexico approximated the present-day Fall Line Hills. The limestones in southwestern Georgia were deposited on a relatively shallow water continental shelf similar to that of the modern Bahamas and Florida Bay, north of the Florida keys.

In western Georgia, between the Fall Line Hills area to the north and the Dougherty Plain area to the south, there is a band of moderately rolling and dissected hills. This region has commonly been included in the Fall Line Hills area, although the geology and topography differ. The deposits of this region consist mainly of variably limey, locally fossiliferous, shallow-water, marine sands and clays of early Tertiary age.

To the south of the Fall Line Hills and east of the Dougherty Plain is a large, rolling upland area known as the Altamaha Upland. This region is mostly underlain by the Altamaha Formation of late Tertiary, Miocene age. The sediments of the Altamaha Formation consist chiefly of sand and kaolin and are very similar to some upper Cretaceous and lower Tertiary deposits of the Fall Line Hills area. However, the Altamaha Upland deposits contain more sandstone and claystone phases and are more resistant to physical erosion than sediments in the Fall Line Hills.

East of the Altamaha Upland and adjacent to the Atlantic Ocean is a band of thin, comparatively young sands and clays of late Tertiary and Quaternary age that compose the Coastal Georgia area. These sediments represent paleo-barrier island sequences that are analogous to modern deposition along the Georgia coast. These thin sands and clays are underlain by phosphatic, shallow water, marine deposits of Miocene age that may be seen in the Savannah, Altamaha, Satilla, and St. Marys river basins.

Climate

The climate of Georgia can be described generally as humid and temperate. Summers are warm to hot, with much of the annual precipitation occurring in the summer. Winters are cool to cold, and moist. Average annual precipitation varies significantly across the state, from less than 45 inches to over 70 inches. In northern Georgia, monthly precipitation totals are highest in late winter to early spring (March to April). A secondary peak in precipitation occurs in July, due to thunderstorm activity. In southeastern Georgia, maximum rainfall occurs in late summer to early fall. Southwestern Georgia locations typically experience two relatively even peaks of precipitation in March and July, with a third peak in December.

For the state as a whole, October is the month of lowest rainfall, but this monthly precipitation minimum also varies significantly across the state. For example, monthly precipitation totals are lowest in March in east-central Georgia, and in November in the extreme southeastern portion of the state.

Severe weather events occur primarily in the warmer months. Tornadoes spawned by intense thunderstorms are most likely in March, April, and May and least likely in September and October. While tornadoes have historically been recorded from nearly

every county in the state, the most violent tornadoes have been concentrated in north-central Georgia. Extreme northeastern Georgia and the coastal areas of the state have the lowest incidence of tornadoes. Severe tropical storms and hurricanes are caused by development of large masses of warm, moist air over the tropical oceans. Most tropical storms affecting Georgia reach the state from the Gulf of Mexico. These storms pass over the panhandle of Florida and lose much of their energy in the process. Storms originating in the South Atlantic are more likely to provide hurricane-force winds to the coastal region of the state. The peak period of occurrence of tropical storms and hurricanes along the Atlantic coast is from August to October.

Average daily January temperatures vary from 25 to 60 degrees Fahrenheit across the state. Similarly, average daily July temperatures range from 60 to 90 degrees Fahrenheit. Locations in southcentral Georgia average 90 days per year with maximum temperatures above 90 degrees Fahrenheit, while sites in northernmost Georgia experience less than 10 such days per year. High-elevation sites in the mountains of northern Georgia average 120 days with minimum temperatures below 32 degrees Fahrenheit, while locations along the coast and the southeastern border experience less than 30 such days per year.

Ecoregions of the State

The discussion of land use trends, high priority species and habitats, and conservation objectives in this report is organized by ecological region, or ecoregion. The major divisions used in this report are as follows: 1) Southwestern Appalachians/Ridge & Valley; 2) Blue Ridge; 3) Piedmont; 4) Southeastern Plains; and 5) Southern Coastal Plain. Boundaries of the first three of these entities approximate those of corresponding physiographic provinces discussed above, while the combined boundaries of the fourth and fifth ecoregions together comprise the Coastal Plain physiographic province. Figure 4 shows the major (Level III) ecoregions used in this report as well as subunits of those ecoregions (Level IV) that reflect distinctive landscape features or regions. Although the Southwestern Appalachians and Ridge & Valley are separate Level III ecoregions, they are treated as one unit in this document because they share many topographic, geologic, soil, and biotic components.

Descriptions of Georgia ecoregions are found in the corresponding sections that follow under “Conservation Landscape Assessments and Conservation Strategies”. The text is modified from Griffith et al. (2001).

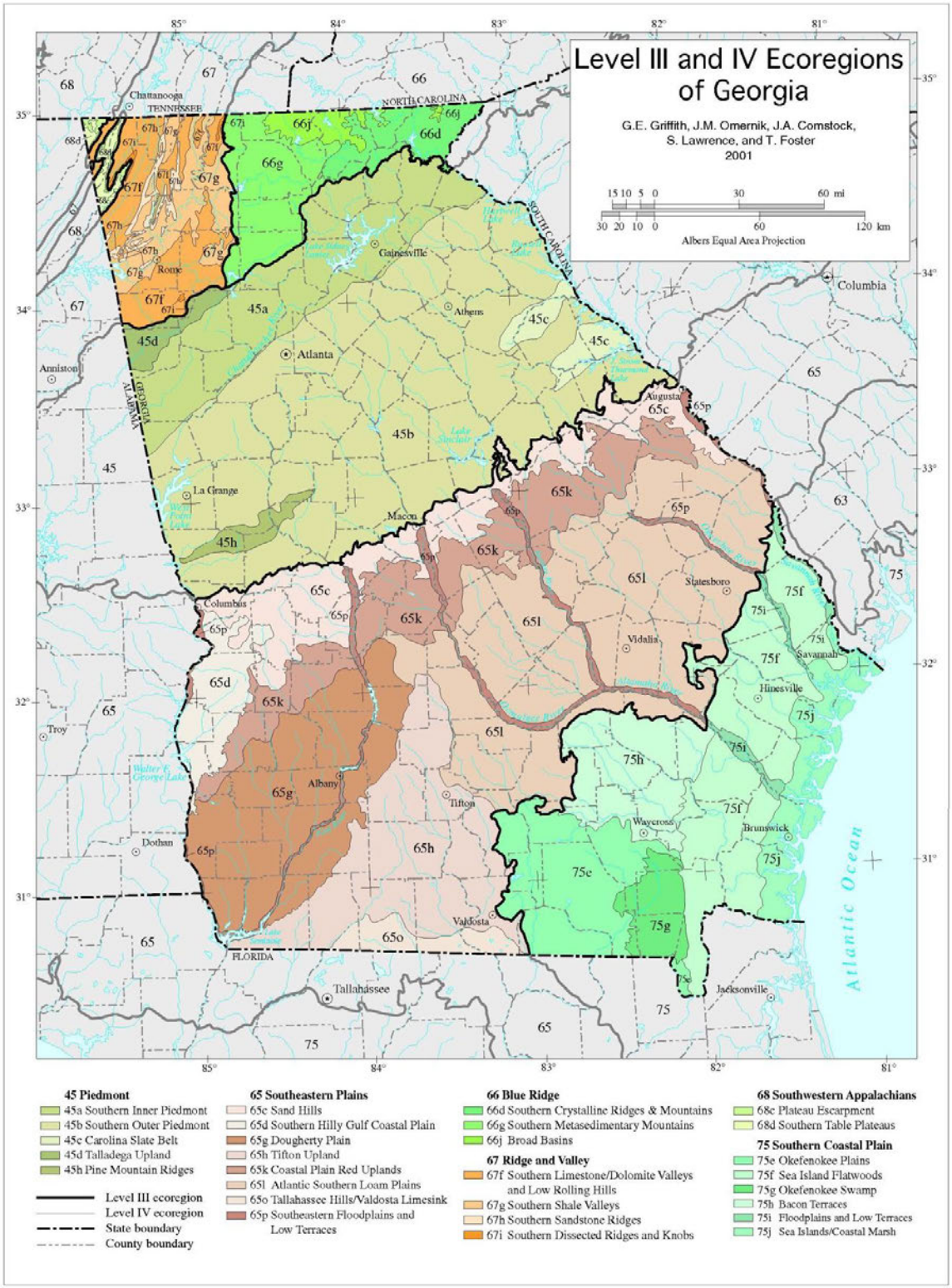

Figure 6. Level III and IV Ecoregions of Georgia

Patterns of Wildlife Diversity

Biogeographic factors such as latitude, topography and continental position are basic to an understanding of Georgia's biodiversity as compared to other areas of similar size. A well-known relationship exists between biodiversity and latitude in that species diversity generally increases from the poles to the equator, with far more species of plants and animals found in the tropics than in higher latitudes (Brown and Gibson 1983). Georgia's location within the temperate zone is associated with moderate to high levels of biodiversity. The variety in climate due to the latitudinal span of Georgia is augmented by its topography.

The effect of elevation on climate is similar to that of latitude, so that in terms of climate, Georgia effectively spans more than the four to five degrees of latitude it actually covers. Due to the elevation of the mountains in the northern part of the state, biotic elements of northern latitudes can be found within Georgia. This location has served as one of several refugia during the most recent glacial events, shaping our existing complement of life forms. Extreme variability in temperature for a given location is related to lower levels of biodiversity in that fewer life forms have adapted to such conditions. The centers of continents, distant from the moderating effects of oceans, have the greatest extremes in annual temperatures, and in general, fewer numbers of species compared to coastal areas with moderate climate.

Georgia's position on the Atlantic Slope affords a relatively moderate climate associated with a more diverse flora and fauna. Unlike the uplifted western edge of the North American continent, the Atlantic coast is submerged and highly irregular. The lower reaches of rivers that drain the Atlantic Slope transition into estuaries, and elevation and topographic diversity decline gradually toward the coast. This results in a varied physiography associated with diverse terrestrial and aquatic habitats.

Plant species diversity in Georgia is high due in part to two distinct elements of biogeography, the "rich and ancient flora covering the Southern Appalachians, and the many unusual insectivorous plants that inhabit our bogs and wetlands" (Stein et al, 2000). Both the Appalachian region and the Southern Coastal Plain have high levels of endemism. A number of narrowly endemic plant species are also associated with the granite outcrops of the Georgia Piedmont. Nationally, Georgia ranks seventh in terms of overall diversity of vascular plants.

Georgia ranks second among all states in amphibian diversity, third in freshwater fish diversity, seventh in reptile diversity, fifteenth in bird diversity, and seventeenth in mammal diversity (Stein, 2002). Based on a 2000 nationwide assessment of 21,395 species, Georgia ranks sixth in the nation in overall biological diversity based on numbers of vascular plants, vertebrate animals, and the better known invertebrate groups. Georgia also ranks twelfth in the nation in terms of endemic species, eighth in percentage of species considered globally imperiled (12.9%), and fifth in terms of number of known or suspected extinctions (Stein et al., 2000).

Species of Conservation Concern

The distribution of species of conservation concern across the state generally reflects overall patterns of wildlife diversity. However, the distributions of high priority animals and plants by ecoregions reflect diverging patterns of critical habitat distribution as well as geographic patterns of imperilment. The greatest numbers of high priority animal species can be found in the Southwestern Appalachians/Ridge & Valley ecoregions, followed by the Southeastern Plains, Southern Coastal Plain, Blue Ridge and Piedmont. For high priority plant species, the greatest numbers are found in the Southeastern Plains, followed by the Southern Coastal Plain, Piedmont, Blue Ridge, and Southwestern Appalachians/Ridge & Valley. This lack of correlation between high priority animal and plant distributions reflects divergent patterns of rarity and imperilment.

The large number of high priority animals in the Southern Appalachians/Ridge & Valley ecoregions reflects the extremely high number of rare or imperiled fish and aquatic invertebrates in this region. The Southeastern Plains region is second highest in number of high priority animals, and this total reflects a number of rare animal species distributed over several taxonomic groups. In contrast, the high number of rare plant species associated with the Southeastern Plains reflects associations with isolated wetlands, rock outcrops, wet pine savannas and seepage bogs, calcareous swamps, and several other discrete or edaphically controlled habitat types. The second-ranking ecoregion for rare or imperiled plants, the Southern Coastal Plain, is also characterized by a number of important natural habitats including sandhills, isolated wetlands, pine flatwoods, barrier island beaches and dunes, and maritime forest. Patterns of landscape and species diversity within each ecoregion will be discussed under "Conservation Landscape Assessments and Conservation Strategies".

While all of these high priority species are of conservation concern, the recommended conservation emphasis varies within the group. For one species or group of species, the most effective approach may be broad-scale habitat management over a large portion of its range, while for another species the most important goal, at least in the short term, is protection of a relatively small number of known viable populations by protecting specific sites or critical habitats. A third subset of high priority species represents the "worst case scenario" in which a species is extirpated or nearly extirpated from the state, and in which case the emphasis must be on maintenance and/or restoration of critical habitats as well as reintroduction or augmentation of populations. Unfortunately, several freshwater mussel species fall into this category. A fourth group of high priority species represents a subset for which there is evidence of rarity or decline, but for which there is currently not enough information on range, threats, or specific conservation needs to formulate a specific conservation strategy. For these species, research and survey efforts are the appropriate conservation actions.

Land Use and Human Impacts

Human Population Trends

Georgia has experienced extremely rapid population growth since the 1970s and is one of the fastest growing states in the nation. From 1980 to 2010 the population of Georgia grew from 5.46 million to 10.1 million (see below). From April 1, 2010 to July 1, 2014, the population of Georgia grew 4.2%. In comparison, the population of the United States grew 3.3% during the same period (U.S. Census Bureau 2015).

Table 2. Georgia's Population, 1980 - 2014

Georgia Population	
1980	5,462,982
1990	6,478,149
2000	8,186,453
2010	9,687,653
2014 (estimate)	10,097,343

Source: U.S. Census Bureau (http://quickfacts.census.gov/qfd/states/13000.html)

According to current projections, Georgia's population will increase 46%, from 10.1 to 14.7 million people, by 2030. The highest population density in the state will remain in the metropolitan Atlanta area, and substantial urban/suburban growth will occur in the northern and coastal counties (Georgia Office of Planning and Budget 2010). In 2010, the population density in Georgia was 168.4 individuals per square mile, while the population density of the United States was 87.4 individuals per square mile (U.S. Census Bureau 2015)

Land Cover/ Land Use Trends

Analysis of data on 13 land cover classes indicates that the largest change from 1974 to 2008 by percentage occurred in the high-density and low-density urban categories (366% and 401%, respectively) (Natural Resources Spatial Analysis Laboratory 2015). The overall percentage of these two land cover classes in the Georgia landscape increased from 0.97% in 1974 to 9.6% in 2008. While still a relatively small fraction of the total area of Georgia, the impacts related to these land uses are disproportionately high. The high rate of expansion of "sprawl zones" in Georgia represents a significant trend in terms of future impacts on wildlife species and habitats.

Habitat loss and modification attributed to increases in urban and suburban areas represent the primary threats to wildlife diversity in Georgia. These impacts include stream habitat losses due to construction of water supply reservoirs, habitat fragmentation from construction of roads and utility corridors, and conversion of natural habitats to developed areas. Other important land use factors affecting wildlife habitats and species include conversion of natural habitats for agricultural or silvicultural uses as well as

activities associated with existing agricultural and forestry operations that do not meet the standards of best management practices.

Land cover trends for the period 2006 to 2011 derived from National Land Cover Database (http://www.mrlc.gov) data are provided for each ecoregion in Section IV. Though this analysis covers only half of the time period since the 2005 SWAP, it includes the time period from 2006-2008, a period of intensive development in the state. A summary of these general land cover trends is presented in the table below. Trends are expressed as percentage change per land cover class.

Table 3. Landcover Change by Ecoregion, 2006 – 2011 (n/c = no change)

	Open Water	Developed	Forest	Agriculture	Wetlands	Early Successional
SA/RV	n/c	+2.4%	-1.5%	-1.1%	n/c	+11.2%
BR	+2.9%	+1.6%	-0.8%	-1.8%	n/c	+15.3%
PD	n/c	+3.2%	-5.4%	-1.1%	+2.0%	+27.1%
SP	+2.4%	+1.2%	-5.0%	-2.7%	+0.1%	+21.2%
SCP	+6.1%	+2.1%	-6.0%	-3.0%	+0.1%	+12.1%

SA/RV=Southwestern Appalachians/Ridge & Valley Ecoregion
BR=Blue Ridge Ecoregion
PD=Piedmont Ecoregion
SP=Southeastern Plains Ecoregion
SCP=Southern Coastal Plains Ecoregion

Developed = Open space, low, medium, and high intensity urban
Forest=Deciduous, pine, and mixed forest
Agriculture=Hay/pasture and cultivated crops
Wetlands=Woody and emergent wetlands
Early Successional=Barren, herbaceous, scrub/shrub

Overall, the period 2006-2011 appears to be relatively stable from a general landcover perspective. The most notable trends for these 6 years are a substantial increase in early successional land cover in all ecoregions, increases in developed land, stable wetlands trends, stable or increasing open water, and overall losses of forest land cover. The forest loss, spread evenly across deciduous, evergreen and mixed forests types, is primarily a transition to herbaceous, scrub/shrub, and barren land cover and developed land classes. Large increases in the early successional classes during this time period could represent conversion of forest land to other land uses, or could represent the early stages of reforestation. Some of the decline in forest land could also be explained from timber revenues declining after 2007 and overall decreases in reforestation rates as silviculture became less profitable relative to other land uses. However the most likely explanation is

that this trend reflects substantial timber harvest in the period 2006-2008, when timber prices were significantly higher.

Hay/pasture and cultivated crop classes appeared to be relatively stable in the state during this period. The increase in development is likely due to larger forested properties being subdivided, sold and converted to suburban type developments during the growth period (2006-2008). This loss of forest land to development has significant consequences for wildlife conservation in the state.

Importantly, stable or slightly increasing wetland land cover during this time period may signal good news statewide as the trend of wetland loss seems to have abated. Notably, wetlands in the Southeastern Plains and Southern Coastal Plain, which were significantly impacted by ditching, draining, and conversion to other land uses in previous decades, appear to be stable from 2006-2011. This may be due to lower availability of marginal and easily converted wetlands and higher costs of hydrologic modifications relative to economic gains from wetland conversion.

Altered Fire Regimes

In addition to converting natural habitats into agricultural or urban environments, humans have had a pervasive influence on regional and local natural processes in seemingly natural settings, altering the natural processes of the land. Perhaps the most obvious example is fire suppression. Fire is one of the most significant forms of disturbance in the natural landscape. It influences species composition of both plant and animal communities over a wide range of habitats. Wildfires caused by lightning or set by humans are believed to have been important factors sustaining biological diversity in the Georgia landscape for at least the last several thousand years. The timing, scale, frequency and intensity of these wildfires varied from site to site, and this variability, in combination with other local environmental gradients, influenced the diversity of natural communities and species found in this area.

During the 20th century, fire came to be viewed as detrimental to the economy and the natural environment. This perspective was reinforced by early policies of the U.S. Forest Service (Earley 2004). Human-set fires were greatly reduced, and both lightning- and human-ignited fires were suppressed. Negative opinions about prescribed fire programs are still held by a significant segment of the public today. Some are opposed to prescribed burns because of concerns about smoke hazards, air pollution, or aesthetics. Others perceive negative impacts to wildlife from prescribed burns or associate all fire with catastrophic events. Although recognition of the importance of prescribed fire for natural resource conservation has grown among land managers in recent years, there are new constraints on its use in terms of social acceptance and policy (Edwards et al. 2013).

State air quality regulations and policies have been developed to comply with air quality standards under the federal Clean Air Act standards. The Environmental Protection Agency (EPA) sets standards for air quality in the form of the National Ambient Air Quality Standards. In 2007, the EPA revised the standard by lowering permissible levels of fine particulate matter (pm2.5). This type of pollutant comes from a variety of sources,

including exhaust from internal combustion engines, coal-fired power plants, agriculture, and biomass burning, including prescribed fire. While prescribed fire is a relatively minor source of pm2.5 compared to the others listed above, it is highly visible and easily targeted for restrictions. Prescribed fire is the only emission source that is managed through a permitting system that ensures that the activity occurs when atmospheric dispersion is optimal (Edwards et al. 2013).

While roughly one million acres of prescribed burning is conducted in Georgia annually, the majority of this burning is site preparation for silviculture. Nearly all of this burning is conducted outside of the parameters (i.e., timing, frequency and intensity) of natural burning regimes. Increasing human populations and continued urban sprawl prohibit the restoration of natural fire regimes on a broad scale. As a result, the Georgia landscape of today contrasts sharply with the open oak woodlands, park-like longleaf pine, extensive canebrakes and other fire-dependent habitats described by William Bartram, John Muir and other early naturalists. The maintenance of many species of plants and animals in the Georgia landscape depends on restoration and maintenance of fire-dependent communities. Implementation of these management programs remains a daunting task in the face of continued suburban sprawl, increased restrictions on prescribed burns to meet air quality standards, and concerns about smoke management along highways.

Impacts on Aquatic and Wetland Habitats

Economic growth and development in the state have also resulted in profound changes to aquatic and wetland habitats. These hydrologic alterations vary from region to region, but include construction of hydropower dams, water supply reservoirs and other types of impoundments on large and medium-sized rivers, channelization of streams, drainage of wetlands by ditches or drainage tiles, and withdrawal of groundwater and surface water. These types of activities often result in impacts to a wide variety of species in an area much larger than the footprint of the construction area. For example, construction of dams on major rivers can impact aquatic and wetland systems miles upstream and downstream of the impoundment through alteration of instream flows, changes in water quality, and physical isolation of populations of aquatic species. Similarly stream channelization affects not only the aquatic habitat in the channelized segment, but also downstream areas and adjacent floodplain habitats.

Regulated releases of water from impoundments result in downstream flow regimes in which the amplitude and seasonal variation differ from those of free-flowing streams. As a consequence, floodplains do not flood as often or extensively as they would under natural conditions; this diminished flooding reduces the overbank deposition and distribution of nutrient-rich sediments to the floodplain as well as the distribution of nutrients to downstream habitats. The cumulative effects of numerous reservoirs on natural communities and ecological services associated with free-flowing rivers are not well understood, but are of growing concern (Cowie 2002).

In regions such as southwestern Georgia, where there is significant groundwater withdrawal for irrigation, streamflow depletion can occur due to changes in regional hydrologic gradients (Rugel et al. 2011). In addition to dewatering stream segments and

impacting nutrient loading to downstream communities, reduced streamflows affect channel morphology and increase stream temperatures, threatening the viability of aquatic biota (Golladay et al. 2004; Pringle and Triska 2000; Bunn and Arthington 2002). Wetlands such as seeps or geographically isolated depression wetlands that are influenced by groundwater may also be impacted by regional groundwater withdrawal.

Increases in the amount of impervious land surface associated with urbanization can result in significant impacts on water quality and quantity in streams, rivers, and wetlands, particularly in areas where riparian buffer vegetation has been removed. Similarly, disruption of riparian vegetation by cattle and other livestock results in erosion, sedimentation, and increased inputs of excess nutrients to streams. Headwater streams are particularly vulnerable to removal or destruction of riparian buffers, and changes in these upper reaches can threaten the biological integrity of entire river networks through disruptions of food webs (Hutchens and Wallace 2002) and elevated stream temperatures (Meyer et al. 2005, 2007).

Georgia's total wetland acreage is estimated to be 7.7 million acres, including 378,000 acres of coastal marshlands. Development associated with coastal marshlands has been regulated by the state since 1970 through the Coastal Marshlands Protection Act. For regulatory protection of freshwater wetlands Georgia relies on federal water quality certification under the Clean Water Act. Protection is not provided for geographically isolated wetlands in the state because they are not considered waters of the U.S. No programs exist for statewide monitoring and assessment of freshwater wetland conditions (Fowler 2008), so the degree to which these wetlands have been degraded by hydrologic alterations or pollutants is not known. A study of Carolina bays in Georgia found that the majority of the smaller wetlands had hydrologic alterations or other forms of degradation associated with agricultural uses (VandeGenachte and Cammack 2002). Similar findings were reported by Martin (2010) in sinkhole depressions in southwestern Georgia.

The percentage of streams meeting designated uses varies greatly by ecoregion, as shown in Figure 7 below. In the Blue Ridge ecoregion, some 58% of monitored streams supported designated uses, while only 27% of streams monitored in the Southern Coastal Plain were judged to fully support designated uses. The distribution of streams evaluated for support of designated uses in 2012 is shown in Figure 8.

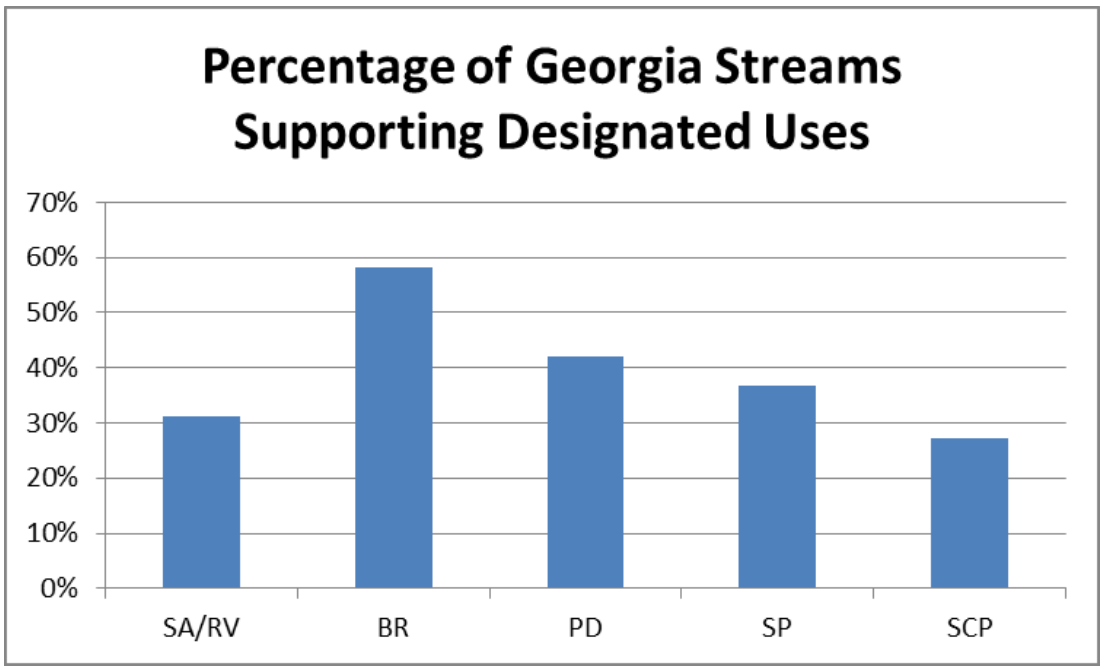

Figure 7. Percentage of Georgia Streams Supporting Designated Uses by Ecoregion, 2012

SA/RV= Southwestern Appalachians/Ridge and Valley Ecoregion
BR= Blue Ridge Ecoregion
PD=Piedmont Ecoregion
SP=Southeastern Plains Ecoregion
SCP=Southern Coastal Plain Ecoregion

Source: Georgia Environmental Protection Division

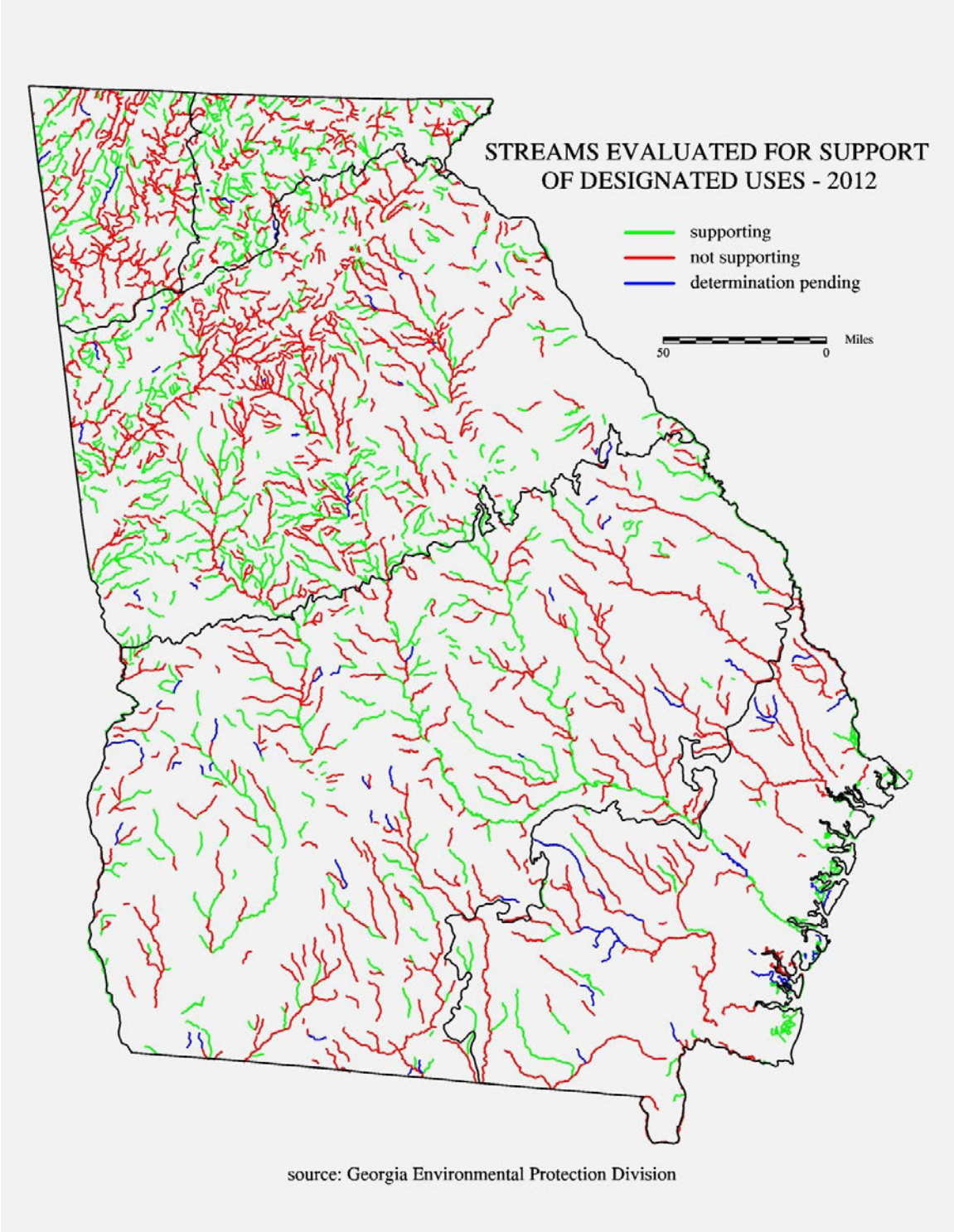

Figure 8. Streams Evaluated for Support of Designated Uses, 2012

Nonnative Invasive Species

Human activities have resulted in the introduction of many nonnative plants into the Georgia landscape. Some of these species were deliberately introduced as crop or horticultural plants, livestock, or pets and later escaped from cultivation or domestication. Others, like kudzu, autumn olive, Japanese honeysuckle, and bicolor lespedeza, were introduced to control erosion or provide food for wildlife. Still other nonnative species were accidentally introduced by importation of food and other materials. While many of these species are relatively benign or serve as pests primarily of crops, lawns, or orchards, a number of exotic species are capable of invading natural communities and causing severe negative impacts to wildlife. Chinese privet has colonized floodplain and upland habitats throughout the state, suppressing native vegetation through shading and allelopathic effects. Nepalese browntop and Japanese honeysuckle are capable of suppressing the diversity of native herbs in many forested communities. Cogon grass, an introduced species from Africa, outcompetes native grasses and burns intensely, posing a risk to human safety. Water hyacinth, hydrilla, and alligatorweed are notable exotic weeds in Georgia.

Many exotic pest plants have been identified for the Southeast (Miller 2003), and techniques for control of these pests are being explored and implemented in various habitats. Severe infestations of exotic plants exist on public conservation lands as well as on private lands, and responding to this form of "biological pollution" will be a major task for land managers in the future.

Nonnative animals cause similar impacts to high priority species and habitats. For example, the fire ant has been found to cause mortality to gopher tortoises and southern hognose snakes. The nine-banded armadillo feeds on eggs of ground-nesting birds such as northern bobwhite. Populations of eastern hemlock and Carolina hemlock are being impacted at a regional scale by the hemlock wooly adelgid, an insect that was also accidentally introduced from Asia. Other non-native insects harmful to trees include the European gypsy moth, emerald ash borer, and Asiatic oak weevil.

Millions of cave-dwelling bats in the eastern United States have been killed by "white nose syndrome," a disease caused by an introduced fungus that disrupts normal hibernation patterns, causing bats to arouse frequently from torpor and leading to debilitation and death. Feral swine impact a wide variety of habitats, wallowing in wet areas, uprooting and eating native plants, fungi, amphibians, and eggs of ground-nesting birds, removing native groundcover, and contributing to soil erosion and stream sedimentation. On barrier islands, feral swine are major predators of sea turtle and shorebird nests. Nonnative animals of concern in aquatic habitats include the flathead catfish, island apple snail, red shiner, lionfish, and Asian rice eel. Appendix I includes a detailed discussion of ongoing efforts to assess and control nonnative invasive species in Georgia.

Conservation Lands

The amount of land in permanent or long-term conservation use varies greatly from region to region. This fact influences the types of challenges faced by wildlife as well as the conservation objectives and strategies that will be emphasized in a particular region. Approximately 6.7% of the Southwestern Appalachians/Ridge and Valley and Piedmont ecoregions is in some form of public conservation ownership. Nearly 42% of the total area of the Blue Ridge ecoregion is in state or federal ownership with a large holding composed of the Chattahoochee-Oconee National Forest. Publicly owned lands in the Coastal Plain are predominantly properties of the U.S. Department of Defense or the U.S. Fish and Wildlife Service. The largest area of the state, represented by middle and southwestern Georgia, has the lowest percentage of state and federal conservation lands, approximately 3% (Figure 8).

In recent years, several large tracts of public land have been acquired in the upper Coastal Plain. The properties have been purchased through collaborative efforts by the state and federal agencies, private foundations, and nongovernmental agencies. Of the 352,000 acres of state-owned conservation lands, nearly one third were purchased since 1992 (Edwards et al. 2013). In addition, more than 250,000 acres of private lands are protected by permanent conservation easements held by private land trusts or state agencies. In addition, communities throughout the state have taken advantage of private, state, or local funding sources to purchase properties for community greenspace. Many of these county- or city-level projects focus on long-term protection of important conservation areas such as river corridors. Figure 9 shows the distribution of lands conserved by state, federal, local, and private groups.

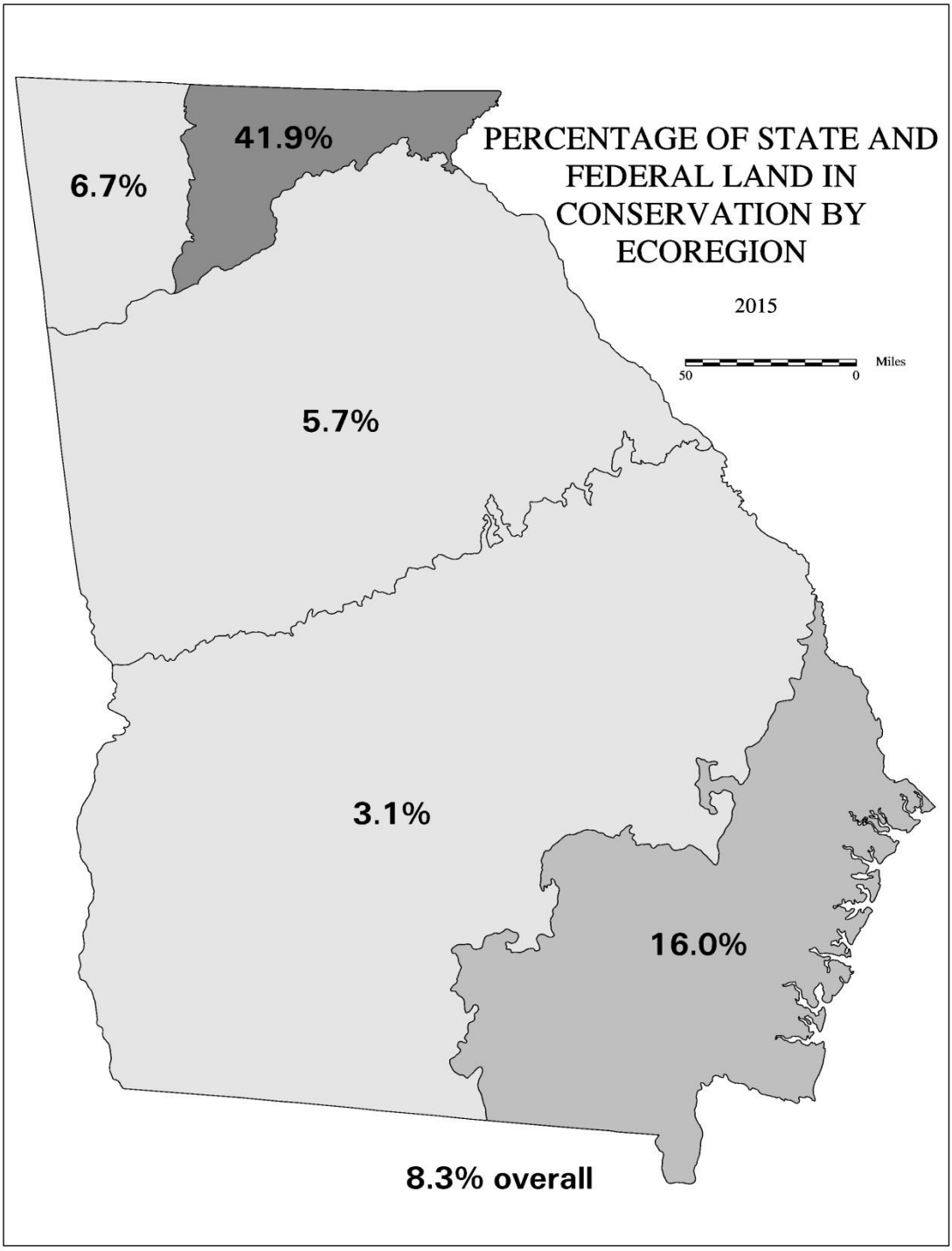

Figure 9. Percentage of state and federal land in conservation use by ecoregion, 2015

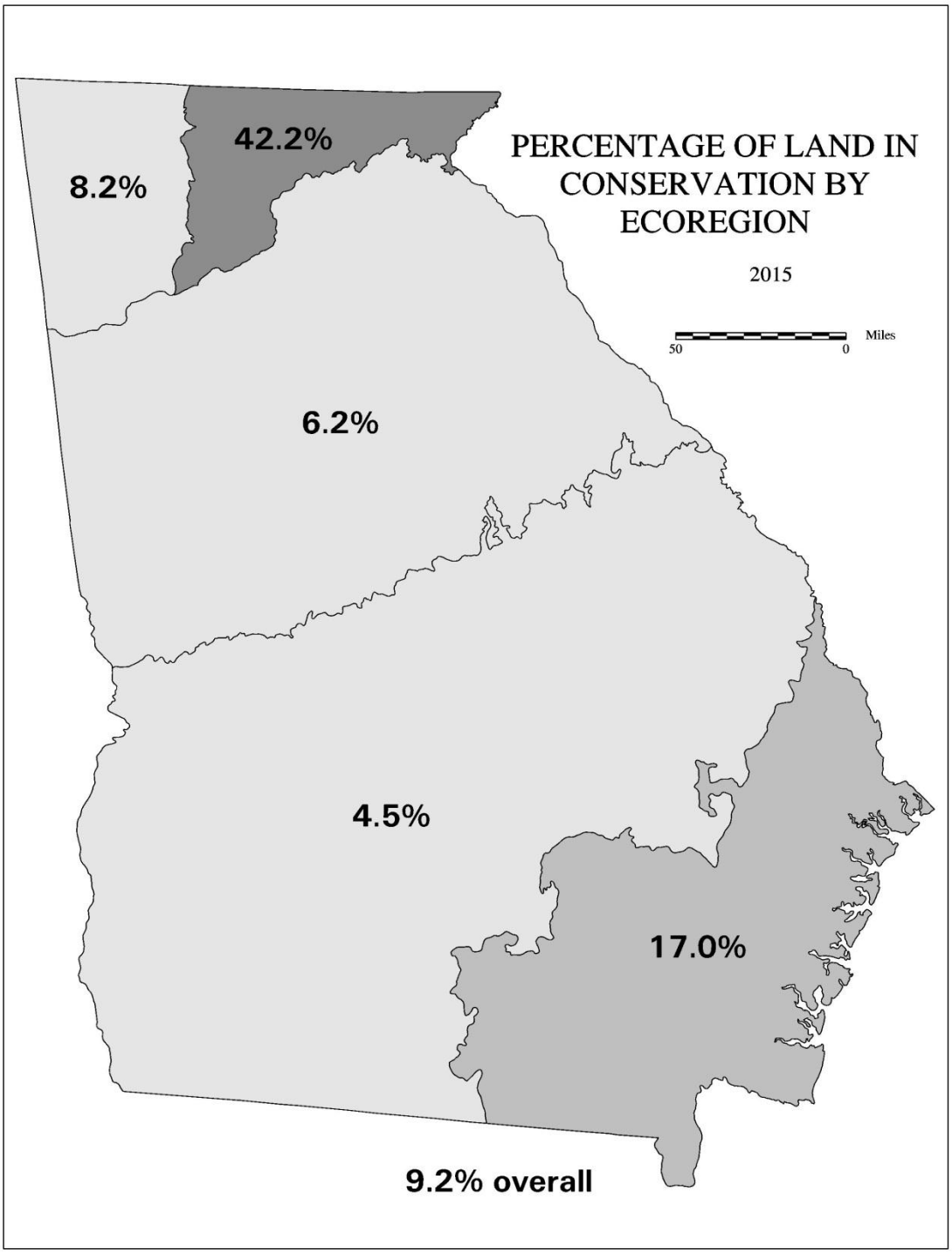

Figure 10. Percentage of land in conservation use by ecoregion, 2015

IV. Conservation Landscape Assessments and Conservation Strategies

Southwestern Appalachians/Ridge & Valley

Ecoregional Overview

The Southwestern Appalachians and Ridge & Valley ecoregions cover approximately 1,982,245 acres in northwestern Georgia. Approximately 162,544 acres (8.2 percent of the total area) are in some form of permanent conservation ownership. Georgia DNR manages approximately 28,860 acres owned in fee simple by the State of Georgia and an additional 54,830 acres in short-term leases or management agreements. Federal land ownership includes 66,160 acres managed by the U.S. Forest Service, 6,393 acres managed by the National Park Service, and 2,677 acres managed by the Department of Defense. These two ecoregions are treated as one unit in this report because they share many characteristics relating to geology, topography, soils, and vegetation.

The Southwestern Appalachian region stretches from Kentucky to Alabama and is characterized by low, flat-topped mountains containing a mosaic of forest and woodland with some cropland and pasture. The eastern boundary of this ecoregion is relatively smooth and notched by small eastward flowing streams; the western boundary has a rougher escarpment that is more deeply incised. The deeper ravines and escarpment slopes of this ecoregion contain mixed mesophytic forest, while the top of the plateau has more xeric mixed pine-oak forests and woodlands characterized by mixed oaks. Subdivisions of the Southwestern Appalachians include the Plateau Escarpment and the Southern Table Plateaus.

The Plateau Escarpment is characterized by steep, forested slopes and high gradient streams. Local relief is often 1000 feet or more. The geologic strata include Mississippian-age limestone, sandstone, shale, and siltstone, and Pennsylvanian-age shale, siltstone, sandstone, and conglomerate. Vegetation in the ravines and gorges includes mixed oak and chestnut oak forests on the upper slopes and more mesic forests on the middle and lower slopes and along streams and floodplain terraces.

The Southern Table Plateaus include Sand Mountain, Lookout Mountain, and Pigeon Mountain. While similar in some respects to the Cumberland Plateau in Tennessee, this region is lower in elevation, has a slightly warmer climate, and has more agriculture. It is mostly forested with mixed oak and oak-hickory communities. The plateau surface is less dissected with lower relief compared to the Plateau Escarpment, and it has slightly cooler temperatures and higher precipitation than the adjacent Ridge and Valley.

The Ridge & Valley is a relatively low-lying region situated between the Blue Ridge and the Southwestern Appalachians. Its roughly parallel ridges and valleys contain a variety of geologic materials, including limestone, dolomite, shale, siltstone, sandstone, chert, mudstone, and marble. Springs and caves are relatively numerous in this ecoregion. Ridges and slopes in this ecoregion are mostly forested, while pasture and row crops dominate the valleys. Subdivisions of the Ridge & Valley in Georgia include the

Southern Limestone/Dolomite Valleys and Low Rolling Hills, the Southern Shale Valleys, the Southern Sandstone Ridges, and the Southern Dissected Ridges and Knobs.

The Southern Limestone/Dolomite Valleys and Low Rolling Hills comprise a heterogeneous region underlain primarily by limestone and cherty dolomite. Landforms are mostly undulating valleys and rounded ridges and hills, with many caves and springs. Soil productivity is variable and land cover includes oak-hickory and oak-pine forests, pasture, row crops, and urban/industrial.

The Southern Shale Valleys consist of undulating to rolling valleys and low, rounded hills and knobs underlain by shale. The soils in this area formed from shale, shaly limestone, and clayey sediments, and tend to be deep, acidic, moderately well-drained, and slowly permeable. The steeper slopes are used for pasture or have reverted to brush and mixed forest. Small fields of hay and row crops are grown on the toe slopes and along streams.

The Southern Sandstone Ridges encompass the major sandstone ridges of the Ridge & Valley, but also include areas of shale, siltstone, and conglomerate. The steep, forested ridges tend to have smooth, narrow crests, and soils are typically stony, sandy, and low in fertility. The chemistry of streams flowing down the ridges varies greatly depending on underlying geologic material. Oak-hickory-pine forests are the dominant land cover.

The Southern Dissected Ridges and Knobs contain interrupted or hummocky ridges. Although shale is common, there is a mixture and interbedding of geologic materials, including cherts, siltstone, sandstone, and quartzose limestone. Oak forests and pine forests are typical for the higher elevations of the ridges, with more mesic forests on the lower slopes, knobs, and draws.

The predominant landcover types in the Southwestern Appalachian/Ridge & Valley ecoregions are deciduous forest, mixed forest and row crop/pasture (Kramer and Elliott, 2004). An analysis of land use changes from 1974 to 1998 based on satellite imagery indicated the following general trends:

- A decrease in row crop/pasture (from 32.94% of total landcover to 27.90%)
- An increase in high-intensity and low-intensity urban (from 4.41% of total landcover to 6.42%)
- An increase in deciduous and mixed forest (from 37.21% of total landcover to 44.18%)
- A decrease in evergreen forest (from 18.30% of total landcover to 14.52%)
- A decrease in clearcut/sparse vegetation (from 6.54% of total landcover to 5.82%)

These trends indicate a general decline in the total acreage devoted to active agricultural uses, an increase in hardwood and mixed forest types, an increase in residential and commercial development, and a decline in evergreen (pine and redcedar) forest types.

Analysis of land use change from 2006 to 2011 indicates a 1.5% decrease in forested land, 1.1% decrease in agricultural land, 2.4% increase in developed land, and 11.2% increase in early successional habitat. The increase in early successional classes (barren, herbaceous, and scrub/shrub) likely represents an increase in timber harvest during this period. See Appendix N for more information on land cover trends in this ecoregion.

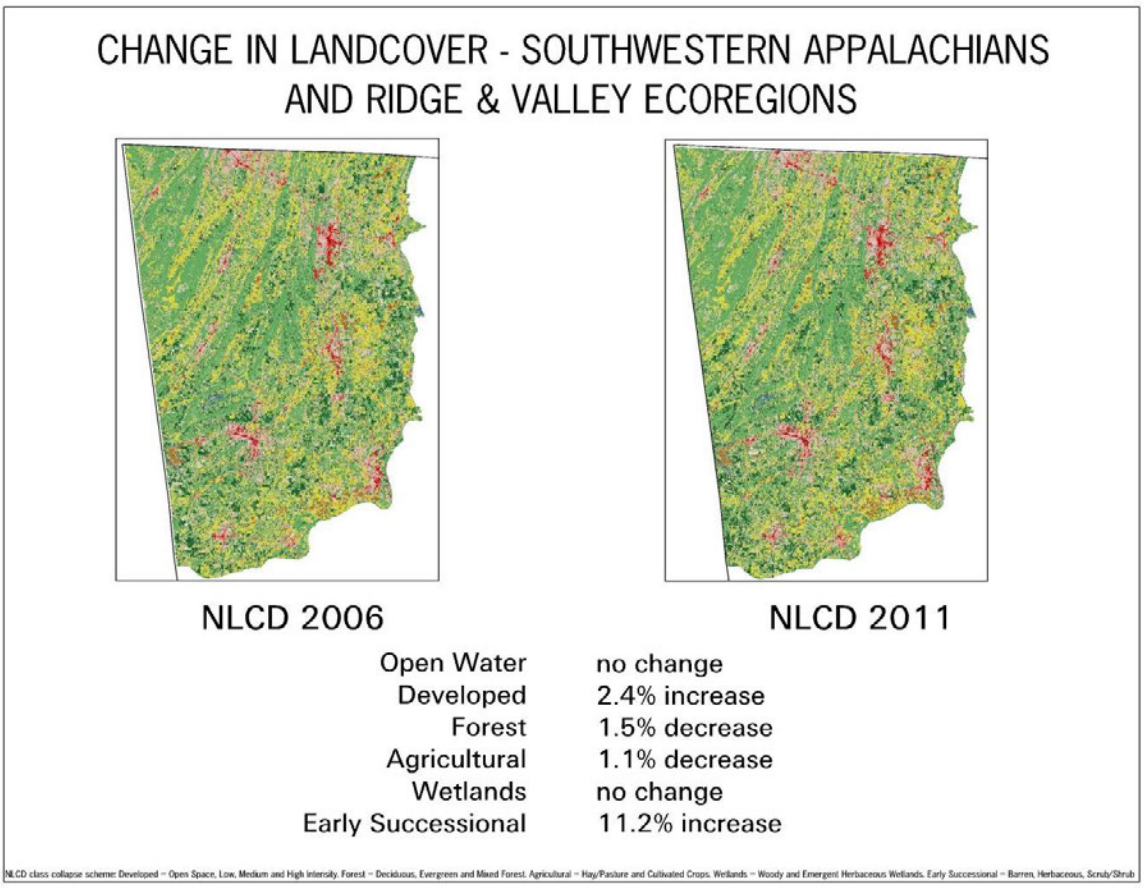

Figure 11. Change in landcover from 2006 to 2011 in the Southwestern Appalachians and Ridge & Valley ecoregions.

High Priority Species and Habitats

The technical teams identified 110 high priority animal species in the Southwestern Appalachians/Ridge & Valley ecoregions. These include 11 birds, 8 mammals, 2 reptiles, 6 amphibians, 35 fish, 27 mollusks, 9 aquatic arthropods, and 12 terrestrial arthropods. These species are listed in Table 4, with information on global and state rarity ranks, protected status (if any) under federal or state law, and habitat and range in Georgia. In addition, 65 species of high priority plants were identified for the Southwestern Appalachians/Ridge & Valley. These are listed in Table 5.

High priority habitats for the Southwestern Appalachians/Ridge & Valley ecoregions are described below:

1. Acidic Meadows Over Sandstone or Shale
Open, grassy habitats over shallow acidic soils; edaphic factors control species composition and diversity. May be moist or dry, depending on topographic setting. These small patch habitats are relatively rare in Georgia.

2. Calcareous Flatwoods (Hardwood Flats)
Relatively open, flat, shallowly and seasonally wet forested habitats dominated by hardwoods and including rare or uncommon species such as nutmeg hickory and Alabama leatherflower. Shrub and herb diversity is high. A small patch habitat restricted to low-lying areas with clayey calcareous soils.

3. Calcareous Prairies (Coosa Valley Prairies)
Open grass- and forb-dominated communities over clayey calcareous soils that inhibit growth of woody species. Groundlayer plant species diversity is high, and includes disjunct species known primarily from midwestern prairies. Includes wet and dry prairie subtypes. These habitats require periodic fire for maintenance.

4. Canebrakes
Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require periodic fire or other form of disturbance for maintenance.

5. Caves, Rock Shelters, Talus Slopes
These habitats share certain structural characteristics, such as a bedrock component with a variety of microhabitats that provide cover for priority animal species. They are typically embedded in a larger matrix of forest habitats. Caves are unique in their lack of sunlight and vegetation and dependence on outside materials for energy flows. Rock shelters can be found under cliffs (vertical exposures of rock). Talus slopes are accumulations of rock beneath cliffs and steep slopes. This region contains the majority of Georgia's caves and provides habitat for rare species such as gray and Indiana myotis.

6. Forested Limestone Slopes and Terraces
This forest type is found at middle elevations along Lookout and Pigeon Mountain. Characterized by submesic hardwood forest, with species composition dependent on aspect and slope position. Includes partially forested limestone ledges along streams.

7. High Gradient First- and Second-Order Streams
Small, clear, cold, tumbling streams with bedrock riffles and sandy pools. Found at higher elevations and upper ends of steep ravines and slopes. These streams typically experience wide seasonal variations in flow; some receive substantial input from groundwater.

8. Limestone Glades and Barrens (Cedar Glades)
Open habitats dominated by grasses or forbs, with scattered eastern redcedars and other trees. These habitats contain a large number of endemic plant species. Glades occur on thin, rocky soils, and are typically dominated by forbs; barrens are in areas with deeper soils and are dominated by grasses. The largest and most important area of cedar glades/barrens in Georgia is centered on Chickamauga-Chattanooga National Military Park.

9. Mesic Hardwood Forests
Mesic forests of bluffs, ravines, and colluvial flats, characterized by a diverse canopy of hardwood species such as yellow poplar, black cherry, white oak, shagbark hickory, northern red oak, bigleaf magnolia, sugar maple, and American beech. Hemlock and loblolly pine may be minor components in some areas. Mature examples are characterized by a rich understory of shrubs and herbaceous plants. This large patch habitat includes a rich mesic hardwood forest subtype found on calcareous soils.

10. Medium to Large Rivers
Lower gradient streams of valley bottoms, characterized by sandy, silty, or gravelly substrates. Typically surrounded by agricultural lands on the broad, fertile floodplains. Nearly all examples of large river floodplain forest in the Ridge & Valley region have been converted to other types of land cover.

11. Montane Longleaf Pine-Hardwood Forests
Dry forests composed of longleaf pine and mixed hardwood species, including mountain chestnut oak, southern red oak, and various scrub oaks. Significant examples occur in the Ridge & Valley region near Rome. Nearly all Georgia examples are fire-suppressed and exhibit lower species diversity than corresponding habitats in Alabama.

12. Oak Woodlands
An uncommon subxeric vegetation type found at higher elevations, oak woodlands are usually surrounded by xeric pine or pine-oak forest. Canopy dominants may include southern red oak, scarlet oak, post oak, and blackjack oak, with persimmon, blackgum, and other hardwood species. Probably maintained by a combination of infrequent fire and edaphic factors. Pigeon and Lookout Mountain contain good but narrow ecotonal examples.

13. Pine-Oak Woodlands and Forest
Relatively open subxeric to xeric forest or woodland, typically dominated by shortleaf pine, Virginia pine, and post and blackjack oaks, often with a diverse grass and shrub layer. May also include chestnut oak, scarlet oak, and other dry-site hardwood species. Includes typical shortleaf pine-post oak woodlands as well as mixed pine-oak scrub and dry pine-oak forest.

14. Red Maple/Blackgum Swamps
Nonalluvial or small stream swamp forests dominated by red maple and swamp blackgum. These are often found along small low-gradient streams, in shallow

depressions, or on wet flats. Often boggy, with a layer of peat, these wetlands have been impacted by construction of drainage ditches.

15. Sagponds (Isolated Depressional Wetlands)
Depressions formed by subsidence of soil due to groundwater percolation in the underlying rock. Contain a variety of vegetation types from freshwater emergents to swamp forest, depending on hydroperiod and other factors. Forested types are usually dominated by willow oak, swamp blackgum, and red maple. These unusual wetlands may include disjunct coastal plain species.

16. Sandstone Barrens and Outcrops
This edaphic habitat type includes sandstone boulders and outcrops of the Appalachian (Cumberland) Plateau as well as scoured sandstone ledges near streams. These open, rocky habitats are typically bordered by Virginia and shortleaf pine, chestnut oak, and a variety of shrubs.

17. Springs and Spring Runs; Gravelly Seeps
Springs are highly localized points of groundwater discharge that typically feed spring runs, while seeps may be broader or less defined areas of perennial or seasonal flows. The Ridge & Valley region contains a number of high-discharge springs. The waters of springs and associated habitats can be highly variable, depending on hydrology. These perennially cool and clear waters provide important habitat to a number of animal species, particularly salamanders and fish such as the coldwater darter.

18. Streams
Moderate to low gradient streams running through lower coves and valleys. Riffle, pool, and shoal habitats may be present. Substrates include gravel, pebbles, boulders, and bedrock. Aquatic plants may also be present. Pools are often silt-bottomed. These streams become turbid after rain. These are generally more productive than headwater streams because of limestone valley bottoms.

19. Underground Streams
Includes streams of all sizes flowing through caves and other underground passages. These aquatic systems are important for rare species such as the southern cavefish and Tennessee cave salamander.

<u>Problems Affecting Wildlife Diversity</u>

One of the factors impacting wildlife diversity in the Southwestern Appalachians/Ridge & Valley region is an increase in residential and commercial development along major highways and on the outskirts of metropolitan areas. This has resulted in loss of both agricultural and forest land, and has resulted in habitat fragmentation as new roads and utility corridors have been constructed. Much of the development of industrial and commercial sites has occurred along Interstate Highway 75 and other major highways. Expansion of the Chattanooga metropolitan area has resulted in significant residential development in several counties in Northwest Georgia, with associated subdivisions,

roads, utility corridors, and retail centers. Other metropolitan areas experiencing significant growth in this region include Rome, Dalton, Calhoun, Chatsworth and Trenton. Much of the industrial development in this region has occurred in the valleys near major streams and roads. Residential development has occurred in these same areas, but increasingly houses and subdivisions are being constructed in more remote locations, including secluded coves, steep forested slopes and along the brows of Lookout Mountain and Sand Mountain.

Past conversion of forest and woodland habitats to agricultural uses has resulted in the loss of virtually all river floodplain forest and associated habitats such as canebrakes in this region. The fertile valleys and river bottoms are employed for a wide variety of agricultural uses, including row crops, pasture, and hay fields. In several watersheds (e.g., West Chickamauga Creek) vegetated stream buffers are often too narrow to provide adequate erosion control, and in some areas livestock have unrestricted access to streams. These practices result in a general degradation of water quality and habitat for aquatic species. Expanding vegetated stream buffers and restricting livestock access to streams would provide significant benefits to some of Georgia's most imperiled aquatic species.

Based on Environmental Protection Division monitoring data for 2012, approximately 31% of monitored streams in the Southwestern Appalachians/Ridge & Valley ecoregions support designated uses (as measured by percent of total monitored stream miles); 67% did not support designated uses, and 2% were pending assessment. The percentage of monitored stream miles not supporting designated uses is the highest of all ecoregions. Point-source discharges into streams in this region include effluent from industrial facilities and treated wastewater from municipal treatment facilities. Other stressors of water quality include nutrient, pesticide or sediment inputs from roadways, cultivated fields, and pastures. Given the high number of imperiled mollusks in this ecoregion, improvements in water quality are a high priority for maintenance of wildlife diversity.

Groundwater withdrawals for industrial, municipal, and residential uses as well as contamination of groundwater represent potential impacts to sensitive karst environments such as caves. This region contains the vast majority of Georgia's 600+ caves. Most of these caves are found on private land, and only a few have been adequately surveyed for rare cave fauna. However, occurrences of several rare species have been documented from these caves, including gray myotis, Tennessee cavefish, and Tennessee cave salamander. All of these species are particularly sensitive to changes in the quantity or quality of water in underground streams.

Construction of dams or other structures altering stream flow represents another significant problem for aquatic species in this region. Most of the major river impoundments (e.g., Lake Allatoona, Carter's Lake, Weiss Lake) affecting streams in this area lie outside the Southwestern Appalachians/Ridge & Valley ecoregions, but the impacts of these impoundments extend upstream and downstream of the dams. These impacts include loss of stream habitat, creation of migration barriers, isolation of subpopulations, and degraded water quality (low dissolved oxygen, altered water temperatures).

Conversion of upland hardwood and pine-hardwood forests to pine plantations has also resulted in impacts to wildlife diversity. While not as prevalent in this region as in other areas of the state, this conversion has resulted in a decrease in habitat for a number of declining bird species. Specific problems associated with this forest conversion include loss of vegetative structure and nesting sites, decline in hard and soft mast production, loss of understory and groundcover diversity, and physical disturbance of habitat for organisms found in leaf litter or soil.

Fire suppression is a significant problem in this region. Extension of residential and commercial development from urban centers into surrounding suburbs has resulted in many fire-dependent habitats being surrounded by highways, subdivisions, or retail centers. Concerns about smoke management, air quality, and damage to structures make it difficult to implement prescribed burn plans for some of these important habitats. For example, while a fire plan has been developed for Chickamauga-Chattanooga National Military Park, concerns about smoke management problems along heavily traveled U.S. Highway 27 and potential damage to historic structures and monuments in the park represent impediments to implementation of the plan. Throughout the region, a lack of fire has resulted in the decline in the extent and quality of habitats such as limestone terrace woods, sagponds, longleaf pine-mixed hardwood forest, oak and pine-oak woodlands and forests, calcareous prairies, canebrakes, and limestone glades and barrens.

Invasive species and diseases pose significant threats to high priority species and habitats in this region. The red shiner is an introduced fish suspected of having a serious impact on several native fish in the Coosa River system through competition and hybridization. Other exotic aquatic species of concern include the Asiatic clam and the zebra mussel (the latter is currently not known from Georgia, but is a very serious aquatic pest in other states, including Tennessee). The hemlock woolly adelgid has caused serious decline in eastern hemlock stands, and the emerald ash borer is a threat to ash trees in this ecoregion. Notable examples of nonnative plant species of concern in this region include Nepalese browntop, Chinese privet, Japanese honeysuckle, oriental bittersweet, royal paulownia, silvergrass, and autumn olive. White-nose syndrome is the primary wildlife disease impacting species of conservation concern in this ecoregion.

For some high priority species and habitats, unmanaged recreational use represents a serious problem. High levels of use by rock climbers may threaten habitats such as sandstone barrens and limestone ledges and impact associated rare species. Similarly, cave exploration by careless or inexperienced cavers can result in significant impacts to cave formations and populations of rare cave fauna. Indiscriminant use of all-terrain vehicles (ATVs) and other vehicles in or adjacent to streams, springs, calcareous flatwoods, or rare edaphically controlled communities such as calcareous prairies and limestone glades can result in significant impacts to high priority species and habitats.

Incompatible road and utility corridor management pose problems for some high priority plant species such as Cumberland rose gentian, royal catchfly, and prairie purple coneflower. For these species, use of herbicides and other vegetation management tools

should be planned and implemented in a way that minimizes impacts to rare plant populations occurring in the road right-of-way or utility corridor.

High Priority Sites and Landscape Features

The current assessment and previous conservation planning efforts have identified a number of important sites and landscape features in the Southwestern Appalachians and Ridge & Valley ecoregions (The Nature Conservancy 2003, Edwards et al. 2013). The following are examples of high priority conservation sites in these ecoregions.

Blacks Bluff

This steep-sloped bluff located along the Coosa River near Rome contains populations of limerock arrowwood and large flowered skullcap, as well as examples of mesic hardwood forest. The Nature Conservancy owns and manages this site as Blacks Bluff Preserve. Similar Coosa River bluff environments are found nearby and are in need of permanent protection.

Carbondale Swamp

This relatively small wetland site surrounded by residential and industrial development is notable for containing a population of least trillium and an example of calcareous flatwoods habitat. This wetland habitat is considered globally rare. A mitigation site acquired by the Georgia Department of Transportation contains the only protected example of this habitat in Georgia.

Chickamauga-Chattanooga National Military Park

This 5,100-acre tract is owned and managed by the National Park Service. Important natural communities contained in this site include examples of cedar glades and open redcedar woodlands. High priority species include least gladecress, white prairie clover, and several other rare calciphiles found in Georgia only from this area. Cedar glade habitats in this area have been impacted by decades of fire suppression, which has resulted in the encroachment of woody vegetation (redcedars and shrubs) and reduction in the extent of limestone glade and barren habitats.

Coosa Valley Prairies

These remnant patches of prairie habitat contain several globally rare species of plants. Both dry prairie and wet prairie types are present within the area; these represent very distinctive and imperiled natural communities. The best examples of these prairies known in Georgia are protected through a conservation easement donated to The Nature Conservancy by former owner Temple-Inland Forest. This property, now owned by Plum Creek Timber, has been designated Critical Habitat for the federally protected whorled sunflower. A long-term monitoring and management plan developed by The

Nature Conservancy is facilitating restoration and maintenance of these prairies as well as adjacent shortleaf pine-post oak woodland habitats.

Drummond Swamp/Sagponds

Drummond Swamp is a 700+ acre site containing a large sagpond as well as the only Georgia population of Georgia alder, a species that is state protected and petitioned for federal listing. A portion of this site is protected through a conservation easement. Other sagponds are located in scattered locations in the Southern Shale Valleys area of the Ridge and Valley region. These wetlands vary in size, depth, and species composition, but often support Coastal Plain disjunct species. Sagponds are important habitats in need of long-term protection and restoration.

Lavender Mountain/Horseleg Mountain

These low mountain ridges located west of Rome contain globally significant examples of montane longleaf pine-hardwood forest, pine-oak woodland and forest, limestone glades and barrens, and mesic hardwood forest. Rare species known from this area include flatwoods rattlesnake-root, Alabama leather-flower, large-flowered skullcap, and Tennessee yellow-eyed grass. Long-term conservation of these natural habitats requires careful application of prescribed fire.

Lookout/Sand Mountain

These two mountains make up the main portion of the Southern Table Plateaus in Georgia. Important conservation sites within this 50,000+ acre landscape include Johnson Crook, Cloudland Canyon State Park, and Zahnd Natural Area. The Johnson Crook area contains more than twenty caves as well as limestone outcrops, mesic hardwood forest, and redcedar-pine woodland. At least five rare plant species have been documented from this area and the potential for discovering other rarities is high. A portion of this site has been protected the Georgia Land Trust and Southeastern Cave Conservancy. Cloudland Canyon, owned by the State of Georgia and managed as a state park, contains many rare plants and animals. Significant natural communities include limestone outcrops, caves, mesic hardwood forest, redcedar-pine woodland, seeps and springs. Zahnd Natural Area, the largest state-owned natural area in North Georgia, contains examples of sandstone barrens/outcrop, sagponds, pine-oak woodlands and forest, and underground streams.

Pigeon Mountain

Pigeon Mountain represents the easternmost segment of the Appalachian Plateau in Georgia. This site is approximately 25,000 acres, over 20,000 acres of which is state-owned or other conservation land managed as Crockford-Pigeon Mountain Wildlife Management Area. More than two dozen rare plant species are known from this site. High priority habitats include forested limestone slopes and terraces, high gradient first- and second-order streams, mesic hardwood forests, sagponds, sandstone outcrops,

underground streams, and caves. The state-protected Pigeon Mountain salamander is known only from the eastern slopes of Pigeon and Lookout Mountains. Other high priority species include green salamander, limerock arrowwood, three-flowered hawthorn, and Alabama snow-wreath.

Southern Sandstone Ridges (Armuchee Ridges)

The Southern Sandstone Ridges, also known as Armuchee Ridges, comprise the major sedimentary ridges of the Ridge & Valley; notable examples include Dick Ridge and Taylor Ridge. Much of this area is owned by the federal government and managed as the Armuchee Ranger District of the Chattahoochee National Forest. The steep, forested ridges are typically stony, sandy, and low in fertility. Oak-hickory-pine forests are the dominant land cover, with small remnant stands of montane longleaf pine. A new natural community known as shale barrens has been described from this area. High priority plants known from this area include Frasier loosestrife and large-flowered skullcap. The Armuchee Ridges Priority Amphibian and Reptile Conservation Area supports a number of species endemic to karst regions, such as the cave salamander. Green salamanders occur in the rocky outcrops and brown-backed salamanders are found in artesian springs and their outflow streams.

<u>High Priority Waters</u>

Figure 12 shows the high priority streams and watersheds identified by the Aquatic Habitat Technical Team. These streams were chosen on the basis of documented occurrences of high priority aquatic species, high water quality rankings based on Index of Biotic Integrity scores, and designation as exemplary streams in a previous study by The Nature Conservancy. Examples include Conasauga River, Coosa River, Etowah River, Oostanaula River, Chattooga River, Teloga Creek, Euharlee Creek, Cedar Creek, Chattanooga Creek, Chickamauga Creek, West Chickamauga Creek, Holly Creek, Coahulla Creek, and Cole City Creek. For more information on high priority waters in this region, refer to the Aquatic Habitat Technical Team report in Appendix F.

<u>Conservation Goals</u>

- Maintain known viable populations of all high priority species and function examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance,

developing specific educational messages, and managing exotic species populations on public lands.

- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments
- Continue efforts to recover federally listed species by implementation of recovery plans and restore populations of other high priority species.
- Improve water quality throughout the region, with special emphasis on high priority streams

Conasauga River

The Conasauga River watershed is home to 76 species of native fish, 26 species of freshwater mussels, 20 snails, and 20 salamanders. This river flows from its origin in the Chattahoochee National Forest in Georgia northward into the Cherokee National Forest in Tennessee, then through private lands south into Georgia, eventually merging with the Oostanaula River near Resaca.

The Nature Conservancy (TNC) has been working in the Conasauga River Watershed since 1997, focusing on restoration of key reaches of the river mainstem as well as significant tributary streams such as Holly and Sumac Creeks. Restoration projects have included working with landowners and NRCS on reestablishment of riparian buffers, bank sloping, cattle fencing, and alternative watering sources for cattle, and access controls. Land protection through acquisition is also an important focus of work in the watershed.

Ongoing research conducted by the USGS and the UGA Odum School of Ecology and Georgia Museum of Natural History in the watershed has focused on monitoring fish and mussels and identifying water quality problems, threats to imperiled species, and critical sites for conservation. Much of this research has been funded through federal grants administered by the USFWS. In 2007, analysis of survey data indicated that populations of some Conasauga fish species had declined significantly over the past 5 to 7 years.

In 2008, approximately 70 participants attended the first Conasauga Summit, organized by the USFWS and TNC. The goals of the summit were to (1) inform stakeholders of the latest research results on status of imperiled fish, mussels, and other aquatic species in the basin; (2) discuss ongoing coordination activities with landowners and industry in the basin to improve water quality and habitat for these species; and (3) develop a list of important action items to recover imperiled species. Strategic Habitat Conservation is taking place by using information gathered at the Conasauga Summit to inform biological planning and conservation design, enabling conservation delivery.

In June 2009, the USFWS developed a proposal for a Conasauga National Wildlife Refuge that would protect and restore high priority aquatic and riparian habitat to facilitate recovery of rare aquatic species, provide habitat for high priority neotropical migratory birds, provide recreational opportunities to the public, and implement environmental education and interpretation programs that focus on ecosystem management and stewardship. Information on this proposed refuge can be found at: http://www.fws.gov/athens/rivers/FactSheetConasaugaRiver.pdf

Strategies and Partnerships to Achieve Conservation Goals

- Provide financial incentives and technical expertise to encourage prescribed burns, through Interagency Burn Team and other means
- Work with NRCS staff to identify high priority habitats and sites for implementation of habitat enhancement/restoration projects through Farm Bill programs (e.g., restoration of oak and shortleaf pine-oak woodlands, longleaf pine-hardwood forest, and stream buffers.)
- Use state lands and other public lands (USFS, NPS) to showcase habitat restoration efforts.
- Control invasive exotic species populations on public lands and provide technical assistance to private landowners to discourage use of invasive exotics
- Work with GDOT and local governments to minimize direct impacts to high priority species and habitats from road construction and maintenance.
- Work with Georgia Power and private landowners to identify and conserve populations of rare species in and adjacent to utility corridors
- Develop educational materials on high priority species and habitats in the ecoregion and provide these to environmental educators at WRD facilities (e.g., Arrowhead Education Center) and other facilities
- Work with NRCS, GFC, and GFA to revise forestry BMPs for better protection of streams and wetlands and maintenance of important wildlife habitats
- Work with The Nature Conservancy, USFWS, Georgia Land Conservation Center and local land trusts to provide protection for high priority wetlands and stream corridors.

Highest Priority Conservation Actions

Highest priority conservation actions (ranked "Very High" or "High") identified by the technical teams, advisory committee, and other stakeholders specifically for these two ecoregions include the following (see Appendix P for details):

- Continue and expand monitoring of rare species throughout the Coosa Basin and evaluate this approach for use in other basins. Continue DNR's Stream Team surveys throughout the Coosa River Basin and UGA aquatic surveys and monitoring efforts in the Etowah and Conasauga River systems.
- Continue long-term monitoring of Pigeon Mountain salamander and other cave-inhabiting salamander populations; conduct surveys for other high priority cave and outcrop species.
- Monitor populations of gray bats in caves; conduct monitoring of caves with populations of other bats currently affected or likely to be affected by WNS. Count bats and coordinate with researchers studying the disease and potential treatment options.
- Implement occupancy sampling for freshwater mussels and snails in the under sampled reaches of the upper Coosa, including Coosawattee, Oostanaula, and Chattooga rivers.

- Continue assessment of water quality and contaminants in the Conasauga River system. Identify major toxicological stressors and the tributaries or mainstem reaches that provide the greatest concentrations of stressors. Continue evaluation of ditches as a source for nutrients and herbicides
- Protect critical reaches of the Conasauga River system through targeted acquisition and easements with willing landowners. Provide targeted outreach and technical transfer to farmers to help minimize agricultural impacts to river.

For highest priority conservation actions of statewide scope, see Section V of this report.

Bird Conservation in the Southwestern Appalachians/Ridge & Valley Ecoregions

The greatest bird conservation issue in these ecoregions is conversion of hardwood and mixed pine/hardwood forest to loblolly pine plantations, residential or commercial developments, or agricultural uses. A large percentage of natural vegetation has been converted for other uses, and mature forest and the birds dependent on mature forest are less secure here than in any other region in the Southern Appalachians. The long-term health of populations of priority birds including Acadian Flycatcher, Wood Thrush, and Yellow-throated Warbler will depend on maintenance and management of remnant forest stands as well as aggressive restoration efforts. It is recommended that at least eight upland hardwood forest patches greater than 4,000 hectares be sustained and that the number of such patches in the 4,000 to 40,000 hectare range be increased. More than 80% of the mixed mesophytic hardwood acreage within these patches should be managed for long rotation or old growth.

Existing short-rotation pine, while of less benefit to birds than mature forest, is nevertheless much more valuable than more intensive land uses, and it is recommended that the current percentage of land in this cover type be retained. All existing southern yellow pine and mixed pine hardwood habitats should be actively and appropriately managed with fire to improve habitat quality, and acreage should be increased where possible by reforestation of abandoned agricultural fields. Priority species associated with mature pine forests in the Ridge and Valley include Bachman's Sparrow and Brown-headed Nuthatch.

Table 4. Southwestern Appalachians/Ridge & Valley High Priority Animals (110 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
AA	Cambarus cymatilis	Conasauga Blue Burrower	G1	S1		E	Sandy clay burrows up to 1 mile from nearest stream
AA	Cambarus distans	Boxclaw Crayfish	G5	S1			Clear cool streams under debris or clean slab rocks; streams can dry to isolated pools
AA	Cambarus extraneus	Chickamauga Crayfish	G2	S2		T	Small to medium shallow rocky streams with moderate current
AA	Cambarus fasciatus	Etowah Crayfish	G3	S2		T	Lotic habitats under rocks in flowing water
AA	Cambarus manningi	Greensaddle Crayfish	G4	S1?			Rocky riffles in streams with moderate to swift current
AA	Cambarus scotti	Chattooga River Crayfish	G3	S2		T	Rocky riffles in streams with moderate to swift current
AA	Cambarus unestami	Blackbarred Crayfish	G2	S3		T	High elevation streams with bedrock or rocks
AA	Gomphus consanguis	Cherokee Clubtail	G3	S2		T	Spring-fed moderately-flowing forest streams, especially where they drain small ponds
AA	Ophiogomphus incurvatus	Appalachian Snaketail	G3T2T3	S2			Small to medium spring-fed streams with mud and gravel bottoms.
AM	Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	G5	S3S4			isolated wetlands for breeding; variety of open, upland habitats; CP - sandhills, oldfields, dry pine savanna
AM	Aneides aeneus	Green Salamander	G3G4	S3		R	Moist rock crevices; canopies of trees; within hardwood forests
AM	Cryptobranchus alleganiensis	Hellbender	G3G4	S3		T	Clear, rocky streams within Tennessee River drainages and Cartacay River
AM	Eurycea aquatica	Brown-backed Salamander	G3	S1			springs in RV and Cumberland Plateau
AM	Gyrinophilus palleucus	Tennessee Cave Salamander	G2G3	S1		T	Streams in caves; substrates include rock, gravel, sand, and mud
AM	Plethodon petraeus	Pigeon Mountain Salamander	G2	S2		R	Moist, rocky woods; cave entrances
BI	Ammodramus savannarum pratensis	Grasshopper Sparrow	G5	S4			Breeds in grasslands, pasture lands, PD RV, rare in CP. Wintering range poorly known.
BI	Colinus virginianus	Northern Bobwhite	G5	S5			Early successional habitat, open pine savanna (frequent fire maintained in small burn unit size), fallow habitats associated with crop lands, extensive forest regen areas (area sensitive - minimal fall pop of 700 birds for viability on 3000+acres)
BI	Euphagus carolinus	Rusty Blackbird	G4	S3			Bottomland forest, pecan orchards, agricultural fields
BI	Grus americana	Whooping Crane	G1	S1	LE		Open, mostly emergent herbaceous freshwater wetlands and fields for stop-over sites
BI	Haliaeetus leucocephalus	Bald Eagle	G5	S3		T	Edges of lakes & large rivers; seacoasts
BI	Ixobrychus exilis	Least Bittern	G5	S3			Fresh and brackish water wetlands with emergent herbaceous cover including impoundments, natural freshwater marshes, and tidally influenced marshes
BI	Lanius ludovicianus	Loggerhead Shrike	G4T3Q	S3			Open woods; field edges, pastures, ball fields, industrial park, primary dunes, hammocks
BI	Limnothlypis swainsonii	Swainson's Warbler	G4	S3			Dense undergrowth or canebrakes in swamps and river floodplains, small mountain pop in rhododendron and mountain laurel thickets
BI	Peucaea aestivalis	Bachman's Sparrow	G3	S2		R	Open pine or oak woods; old fields; brushy areas, young large grassy pine regeneration areas
BI	Protonotaria citrea	Prothonotary Warbler	G5	S4			Bottomland forest, swamps, and similar forested wetlands. Nests in tree cavities.
BI	Tyto alba	Barn Owl	G5	SU			Nests in large hollow trees or old buildings (particularly cement silos) in areas with extensive pasture or grassland or other open habitats such as marsh
FI	Acipenser fulvescens	Lake Sturgeon	G3G4	S3			Large freshwater rivers & lakes over clean firm substrate
FI	Cyprinella caerulea	Blue Shiner	G2	S2	LT	E	Flowing runs and pools in streams with cool water and firm substrates

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 4. Southwestern Appalachians/Ridge & Valley High Priority Animals (110 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Erimonax monachus	Spotfin Chub	G2	SX	LT		Large creeks to medium-sized rivers; moderate to swift currents over gravel to bedrock
FI	Etheostoma cinereum	Ashy Darter	G2G3	SX			Medium to large upland streams in slackwater areas with silt-free substrate and cover such as boulders or snags
FI	Etheostoma ditrema	Coldwater Darter	G2	S1		E	Vegetated springs and spring runs or small streams with spring influence
FI	Etheostoma duryi	Blackside Snubnose Darter	G4	S1		R	Small to medium streams, gravel to cobble bottoms; riffles and pools
FI	Etheostoma etowahae	Etowah Darter	G1	S1	LE	E	moderate to high gradient streams over cobble to gravel in areas of swift current
FI	Etheostoma rufilineatum	Redline Darter	G5	S1S3			Swift shallow riffles of rocky streams
FI	Etheostoma rupestre	Rock Darter	G4	S2		R	Swift rocky riffles often associated with attached vegetation such as Podostemum
FI	Etheostoma scotti	Cherokee Darter	G2	S2	LT	T	Small to medium-sized creeks with moderate current and rocky substrates
FI	Etheostoma trisella	Trispot Darter	G1	S1		E	Breeding: vegetated spring seepage areas typical Nonbreeding: clear streams in vegetated shallow slackwater areas
FI	Fundulus catenatus	Northern Studfish	G5	S2		R	Margins of small to medium streams in areas of sluggish to moderate current
FI	Hemitremia flammea	Flame Chub	G3	S1		E	Springs and springfed streams; often associated with aquatic vegetation
FI	Hiodon tergisus	Mooneye	G5	S1			Usually found near the surface of large streams, rivers, and swift tailwaters of locks and dams
FI	Hybopsis lineapunctata	Lined Chub	G3G4	S2		R	Upland creeks over sandy substrate with gentle current
FI	Hybopsis sp. 9	Etowah Chub	G1Q	S1S2			Generally in creeks and small to medium rivers over sand-silt bottom, usually in pools adjacent to riffle areas. Tends to occupy smaller streams in east than in west.
FI	Ichthyomyzon bdellium	Ohio Lamprey	G3G4	S1		R	Medium to large rivers, mud to gravel bottoms; riffles in small tributaries
FI	Lampetra aepyptera	Least Brook Lamprey	G5	S2			ammocoetes associated with mud, silt, and macrophytes. Adults associated with sand and gravel.
FI	Lythrurus lirus	Mountain Shiner	G4	S3			Cool, clear streams in flowing water over sandy to rocky substrates
FI	Macrhybopsis sp. 1	Coosa Chub	G3G4	S1		E	Fast water in large streams and rivers
FI	Moxostoma carinatum	River Redhorse	G4	S3		R	Swift waters of medium to large rivers
FI	Notropis ariommus	Popeye Shiner	G3	S1		E	Large streams and small rivers in flowing pools areas over gravel
FI	Notropis asperifrons	Burrhead Shiner	G4	S2		T	Small streams to medium-sized rivers in pools, slow runs, and backwater areas
FI	Noturus eleutherus	Mountain Madtom	G4	S1		E	Riffle areas in medium to large rivers over coarse gravel and rubble
FI	Noturus flavipinnis	Yellowfin Madtom	G1	SX	LT		Pools and backwaters of medium-sized creeks; gravel and pebble substrate
FI	Noturus munitus	Frecklebelly Madtom	G3	S1		E	Shoals and riffles of moderate to large streams and rivers
FI	Percina antesella	Amber Darter	G1G2	S1	LE	E	Riffles & runs of medium-sized rivers, patches of sand and small gravel, riverweed
FI	Percina jenkinsi	Conasauga Logperch	G1	S1	LE	E	Fast-flowing chutes and pools over clean substrates of gravel or cobbles
FI	Percina kusha	Bridled Darter	G2	S1		E	Flowing pools and runs in large streams and small to medium sized rivers with clear water
FI	Percina lenticula	Freckled Darter	G3	S2		E	Swift deep runs of main river channels around large woody debris, possibly over a rocky substrate
FI	Percina sciera	Dusky Darter	G5	S3		R	Large creeks and rivers in moderate current associated with woody debris, undercut banks, or vegetation

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Table 4. Southwestern Appalachians/Ridge & Valley High Priority Animals (110 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Percina tanasi	Snail Darter	G2G3	S1	LT	E	Large streams to medium-sized rivers in riffle areas with sand or gravel substrate
FI	Phenacobius uranops	Stargazing Minnow	G4	S1		T	Riffle areas in small to medium rivers
FI	Phoxinus tennesseensis	Tennessee Dace	G3	S1		E	pool areas of clear headwater creeks, typically less than 2 m in width
FI	Typhlichthys subterraneus	Southern Cavefish	G4	S1		E	Underground streams
MA	Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	G3G4	S3		R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps
MA	Myotis grisescens	Gray Myotis	G3	S1	LE	E	Caves with flowing water or with large creeks or bodies of water nearby, also storm sewers and artificial caves in other states. Unknown summer roosts in eastern portion of GA range. Marble mines?
MA	Myotis leibii	Eastern Small-footed Myotis	G3	S2			Caves; mines; abandoned buildings, bridges, rock shelters in mountainous areas; high elevation talus fields
MA	Myotis lucifugus	Little Brown Myotis	G3	S3			Caves & mines; mixed forests, structures, bat houses
MA	Myotis septentrionalis	Northern Myotis	G2G3	S2S3			Caves & mines in winter; riparian areas, upland forests, cracks and crevices in dead and live trees in summer
MA	Myotis sodalis	Indiana Myotis	G2	S1	LE	E	Limestone caves with pools; wooded areas near streams, upland forests, large snags in open areas including ridge tops
MA	Perimyotis subflavus	Tri-colored Bat	G3	S5			Open forests with large trees and woodland edges; roost in tree foliage; hibernate in caves or mines with high humidity.
MA	Spilogale putorius	Eastern Spotted Skunk	G4	S3			brushy, rocky, wooded habitats; avoids wetlands
MO	Campeloma regulare	Cylinder campeloma	G4	S2			Large rivers to small streams along margins
MO	Elimia ornata	Ornate Elimia	G1	S1			Medium sized rivers
MO	Elimia striatula	File Elimia	G2	S1			Creeks, spring/spring brook
MO	Elliptio arca	Alabama Spike	G2G3Q	S1		E	Med creeks to Lg rivers; sand and gravel substrate
MO	Elliptio arctata	Delicate Spike	G2G3Q	S2		E	Creeks and rivers with moderate current; mainly in crevices and under large rocks in silt deposits
MO	Hamiota altilis	Finelined Pocketbook	G2G3	S2	LT	T	Small streams to large rivers; sand, gravel, and cobble substrates; usually not in swift current
MO	Lampsilis straminea	Southern Fatmucket	G5T	S2			Small creeks to rivers in slow to moderate current; sand, sandy mud and gravel substrates
MO	Lasmigona holstonia	Tennessee Heelsplitter	G3	S1			Small to large creeks; Occurs often in small creeks and medium sized rivers and spring runs. Sandy substrates, may be mixed with some gravel or mud
MO	Leptoxis foremani	Interrupted Rocksnail	G1	S1	E	E	Rocky shoals in current.
MO	Leptoxis praerosa	Onyx Rocksnail	G5	S1			Big rivers, found on algae covered rocks in strong current
MO	Medionidus acutissimus	Alabama Moccasinshell	G2	S1	LT	T	Large rivers to medium sized creeks; sand and gravel substrate; slow to swift current
MO	Medionidus conradicus	Cumberland Moccasinshell	G3G4	S1			Large creeks in TN Basin tributaries; shoal and run habitats; sand and gravel, frequently occurs under large, flat rocks
MO	Medionidus parvulus	Coosa Moccasinshell	G1Q	S1	LE	E	Shoal areas of large rivers to medium sized creeks with sand and gravel substrates.
MO	Pleurobema decisum	Southern Clubshell	G2	S1	LE	E	Large rivers to medium sized streams with flowing water; gravel with interstitial sand
MO	Pleurobema georgianum	Southern Pigtoe	G1	S1	LE	E	Large rivers to medium sized creeks in riffles, runs, and shoals; sand and gravel substrate

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Table 4. Southwestern Appalachians/Ridge & Valley High Priority Animals (110 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
MO	Pleurobema hanleyianum	Georgia Pigtoe	G1	S1	E	E	Large rivers to medium sized creeks; mainstem only, not in tribs
MO	Pleurobema hartmanianum	Cherokee Pigtoe	G1	S1			Appears to have been restricted to shoal habitats based on historical collection data.
MO	Pleurocera pyrenella	Skirted Hornsnail	G2	S2			Mountain streams
MO	Pleurocera showalteri	Upland Hornsnail	G2Q	S1			Medium sized rivers
MO	Pleurocera vestita	Brook hornsnail	G3	S2			Aquatic habitats
MO	Pleuronaia barnesiana	Tennessee Pigtoe	G2G3	S1			small streams to large rivers with flowing water in TN Basin tributaries; stable gravel with interstitial sand
MO	Ptychobranchus fasciolaris	Kidneyshell	G4G5	S1			Small creeks to large rivers with moderately strong current in substrate of coarse gravel and sand
MO	Ptychobranchus foremanianus	Rayed Kidneyshell	G1	S1		E	Medium to large rivers in moderate to swift current; sand and gravel substrate
MO	Strophitus connasaugaensis	Alabama Creekmussel	G3	S1		E	Large rivers to medium sized creeks with moderate current; sand and gravel substrate
MO	Toxolasma corvunculus	Southern Purple Lilliput	G1	S1?			Flowing waters of creeks to medium rivers
MO	Villosa nebulosa	Alabama Rainbow	G3	S2			Large rivers to small streams; flowing water with gravel and sand substrates, may be found in fine sediments among cobble and boulders
MO	Villosa umbrans	Coosa Creekshell	G2	S2			gravel and sand substrates in shoal and riffle habitats
RE	Graptemys pulchra	Alabama Map Turtle	G4	S3		R	Rivers & large streams
RE	Pituophis melanoleucus melanoleucus	Northern Pine Snake	G4T4	S2			Dry pine or pine-hardwood forests
TA	Amblyscirtes belli	Bell's Roadside-skipper	G3G4	S3			Wet hardwoods, river oats
TA	Amblyscirtes carolina	Carolina roadside-skipper	G3G4	S2S3			Wet situations with cane
TA	Amblyscirtes reversa	Reversed roadside-skipper	G3G4	S2S3			Wet hardwoods, cane, hardwood slopes with cane
TA	Autochton cellus	Golden-banded skipper	G4	S2			Hog peanut, areas of intact groundcover
TA	Bombus affinis	Rusty-patched bumblebee	G1	SH			
TA	Danaus plexippus	Monarch butterfly	G4	S4			Milkweeds
TA	Erora laeta	Early hairstreak	GU	S2S3			Hardwood, beech trees
TA	Euphydryas phaeton	Baltimore checkerspot	G4	S2			Chattahoochee River parks
TA	Pieris virginiensis	West Virginia White	G3	S3			Hardwoods
TA	Satyrium edwardsii	Edwards hairstreak	G4	S3			Blackjack oak
TA	Speyeria diana	Diana fritillary	G3G4	S3			Hardwood forests
TA	Temnothorax_GA_01	Temnothorax new species	GNR	SU			Ridge forest, Quercus monticola branches

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 5. Southwestern Appalachians/Ridge & Valley High Priority Plants (65 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Aesculus glabra	Ohio Buckeye	G5	S2			Mesic forests in circumneutral soil
Agalinis decemloba	Ten-lobed Purple Foxglove	G4Q	S1			Dry, grassy meadows.
Agastache nepetoides	Yellow Giant Hyssop	G5	S1			Openings in rich hardwoods
Alnus maritima ssp. georgiensis	Georgia Alder	G3T1	S1		T	Open, spring-fed swamps
Amelanchier sanguinea	Roundleaf Serviceberry	G5	S1?			Rocky slopes
Anemone berlandieri	Glade Windflower	G4?	S1S2			Granite outcrop ecotones; openings over basic rock
Arabis georgiana	Georgia Rockcress	G1	S1	C	T	Rocky or sandy river bluffs and banks, in circumneutral soil
Asclepias purpurascens	Purple Milkweed	G5?	S1		R	Calcareous flatwoods, wet meadows near Rome
Aureolaria patula	Spreading Yellow Foxglove	G3	S1		T	Circumneutral alluvial bottoms
Baptisia australis var. aberrans	Glade Blue Wild Indigo	G5T2	S2			Limestone glades and barrens
Berberis canadensis	American Barberry	G3	S1		E	Cherty, thinly wooded slopes
Buchnera americana	American Bluehearts	G5?	S1			Wet meadows; seasonally moist barrens and limestone glades
Calamovilfa arcuata	Cumberland Sandreed	G2G3	S1			Georgia habitat information not available
Carya laciniosa	Shellbark Hickory	G5	S2?			Bottomland forests
Carya myristiciformis	Nutmeg Hickory	G4	S1		R	Calcareous flatwoods
Chelone lyonii	Appalachian Turtlehead	G4	SNR			Wet woods, streamsides, fens of S. Appalachians
Clematis fremontii	Fremont's Leatherflower	G5	S1		E	Grassy openings in flatwoods of mostly lowland oaks and red maple
Clematis socialis	Alabama Leather Flower	G1	S1	LE	E	Grassy openings in flatwoods of mostly lowland oaks and red maple
Crataegus aemula	Rome Hawthorn	G2G3	S2?			Upland hardwood forests; creek flats
Crataegus mendosa	Albertville Hawthorn	G2G3Q	S1			Rocky woods, glades
Crataegus mollis	Downy Hawthorn	G5	SNR			Georgia habitat information not available
Crataegus triflora	Three-Flower Hawthorn	G2G3	S1		T	Hardwood forests on rocky, limestone slopes
Delphinium alabamicum	Alabama Larkspur	G2	SH			gravel hills in limestone glades
Desmodium ochroleucum	Cream-Flowered Tick-Trefoil	G1G2	S1		T	Open, calcareous woodlands, including lower slope of Pigeon Mountain
Dulichium sp. nov. (unpublished)	Coosa Prairie Threeway Sedge	GNR	S1			Coosa wet prairies
Echinacea simulata	Prairie Purple Coneflower	G4	S2S3			Remnant prairies in the Coosa flatwoods near Rome
Helianthus verticillatus	Whorled Sunflower	G1Q	S1	C	E	Remnant prairies
Hydrastis canadensis	Goldenseal	G3G4	S2		E	Rich woods in circumneutral soil
Jamesianthus alabamensis	Jamesianthus	G3	S1		E	Streambanks, in circumneutral soil
Juglans cinerea	Butternut	G4	S2			Openings in bottomland forests and in the mesophytic hardwood forests of rich mountain coves
Leavenworthia exigua var. exigua	Least Gladecress	G4T3	S2		T	Limestone glades
Lilium canadense	Canada Lily	G5	S2?			Openings in rich woods
Lilium michiganense	Michigan Lily	G5	S1		R	Remnant wet prairies andcalcareous flatwoods
Lilium philadelphicum	Wood Lily	G5	S1		E	Wet meadows over sandstone
Lysimachia fraseri	Fraser's Loosestrife	G3	S2		R	Moist, open, bouldery gravel bars and streambanks; edges of sandstone and granite outcrops
Marshallia mohrii	Coosa Barbara's-Buttons	G3	S2	LT	T	Remnant Coosa Valley prairies; maintained rights-of-way
Marshallia trinervia	Broadleaf Barbara's-Buttons	G3	S1S2			Streamsides in open, bouldery gravel bars and washed, sandy banks

Table 5. Southwestern Appalachians/Ridge & Valley High Priority Plants (65 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Neviusia alabamensis	Alabama Snow-Wreath	G2	S1		T	Along wet weather streams over limestone
Onosmodium molle ssp. occidentale	Western Marble-Seed	G4G5T4?	S1			Limestone glades and adjacent woods
Panax quinquefolius	American Ginseng	G3G4	S3			Mesic hardwood forests; cove hardwood forests
Philadelphus pubescens	Hairy Mockorange	G5?	S1			Limestone ledges and rocky banks
Platanthera integrilabia	Monkeyface Orchid	G2G3	S1S2	C	T	Red maple-gum swamps; peaty seeps and streambanks with Parnassia asarifolia and Oxypolis rigidior
Polymnia laevigata	Tennessee Leafcup	G3	S1			Bouldery slopes
Quercus similis	Swamp Post Oak	G4	S1			Bottomland swamps and other wet habitats
Rhynchospora thornei	Thorne's Beakrush	G3	S2			Margins of limesink ponds; moist limestone barrens, wet prairies
Rudbeckia heliopsidis	Little River Black-Eyed Susan	G2	S1		T	Limestone or sandstone barrens and streamsides
Sabatia capitata	Cumberland Rose Gentian	G2	S2		R	Meadows over sandstone or shale
Sagittaria secundifolia	Little River Water-Plantain	G1	S1	LT	T	Crevices in sandstone in fast flowing streams
Scutellaria montana	Large-Flower Skullcap	G4	S3	LT	T	Mesic hardwood-shortleaf pine forests; usually mature forest with open understory, sometimes without a pine component
Silene regia	Royal Catchfly	G3	S1		E	Limestone barrens; remnant prairies
Silphium mohrii	Cumberland Rosinweed	G3?Q	S1?			Rocky hardwood forests
Solidago arenicola	Black Warrier Goldenrod	G2G3	S1			Georgia habitat information not available
Spiraea virginiana	Virginia Spirea	G2	S1	LT	T	Bouldery gravel bars and ledges along major streams
Spiranthes magnicamporum	Great Plains Ladies-Tresses	G4	S1		E	Limestone glades
Symphyotrichum georgianum	Georgia Aster	G3	S2	C	T	Upland oak-hickory-pine forests and openings; sometimes with Echinacea laevigata or over amphibolite
Thalictrum debile	Trailing Meadowrue	G2	S1		T	Mesic hardwood forests over limestone
Thaspium pinnatifidum	Cutleaf Meadow-Parsnip	G2G3	S1		E	Limestone outcrops and barrens
Thermopsis fraxinifolia	Ash-Leaved Bush-Pea	G3?	S2?			Oak and oak-pine ridge forests
Thermopsis villosa	Carolina Golden Banner	G3?	S1?			Mesic forests, floodplains and roadsides; mostly in sandy soils
Trillium pusillum	Least Trillium	G3	S1		E	Red maple-blackgum swampy woods in sticky clay soils
Trillium sp. nov. (unpublished)	Lookout Mountain Toadshade	GNR	S2			Hemlock-mixed hardwood bluffs
Veratrum woodii	Ozark Bunchflower	G5	S2		R	Mesic hardwood forests over basic soils
Viburnum bracteatum	Limerock Arrowwood	G1G2	S1		E	Mesic hardwood forests over limestone
Xerophyllum asphodeloides	Eastern Turkeybeard	G4	S1		R	Xeric oak-pine forests
Xyris tennesseensis	Tennessee Yellow-Eyed Grass	G2	S1	LE	E	Seepy margins of limestone spring runs

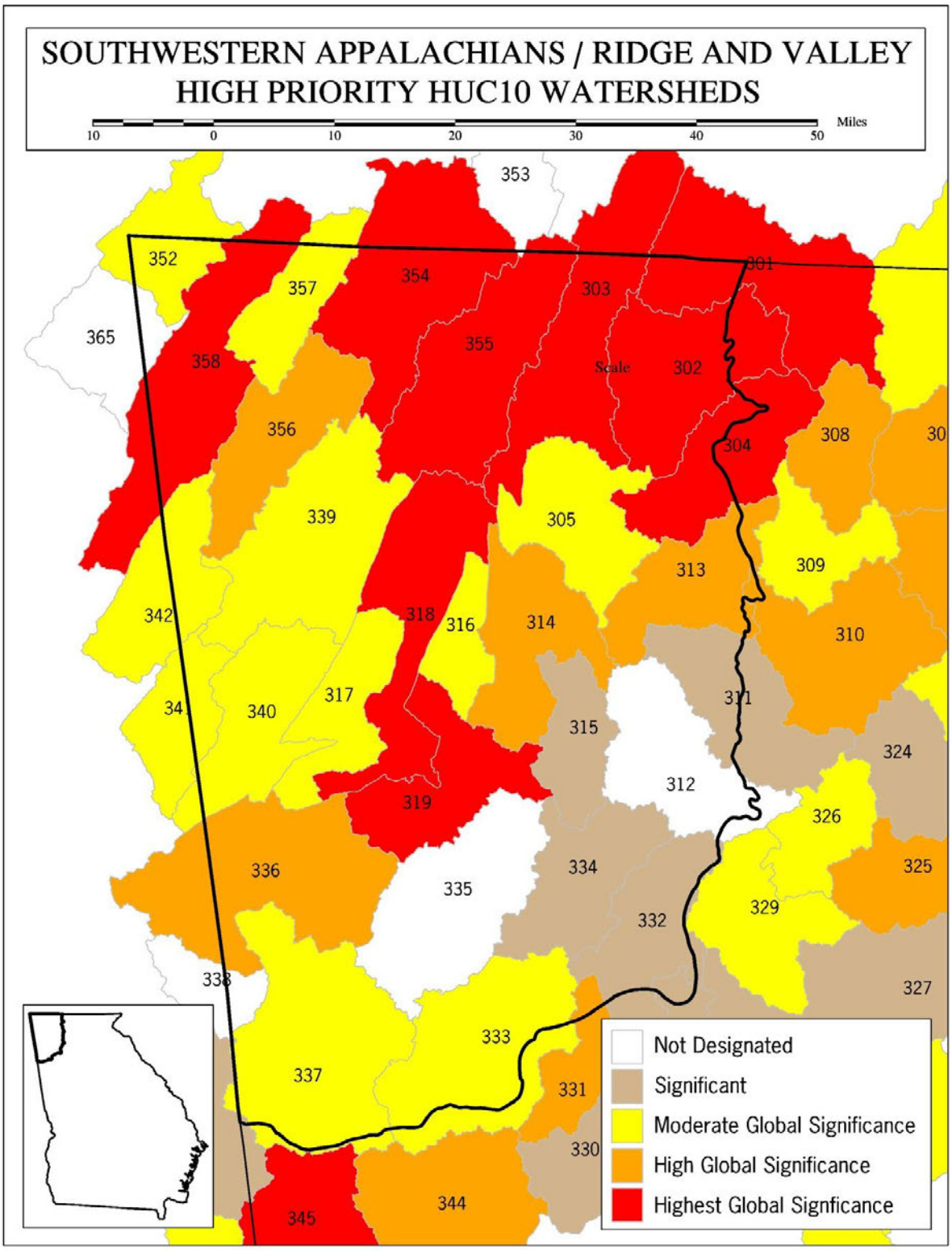

Figure 12. High Priority Waters, Southwestern Appalachians/Ridge & Valley Ecoregions

Blue Ridge Ecoregion

Ecoregional Overview

The Blue Ridge ecoregion of Georgia covers approximately 1,694,412 acres. This total includes approximately 688,528 acres in conservation ownership. Georgia DNR manages 25,217 acres owned in fee simple by the State of Georgia and an additional 34,620 acres through leases or management agreements. Most of the conservation land (approximately 613,000 acres) in the region is owned by the federal government and managed by the USDA Forest Service. Other federal land managers include the Department of Defense (8,605 acres) and the Tennessee Valley Authority (5,066 acres). This ecoregion has a higher percentage of land in conservation use (42.2%) than all of the other ecoregions.

Landforms of the Blue Ridge range from narrow ridges to hilly plateaus to more massive mountainous areas with high peaks. The mostly forested slopes, high-gradient, cool, clear streams, and rugged terrain occur on a mix of igneous, metamorphic, and sedimentary geology. High peaks in this region may have annual precipitation of over 70 inches. The southern Blue Ridge is one of the richest centers of biodiversity in North America. Characteristic vegetation includes northern hardwood forest, submesic oak forests, heath thickets, shrub balds, hemlock-hardwood-white pine forests, cove hardwood forests, and mountain bogs. The three subdivisions of the Blue Ridge ecoregion in Georgia are the Southern Crystalline Ridges and Mountains, the Southern Metasedimentary Mountains, and the Broad Basins.

The Southern Crystalline Ridges and Mountains include the highest and wettest mountains in Georgia. These occur primarily on Precambrian igneous and metamorphic rocks. The common crystalline rock types include gneiss, schist, and quartzite. Soils are well-drained, acidic, and loamy. Mafic and ultramafic rocks also occur, contributing to circumneutral soils. Elevations of this rough, dissected region range from approximately 1800 feet to over 4000 feet; Brasstown Bald, the highest point in Georgia is 4,784 feet above mean sea level. Although there are a few small areas of pasture, orchards, and other clearings, this region is mostly forested.

The Southern Metasedimentary Mountains contain rocks that are generally not as strongly metamorphosed as those in the Southern Crystalline Mountains. The geologic materials are mostly late Precambrian and include slate, conglomerate, phyllite, metagraywacke, metasiltstone, metasandstone, and quartzite, with some schist and gneiss. Although the highest peaks are lower than in the preceding region, there are some isolated rugged mountains, such as the Cohuttas, Rich Mountain, and Fort Mountain.

The Broad Basins region is drier, and has lower elevations and less relief than the two preceding regions. Soils in this region are generally deep, well-drained, and loamy to clayey. Although this rolling foothills region is mostly forested, it has more pasture than

adjacent regions as well as areas of row crops and truck crops on terraces and floodplains. Much of the pasture and corn crops support local cattle, hog, or poultry operations.

The predominant landcover types in the Blue Ridge ecoregion are deciduous/mixed forest and evergreen forest (Kramer and Elliott, 2004). An analysis of land use changes from 1974 to 1998 based on satellite imagery indicated the following general trends:

- A decrease in row crop/pasture (from 7.31% of total landcover to 6.66%)
- An increase in high-intensity and low-intensity urban (from 1.26% of total landcover to 4.81%)
- An increase in clearcut/sparse vegetation (from 1.20% of total landcover to 3.16%)
- A decrease in evergreen forest (from 17.25% of total landcover to 12.12%)
- A very slight increase in deciduous/mixed forest (from 71.25% of total landcover to 71.69%)

These trends indicated a slight decline in the total acreage devoted to active agricultural uses, a significant increase in residential and commercial development, an increase in disturbance related habitats (probably representing harvest or loss of pine-dominated stands) and essentially no change in the predominant land cover type, deciduous/mixed forest during this period.

An analysis of land use change from 2006 to 2011 indicates a 2.9% increase in open water, 1.6% increase in developed land, 1.8% decrease in agricultural land, 0.8% decrease in forest land, 15.3% increase in early successional vegetation, and no change in wetland landcover. These figures confirm a continuation of decline in agricultural and forest land and an increase in developed land. The significant increase in early successional landcover classes (barren, herbaceous, and scrub/shrub) is likely a result of higher rates of timber harvest during the early portion of this six-year period, when timber prices were relatively high. See Appendix N for more information on recent landcover trends.

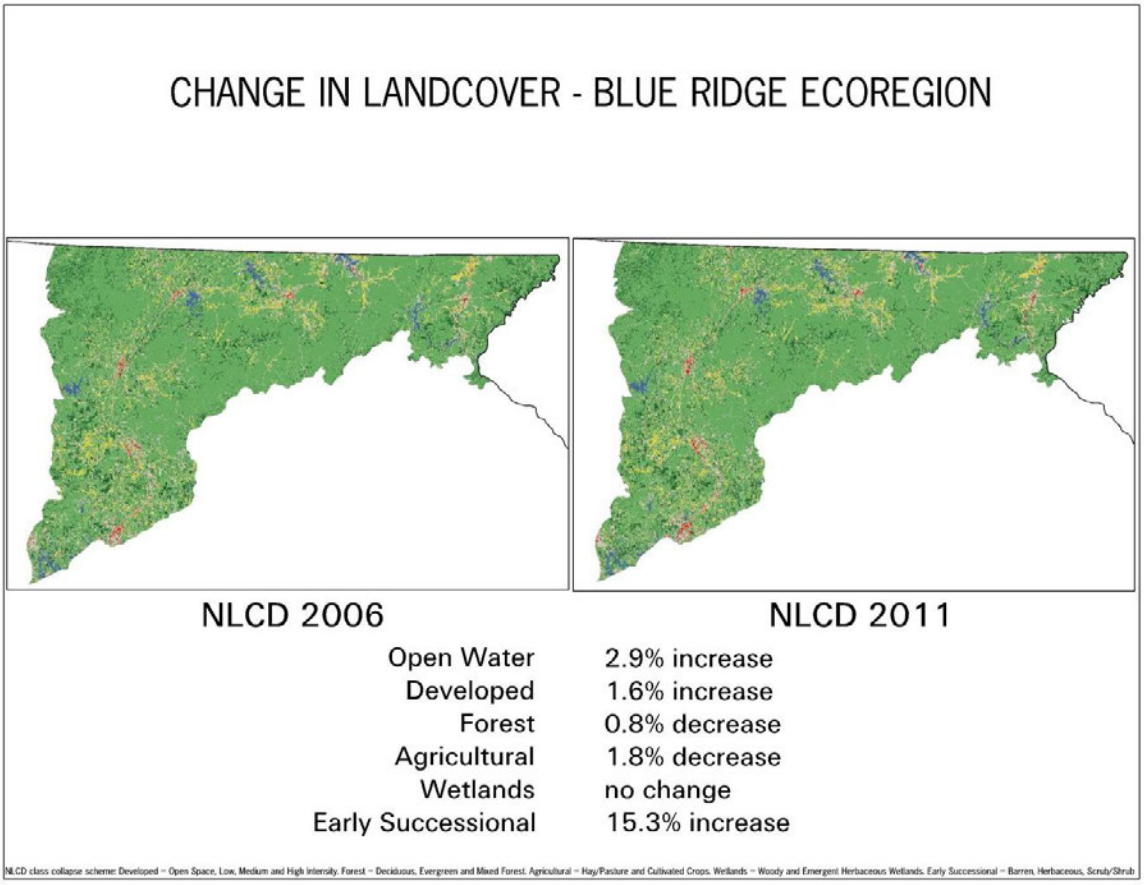

Figure 13. Change in landcover from 2006 to 2011 in the Blue Ridge ecoregion.

High Priority Species and Habitats

The technical teams identified 89 high priority animal species in the Blue Ridge ecoregion. These included 9 birds, 14 mammals, 2 reptiles, 3 amphibians, 35 fish, 3 mollusks, 9 aquatic arthropods, and 15 terrestrial arthropods. These species are listed in Table 6, with information on global and state rarity ranks, protected status (if any) under federal or state law, and habitat and range in Georgia. In addition, 66 species of high priority plants were identified for the Blue Ridge. These are listed in Table 7.

High priority habitats for the Blue Ridge ecoregion are described below:

1. Boulderfield Forests
High elevation mesic hardwood forest; dominated by broadleaf deciduous trees, occupying north-facing areas with angular rocks or blocks of rock and little visible soil. Includes rich flora with northern affinities. Typically very mesic, with trees such as yellow buckeye, sweet birch, yellow birch, rosebay rhododendron. A rare community of the Blue Ridge; only a few examples are known.

2. Canebrakes
Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require fire or other form of periodic disturbance for maintenance. Most examples in this ecoregion are small and fire-suppressed.

3. Caves, Rock Shelters, Talus Slopes
These habitats share characteristics, such as a bedrock component with a variety of microhabitats that provide cover for priority animal species. These habitats are usually embedded in a larger matrix of forest habitats. The Blue Ridge contains relatively few caves; these are typically fracture-type caves rather than solution caves. Rock shelters can be found under cliffs (vertical exposures of rock). Talus slopes are accumulations of rock beneath cliffs and steep slopes.

4. Floodplain Hardwood Forests
Forested wetlands characterized by a diverse association of deciduous hardwood trees, including both montane and low-elevation species. Generally lacking in the more flood-adapted oaks and hickories prevalent in Piedmont bottomland hardwood forests. Many of these floodplain forests were converted to agricultural uses early in the history of settlement of this region.

5. Hemlock-Hardwood-White Pine Forests
Mesic and submesic forests dominated by a mixed canopy of hardwoods and hemlock and/or white pine. Hemlock forests are typically found along small to medium streams, in sheltered valleys and ravines. Thickets of rhododendron and mountain laurel frequently form a dense understory, which is important for many neotropical migratory birds. White pine may share dominance with oak-dominated forests in low- to mid-elevation slopes and sheltered low ridges. A serious threat to this forest type is the hemlock wooly adelgid, which is spreading from east to west across the region. A rare subtype of this forest type containing Carolina hemlock is found in scattered locations in the lower Blue Ridge.

6. High-Elevation Early Successional Habitats
Includes a variety of vegetation types found at high elevations that are maintained by periodic natural or anthropogenic disturbance. Many high priority species are dependent on this habitat type, including the golden-winged warbler, Appalachian Bewick's wren, star-nosed mole, pygmy shrew, and fringed gentian.

7. High Elevation Forested Heath Thickets
High elevation habitats characterized by dense thickets of ericaceous shrubs under an open canopy of hardwood trees. Herbaceous layer is sparse to patchy. Typical shrubs include huckleberry, mountain laurel, and rosebay rhododendron.

8. High Elevation Rocky Summits and Shrub Balds
These are small patch habitats typically found only on the highest peaks of the Blue Ridge in association with northern hardwood forest. Characterized by a mosaic of exposed rock and patches of shrub or herb-dominated vegetation. Trees are mostly dwarfed northern red oak. Shrubs may include Catawba rhododendron, mountain laurel, huckleberry, mountain ash, viburnum, and hawthorn.

9. Low Elevation Seepy Thickets and Wet Woods
Seasonally inundated or spring-fed wetland habitats. Thickets are dominated by a variety of shrubs. Includes forested habitats along seepage slopes and at the edge of mountain bogs, some of which are maintained by the actions of beaver.

10. Medium to Large Rivers
Moderate to high gradient rivers with cold, clear riffles, pools, and runs. Substrates may include boulders, bedrock, gravel, and pebbles. Many of these rivers traverse steep gorges. These aquatic habitats are low in productivity compared to streams of the Southwestern Appalachians/Ridge & Valley.

11. Mixed Pine-Hardwood Forests
Mesic to submesic forests of hardwoods and pines, typically at middle to low elevations over a broad range of topographic conditions. A large patch habitat that comprises a major forest type of the Blue Ridge. Dominants may include yellow-poplar, sweetgum, various oaks, and loblolly, white, and/or shortleaf pine.

12. Moist Cliff Faces and Spray Cliffs
Vertical to gently sloping rock faces located adjacent to waterfalls or seepage zones. These are wetlands dominated by mosses, liverworts, vascular herbs, and sparse shrubs or scrubby trees adapted to thin soils and high humidity. These small patch habitats represent unusually stable environments, where temperatures are moderated by the constant spray or seepage. Include many bryophytes and ferns representing disjunct occurrences from tropical regions as well as Southern Appalachian endemics.

13. Mountain Bogs and Wet Meadows
A mosaic of wetland communities usually dominated by shrubs or emergent herbs, with scattered trees. May occur as elongate bands along stream valleys, or in much smaller and more compact patches on flats or slopes. Includes wetlands maintained by beaver activity as well as small, sheltered seepage areas along the headwaters of mountain creeks.

14. Northern Hardwood Forests
High elevation mesic forests found in upper coves, flats and slopes with northerly aspects, usually at elevations above 3,500 ft. Dominant canopy species include American beech, yellow birch, sugar maple, and yellow buckeye, with white basswood, northern red oak, white ash, and black cherry also present. These forests are subject to broad scale disturbances such as ice storms. Old growth examples are rare and usually restricted to steeply sloped, inaccessible areas.

15. Oak Forest and Woodlands
This vegetation type includes a wide variety of upland forests dominated by Appalachian oaks. Composition and complexity of oak forests vary with elevation, slope and moisture. In more mesic sites, canopy dominants may include red oak, white oak, and black oak, along with hickories and mesophytic hardwoods. Canopy dominants of more xeric sites may include mountain chestnut oak, scarlet oak, southern red oak, and northern red oak. Also includes subxeric or xeric oak woodlands found on ridges and upper slopes at high elevations. These oak-dominated forests and woodlands represent the most extensive natural vegetation type of the Blue Ridge.

16. Pine-Oak Woodlands and Forest
Relatively open subxeric forest to xeric woodland, typically dominated by shortleaf pine, pitch pine, Virginia pine, and post and blackjack oaks, often with a diverse grass and shrub layer. A rare subtype is found on serpentine soils. Pitch pine, Virginia pine, red maple and post oak are the dominant canopy trees in this rare community; understory trees of sourwood, dogwood and sassafras are usually thinly scattered and shrubs are sparse to dense.

17. Rich Mesic Hardwood Forests (Cove Hardwoods)
The mixed mesophytic hardwood forests of the Southern Appalachians are the most biologically diverse habitats in the United States. Variations of this forest type can be found in the Blue Ridge at elevations from 1,000 to 3,800 ft. They are typically found in mesic sites on concave landforms and ravines, or on protected north and east-facing slopes at low elevations. A diverse mixture of mesophytic trees dominates the canopy, including yellow poplar, white basswood, sugar maple, yellow and sweet birch, cucumber magnolia, yellow buckeye, black cherry, eastern hemlock, white ash, blackgum, American beech, red maple, and various oaks and hickories.

18. Rocky Bluffs and Streambanks
Plant composition of these rocky streamside habitats is variable, depending on stream size, amount of rock, and extent of flooding. These periodically scoured rocky habitats typically support few trees and sparse to moderate shrubs (sometimes thickets). A diverse stratum of light-loving herbs may be present.

19. Springs and Spring Runs; Gravelly Seeps
Springs are highly localized groundwater expressions. The waters of springs and associated habitats can be highly variable, depending on hydrology (hydroperiod and volume) and edaphic factors. These cool clean waters provide important habitat to a number of animal species, particularly salamanders.

20. Streams
Cold, clear, high gradient streams typically containing riffles, plunge-pools, cascades, and waterfalls. Substrata dominated by bedrock and boulders, but sand and gravel may also be present in depositional areas. These streams have low productivity and aquatic vegetation is rarely present.

21. Xeric Pine Woodlands
A heterogeneous group of xeric pine-dominated woodlands found on ridges and steep slopes with southerly aspects, knobs, and low-elevation peaks. Below 2,400 ft. shortleaf pine is a dominant, with Virginia pine a common associate. From 2,400 to 2,800 ft. on the driest ridges pitch pine dominates. Above 2,800 ft. on slopes and ridges, Table Mountain pine dominates. All of these habitats require periodic fire for maintenance.

Problems Affecting Wildlife Diversity

One of the primary factors impacting habitats and species in the Blue Ridge region is the rapid pace of residential and commercial development along major highways and on the outskirts of metropolitan areas. Much of this development is occurring as a result of an influx of people from other areas of the state as well as immigrants from other states. New industrial and commercial sites have been developed along recently improved highways, including Georgia Highways 515 and U.S. Highways 19, 76, 129, 441, and 575. Metropolitan areas experiencing significant growth in this region include Clayton, Jasper, Blue Ridge, and Dawsonville.

Valleys and river bottoms in the Blue Ridge region have long been employed for a wide variety of agricultural uses, including row crops, pasture, and hay fields. In some watersheds vegetated stream buffers are too narrow to provide adequate erosion control, and in some areas livestock have unrestricted access to streams. These practices result in a general degradation of water quality and habitat for aquatic species. Expanding vegetated stream buffers and restricting livestock access to streams would provide significant benefits to imperiled aquatic species.

Point-source discharges into streams in this region include wastewater industrial facilities, and municipal treatment facilities. According to EPD stream monitoring data for 2012, 58% of streams meet designated uses (based on percentage of total monitored stream miles); 41% do not support designated uses, with 1% of stream segments pending assessment. The percentage of monitored streams meeting designated uses is the highest of all five Georgia ecoregions, due in large part to the high proportions of forest cover and conservation land.

Conversion of upland hardwood and pine-hardwood forests to pine plantations has also resulted in impacts to wildlife diversity. Specific problems associated with this forest conversion include loss of vegetative structure and nesting sites, decline in hard and soft mast production, loss of understory and groundcover diversity, and physical disturbance of habitat for organisms found in leaf litter or soil.

Fire suppression is also a significant problem in this region. Extension of residential and commercial development from urban centers into surrounding suburbs has resulted in many fire-dependent habitats being surrounded by highways, subdivisions, or retail centers. Concerns about smoke management, air quality, and damage to structures make it difficult to implement prescribed burn plans for some of these important habitats. Throughout the region, a lack of fire has resulted in the decline in the extent and quality

of habitats such as canebrakes, oak woodlands, and table mountain pine woodlands. Difficulties in implementing prescribed fire programs in the interface between residential and conservation lands present obstacles for restoration of these important habitats.

Invasive nonnative species pose significant threats to high priority species and habitats in this region. Feral hogs are a particularly noxious problem, due to their fecundity and indiscriminant use of habitats. Exotic plant species of concern include Nepalese browntop, Chinese privet, Japanese honeysuckle, oriental bittersweet, royal paulownia, kudzu, and autumn olive. A particularly important nonnative forest pest is the hemlock wooly adelgid, which has spread across the Georgia Blue Ridge from east to west, causing significant losses of eastern hemlock forest. The hemlock wooly adelgid also poses a direct threat to populations of the rare Carolina hemlock. In addition to impacts on forest communities, this pest threatens adjacent stream communities by causing loss of streamside vegetation. The USDA Forest Service is currently implementing various control measures against this invasive organism. Other insect pests that threaten forests in this region include the European gypsy moth and emerald ash borer.

Non-native fungal diseases have also disrupted forest communities at landscape scales--most notably, the chestnut blight fungus, which eliminated the American chestnut as a canopy tree in Georgia and greatly altered the vegetation and ecology of forests throughout the Blue Ridge. Dogwood anthracnose, caused by a non-native fungus, is currently a threat to eastern dogwood trees, especially those in dense, mesic forests. An introduced fungus, *Pseudogymnoascus destructans* (*Pd*) is the causative agent for white-nose syndrome, which has caused bat declines of over 90% in some caves in this ecoregion. This disease threatens formerly common species such as the tricolor bat, and is the primary threat to the northern long-eared bat, recently listed under provisions of the federal Endangered Species Act.

For some high priority species and habitats, unmanaged recreational use represents a serious problem. High levels of use by rock climbers and hikers may threaten habitats such as high elevation summits and spray cliffs/gorge walls. Similarly, exploration by unethical or inexperienced cavers can result in significant impacts to caves and spread the *Pd* fungus that causes white-nose syndrome from one cave to another. Indiscriminant use of all-terrain vehicles (ATVs) and other vehicles in or adjacent to streams or wetlands or on steep side slopes can result in significant impacts to aquatic habitats.

Construction of dams or other structures altering stream flow represents another significant problem for aquatic species in this region. These impacts, from impoundments such as Rabun Lake, Hiawassee Lake, and Lake Seed, include impaired water quality, barriers to migration, and isolation of subpopulations of aquatic species. Construction of new water supply reservoirs represents a threat to high priority aquatic species in this ecoregion.

Incompatible road and utility corridor management represent problems for some high priority plants such fringed gentian, large-flowered skullcap, persistent trillium, and Carolina hemlock. For these species, use of herbicides and other vegetation management

tools should be planned and implemented in a way that minimizes impacts to rare plant populations occurring in the road right-of-way or utility corridor.

High Priority Sites and Landscape Features

The current assessment and previous conservation planning efforts have identified a number of important sites and landscape features in this region of the state. An assessment of the Blue Ridge ecoregion conducted by The Nature Conservancy in cooperation with state natural heritage programs in Georgia, Tennessee, North Carolina, South Carolina, and Virginia identified 33 high priority conservation areas in Georgia representing approximately 149,300 acres (The Nature Conservancy, 2000). Recent field surveys have identified additional sites. The following are examples of important sites and landscape features in the Blue Ridge ecoregion.

Amicalola Creek Watershed/Dawson Forest WMA

This site contains a number of rare species, including the Etowah darter, holiday darter and eastern turkeybeard . Much of the immediate Amicalola Creek corridor is protected by state ownership and managed as Dawson Forest WMA, but residential development is impacting terrestrial and aquatic habitats in the watershed. This site lies on the border of the Blue Ridge and Piedmont ecoregions. A portion of Amicalola Creek has been proposed for study as a potential State Scenic River.

Blood Mountain/Coosa Bald/Sosebee Cove

This 3,200-acre site, found within the Chattahoochee National Forest, includes important examples of shrub bald, northern hardwood forest, and boulderfield forest habitats. These high-elevation habitats are rare in Georgia, and are recognized as important habitats in the Chattahoochee-Oconee National Forest Plan. Other examples of priority high-elevation habitats can be found at Tray Mountain, Brasstown Bald, and Rabun Bald. Perhaps the most significant long-term threat to these cool, moist environments and their associated species is global warming.

Chattooga Basin/Highlands Plateau

This 119,600 acre conservation landscape spans the upper Chattooga watershed in Georgia and South Carolina and the Highlands Plateau region in North Carolina. In Georgia, this area includes Cedar Cliffs, Buzzard Rock Cliffs, and the Ellicott Rock Wilderness Area. Numerous rare species and significant natural communities are contained within this landscape unit. The Upper Chattooga Basin is a designated Priority Amphibian and Reptile Conservation Area and supports high salamander diversity. It is the only place in Georgia with southern Appalachian and southern gray-cheeked salamanders. Green salamanders occur in forested areas with rock-outcroppings. While most of the area in Georgia is protected by special designation within the Chattahoochee National Forest, habitats in privately owned tracts within this area are being impacted by residential development. Another threat to this and many other conservation sites in the Blue Ridge is the hemlock wooly adelgid.

Etowah River Watershed

The Etowah River has its headwaters in the Blue Ridge Mountains. The upper portion of the Etowah River watershed provides habitat for numerous rare species, including a dozen species of imperiled fish and freshwater mussels. Several rare plants have also been documented from the Etowah River corridor. This watershed is threatened by residential and industrial development. This watershed was the subject of a grant to develop a Habitat Conservation Plan for federally listed aquatic species. In addition, a portion of the Etowah River was proposed for study as a potential State Scenic River.

Fort Mountain/Cohutta Mountains

This conservation site encompasses the western portion of the Cohutta Mountains and includes a number of important habitats including cove hardwood forest, mixed pine-hardwood forest, rock shelters, xeric pine-oak woodlands, and rocky bluffs/streambanks. Abandoned mines in the area provide suitable habitat for several species of bats. The Cohutta Mountain area is perhaps the largest contiguously forested upland region in the state, with attendant high salamander diversity. The area contains the headwaters of the Conasauga River. Most of this conservation site is under federal (USDA Forest Service) or state (Georgia DNR) management.

Hiawassee Seeps/Nantahala Mountains

This site, which straddles the Georgia-North Carolina border, includes important seep/wet meadow habitats that support the green pitcherplant and other bog species. It is threatened by residential development and associated hydrologic alterations in the landscape. While this is the only extant population of green pitcherplant in Georgia, similar low elevation seeps and bogs are found in scattered locations in the Hiawassee River drainage and elsewhere in the Blue Ridge of Georgia. The Nantahala Mountains region is a Priority Amphibian and Reptile Conservation Area. This site supports high salamander diversity as well as populations of eastern milk snakes and coal skinks.

Tallulah Gorge/Tugaloo Basin

Tallulah Gorge is a deep (600 ft.), narrow quartzitic rock gorge with sheer, almost vertical walls. The Tallulah River has been dammed to create a series of reservoirs, but much of the gorge and surrounding land is in relatively undisturbed condition. Important natural communities in this area include mesic cove hardwood forests, xeric pine-oak forests, and quartzitic cliffs. Rare species known from this area include persistent trillium, monkeyface orchid, Carolina hemlock, and green salamander. In 2015, a peregrine falcon nest was documented from the gorge walls, the first such nest in the wild in Georgia for over 80 years. Much of Tallulah Gorge is now managed as a state park, and adjacent property is managed by the USDA Forest Service. The Tugaloo Basin has the second highest salamander species richness in Georgia, and includes all but one of the known populations of the locally endemic patch-nosed salamander, as well as green salamanders.

Toms Swamp

This site located on the Chattahoochee National Forest includes mountain bog habitat containing mountain purple pitcherplant and Carolina bog-myrtle. Bog habitat at this site has been enhanced through cooperative efforts of the U.S. Forest, Georgia Department of Natural Resources, Atlanta Botanical Garden, the State Botanical Garden of Georgia, and other members of the Georgia Plant Conservation Association. Other mountain bog sites in the Blue Ridge are being actively restored by these conservation partners.

Upper Tallulah River Watershed

The headwaters of the Tallulah River contain several important habitats including hemlock-white pine-hardwood forest, rich mesic hardwood forests, and mountain streams and rivers. High priority species known from the sheltered coves and valleys of the upper Tallulah River watershed include water shrew, hairy-tailed mole, and red squirrel.

Woody Lake Bog

This small privately owned conservation site provides habitat for the state- and federally-protected bog turtle. This and other mountain bog/wet meadow habitats in the Blue Ridge are threatened by surrounding residential or commercial developments, hydrologic alterations, and encroachment by woody vegetation. Mountain bogs and wet meadows require periodic management. Under conditions prevalent in earlier times these habitats would be maintained by a combination of fire and the action of beaver.

<u>High Priority Waters</u>

Figure 14 shows the high priority streams and watersheds identified by the Aquatic Habitat Technical Team for this ecoregion. These streams were selected on the basis of documented occurrences of high priority aquatic species, the relative rarity of those species. Examples of high priority watersheds in the Blue Ridge include Holly Creek, Conasauga River, Mountaintown Creek, Cartecay River, Talking Rock Creek, Toccoa River, Amicalola Creek, Long Swamp Creek, Shoal Creek, Cochrans Creek, Chestatee River, Brasstown Creek, Chattahoochee River, Etowah River, Chattooga River, and Little Tennessee River. Refer to the Fishes and Aquatic Invertebrates Technical Team report in Appendix E for details on the factors that contribute to the global significance score of individual watersheds.

Conservation Goals

- Maintain known viable populations of all high priority species and functional examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, developing specific educational messages, and managing exotic species populations on public lands.
- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments
- Continue efforts to recover federally listed species by implementation of recovery plans and restore populations of other high priority species.

Strategies and Partnerships to Achieve Conservation Goals

- Support efforts by the U.S. Forest Service to implement prescribed burns to restore high priority habitats, including oak woodlands, table mountain pine stands, and shortleaf pine-post oak woodlands.
- Provide fire training and equipment to WRD and PRHS staff and encourage participation in interagency fire teams.
- Work with NRCS staff to identify high priority habitats and sites for implementation of habitat enhancement/restoration projects through Farm Bill programs (e.g., restoration of canebrakes, xeric pine woodlands, pine-oak woodlands/forest, and oak forest/woodlands)
- Prioritize control efforts for exotic species on public lands and provide technical assistance to private landowners to discourage use of invasive exotics
- Use state parks, wildlife management areas, and national forest lands to showcase habitat restoration efforts.
- Work with GDOT and local governments to minimize direct impacts to high priority species and habitats from road development projects
- Work with Georgia Power and private landowners to identify and conserve populations of rare species in and adjacent to utility corridors
- Develop educational materials on high priority species and habitats in the ecoregion and provide these to environmental educators at WRD facilities (e.g., Smithgall-Dukes Creek Conservation Area) and other facilities
- Work with the U.S. Forest Service, The Nature Conservancy, Georgia Land Conservation Center and local land trusts to provide protection for high priority wetlands and stream corridors.

- Share data on rare species and significant natural communities with staff of the Chattahoochee National Forest and provide input into forest management plans and biological evaluations.
- Provide enforcement to limit illegal ATV use. Work with ATV groups and ATV manufacturers to promote responsible use.
- Continue efforts to monitor ginseng trade through the Ginseng Management Program, and investigate illegal trade in nongame plants and animals.

Highest Priority Conservation Actions

Highest priority conservation actions (actions ranked "Very High" or "High") identified by the technical teams, Steering Committee, and other stakeholders specifically for this ecoregion include the following (see Appendix P for details):

- Conduct monitoring of caves with populations of bats currently affected or likely to be affected by white nose syndrome. Count bats and coordinate with researchers studying the disease and potential treatment options.
- Continue Conasauga River mainstem monitoring of fishes and water quality. Expand project to include mussels and other rare aquatic species as appropriate. Integrate results with ongoing water quality and contaminant studies.
- Implement occupancy sampling for freshwater mussels and snails in under-sampled reaches of the upper Coosa, including Coosawattee, Oostanaula, and Chattooga rivers.
- Develop Little Tennessee River System Watershed Plan. Work with USFWS and other partners to identify on-the-ground conservation projects that will improve water quality for people and aquatic species.
- Protect critical reaches of the Conasauga River system through targeted acquisition and easements with willing landowners. Provide targeted outreach and technical transfer to farmers to help minimize agricultural impacts to river.
- Restore mountain bogs. Restore or enhance populations of rare bog plants and continue bog turtle headstart and population establishment efforts. Monitor bog turtle populations.
- Develop a Sicklefin Redhorse Conservation Agreement. Support development and actively participate in a multi-partner effort to conserve the Sicklefin Redhorse.

For highest priority conservation actions of statewide scope, see Section V.

Oak Woodland Restoration on Chattahoochee-Oconee National Forests

Restoring oak woodlands is the largest single restoration acreage objective of the Land and Resource Management Plan for Chattahoochee-Oconee National Forests. The 2004 revised plan has an objective to restore 10,000 acres of open oak woodland on the Chattahoochee and 1,000 acres on the Oconee within the first 10 years of Plan implementation. Other objectives call for additional acreage for restoration of pine, pine-oak, or oak-pine forests that share ecological characteristics with oak woodland.

Bartram (1791) and Brewster (1885) described extensive open oak and pine woodlands in their travels through the southern Appalachians, which supported a unique assemblage of plant and wildlife species. The presence of significant grass and herbaceous cover in these forests has been documented for the past 10,000 years in the pollen record (Delcourt and Delcourt 1997). Some of the wildlife species, such as northern bobwhite and golden-winged warbler, that have been recorded as common in these forest types (Brewster 1885, 1886) have decline significantly in the region (Sauer et al. 2001). Since the end of annual woods burning and the end of free-ranging herbivores in the late 1920's to early 1930's, there has been a precipitous decline in this habitat type as forest succession first closed the canopy then provided conditions for the development of dense shade tolerant but fire intolerant mid-story. Current forests are typically densely stocked, closed-canopied stands with little or no herbaceous understories.

Woodland restoration is envisioned as recreating complexes of open habitat with tree densities varying irregularly from grassland to woodland condition, often grading into surrounding open forest conditions. This irregular density is meant to mimic historical conditions created and maintained by variation in fire intensities due to slope, aspect, landform, and soil type. In general, the most open parts of these complexes would occur on drier upper slopes and ridges and on south and west aspects. Using a single upslope fire run as a 'template,' intensity is lowest at the base of the slope, builds rapidly with progress upslope, and reaches its peak at the 'shoulder' of the ridgeline at the top of the slope. Similarly, top kill of woody vegetation shows a gradient with larger stems being killed as one ascends the slope. Ridge crest fires are variable in intensity with greatest intensity occurring on narrow crests. Fire intensity drops off rapidly with increasing distance away from the point of maximum intensity, changing into a backing fire of relatively low intensity on the lee slopes. Where fires burned at large scales of thousands to tens of thousands of acres, a mosaic of conditions resulting from variable fire behavior resulted.

There are four primary treatment types needed for woodland restoration: (1) thinning (reduction) of overstory canopy, (2) largely eliminating the midstory canopy, (3) reducing the sprouting of hardwood rootstocks, especially of the fire intolerant species, and (4) reduction in the litter and duff layer depth. This will involve a combination of selective timber removal, prescribed fire, and the use of herbicides to control vigorous re-sprouting of fire intolerant hardwoods. The Chattahoochee-Oconee National Forests is currently implementing several large-scale oak woodland projects with a goal of restoring this important community to the landscape.

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Delcourt, H. R., and P. A. Delcourt. 1997. Pre-Columbian Native American use of fire on southern Appalachian landscapes. Conservation Biology 11:10-14.

Table 6. Blue Ridge High Priority Animals (89 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
AA	Cambarus coosawattae	Coosawattee Crayfish	G2	S2		E	Riffle habitats in the Coosawattee River system
AA	Cambarus fasciatus	Etowah Crayfish	G3	S2		T	Lotic habitats under rocks in flowing water
AA	Cambarus georgiae	Little Tennessee Crayfish	G2G3	S1		E	Flowing parts of medium size rivers with sandy-clay substrate
AA	Cambarus parrishi	Hiwassee Headwaters Crayfish	G2	S1		E	Rocky areas between riffles and in flowing runs in clear cold headwater streams
AA	Cambarus speciosus	Beautiful Crayfish	G2	S2		E	Medium-sized streams with clear water and moderate to swift current with rock-littered substrate
AA	Macromia margarita	Mountain River Cruiser	G3	S1S2			Rocky mountain streams and rivers with good current
AA	Ophiogomphus edmundo	Edmund's Snaketail	G1G2	S1		E	Clear, moderately flowing streams and rivers with riffles.
AA	Ophiogomphus incurvatus	Appalachian Snaketail	G3T2T3	S2			Small to medium spring-fed streams with mud and gravel bottoms.
AM	Aneides aeneus	Green Salamander	G3G4	S3		R	Moist rock crevices; canopies of trees; within hardwood forests
AM	Cryptobranchus alleganiensis	Hellbender	G3G4	S3		T	Clear, rocky streams within Tennessee River drainages and Cartacay River
AM	Urspelerpes brucei	Patch-nosed Salamander	G1	S1			headwater streams
BI	Colinus virginianus	Northern Bobwhite	G5	S5			Early successional habitat, open pine savanna (frequent fire maintained in small burn unit size), fallow habitats associated with crop lands, extensive forest regen areas (area sensitive - minimal fall pop of 700 birds for viability on 3000+acres)
BI	Euphagus carolinus	Rusty Blackbird	G4	S3			Bottomland forest, pecan orchards, agricultural fields
BI	Haliaeetus leucocephalus	Bald Eagle	G5	S3		T	Edges of lakes & large rivers; seacoasts
BI	Limnothlypis swainsonii	Swainson's Warbler	G4	S3			Dense undergrowth or canebrakes in swamps and river floodplains, small mountain pop in rhododendron and mountain laurel thickets
BI	Setophaga cerulea	Cerulean Warbler	G4	S1B,S2M		T	Mature deciduous forest; floodplains or other mesic conditions
BI	Setophaga kirtlandii	Kirtland's Warbler	G3G4	SNRN	LE	E	Transient; varying habitats during late spring and fall
BI	Sphyrapicus varius appalachiensis	Appalachian Yellow-bellied Sapsucker	G5	S1B,S5M			Georgia habitat information not available
BI	Tyto alba	Barn Owl	G5	SU			Nests in large hollow trees or old buildings (particularly cement silos) in areas with extensive pasture or grassland or other open habitats such as marsh
BI	Vermivora chrysoptera	Golden-winged Warbler	G4	S1B,S2M		E	Regenerating clearcuts and burned areas; overgrown pastures, open oak forest, beaver pond regeneration
FI	Acipenser fulvescens	Lake Sturgeon	G3G4	S3			Large freshwater rivers & lakes over clean firm substrate
FI	Cyprinella caerulea	Blue Shiner	G2	S2	LT	E	Flowing runs and pools in streams with cool water and firm substrates
FI	Cyprinella callitaenia	Bluestripe Shiner	G2G3	S2		R	Flowing areas in large creeks and medium-sized rivers over rocky substrates
FI	Erimystax insignis	Blotched Chub	G4	S2		E	Medium to large clear streams in moderate current with substrate of gravel to cobble
FI	Etheostoma brevirostrum	Holiday Darter	G2	S1		E	Small creeks to moderate sized rivers in gravel and bedrock pools
FI	Etheostoma chlorobranchium	Greenfin Darter	G4	S2		T	Cool to cold high elevation creeks and rivers in swift current with boulder to bedrock substrate

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 6. Blue Ridge High Priority Animals (89 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Etheostoma etowahae	Etowah Darter	G1	S1	LE	E	moderate to high gradient streams over cobble to gravel in areas of swift current
FI	Etheostoma gutselli	Tuckasegee Darter	G3G4	S2			High gradient creeks and medium-sized rivers
FI	Etheostoma rufilineatum	Redline Darter	G5	S1S3			Swift shallow riffles of rocky streams
FI	Etheostoma rupestre	Rock Darter	G4	S2		R	Swift rocky riffles often associated with attached vegetation such as Podostemum
FI	Etheostoma scotti	Cherokee Darter	G2	S2	LT	T	Small to medium-sized creeks with moderate current and rocky substrates
FI	Etheostoma vulneratum	Wounded Darter	G3	S1		E	Fast rocky riffles of small to medium rivers
FI	Hybopsis lineapunctata	Lined Chub	G3G4	S2		R	Upland creeks over sandy substrate with gentle current
FI	Lampetra aepyptera	Least Brook Lamprey	G5	S2			ammocoetes associated with mud, silt, and macrophytes. Adults associated with sand and gravel.
FI	Lythrurus lirus	Mountain Shiner	G4	S3			Cool, clear streams in flowing water over sandy to rocky substrates
FI	Macrhybopsis sp. 1	Coosa Chub	G3G4	S1		E	Fast water in large streams and rivers
FI	Micropterus chattahoochee	Chattahoochee Bass	GNR	S1			flowing sections of streams and rivers, including river shoals
FI	Micropterus sp. cf coosae "Savannah"	Bartrams Bass	GNR	S3			upland streams and rivers
FI	Moxostoma carinatum	River Redhorse	G4	S3		R	Swift waters of medium to large rivers
FI	Moxostoma sp. 2	Sicklefin Redhorse	G2Q	S1	C	E	Riffles, runs and pools in large creeks and small to medium-sized rivers. Juveniles may also occur in reservoirs downstream of spawning sites
FI	Notropis asperifrons	Burrhead Shiner	G4	S2		T	Small streams to medium-sized rivers in pools, slow runs, and backwater areas
FI	Notropis hypsilepis	Highscale Shiner	G3	S3		R	Flowing areas of small to large streams over sand or bedrock substrates
FI	Notropis photogenis	Silver Shiner	G5	S1		E	Large creeks to small rivers in riffles to flowing pools over firm substrates
FI	Notropis scepticus	Sandbar Shiner	G4	S2		R	Large streams to medium-sized rivers in flowing pools over sandy to rocky substrates
FI	Noturus munitus	Frecklebelly Madtom	G3	S1		E	Shoals and riffles of moderate to large streams and rivers
FI	Percina antesella	Amber Darter	G1G2	S1	LE	E	Riffles & runs of medium-sized rivers, patches of sand and small gravel, riverweed
FI	Percina aurantiaca	Tangerine Darter	G4	S2		E	Deep riffles and runs with boulders, cobble, or bedrock in large to moderate headwaters of Tennessee River
FI	Percina aurolineata	Goldline Darter	G2	S2	LT	E	Shallow rocky riffles with swift current in medium-sized rivers
FI	Percina crypta	Halloween Darter	G2	S2		T	larger streams in riffle/shoal habitat
FI	Percina jenkinsi	Conasauga Logperch	G1	S1	LE	E	Fast-flowing chutes and pools over clean substrates of gravel or cobbles
FI	Percina kusha	Bridled Darter	G2	S1		E	Flowing pools and runs in large streams and small to medium sized rivers with clear water
FI	Percina lenticula	Freckled Darter	G3	S2		E	Swift deep runs of main river channels around large woody debris, possibly over a rocky substrate
FI	Percina sciera	Dusky Darter	G5	S3		R	Large creeks and rivers in moderate current associated with woody debris, undercut banks, or vegetation

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 6. Blue Ridge High Priority Animals (89 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Percina squamata	Olive Darter	G3	S1		E	High gradient upland rivers with large rocky substrate in moderate to swift current
FI	Phenacobius crassilabrum	Fatlips Minnow	G3G4	S2		E	Riffle areas in small to medium rivers
MA	Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	G3G4	S3		R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps
MA	Mustela nivalis	Least Weasel	G5	S1			Extreme northern Georgia, meadows, fields, brushy areas, open woods
MA	Myotis leibii	Eastern Small-footed Myotis	G3	S2			Caves; mines; abandoned buildings, bridges, rock shelters in mountainous areas; high elevation talus fields
MA	Myotis lucifugus	Little Brown Myotis	G3	S3			Caves & mines; mixed forests, structures, bat houses
MA	Myotis septentrionalis	Northern Myotis	G2G3	S2S3			Caves & mines in winter; riparian areas, upland forests, cracks and crevices in dead and live trees in summer
MA	Myotis sodalis	Indiana Myotis	G2	S1	LE	E	Limestone caves with pools; wooded areas near streams, upland forests, large snags in open areas including ridge tops
MA	Parascalops breweri	Hairy-tailed Mole	G5	S1			Deciduous woodlands with thick humus; prefers well-drained light moist soil
MA	Perimyotis subflavus	Tri-colored Bat	G3	S5			Open forests with large trees and woodland edges; roost in tree foliage; hibernate in caves or mines with high humidity.
MA	Sorex dispar	Long-tailed or Rock Shrew	G4	S1			Mountainous, forested areas (deciduous or evergreen) with boulderfields, cliffline breakdown, loose talus - may also occur in and along high-gradient mtn streams
MA	Sorex palustris	Water Shrew	G5	S1			Mountainous, along small cold streams with thick overhanging riparian growth
MA	Spilogale putorius	Eastern Spotted Skunk	G4	S3			brushy, rocky, wooded habitats; avoids wetlands
MA	Sylvilagus obscurus	Appalachian Cottontail	G4	S1S2		R	heath (Vaccinium, Kalmia) thickets within high elevation forests
MA	Synaptomys cooperi	Southern Bog Lemming	G5	S1			Bogs, marshes, meadows, and upland forests with thick humus layer
MA	Tamiasciurus hudsonicus	Red Squirrel	G5	S3			Northern hardwood - Cove hardwood - Hemlock forests
MO	Elimia striatula	File Elimia	G2	S1			Creeks, spring/spring brook
MO	Strophitus connasaugaensis	Alabama Creekmussel	G3	S1		E	Large rivers to medium sized creeks with moderate current; sand and gravel substrate
MO	Villosa nebulosa	Alabama Rainbow	G3	S2			Large rivers to small streams; flowing water with gravel and sand substrates, may be found in fine sediments among cobble and boulders
RE	Glyptemys muhlenbergii	Bog Turtle	G3	S2	LT	E	Mountain bogs; wet meadows; edges of mountain streams
RE	Pituophis melanoleucus melanoleucus	Northern Pine Snake	G4T4	S2			Dry pine or pine-hardwood forests
TA	Amblyscirtes carolina	Carolina roadside-skipper	G3G4	S2S3			Wet situations with cane
TA	Amblyscirtes reversa	Reversed roadside-skipper	G3G4	S2S3			Wet hardwoods, cane, hardwood slopes with cane
TA	Autochton cellus	Golden-banded skipper	G4	S2			Hog peanut, areas of intact groundcover
TA	Bombus affinis	Rusty-patched bumblebee	G1	SH			
TA	Bombus borealis	Northern amber bumble	G4G5	S1			Northern hardwoods
TA	Danaus plexippus	Monarch butterfly	G4	S4			Milkweeds

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 6. Blue Ridge High Priority Animals (89 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
TA	Erora laeta	Early hairstreak	GU	S2S3			Hardwood, beech trees
TA	Erynnis martialis	Mottled duskywing	G3	S2			New Jersey tea, longleaf-wiregrass, mountain hardwoods
TA	Euphydryas phaeton	Baltimore checkerspot	G4	S2			Chattahoochee River parks
TA	Phyciodes batesii maconensis	Tawny crescent	G4T2T3	S2			Higher mountains in BR, wavy-leaved aster, dry banks
TA	Pieris virginiensis	West Virginia White	G3	S3			Hardwoods
TA	Polygonia faunus	Green comma	G5T3T4	S3			Hardwoods, higher elevations
TA	Satyrium edwardsii	Edwards hairstreak	G4	S3			Blackjack oak
TA	Speyeria diana	Diana fritillary	G3G4	S3			Hardwood forests
TA	Temnothorax_GA_01	Temnothorax new species	GNR	SU			Mixed open forest

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 7. Blue Ridge High Priority Plants (66 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Agalinis decemloba	Ten-lobed Purple Foxglove	G4Q	S1			Dry, grassy meadows.
Agastache scrophulariifolia	Purple Giant Hyssop	G4	SH			Forested floodplains; river terraces
Amelanchier sanguinea	Roundleaf Serviceberry	G5	S1?			Rocky slopes
Berberis canadensis	American Barberry	G3	S1		E	Cherty, thinly wooded slopes
Buchnera americana	American Bluehearts	G5?	S1			Wet meadows; seasonally moist barrens and limestone glades
Carex acidicola	Acid-Loving Sedge	G2G3	S2?			Granite outcrop woodlands
Carex biltmoreana	Biltmore Sedge	G3	S1		T	High elevation ledges and rock faces
Chelone cuthbertii	Cuthbert's Turtlehead	G3	S1		T	Bogs and wet meadows
Coreopsis rosea	Pink Tickseed	G3	S1			Banks of blackwater rivers; pond shores
Cymophyllus fraserianus	Fraser's Sedge	G4	S1		T	Mixed hardwood-hemlock forests
Danthonia epilis	Bog Oat-Grass	G3G4	S1?			Mountain bogs
Diplophyllum andrewsii	Andrews' Diplophyllum (Liverwort)	G3	SNR			Occurs as a pioneer on partly or strongly shaded (rarely quite sunny) open mineral soil, especially on loamy soil of roadside banks, or on eroding banks along streams, more rarely on soil and the accumulating detritus at the foot of ledges, where it may invade rock crevices.
Euphorbia purpurea	Glade Spurge	G3	S1			Seeps over amphibolite
Fothergilla major	Large Witch-Alder	G3	S1		T	Rocky (sandstone, granite) woods; bouldery stream margins
Frullania appalachiana	Appalachian Frullania	G1?	S1?			On tree trunks and decaying wood above 3800 ft.
Gentianopsis crinita	Fringed Gentian	G5	S1		T	Wet meadows and grassy roadsides over circumneutral soils
Gymnoderma lineare	Rock Gnome Lichen	G3	S1	LE	E	Moist cliff faces
Helianthus glaucophyllus	Whiteleaf Sunflower	G3G4	S1			Open, oak-hickory woods above 2500 ft.
Helianthus smithii	Smith's Sunflower	G2Q	S1			Dry open woods and thickets
Helodium blandowii	Blandow's Feather Moss	G5	S1?			On tree bases, hummocks in montane seeps
Helonias bullata	Swamp-Pink	G3	S1	LT	T	Open swamps
Hydrastis canadensis	Goldenseal	G3G4	S2		E	Rich woods in circumneutral soil
Hypnum cupressiforme var. filiforme	Filiform Cypress-Moss	G5TNR	S2?			Hanging as green threads from rocks or bark, perhaps above 3800 ft.
Isotria medeoloides	Small Whorled Pogonia	G2	S2	LT	T	Mixed hardwood- pine forests with open understory; history of nearby heavy logging, homesite or road clearing activity
Juglans cinerea	Butternut	G4	S2			Openings in bottomland forests and in the mesophytic hardwood forests of rich mountain coves
Kalmia carolina	Carolina Bog Myrtle	G4	S1		T	Open swamps and wet meadows; mountain bogs and Atlantic white-cedar swamps
Leiophyllum buxifolium	Sand-Myrtle	G4	S1		T	High altitude rocky ledges
Lejeunea blomquistii	Blomquist's Lejeunea	G1G2	SH			Waterfall spray zones
Lilium canadense	Canada Lily	G5	S2?			Openings in rich woods
Liparis loeselii	Fen Orchid	G5	S1			Ultramafic fens
Lysimachia fraseri	Fraser's Loosestrife	G3	S2		R	Moist, open, bouldery gravel bars and streambanks; edges of sandstone and granite outcrops
Megaceros aenigmaticus	Headwaters Hornwort	G3	S1		T	Shaded rocks in small streams, springs or waterfall spray zones
Monotropsis odorata	Sweet Pinesap	G3	S1		T	Upland forests

Table 7. Blue Ridge High Priority Plants (66 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Oncophorus raui	Rau's Oncophorus Moss	G3	SNR			Moist acidic rocks or cliffs near streams and waterfalls
Packera millefolia	Blue Ridge Golden Ragwort	G2	S1		T	High elevation rock outcrops
Panax quinquefolius	American Ginseng	G3G4	S3			Mesic hardwood forests; cove hardwood forests
Panax trifolius	Dwarf Ginseng	G5	S1			Mesic hardwood-coniferous forests
Pedicularis lanceolata	Swamp Lousewort	G5	S1		E	Bogs and wet woods
Plagiochila caduciloba	Brittle-Lobed Leafy Liverwort	G2	S1?			Moist cliff faces
Plagiochila sharpii	Sharp's Leafy Liverwort	G2G4	S1?			Moist cliff faces and spray zones
Plagiomnium carolinianum	Carolina Wavy-Leaf Moss	G3	S2?			Moist cliff faces
Platanthera flava var. herbiola	Pale Green Orchid	G4?T4Q	SH			Red maple-gum swamps
Platanthera grandiflora	Large Purple Fringed Orchid	G5	S1			Wet thickets; seepy open northern hardwood forests
Platanthera integrilabia	Monkeyface Orchid	G2G3	S1S2	C	T	Red maple-gum swamps; peaty seeps and streambanks with Parnassia asarifolia and Oxypolis rigidior
Platanthera peramoena	Purple Fringeless Orchid	G5	S1			Wet meadows, openings among bottomland hardwoods
Platyhypnidium pringlei	Pringle's Platyhypnidium	G2G3	S1			Seepy rock cliffs
Pohlia rabunbaldensis	Rabun Bald Feather-Moss	G1	S1?			Rocky moist openings, select high balds
Quercus similis	Swamp Post Oak	G4	S1			Bottomland swamps and other wet habitats
Sanguisorba canadensis	Canada Burnet	G5	S1		T	Seepy meadows and thickets
Sarracenia oreophila	Green Pitcherplant	G2	S1	LE	E	Wet meadows; upland bogs
Sarracenia purpurea var. montana	Mountain Purple Pitcherplant	G5T1T3	S1		E	Mountain bogs
Shortia galacifolia	Oconee Bells	G2G3	S1		E	Mesic forests with mountain laurel and rhododendron
Sibbaldiopsis tridentata	Three-Toothed Cinquefoil	G5	S1		E	Rocky summits
Silene ovata	Mountain Catchfly	G3	S1S2		R	Mesic deciduous or beech-magnolia forests over limestone; bouldery, high elevation oak forests
Solidago simulans	Cliffside Goldenrod	G2	S1		E	Seepy summits of granite domes; moist, steep, rocky slopesand cliffs
Spiraea latifolia	Broadleaf Bog Meadowsweet	G5T5	S1			Mountain bogs; roadside seepage slopes
Streptopus lanceolatus var. lanceolatus	Rosy Twisted-Stalk	G5T5	S1		T	High elevations boulderfields
Symphyotrichum georgianum	Georgia Aster	G3	S2	C	T	Upland oak-hickory-pine forests and openings; sometimes with Echinacea laevigata or over amphibolite
Thalictrum coriaceum	Appalachian Meadowrue	G4	S1?			Rich woods
Thermopsis fraxinifolia	Ash-Leaved Bush-Pea	G3?	S2?			Oak and oak-pine ridge forests
Thermopsis villosa	Carolina Golden Banner	G3?	S1?			Mesic forests, floodplains and roadsides; mostly in sandy soils
Trillium persistens	Persistent Trillium	G1	S1	LE	E	Mesic hardwood forests, upland forests
Trillium sp. nov. (unpublished)	Amicalola Trillium	GNR	S1			Mixed hardwood bluffs
Triphora trianthophora	Three-Birds Orchid	G3G4	S2?			Loamy soils of rhododendron thickets; hardwood forests
Tsuga caroliniana	Carolina Hemlock	G3	S1		E	Rocky bluffs
Waldsteinia lobata	Piedmont Barren Strawberry	G2G3	S2		R	Stream terraces and adjacent gneiss outcrops

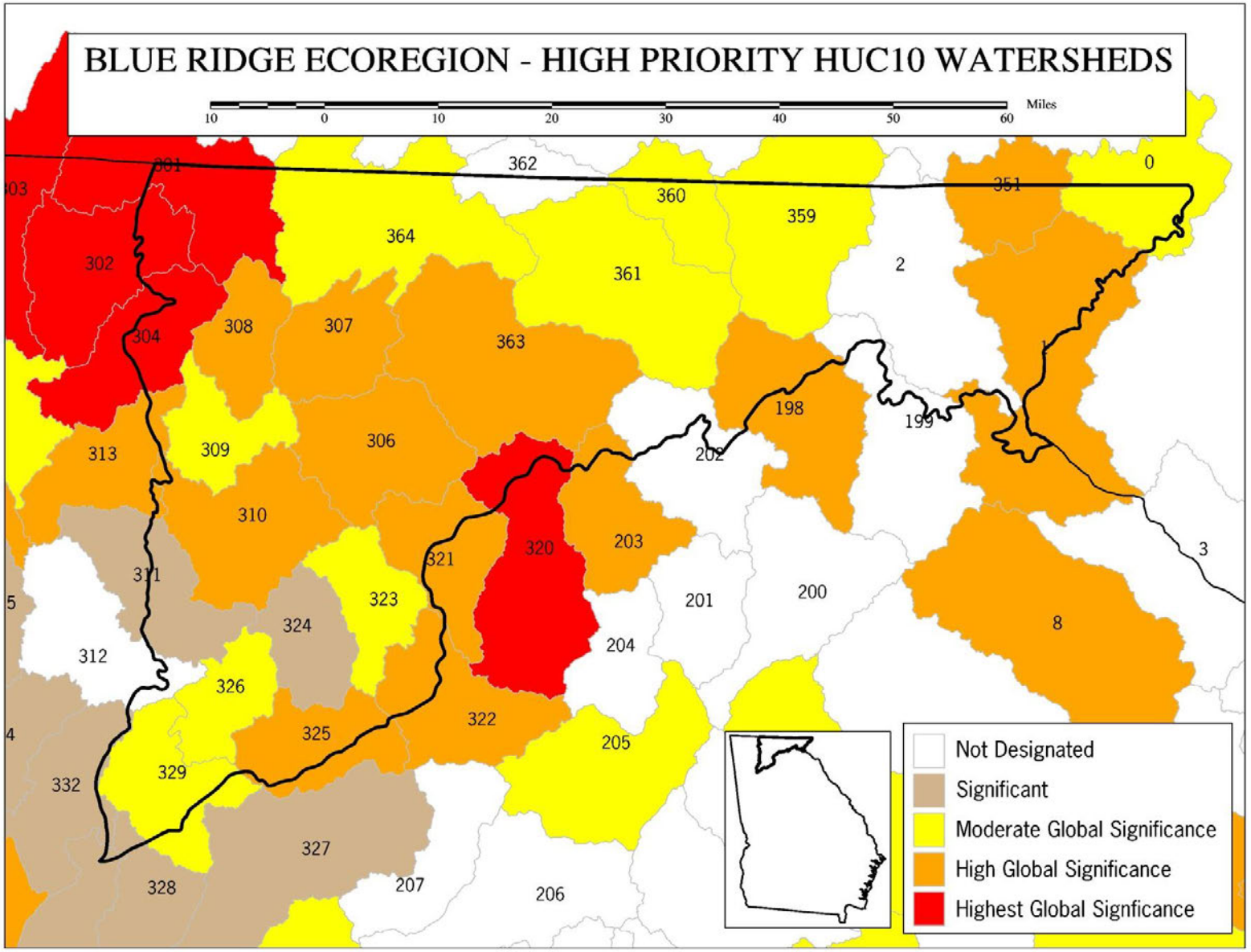


Figure 14. High Priority Waters, Blue Ridge Ecoregion

Piedmont Ecoregion

Ecoregional Overview

The Piedmont ecoregion encompasses about 11,003,500 acres, or about 29% of the state. Approximately 634,620 acres of this ecoregion are in permanent or long-term conservation ownership. Georgia DNR manages 81,655 acres owned in fee simple by the State of Georgia and an additional 181,643 acres through short-term leases or management agreements. Federal land ownership includes 180,221 acres managed by the USDA Forest Service, 168,755 acres managed by the U.S. Department of Defense (including the Army Corps of Engineers), 35,711 acres managed by the U.S. Fish & Wildlife Service, and 11,525 acres managed by the National Park Service. The Piedmont has the second lowest percentage of lands in permanent conservation status (6.2%) of all ecoregions in Georgia.

The Piedmont comprises a transitional area between the mountainous ecoregions to the northwest and the relatively flat Coastal Plain to the southeast. Geologically, it is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected plains and isolated monadnocks (rounded hills). The soils tend to be finer-textured than in the coastal plain ecoregions. Once largely cultivated, much of this region has reverted to pine and hardwood woodlands, and, more recently, to sprawling urban and suburban areas. Subdivisions of the Piedmont ecoregion in Georgia include the Southern Inner Piedmont, the Southern Outer Piedmont, the Carolina Slate Belt, the Talladega Upland, and the Pine Mountain Ridges.

The rolling to hilly, well-dissected upland of the Southern Inner Piedmont contains mostly schist, gneiss, and granite bedrock. West of Atlanta and into Alabama, mica schist and micaceous saprolite are typical. To the east, biotite gneiss is more common. The region is now mostly forested with oak-pine, oak-hickory, and loblolly-shortleaf pine forests. Open areas are mostly in pasture, although there are some small areas of cropland. Hay, cattle, and poultry are the main agricultural products. Urban/suburban land cover has increased greatly within this ecoregion over the past twenty years.

The Southern Outer Piedmont ecoregion has lower elevations, less relief, and less precipitation than the Southern Inner Piedmont. Loblolly-shortleaf pine is the major forest type, with less oak-hickory and oak-pine than in the Southern Inner Piedmont. Gneiss, schist and granite are the dominant rock types, covered with deep saprolite and mostly red, clayey subsoils. The southern boundary of the ecoregion occurs at the Fall Line, where unconsolidated coastal plain sediments overlay the metamorphic and igneous rocks of the Piedmont.

As its name suggests, the Carolina Slate Belt is found primarily in the Carolinas, although a small portion extends into Georgia. The region's mineral-rich metavolcanic and metasedimentary rocks with slatey cleavage are finer-grained and less metamorphosed

than most Piedmont regions. This area tends to be less rugged and dissected, with wider valleys than other Piedmont areas, and with more silty and silty clay soils.

The Talladega Upland contains dissected hills and tablelands that are mostly forested and at generally higher elevations than the Southern Inner and Southern Outer Piedmont. The geology is distinctive, consisting of mostly phyllite, quartzite, slate, metasiltstone, and metaconglomerate, in contrast to the metamorphic and intrusive igneous rocks of the Southern Inner and Southern Outer Piedmont. The climate of the Talladega Upland is slightly cooler and wetter than the other ecoregions of the Georgia Piedmont. Oak-hickory-pine forest is the dominant natural vegetation type.

The Pine Mountain Ridges, a narrow region in the southwest portion of the Georgia Piedmont, contains quartzite-capped, steep-sloped ridges that rise 300-400 feet to elevations over 1300 feet. Pine Mountain and Oak Mountain are the primary linear ridges trending southwest to northeast, and several other smaller ridges and mountains between these, including Bull Trail Mountain, Indian Grave Mountain, Salter Mountain, and Huckleberry Pinnacle, add to the region's more mountainous appearance. The Flint River has cut narrow, steep gorges through the ridges. Streams in this region are generally of higher gradient than surrounding areas of the Southern Outer Piedmont and contain more rocky or gravelly substrates.

The predominant landcover types in the Piedmont are deciduous/mixed forest and evergreen forest (Kramer and Elliott, 2004). An analysis of land use changes from 1974 to 1998 based on satellite imagery indicated the following general trends:

- A decrease in row crop/pasture (from 19.47% of total landcover to 15.51%)
- An increase in high-intensity and low-intensity urban (from 4.86% of total landcover to 9.57%)
- An increase in clearcut/sparse vegetation (from 3.82% of total landcover to 7.38%)
- A decrease in deciduous/mixed forest (from 38.23% of total landcover to 33.98%)
- A slight decrease in evergreen forest (from 28.86% of total landcover to 28.17%)

These trends indicate a general decline in the total acreage devoted to active agricultural uses, a significant increase in residential and commercial development, an increase in cleared or sparsely vegetated habitats (likely from a wide range of activities, including construction, timber harvest, and abandonment of agricultural fields), a decline in deciduous/mixed forest, and little change in the total acreage of pine forest (represented primarily by loblolly pine plantations in this ecoregion).

An analysis of land use change from 2006 to 2011 indicates a 27% increase in early successional vegetation, a 5.4% decrease in forest cover, a 3.2% increase in developed land, a 2.0% increase in wetland landcover, and slight decrease in agricultural land. These figures demonstrate a combination of increasing development and loss of forest land in the Piedmont ecoregion in recent years. See Appendix N for more information.

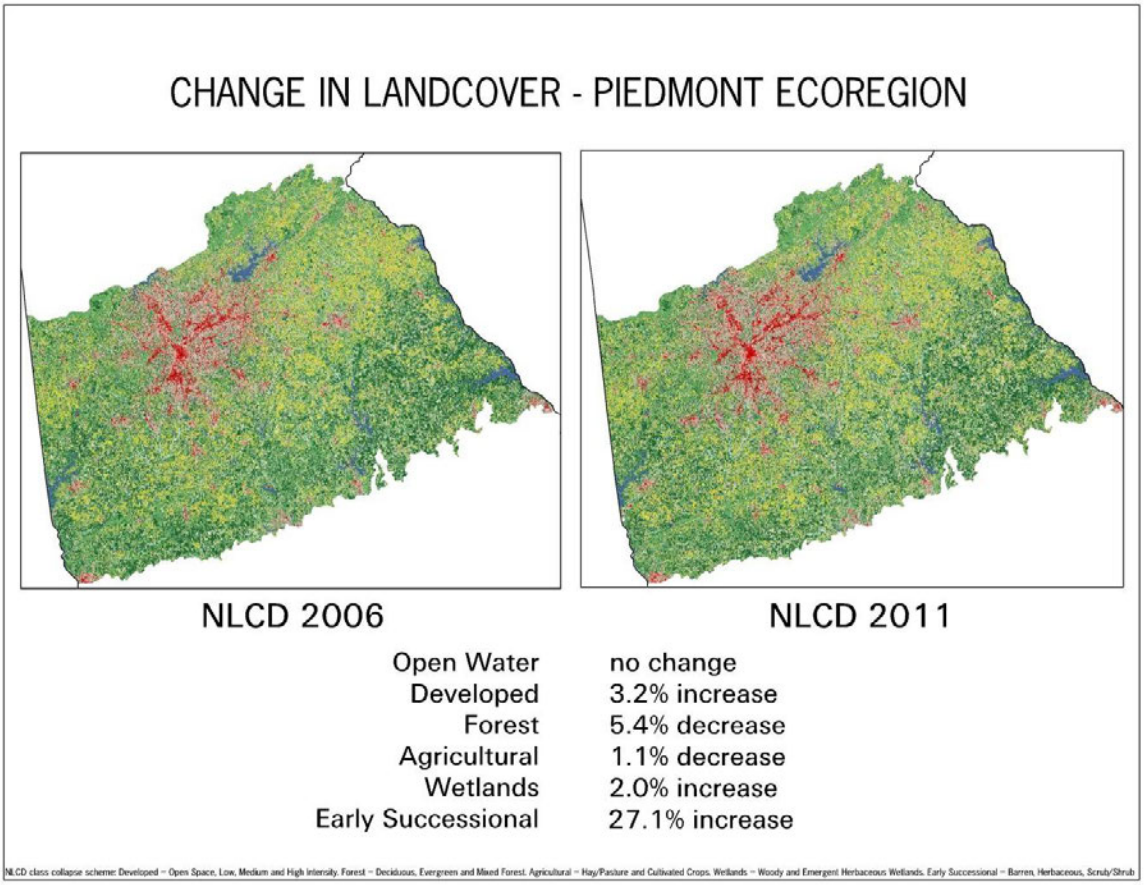


Figure 15. Change in landcover from 2006 to 2011 in the Piedmont ecoregion.

High Priority Species and Habitats

The technical teams identified 87 high priority animal species in the Piedmont ecoregion. These included 17 birds, 3 reptiles, 5 mammals, 3 amphibians, 11 mollusks, 29 fish, 8 aquatic arthropods, and 14 terrestrial arthropods. These species are listed in Table 8, with information on global and state rarity ranks, protected status (if any) under federal or state law, and habitat and range in Georgia. In addition, 66 species of high priority plants were identified for the Piedmont. These are listed in Table 9.

High priority habitats for the Piedmont ecoregion are listed and briefly described below:

1. Beaver Ponds; Freshwater Marsh
Beaver ponds are temporary impoundments created by beaver on small to medium sized streams. Freshwater marshes develop in shallow beaver ponds and along the edges of larger lakes and ponds. Dominants include a variety of sedges, rushes, grasses, and forbs,

with scattered buttonbush, red maple, swamp dogwood, and tag alder. Few Georgia examples exist that are not invaded by the exotic weed, Murdannia. These wetlands provide habitat for a wide variety of wildlife species.

2. Bottomland Hardwood Forests
Forested wetlands of alluvial river floodplains, characterized by a diverse association of deciduous hardwood trees. Canopy dominants vary, but may include water oak, willow oak, overcup oak, cherrybark oak, swamp chestnut oak, green ash, sweetgum, bitternut hickory, and pignut hickory. Shrub layer may be dense or relatively sparse, containing a variety of mesophytic or hydrrophytic woody plants and often a significant woody vine component. Many of these habitats have been impacted by invasive exotic species such as Chinese privet and Nepalese browntop.

3. Canebrakes
Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require fire or other form of periodic disturbance for maintenance. Most canebrakes in this region are relatively small and fire-suppressed, often occurring along the edges of fields and other clearings.

4. Granite Outcrops
Diverse mosaics of exposed granitic rock, herb and shrub dominated patches, and wetland microhabitats. Most have shallow solution pits that collect soil and support various stages of plant succession. These environments support rare or endemic species of plants and animals. The most important of these habitats contain a variety of solution pits, seepage zones, and bare rock exposures. Some outcrops are monadnocks (isolated rock domes or low mountains) while others are flat rock exposures. The Georgia Piedmont is the center of granite outcrop species diversity.

5. Medium to Large Rivers
Low to moderate gradient meandering rivers, typically with heavy sediment loads. Floodplains are relatively narrow compared to similar rivers in the Coastal Plain. Extensive shoal habitats may occur, especially along the Fall Line. Dominant habitats include runs, pools, and shoals. Substrate is variable, but is dominated by sand in runs and pools and by bedrock in shoals. Aquatic vegetation may be present.

6. Mesic Hardwood Forests
Non-wetland forests of floodplains, ravines, and north-facing slopes in the Piedmont. These may include species such as American beech, white oak, northern red oak, bitternut hickory, pignut hickory, shagbark hickory, bigleaf magnolia, yellow poplar, blackgum, dogwood, black cherry, and loblolly pine. Typical shrubs include spicebush, sweetshrub, pawpaw, Oconee azalea, rusty viburnum, and pinxter-flower.

7. Montane Longleaf Pine-Hardwood Forest
A subxeric or xeric mixed forest with longleaf pine, oaks, and hickories. Georgia examples are typically fire-suppressed. Pine Mountain contains many globally

significant examples; other occurrences of this rare forest type can be found along Dugdown and Hightower Mountains and in Paulding Forest and Sheffield WMAs. Includes a rare longleaf pine/Georgia oak subtype found on Hollis quartzite along the main Pine Mountain ridge.

8. Oak Woodlands and Savannas
Rare upland hardwood habitats found in scattered locations in the Piedmont. These xeric or subxeric oak-dominated woodland are influenced by edaphic conditions (i.e. thin soils, mafic rocks) and periodic fire. Dominants may include southern red oak, scarlet oak, post oak, and blackjack oak, sometimes with shortleaf pine. Sparkleberry and hawbushes are common shrub components. A particularly rare type, the post oak-blackjack oak savanna, was apparently much more common in pre-settlement times; only small, fire-suppressed remnants of these habitats exist today.

9. Oak-Hickory-Pine Forest
Considered the climax forest of the Piedmont, this forest type formerly covered 50% to 75% of the region; most examples on fertile soils were eliminated by conversion to agricultural uses. Remaining examples are often found in rocky areas that were difficult to convert to agricultural fields. Typically include a variety of hardwood species such as white oak, black oak, southern red oak, pignut hickory, shagbark hickory, mockernut hickory, red maple, blackgum, shortleaf pine, and loblolly pine, with dogwood, rusty viburnum, hog plum, dwarf pawpaw, and various hawbushes in the understory. American chestnut was formerly a major component of the canopy. Examples over circumneutral soils influenced by mafic or ultramafic bedrock are often floristically richer, and may contain species such as Oglethorpe oak, basswood, red mulberry, redbud, and fringetree.

10. Rocky or Cobbly River Shoals
Shallow, high gradient reaches with swift water and rocky substrates. These habitats are important spawning areas for fish, including darters, shiners, and suckers (such as the extremely rare robust redhorse). In addition, shoals provide foraging areas for wading birds, and sunning areas for turtles. May contain dense growths of riverweed (*Podostemum ceratophyllum*). The shoals spiderlily (*Hymenocallis coronaria*), a State-protected plant, is found on rocky shoals in the middle reaches of the Savannah, Flint, and Chattahoochee rivers. Many shoals have been degraded by stream impoundments, altered water quality, and excessive silt deposition.

11. Rocky/Sandy River Bluffs
Exposed rocky or sandy bluffs along rivers in the Piedmont are often characterized by mixed pine-oak vegetation with shortleaf pine, loblolly pine post oak, eastern redcedar, southern red oak, blackjack oak, and white oak. Small trees and shrubs may include hornbeam, winged elm, sparkleberry, winged sumac, yucca, and century plant. More sheltered or east-facing bluffs may have mountain laurel and rosebay rhododendron.

12. Serpentine Outcrops/Woodland/Savanna
This globally rare habitat represents a complex mosaic of woodlands and savannas with scattered outcropping of serpentine rocks. The pine-mixed hardwood vegetation includes longleaf pine as a dominant. This type is maintained by fire and edaphic conditions. The only known Georgia examples are fire-suppressed. These habitats include disjunct coastal plain species such as pineland Barbara-buttons and Georgia plume.

13. Springs and Spring Runs
Springs are highly localized groundwater expressions. The waters of springs and associated habitats can be highly variable, depending on hydrology (hydroperiod and volume) and edaphic factors. Springs of the Piedmont have varying mineral content, chemical properties, and temperatures. Includes spring pools and first order streams immediately below springs where rare fish and invertebrates may occur.

14. Streams
In the upper Piedmont, streams are low to moderate gradient and typically contain well-defined riffles and pools. Substrate consists of gravel, pebble, sand, and silt; some bedrock may also be present. Lower Piedmont streams are lower gradient, have fewer riffles and pools, and their substrates have a higher proportion of silt, clay, and detritus than upper Piedmont streams. Turbidity is highly variable, but most of these streams become highly turbid after rain.

15. Upland Depression Swamp
A non-alluvial open swamp with water oak, southern shagbark hickory, Oglethorpe oak, and loblolly and shortleaf pine. Coastal plain elements in the understory include swamp palmetto and parsley haw. Usually found on Iredell or Enon soils in the lower Piedmont. These sticky, plastic soils pond water in the spring, resulting in swampy conditions for a portion of the year.

16. Xeric Pine Woodlands
Pine-dominated habitats of dry, rocky ridgetops and granitic outcrops. Dominants are loblolly, shortleaf, and Virginia pine. These woodland habitats are maintained by a combination of edaphic factors and periodic fire.

Problems Affecting Wildlife Diversity

One of the primary factors impacting habitats and species in the Piedmont is the rapid pace of residential and commercial development. These development pressures have resulted in the loss or fragmentation of a number of habitats, including bottomland hardwood forest, oak-hickory-pine forest, granite outcrops, and mesic hardwood forest. Much of this is due to the development of new industrial and commercial sites along interstate highways and other major highways.

Metropolitan Atlanta is the ninth-largest metropolitan statistical area in the United States, with an estimated 2013 population of 5.49 million. Continued expansion of the Atlanta metropolitan area has resulted in development of subdivisions, roads, utility corridors,

and retail centers. Other metropolitan areas experiencing significant growth in this region include Augusta, Gainesville, Columbus, and Athens.

Point-source discharges into streams in this region include wastewater industrial facilities, and municipal treatment facilities. According to EPD stream monitoring data for 2012, 42% of streams meet designated uses (based on percentage of total monitored stream miles); 57% do not support designated uses, with 1% pending assessment. The percentage of streams supporting designated uses in the Piedmont is second highest of the five ecoregions.

Former conversion of forest and woodland habitats to agricultural uses resulted in the loss of most of the original upland forest (generally described as oak-hickory-pine forest, but containing a wide variety of subtypes) in this region. In addition, erosional soil losses buried many floodplains and river shoals in up to 12 feet of silt. Many of these habitats have recovered partially in the intervening decades. For example, reductions in the rates of sedimentation have resulted in reemergence of shoals in several areas of the Piedmont. However, reductions in streamflow fluctuations by upstream dams have resulted in isolation and dewatering of floodplains in many areas of this ecoregion. Restoration of more natural hydrologic conditions, maintenance of vegetated stream buffers, and continued improvements in erosion and sedimentation control are essential to the protection of aquatic diversity in this ecoregion.

Conversion of remaining upland hardwood and pine-hardwood forests to pine plantations also presents problems for wildlife. Specific problems associated with this forest conversion include loss of vegetative structural diversity and nesting sites, decline in hard and soft mast production, loss of understory and groundcover species diversity, and physical disturbance of habitat for organisms found in leaf litter or soil. The Pine Mountain region has experienced a decline in montane longleaf pine-hardwood forest as a result of conversion to loblolly pine plantations over several decades. However, some harvested loblolly pine stands have been replanted in longleaf pine in recent years.

Fire suppression is also a significant problem in this region. The remarkable expansion of residential and commercial development zones from urban centers into surrounding suburbs has resulted in many fire-dependent habitats being surrounded by highways, subdivisions, or retail centers. Concerns about smoke management, air quality, and damage to structures make it difficult to implement prescribed burn plans for these habitats. For example, while a fire plan has been developed for Kennesaw Mountain National Military Park, concerns about smoke management problems and potential damage to historic structures and monuments in the park represent major impediments to implementation of the plan. Throughout the region, a lack of fire has resulted in the decline in the extent and quality of habitats such as oak-pine-hickory forest, oak woodlands and savannas, montane longleaf pine-hardwood forest, serpentine outcrops/woodland/savanna, and canebrakes.

Invasive nonnative species pose significant problems to habitats in this region. The Asiatic clam and feral hogs are examples of exotic animal species. Most river

floodplains and valleys in the Piedmont are overrun with exotic plants such Chinese privet and Nepalese browntop. Japanese honeysuckle, kudzu, and autumn olive are major components of the understory in many upland forest stands.

For some high priority species and habitats, unmanaged recreational use represents a serious problem. In the Piedmont, river shoals have traditionally been sites of concentrated recreational use (e.g., fishing, picnicking). Today, many of these shoal areas are being heavily impacted by ATV and ORV traffic as well as littering. Use of motorized vehicles or horses on granite outcrops can result in significant impacts to plant communities, substrates, and rare species associates.

Granite Rock Outcrops

Georgia contains nearly 90% of all known Piedmont granitic outcrops. Granite rock outcrops host unique microhabitats that are characterized by a granitic substrate with pockets of acidic, nutrient-poor mineral soil. These harsh environments can fluctuate between hydric and xeric several times a year. Vernal pools, or solution pits, are shallow, flat-bottomed depressions where water collects after a rain. These pools are formed naturally by erosion over millions of years and are home to several high priority species that are severely restricted in their range, including mat-forming quillwort, black-spored quillwort, and snorkelwort. Unfortunately, these species are in steady decline where populations are not protected.

Specific threats to these habitats include destruction of habitat from quarrying activities, recreational use (trail bicycles, ORV traffic, littering, vandalism, fire building, overuse for education), eutrophication resulting from conversion of habitat to pasture (cattle waste adds nutrients that favor competing vegetation), pollution (dumping of trash and airborne deposition), invasive exotic species, and shading due to tree growth.

The highest priority for management of granite outcrops is to preserve habitat and avoid disturbance. Efforts should be made to bring these important habitats into some kind of protection. Currently, only six granite rock outcrop sites are protected in Georgia.

Construction of dams or other structures altering stream flow represents another significant problem for aquatic species in this region. The Piedmont is the primary region of water supply reservoir construction in Georgia. These impoundments threaten the viability of populations of native aquatic species, including rare species such as the Cherokee darter, Etowah darter, and bluestripe shiner. The various impacts to these aquatic fauna from impoundments include direct loss of lotic habitat, barriers to dispersal, alteration of instream flows, and impaired water quality (altered temperature and dissolved oxygen regimes).

Incompatible road and utility corridor management represent potential threats for some high priority plants of open areas, such as Georgia rockcress, Georgia aster, harperella, and pool sprite. Indiscriminant use of herbicides or excessive ground disturbance along roads and in utility corridors may impact adjacent terrestrial and aquatic habitats. Vegetation management programs should be planned and implemented in a way that minimizes impacts to rare plant populations occurring in the road right-of-way or utility corridor.

Encroachment of vegetated stream buffers and general loss of permeable watershed surfaces are particularly significant problems in this ecoregion, due to intense development pressures and the resulting rapid increase in density of roads, utility corridors, lawns, and parking areas near streams. In many areas, the amount of impermeable surface in the local watershed provides very little capacity for amelioration of nonpoint source pollution, leads to flash flooding and streambank scouring, and greatly diminishes groundwater recharge capacity.

High Priority Sites and Landscape Features

The current assessment and previous conservation planning efforts have identified a number of important sites and landscape features in this region. An assessment of the Piedmont ecoregion in the Southeast conducted by The Nature Conservancy in cooperation with state natural heritage programs in Alabama, Georgia, South Carolina, North Carolina, and Virginia identified a number of high priority terrestrial and aquatic conservation areas. Recent surveys by Georgia DNR and other organizations have resulted in the identification of additional priority sites. The following are examples of important sites and landscape features in Georgia's Piedmont.

Burks Mountain/Dixie Mountain

This site is highly significant, both geologically and ecologically. The ridge comprising Burks Mountain and Dixie Mountain is underlain with magnesium rich (ultramafic) rock known as "serpentine". This landform is reportedly the largest serpentine ridge east of the Appalachian Mountains and south of Maryland. Vegetation types on the upper slopes of the ridge include open woodland with scattered rock outcrops ("serpentine barrens"), as well as xeric hardwood-pine forest with longleaf pine. This area contains the only Piedmont populations of two State-protected plants: Georgia plume (*Elliottia racemosa*) and pineland Barbara buttons (*Marshallia ramosa*) as well as a population of the endemic Dixie Mountain breadroot (*Pediomelum piedmontanum*).

Currahee Mountain/Lake Russell WMA

This site, located in the upper Piedmont on the Chattahoochee National Forest, is an important area for restoration of shortleaf pine-post oak woodland habitat. This high priority habitat, formerly common in the upper Piedmont and Blue Ridge, was greatly reduced in extent and condition due to decades of forest conversion and fire suppression. Restoration of shortleaf pine-post oak woodland habitat at this site has greatly benefited

the federally protected smooth purple coneflower (*Echinacea laevigata*) and associated species.

Granite Outcrops (numerous sites)

These small "islands" of biological diversity are found scattered across the Piedmont of Georgia, and contain some of the most imperiled species in the state. Granite outcrop habitats are threatened by quarrying, grazing, off-road vehicles and sedimentation. Protected examples of these habitats can be found at Panola Mountain State Park, Davison-Arabia Mountain Preserve, Stone Mountain, Rock and Shoals Outcrop Natural Area, Camp Meeting Rock Preserve, and Heggies Rock Preserve. Several other granite outcrop sites should be protected in order to preserve a representative portion of the native flora and fauna of these important ecosystems.

Oconee National Forest/Piedmont National Wildlife Refuge

These two federal properties comprise the largest block of publicly owned land in the lower Piedmont. Much of the habitat in Oconee National Forest and Piedmont National Wildlife Refuge consists of loblolly pine stands on upland sites that have been severely impacted by previous agricultural practices. However, these federal lands also contain significant examples of oak-hickory-pine forest, mesic hardwood forest, bottomland hardwood forest, upland depression swamp, and other high priority habitats. High priority species known from this conservation landscape include red-cockaded woodpecker (*Picoides borealis*) Bachman's sparrow (*Aimophila aestivalis*), American ginseng (*Panax quinquefolius*), and Oglethorpe oak (*Quercus oglethorpensis*).

Pine Mountain/Flint River

Pine Mountain is a series of linear ridges extending from Auburn, Alabama northeastward to Barnesville, Georgia. This mountain is composed largely of Hollis quartzite, an extremely hard rock of almost pure silica that is highly resistant to erosion. Pine Mountain rises 300 to 500 feet above the surrounding lands of the lower Piedmont. Toward its eastern end, Pine Mountain is cut by the Flint River in a series of twisting, narrow gorges approximately 400 feet deep. This mountainous area includes several examples of globally rare natural communities associated with the greater longleaf pine ecosystem. The biota of the Pine Mountain/Flint River region represents a diverse mixture of montane, piedmont and coastal plain elements. High priority plants known from the Pine Mountain/Flint River region include shoals spiderlily, Schwerin's indigo-bush, fringed campion, and relict trillium. Several coastal plain fishes, amphibians and reptiles have northward range extensions in this region. High priority vertebrates reported from the Pine Mountain/Flint River region include Barbour's map turtle, alligator snapping turtle, Webster's salamander, seepage salamander, and bluestripe shiner. Several rare freshwater mollusks have also been documented from the Flint River.

Pool Mountain

This conservation site in the eastern Piedmont contains a rich mesic hardwood forest more typical of the Blue Ridge, with several rare or uncommon plants, including state protected species such as Wood's false hellebore (*Veratrum woodii*). Pool Mountain has archaeological, historical, and geological significance. This exemplary site is surrounded by residential and commercial development in eastern Gwinnett County, but a portion of the site was acquired by Gwinnett County for use as a park. Similar sites with rich mesic hardwood forests can be found in ravines along the Chattahoochee, Oconee, Flint, and Ocmulgee rivers.

Sheffield Tract WMA/Paulding Forest WMA

This important conservation site includes globally significant examples of montane longleaf pine-hardwood forest, mesic hardwood forest, oak-hickory-pine forest, and high priority streams (e.g., Raccoon Creek) that support rare species such as the Cherokee darter and Etowah darter. Recent land acquisition projects supported by a combination of state, federal, local, and private funds have added significantly to the amount of public conservation land in this area. Other high priority landscape features with montane longleaf pine-hardwood forest communities in this portion of the western Piedmont include Dugdown Mountain and Hightower Mountain.

<u>High Priority Waters</u>

Figure 16 shows the high priority watersheds identified by the Aquatic Habitat Team for this ecoregion. These streams were chosen on the basis of documented occurrences of high priority aquatic species and the relative rarity of these species. Examples of high priority stream in the Piedmont include Amicalola Creek, Etowah River, Raccoon Creek, Chestatee River, Chattahoochee River, Tallapoosa River, Little Tallapoosa River, Potato Creek, Flint River, Yellowjacket Creek, House Creek, North Oconee River, Middle Oconee River Little River, Broad River, South Fork Broad River, Long Creek, and Savannah River. Refer to the Aquatic Habitat Technical Team report in Appendix F for details on the factors contributing to the significance of these and other high priority streams.

<u>Conservation Goals</u>

- Maintain known viable populations of all high priority species and functional examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.

- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, developing specific educational messages, and managing exotic species populations on public lands.
- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments and sharing information from DNR biodiversity databases.
- Continue efforts to recover federally listed species by implementation of recovery plans

Mature Pine and Upland Hardwood Forests

Public lands are an important component of the Piedmont landscape and may serve as core areas from which to manage or expand wildlife habitat. Forest products companies are the largest private landowners in the Piedmont and provide tremendous opportunities for increased cooperative management strategies to accomplish wildlife conservation objectives. Private, non-industrial landowner incentive programs can be increased in key areas as well, further adding to core habitat for high priority Piedmont species.

Land tenure in this ecoregion is changing rapidly, however. Recent land divestitures by corporate landowners point to the need for conservation organizations to act quickly when properties containing high priority habitats and species are placed on the market. Partnerships with corporate landowners that involve technical and field assistance can facilitate identification of these habitats and development of specific proposals for long-term protection. A particularly high priority in this ecoregion is protection, restoration and maintenance of montane longleaf pine communities in areas such as Pine Mountain, the Sheffield/Paulding Forest WMA area, and the Dugdown Mountain/Hightower Mountain area.

Strategies and Partnerships to Achieve Conservation Goals

- Provide financial incentives and technical expertise to encourage prescribed burns for high priority fire-maintained habitats (e.g., serpentine woodlands/savannas, montane longleaf pine-hardwood forest) through participation in the Interagency Burn Team and other means.
- Work with NRCS staff to identify high priority habitats and sites for implementation of habitat enhancement/restoration projects through Farm Bill programs (e.g., thinning and burning pine stands, restoration of oak and shortleaf pine-oak woodlands)
- Establish partnerships to assess and combat exotic species populations on public lands and provide technical assistance to private landowners to discourage use of invasive exotics.

- Use state parks, wildlife management areas, natural areas, and other public lands to showcase habitat restoration efforts (removal of exotic species, prescribed fires, reduction of deer populations, restoration of streams and stream buffers).
- Work with GDOT and local governments to minimize direct impacts to high priority species and habitats from road development projects
- Work with Georgia Power and private landowners to identify and conserve populations of rare species in and adjacent to utility corridors
- Develop educational materials on high priority species and habitats in the ecoregion and provide these to environmental educators at WRD educational facilities (e.g., Charlie Elliott Wildlife Center) and other facilities
- Work with EPD and local governments to assess potential impacts of stream buffer variances, with special emphasis on high priority streams and watersheds.
- Work with GFC and SIC to facilitate revision of forestry BMPs for better protection of streams and wetlands and maintenance of important wildlife habitats
- Work with The Nature Conservancy, USFWS, Georgia Land Conservation Center and local land trusts to provide protection for high priority wetlands and stream corridors.

Highest Priority Conservation Actions

Highest priority conservation actions (actions ranked "Very High" or "High") identified by the technical teams, advisory committee, and other stakeholders specifically for this ecoregion include the following (see Appendix P for details):

- Develop a baseline database of stream geomorphic characteristics in high quality Cherokee Darter streams. Use these data to revise stream restoration methods used in the Etowah basin.
- Conduct surveys for Black Rails in high marsh areas of saltmarsh and possibly other shallowly flooded freshwater habitats.
- Implement diadromous fish restoration projects in Piedmont streams. Evaluate existing population status, commercial and recreational fisheries, and habitat limitations. Look for opportunities to enhance habitat through a suite of alternatives.
- Implement Shoal Creek, Smithwick Creek, and Raccoon Creek watershed projects to benefit high priority aquatic species.
- Maintain Robust Redhorse Conservation Committee to assure restoration of robust redhorse populations. Conduct research and management efforts to develop six self-sustaining populations of robust redhorse throughout its historic range.
- Work with private landowners to restore and manage high priority upland habitats, including montane longleaf pine communities.

For high priority conservation actions of statewide scope, see Section V.

Table 8. Piedmont High Priority Animals (90 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
AA	Cambarus englishi	Tallapoosa Crayfish	G3	S2		R	Cobble-rubble riffles of medium size rivers.
AA	Cambarus fasciatus	Etowah Crayfish	G3	S2		T	Lotic habitats under rocks in flowing water
AA	Cambarus harti	Piedmont Blue Burrower	G1	S1		E	Complex burrows in floodplain areas with sandy-organic soil
AA	Cambarus howardi	Chattahoochee Crayfish	G3Q	S2		T	Riffle areas of streams; in rocks with swift-flowing water
AA	Cambarus strigosus	Lean Crayfish	G2	S2		T	Complex burrows in sandy clay soil, often among roots; Savannah R. drainage
AA	Distocambarus devexus	Broad River Burrowing Crayfish	G1	S1		T	Sandy-clay burrows in Broad River drainage.
AA	Ophiogomphus incurvatus	Appalachian Snaketail	G3T2T3	S2			Small to medium spring-fed streams with mud and gravel bottoms.
AA	Procambarus acutissimus	Sharpnose Crayfish	G5	S2			Temporary fluctuating pools or ponds to permanent lotic habitats (not typical of GA populations); sometimes in simple burrows
AM	Eurycea chamberlaini	Chamberlain's Dwarf Salamander	G4	S2			Seepage ravines/stream sides; bogs, sphagnum beds, marshes
AM	Necturus punctatus	Dwarf Waterdog	G5	S2S3			Sluggish streams with substrate of leaf litter or woody debris
AM	Urspelerpes brucei	Patch-nosed Salamander	G1	S1			headwater streams
BI	Ammodramus savannarum pratensis	Grasshopper Sparrow	G5	S4			Breeds in grasslands, pasture lands, PD RV, rare in CP. Wintering range poorly known.
BI	Colinus virginianus	Northern Bobwhite	G5	S5			Early successional habitat, open pine savanna (frequent fire maintained in small burn unit size), fallow habitats associated with crop lands, extensive forest regen areas (area sensitive - minimal fall pop of 700 birds for viability on 3000+acres)
BI	Elanoides forficatus	Swallow-tailed Kite	G5	S2		R	River swamps; marshes, forages over pastures and ag fields - post breeding. Forage in well burned open pine woodlands where exist. Open pine and bottomland forest with super canopy pines preferred nest sites. Will nest in non-emergent hardwoods and thinned pine plantations as well - typically several years before final harvest.
BI	Euphagus carolinus	Rusty Blackbird	G4	S3			Bottomland forest, pecan orchards, agricultural fields
BI	Falco peregrinus	Peregrine Falcon	G4	S1		R	Rocky cliffs & ledges; seacoasts - migration; skyscrapers
BI	Grus americana	Whooping Crane	G1	S1	LE		Open, mostly emergent herbaceous freshwater wetlands and fields for stop-over sites
BI	Haliaeetus leucocephalus	Bald Eagle	G5	S3		T	Edges of lakes & large rivers; seacoasts
BI	Ixobrychus exilis	Least Bittern	G5	S3			Fresh and brackish water wetlands with emergent herbaceous cover including impoundments, natural freshwater marshes, and tidally influenced marshes
BI	Lanius ludovicianus	Loggerhead Shrike	G4T3Q	S3			Open woods; field edges, pastures, ball fields, industrial park, primary dunes, hammocks
BI	Laterallus jamaicensis	Black Rail	G3G4	S1			Very shallowly flooded freshwater marshes, brackish marshes, and saltmarshes. Some high marsh areas of the saltmarsh may have breeding pairs
BI	Limnothlypis swainsonii	Swainson's Warbler	G4	S3			Dense undergrowth or canebrakes in swamps and river floodplains, small mountain pop in rhododendron and mountain laurel thickets
BI	Peucaea aestivalis	Bachman's Sparrow	G3	S2		R	Open pine or oak woods; old fields; brushy areas, young large grassy pine regeneration areas
BI	Picoides borealis	Red-cockaded Woodpecker	G3	S2	LE	E	Open pine woods; pine savannas
BI	Protonotaria citrea	Prothonotary Warbler	G5	S4			Bottomland forest, swamps, and similar forested wetlands. Nests in tree cavities.
BI	Rallus elegans	King Rail	G4	S3			Freshwater to brackish emergent herbaceous wetlands of grasses, sedges, cattails, wild rice; herbaceous portions of forested wetlands.

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 8. Piedmont High Priority Animals (90 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
BI	Setophaga kirtlandii	Kirtland's Warbler	G3G4	SNRN	LE	E	Transient; varying habitats during late spring and fall
BI	Tyto alba	Barn Owl	G5	SU			Nests in large hollow trees or old buildings (particularly cement silos) in areas with extensive pasture or grassland or other open habitats such as marsh
FI	Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	G3T3	S3	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates; spawn as far inland as Macon, GA on the Ocmulgee
FI	Alosa sapidissima	American Shad	G5	S5			large rivers between coast and fall zone are used for spawning and early life history stages
FI	Ameiurus serracanthus	Spotted Bullhead	G3	S3		R	Large streams and rivers with moderate current and rock-sand substrate
FI	Carpiodes velifer	Highfin Carpsucker	G4G5	S2S3			swift sandy areas associated with sandbars, yoy found in backwaters and on margins of sandbars
FI	Cyprinella callitaenia	Bluestripe Shiner	G2G3	S2		R	Flowing areas in large creeks and medium-sized rivers over rocky substrates
FI	Cyprinella gibbsi	Tallapoosa Shiner	G4	S3			Medium-sized creeks in moderate to swift current over sand, gravel, or bedrock substrates
FI	Cyprinella xaenura	Altamaha Shiner	G2G3	S2S3		T	Medium-sized to large streams in runs or pools over sand to rocky substrates
FI	Etheostoma brevirostrum	Holiday Darter	G2	S1		E	Small creeks to moderate sized rivers in gravel and bedrock pools
FI	Etheostoma chuckwachatte	Lipstick Darter	G3	S2		E	Medium to large streams with moderate to swift current over gravel, cobble, and boulder substrate
FI	Etheostoma etowahae	Etowah Darter	G1	S1	LE	E	moderate to high gradient streams over cobble to gravel in areas of swift current
FI	Etheostoma parvipinne	Goldstripe Darter	G4G5	S2S3		R	Small sluggish streams and spring seepage areas in vegetated habitat
FI	Etheostoma rupestre	Rock Darter	G4	S2		R	Swift rocky riffles often associated with attached vegetation such as Podostemum
FI	Etheostoma scotti	Cherokee Darter	G2	S2	LT	T	Small to medium-sized creeks with moderate current and rocky substrates
FI	Fundulus bifax	Stippled Studfish	G2G3	S1		E	Slow eddies over sand or gravel along the margins of riffles and runs in medium-sized streams to small rivers
FI	Hybopsis lineapunctata	Lined Chub	G3G4	S2		R	Upland creeks over sandy substrate with gentle current
FI	Hybopsis sp. 9	Etowah Chub	G1Q	S1S2			Generally in creeks and small to medium rivers over sand-silt bottom, usually in pools adjacent to riffle areas. Tends to occupy smaller streams in east than in west.
FI	Macrhybopsis sp. 1	Coosa Chub	G3G4	S1		E	Fast water in large streams and rivers
FI	Micropterus cataractae	Shoal Bass	G3	S2			large river, shoal and fluvial specialist
FI	Micropterus chattahoochee	Chattahoochee Bass	GNR	S1			flowing sections of streams and rivers, including river shoals
FI	Micropterus sp. cf coosae "Altamaha/Ogeechee"	Undescribed Redeye Bass	GNR	S3			believed to be headwater species but patterns altered by non-native species
FI	Micropterus sp. cf coosae "Savannah"	Bartrams Bass	GNR	S3			upland streams and rivers
FI	Moxostoma robustum	Robust Redhorse	G1	S1		E	Med to large rivers, shallow riffles to deep flowing water; moderately swift current
FI	Notropis hypsilepis	Highscale Shiner	G3	S3		R	Flowing areas of small to large streams over sand or bedrock substrates
FI	Notropis scepticus	Sandbar Shiner	G4	S2		R	Large streams to medium-sized rivers in flowing pools over sandy to rocky substrates
FI	Noturus munitus	Frecklebelly Madtom	G3	S1		E	Shoals and riffles of moderate to large streams and rivers
FI	Percina antesella	Amber Darter	G1G2	S1	LE	E	Riffles & runs of medium-sized rivers, patches of sand and small gravel, riverweed

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 8. Piedmont High Priority Animals (90 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Percina crypta	Halloween Darter	G2	S2		T	larger streams in riffle/shoal habitat
FI	Percina kusha	Bridled Darter	G2	S1		E	Flowing pools and runs in large streams and small to medium sized rivers with clear water
FI	Percina smithvanizi	Muscadine Darter	G3	S3		R	Flowing pool areas with substrate of sand, detritus, or bedrock in small rivers
MA	Myotis austroriparius	Southeastern Myotis	G3G4	S3			Caves & buildings near water; large hollow trees in bottomland hardwood swamps
MA	Myotis grisescens	Gray Myotis	G3	S1	LE	E	Caves with flowing water or with large creeks or bodies of water nearby, also storm sewers and artificial caves in other states. Unknown summer roosts in eastern portion of GA range. Marble mines?
MA	Myotis septentrionalis	Northern Myotis	G2G3	S2S3			Caves & mines in winter; riparian areas, upland forests, cracks and crevices in dead and live trees in summer
MA	Perimyotis subflavus	Tri-colored Bat	G3	S5			Open forests with large trees and woodland edges; roost in tree foliage; hibernate in caves or mines with high humidity.
MA	Spilogale putorius	Eastern Spotted Skunk	G4	S3			brushy, rocky, wooded habitats; avoids wetlands
MO	Alasmidonta arcula	Altamaha Arcmussel	G2	S3		T	Large rivers and reservoirs on gently sloping banks with soft and fine sediments. Often under overhanging willows.
MO	Anodontoides radiatus	Rayed Creekshell	G3	S2		T	Small creeks to large rivers with moderate current in mud, sand, and gravel
MO	Elimia mutabilis	Oak Elimia	G2Q	S2			shoals in medium sized rivers
MO	Elliptio nigella	Winged Spike	G1	S2			Large rivers in swift and shallow shoals. Often times associated with large crevices and cavities in and around limestone boulders.
MO	Hamiota altilis	Finelined Pocketbook	G2G3	S2	LT	T	Small streams to large rivers; sand, gravel, and cobble substrates; usually not in swift current
MO	Hamiota subangulata	Shinyrayed Pocketbook	G2	S2	LE	E	Medium sized creeks to large rivers in sand substrates in slow to swift flowing water.
MO	Lampsilis straminea	Southern Fatmucket	G5T	S2			Small creeks to rivers in slow to moderate current; sand, sandy mud and gravel substrates
MO	Medionidus penicillatus	Gulf Moccasinshell	G2	S1	LE	E	Large rivers to small creeks; found in a variety of substrates
MO	Pleurobema pyriforme	Oval Pigtoe	G2	S1	LE	E	Large rivers to small creeks with slow to moderate current in pool, run, and riffle habitats; combinations of clay, sand, and gravel substrate
MO	Somatogyrus alcoviensis	Reverse Pebblesnail	G1Q	S1			Medium to small rivers with moderate gradient in riffle habitat; found on bedrock, cobble, and boulders
MO	Somatogyrus tenax	Savannah Pebblesnail	G2G3Q	S2S3			Medium rivers, undersides of cobbles and boulders in shallow rocky rapids; also found in association with aquatic vegetation
RE	Graptemys barbouri	Barbour's Map Turtle	G2	S3		T	Rivers & large creeks of Apalachicola River drainage; possible in Ochlockonee
RE	Macrochelys temminckii	Alligator Snapping Turtle	G3G4	S3		T	Streams and rivers; impoundments; river swamps
RE	Pituophis melanoleucus melanoleucus	Northern Pine Snake	G4T4	S2			Dry pine or pine-hardwood forests
TA	Amblyscirtes alternata	Dusky roadside-skipper	G2G3	S3			Sunny patches in pine forests
TA	Amblyscirtes belli	Bell's Roadside-skipper	G3G4	S3			Wet hardwoods, river oats
TA	Amblyscirtes carolina	Carolina roadside-skipper	G3G4	S2S3			Wet situations with cane
TA	Bombus affinis	Rusty-patched bumblebee	G1	SH			
TA	Bryophaenocladius chrissichuckorum	Midge (Heggie's Rock)		S1			Heggie's Rock pools, adjacent outcrops?
TA	Danaus plexippus	Monarch butterfly	G4	S4			Milkweeds
TA	Euphydryas phaeton	Baltimore checkerspot	G4	S2			Chattahoochee River parks

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 8. Piedmont High Priority Animals (90 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
TA	Habronattus sabulosus	Jumping spider (Heggie's Rock)	GNR	S1S2			Granite flatrock outcrops
TA	Melanoplus longicornis	A spur-throat grasshopper	G1G2	S2			Hardwoods
TA	Neonympha helicta	Helicta satyr	G3G4	S2			Dry fields
TA	Pieris virginiensis	West Virginia White	G3	S3			Hardwoods
TA	Satyrium edwardsii	Edwards hairstreak	G4	S3			Blackjack oak
TA	Speyeria diana	Diana fritillary	G3G4	S3			Hardwood forests
TA	Trimerotropis saxatalis	Lichen or rock grasshopper	G3	S3			Granite flatrock outcrops

Table 9. Piedmont High Priority Plants (66 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Acmispon helleri	Carolina Trefoil	G5T3	S1		E	Clayey soil over ultramafic rock; post oak-blackjack oak savannas
Aesculus glabra	Ohio Buckeye	G5	S2			Mesic forests in circumneutral soil
Allium speculae	Flatrock Onion	G2	S2		T	Granite outcrops (limited to Lithonia Gneiss types)
Amorpha nitens	Shining Indigo-Bush	G3?	S1?			Rocky, wooded slopes; alluvial woods
Amorpha schwerinii	Schwerin's Indigo-Bush	G3G4	S2			Rocky upland woods
Amphianthus pusillus	Pool Sprite, Snorkelwort	G2	S2	LT	T	Vernal pools on granite outcrops
Amsonia ludoviciana	Louisiana Blue Star	G3	S2			Open woods near granite outcrops (limited to Lithonia Gneiss types)
Anemone berlandieri	Glade Windflower	G4?	S1S2			Granite outcrop ecotones; openings over basic rock
Anemone caroliniana	Carolina Windflower	G5	S1?			Upland seepage swamp openings over Iredell soils; wet meadows
Arabis georgiana	Georgia Rockcress	G1	S1	C	T	Rocky or sandy river bluffs and banks, in circumneutral soil
Baptisia megacarpa	Bigpod Wild Indigo	G2	S1			Floodplain forests
Berberis canadensis	American Barberry	G3	S1		E	Cherty, thinly wooded slopes
Boechera missouriensis	Missouri Rockcress	G5	S2			Granite and amphibolite outcrops
Calamintha sp. nov. (undescribed)	Indian Grave Mountain Wild Savory	GNR	S1			Montane longleaf woodlands
Carex biltmoreana	Biltmore Sedge	G3	S1		T	High elevation ledges and rock faces
Carex radfordii	Radford's Sedge	G2	S1?		T	Rich woods of marble ravines
Cirsium virginianum	Virginia Thistle	G3	S2?			Moist pinelands; moist longleaf pine/wiregrass savannas
Crataegus aemula	Rome Hawthorn	G2G3	S2?			Upland hardwood forests; creek flats
Crataegus aprica	Sunny Hawthorn	GNR	S1			Open, sandy, rocky dry sites in lower elevation mountains and perhaps Piedmont.
Croomia pauciflora	Croomia	G3	S2		T	Mesic hardwood forests, usually with Fagus and Tilia
Cuscuta harperi	Harper's Dodder	G2G3	S1		E	Altamaha Grit outcrops; granite outcrops; often with Liatris microcephala as host
Danthonia epilis	Bog Oat-Grass	G3G4	S1?			Mountain bogs
Draba aprica	Open-Ground Whitlow-Grass	G3	S1S2		E	Granite and amphibolite outcrops, usually in redcedar litter
Echinacea laevigata	Smooth Purple Coneflower	G2G3	S2	LE	E	Upland forests over amphibolite
Eleocharis wolfii	Spikerush	G3G5	S1			Shallow pools on granite outcrops
Eriocaulon koernickianum	Dwarf Pipewort	G2	S1		E	Granite outcrops
Eurybia jonesiae	Piedmont Bigleaf Aster	G3?	S2			Mixed oak-hickory forests
Fimbristylis brevivaginata	Flatrock Fimbry	G2	S2			Granite outcrops
Fothergilla gardenii	Dwarf Witch-Alder	G3G4	S2		T	Openings in low woods; swamps
Helianthus smithii	Smith's Sunflower	G2Q	S1			Dry open woods and thickets
Hydrastis canadensis	Goldenseal	G3G4	S2		E	Rich woods in circumneutral soil
Hymenocallis coronaria	Shoals Spiderlily	G2Q	S2		T	Rocky shoals of broad, open rivers
Isoetes melanospora	Black-Spored Quillwort	G1	S1	LE	E	Vernal pools on granite outcrops
Isoetes tegetiformans	Mat-Forming Quillwort	G1	S1	LE	E	Vernal pools on granite outcrops
Juglans cinerea	Butternut	G4	S2			Openings in bottomland forests and in the mesophytic hardwood forests of rich mountain coves
Juniperus communis var. depressa	Ground Juniper	G5T5	S1			Gneiss ledges

Table 9. Piedmont High Priority Plants (66 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Lilium canadense	Canada Lily	G5	S2?			Openings in rich woods
Lysimachia fraseri	Fraser's Loosestrife	G3	S2		R	Moist, open, bouldery gravel bars and streambanks; edges of sandstone and granite outcrops
Monotropsis odorata	Sweet Pinesap	G3	S1		T	Upland forests
Nestronia umbellula	Indian Olive	G4	S3		R	Mixed with dwarf shrubby heaths in oak-hickory-pine woods; often in transition areas between flatwoods and uplands
Panax quinquefolius	American Ginseng	G3G4	S3			Mesic hardwood forests; cove hardwood forests
Paronychia virginica	Yellow Nailwort	G4	S1		E	Serpentine outcrops
Pediomelum piedmontanum	Dixie Mountain Breadroot	G1	S1		E	Shallow soils over mafic (serpentine) rock, upland longleaf pine-mixed oak savanna and powerline rights-of-way
Platanthera integrilabia	Monkeyface Orchid	G2G3	S1S2	C	T	Red maple-gum swamps; peaty seeps and streambanks with Parnassia asarifolia and Oxypolis rigidior
Portulaca umbraticola ssp. coronata	Wingpod Purslane	G5T2	S2			Granite outcrops; Altamaha Grit outcrops
Ptilimnium nodosum	Harperella	G2	S1	LE	E	Granite outcrop seeps; shallow seasonal ponds in limesink depressions
Quercus oglethorpensis	Oglethorpe Oak	G3	S2		T	Broad River bottomlands; upland seepage swamps over Iredell and Enon soils with seasonally wet clay beds
Rhus michauxii	Dwarf Sumac	G2G3	S1	LE	E	Open forests over ultramafic rock
Sabatia capitata	Cumberland Rose Gentian	G2	S2		R	Meadows over sandstone or shale
Schisandra glabra	Bay Starvine	G3	S2		T	Rich woods on stream terraces and lower slopes
Schwalbea americana	Chaffseed	G2G3	S1	LE	E	Open pinelands, as in well-managed, somewhat moist longleaf pine-wiregrass forests seeps
Sedum nevii	Nevius' Stonecrop	G3	S1		T	Gneiss ledges on river bluffs
Sedum pusillum	Granite Stonecrop, Puck's Orpine	G3	S3		T	Granite outcrops, often in mats of Hedwigia moss under Juniperus virginiana
Silene polypetala	Fringed Campion	G2	S2	LE	E	Mesic deciduous forests
Stewartia malacodendron	Silky Camellia	G4	S2		R	Along streams on lower slopes of beech-magnolia or beech-basswood-Florida maple forests
Symphyotrichum georgianum	Georgia Aster	G3	S2	C	T	Upland oak-hickory-pine forests and openings; sometimes with Echinacea laevigata or over amphibolite
Trillium persistens	Persistent Trillium	G1	S1	LE	E	Mesic hardwood forests, upland forests
Trillium reliquum	Relict Trillium	G3	S3	LE	E	Mesic hardwood forests; limesink forests; usually with Fagus and Tilia
Trillium sp. nov. (unpublished)	Southern Decumbent Trillium	GNR	S1			Mesic hardwoods
Triphora trianthophora	Three-Birds Orchid	G3G4	S2?			Loamy soils of rhododendron thickets; hardwood forests
Veratrum woodii	Ozark Bunchflower	G5	S2		R	Mesic hardwood forests over basic soils
Viburnum rafinesquianum var. affine	Downy Arrowwood	G5TNR	S1			Limestone bluffs along major rivers
Waldsteinia lobata	Piedmont Barren Strawberry	G2G3	S2		R	Stream terraces and adjacent gneiss outcrops
Xerophyllum asphodeloides	Eastern Turkeybeard	G4	S1		R	Xeric oak-pine forests
Xyris scabrifolia	Harper's Yellow-Eyed Grass	G3	S1			Sedge bogs; pitcherplant bogs; pine flatwoods
Xyris tennesseensis	Tennessee Yellow-Eyed Grass	G2	S1	LE	E	Seepy margins of limestone spring runs

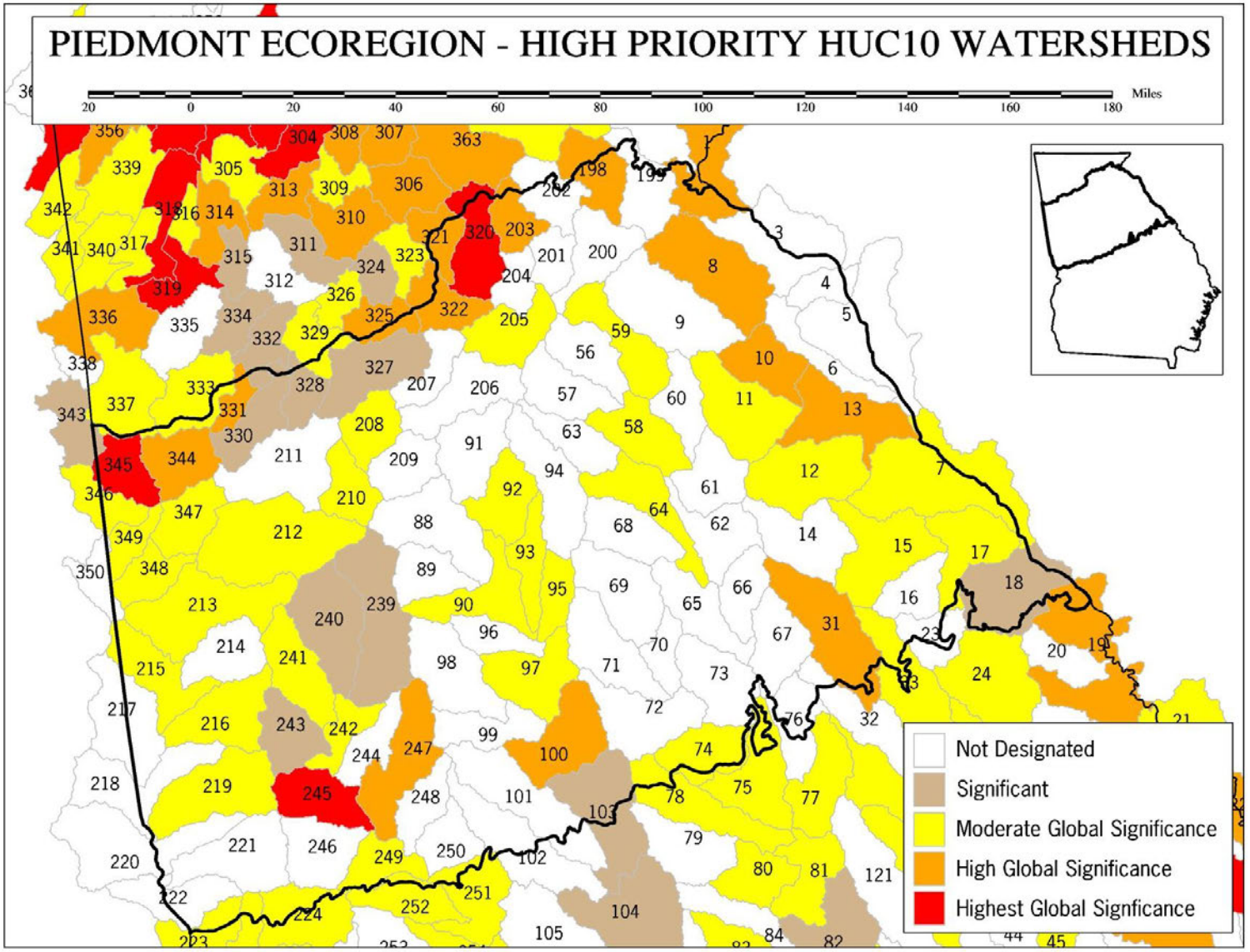


Figure 16. High Priority Waters, Piedmont Ecoregion

Southeastern Plains Ecoregion

Ecoregional Overview

The Southeastern Plains ecoregion stretches across middle and southwestern Georgia, covering approximately 16,252,663 acres. It is bordered on the northwest by the Piedmont and on the southeast by the Southern Coastal Plain. The northwestern edge of this ecoregion is known as the Fall Line, a distinctive zone of transition between the topographically varied Piedmont and the relatively flat Coastal Plain. Approximately 675,000 acres are in permanent or long-term conservation ownership. Georgia DNR manages approximately 133,500 acres owned in fee simple by the State of Georgia and an additional 62,700 acres in leases or management agreements. Federal land ownership includes approximately 258,300 acres managed by the U.S. Department of Defense, 14,050 acres managed by the U.S. Fish & Wildlife Service, 4,619 acres managed by the Natural Resources Conservation Service, and 1,157 acres managed by the National Park Service. While this ecoregion is the largest in the state, it has the lowest percentage of lands in permanent conservation status (4.5%).

This expansive ecoregion of irregular plains and broad interstream areas contains a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is mostly longleaf pine-wiregrass, longleaf pine-scrub oak, oak-hickory-pine and southern mixed forest. Geologic strata of this region are of Cretaceous or Tertiary age. Elevations and relief are generally less than in the Piedmont and greater than in the Southern Coastal Plain. Streams in this region have relatively low gradients and sandy substrates. Subdivisions of the Southeastern Plains in Georgia include the Sand Hills, the Southern Hilly Gulf Coastal Plain, the Dougherty Plain, the Tifton Upland, the Sand Hills, the Tallahassee Hill/Valdosta Limesink, and the Southeastern Floodplains and Low Terraces.

The Sand Hills are a narrow, rolling to hilly, highly dissected belt stretching across the state from Augusta to Columbus. The region is composed primarily of Cretaceous and Eocene marine sands and clays deposited over the crystalline and metamorphic rocks of the Piedmont. Soils are mostly excessively well drained and low in nutrients, although soils in some areas contain more loamy and clayey horizons. The driest sites have typical sandhill vegetation characterized by longleaf pine and turkey oak. Other areas have shortleaf-loblolly pine forests or mixed oak-pine forests. Atlantic white-cedar swamps can be found in a few areas in the western portion of the Sand Hills region.

The Southern Hilly Gulf Coastal Plain is characterized by irregular plains and gently rolling hills developed over bands of sand, clay, and marl formations. This heterogeneous region, which stretches west across Alabama and into Mississippi, has a variety of clayey, loamy, and sandy soils. The natural vegetation is mostly oak-hickory-pine forest, transitioning to southern mixed forest at its southern border. Land cover is mostly mixed forest and woodland, pine plantations, and small areas of pasture and cropland.

The Dougherty Plain is mostly flat to gently rolling and influenced by limestone near the surface of the soil. The karst topography contains numerous sinkholes and springs, and relatively few streams in the flatter part of the plain. Predominant landcover types are row crop and pasture, with some small areas of upland mixed forest. Crops such as cotton, peanuts and pecans are common. Many shallow, flat-bottomed depressions (Grady ponds and limesink ponds) are scattered throughout the region.

The Tifton Upland has rolling, hilly topography with a mosaic of agriculture, pasture, and some mixed pine/hardwood forests. Soils are well-drained, brownish, and loamy, often with iron-rich or plinthic layers. They support crops of cotton, peanuts, soybeans, and corn. On the western edge of the region the Pelham Escarpment has bluffs, caves, and deep ravines that support mesic hardwood forest and several rare plants.

The Coastal Plain Red Uplands formed on reddish Eocene sand and clay formations. Soils are mostly well-drained with a brown or reddish brown loamy or sandy surface layer and red subsoils. The majority of the area is in cropland or pasture, with some woodland on steeper slopes. The Fort Valley Plateau falls within this ecoregion, a relatively small agricultural area characterized by flat terrain.

The Atlantic Southern Loam Plains, also known as the Vidalia Upland, is generally lower, flatter, and more gently rolling than the Coastal Plain Red Uplands and has more cropland and finer-textured soils than the adjacent Sea Island Flatwoods. It has an abundance of agriculturally important soils in active cultivation, but also contains forests in areas that are more sloping or are low, flat and poorly drained. Parallel to some of the major streams in this region (e.g., Ohoopee, Little Ohoopee, Canoochee, and Little Ocmulgee) are deep wind-derived sand ridges with xeric vegetation such as longleaf pine-turkey oak forests as well as evergreen shrubs such as sandhills rosemary and woody mints.

The Tallahassee Hills/Valdosta Limesink region includes two topographically different areas, both influenced by underlying limestone. The Floridan aquifer is thinly confined in this region and streams may be intermittent or flow underground in the karst landscape. The Tallahassee Hills portion has rolling, hilly topography that is mostly covered in pine forest. Clayey sands weathered to a thick red residual soil are typical. The Valdosta Limesink area has lower relief and more solution basins containing ponds, lakes, and swamps, as well as more cropland. Major natural vegetation types include pine-mixed oak forest on clay-based upland soils, bayswamp and pondcypress swamp in depressions, and longleaf pine-scrub oak on sandy, well-drained areas.

Southeastern Floodplains and Low Terraces comprise a region of large sluggish rivers and backwaters with ponds, swamps, and oxbow lakes. Swamp forests of bald cypress and water tupelo and oak-dominated bottomland hardwood forests provide important wildlife corridors and habitat. This region includes the major alluvial river corridors, such as the Chattahoochee, Flint, Ocmulgee, Oconee, Ogeechee, and Savannah.

The predominant landcover types in the Southeastern Plains are row crop/pasture, evergreen forest, and forested wetland (Kramer and Elliott, 2004). An analysis of land use changes from 1974 to 1998 based on satellite imagery indicated the following general trends:

- A slight decrease in row crop/pasture (from 38.47% of total landcover to 32.73%)
- A slight increase in high-intensity and low-intensity urban (from 1.83% of total landcover to 2.85%)
- An increase in clearcut/sparse vegetation (from 4.66% of total landcover to 7.32%)
- An increase in evergreen forest (from 22.97% of total landcover to 27.19%)
- A decrease in forested wetlands (from 16.39% of total landcover to 14.52%)
- A decrease in deciduous/mixed forest (from 14.55% of total landcover to 13.70%)

These trends indicate a decline in the total acreage devoted to active agricultural uses and a corresponding increase in evergreen forest. This change likely reflects the trend toward enrollment of agricultural lands in the Conservation Reserve Program during this time period. The decrease in deciduous/mixed forest and forested wetlands and the increase in clearcut/sparse vegetation reflect, in part, the harvest of hardwood and hardwood-pine forests. Some of these forests were likely converted to pine plantations. Overall, this ecoregion has undergone a relatively modest urban/suburban expansion which has been limited primarily to the outlying areas of large metropolitan areas and major highway corridors.

An analysis of land use change from 2006 to 2011 indicates a 21.2% increase in early successional vegetation, a 2.4% increase in open water and 1.2% in developed land, a 5% decrease in forest land, a 2.7% decrease in agricultural land, and little change in wetland acreage. These figures demonstrate an overall decline in forest cover and a continuation of the increase in early successional classes (barren, herbaceous, and scrub/shrub) and decrease in acreage devoted to agricultural uses. The large increase in early successional habitat may represent increased timber harvest during this period, when timber prices were relatively high. See Appendix N for more information on landcover trends.

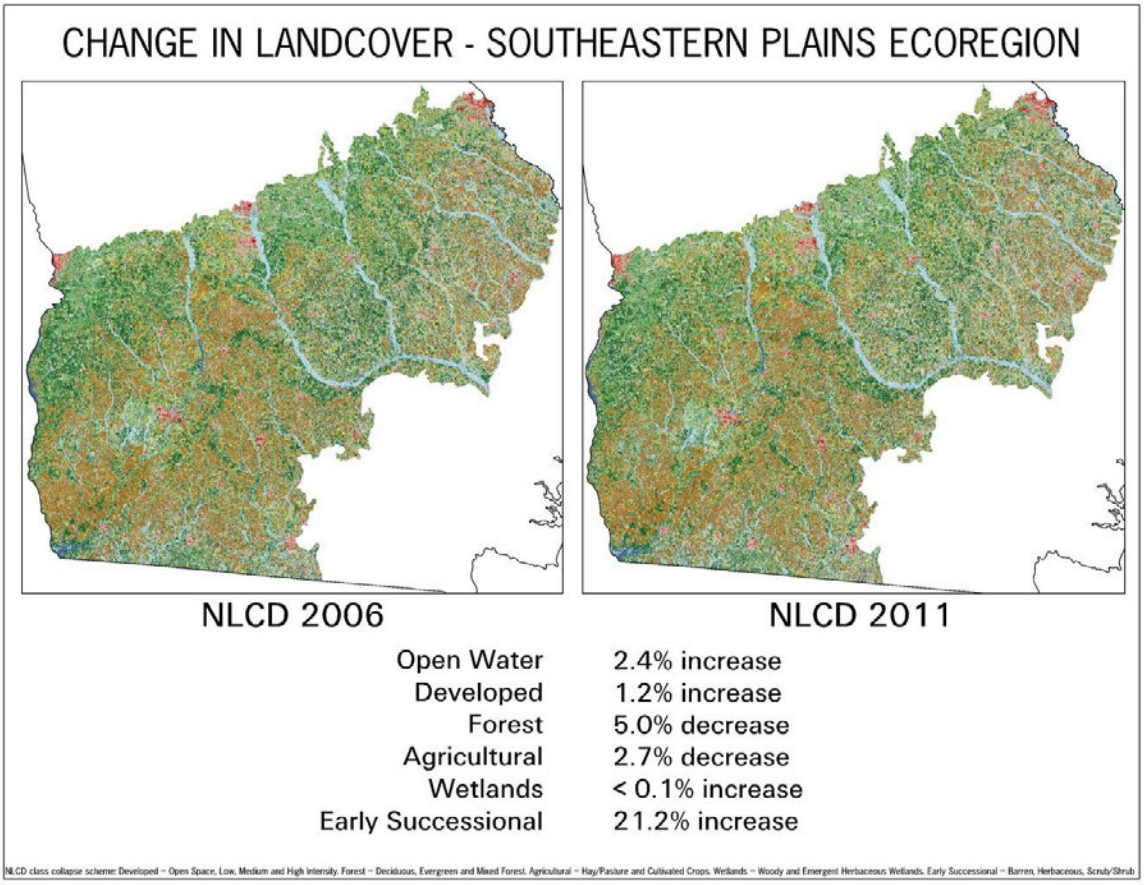


Figure 17. Change in landcover from 2006 to 2011 in the Blue Ridge ecoregion.

According to EPD stream monitoring data for 2012, 37% of streams in this region support designated uses (based on percentage of total monitored stream miles); 59% do not support designated uses, with 4% pending assessment. The percentage of monitored streams supporting designated uses in the Southeastern Plains is second lowest of the five ecoregions.

High Priority Species and Habitats

The technical teams identified 145 high priority animal species in the Southeastern Plains ecoregion. These included 22 birds, 7 mammals, 11 reptiles, 10 amphibians, 13 mollusks, 22 fishes, 9 aquatic arthropods, and 57 terrestrial arthropods. These species are listed in Table 7, with information on global and state rarity ranks, protected status (if any) under federal or state law, and habitat and range in Georgia. In addition, 118 species of high priority plants were identified for the Southeastern Plains. These are listed in Table 8.

High priority habitats for the Southeastern Plains are listed and briefly described below:

1. Alluvial (Brownwater) Rivers and Swamps
Large, low-gradient, meandering rivers with sandbars, sloughs and extensive floodplain swamps. Floodplains of these systems may remain inundated for extensive periods. Sand and silt are the dominant substrata and these rivers typically carry heavy sediment loads. Extensive cypress-gum swamps can be found on all major alluvial rivers in the upper portion of the Southeastern Plains. These systems have been impacted by altered flows from upstream dams.

2. Altamaha Grit Outcrops
These small patch habitats represent mosaics of indurated sandstone outcrops (vertical and horizontal surfaces) interpersed with rock-influenced pine woodland, bogs, and bottomlands. Characterized by several endemic species and plant associations.

3. Atlantic Whitecedar Swamps; Clearwater Stream Swamps
Narrow, linear forested systems along cold, clear streams of the Fall Line sandhills. Characterized by a fairly dense canopy of Atlantic whitecedar, with pond pine, red maple, sweetbay, and other mesic-hydric site species. Clearwater stream swamps are similar but without Atlantic whitecedar in the canopy. The shrub layer is usually well developed and diverse, while the groundlayer herbaceous vegetation is often sparse. These systems are thought to be maintained by periodic fire, beaver activity, and possibly other forms of disturbance.

4. Bayheads and Titi Swamps
Forested wetlands dominated by broad-leaved evergreen trees: sweetbay, redbay, and loblolly bay. Usually found in domed peatlands, broad interstream flats, or shallow drainageways. Includes shrubby areas dominated by titi (*Cyrilla racemiflora*). Considered a late successional community in a variety of hydrogeomorphic settings in the Coastal Plain.

5. Beech-Magnolia Slope Forests
These are uncommon Coastal Plain hardwood forests, typically found on very mesic river bluffs, and occasionally on gentle slopes that are naturally protected from fire by topographic setting. In addition to American beech and southern magnolia, may contain water oak, water hickory, American holly, and other fire-intolerant species. Often small in extent and occupying a narrow zone between wetland and fire-maintained upland forests. May contain epiphytic species such as green-fly orchid. Often associated with and in close proximity to hillside seeps.

6. Black Belt Prairies
Small-patch prairie habitats occurring over alkaline Oktibbeha soils. These soils are adhesive when wet and hard when dry, limiting the growth of woody plants. Black Belt prairies consist of herb-dominated patches interspersed with woody scrub component. These rare habitats are maintained by a combination of soil conditions and periodic fire.

7. Bottomland Hardwood Forests
Diverse hardwood-dominated forests found on natural levees, upper floodplain flats and terraces along brownwater and blackwater rivers. Characterized by a diverse canopy of hardwood species dominated by various oaks, green ash, sweetgum, red maple, water hickory, and other mesic species. These extensive forested systems provide habitat for a wide variety of wildlife species, and are especially important for wide-ranging forest interior species. Bottomland hardwood forests have been impacted by altered hydrologic conditions, forest conversion, and invasive exotic species.

8. Calcareous Swamps
Hardwood dominated swamp forests that are influenced by calcareous soils. Examples include Spring Creek in the Dougherty Plain. These spring-fed swamps may contain rare plants such as variable-leaved water plantain. Similar habitats are found along tributaries of the Ocmulgee and Ogeechee rivers (e.g., Limestone Creek, Williamson Swamp Creek)

9. Canebrakes
Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require periodic fire or other form of disturbance for maintenance.

10. Caves
Found primarily along the Pelham Escarpment in the southwestern portion of the ecoregion. A few caves are also found in karst environments near Cochran and Sandersville. These Coastal Plain caves provide habitat for high priority species such as the southeastern myotis and Georgia blind salamander.

11. Evergreen Hammocks and Mesic Hardwood Forests
Evergreen hammocks are typically associated with small isolated uplands within a floodplain or depressional wetland. Protected from frequent fire, these habitats are characterized by a canopy of submesic oaks and hickories, with southern magnolia, American holly, ironwood, flowering dogwood and spruce pine. Mesic hardwood forests are similar, and may occur in terraces above bottomland hardwood forests, ravines, or nonalluvial flats protected from frequent fire.

12. Flint Kaolin Outcrops
Rare and unusual rock outcrops composed of flint kaolin, a hard, flinty conglomerate of metamorphosed sediments. The outcrops are surrounded by xeric mixed oak/pine forest. Plant communities of these habitats resemble those of Altamaha Grit outcrops. Known only from Columbia County in the northeastern portion of this ecoregion.

13. Forested Depressional Wetlands
Seasonally or semi-permanently flooded forests of depressional features, including Carolina bays, limesinks, and Grady ponds. Soils range from mineral to organic and canopy dominants may include bays, pondcypress, and/or pond pine. Fire plays a role in maintaining some of these systems. Isolated wetlands that do not support fish

populations are very important breeding habitats for amphibians such as the flatwoods salamander.

14. Freshwater "Prairies"
Semipermanently flooded freshwater wetlands dominated by emergent vegetation and floating macrophytes, with scattered cypress, buttonbush, and swamp blackgum. The primary example in this region is Grand Bay, possibly the largest Carolina bay known. Other examples can be found in the Tallahassee Hills/Valdosta Limesink region. Fluctuations in water levels and/or periodic fire are required for maintenance. Many of these habitats have been impacted by altered hydrology (impoundment with dams or drainage) and/or fire suppression.

15. Hillside Seeps
Small patch habitats found on moist to wet lower slopes in sandy terrain. These seeps represent natural groundwater discharge points. May be dominated by shrubs or herbs (including pitcherplants), with scattered trees such as pond, slash, or longleaf pine. Most Georgia examples are fire-suppressed.

16. Limestone and Marl Outcrops; Calcareous Bluffs
Rich riparian or ravine habitats influenced by limestone substrate. Marl gorges and bluffs are restricted to tributaries of the Chattahoochee River (Town Creek, Kolomoki Creek) near Fort Gaines. These "blue marl gorges" have diverse mesic hardwood forests and unusual seepage cliffs. Mesic calcareous bluffs are also found along the Savannah River and contain plant species of northern affinities.

17. Longleaf Pine-Scrub Oak Woodlands
Sparse-canopied xeric longleaf pine system with patchy oak understory composed of turkey oak, sand post oak, bluejack oak, blackjack oak and other scrub oak species. Typically found on deep sand soils, on ridges and upper slopes. Contains a fairly diverse groundlayer of xerophytic grasses and forbs and scattered shrubs.

18. Longleaf Pine-Wiregrass Savannas
Large patch or matrix upland habitats characterized by a sparse canopy of longleaf pine (sometimes with slash pine) and a diverse herb layer dominated by wiregrass. These can range from mesic to dry, depending on topographic position and soils. Transition downslope into wet pine savanna. These habitats are heavily dependent on frequent fire for maintenance.

19. Nonalluvial (Blackwater) Rivers and Swamps
Large, meandering rivers with darkly stained but translucent waters and narrow to wide floodplains. Dominant substrate is sand, which may form bars in larger systems. In contrast to smaller blackwater streams, the forest canopy may only shade a portion of the stream width. Runs and pools are dominant habitats. Large snags represent a significant component of habitat heterogeneity. Limestone shoals occur on some of these rivers. These systems are vulnerable to negative impacts from nutrient loadings and hydrologic disruptions resulting from a wide variety of human activities.

20. Open-Water Ponds and Lakes
Open water aquatic habitats ranging from isolated depressions to impoundments created by beaver. Vegetation is sparse and consists primarily of emergent and floating macrophytes. Many wildlife species are dependent on these habitats. Limesinks are generally round, formed by the collapse of underground caverns, and are found primarily in the Dougherty Plain. Carolina bays are characterized by an elliptical shape, NW-SE axis, and a deep sandy rim on the east and south edges. Beaver activity along small branches may semi-permanently inundate areas, creating open wetlands.

21. Pine Flatwoods
Seasonally wet forests with open to closed pine canopy, often with an ericaceous shrub understory. Canopy dominants may include slash, longleaf, and occasionally pond pine. These habitats generally occur on nonalluvial flats and low terraces, and have a strong herbaceous component (although not as diverse as the longleaf pine savanna). Maintained by periodic fire.

22. Rocky/Sandy River Bluffs
Subxeric mixed pine-hardwood forest on river bluffs that are sandy, or rarely, rocky. May contain species such as white oak, southern red oak, post oak, laurel oak, mockernut hickory, shortleaf pine, loblolly pine and spruce pine. The woody understory may include red buckeye, blueberry, and possumhaw. The herb layer is typically sparse, but may include rare species such as Alabama milkvine.

23. Springs and Spring Runs
Clear, flowing systems with circumneutral pH and stable temperature and flow regimes. Limestone, detritus, and woody debris are dominant substrata. Floodplains of these systems are poorly developed. Mostly confined to the Dougherty Plain. Many of the larger springs in this ecoregion serve as important cool-water refuges for species such as striped bass.

24. Steephead Ravines
Rich mesic ravine forests characterized by a diverse canopy of hardwood trees, including American beech, southern sugar maple, southern magnolia, pyramid magnolia, basswood, and sugarberry. The most significant examples are the "Torreya Ravines" of the lower Pelham Escarpment near Lake Seminole. Similar habitats are found in the upper ends of narrow ravines in the Fall Line Sandhills and along the edges of deep limesinks in the Dougherty Plain.

25. Streams (Blackwater)
Meandering acidic streams with tea-stained, translucent waters and small to moderate-sized floodplains. Blackwater streams are highly acidic, high in dissolved organic materials, and low in suspended materials. Streambeds are characterized by sandy substrates, often with extensive woody debris and live plant roots are often interspersed. Pools and runs are the dominant microhabitats, but these are occasionally interspersed with beaver ponds and limestone outcroppings. Many of these aquatic systems have been

impacted by channelization, impoundment, and encroachment by agricultural and silvicultural uses.

26. Wet Pine Savannas, Herb and Shrub Bogs
Open pine savanna dominated by longleaf or slash pine, with interspersed bogs. Herb bogs are found in low swales or depressions. Herb bogs are often characterized by pitcherplants and a high diversity of forbs. Shrub bogs occur in the ecotones of Carolina bays or cypress ponds and along the drier edges of bay swamps. Dominated by shrubs with a few (usually stunted) scattered pines and a sparse herb layer.

27. Xeric Aeolian Dunes
Wind-formed deep and well-drained dunes found mostly along the eastern side of rivers such as the Ohoopee, Little Ohoopee, Canoochee, and Little Ocmulgee. These unusual xeric habitats are dominated by deciduous or evergreen scrub oaks and scattered pines, with little groundcover other than patches of wiregrass and lichens. A number of rare plants are associated with these habitats, including sandhills rosemary and Ashe's savory.

The Longleaf Pine Ecosystem

Longleaf pine forests and savannas once covered approximately 92 million acres across the Southeast. Today, less than 3 percent of this habitat remains, and what is left is being lost at an estimated rate of 100,000 acres per year. In the last 30 years alone, longleaf pine acreage in North Florida has declined by 84 percent. Rangewide, longleaf pine-dominated ecosystems support more than 300 globally imperiled species; the steady decline in abundance and health of this habitat is thus linked with increasing imperilment of these species. Longleaf pine-wiregrass savannas and embedded wetlands comprise some of the most biologically diverse natural communities in North America. In Georgia, most of the remaining longleaf pine habitat is found on military bases or on quail plantations and other large privately owned tracts in the Red Hills and lower Dougherty Plain. Throughout its former range, the longleaf pine ecosystem is being impacted by forest conversion, fire suppression, habitat fragmentation, and invasive exotics species.

Several organizations, including the Longleaf Alliance, The Nature Conservancy, the Georgia Wildlife Federation, Tall Timbers Research Station, Georgia Forestry Commission, Joseph Jones Ecological Research Center and Georgia DNR have focused research, education, and conservation efforts on this globally significant ecosystem. In addition to protecting high priority sites through fee-simple ownership or conservation easements, ongoing efforts include promotion of prescribed burning, providing technical guidance to private landowners wanting to reforest with longleaf pine, developing educational materials explaining the significance of this habitat, and conducting field research on ecosystem functions and restoration techniques. A number of private landowners and forestry consultants have been instrumental in efforts to restore and maintain habitat quality in the longleaf pine ecosystem.

Problems Affecting Wildlife Diversity

Past conversion of forest and woodland habitats to agricultural uses has resulted in the loss of much of the natural upland vegetation in this area. In particular, the more mesic subtypes of longleaf pine-dominated forest/savanna, a predominant vegetation type in pre-settlement times, have been greatly reduced in the landscape. Remaining examples can be found in the Tallahassee Hills region and a few sites elsewhere in the region (e.g., Ichauway Plantation in the Dougherty Plain). More xeric sites (e.g., Fall Line sandhills and xeric aeolian dunes) that are generally unsuitable for agricultural uses still contain intact examples of longleaf pine-scrub oak woodlands and associated habitats. Wetland habitats adjacent to or surrounded by cultivated fields may be impacted by encroachment of soil-disturbing activities or by construction of drainage ditches. Other habitat types impacted by conversion to agricultural uses include forested depression wetlands, canebrakes, and beech-magnolia slope forests.

The uplands of this region are currently employed for a wide variety of agricultural uses, including row crops, orchards, pastures, and hayfields. In some watersheds, particularly in the Dougherty Plain, vegetated stream buffers are often too narrow to provide adequate erosion control. In other areas, intermittent or seasonal headwater streams and seeps have been impacted by encroachment of soil-disturbing practices. These activities result in a general degradation of water quality and habitat for aquatic and wetland species. Expanding vegetated stream buffers and protecting headwater streams would provide significant benefits to some of Georgia's most imperiled aquatic species as well as species associated with streamside bogs and seeps.

Conversion of upland pine and pine-hardwood forests to pine plantations has also resulted in impacts to wildlife diversity. In some cases, this conversion has resulted in replacement of the original longleaf pine canopy with slash or loblolly pine, while the groundlayer vegetation retains much of the original diversity due to frequent prescribed burns and less intensive site preparation techniques. Where intensive site preparation techniques have been utilized and/or burning has been eliminated as a management tool, much of this native groundlayer diversity has been lost, and habitat suitability for many high priority animals (e.g., red-cockaded woodpecker, Bachman's sparrow, northern bobwhite quail, gopher tortoise, indigo snake, flatwoods salamander) has been greatly reduced.

Although many landowners within this ecoregion utilize prescribed fire as a management tool, there are some areas in which altered fire regimes constitute a significant problem for wildlife. Expansion of residential and commercial development from urban centers into surrounding suburbs has resulted in many fire-dependent habitats being surrounded by highways, subdivisions, or retail centers. In these areas, concerns about smoke management, air quality, and damage to structures make it difficult to implement prescribed burn plans. In other areas, existing agricultural fields, roads, or utility corridors may isolate fire-dependent wetland communities from forested upland areas that would normally serve as fire source areas.

Extensive peat-bottomed wetland habitats that are difficult to burn are often excluded from prescribed burn plans. Historically, fires in the larger Carolina bays occurred at approximately 25-year intervals. Today, fire exclusion and altered hydrologic conditions have greatly reduced the variety of habitat types represented within depression wetlands. Grand Bay, one of the most extensive wetlands in the state, is maintained primarily by fluctuating water levels along with periodic prescribed fires. This type of management is critical for maintenance of freshwater marsh habitat for the Florida water rat, Florida sandhill crane, and other associated species.

Groundwater and surface water withdrawals for agricultural uses represent significant impacts to wetlands, streams and sensitive karst environments, particularly in the Dougherty Plain. These withdrawals are capable of greatly reducing the hydroperiod of depression wetlands and reducing flows substantially in streams, affecting habitat for a wide variety of rare or declining birds, mussels, fishes, amphibians, reptiles, and plants. In addition, these withdrawals can remove water that would normally from sensitive environments such as caves, springs, and underground streams.

While less prevalent than in other ecoregions, residential and commercial development has resulted in loss of habitats on the periphery of metropolitan areas and along major highways. This is most noticeable in metropolitan areas of Columbus, Albany, Tifton, Valdosta, Warner-Robins, Statesboro, and Augusta. Development pressures have resulted in the loss or fragmentation of a number of upland habitats, alteration of fire regimes, increased sedimentation of streams, and filling or draining of isolated wetlands.

Invasive exotic species pose significant problems to habitats and species in this region. Notable examples include feral hogs, Chinese privet, hydrilla, Japanese climbing fern, cogon grass, and Asian clam. Feral hogs are particularly damaging to understory vegetation in mesic upland hardwood forests, where they feed on roots, tubers, and fruits of a wide variety of herbs, including rare species such as relict trillium. They are also capable of impacting a wide variety of plant species associated with wet pine savannas and herb bogs. Hydrilla is a noxious aquatic weed that has infested shallow water habitats in Lake Seminole, reducing aquatic habitat quality. Japanese climbing fern, a well-known pest in Florida, has gained a foothold in this ecoregion, and cogon grass, a very serious exotic pest plant has recently been documented.

For some high priority species and habitats, unmanaged recreational use represents a serious problem. For example, ATV use in and adjacent to the Ohoopee River may represent a threat to populations of rare mussels such as the Altamaha spinymussel. The potential impacts from this type of recreational use include destabilization of streambanks, excessive sedimentation, pollution from fuel spills, and direct mortality from vehicular impacts. Unmanaged vehicular traffic on xeric aeolian dunes, sandhills, and rock outcrops (e.g., Altamaha Grit) results in damage to the sparse xerophytic vegetation, destabilization of substrates, and direct mortality to rare or declining species such as the gopher tortoise, indigo snake, and eastern diamondback rattlesnake.

Construction of dams or other structures altering stream flow represents a significant problem for high priority species and habitats in this region. Most of the major river impoundments affecting streams and associated wetlands in this area are in the Piedmont (e.g., Lake Sinclair, Lake Oconee, Lake Jackson, West Point Lake, Lake Lanier, Clarks Hill Lake, Jackson Lake), but the regulation of flows on these alluvial river systems results in altered hydroperiods and sediment transport regimes for riverine swamps and bottomland hardwood forests, which in turn affects species composition, structure, and function of these ecosystems. Woodruff Dam at Lake Seminole serves as a barrier for passage of species such as the gulf sturgeon.

Nonalluvial (blackwater) rivers and streams are particularly vulnerable to nutrient loadings and hydrologic disruptions from groundwater and surface water withdrawals, draining of adjacent wetlands, insufficient stream buffers, and other factors. Impacts on these nonalluvial systems include increased flow variability, low dissolved oxygen conditions, increased silt loadings, and resulting stresses to aquatic organisms.

Throughout this ecoregion, depressional wetlands have been impacted by construction of impoundments or drainage ditches. These alterations of natural hydrologic conditions, along with the elimination of fire as a management tool, result in a decline in the number and variety of depression wetland communities.

High Priority Sites and Landscape Features

The current assessment and previous conservation planning efforts have identified a number of ecologically important sites and landscape features in this region of the state. An assessment of the East Gulf Coastal Plain conducted by The Nature Conservancy in cooperation with state natural heritage programs in Alabama, Georgia, Florida, Mississippi, and Louisiana identified 15 high priority areas of conservation interest in Georgia (The Nature Conservancy, 1999). A similar assessment conducted for the South Atlantic Coastal Plain in cooperation with state natural heritage programs in Georgia, Florida, and South Carolina identified 38 high priority conservation areas in Georgia (The Nature Conservancy, 2002). Field surveys conducted by Georgia DNR staff and others have brought additional areas of conservation interest to light in recent years (Edwards et al. 2013). The following list includes examples of significant sites and landscape features in the Southeastern Plains ecoregion.

Alapaha River Corridor

The Alapaha River is a nonalluvial (blackwater) river in the Gulf Coastal Plain of Georgia. The Alapaha River corridor includes significant upland habitats associated with sandhill environments. This system includes longleaf pine-scrub oak woodlands, old-growth dwarf pondcypress swamps, mesic hardwood bluffs, and depression ponds. High priority species associated with these habitats include striped newt, gopher frog, gopher tortoise, spotted turtle, eastern indigo snake, eastern diamondbacked rattlesnake, tiger salamander, silky camellia, and pondspice. The Alapaha River is inhabited by the

Suwannee River alligator snapping turtle, a distinct, newly described species that is rarer in Georgia than the species found in other drainages. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Altamaha River Corridor

The Altamaha basin drains a total of 14,400 square miles, more than one-fourth of Georgia's land surface. Natural communities associated with this immense river system include oxbow lakes, sandbars, evergreen hammocks, sand ridge scrub forests, hardwood levee forests, cypress-gum swamps, pine flatwoods, limestone shoals, coastal marshes, and open-water estuaries. Important habitats located adjacent to the river floodplain include springs, bogs, Carolina bays and cypress/gum ponds.

Numerous high priority plants and animals are known from the Altamaha River corridor. Examples include green fly orchid, pondspice, Georgia plume, Franklinia, red-cockaded woodpecker, gopher tortoise, indigo snake, Bachman's sparrow, and swallow-tailed kite. Several rare and/or endemic bivalves have been reported from the Altamaha River, including the Altamaha spinymussel and Altamaha arcmussel. Ongoing efforts to provide long-term protection for the Altamaha River corridor involve a number of agencies and organizations, including Georgia DNR, U.S. Department of Defense, The Nature Conservancy, The Conservation Fund, the U.S. Fish & Wildlife Service, Plum Creek Timber Company, The Longleaf Alliance, International Paper, and Rayonier, Inc. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Broxton Rocks/Altamaha Grit Outcrops

Altamaha Grit outcrops can be considered a high priority habitat type endemic to Georgia. These outcrops, composed of indurated sandy clay often commonly called "sandstone", are typically associated with longleaf pine-scrub oak woodlands or longleaf pine-wiregrass savannas. They occur in scattered locations in the Tifton Upland and Vidalia Upland regions of the Southeastern Plains. Perhaps the most significant examples of this habitat type can be found at Broxton Rocks Preserve, owned and managed by The Nature Conservancy in Coffee County, as well as the nearby Flat Tub Landing WMA. Other significant examples of Altamaha Grit outcrops can be found in Turner, Laurens, Treutlen and Washington counties. Several additional examples of this habitat type should be protected and managed in a landscape context of fire-maintained upland and wetland communities.

Caves of Southwest Georgia

Caves in the Pelham Escarpment area of southwestern Georgia represent significant natural communities. Several of these caves also provide habitat for rare species such as the southeastern bat, Georgia blind salamander, and Dougherty Plain cave crayfish. Associated natural communities of significance include limesinks, springs and mesic ravine forests. No caves in this region of the state are in public ownership, though some

are protected through conservation easements. These sensitive habitats are threatened by point and nonpoint pollution, sedimentation and vandalism.

Chickasawhatchee Swamp/Ichauway Plantation

Chickasawhatchee Swamp is an extensive habitat complex that represents the second-largest nonalluvial swamp system in Georgia. This area contains a number of important habitats, including springs, pondcypress ponds, and bottomland hardwood forest. The State of Georgia owns and manages a large portion of this site as Chickasawhatchee Wildlife Management Area. Ichauway Plantation is a privately owned conservation and research site that contains a variety of high priority riverine, wetland, and upland habitats. The Chickasawhatchee/Ichauway Plantation PARCA supports populations of Florida green watersnakes and alligator snapping turtles, and larger streams in this region have Barbour's map turtles in abundance. Upland communities of longleaf pine support gopher tortoises, eastern diamond-backed rattlesnakes, pine snakes, southern hognose snakes, and non-breeding habitat for reticulated flatwoods salamanders, gopher frogs, tiger salamanders, and striped newts, all of which breed in nearby isolated wetlands. This site serves as important groundwater/surface water exchange area; its protection is critical for the maintenance of groundwater and surface water quality in this region.

Fort Benning/Western Fall Line Sandhills

Fort Benning and surrounding areas in the upper Coastal Plain of West Georgia include significant examples of longleaf pine-scrub oak woodland, blackwater streams, alluvial river and swamp, mesic hardwood forest, and sandy bluffs. Over 40 species of conservation concern are known from this conservation area, including red cockaded woodpecker, Bachman's sparrow, Georgia rockcress, bay starvine, and relict trillium. High priority reptiles and amphibians in this area include gopher tortoise, Barbour's map turtle, alligator snapping turtle, eastern diamond-backed rattlesnake, pine snake, southern hognose snake, southern coal skink, gopher frog, tiger salamander, Chamberlain's dwarf salamander, and striped newt. Biologists from The Nature Conservancy and Georgia DNR have worked with Fort Benning staff to identify and develop management recommendations for significant natural communities and rare species populations on the base. Significant land acquisitions in this area of the western Fall Line Sandhills region have been made possible by funding from the U.S. Department of Defense, U.S. Fish and Wildlife Service, The Nature Conservancy, and the State of Georgia.

Fort Gordon

Located in the upper portion of the Southeastern Plains southwest of Augusta, this military facility contains significant examples of longleaf pine-scrub oak woodland, longleaf pine-wiregrass savannas, Atlantic whitecedar swamps, mesic hardwood forest, and blackwater streams. Rare species known from this conservation area include sandhills rosemary, Pickering's morning glory, Carolina redtop, sweet pitcherplant, red cockaded woodpecker, bluebarred pygmy sunfish, dwarf waterdog, southern hognose snake, gopher tortoise, Barbour's map turtle, alligator snapping turtle, eastern diamond-backed rattlesnake, pine snake, southern coal skink, gopher frog, tiger salamander, Chamberlain's dwarf salamander, and striped newt. The Nature Conservancy and the

State of Georgia have collaborated with the U.S. Department of Defense on vegetation monitoring and rare species management on this military base.

Grand Bay/Banks Lake

This high priority conservation landscape includes approximately 20,000 acres in south-central Georgia. Major landowners are the U.S. Fish and Wildlife Service (Banks Lake NWR), the U.S. Air Force (Moody AFB) and Georgia DNR (Grand Bay WMA). This area includes several large, shallow depressions similar to Carolina bays, but which may actually be solution sinks. If Grand Bay is actually a Carolina bay, it would be one of the largest known. Natural communities of interest include cypress-gum swamps, broadleaf evergreen hammocks, pine flatwoods, and open-water lakes. High priority species known from this area include greenfly orchid and Florida water rat.

Kinchafoonee and Muckalee Creeks

These blackwater (nonalluvial) streams are found in southwestern Georgia. Kinchafoonee and Muckalee creeks provide habitat for a wide variety of aquatic species, including more than a dozen species of imperiled fish and mussels. Protection of these and other high priority blackwater stream systems through enhancement of stream buffers, regulation of groundwater and surface water withdrawals, and reduction of pollution sources is critical for maintenance of high priority aquatic species in this ecoregion.

Lake Seminole/Spring Creek

This site generally encompasses the area surrounding Lake Seminole (managed by the U.S. Army Corps of Engineers) at the confluence of the Flint and Chattahoochee rivers. It also includes the lower portion of Spring Creek, a tributary of the Flint River Important natural communities include lacustrine habitats, clay-based sandhills, steephead ravines, springs, and limesink ponds. Longleaf pine communities and embedded isolated wetlands provide habitat for gopher tortoises and eastern diamond-backed rattlesnakes. A small, remnant population of eastern indigo snakes also is found here, the only known remaining population in SW Georgia. Other high priority species in this area include Florida torreya, gulf sturgeon, Barbour's map turtle, Chamberlain's dwarf salamander, Georgia blind salamander, and alligator snapping turtle. Protected state lands surrounding Lake Seminole include Silver Lake WMA and Lake Seminole State Park

Lower Flint River Corridor

The lower Flint River corridor includes many significant aquatic and terrestrial habitats, including springs, limestone shoals, mesic bluff forest, sinkholes, longleaf pine forest, and large riverine habitat. A large number of imperiled mussels can be found in the lower Flint River and tributary streams. Conserved lands in this area include Elmodel WMA, Flint River WMA. Radium Springs, Ichauwaynochaway Creek, and Spring Creek are notable tributaries to the Flint River. The lower Flint River has populations of Barbour's map and alligator snapping turtles. Chamberlain's dwarf salamanders are found in

seepages in this region. This area is underlain by the Floridan Aquifer which is home to the Georgia blind salamander.

Ocmulgee River Corridor/Oaky Woods WMA

The Ocmulgee River corridor south of Warner Robins contains a number of high priority habitats, including bottomland hardwood forest, mesic hardwood forest, alluvial river and swamp, Black Belt prairies, limesinks, and caves. This area supports the only black bear population in central Georgia, as well as several other high priority species such as Ocmulgee skullcap and relict trillium. Acquisition of a large portion of the property formerly leased from Weyerhaeuser has increased protection for these habitats. A recent multi-agency effort to expand Ocmulgee National Monument and Bond Swamp National Wildlife Refuge has focused on the need to conserve natural and cultural resources and provide additional opportunities for outdoor recreation.

Ogeechee River Corridor

The Ogeechee River originates in the lower Georgia Piedmont and flows 245 miles to the Atlantic Ocean at Ossabaw Sound. Natural communities of the Ogeechee River corridor include limestone shoals, sandbars, cypress-gum swamps, springs, bottomland hardwood forests and coastal salt marshes. Important habitats adjacent to the river floodplain include Carolina bays, springs, limesinks, sandhills and Altamaha Grit outcrops. Examples of high priority species associated with the Ogeechee River floodplain and adjacent habitats include Georgia plume, wood stork, and swallow-tailed kite. Numerous springs provide cool-water refuges for striped bass and other game fish.

The Ogeechee is relatively free from significant development, except in the lower portions. This river has been considered for inclusion as a component of the Georgia Scenic River system and was nominated as a potential National Wild and Scenic River. Impacts to the river corridor include residential and industrial development (especially along the coast), conversion of bottomland hardwood forests, and drainage of adjacent wetland habitats. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Ohoopee/Little Ohoopee Rivers and Dunes

The Ohoopee and Little Ohoopee rivers of east-central Georgia represent important examples of non-alluvial (blackwater) stream ecosystems. These rivers flow southeastward for a total of approximately 110 miles from their headwaters to the Altamaha River. The Ohoopee/Little Ohoopee rivers contain a variety of natural communities, including cypress-gum swamps, bottomland hardwood forests and white sandbars. The "Ohoopee Dunes" consist of a series of high undulating sand ridges lying east of, and parallel to, the Ohoopee and Little Ohoopee rivers. These deep, coarse sand dunes were formed by wind action during the late Pleistocene.

Natural communities of the xeric upper dunes include dwarf oak-evergreen scrub, evergreen scrub-lichen vegetation and longleaf pine-scrub oak woodlands. The lower slopes of the dunes, near the edge of the river floodplains, contain diverse "bayhead"

forests, seeps, and bogs. Numerous rare plant and animal species have been documented from these ecosystems; examples include sandhills rosemary, Ashe's savory, Indian olive, eastern indigo snake, gopher tortoise, striped newt, and Altamaha spinymussel. Approximately 2,500 acres of this habitat is owned by the State of Georgia and managed as Ohoopee Dunes State Natural Area. The Nature Conservancy owns and manages an adjacent 267-acre tract as Ohoopee Dunes Preserve, and the U.S. Fish and Wildlife Service owns a tract that is managed by Georgia DNR as part of the natural area.

Red Hills Region

The Red Hills region of southwestern Georgia contains impressive examples of longleaf pine/wiregrass savannas, pitcherplant bogs, blackwater creek swamps, blackwater rivers, wet pine flatwoods and other natural communities. Most of this area is in private ownership and managed as quail plantations. Many high priority plants and animals have been documented from this region, and efforts are ongoing to provide permanent protection for the most important sites and habitats through fee-simple acquisition, conservation easements, and long-term management agreements such as Safe Harbor. High priority reptiles and amphibians in this area include gopher tortoise, eastern diamond-backed rattlesnake, pine snake, alligator snapping turtle, one-toed amphiuma, and tiger salamander.

Yuchi WMA/Plant Vogtle

This site along the Savannah River south of Augusta contains Pleistocene beach dune-origin sandhills that are a stronghold for southern hognose and pine snakes. Gopher tortoises are also present, though depleted from past human collection for food. Dwarf waterdogs, Chamberlain's dwarf salamanders, and spotted turtles are likely in the blackwater streams and riparian zones. The Savannah slimy salamander, a Georgia endemic, may occur in the uplands.

High Priority Waters

Figure 18 shows the high priority streams and watersheds identified by the Aquatic Habitat Technical Team for this ecoregion. These streams were chosen on the basis of documented occurrences of high priority aquatic species and relative rarity of these species. Examples of high priority streams in the Southeastern Plains include Spring Creek, Pataula Creek, Patsiliga Creek, Chickasawhatchee Creek, Kinchafoonee Creek, Kiokee Creek, Ichawaynochaway Creek, Hannahatchee Creek, Buckhead Creek, Flint River, Savannah River, Brier Creek, Ogeechee River, Withlacoochee River, Ochlockonee River, Alapaha River, Williamson Swamp Creek, Suwannee River, Aucilla River, Little Ohoopee River, Oconee River, Ocmulgee River, and Altamaha River. Refer to the Aquatic Habitat Technical Team report in Appendix F for details on the identification of high priority watersheds.

Conservation Goals

- Maintain known viable populations of all high priority species and functional examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, developing specific educational messages, and managing exotic species populations on public lands.
- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments
- Continue efforts to recover federally listed species by implementation of recovery plans

Strategies and Partnerships to Achieve Conservation Goals

- Provide financial incentives and technical expertise to encourage prescribed burns, through Interagency Burn Team and other means
- Work with NRCS staff to identify high priority habitats and sites for implementation of habitat enhancement/restoration projects through Farm Bill programs (e.g., restoration of longleaf pine-dominated forests and savannas)
- Use state lands (e.g., Doerun Pitcherplant Bog Natural Area, Big Dukes Pond Natural Area, Mayhaw WMA) and other public lands to showcase habitat restoration efforts. Complete management plans for all state lands and incorporate management objectives for populations of high priority species.
- Assess nonnative invasive species populations on public lands and provide technical assistance to private landowners to discourage use of invasive plants
- Work with GDOT and local governments to minimize direct impacts to high priority species and habitats from development projects
- Work with Georgia Power and private landowners to identify and conserve populations of rare species in and adjacent to utility corridors
- Develop educational materials on high priority species and habitats in the ecoregion and provide these to environmental educators at WRD facilities (e.g., GoFish Center, Grand Bay Education Center) and other facilities
- Work with GFC and SFI-SIC to facilitate development of forestry BMPs for maintenance of important wildlife habitats
- Work with The Nature Conservancy, USFWS, Georgia Land Conservation Center and local land trusts to provide protection for high priority wetlands and stream corridors.

Highest Priority Conservation Actions

High priority conservation actions (actions rated "Very High" or "High") identified by the technical teams, advisory committee, and other stakeholders specifically for this ecoregion include the following (see Appendix P for details):

- Assess Middle Georgia black bear population and habitat conservation needs; develop conservation plan for the Ocmulgee River corridor.
- Conduct surveys for Black Rails in high marsh areas of saltmarsh and possibly other shallowly flooded freshwater habitats.
- Continue monitoring freshwater mussel populations in key sites in the lower Flint River Basin and Sawhatchee Creek (lower Chattahoochee).
- Survey mussels in poorly sampled stream reaches in the Ochlockonee, Withlacoochee and Suwanee basins. Species of interest include Suwanee Moccasinshell, Ochlockonee Mocassinshell, Suwanee Pigtoe, Oval Pigtoe, and Shinyrayed Pocketbook.
- Continue Line Transect Distance Sampling (LTDS) of gopher tortoise populations to maintain gopher tortoise Candidate Conservation Agreement.
- Continue monitoring hellbender and eastern indigo snake occupancy.
- Monitor reproductive activity at known, recently extant ponds used by pond-breeding amphibians.
- Maintain Robust Redhorse Conservation Committee to assure restoration of robust redhorse populations. Conduct research and management efforts to develop six self-sustaining populations of robust redhorse throughout its historic range.
- Incorporate Henslow's Sparrow habitat management into management plans on all WMAs that have confirmed wintering sites
- Monitor populations of southeastern bats in Southwest Georgia caves; conduct monitoring of caves with populations of other bats currently affected or likely to be affected by WNS. Count bats and coordinate with researchers studying the disease and potential treatment options.
- Implement restoration projects for Gulf striped bass and other diadromous fish. Evaluate existing population status, commercial and recreational fisheries, and habitat limitations. Look for opportunities to enhance habitat.
- Implement red-cockaded woodpecker conservation on private lands, through safe harbor agreements and mitigated take from small, isolated populations. Administer landowner incentive program for safe harbor participants.
- Conduct surveys of southwest Georgia isolated wetlands. Assess sites for potential suitable habitat for high priority species of conservation concern. Obtain landowner contacts and conduct rare species survey at sites with high potential.

Other high priority conservation actions that are statewide in scope are addressed in Section V of this report.

Table 10. Southeastern Plains High Priority Animals (151 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
AA	Cambarus cryptodytes	Dougherty Plain Cave Crayfish	G2	S2		T	Pool areas of subterranean systems
AA	Cambarus doughertyensis	Dougherty Burrowing Crayfish	G1	S1		E	Primary burrower in wooded wetlands; black sticky clay soil.
AA	Cambarus truncatus	Oconee Burrowing Crayfish	G2	S2		T	Complex burrows in sandy clay soil
AA	Cordulegaster sayi	Say's Spiketail	G2	S2		T	Trickling hillside seepages in deciduous forest with scrub-oak sandhills nearby
AA	Ophiogomphus australis	Southern Snaketail	G1G2	S1			Small streams in woodland with some gravely substrate
AA	Procambarus acutissimus	Sharpnose Crayfish	G5	S2			Temporary fluctuating pools or ponds to permanent lotic habitats (not typical of GA populations); sometimes in simple burrows
AA	Procambarus gibbus	Muckalee Crayfish	G3Q	S2		T	Found in flowing streams with good oxygen supply
AA	Procambarus verrucosus	Grainy Crayfish	G4	S2		R	Marshes and standing water (often temporary) adjacent to small, coastal plain creeks.
AA	Procambarus versutus	Sly Crayfish	G5	S1		R	Found in debris in moderately swift streams. Found in root masses and plants.
AM	Ambystoma bishopi	Reticulated Flatwoods Salamander	G2	S1	LE		Pine flatwoods; moist savannas; isolated cypress/gum ponds
AM	Ambystoma cingulatum	Frosted Flatwoods Salamander	G2	S1	LT	T	Pine flatwoods; moist savannas; isolated cypress/gum ponds
AM	Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	G5	S3S4			isolated wetlands for breeding; variety of open, upland habitats; CP - sandhills, oldfields, dry pine savanna
AM	Amphiuma pholeter	One-toed Amphiuma	G3	S1		R	Organic muck beds in floodplains and seepage bogs
AM	Desmognathus auriculatus	Southern Dusky Salamander	G5	S2			Mucky areas usually in or near moving water
AM	Eurycea chamberlaini	Chamberlain's Dwarf Salamander	G4	S2			Seepage ravines/stream sides; bogs, sphagnum beds, marshes
AM	Haideotriton wallacei	Georgia Blind Salamander	G2	S1		T	Cave pools; aquifer
AM	Lithobates capito	Gopher Frog	G3	S2S3		R	Sandhills; dry pine flatwoods; breed in isolated wetlands
AM	Necturus punctatus	Dwarf Waterdog	G5	S2S3			Sluggish streams with substrate of leaf litter or woody debris
AM	Notophthalmus perstriatus	Striped Newt	G2G3	S2	C	T	Pine flatwoods, sandhills; isolated wetlands
BI	Ammodramus henslowii	Henslow's Sparrow	G4	S2		R	Grassy areas, especially wet grasslands, pitcher plant bogs, pine flatwoods, power-line corridors in CP. Require open veg at ground level with grass canopy above
BI	Ammodramus savannarum pratensis	Grasshopper Sparrow	G5	S4			Breeds in grasslands, pasture lands, PD RV, rare in CP. Wintering range poorly known.
BI	Colinus virginianus	Northern Bobwhite	G5	S5			Early successional habitat, open pine savanna (frequent fire maintained in small burn unit size), fallow habitats associated with crop lands, extensive forest regen areas (area sensitive - minimal fall pop of 700 birds for viability on 3000+acres)
BI	Coturnicops noveboracensis	Yellow Rail	G4	SU			
BI	Egretta caerulea	Little Blue Heron	G5	S4			Nest in single species and mixed species colonies in various inland forested fresh-water wetlands, including impounded wetlands, cypress swamps, and similar habitats
BI	Egretta tricolor	Tricolored Heron	G5	S4			Nests in colonies (often with other wading bird species) in wetlands and on isolated islands. Feeds in shallow wetlands, creeks and rivers. The most coastal of all our waders.
BI	Elanoides forficatus	Swallow-tailed Kite	G5	S2		R	River swamps; marshes, forages over pastures and ag fields - post breeding. Forage in well burned open pine woodlands where exist. Open pine and bottomland forest with super canopy pines preferred nest sites. Will nest in non-emergent hardwoods and thinned pine plantations as well - typically several years before final harvest.
BI	Euphagus carolinus	Rusty Blackbird	G4	S3			Bottomland forest, pecan orchards, agricultural fields

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 10. Southeastern Plains High Priority Animals (151 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
BI	Falco sparverius paulus	Southeastern American Kestrel	G5T4	S2		R	Open pine grasslands with snags in Coastal Plain, also hayfields and pasture lands
BI	Grus americana	Whooping Crane	G1	S1	LE		Open, mostly emergent herbaceous freshwater wetlands and fields for stop-over sites
BI	Haliaeetus leucocephalus	Bald Eagle	G5	S3		T	Edges of lakes & large rivers; seacoasts
BI	Ixobrychus exilis	Least Bittern	G5	S3			Fresh and brackish water wetlands with emergent herbaceous cover including impoundments, natural freshwater marshes, and tidally influenced marshes
BI	Lanius ludovicianus	Loggerhead Shrike	G4T3Q	S3			Open woods; field edges, pastures, ball fields, industrial park, primary dunes, hammocks
BI	Laterallus jamaicensis	Black Rail	G3G4	S1			Very shallowly flooded freshwater marshes, brackish marshes, and saltmarshes. Some high marsh areas of the saltmarsh may have breeding pairs
BI	Limnothlypis swainsonii	Swainson's Warbler	G4	S3			Dense undergrowth or canebrakes in swamps and river floodplains, small mountain pop in rhododendron and mountain laurel thickets
BI	Mycteria americana	Wood Stork	G4	S3	LT	E	Breeding Cypress/gum ponds; impounded wetlands with islands or emergent cypress, river swamps; Foraging - marshes (fresh and intertidal); river swamps; bays; farm ponds,
BI	Passerina ciris	Painted Bunting	G5	S2S3			Most in Lower Coastal Plain in thickets, woodland borders, marsh edges, and brushy areas. Smaller numbers in Upper Coastal Plain, particularly the eastern half, agricultural habitat
BI	Peucaea aestivalis	Bachman's Sparrow	G3	S2		R	Open pine or oak woods; old fields; brushy areas, young large grassy pine regeneration areas
BI	Picoides borealis	Red-cockaded Woodpecker	G3	S2	LE	E	Open pine woods; pine savannas
BI	Protonotaria citrea	Prothonotary Warbler	G5	S4			Bottomland forest, swamps, and similar forested wetlands. Nests in tree cavities.
BI	Rallus elegans	King Rail	G4	S3			Freshwater to brackish emergent herbaceous wetlands of grasses, sedges, cattails, wild rice; herbaceous portions of forested wetlands.
BI	Tyto alba	Barn Owl	G5	SU			Nests in large hollow trees or old buildings (particularly cement silos) in areas with extensive pasture or grassland or other open habitats such as marsh
FI	Acipenser brevirostrum	Shortnose Sturgeon	G3	S2	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates
FI	Acipenser oxyrinchus desotoi	Gulf Sturgeon	G3T2	SX			Estuaries; deep pools at lower end of large rivers
FI	Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	G3T3	S3	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates; spawn as far inland as Macon, GA on the Ocmulgee
FI	Alosa alabamae	Alabama Shad	G2G3	S1		T	Migrates into Gulf coastal rivers for reproduction
FI	Alosa sapidissima	American Shad	G5	S5			large rivers between coast and fall zone are used for spawning and early life history stages
FI	Ameiurus serracanthus	Spotted Bullhead	G3	S3		R	Large streams and rivers with moderate current and rock-sand substrate
FI	Carpiodes velifer	Highfin Carpsucker	G4G5	S2S3			swift sandy areas associated with sandbars, yoy found in backwaters and on margins of sandbars
FI	Chologaster cornuta	Swampfish	G5	S2S3			near vegetation and debris in swamps, ponds, ditches, and slow moving streams, pools backwaters
FI	Cyprinella callitaenia	Bluestripe Shiner	G2G3	S2		R	Flowing areas in large creeks and medium-sized rivers over rocky substrates
FI	Elassoma gilberti	Gulf Coast Pygmy Sunfish	G4G5	S2S3			vegeated habitats with no or slow flow in the Coastal Plain
FI	Elassoma okatie	Bluebarred Pygmy Sunfish	G2G3	S1		E	Temporary ponds and stream backwaters with dense aquatic vegetation
FI	Enneacanthus chaetodon	Blackbanded Sunfish	G3G4	S1		E	Blackwater streams; bays; cypress/gum ponds
FI	Etheostoma parvipinne	Goldstripe Darter	G4G5	S2S3		R	Small sluggish streams and spring seepage areas in vegetated habitat

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 10. Southeastern Plains High Priority Animals (151 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Lucania goodei	Bluefin Killifish	G5	S1		R	Heavily vegetated ponds and streams with little or no current; frequently associated with springs
FI	Micropterus notius	Suwannee Bass	G3	S2		R	Flowing water over rocky shoals or large springs and spring runs
FI	Micropterus sp. cf coosae "Altamaha/Ogeechee"	Undescribed Redeye Bass	GNR	S3			believed to be headwater species but patterns altered by non-native species
FI	Micropterus sp. cf coosae "Savannah"	Bartrams Bass	GNR	S3			upland streams and rivers
FI	Moxostoma robustum	Robust Redhorse	G1	S1		E	Med to large rivers, shallow riffles to deep flowing water; moderately swift current
FI	Notropis hypsilepis	Highscale Shiner	G3	S3		R	Flowing areas of small to large streams over sand or bedrock substrates
FI	Percina crypta	Halloween Darter	G2	S2		T	larger streams in riffle/shoal habitat
FI	Pteronotropis euryzonus	Broadstripe Shiner	G3	S3		R	Flowing areas of medium sized streams associated with sandy substrate and woody debris or vegetation
FI	Pteronotropis welaka	Bluenose Shiner	G3G4	S1		T	Quiet backwaters and vegetated pools of streams and rivers
MA	Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	G3G4	S3		R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps
MA	Geomys pinetis	Southeastern Pocket Gopher	G5	S3S4		T	sandy well-drained soils in open pine woodlands with grassy or herbaceous groundcover, fields, grassy roadsides
MA	Lasiurus intermedius	Northern Yellow Bat	G4G5	S3			Wooded areas near open water or fields, hardwoods - live oaks preferred, large trees
MA	Myotis austroriparius	Southeastern Myotis	G3G4	S3			Caves & buildings near water; large hollow trees in bottomland hardwood swamps
MA	Neofiber alleni	Round-tailed Muskrat	G3	S3		T	Freshwater marshes; bogs
MA	Perimyotis subflavus	Tri-colored Bat	G3	S5			Open forests with large trees and woodland edges; roost in tree foliage; hibernate in caves or mines with high humidity.
MA	Spilogale putorius	Eastern Spotted Skunk	G4	S3			brushy, rocky, wooded habitats; avoids wetlands
MO	Alasmidonta triangulata	Southern Elktoe	G1Q	S1		E	Gently sloping banks with soft substrate. Often in slackwater areas and possibly in reservoirs. Mixtures of mud, sand, and gravel substrate
MO	Anodontoides radiatus	Rayed Creekshell	G3	S2		T	Small creeks to large rivers with moderate current in mud, sand, and gravel
MO	Elimia darwini	Pup Elimia	G1	S1			small streams and springs
MO	Elimia inclinans	Slanted Elimia	G1G2	S1S2			Creeks and medium-sized rivers in the Flint River basin
MO	Elimia induta	Gem Elimia	G2	S2			Flint River tributaries in SW GA
MO	Elimia timida	Timid Elimia	G1	S1			small streams and springs on the right side of the Ocmulgee River.
MO	Elliptio spinosa	Altamaha Spinymussel	G1G2	S1	LE	E	Large Rivers in firm sand substrate; good flow
MO	Fusconaia masoni	Atlantic Pigtoe	G2	S1		E	Medium sized streams to large rivers from the Ogeechee River northward; coarse sand and gravel at downstream edge of riffles; fast flowing and well oxygenated water
MO	Lampsilis straminea	Southern Fatmucket	G5T	S2			Small creeks to rivers in slow to moderate current; sand, sandy mud and gravel substrates
MO	Marstonia agarhecta	Ocmulgee Marstonia	G1	S1			Submerged logs in clear water with slight current; occasionally individuals found in silt that contained large amounts of diatoms (Thompson, 1977)
MO	Marstonia gaddisorum	Emily's Marstonia	G1	S1			Springs/small stream in Oconee basin
MO	Quadrula kleiniana	Suwannee Pigtoe	G2G3	S2			Georgia habitat information not available
MO	Somatogyrus rheophilus	Flint Pebblesnail	G1	S1			Mainstem of medium to large rivers
RE	Clemmys guttata	Spotted Turtle	G5	S3		U	Heavily vegetated swamps, marshes, bogs, small ponds, tidally influenced freshwater wetlands; nest and possibly hibernate in surrounding uplands

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 10. Southeastern Plains High Priority Animals (151 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
RE	Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	G4	S4			Early successional habitats on barrier islands and mainland; pine flatwoods; sandhills; maritime forests/hammocks; ruderal habitats
RE	Drymarchon couperi	Eastern Indigo Snake	G3	S2	LT	T	Sandhills; pine flatwoods; dry hammocks; summer habitat includes wetlands
RE	Eumeces anthracinus	Coal Skink	G5	S2			Mesic forests; often near streams, springs or bogs
RE	Gopherus polyphemus	Gopher Tortoise	G3	S3	C	T	Sandhills; dry hammocks; longleaf pine-turkey oak woods; old fields
RE	Graptemys barbouri	Barbour's Map Turtle	G2	S3		T	Rivers & large creeks of Apalachicola River drainage; possible in Ochlockonee
RE	Heterodon simus	Southern Hognose Snake	G2	S1S2		T	Sandhills; fallow fields; longleaf pine-turkey oak
RE	Macrochelys temminckii	Alligator Snapping Turtle	G3G4	S3		T	Streams and rivers; impoundments; river swamps
RE	Ophisaurus compressus	Island Glass Lizard	G3G4	S2			Pine savannas, pine flatwoods, secondary dunes/interdunal swales on islands
RE	Ophisaurus mimicus	Mimic Glass Lizard	G3	S1		R	Pine flatwoods; savannas; seepage bogs
RE	Pituophis melanoleucus mugitus	Florida Pine Snake	G4T3	S3			Sandhills; scrub; pine savanna; old fields
TA	Acronicta albarufa	Albarufan dagger moth	G3G4	S2			Ohoopee dunes
TA	Alloblackburneus troglodytes	Little gopher tortoise scarab beetle	GNR	SU			Gopher tortoise burrows
TA	Amblyomma tuberculatum	Gopher tortoise tick	G2G3	S2			Sandhills, longleaf pine woodlands, other sandy open habitats
TA	Amblyscirtes alternata	Dusky roadside-skipper	G2G3	S3			Sunny patches in pine forests
TA	Aphodius aegrotus	A dung beetle	G3G4	S3			Pocket gopher mounds
TA	Aphodius alabama	A dung beetle	G2	S2			Pocket gopher mounds
TA	Aphodius baileyi	A dung beetle	G2G3	S2S3			Pocket gopher mounds
TA	Aphodius bakeri	A dung beetle	G2G3	S2S3			Pocket gopher mounds
TA	Aphodius dyspistus	A dung beetle	G3G4	S3			Pocket gopher mounds
TA	Aphodius gambrinus	Amber pocket gopher Aphodius beetle	G2	S2			Pocket gopher mounds
TA	Aphodius hubbelli	A dung beetle	GNR	S3			Pocket gopher mounds
TA	Aphodius laevigatus	Large pocket gopher Aphodius beetle	G3G4	S3			Pocket gopher mounds
TA	Aphodius pholetus	Rare pocket gopher Aphodius beetle	G1G2	S1			Pocket gopher mounds
TA	Aphodius platypleurus	Broad-sided pocket gopher Aphodius beetle	G2G3	S2			Pocket gopher mounds
TA	Aphodius tanytarsus	Long-clawed pocket gopher Aphodius beetle	G2G3	S2			Pocket gopher mounds
TA	Aptenopedes apalachee	Apalachee linear-winged grasshopper	GU	S2			Longleaf pine savannas
TA	Atrytone arogos arogos	Eastern Aragos Skipper	G3T1T2	SH			Sandhills/longleaf: opsided indiangrass or big bluestem
TA	Bombus affinis	Rusty-patched bumblebee	G1	SH			
TA	Callophrys hesselli	Hessell's hairstreak	G3G4	S2			Atlantic white cedar
TA	Callophrys irus	Frosted elfin	G3	SH			Lupinus perennis, sandhills
TA	Catocala grisatra	Grisatra underwing moth	G1G3	SU			Sandhills with hawthorns
TA	Caupolicana electa	Plasterer bee	GNR	S1S2			Sandhills
TA	Chelyoxenus xerobatis	Gopher tortoise hister beetle	G2G3s2	S2			Gopher tortoise burrows
TA	Chlosyne gorgone gorgone	Gorgone checkerspot	G5T2T3Q	S2			Sandhills
TA	Cicindela nigrior	Autumn tiger beetle	G2G3	S2			Sandhills
TA	Crossidius grahami	Ohoopee dunes Crossidius beetle	GNR	S2			Sandhills with Chrysoma paucifloscula

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 10. Southeastern Plains High Priority Animals (151 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
TA	Cyclocosmia torreya	Torreya trap-door spider	GNR	SU			Hardwood ravines
TA	Danaus plexippus	Monarch butterfly	G4	S4			Milkweeds
TA	Dorymyrmex bossutus	Sandhills cone ant	G?	S2			Sandhills
TA	Eotettix palustris	Longleaf spur-throated grasshopper	GU	S3			Longleaf pine savannas
TA	Erynnis martialis	Mottled duskywing	G3	S2			New Jersey tea, longleaf-wiregrass, mountain hardwoods
TA	Euphoria aeusutosa	Pocket gopher flower beetle	G2	S2			Pocket gopher mounds
TA	Fernaldella georgiana	Ohoopee Geometer	G1G3	S2S3			Woody goldenrod, sandy dune systems
TA	Floritettix borealis	A grasshopper	G5TU	S2			Longleaf pine savannas
TA	Geopsammodius ohoopee	Ohoopee dunes scarab beetle	GNR	S2			Sandhills
TA	Hesperia attalus slossonae	Dotted skipper	G3G4T3	S1			Sandhills, buckwheat
TA	Hesperia meskei	Meske's skipper	G3G4	S2S3			Sandhills
TA	Hesperotettix floridensis	A grasshopper	GU	S2			Longleaf pine savannas
TA	Hypothyce osburni	Osburn's hypothyce	GNR	S1			Sandhills
TA	Idia gopheri	Gopher tortoise burrow noctuid moth	G2G3	S1S2			Sandhills, open longleaf pine uplands; gopher tortoise commensal occurring at some subset of tortoise sites
TA	Machimus polyphemi	Gopher tortoise robber fly	G2	S1?			Gopher tortoise burrows
TA	Melanoplus acidocercus	A spur-throat grasshopper	GU	S3			Sandhills
TA	Melanoplus clypeatus	Shield-tailed spur-throat Grasshopper	GU	S3			Mesic longleaf
TA	Melanoplus nossi	Noss' spur-throat grasshopper	G3 (rec)	S2/S3			Hardwoods
TA	Melanoplus sp nov 1	A spur-throat grasshopper	G2 (rec)	S2			Fall Line Sandhills; GA endemic
TA	Melanoplus sp nov 2	A spur-throat grasshopper	G1 (rec)	S1			Fall Line Sandhills; GA endemic
TA	Melanoplus stegocercus	A spur-throat grasshopper	G1G3	S2			Georgia endemic; Ohoopee Dunes sandhills
TA	Melanoplus tumidicercus	A spur-throat grasshopper	GU	S2			Pine woods
TA	Mycotrupes cartwrighti	Cartwright's burrowing beetle	G3	S2			Longleaf pine savannas
TA	Mycotrupes lethroides	Large Mycotrupes	GU	S1S2			Sandhills
TA	Onthophagus polyphemi polyphemi	Onthophagus tortoise commensal scarab beetle	G2G3	S2			In association with Gopherus polyphemus burrows
TA	Pheidole davisi	Pine barrens Pheidole	GNR	S3			Sandhills
TA	Polites baracoa	Baracoa skipper	G4	SH			Sandhill habitats, grassy areas
TA	Polyphylla donaldsoni	Donaldson's lined june beetle	GNR	S2			Sandhills
TA	Satyrium edwardsii	Edwards hairstreak	G4	S3			Blackjack oak
TA	Sphodros abbotii	Purse-web spider	G4G5	S2			Hardwoods
TA	Zale perculta	Okefenokee zale moth	G2	S2			Cypress swamps

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 11. Southeastern Plains High Priority Plants (118 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Agalinis georgiana	Georgia Purple Foxglove	G1Q	S1			Mesic to submesic wiregrass pinelands
Arnoglossum sulcatum	Grooved-Stem Indian-Plantain	G3	S1			Bottomland forests
Asclepias rubra	Red Milkweed	G4G5	S1			Bogs, wet savannas
Asplenium heteroresiliens	Morzenti's Spleenwort	G2	S1		T	Limestone and marl outcrops; tabby ruins
Astragalus michauxii	Sandhill Milkvetch	G3	S2		T	Longleaf pine-wiregrass savannas; turkey oak scrub
Balduina atropurpurea	Purple Honeycomb Head	G2	S2S3		R	Wet savannas, pitcherplant bogs
Baptisia megacarpa	Bigpod Wild Indigo	G2	S1			Floodplain forests
Brickellia cordifolia	Heartleaf Brickellia	G2G3	S2		T	Mesic hardwood forests
Calystegia catesbiana ssp. Sericata	Catesby's Bindweed	G3T2?Q	S1?			Longleaf pine- wiregrass savannas
Carex baltzellii	Baltzell's Sedge	G3	S1		E	Beech-magnolia slope forests
Carex decomposita	Cypress-Knee Sedge	G3G4	S2?			Swamps and lake margins on floating logs
Carex exilis	Meager Sedge	G5	S1			Atlantic white-cedar swamps
Carex thornei	Thorne's Sedge	G2G3	S2?			Floodplain low terraces, sw. GA.
Ceratiola ericoides	Rosemary	G4	S2		T	Ohoopee Dunes; deep sandridges
Chamaecrista deeringiana	Florida Senna	G2G4Q	S1?			Sandhill scrub; longleaf pine-wiregrass savannas
Chamaecyparis thyoides	Atlantic White-Cedar	G4	S2		R	Clearwater stream swamps in fall line sandhills
Coreopsis integrifolia	Ciliate-Leaf Tickseed	G1G2	S1S2		T	Floodplain forests, streambanks
Crataegus aprica	Sunny Hawthorn	GNR	S1			Open, sandy, rocky dry sites in lower elevation mountains and perhaps Piedmont.
Crataegus mendosa	Albertville Hawthorn	G2G3Q	S1			Rocky woods, glades
Crataegus triflora	Three-Flower Hawthorn	G2G3	S1		T	Hardwood forests on rocky, limestone slopes
Croomia pauciflora	Croomia	G3	S2		T	Mesic hardwood forests, usually with Fagus and Tilia
Croton elliottii	Pondshore Croton	G2G3	S2S3			Pond margins and wet savannas
Cuscuta harperi	Harper's Dodder	G2G3	S1		E	Altamaha Grit outcrops; granite outcrops; often with Liatris microcephala as host
Cypripedium kentuckiense	Kentucky Ladyslipper	G3	S1		E	Forested, springhead seeps in sandy soils
Desmodium ochroleucum	Cream-Flowered Tick-Trefoil	G1G2	S1		T	Open, calcareous woodlands, including lower slope of Pigeon Mountain
Elliottia racemosa	Georgia Plume	G2G3	S2S3		T	Scrub forests; Altamaha Grit outcrops; open forests over ultramafic rock
Eriophorum virginicum	Tawny Cottongrass	G5	S1			Mountain bogs; peaty wet meadows in alluvial flats in Fall Line sandills; also in Okefenokee Swamp
Eustachys floridana	Florida Finger Grass	G2?	S1?			Sandhills and flatwoods
Fimbristylis perpusilla	Harper's Fimbry	G2	S1		E	Exposed muddy margins of pineland ponds
Fothergilla gardenii	Dwarf Witch-Alder	G3G4	S2		T	Openings in low woods; swamps
Glandularia bipinnatifida var. bipinnatifida	Dakota Vervain	G5T5	S1			Georgia habitat information not available
Habenaria quinqueseta	Michaux's Orchid	G4G5	S1?		T	Rich, moist hardwood hammocks, pine flatwoods, roadside ditches
Hamamelis ovalis	Bigleaf Witch-Hazel	GNR	S1			Ecotone between bay swamp and Slash Pine woodland
Helenium brevifolium	Bog Sneezeweed	G4	S1			Seepage bogs, sometimes with Sarracenia rubra near the Fall Line
Hypericum adpressum	Bog St. Johnswort	G3	S1			Swamps

Table 11. Southeastern Plains High Priority Plants (118 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Hypericum erythraeae	Georgia St.-John's-Wort	G2	S2			Seepage bogs; roadside ditches
Illicium floridanum	Florida Anise-Tree	G5	S1		E	Steepheads, floodplain forests
Isoetes boomii	Boom's Quillwort	G1	S1S2			Shallow water (one foot deep) of slow moving streams
Isoetes flaccida	Florida Quillwort	G3	S2?			Shaded pond margins, cypress swamps, open miry places; margins of sluggish pineland streams often with cypress
Isoetes hyemalis	Winter Quillwort	G2G3	S1?			Sandy blackwater creek banks; deciduous swamps
Isoetes junciformis	Rush Quillwort	G1?Q	S1?			Low, seasonally flooded swales
Justicia angusta	Narrowleaf Water-Willow	G3Q	S1			Roadside ditches; perhaps with Hartwrightia in shallow sloughs and wet savannas
Kalmia carolina	Carolina Bog Myrtle	G4	S1		T	Open swamps and wet meadows; mountain bogs and Atlantic white-cedar swamps
Lachnocaulon beyrichianum	Southern Bog-Button	G4	S1?			Flatwoods
Leitneria floridana	Corkwood	G3	S1		T	Swamps; sawgrass-cabbage palmetto marshes
Liatris tenuifolia var. quadriflora	Florida Narrowleaf Blazing Star	G4G5T4T5	S1?			Open oak or pine woods
Lilium pyrophilum	Pineland Lily	G2	S1			Altamaha grit, open low woods
Lindera melissifolia	Pondberry	G2G3	S2	LE	E	Pond margins and wet savannas
Lindera subcoriacea	Bog Spicebush	G2G3	S1?			Bayheads; seepy forested slopes
Litsea aestivalis	Pondspice	G3?	S2		R	Cypress ponds; swamp margins
Lythrum curtissii	Curtiss' Loosestrife	G1	S1		T	Openings in calcareous swamps
Macbridea caroliniana	Carolina Bogmint	G2G3	S1		R	Bogs; marshes; alluvial woods
Macranthera flammea	Bog Flameflower	G3	S1?		T	Wet, sandy thickets; pitcherplant bogs
Malaxis spicata	Florida Adders-Mouth Orchid	G4?	S1			Low hammocks; spring-fed river swamps
Matelea alabamensis	Alabama Milkvine	G2	S1		T	Open bluff forests; mesic margins of longleaf pine sandridges
Matelea floridana	Florida Milkvine	G2	S1			Open bluff forests
Morella inodora	Odorless Bayberry	G4	S1?		T	Bayheads, titi swamps; forests with pond pine
Najas filifolia	Narrowleaf Naiad	G1	S1		E	Lakes
Nestronia umbellula	Indian Olive	G4	S3		R	Mixed with dwarf shrubby heaths in oak-hickory-pine woods; often in transition areas between flatwoods and uplands
Oxypolis canbyi	Canby's Dropwort	G2	S2	LE	E	Cypress ponds and sloughs; wet savannas
Oxypolis ternata	Savanna Cowbane	G3	S2			Wet pine savannas and bogs
Panax quinquefolius	American Ginseng	G3G4	S3			Mesic hardwood forests; cove hardwood forests
Pinguicula primuliflora	Clearwater Butterwort	G3G4	S1		T	In shallow, sandy, clearwater streams and seeps; Atlantic whitecedar swamps
Pityopsis oligantha	Few-Flowered Golden-Aster	G2G4	S1S2			Flatwoods, bogs and seeps of Southwest Georgia
Plagiochila floridana	Florida Leafy Liverwort	G2?	SNR			Deep, partially evergreen swamp forests and rich hammock forests, where most often at tree bases and on exposed roots, sometimes on exposed knees of Taxodium distichum
Plantago sparsiflora	Pineland Plantain	G3	S2			Open, wet pine savannas; shallow ditches and seeps, especially in mowed rights-of-way
Platanthera conspicua	Large White Fringed Orchid	G4G5T3T4	S1			Bogs, seeps, roadsides, wet savannas

Table 11. Southeastern Plains High Priority Plants (118 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Platanthera integra	Yellow Fringeless Orchid	G3G4	S1			Wet savannas, pitcherplant bogs
Portulaca biloba	Grit Portulaca	G1G2	S1			Altamaha Grit outcrops
Pteroglossaspis ecristata	Wild Coco	G2G3	S2		T	Grassy saw palmetto barrens; longleaf pine grasslands, sometimes with Schwalbea americana
Ptilimnium nodosum	Harperella	G2	S1	LE	E	Granite outcrop seeps; shallow seasonal ponds in limesink depressions
Rhexia aristosa	Awned Meadowbeauty	G3G4	S2			Pond margins and wet savannas
Rhexia salicifolia	Willowleaf Meadowbeauty	G2	S1			Georgia habitat information not available
Rhododendron eastmanii	May Pink Azalea	G2	S1S2			Deciduous forest streamsides
Rhododendron prunifolium	Plumleaf Azalea	G3	S3		T	Mesic hardwood forests in ravines and on sandy, seepy streambanks
Rhynchospora breviseta	Short-Bristle Beakrush	G3G4	SU			Bogs; flatwoods
Rhynchospora crinipes	Bearded Beakrush	G2	S1			Streambanks and shallow streambeds
Rhynchospora culixa	Georgia Beakrush	G1Q	S1			Pine savannas; flatwoods
Rhynchospora decurrens	Decurrent Beakrush	G3G4	S2?			Swamps
Rhynchospora pleiantha	Clonal Thread-Leaved Beakrush	G2G3	SH			Margins of limesink depression ponds (dolines)
Rhynchospora punctata	Spotted Beakrush	G1?	S1?			Wet savannas, pitcherplant bogs
Rhynchospora solitaria	Solitary Beakrush	G1	S1		E	Wet, sandy, peaty depressions
Rhynchospora thornei	Thorne's Beakrush	G3	S2			Margins of limesink ponds; moist limestone barrens, wet prairies
Sageretia minutiflora	Climbing Buckthorn	G4	S2		T	Calcareous bluff forests; maritime forests over shell mounds
Salix floridana	Florida Willow	G2	S1		E	Spring runs; seepy, sphagnous wetlands with Eleocharis tortilis, Itea, Alnus, Orontium, Arnoglossum sulcatum
Sarracenia leucophylla	Whitetop Pitcherplant	G3	S1		E	Wet savannas, pitcherplant bogs
Sarracenia psittacina	Parrot Pitcherplant	G4	S2S3		T	Wet savannas, pitcherplant bogs
Sarracenia purpurea var. venosa	Lowland Purple Pitcherplant	GNR	S1		E	Pitcherplant bogs of S. Atlantic Coastal Plain and rarely Piedmont
Sarracenia rubra aff. gulfensis	Sweet Pitcherplant	GNR	S1		T	Atlantic white-cedar swamps
Schisandra glabra	Bay Starvine	G3	S2		T	Rich woods on stream terraces and lower slopes
Schoenoplectus erectus ssp. raynalii	Raynal's Bulrush	G4G5T4T5	S1			Margins of seasonal ponds
Schoenoplectus etuberculatus	Clearwater Bulrush	G3G4	S2			Marshes; shallow ponds; peaty swamps, as Okefenokee Swamp and Atlantic whitecedar swamps
Schwalbea americana	Chaffseed	G2G3	S1	LE	E	Open pinelands, as in well-managed, somewhat moist longleaf pine-wiregrass forests seeps
Scutellaria altamaha	Altamaha Skullcap	G2G3	S2?			Sandy, deciduous woods
Scutellaria mellichampii	Mellichamp's Skullcap	GNR	S2?			Sandy deciduous woods
Sideroxylon macrocarpum	Ohoopee Bumelia	G3Q	S3		R	Dry longleaf pine woods with oak understory; often hidden in wiregrass
Silene ovata	Mountain Catchfly	G3	S1S2		R	Mesic deciduous or beech-magnolia forests over limestone; bouldery, high elevation oak forests
Silene polypetala	Fringed Campion	G2	S2	LE	E	Mesic deciduous forests
Sium floridanum	Florida Water-Parsnip	G1Q	S1?			Calcareous swamps; floodplains
Spiranthes longilabris	Giant Spiral Ladies-Tresses	G3	S1			Pine flatwoods, wet savannas, low hammocks with saw palmetto
Sporobolus teretifolius	Wire-Leaf Dropseed	G2	S2?			Longleaf pine-wiregrass savannas, pitcherplant bogs
Stachys hyssopifolia var. lythroides	Tallahassee Hedge-Nettle	G5T1Q	S1			Moist longleaf pine savannas; roadside ditches

Table 11. Southeastern Plains High Priority Plants (118 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Stewartia malacodendron	Silky Camellia	G4	S2		R	Along streams on lower slopes of beech-magnolia or beech-basswood-Florida maple forests
Stokesia laevis	Stokes Aster	G4	S1			Pitcherplant bogs
Symphyotrichum georgianum	Georgia Aster	G3	S2	C	T	Upland oak-hickory-pine forests and openings; sometimes with Echinacea laevigata or over amphibolite
Teloschistes exilis	Slender Orange Bush Lichen	G3G5	S1?			Relict Blackland prairies; on bark, especially on stunted Campsis radicans and in Cornus asperifolia thickets
Tephrosia mohrii	Dwarf Goat's-Rue	G3	S1?			Scrub; longleaf pine-wiregrass savannas
Thalictrum cooleyi	Cooley's Meadowrue	G2	S1	LE	E	Pond margins and wet savannas
Torreya taxifolia	Florida Torreya	G1	S1	LE	E	Rich ravines in extreme Southwest Georgia
Tridens carolinianus	Carolina Redtop	G3G4	S2?			Dry, open mixed oak-pine forests of the Fall Line Sandhills
Trillium decipiens	Mimic Trillium	G3	S3?			Mesic hardwood forests; limesink forests
Trillium reliquum	Relict Trillium	G3	S3	LE	E	Mesic hardwood forests; limesink forests; usually with Fagus and Tilia
Trillium sp. nov. (unpublished)	Southern Decumbent Trillium	GNR	S1			Mesic hardwoods
Veratrum woodii	Ozark Bunchflower	G5	S2		R	Mesic hardwood forests over basic soils
Verbesina walteri	Carolina Crownbeard	G4	S1?			Moist slopes of hardwood bluffs and edges of colluvial swamps with calcareous substrate; along Savannah River
Waldsteinia lobata	Piedmont Barren Strawberry	G2G3	S2		R	Stream terraces and adjacent gneiss outcrops
Xyris drummondii	Drummond's Yellow-Eyed Grass	G3	S1			Pine flatwoods
Xyris scabrifolia	Harper's Yellow-Eyed Grass	G3	S1			Sedge bogs; pitcherplant bogs; pine flatwoods

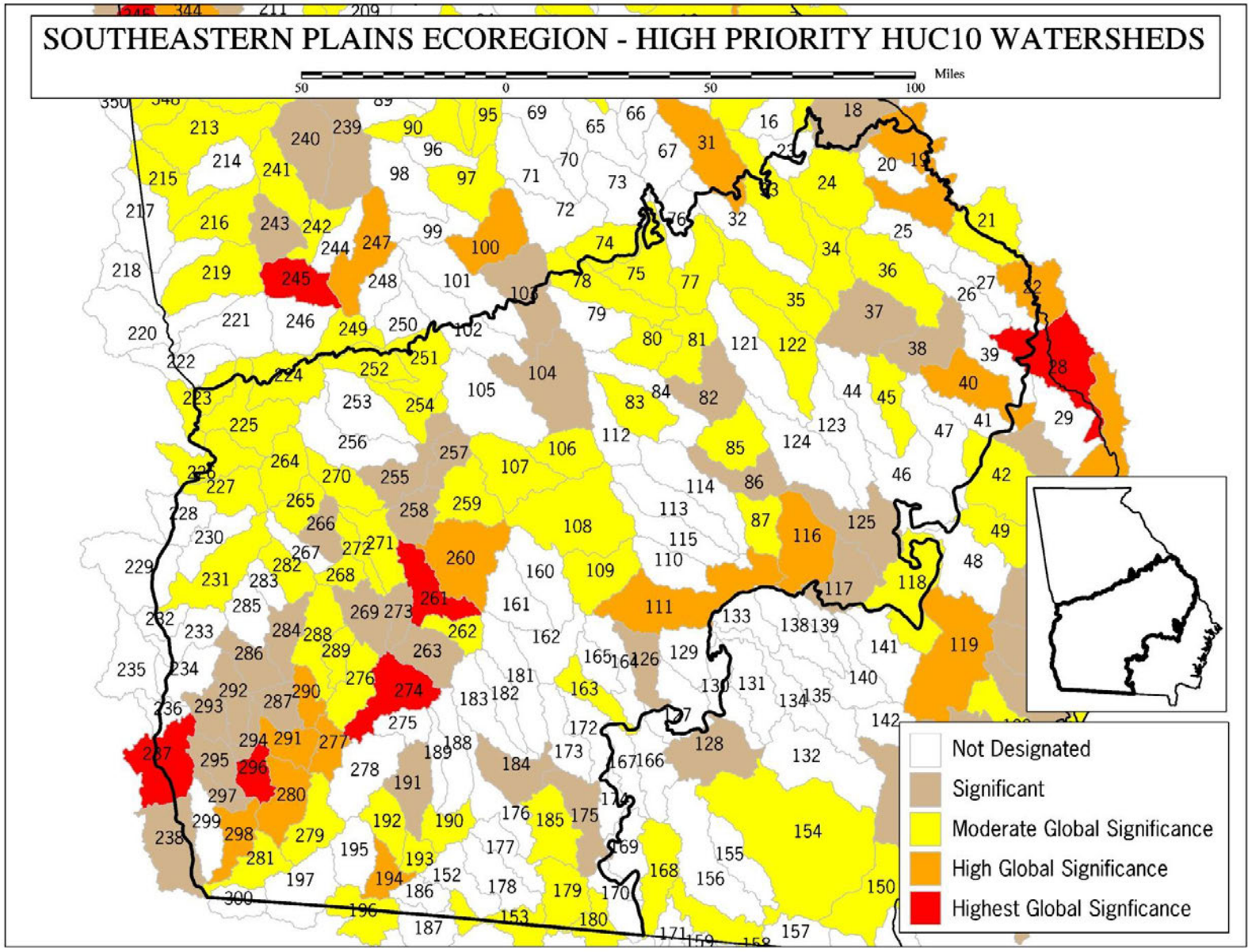


Figure 18. High Priority Waters, Southeastern Plains Ecoregion

Southern Coastal Plain Ecoregion

Ecoregional Overview

The Southern Coastal Plain ecoregion covers approximately 6,634,517 acres in Georgia. Approximately 1,121,120 acres (17% of the ecoregion) are in some form of permanent or long-term conservation ownership. Georgia DNR manages approximately 159,790 acres owned in fee simple by the State of Georgia and an additional 108,500 in leases or management agreements. Federal land ownership includes approximately 431,446 acres managed by the U.S. Fish & Wildlife Service, 294,658 acres managed by the Department of Defense, 34,420 acres managed by the National Park Service, and 6,613 acres managed by the Natural Resources Conservation Service. The vast majority of federal land is found in two properties - Okefenokee National Wildlife Refuge and Fort Stewart Military Reservation.

Regionally, the Southern Coastal Plain extends from South Carolina and Georgia through much of central Florida, and along the Gulf coast lowlands of the Florida Panhandle, Alabama, and Mississippi. This ecoregion is lower in elevation with less relief and wetter soils than the Southeastern Plains. Once covered by a variety of forest communities that included longleaf pine, slash pine, pond pine, beech-magnolia, and mixed upland hardwoods, land cover in the region is now predominantly slash and loblolly pine plantations with cypress-gum, bay swamp, and bottomland hardwoods in low lying areas. Ecoregional subdivisions of the Southern Coastal Plain include the Okefenokee Plains, Sea Island Flatwoods, Okefenokee Swamp, Bacon Terraces, Floodplains and Low Terraces, and Sea Islands/Coastal Marsh.

The Okefenokee Plains consist of flat plains and low terraces developed on Pleistocene-Pliocene sands and gravels, and contain pine stands interspersed with numerous swamps and bays. There are some highly acidic natural lakes with low clarity and darkly colored water. Soils in the region are somewhat poorly drained to poorly drained. The region has mostly coniferous forest and young pine plantation land cover, with areas of forested wetlands.

The Sea Island Flatwoods are poorly drained flat plains with Pleistocene terraces and shoreline deposits. Poorly drained soils are common in this region; small areas of better-drained soils contribute to ecological diversity. Trail Ridge forms the eastern boundary of the Okefenokee Swamp. Loblolly and slash pine plantations cover much of the region.

The Okefenokee Swamp is a mixture of forested swamp and freshwater marsh with some pine-dominated uplands. The swamp drains to the south and southwest and contains the headwaters for the St. Marys and Suwannee Rivers as well as numerous islands, lakes, and thick beds of peat. The slow-moving waters are darkly colored and acidic. Cypress, swamp blackgum, and bay forests are common, with scattered areas of prairie, which are comprised of grasses, sedges, and various aquatic plants. Cycles of drought and fire affect both its vegetation and wildlife.

The Bacon Terraces include several relatively flat, moderately dissected terraces with subtle east-facing scarps. The terraces, developed on Pliocene to Pleistocene sands and gravels, are dissected in a dendritic pattern by much of the upper Satilla River basin. Cropland is mostly on well-drained soils on the long, narrow, flat to gently sloping ridges paralleling the stream courses. The broad flats of the interfluves are typically poorly drained pine stands, while bottomland hardwood forests are found in the wet, narrow floodplains.

Floodplains and Low Terraces are a continuation of the region of the same name in the Southeastern Plains, and consist of the broad floodplains and terraces of major rivers, such as the Savannah, Ogeechee, and Altamaha. Soils consist of stream alluvium and terrace deposits of sand, silt, clay, and gravel, along with some organic muck and swamp deposits. Swamp forests of bald cypress and water tupelo and oak-dominated bottomland hardwood forests provide important wildlife habitat.

The Sea Islands/Coastal Marsh region contains the lowest elevations in Georgia and is a highly dynamic environment affected by ocean wave, wind, and river action. Mostly sandy soils occur on the barrier islands, while organic and clayey soils occur in the freshwater, brackish, and salt marshes. Maritime forests of live oak, redcedar, slash pine, and cabbage palmetto grow on parts of the barrier islands, and various species of cordgrass, saltgrass, and rushes are dominant in the marshes. The coastal marshes, tidal creeks, and estuaries represent important nursery areas for fish, crabs, shrimp, and other marine or estuarine organisms.

The predominant landcover types in the Southern Coastal Plain are evergreen forest and forested wetlands. These two types combined account for approximately 62% of the total land area in the ecoregion. (Kramer and Elliott, 2004) An analysis of land use changes from 1974 to 1998 based on satellite imagery indicated the following general trends:

- A decrease in row crop/pasture (from 9.74% of total landcover to 8.52%)
- An increase in high-intensity and low-intensity urban (from 1.52% of total landcover to 2.63%)
- An increase in clearcut/sparse vegetation landcover types (from 8.54% of total landcover to 11.70%)
- A decrease in forested wetlands (from 30.57% of total landcover to 26.11%)
- Little apparent change in evergreen forest (from 35.28% of total landcover to 35.97%)

These trends indicate a general decline in the total acreage devoted to active agricultural uses, an increase in residential and commercial development, an increase in clearcuts, fallow fields, and other sparsely vegetated landcover resulting from a variety of land use practices, and a decline in forested wetlands.

Analysis of land use changes from 2006 to 2011 indicates a 12.1% increase in early successional vegetation, a 6.1% increase in open water and 2.1% increase in developed land, a 6% decrease in forest land, and a 3% decrease in agricultural land. These figures confirm a continuation of the overall decline in agricultural uses, a decrease in overall forest cover, and an increase in early successional habitats resulting from timber harvest, development, and other activities. The increase in open water may represent more open conditions following significant fires and salvage logging in the Okefenokee Swamp region. See Appendix N for more information on landcover trends in this ecoregion.

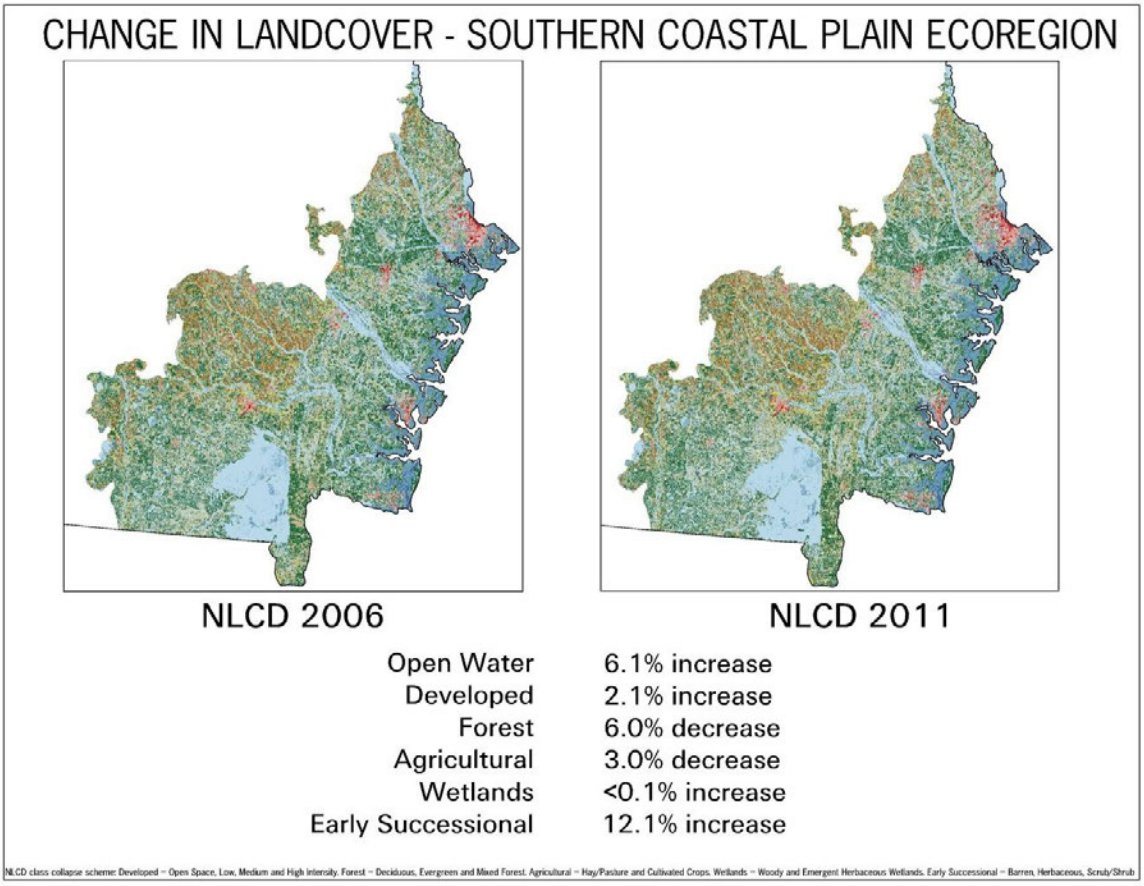


Figure 19. Change in landcover from 2006 to 2011 in the Blue Ridge ecoregion.

According to EPD stream monitoring data for 2012, 27% of streams in this region support designated uses (based on percentage of total monitored stream miles); 61% do not support designated uses, with 12% pending assessment. The percentage of monitored streams supporting designated uses in the Southern Coastal Plain is lowest of the five ecoregions.

High Priority Species and Habitats

The technical teams identified 120 high priority animal species in the Southern Coastal Plain. These included 35 birds, 14 reptiles, 11 mammals, 7 amphibians, 15 mollusks, 12 fish, 4 aquatic arthropods, and 22 terrestrial arthropods. These species are listed in Table 9, with information on global and state rarity ranks, protected status (if any) under federal or state law, and habitat and range in Georgia. In addition, 68 species of high priority plants were identified for the Southern Coastal Plain. These are listed in Table 10.

High priority habitats for the Southern Coastal Plain are listed and briefly described below:

1. Alluvial (Brownwater) Rivers and Swamps
Large, low-gradient, meandering rivers with sandbars, sloughs and extensive floodplain swamps. Floodplains of these systems may remain inundated for extensive periods. Sand and silt are the dominant substrata and these rivers typically carry heavy sediment loads. Dominant canopy trees are baldcypress and tupelo gum; the understory tree/shrub vegetation may be patchy, often consisting of swamp privet, water elm, swamp dogwood, red maple, and Carolina ash. Cypress and gum-dominated swamps can be found along the Altamaha, Savannah, and Ogeechee rivers. These systems have been impacted by altered flows from upstream dams.

2. Barrier Island Freshwater Wetlands and Ponds
Usually found in broad flats or in elliptical to linear interdune depressions on Georgia's coastal barrier islands. These wetland habitats are variable in physiognomy and species composition; deeper, more permanently flooded ponds often have a large extent of open water; shallower ponds are usually dominated by a combination of submergent, emergent and/or floating macrophytes. Trees or shrubs are present mainly along the edges of the ponds. These habitats have been impacted by groundwater withdrawals, fire suppression, and invasive exotic plants such as Chinese tallow tree.

3. Bayheads and Titi Swamps
Forested wetlands dominated by broad-leaved evergreen trees: sweetbay, redbay, and loblolly bay. Usually found in domed peatlands, broad interstream flats, or shallow drainageways. Includes shrubby areas dominated by titi (*Cyrilla racemiflora*). These are considered late successional communities in a variety of hydrogeomorphic settings in the Coastal Plain.

4. Beech-Magnolia Slope Forests
These are uncommon Coastal Plain hardwood forests, typically found on very mesic river bluffs, and occasionally on gentle slopes that are naturally protected from fire by topographic setting. In addition to American beech and southern magnolia, may contain water oak, water hickory, American holly, and other fire-intolerant species. Often small in extent and occupying a narrow zone between wetland and fire-maintained upland forests. May contain epiphytic species such as green-fly orchid. Often associated with and in close proximity to hillside seeps.

5. Bottomland Hardwood Forests
Diverse hardwood-dominated forests found on natural levees, upper floodplain flats and terraces along brownwater and blackwater rivers. Characterized by a diverse canopy of hardwood species dominated by various oaks, green ash, sweetgum, red maple, water hickory, and other mesic species. These extensive forested systems provide habitat for a wide variety of wildlife species, and are especially important for wide-ranging forest interior species. Bottomland hardwood forests have been impacted by altered hydrologic conditions, forest conversion, and invasive exotic species.

6. Brackish Marsh and Salt Marsh
Salt marshes are salt-tolerant grasslands, dominated by cordgrasses and rushes, over soils with circumneutral pH. These are extremely productive habitats. Brackish marshes occupy a wide ecotonal zone in the vicinity of river mouths.

7. Canebrakes
Thickets of native river cane found along rivers and creeks under sparse to full tree cover. Canebrakes represent important wildlife habitat for a variety of neotropical birds and insects. These habitats require periodic fire or other form of disturbance for maintenance.

8. Coastal Beaches and Sand Bars
Beaches and sand bars are dynamic, high-energy intertidal systems that represent important habitat for shorebirds and sea turtles. Longshore movement of sand on barrier islands results in erosion at the north end and building up at the south end. These unvegetated habitats are important foraging areas for coastal shorebirds; sea turtles nest in the foredunes at the upper ends of sandy beaches.

9. Coastal Dunes and Bluffs
These habitats consist of sparsely vegetated sandy interdunes, rear dunes, and bluffs. They constitute important habitats for a number of high priority species adapted to harsh temperatures and salt spray. Coastal dune habitats include a number of important microhabitats such as interdune meadows and depressions, shrub thickets, and dune scrub forests. Similar vegetation can be found along eroded or exposed coastal bluffs.

10. Coastal Scrub-Shrub Wetlands
Shrub dominated estuarine communities found along the upper border of salt marsh or brackish marsh. These habitats are infrequently flooded by tidal action and form ecotones between wetland and terrestrial environments. Typical shrubs include groundsel tree, marsh elder, yaupon holly, wax myrtle, Florida privet, and false willow. Wind-pruned redcedar may also be present.

11. Estuarine and Inshore Marine Waters
Estuaries (brackish waters between barrier islands and mainland) and near-shore ocean waters. Estuaries serve as nurseries for many species of fish and shellfish as well as habitats for manatees and other marine mammals. Species composition in these aquatic communities is influenced by tidal regime and salinity.

12. Evergreen Hammocks and Mesic Hardwood Forests
Evergreen hammocks are typically associated with small isolated uplands within a floodplain or depressional wetland. Protected from frequent fire, these habitats are characterized by a canopy of submesic oaks and hickories, with southern magnolia, American holly, ironwood, flowering dogwood and spruce pine. Mesic hardwood forests are similar, and may occur in terraces above bottomland hardwood forests, ravines, or nonalluvial flats protected from frequent fire.

13. Forested Depressional Wetlands
Seasonally or semi-permanently flooded forests of depressional features in broad interstream flats. Soils range from mineral to organic and canopy dominants may include bays, pondcypress, and/or pond pine. Fire plays a role in maintaining some of these systems. Isolated wetlands that do not support fish populations are very important breeding habitats for amphibians such as the flatwoods salamander.

14. Freshwater "Prairies"
Semipermanently flooded freshwater wetlands dominated by emergent vegetation and floating macrophytes, with scattered cypress, buttonbush, and swamp blackgum. The primary example in this region is the Okefenokee Swamp. Fluctuations in water levels and/or periodic fire are required for maintenance. Many of these habitats have been impacted by altered hydrology (impoundment with dams or drainage) and/or fire suppression.

15. Hillside Seeps
Small patch habitats found on moist to wet lower slopes in sandy terrain. These seeps represent natural groundwater discharge points. May be dominated by shrubs or herbs (including pitcherplants), with scattered trees such as pond, slash, or longleaf pine. Most Georgia examples are fire-suppressed.

16. Longleaf Pine-Scrub Oak Woodlands
Sparse-canopied xeric longleaf pine system with patchy oak understory composed of turkey oak, sand post oak, bluejack oak, blackjack oak and other scrub oak species. Typically found on deep sand soils, on ridges and upper slopes. Contains a fairly diverse groundlayer of xerophytic grasses and forbs and scattered shrubs.

17. Longleaf Pine-Wiregrass Savannas
Large patch or matrix upland habitats characterized by a sparse canopy of longleaf pine (sometimes with slash pine) and a diverse herb layer dominated by wiregrass. Can range from mesic to dry, depending on topographic position and soils. Transition downslope into wet pine savannas, pine flatwoods, or other wetlands. These habitats are heavily dependent on frequent fire for maintenance.

18. Maritime Forest and Coastal Hammocks
Coastal forests dominated by live oak and palmetto; hammocks are small islands of maritime forest usually surrounded by brackish water and/or salt marsh. These are

restricted to a narrow band of shoreline and barrier islands. Characterized by sandy soils and wind-pruned canopy trees. Provide important habitat for neotropical migrant birds.

19. Mud and Sand Flats
Periodically inundated mud and sand deposits located in estuarine or inshore marine waters. These unvegetated habitats are generally covered at high tide and exposed at low tide. They serve as important feeding areas for a number of coastal shorebirds such as plovers, sandpipers, and dowitchers.

20. Nonalluvial (Blackwater) Rivers and Swamps
Large, meandering rivers with tea-stained, but translucent waters and narrow to wide floodplains. Dominant substrate is sand, which may form bars in larger systems. In contrast to blackwater streams, forest canopy may only shade a portion of the stream width. Runs and pools are dominant habitats. Large snags are a significant component of habitat heterogeneity. Limestone shoals occur on some of these rivers.

21. Offshore Marine Waters
Georgia's offshore marine waters provide habitat for a number of high priority species, including loggerhead, green, Kemp's ridley, and leatherback turtles, North Atlantic right whales, and bottlenose dolphins. Hard-bottom areas are especially important habitats for marine fish and sessile organisms.

22. Open-Water Ponds and Lakes
Open water aquatic habitats ranging from isolated depressions to impoundments created by beaver. Vegetation is sparse and consists primarily of emergent and floating macrophytes. These habitats are relatively uncommon in this region, and are maintained by periodic fire and fluctuating water levels.

23. Pine Flatwoods
Mesic or wet forests on flat, poorly-drained areas of the lower Coastal Plain. Dominated formerly by longleaf pine, now typically by slash pine, occasionally with loblolly or pond pine. Contains a well-developed shrub layer consisting of saw palmetto, gallberry, lowbush blueberry, and other ericaceous species. One of the most extensive and prevalent habitats of this ecoregion.

24. Tidal Rivers and Freshwater Tidal Marsh
Includes tidally influenced portions of rivers and creeks and associated wetlands. Freshwater tidal marshes are wetlands found along the margins of tidal rivers and creeks above the brackish water zone, typically dominated by giant cutgrass, sawgrass, pickerel weed, wild rice, cattail, rushes, and a variety of other herbs

25. Wet Pine Savannas, Herb and Shrub Bogs
Wet pine savannas are poorly drained wetlands with open to sparse canopies dominated by longleaf, slash, and/or pond pine. The shrub layer may be sparse, consisting mainly of gallberry, wax myrtle, and blueberries. The herbaceous layer is often diverse and dense,

dominated by grasses, sedges, composites, orchids, and lilies. May include small peat-filled depressions dominated by titi and other shrubs or by herbaceous bog plants.

Problems Affecting Wildlife Diversity

One of the primary stressors of wildlife diversity in the Southern Coastal Plain is the rapid pace of development in the coastal counties. Intense development pressures have resulted in the loss or fragmentation of a number of habitats, including maritime forest, pine flatwoods, coastal bluffs, and forested depression wetlands. In fact, the pace of commercial and residential development appears to be increasing as new residents flock to the Georgia coast to metropolitan areas such as Brunswick, St. Simons, Jekyll Island, Kings Bay, and Savannah. Development of subdivisions, roads, utility corridors, and commercial facilities has burgeoned in this area of the state. Non-coastal metropolitan areas experiencing significant growth include Waycross and Valdosta. Examples of species affected by this development pressure include Bachman's sparrow, painted bunting, gopher tortoise, and southeastern pocket gopher.

Past conversion of natural pine-dominated stands to commercial pine plantations with intensive site preparation and drainage of wetland habitats has resulted in an overall decline in species diversity. While many of the biotic components of the original forests are still extant, the simplified canopy composition and understory structure has resulted in lower overall wildlife habitat quality. Examples of priority species impacted by forest conversion include Bachman's sparrow, eastern indigo snake, flatwoods salamander, and southern hognose snake.

Fire suppression can also be a significant problem, as many fire-dependent habitats lie adjacent to residential areas, highways, or commercial/industrial zones. Throughout the region, a lack of fire has resulted in the decline in the extent and quality of habitats such as herb and shrub bogs, wet pine flatwoods, freshwater "prairies", longleaf pine-wiregrass savannas, and longleaf pine-scrub oak woodlands. Fire suppression in sites containing isolated depression wetlands impacts populations of gopher frogs, striped newts, and flatwoods salamanders; other examples of species affected by fire suppression include gopher tortoise, Florida pine snake, eastern indigo snake, purple honeycomb head, hairy rattleweed, and all seven species of pitcherplants native to Georgia.

Groundwater withdrawals for industrial and municipal uses have resulted in dewatering of many of the small but significant depression wetlands, especially along the coast. This impact presents significant problems for rare wading birds, including the wood stork and tricolored heron, as well as species such as striped newt, gopher frog, dwarf siren, and dwarf waterdog.

Construction of dams or other structures altering stream flow represents a significant problem for some high priority species and habitats in this region. Most of the major river impoundments affecting streams and associated wetlands in this area are in the Piedmont, but the regulation of flows on these alluvial river systems results in altered

hydroperiods for riverine swamps and bottomland hardwood forests, which in turn affects species composition and function of these ecosystems. For example, there is evidence that diminished flow variability in the Savannah River produced by upstream dams impacts the periodic flushing of tributary streams such as Ebenezer Creek, which may contribute to problems with low dissolved oxygen in this old-growth cypress-gum swamp. Alteration of sediment transport regimes in these alluvial river systems impacts the productivity of estuarine areas as well as the coastal sand-sharing system.

Nonalluvial (blackwater) rivers and streams are vulnerable to nutrient loadings and hydrologic disruptions from groundwater and surface water withdrawals, draining of adjacent wetlands, insufficient stream buffers, and other factors. Impacts on these systems from human activities include increased flow variability, reduced dissolved oxygen, and increased silt loads.

Invasive exotic species pose significant problems to habitats in this region. Examples of exotic animals causing significant negative impacts in this region include flathead catfish and feral hogs. Other nonnative species that are of concern include island apple snails, and feral grazers such as cattle and horses. Examples of invasive exotic plants in this ecoregion include Chinese tallow tree, water hyacinth, alligatorweed, parrotfeather, giant reed, tropical soda apple, and coastal bermudagrass. The channeled apple snail, a South American species that is a well-known pest in Florida, has been recently found in the Satilla River watershed.

For rare marine species such as the North Atlantic right whale, West Indian manatee and loggerhead, collisions with boats and/or incidental take by fishing operations (capture or entanglement in nets or other fishing gear) can cause significant negative population impacts. Unmanaged recreational use of beach and dune environments represents a significant threat to nesting sea turtles as well as a variety of coastal shorebirds, including American oystercatcher, black skimmer, least tern, and piping plover.

Vehicle induced mortality is a significant problem for several high priority species in this area. Examples include eastern diamondback rattlesnake, eastern indigo snake, gopher tortoise, diamondback terrapin, Sherman's fox squirrel, and Florida pine snake. For these and other species, construction of new roads results in increased risk of direct mortality as well as fragmentation of habitat.

While climate change will undoubtedly affect habitats throughout Georgia, the impacts will likely be most obvious and significant in this ecoregion. Conservation plans in this region must acknowledge the need to protect coastal uplands as well as wetlands, and provide opportunities for migration of habitats and species as sea levels and coastlines change. Restoration of more natural hydrology in alluvial rivers that feed the coastal sand-sharing system may help mitigate the impacts of coastline changes. In addition, development plans must include setbacks and buffers to provide protection for both wildlife and humans as sea levels and storm surge levels rise in the coming decades.

High Priority Sites and Landscape Features

The current assessment and previous conservation planning efforts have identified a number of ecologically important sites and landscape features in this region of the state. An assessment of the South Atlantic Coastal Plain in cooperation with state natural heritage programs in Georgia, Florida, and South Carolina identified 38 high priority conservation areas in Georgia (The Nature Conservancy, 2002). Additional surveys conducted by Georgia DNR staff and others have brought additional areas of conservation interest to light in recent years. The following list includes examples of some of the most significant sites and landscape features identified to date for the Southern Coastal Plain ecoregion.

Alapaha River Corridor

The Alapaha River is a blackwater (nonalluvial) river in the Gulf Coastal Plain of Georgia. The Alapaha River corridor includes significant upland habitats associated with sandhill environments. This system includes longleaf pine-scrub oak woodlands, old-growth dwarf pondcypress swamps, mesic hardwood bluffs, and depression ponds. High priority species associated with these habitats include striped newt, gopher frog, gopher tortoise, spotted turtle, eastern indigo snake, eastern diamondbacked rattlesnake, tiger salamander, silky camellia, and pondspice. The Alapaha River is inhabited by the Suwannee River alligator snapping turtle, a distinct, newly described species that is rarer in Georgia than the species found in other drainages. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Altamaha River Corridor

The Altamaha basin drains a total of 14,400 square miles, more than one-fourth of Georgia's land surface. Natural communities associated with this immense river system include oxbow lakes, sandbars, evergreen hammocks, sand ridge scrub forests, hardwood levee forests, cypress-gum swamps, pine flatwoods, limestone shoals, coastal marshes, and open-water estuaries. Important habitats located adjacent to the river floodplain include springs, bogs, Carolina bays and cypress/gum ponds.

Numerous high priority plants and animals are known from the Altamaha River corridor. Examples include green fly orchid, pondspice, Georgia plume, Franklinia, red-cockaded woodpecker, gopher tortoise, indigo snake, Bachman's sparrow, and swallow-tailed kite. Several rare and/or endemic bivalves have been reported from the Altamaha River, including the Altamaha spinymussel and Altamaha arcmussel. Ongoing efforts to provide long-term protection for the Altamaha River corridor involve a number of agencies and organizations. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Crooked River State Park/Kings Bay Naval Base

These two adjacent public lands contain several high priority habitats, including estuarine waters, maritime forest, coastal river bluffs, wet pine flatwoods, and pine-oak coastal

scrub. Rare species known from these sites include pondspice, Florida wild privet, climbing buckthorn, Florida orange-grass, Bartram's air-plant, gopher tortoise, and West Indian manatee. Estuaries and embedded marsh islands are habitat for diamondback terrapins. Other high priority species found in upland areas in this region include island glass lizards and eastern diamond-backed rattlesnakes.

Ebenezer Creek/Savannah River

Ebenezer Creek, a non-alluvial tributary of the Savannah River, is a "backwater swamp", whose hydrology is influenced significantly by water levels in the lower Savannah River. The lower portion of Ebenezer Creek contains an old growth baldcypress-water tupelo swamp. Other high priority habitats include bottomland hardwoods, shrub bog, pine flatwoods, mesic river bluff forests, hillside seeps, titi swamp, and alluvial river swamp. Rare species known from this area include silky camellia, sweet pitcherplant, Rafinesque's big-eared bat, swallowtailed kite, and painted bunting.

Fort Stewart

This military base contains some of the best examples of natural habitats in Georgia's Southern Coastal Plain, including extensive longleaf pine-dominated uplands, isolated depression wetlands, wet pine flatwoods, and nonalluvial river swamp. High priority species known from this site include frosted flatwoods salamander, striped newt, gopher frog, pine snake, southern hognose snake, mimic glass lizard, tiger salamander, southern dusky salamander, striped newt, red-cockaded woodpecker, Sherman's fox squirrel, purple honeycomb head, and pondspice. The U.S. Department of Defense collaborates with Georgia DNR and other agencies and organizations to ensure the viability of priority species and their habitats on the base and in surrounding lands.

Ogeechee River Corridor

The Ogeechee River originates in the lower Georgia Piedmont and flows 245 miles to the Atlantic Ocean at Ossabaw Sound. Natural communities of the Ogeechee River corridor include limestone shoals, sandbars, cypress-gum swamps, springs, bottomland hardwood forests and coastal salt marshes. Important habitats adjacent to the river floodplain include Carolina bays, springs, limesinks, sandhills and Altamaha Grit outcrops. Examples of high priority species associated with the Ogeechee River floodplain and adjacent habitats include Georgia plume, wood stork, and swallow-tailed kite. Numerous springs provide cool-water refuges for striped bass and other game fish.

The Ogeechee is relatively free from significant development, except in the lower portions. This river has been considered for inclusion as a component of the Georgia Scenic River system and was nominated as a potential National Wild and Scenic River. Impacts to the river corridor include residential and industrial development (especially along the coast), conversion of bottomland hardwood forests, and drainage of adjacent wetland habitats. (Note: this conservation landscape spans the Southeastern Plains and Southern Coastal Plain).

Okefenokee Swamp

This remarkable, extensive nonalluvial wetland system has been described as a "bog swamp" (Wharton, 1978) due to the fact that it is a huge, peat-filled basin with measurable sheet flow. High priority habitats associated with this ecosystem complex include freshwater "prairies", pine flatwoods, pondcypress savanna, wet pine savannas, titi swamp, herb and shrub bogs. Examples of rare species known from the Okefenokee Swamp include Florida sandhill crane, Sherman's fox squirrel, flatwoods salamander, Florida water rat, striped newt, wood stork, Florida black bear, Rafinesque's big-eared bat, Florida orange grass, and Okefenokee giant pitcherplant.

Ossabaw Island

Third largest of Georgia's barrier islands, Ossabaw consists of approximately 12,000 acres of upland and at least twice that acreage of marsh. Ossabaw is owned by the State of Georgia and managed as a WMA and natural area. Development on the island is restricted to five houses and some outbuildings. Habitats present include beach, dunes, maritime forest, salt marsh and tidal creeks, and freshwater ponds. Understory vegetation is sparse due to past grazing by deer and feral livestock, but is recovering due to recent efforts to control populations of grazers. Two mixed-species wading bird rookeries occur on the island. Ossabaw's beaches support nesting by loggerhead turtles and several species of coastal shorebirds. High priority plant species include soapberry and climbing buckthorn.

Sapelo Island

Sapelo Island is a barrier island mostly owned by the State of Georgia and accessible only by boat or plane. It consists of approximately 11,000 acres of upland and several thousand acres of marsh. The island is managed as a Wildlife Management Area and a National Estuarine Research Reserve. The University of Georgia Marine Institute operates a research facility on the island. Development on the island is restricted to buildings constructed by some of the original plantation owners, now used to house staff of the Marine Institute and DNR, and houses associated with a 500-acre private community. Habitats present include salt marsh, maritime forest, second-growth pine, dunes and approximately 6 miles of beach. One small freshwater pond supports a small wading bird rookery. Beaches are used as nesting areas by loggerhead turtles and four species of rare or uncommon shorebirds. Plants of conservation interest on the island include Chapman's oak, soapberry, and other species of plants restricted to shell mounds.

St. Simons/Little St. Simons

This site consists of Little St. Simon's Island and the undeveloped northern ends of St. Simon's Island and Sea Island, including Pelican Spit, an accreting sandbar in the Hampton River on the north end of Sea Island. St. Simon's and Sea Island are almost entirely privately owned and connected to the mainland by causeway. Habitat types are similar to those described for Sapelo and Ossabaw. There is a mixed-species wading bird rookery on the north end of St. Simon's Island that includes nesting wood storks.

Cannons Point Preserve on the north end of the island is a significant conservation tract owned by the St. Simons Land Trust. Little St. Simons Island supports a small egret rookery and a small great blue heron rookery. The seven miles of beach on Little St. Simons support limited nesting by loggerhead turtles and significant nesting populations of five shorebirds. This privately owned property has recently received permanent protection through a conservation easement granted to The Nature Conservancy

St. Marys and Suwannee Rivers

From its headwaters in the Okefenokee Swamp to its outlet on the Atlantic Ocean, the St. Marys meanders over 120 miles in a straight-line distance of only 40 miles. Tidal influence extends as far upstream as the Folkston area. The Suwannee also originates in the Okefenokee, flowing southwestward 18 miles to the Georgia-Florida state line. From there it continues approximately 265 miles to its outlet on the eastern Gulf of Mexico. Like the St. Marys, the upper Suwannee is characterized by slow stream flow and numerous meanders. Further south, the Suwannee flows swiftly over limestone shoals, then enters a region in which numerous springs contribute to its discharge. Other important natural features of these blackwater stream corridors include sandbars, clay or limestone banks, sandy bluffs, cypress-gum swamps, bottomland hardwood forests, pine flatwoods, tidal swamps, sawgrass flats and coastal marshes. Protection of these river floodplains will help maintain important wildlife migration corridors between the Okefenokee Swamp, the lower Suwannee delta and estuaries, Georgia's coastal wetlands, and lands of the Osceola National Forest.

<u>High Priority Waters</u>

Figure 20 shows high priority streams and watersheds identified for the Southern Coastal Plain by the Aquatic Habitat Technical Team. These streams were chosen on the basis of documented occurrences of high priority aquatic species and the relative rarity of these species. Examples of high priority streams in this ecoregion include the Savannah River, Altamaha River, Brunswick River, Alapaha River, St. Marys River, Suwannee River, Doboy Ogeechee River, Satilla River, and Turtle River. Refer to the Aquatic Habitat Technical Team report in Appendix F for more information on the methods used to identify high priority waters.

Coastal Beaches and Dunes

Georgia's coastal beaches and dunes represent critical habitats for rare turtles and shorebirds. Intertidal sand beaches provide foraging habitat for a great number of shorebirds, including sandpipers, plovers, sanderlings, turnstones, terns, and dowitchers. These birds feed on the abundant invertebrate fauna of intertidal areas and nest among the sparsely vegetated dunes and beach wrack. Loggerhead sea turtles nest in the foredunes at the upper edge of the beach, and several rare plants are found in interdune or rear dune/bluff habitats. Beachfront property is also perhaps the most highly prized real estate in Georgia for residential development and recreation.

Human activities have resulted in a wide variety of direct and indirect impacts to these important habitats. Impoundment of Georgia's major rivers has reduced sediment input to the coastal sand-sharing system. In addition, construction of sea walls and jetties and dredging of tidal river channels have altered natural sand movement patterns along the coast, resulting in increased erosion of some beaches. Other activities impacting coastal beach and dune habitats include residential and commercial development, vehicular traffic, excessive herbivory (e.g., by feral horses), excessive predation (e.g., from feral hogs, raccoons, dogs, or cats), littering, artificial lighting and unmanaged recreational use. Protection of these important habitats will require a concerted effort involving state, federal, and local governments as well as local residents, educational groups, and civic organizations.

Conservation Goals

- Maintain known viable populations of all high priority species and functional examples of all high priority habitats through land protection, incentive-based habitat management programs on private lands, and habitat restoration and management on public lands.
- Increase public awareness of high priority species and habitats by developing educational messages and lesson plans for use in environmental education facilities, local schools, and other facilities.
- Encourage restoration of important wildlife habitats through reintroduction of prescribed fire, hydrologic restoration, and revegetation efforts.
- Combat the spread of invasive/noxious species in high priority natural habitats by identifying problem areas, providing technical and financial assistance, developing specific educational messages, and managing exotic species populations on public lands.
- Minimize impacts from residential and commercial development on high priority species and habitats by providing input on environmental assessments
- Continue efforts to recover federally listed species by implementation of recovery plans

Strategies and Partnerships to Achieve Conservation Goals

- Provide financial incentives and technical expertise to encourage prescribed burns, through Interagency Burn Team and other means
- Work with NRCS staff to identify high priority habitats and sites for implementation of habitat enhancement/restoration projects through Farm Bill programs (e.g., restoration of longleaf pine-dominated forests and savannas)
- Use state lands (e.g., Crooked River State Park, Sapelo Island, Ossabaw Island) and other public lands to showcase habitat restoration and management efforts. Complete management plans for all state lands and incorporate management objectives for populations of high priority species.
- Assess exotic plant populations on public lands and provide technical assistance to private landowners to discourage use of invasive plants
- Work with GDOT and local governments to minimize direct impacts to high priority species and habitats from development projects
- Work with Georgia Power and private landowners to identify and conserve populations of rare species in and adjacent to utility corridors
- Develop educational materials on high priority species and habitats in the ecoregion and provide these to environmental educators at WRD regional education centers (e.g., Sapelo Island) and other facilities
- Work with GFC and SFI-SIC to facilitate development of forestry BMPs for maintenance of important wildlife habitats
- Work with The Nature Conservancy, USFWS, Georgia Land Conservation Center and local land trusts to provide protection for high priority wetlands and stream corridors.
- Continue collaborative efforts to protect sea turtle nests and minimize impacts from shrimp fisheries
- Continue North Atlantic right whale and manatee recovery and monitoring efforts

Highest Priority Conservation Actions

Highest priority conservation actions (actions rated “Very High” or “High”) identified by the technical teams, Steering Committee, and other stakeholders specifically for this ecoregion include the following (see Appendix P for details):

- Conduct midwinter waterbird survey and piping plover winter survey; conduct research and surveys on southeastern red knot and whimbrels; investigate American oystercatcher ecology and demographics.
- Determine population demographics (size, nesting success, productivity, etc.) for MacGillivray's Seaside Sparrows .
- Assess populations of high priority terrestrial birds in the Coastal Plain (e.g. swallow-tailed kite, southeastern American kestrel, painted bunting, Henslow's sparrow).
- Conduct surveys for Black Rails in high marsh areas of saltmarsh and possibly other shallowly flooded freshwater habitats.

- Conduct surveys for Yellow Rail in pine flatwoods and similar sites as well as other shallowly flooded habitats.
- Continue Line Transect Distance Sampling (LTDS) of gopher tortoise populations to maintain gopher tortoise Candidate Conservation Agreement.
- Monitor reproductive activity at known, recently extant ponds used by pond-breeding amphibians.
- Continue monitoring eastern indigo snake occupancy.
- Conserve key Swallow-tailed Kite nesting habitat along the Satilla River.
- Resolve the current difficulty in protecting newly created or emerging beach nest bird habitat. Educate beachgoers and boaters about the plight of beach nesting birds and passage migrants that use Georgia beaches and offshore bars. Experiment with sand fencing to increase elevation on key offshore bars.
- Manage coyote populations on barrier islands to reduce impacts to beach nesting birds
- Continue restoring and enhancing oyster reef communities along the coast through targeted restoration efforts outside of shellfish harvest areas, enhancements within shellfish harvest areas, and living shoreline implementation to restore oyster communities as well as salt marsh plant species.
- Conduct field inventory and landowner outreach to conserve coastal plain seepage bogs.
- Implement right whale recovery plan in the Southeast U.S.
- Determine the demographic patterns and habitat use of juvenile sea turtles in coastal waters.
- Continue sea turtle stranding and salvage network. Enforce and monitor trawl fisheries for impacts to sea turtles
- Monitor effects of climate change on sea turtles and their nesting habitat. Monitor trends in adult female sea turtle abundance through nest monitoring programs and genetic mark-recapture sampling.
- Continue the Waterbird Conservation Initiative. Identify population trends, stresses, nesting areas, staging sites, and wintering habitat. Work within North American Waterbird Conservation Plan and U.S. Shorebird Conservation Plan recommendations to promote recovery and maintain waterbird populations.
- Implement diadromous fish restoration projects. Evaluate existing population status, commercial and recreational fisheries, and habitat limitations. Look for opportunities to enhance habitat.
- Implement red-cockaded woodpecker conservation on private lands, through safe harbor agreements and mitigated take from small, isolated populations. Administer landowner incentive program for safe harbor participants.

For high priority conservation actions of statewide scope, see Section V of this report.

Table 12. Southern Coastal Plain High Priority Animals (120 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
AA	Callinectes sapidus	Blue Crab	GNR	S4			estuarine habitats: marshes, tidal creeks, estuaries, and coastal rivers
AA	Cambarus truncatus	Oconee Burrowing Crayfish	G2	S2		T	Complex burrows in sandy clay soil
AA	Cordulegaster sayi	Say's Spiketail	G2	S2		T	Trickling hillside seepages in deciduous forest with scrub-oak sandhills nearby
AA	Procambarus petersi	Ogeechee Crayfish	G3	S2			burrows in lotic waters without appreciable silt deposits
AM	Ambystoma cingulatum	Frosted Flatwoods Salamander	G2	S1	LT	T	Pine flatwoods; moist savannas; isolated cypress/gum ponds
AM	Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	G5	S3S4			isolated wetlands for breeding; variety of open, upland habitats; CP - sandhills, oldfields, dry pine savanna
AM	Desmognathus auriculatus	Southern Dusky Salamander	G5	S2			Mucky areas usually in or near moving water
AM	Lithobates capito	Gopher Frog	G3	S2S3		R	Sandhills; dry pine flatwoods; breed in isolated wetlands
AM	Necturus punctatus	Dwarf Waterdog	G5	S2S3			Sluggish streams with substrate of leaf litter or woody debris
AM	Notophthalmus perstriatus	Striped Newt	G2G3	S2	C	T	Pine flatwoods, sandhills; isolated wetlands
AM	Plethodon savannah	Savannah Slimy Salamander	G2G3	S2?			Hardwood forest, mixed forest
BI	Ammodramus caudacutus	Saltmarsh Sparrow	G4	S3			Tidal brackish and salt marsh (low marsh)
BI	Ammodramus henslowii	Henslow's Sparrow	G4	S2		R	Grassy areas, especially wet grasslands, pitcher plant bogs, pine flatwoods, power-line corridors in CP. Require open veg at ground level with grass canopy above
BI	Ammodramus maritimus macgillvraii	Seaside Sparrow (Macgillivray's)	G4T2	S3			Tidal low marsh on or adjacent to creek levees
BI	Ammodramus nelsoni	Nelson's Sparrow	G5	S3			Tidal brackish and salt marsh (low marsh)
BI	Calidris canutus	Red Knot	G4	S3	C	R	Beaches and exposed mudflats
BI	Charadrius melodus	Piping Plover	G3	S2	LT	T	Sandy beaches; tidal flats, inlets
BI	Charadrius wilsonia	Wilson's Plover	G5	S2		T	Sandy beaches; tidal flats
BI	Colinus virginianus	Northern Bobwhite	G5	S5			Early successional habitat, open pine savanna (frequent fire maintained in small burn unit size), fallow habitats associated with crop lands, extensive forest regen areas (area sensitive - minimal fall pop of 700 birds for viability on 3000+acres)
BI	Coturnicops noveboracensis	Yellow Rail	G4	SU			
BI	Egretta caerulea	Little Blue Heron	G5	S4			Nest in single species and mixed species colonies in various inland forested fresh-water wetlands, including impounded wetlands, cypress swamps, and similar habitats
BI	Egretta tricolor	Tricolored Heron	G5	S4			Nests in colonies (often with other wading bird species) in wetlands and on isolated islands. Feeds in shallow wetlands, creeks and rivers. The most coastal of all our waders.
BI	Elanoides forficatus	Swallow-tailed Kite	G5	S2		R	River swamps; marshes, forages over pastures and ag fields - post breeding. Forage in well burned open pine woodlands where exist. Open pine and bottomland forest with super canopy pines preferred nest sites. Will nest in non-emergent hardwoods and thinned pine plantations as well - typically several years before final harvest.
BI	Euphagus carolinus	Rusty Blackbird	G4	S3			Bottomland forest, pecan orchards, agricultural fields
BI	Falco peregrinus	Peregrine Falcon	G4	S1		R	Rocky cliffs & ledges; seacoasts - migration; skyscrapers
BI	Falco sparverius paulus	Southeastern American Kestrel	G5T4	S2		R	Open pine grasslands with snags in Coastal Plain, also hayfields and pasture lands
BI	Gelochelidon nilotica	Gull-billed Tern	G5	S1		T	Salt marshes; fields; sandy beaches, interdune, dredge islands
BI	Grus canadensis pratensis	Florida Sandhill Crane	G5T2T3	S1			Freshwater marshes; bays; fields. Only known from Okefenokee NWR (recent surveys outside swamp detected no birds)
BI	Haematopus palliatus	American Oystercatcher	G5	S2		R	Sandy beaches; tidal flats; salt marshes, shell rakes, sand bars

Table 12. Southern Coastal Plain High Priority Animals (120 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
BI	Haliaeetus leucocephalus	Bald Eagle	G5	S3		T	Edges of lakes & large rivers; seacoasts
BI	Himantopus mexicanus	Black-necked Stilt	G5	S2			Shallow ponds; lagoons, beach, managed impoundments, dredge spoil island/impoundments
BI	Ixobrychus exilis	Least Bittern	G5	S3			Fresh and brackish water wetlands with emergent herbaceous cover including impoundments, natural freshwater marshes, and tidally influenced marshes
BI	Lanius ludovicianus	Loggerhead Shrike	G4T3Q	S3			Open woods; field edges, pastures, ball fields, industrial park, primary dunes, hammocks
BI	Laterallus jamaicensis	Black Rail	G3G4	S1			Very shallowly flooded freshwater marshes, brackish marshes, and saltmarshes. Some high marsh areas of the saltmarsh may have breeding pairs
BI	Limnothlypis swainsonii	Swainson's Warbler	G4	S3			Dense undergrowth or canebrakes in swamps and river floodplains, small mountain pop in rhododendron and mountain laurel thickets
BI	Mycteria americana	Wood Stork	G4	S3	LT	E	Breeding Cypress/gum ponds; impounded wetlands with islands or emergent cypress, river swamps; Foraging - marshes (fresh and intertidal); river swamps; bays; farm ponds,
BI	Numenius phaeopus	Whimbrel	G5	S3			Saltmarsh habitat and outer bars
BI	Passerina ciris	Painted Bunting	G5	S2S3			Most in Lower Coastal Plain in thickets, woodland borders, marsh edges, and brushy areas. Smaller numbers in Upper Coastal Plain, particularly the eastern half, agricultural habitat
BI	Peucaea aestivalis	Bachman's Sparrow	G3	S2		R	Open pine or oak woods; old fields; brushy areas, young large grassy pine regeneration areas
BI	Picoides borealis	Red-cockaded Woodpecker	G3	S2	LE	E	Open pine woods; pine savannas
BI	Protonotaria citrea	Prothonotary Warbler	G5	S4			Bottomland forest, swamps, and similar forested wetlands. Nests in tree cavities.
BI	Rallus elegans	King Rail	G4	S3			Freshwater to brackish emergent herbaceous wetlands of grasses, sedges, cattails, wild rice; herbaceous portions of forested wetlands.
BI	Rynchops niger	Black Skimmer	G5	S1		R	Foraging tidal creeks and Tidal ponds; Nesting sandy beaches, spits and dredge islands
BI	Setophaga kirtlandii	Kirtland's Warbler	G3G4	SNRN	LE	E	Transient; varying habitats during late spring and fall
BI	Sternula antillarum	Least Tern	G4	S2		R	Sandy beaches; sandbars, dredge islands
BI	Tyto alba	Barn Owl	G5	SU			Nests in large hollow trees or old buildings (particularly cement silos) in areas with extensive pasture or grassland or other open habitats such as marsh
FI	Acipenser brevirostrum	Shortnose Sturgeon	G3	S2	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates
FI	Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	G3T3	S3	LE	E	Estuaries; lower end of large rivers in deep pools with soft substrates; spawn as far inland as Macon, GA on the Ocmulgee
FI	Alosa sapidissima	American Shad	G5	S5			large rivers between coast and fall zone are used for spawning and early life history stages
FI	Carpiodes velifer	Highfin Carpsucker	G4G5	S2S3			swift sandy areas associated with sandbars, yoy found in backwaters and on margins of sandbars
FI	Chologaster cornuta	Swampfish	G5	S2S3			near vegetation and debris in swamps, ponds, ditches, and slow moving streams, pools backwaters
FI	Cynoscion nebulosus	Spotted Seatrout	G5	S5			estuarine habitats: oyster bed, salt marshes, tidal creeks
FI	Elassoma okatie	Bluebarred Pygmy Sunfish	G2G3	S1		E	Temporary ponds and stream backwaters with dense aquatic vegetation
FI	Enneacanthus chaetodon	Blackbanded Sunfish	G3G4	S1		E	Blackwater streams; bays; cypress/gum ponds
FI	Lucania goodei	Bluefin Killifish	G5	S1		R	Heavily vegetated ponds and streams with little or no current; frequently associated with springs
FI	Micropterus cataractae	Shoal Bass	G3	S2			large river, shoal and fluvial specialist

Table 12. Southern Coastal Plain High Priority Animals (120 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
FI	Moxostoma robustum	Robust Redhorse	G1	S1		E	Med to large rivers, shallow riffles to deep flowing water; moderately swift current
FI	Sphryna lewini	Scalloped Hammerhead	GNR	S2S3			estuarine and marine: subadults are in estuaries, adults in ocean
MA	Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	G3G4	S3		R	Pine forests; hardwood forests; caves; abandoned buildings; bridges; bottomland hardwood forests and cypress-gum swamps
MA	Eubalaena glacialis	Northern Atlantic Right Whale	G1	S1	LE	E	Inshore and offshore ocean waters
MA	Geomys pinetis	Southeastern Pocket Gopher	G5	S3S4		T	sandy well-drained soils in open pine woodlands with grassy or herbaceous groundcover, fields, grassy roadsides
MA	Lasiurus intermedius	Northern Yellow Bat	G4G5	S3			Wooded areas near open water or fields, hardwoods - live oaks preferred, large trees
MA	Megaptera novaeangliae	Humpback Whale	G4	SNR	LE	E	Inshore and offshore ocean waters
MA	Myotis austroriparius	Southeastern Myotis	G3G4	S3			Caves & buildings near water; large hollow trees in bottomland hardwood swamps
MA	Neofiber alleni	Round-tailed Muskrat	G3	S3		T	Freshwater marshes; bogs
MA	Perimyotis subflavus	Tri-colored Bat	G3	S5			Open forests with large trees and woodland edges; roost in tree foliage; hibernate in caves or mines with high humidity.
MA	Sciurus niger shermani	Sherman's Fox Squirrel	G5T2	SNR?			Pine forests; pine savannas
MA	Trichechus manatus	Manatee	G2	S2	LE	E	Estuaries, tidal rivers, nearshore ocean waters
MA	Tursiops truncatus	Atlantic Bottle-nose Dolphin	G5	S4			Estuaries, tidal rivers, ocean waters
MO	Alasmidonta arcula	Altamaha Arcmussel	G2	S3		T	Large rivers and reservoirs on gently sloping banks with soft and fine sediments. Often under overhanging willows.
MO	Amblema neislerii	Fat Threeridge	G1	S1	LE	E	Sm-Lg rivers with fine sediments with low-moderate gradient & slow-moderate current; pools and riffles; subtrate gravel/cobble to sand and sandy mud
MO	Crassostrea virginica	American Oyster	G5	S4			estuarine habitats: intertidal
MO	Elliptio fraterna	Brother Spike	G1	S1			Large Rivers with sand substrates, little info available.
MO	Elliptio nigella	Winged Spike	G1	S2			Large rivers in swift and shallow shoals. Often times associated with large crevices and cavities in and around limestone boulders.
MO	Elliptio purpurella	Inflated Spike	G2	S2		T	Medium creeks to small rivers; clay, sand, and cravel substrate; moderate current
MO	Elliptoideus sloatianus	Purple Bankclimber	G2	S2	LT	T	Medium to large rivers in the ACF and Ochlockonee basins; all substrates except bedrock. Species was 20 times more likely to occur in cobble substrates (Wisniewski et al. 2013)
MO	Hamiota subangulata	Shinyrayed Pocketbook	G2	S2	LE	E	Medium sized creeks to large rivers in sand substrates in slow to swift flowing water.
MO	Lampsilis cariosa	Yellow Lampmussel	G3G4	S3			Large streams and rivers with good current, sand and gravel
MO	Marstonia castor	Beaverpond Marstonia	G1	S1			Found on aquatic macrophytes in clear flowing water of low gradient creeks
MO	Medionidus penicillatus	Gulf Moccasinshell	G2	S1	LE	E	Large rivers to small creeks; found in a variety of substrates
MO	Medionidus simpsonianus	Ochlockonee Moccasinshell	G1	SH	LE	E	Medium sized river to large creeks with moderate current; muddy sand, sand, and gravel substrates
MO	Medionidus walkeri	Suwannee Moccasinshell	GNR	SX			medium creeks and rivers in slow to moderate current; muddy sand, sand, and gravel.
MO	Pleurobema pyriforme	Oval Pigtoe	G2	S1	LE	E	Large rivers to small creeks with slow to moderate current in pool, run, and riffle habitats; combinations of clay, sand, and gravel substrate
MO	Toxolasma pullus	Savannah Lilliput	G2	S2		T	Large rivers to small creeks, oxbows, and sloughs; found in silty sand and sand in shallow water along banks to about 1 foot deep in some lakes, ponds, streams, and big rivers
RE	Caretta caretta	Loggerhead Sea Turtle	G3	S3	LT	E	Open ocean; sounds; coastal rivers; beaches

Group Codes: AA = aquatic arthropod; AM = amphibian; BI = bird; FI = fish; MA = mammal; MO = mollusk; RE = reptile; TA = terrestrial arthropod

Table 12. Southern Coastal Plain High Priority Animals (120 Records)

Group	Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
RE	Chelonia mydas	Green Sea Turtle	G3	S1	LE	T	Open ocean; sounds; coastal rivers; beaches
RE	Clemmys guttata	Spotted Turtle	G5	S3		U	Heavily vegetated swamps, marshes, bogs, small ponds, tidally influenced freshwater wetlands; nest and possibly hibernate in surrounding uplands
RE	Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	G4	S4			Early successional habitats on barrier islands and mainland; pine flatwoods; sandhills; maritime forests/hammocks; ruderal habitats
RE	Dermochelys coriacea	Leatherback Sea Turtle	G2	S1	LE	E	Open ocean; sounds; coastal beaches
RE	Drymarchon couperi	Eastern Indigo Snake	G3	S2	LT	T	Sandhills; pine flatwoods; dry hammocks; summer habitat includes wetlands
RE	Gopherus polyphemus	Gopher Tortoise	G3	S3	C	T	Sandhills; dry hammocks; longleaf pine-turkey oak woods; old fields
RE	Heterodon simus	Southern Hognose Snake	G2	S1S2		T	Sandhills; fallow fields; longleaf pine-turkey oak
RE	Lepidochelys kempii	Kemp's or Atlantic Ridley	G1	S1	LE	E	Open ocean; sounds; coastal rivers; beaches
RE	Macrochelys temminckii	Alligator Snapping Turtle	G3G4	S3		T	Streams and rivers; impoundments; river swamps
RE	Malaclemys terrapin	Diamondback Terrapin	G4	S4		U	Entire coast, estuarine and marine edge; All saltmarsh, beaches
RE	Ophisaurus compressus	Island Glass Lizard	G3G4	S2			Pine savannas, pine flatwoods, secondary dunes/interdunal swales on islands
RE	Ophisaurus mimicus	Mimic Glass Lizard	G3	S1		R	Pine flatwoods; savannas; seepage bogs
RE	Pituophis melanoleucus mugitus	Florida Pine Snake	G4T3	S3			Sandhills; scrub; pine savanna; old fields
TA	Alloblackburneus troglodytes	Little gopher tortoise scarab beetle	GNR	SU			Gopher tortoise burrows
TA	Amblyomma tuberculatum	Gopher tortoise tick	G2G3	S2			Sandhills, longleaf pine woodlands, other sandy open habitats
TA	Aphodius aegrotus	A dung beetle	G3G4	S3			Pocket gopher mounds
TA	Aphodius dyspistus	A dung beetle	G3G4	S3			Pocket gopher mounds
TA	Aphodius hubbelli	A dung beetle	GNR	S3			Pocket gopher mounds
TA	Aphodius laevigatus	Large pocket gopher Aphodius beetle	G3G4	S3			Pocket gopher mounds
TA	Bombus affinis	Rusty-patched bumblebee	G1	SH			
TA	Callophrys irus	Frosted elfin	G3	SH			Lupinus perennis, sandhills
TA	Caupolicana electa	Plasterer bee	GNR	S1S2			Sandhills
TA	Chelyoxenus xerobatis	Gopher tortoise hister beetle	G2G3s2	S2			Gopher tortoise burrows
TA	Danaus plexippus	Monarch butterfly	G4	S4			Milkweeds
TA	Euphyes berryi	Berry's Skipper	G1G3	S2S3			Freshwater marshes, boggy areas, swamps, utility easements
TA	Euphyes bimacula arbogastii	Two-spotted Skipper	G4	S2S3			Freshwater marshes, sedges
TA	Euphyes dukesi	Duke's Skipper	G3	S2S3			Tidal shrub/swamp, brackish water
TA	Euphyes pilatka	Palatka Skipper	G3G4	S2S3			Sawgrass, brackish water
TA	Machimus polyphemi	Gopher tortoise robber fly	G2	S1?			Gopher tortoise burrows
TA	Neonympha areolatus	Georgia Satyr	G3G4	S3			Freshwater marsh, powerlines
TA	Onthophagus polyphemi polyphemi	Onthophagus tortoise commensal scarab beetle	G2G3	S2			In association with Gopherus polyphemus burrows
TA	Poanes aaroni howardi	Aaron's skipper	G4T4	S2S3			Freshwater marshes
TA	Problema bulenta	Rare Skipper	G2G3	S2S3			Brackish marshes
TA	Satyrium kingi	King's hairstreak	G3G4	S3			Wormsloe, sweetleaf
TA	Sphodros abbotii	Purse-web spider	G4G5	S2			Hardwoods

Table 13. Southern Coastal Plain High Priority Plants (68 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Amorpha georgiana	Georgia Indigo-Bush	G3	S1		E	Longleaf pine flatwoods; stream terraces
Amorpha herbacea var. floridana	Florida Leadbush	G4TNRQ	S1			River terraces along the Alapaha River
Arabis georgiana	Georgia Rockcress	G1	S1	C	T	Rocky or sandy river bluffs and banks, in circumneutral soil
Arnoglossum diversifolium	Variable-Leaf Indian-Plantain	G2	S2		T	Calcareous swamps
Arnoglossum sulcatum	Grooved-Stem Indian-Plantain	G3	S1			Bottomland forests
Asplenium heteroresiliens	Morzenti's Spleenwort	G2	S1		T	Limestone and marl outcrops; tabby ruins
Astragalus michauxii	Sandhill Milkvetch	G3	S2		T	Longleaf pine-wiregrass savannas; turkey oak scrub
Balduina atropurpurea	Purple Honeycomb Head	G2	S2S3		R	Wet savannas, pitcherplant bogs
Baptisia arachnifera	Hairy Rattleweed	G1	S1	LE	E	Pine flatwoods
Brickellia cordifolia	Heartleaf Brickellia	G2G3	S2		T	Mesic hardwood forests
Carex calcifugens	Lime-Fleeing Sedge	G2G4	S2?			Rich bluff forests; evergreen maritime forests
Carex decomposita	Cypress-Knee Sedge	G3G4	S2?			Swamps and lake margins on floating logs
Coreopsis integrifolia	Ciliate-Leaf Tickseed	G1G2	S1S2		T	Floodplain forests, streambanks
Coreopsis rosea	Pink Tickseed	G3	S1			Banks of blackwater rivers; pond shores
Crocanthemum nashii	Florida Scrub Sunrose	G3?	S1			Sand dunes
Ctenium floridanum	Florida Orange-Grass	G2	S1			Moist pine barrens
Dicerandra radfordiana	Radford's Dicerandra	G1Q	S1		E	Sandridges
Eccremidium floridanum	Florida Pygmy Moss	G1?	SNR			Sandy (or clay) dry, open, disturbed sites, thin soil over exposed rocks arouind Taxodium swamp margins
Elliottia racemosa	Georgia Plume	G2G3	S2S3		T	Scrub forests; Altamaha Grit outcrops; open forests over ultramafic rock
Eriochloa michauxii var. michauxii	Michaux's Longleaf Cupgrass	G3G4T3T4	S2?			Coastal freshwater and brackish marshes; flatwoods
Eriophorum virginicum	Tawny Cottongrass	G5	S1			Mountain bogs; peaty wet meadows in alluvial flats in Fall Line sandills; also in Okefenokee Swamp
Evolvulus sericeus var. sericeus	Creeping Morning-Glory	G5T3T5	S1			Altamaha Grit outcrops; open calcareous uplands
Forestiera godfreyi	Godfrey's Wild Privet	G2	S1		E	Mesic, maritime forests over shell mounds
Forestiera segregata var. segregata	Florida Wild Privet	G4T4?	S2			Georgia habitat information not available
Fothergilla gardenii	Dwarf Witch-Alder	G3G4	S2		T	Openings in low woods; swamps
Habenaria quinqueseta	Michaux's Orchid	G4G5	S1?		T	Rich, moist hardwood hammocks, pine flatwoods, roadside ditches
Hartwrightia floridana	Hartwrightia	G2	S1		T	Wet savannas; ditches, sloughs and flatwood seeps
Hypericum erythraeae	Georgia St.-John's-Wort	G2	S2			Seepage bogs; roadside ditches
Justicia angusta	Narrowleaf Water-Willow	G3Q	S1			Roadside ditches; perhaps with Hartwrightia in shallow sloughs and wet savannas
Lachnocaulon beyrichianum	Southern Bog-Button	G4	S1?			Flatwoods
Leitneria floridana	Corkwood	G3	S1		T	Swamps; sawgrass-cabbage palmetto marshes
Lindera melissifolia	Pondberry	G2G3	S2	LE	E	Pond margins and wet savannas
Litsea aestivalis	Pondspice	G3?	S2		R	Cypress ponds; swamp margins
Lycium carolinianum	Carolina Wolfberry	G4	S1			Coastal sand spits
Malaxis spicata	Florida Adders-Mouth Orchid	G4?	S1			Low hammocks; spring-fed river swamps
Matelea alabamensis	Alabama Milkvine	G2	S1		T	Open bluff forests; mesic margins of longleaf pine sandridges
Oxypolis ternata	Savanna Cowbane	G3	S2			Wet pine savannas and bogs

Table 13. Southern Coastal Plain High Priority Plants (68 Records)

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Habitat in Georgia
Plantago sparsiflora	Pineland Plantain	G3	S2			Open, wet pine savannas; shallow ditches and seeps, especially in mowed rights-of-way
Platanthera blephariglottis	Small White Fringed Orchid	G4G5	S1?			Pine flatwoods, roadside ditches, seeps and wet savannas
Platanthera chapmanii	Chapman's Fringed Orchid	G2	S1			Open, wet meadows; pine flatwoods
Platanthera conspicua	Large White Fringed Orchid	G4G5T3T4	S1			Bogs, seeps, roadsides, wet savannas
Platanthera integra	Yellow Fringeless Orchid	G3G4	S1			Wet savannas, pitcherplant bogs
Portulaca biloba	Grit Portulaca	G1G2	S1			Altamaha Grit outcrops
Pteroglossaspis ecristata	Wild Coco	G2G3	S2		T	Grassy saw palmetto barrens; longleaf pine grasslands, sometimes with Schwalbea americana
Ptilimnium ahlesii	Coastal Bishopweed	G1	SH			Tidal freshwater marshes
Quercus similis	Swamp Post Oak	G4	S1			Bottomland swamps and other wet habitats
Rhynchospora breviseta	Short-Bristle Beakrush	G3G4	SU			Bogs; flatwoods
Rhynchospora decurrens	Decurrent Beakrush	G3G4	S2?			Swamps
Rhynchospora fernaldii	Fernald's Beakrush	G3G4	S2?			Sandy, peaty pond margins and depressions
Rhynchospora macra	Many-Bristled Beakrush	G3	S1?			Peaty, sandhill seepage slopes; streamhead pocosins
Rhynchospora pleiantha	Clonal Thread-Leaved Beakrush	G2G3	SH			Margins of limesink depression ponds (dolines)
Rhynchospora punctata	Spotted Beakrush	G1?	S1?			Wet savannas, pitcherplant bogs
Ruellia noctiflora	Night-Blooming Wild Petunia	G2	S1			Open, slash pine flatwoods
Sageretia minutiflora	Climbing Buckthorn	G4	S2		T	Calcareous bluff forests; maritime forests over shell mounds
Sapindus saponaria var. marginatus	Soapberry	G5TNR	SNR			Georgia habitat information not available
Sarracenia psittacina	Parrot Pitcherplant	G4	S2S3		T	Wet savannas, pitcherplant bogs
Sarracenia rubra ssp. rubra	Sweet Pitcherplant	G4T3T4	S2		E	Georgia habitat information not available
Schoenolirion albiflorum	White Sunnybell	G3	S1?			Wet savannas
Scutellaria altamaha	Altamaha Skullcap	G2G3	S2?			Sandy, deciduous woods
Scutellaria mellichampii	Mellichamp's Skullcap	GNR	S2?			Sandy deciduous woods
Sideroxylon macrocarpum	Ohoopee Bumelia	G3Q	S3		R	Dry longleaf pine woods with oak understory; often hidden in wiregrass
Sideroxylon thornei	Swamp Buckthorn	G2	S2		R	Forested limesink depressions; calcareous swamps
Spiranthes floridana	Florida Ladies-Tresses	G1	S1?			Wet savannas; mowed grassy openings in Okefenokee area
Sporobolus pinetorum	Pineland Dropseed	G3	S2?			Wet savannas with wiregrass
Sporobolus teretifolius	Wire-Leaf Dropseed	G2	S2?			Longleaf pine-wiregrass savannas, pitcherplant bogs
Stewartia malacodendron	Silky Camellia	G4	S2		R	Along streams on lower slopes of beech-magnolia or beech-basswood-Florida maple forests
Xyris drummondii	Drummond's Yellow-Eyed Grass	G3	S1			Pine flatwoods
Xyris scabrifolia	Harper's Yellow-Eyed Grass	G3	S1			Sedge bogs; pitcherplant bogs; pine flatwoods

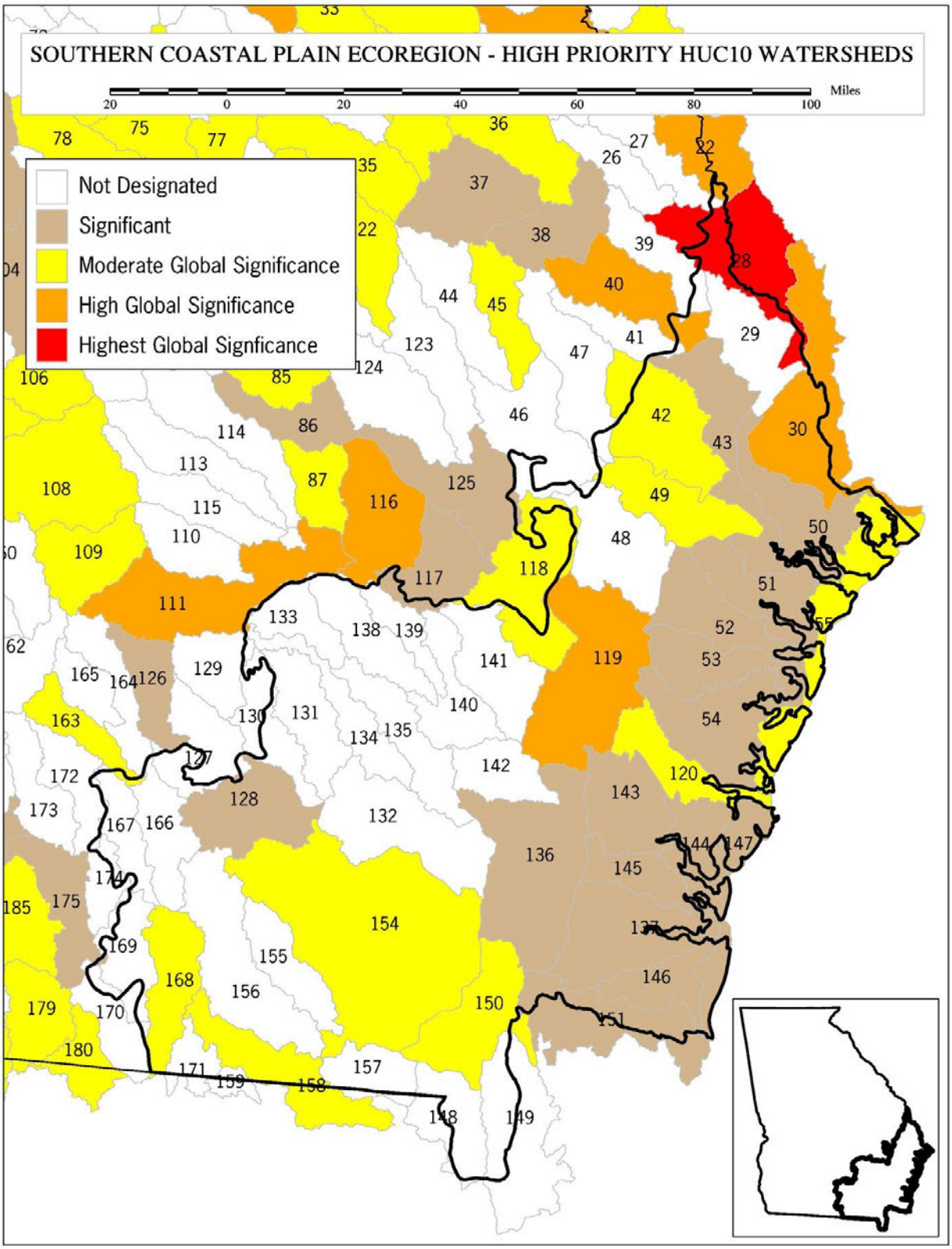


Figure 20. High Priority Waters, Southern Coastal Plain Ecoregion

V. Statewide Wildlife Conservation Themes and Strategies

During the process of outlining and evaluating objectives for wildlife conservation in Georgia, several issues or themes pertaining to high priority species and habitats across the state or in multiple ecoregions were identified. These conservation themes are described below, and the highest priority specific conservation actions associated with each of these themes are listed.

State Wildlife Action Plans (SWAPs) are intended to be living documents subject to revision based on new science and changing conditions. Since 2005 when the Georgia SWAP was developed, the conservation landscape has changed. The state, region and nation are experiencing changes in climate, wildlife diseases, and energy development. These changes represent emerging issues that impact the status and distribution of species and habitats. Therefore, as part of the 2015 revision, Georgia's SWAP describes these emerging issues and proposes conservation actions to address them.

Climate Change

Climate change is consistent, directed change in climatic conditions at regional scales. Climate change is impacting species and habitats, and these effects are projected to increase substantially over time. These climate-driven changes will profoundly affect our ability to conserve fish and wildlife and their habitats.

Climate change has become a central and defining wildlife conservation issue since the development of the original 2005 SWAP. An emerging approach to addressing climate change is called climate change adaptation, or preparing for and coping with climate change impacts on fish and wildlife. The Intergovernmental Panel on Climate Change defines climate change adaptation as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

The impact of climate change reaches beyond state boundaries, exacerbates existing threats to wildlife, and affects each species differently. Consequently, climate change warrants being addressed in the 2015 revision of the Georgia SWAP as an emerging issue. The intent is not to develop a stand-alone "Climate Change Action Plan." Rather, this subsection is an acknowledgement that climate change is an important issue to be dealt with as part of the implementation of the SWAP, but that it is still a threat inherent with uncertainty that requires a great deal more work with researchers and other agencies and conservation organizations to elucidate potential impacts and implement Climate-Smart Conservation.

This subsection identifies the highest priority conservation actions for climate change adaptation over the next 10 years. Other emerging issues, including wildlife diseases and renewable energy development, are addressed in the following subsection. Climate

change is also addressed in the Climate Change Adaptation Technical Team Report in Appendix O.

Georgia's Revision Process in the Context of Climate Change

This 2015 revised version of the SWAP incorporates climate change into the selection of high priority species, habitats, and conservation actions. It contains information on current climate change impacts, predictions for future climate change impacts, and a plan for researching and adapting to the impacts. While conservation goals focus on future conditions, this 10-year plan accounts for near-term challenges and transition needs.

The impacts of climate change do not exist in isolation, but combine with and exacerbate existing threats to fish, wildlife, and habitat. As such, the 2015 Georgia SWAP uses a new lens to reconsider conservation actions. This revisioning is a result of compiling information from regional conservation partnerships, expert opinion, vulnerability assessments, published studies regarding current and potential climate change impacts, and other resources. These interactions were the underpinning for the technical teams to identify high priority species, habitats, and conservation actions. This revised plan acknowledges and addresses the problems of the past and anticipates and attempts to prepare for those of an uncertain future.

Furthermore, physical changes on the landscape impact human elements such as agriculture, water use, and land use. The human element will need to be considered when implementing climate change adaptation. Partners such as the University of Georgia and the State Climatologist can help inform this process.

Tools and Resources

Climate change presents unprecedented challenges, but new tools and regional partnerships offer new opportunities. Regional conservation partnerships provide resources to address the landscape level impacts of climate change on fish and wildlife. The local effects of climate change are often difficult to quantify. A regional issue warrants a regional approach. The following are examples of tools and resources that can facilitate implementation and future revisions of the SWAP to address climate change.

Analysis of Vegetation Type Change. The U.S. Forest Service (USFS) conducted an analysis of vegetation type change for every state. The analysis shows a map of historical vegetation and then the future changes for a single emission scenario and three climate models, and a composite of the changes based on three emissions scenarios and three climate models under no suppression of wildfire. Climate stress index results are shown at the state level. Each projection is accompanied by a description of associated climate changes. Also under consideration is partnering with the National Wildlife Federation (NWF) to create a map of Georgia that overlays the USFS map with terrestrial climate vulnerability index maps with priority habitat areas. NWF is currently developing this resource for the Tennessee Wildlife Resources Agency.

Best Practices for State Wildlife Action Plans. Developed by a working group of the Teaming With Wildlife Committee of the Association of Fish and Wildlife Agencies (AFWA), the best practices recommends incorporating climate change into the revision of SWAPs (AFWA 2012). Best practices include:

- Include climate change and its impacts as one of the criteria used in selecting and prioritizing species of greatest conservation need (SGCN).
- Follow recommendations outlined in AFWA's *Voluntary Guidance for States to Incorporate Climate Change into State Wildlife Action Plans and Other Management Plans* (AFWA 2009)—specifically as described in "Chapter 3: SWAP Revision Process."
- Conduct vulnerability assessments to inform the selection of SGCN and conservation actions. Use *Scanning the Conservation Horizon: A Guide to Climate Change Vulnerability Assessment* (Glick et al. 2011) to determine the best approach for conducting a vulnerability assessment for habitats and species at an appropriate level (as determined by each state). Use an approach that is more quantitative and spatially-explicit than a ranking system. Be specific about the aspect of climate change addressed (e.g., increased precipitation, prolonged drought, increased fire, sea-level rise, etc.), and take advantage of information from assessments already available (e.g., regional vulnerability assessments, university- or nongovernmental organization- led vulnerability assessments).
- Link climate impact to priority actions. Using the best available climate data, specify which impact (e.g., sea-level rise, prolonged drought, increased precipitation, increased fire, etc.) will result in which threat, and which action will address that impact. Avoid unspecified generalities such as "will create corridors" or "eliminate invasive species." To determine which conservation actions will maximize investments, consider both current and projected future conditions and trends.
- Integrate key characteristics of Climate-Smart Conservation.
- Consider key adaptation approaches when developing conservation actions as described in West et al., (2009). Examples include: reduce nonclimate stresses, protect key ecosystem features, and ensure connectivity.
- Work with regional partners such as Landscape Conservation Cooperatives (LCCs) and U.S. Department of Interior (DOI) Climate Science Centers (CSCs) to use climate information and resources as well as ensure that they incorporate state-based information into their programs and resources. Develop a regional adaptation plan to better coordinate individual SWAPs.
- Reach out to diverse partners who work on adaptation to ensure coordination and avoid maladaptation (e.g., hardened structures that would prevent marsh migration as sea levels rise). Key sectors might include coastal interests, transportation, agriculture, forestry, etc.

Climate-Smart Conservation. The 2015 Georgia SWAP incorporates the National Wildlife Federation's (NWF) *Climate-Smart Conservation* (Stein et al., 2014), which recommends paying attention to the following overarching themes:

- Act with intentionality
- Manage for change, not just persistence
- Reconsider goals, not just strategies
- Integrate adaptation into existing work

Key characteristics of climate-smart conservation include:

- Link actions to climate impacts
- Embrace forward-looking goals
- Consider broader landscape context
- Adopt strategies robust in an uncertain future
- Employ agile and informed management
- Minimize carbon footprint
- Account for climate influence on project success
- Safeguard people and wildlife
- Avoid maladaptation

Coastal Datasets. Important coastal datasets for understanding potential sea level rise include the Coastal Habitat Map (Georgia Department of Natural Resources, Sea Level Affecting Marshes Model (SLAMM 6) (Chris Craft, Indiana University), the Analyzing Moving Boundaries Using R (AMBUR) software package, which assists with analyzing and visualizing historical shoreline change, Historical Shoreline Change (Chester Jackson, Georgia Southern University), Hardened Shoreline dataset (Clark Alexander, Skidaway Institute of Oceanography), coastal LiDAR data, FEMA Flood Risk Maps, 2006 National Wetlands Inventory (NWI), and the NOAA tidal gauge historical data at Fort Pulaski.

National Fish, Wildlife, and Plants Climate Adaptation Strategy. In October 2014, the Obama Administration released its Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources, which provides policy guidance for shaping the priorities and actions of seven federal natural resource management agencies (DOI, National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Federal Emergency Management Agency, and U.S. Department of Defense). It envisions an important role for the 2013 National Fish, Wildlife, and Plant Climate Adaptation Strategy (Strategy).

The Landscape Conservation Cooperatives (LCCs) may facilitate the development of action plans for regional implementation of the Strategy that would include specific objectives, actions, and commitments of resources appropriate to their geographic areas. The 2015 Georgia SWAP includes many of the strategies and specific actions to reach the goals of the Strategy, such as identifying resilient areas and protecting genetic material. The Strategy includes seven goals:

1. Conserve and connect habitat
2. Manage species and habitats
3. Enhance management capacity
4. Support adaptive management
5. Increase knowledge and information
6. Increase awareness and motivate action
7. Reduce non-climate stressors

Scanning the Conservation Horizon. Developed by NWF, this document assists fish and wildlife managers in planning, executing, and interpreting climate change vulnerability assessments (VAs). VAs help in identifying which species are likely to be the most strongly affected, and in understanding why these resources are likely vulnerable. Vulnerability to climate change has three components: sensitivity, exposure, and adaptive capacity (Glick et al., 2011).

South Atlantic Landscape Conservation Cooperative Conservation Blueprint. The South Atlantic Landscape Conservation Cooperative has developed the Conservation Blueprint, a spatially-explicit, living plan that describes the places and actions needed to meet conservation objectives in the face of future change. Incorporating information from different partner organizations operating in the South Atlantic ecoregion, the blueprint is the consistent, cross-boundary, cross-organization plan for how the conservation community can respond to change. When used appropriately, regional coarse scale datasets provide a relevant context for finer scale local datasets and conservation actions.

Southeast Conservation Adaptation Strategy. The Southeast Conservation Adaptation Strategy (SECAS) is a shared, long-term vision for lands and waters that sustain fish and wildlife populations that unifies the delivery of conservation action and supports innovation that can be applied across the region. The goal of SECAS is to knit together the conservation blueprints of all of the Landscape Conservation Cooperatives (LCCs) in the southeast U.S. to collaboratively define the conservation landscape of the future. SECAS is a regional initiative led by members of the Southeastern Association of Fish and Wildlife Agencies, supported by federal leaders in the Southeast Natural Resources Leadership Group, and developed through a partnership of all of the LCCs in the southeast U.S. Southeastern LCCs include South Atlantic, Peninsular Florida, Appalachians, Gulf Coastal Plains and Ozarks, and Caribbean and Gulf Coast Prairies LCCs. Through a grant from the Southeast Climate Science Center, the Georgia Department of Natural Resources intends to work with partners on a SECAS effort to summarize key values and goals of SWAPs and other conservation plans in terms of change drivers that may affect the feasibility of achieving those values and goals.

Southeast Resilient Landscapes Model. While not explicitly defined as a climate change adaptation model, the Southeast Resilient Landscapes Model developed by the Nature Conservancy (TNC) identifies key places for conservation in the face of climate change and other factors. The model is based on conserving complex landscapes that increase

diversity and resilience. An estimated resilience score is assigned based on scores of landscape diversity and local connectedness, and ranked relative to the geophysical setting and ecoregion. Landscape diversity refers to the number of landforms, elevation range, and wetland density. Topographic diversity buffers against the impacts of climate change by providing a variety of microclimates. Local connectedness refers to the number of barriers and the degree of fragmentation within a landscape. A highly permeable landscape promotes resilience by facilitating or accommodating range shifts and the reorganization of communities.

Using Doris Duke Charitable Foundation funds, TNC plans to implement Resilience 2015: Southeast Resilient Landscapes Model with the purpose of identifying a network of resilient sites and linkages for the eastern U.S. and communicating the results to agencies and partners. The Georgia Department of Natural Resources (GADNR) has been invited to join the Steering Committee for this project to refine the model and identify resilient coastal areas in the southeast U.S. The longer term goal is to use this and other tools to integrate consideration of a regional context and uncertain futures into conservation management.

Information from TNC's Southeast Resilience Project has been incorporated into the South Atlantic Landscape Conservation Cooperative's datasets. Some of the data from this model has also been incorporated into the draft "Georgia Greenway Opportunities" map in this document. The current and revised products of the Southeast Resilient Landscapes project will continue to inform climate change adaptation efforts going forward. GADNR and others will work with TNC to evaluate the model outputs and recommend improvements.

Also funded by the Doris Duke Charitable Foundation, a land conservation initiative coordinated by the Open Space Institute incorporates information from the Southeast Resilient Landscapes model. The initiative is designed to help land trusts and public agencies focus their conservation efforts on climate change adaptation priorities. The initiative includes several priority areas in Georgia (Open Space Institute, 2015).

Highest Priority Conservation Actions

Conservation actions include research, survey, management, habitat protection, education, outreach, database enhancements, monitoring, regulation/policy, funding, database development, administrative actions, and communication efforts. All involve working with a large number of partners. Some of the following conservation actions are drawn from the technical team reports found in the appendices. Actions that are not drawn from the technical team reports can be found in the Conservation Actions table in Appendix P under the goal of Implement Climate Change Adaptation.

Birds

- Add species to the 2015 list of high priority species, including seaside sparrow, saltmarsh sparrow, and Nelson's sparrow. Primary threats to these species include

climate change scenarios with predicted increases in the variability of rainfall, leading to increased drought conditions punctuated with more extreme rainfall events. This altered rainfall pattern may present new challenges at both ends of the rainfall spectrum, from drought conditions where nesting is not possible, to flood conditions where nests are lost and foraging areas are flooded making them unsuitable for feeding.

A warming climate will likely cause the ranges of many species to shift northward, possibly leading to negative interactions with other species or less favorable environmental conditions that affect reproduction and survival. Some species will likely lose a significant amount of habitat because there are spatial and temporal impediments to habitat migration. This may result in dramatic population declines, extirpations, or even extinctions of species.

Climate change can also cause trophic asynchrony when many species of migratory songbirds have been documented returning to their breeding grounds and nesting earlier in the season as the climate continues to warm. The timing of peak bird nesting, and the flush of insects that feed their young, could become asynchronous, leading to lower productivity rates. Trophic asynchrony is likely much more of a problem in the Arctic, where climate change has been occurring more rapidly than in temperate regions. This would potentially influence several arctic nesting shorebirds, including high priority species in Georgia such as red knot and whimbrel. Arctic warming may influence breeding habitat, prey availability, quality, and timing, and potentially shift or alter other ecological interactions.

- Enhance habitat in utility corridors for use by migratory birds and pollinators. For some migratory bird and pollinator species (e.g., painted bunting and ruby-throated hummingbird), Georgia may be their first significant landfall during spring migration. Georgia may contribute to rebuilding populations of the monarch butterfly, which is being considered for federal listing under the Endangered Species Act at the time of this writing. Conduct research and habitat management for transmission rights-of-way (ROW), which can provide a corridor of habitat that could accommodate major shifts in climate. Conduct pilot projects in partnership with the University of Georgia (UGA) and Georgia Power Company to assess the feasibility of low-cost, low-maintenance Safe Passage management on ROWs. Two identified pilot projects include creating detention ponds and plantings in ROWs on the UGA campus. Habitat would be managed and wildlife use would be monitored by students. If the pilot projects are successful and effective, this action could be expanded to include other ROWs owned by Georgia Power Company.

Mammals

- Continue implementing the North Atlantic Right Whale Recovery Plan. This project is implemented in cooperation with Florida Fish and Wildlife Conservation Commission, National Marine Fisheries Service, and other partners. North Atlantic right whales are among the most endangered whale species with a population

numbering approximately 450 whales. Right whales are the highest priority marine mammal species in Georgia because of their small population size and the importance of Georgia waters to the population's recovery. Waters along the South Carolina, Georgia, and northeast Florida coast are an important wintering ground and the only known calving ground for this species. Climate change may negatively impact forage availability in Northeast U.S. and Canada, and the suitability of wintering habitat in Southeast U.S. Whale distribution in the Southeast U.S. is strongly correlated with water temperature.

- Work with the U.S. Forest Service (USFS) and private landowners to conserve habitat for high priority mammal species. The mountains of northeastern Georgia represent the extreme southern limits of the ranges of several species of mammals, including the long-tailed shrew, water shrew, hairy-tailed mole, Appalachian cottontail, red squirrel, southern bog lemming, and least weasel. Many of these probably represent relict populations left isolated in high elevation sites as the boreal forests retreated northward following the last Ice Age. Though Georgia provides only a very small amount of the total occupied habitat and supports only a very small portion of the entire population for these species, maintenance of these range extremes could conserve a disproportionate amount of the species' genetic diversity because of isolation and adaptation. In general, these species need high quality forested habitat, with accompanying clean streams, rich soils, and rocky outcrops. In Georgia, much of this habitat occurs on national forest land and is under no immediate threat. However, the Georgia Department of Natural Resources should work with the USFS and private landowners to conserve these important high elevation habitats. The ranges of these species might be particularly vulnerable to climate change. A small increase in average temperature would likely result in a northward retreat, reducing or eliminating occupied habitat in Georgia.

Reptiles and Amphibians

- Address and monitor climate change impacts to reptiles and amphibians. Climate change is likely to have adverse effects on herpetofauna. Effects on habitat suitability are the most wide-ranging, but in the case of most of Georgia's turtle species and the American alligator, species that exhibit temperature-dependent sex determination, warming temperatures may skew sex ratios adversely. Georgia Department of Natural Resources (GADNR) cooperators will continue to monitor the length of incubation for all sea turtle nests in the state, which is significantly correlated with incubation temperature and sex ratio.

  Additionally, GADNR will continue periodic qualitative surveys of sea turtle nesting habitat on all barrier island beaches, categorizing each 100 m section as erosional or depositional based on beach and dune morphological characteristics. Annual surveys are compared to determine changes in the erosional state of sea turtle nesting habitat.

  Researchers at UGA conducted an "Amphibian and Reptile Climate Change Vulnerability Assessment" for select southeastern species, including ten that are

considered high priority in Georgia, including flatwoods salamander, tiger salamander, one-toed amphiuma, green salamander, hellbender, striped newt, gopher frog, eastern indigo snake, bog turtle, and gopher tortoise. The predictions are dire for all high priority Georgia species in showing significant reductions in climatically suitable habitat. The assessment maps indicate where climatically suitable habitat is predicted to remain in 2050, and for the striped newt and flatwoods salamander, no habitat is predicted to remain.

- Continue monitoring populations of high priority species. Species include striped newt, flatwoods salamander, hellbender, eastern indigo snake, gopher tortoise. Monitoring will enable comparisons between field observations and predictive models.

- Create permanent fishless wetlands for pond-breeding amphibians. Species of concern include striped newts, tiger salamanders, and gopher frogs. Installing flexible plastic liners in natural or excavated depressions may help maintain breeding habitat in years with low rainfall.

Fishes and Aquatic Invertebrates

- Protect riparian buffers and maintain forest cover in North Georgia watersheds. Georgia occurs within one of the most diverse regions for aquatic species richness in the temperate world. Georgia is among the top five states in the number of native species of mussels (127 species), fishes (265 species), and crayfishes (70 species). Unfortunately, Georgia is also ranked among the top states in the number of imperiled aquatic species. Climate change is a threat to Georgia's aquatic diversity, and habitats are representative of the threats contributing to the global freshwater biodiversity crisis. Species such as brook trout that are restricted to higher elevation, cold water streams may be particularly susceptible to climatic shifts. Efforts to protect riparian buffers and maintain forest cover in North Georgia watersheds are particularly important for these species.

Terrestrial Invertebrates

- For high elevation species that will lose habitat in Georgia, work with neighboring states, Landscape Conservation Cooperatives, and other regional conservation partnerships to ensure that suitable habitat exists in the region. Although legally protected under the Clean Water Act, freshwater marshes are still threatened by sea level rise due to climate change. This threat has the potential to affect species found in freshwater marsh ecosystems, primarily butterflies. In addition, some species found in the Blue Ridge Mountains, especially those near the southern end of their range, may be impacted. Similar to the situation along the coast, communities or host plants may not be able to migrate upslope quickly enough as their current habitat/elevation range becomes unsuitable, or there may simply be no higher elevation place for them to move.

Plants

- Participate in the Safeguarding Database to conserve rare plants. The Georgia Plant Conservation Alliance (GPCA) Safeguarding Database is a centralized, standardized, and updated repository for data pertaining to collaborative plant conservation projects. The database is a tool for tracking rare species in safeguarding and landscape management, and for communicating successes, methods, threats, and needs. Safeguarding can help conserve and restore rare plants species from the effects of landscape change. The database provides details relevant to habitats across the landscape that can serve as indicators for responses to climate change. Sharing this information supplies a broad range of important factors to consider in analyses assessing climate change. The GPCA keeps genetic material for rare plants should assisted migration become necessary. The database was developed by Atlanta Botanical Garden in conjunction with the Georgia Department of Natural Resources, the State Botanical Garden of Georgia, and the Chattahoochee-Oconee National Forest. The GPCA has been successfully coordinating safeguarding efforts since 1995, and restores and introduces rare species into native habitat. Member organizations establish and maintain collections for rare plant species that represent invaluable genetic resources.

Habitat Restoration

- Manage invasive species. Another challenge facing Georgia is the potential expansion of invasive species infestations due to climate change. Some climate change models predict an increase in July heat indexes across the Southeast U.S. from 8-15^{o} F to as high as 20^{o} F. Higher average temperatures may enable invasive species to take advantage of weakened ecosystems and further out-compete native species. It is estimated that global warming will allow 48 percent of currently established invasive plants and animals to expand their ranges northward if current warming trends continue. This effect can already be seen as warming winter temperatures permit species such as kudzu and garlic mustard to survive in areas much farther north than in the past. In addition, it is expected that climate change will contribute to more severe infestations and habitat damage from invasive insect species, including the gypsy moth. Studies have also shown that increased carbon dioxide levels appear to stimulate the growth of invasive plants, and may render herbicides less effective.
- Prioritize management practices on those lands most resilient to change to minimize risk. Management actions that maintain and enhance connectivity in priority areas, and avoid fragmenting habitats would be prioritized.

Ecosystems/Habitat Mapping

- Build a comprehensive, dynamic modeling process. Changes can be incorporated into the model as modeling assumptions shift, land cover and climate changes, and conservation lands are added. This would create a future habitat component to habitat models that will be beneficial for long term planning. Final prioritization inputs will include sea level rise and climate change impacts.

- Incorporate climate change into distribution models for all high priority species. These models will develop future habitat spatial representation of multiple climate scenarios.
- Complete a statewide map of priority habitats and landscape features for a detailed picture of the status of habitats around the states. The current map of 11 counties took three years to complete so the approach needs to be modified in order to meet objectives in a reasonable timeframe. Over the longer term, this map will facilitate strategic conservation, and partners would apply for grants to do some of the work. One recommended area of emphasis is mapping isolated wetlands and monitoring inundation levels to identify variation and responses to precipitation patterns.
- Acquire statewide LiDAR coverage to facilitate habitat mapping. LiDAR, Light Detection and Ranging, is a remote sensing method used to examine the surface of the Earth. Use the statewide LiDAR coverage to show topography and delineate wetlands. Because the results could inform the work of state and federal agencies as well as local governments, the return on investment would be great. Use LiDAR data to develop strategies for protection and management of coastal plain wetlands.
- Create a map to help guide land acquisition and identification of greenways and wildlife corridors. The land trust community could use it to prioritize local protection projects and grant programs. Include some priorities on the map that were identified by The Nature Conservancy. Coordinate with the Oconee Rivers Greenway Commission and other local planning groups to incorporate conservation of wildlife corridors in local greenspace efforts. This is also a strategy of the National Fish, Wildlife, and Plants Climate Adaptation Strategy.
- Consider changes in sea level rise in conservation planning. The past 80 years have seen 10 inches of recorded sea level rise per the National Oceanic and Atmospheric Administration Fort Pulaski tidal gauge near Savannah. Most sea level rise models predict this to accelerate sharply over the next decade. Use the Sea Level Rise Affecting Marshes Model (SLAMM) based on high accuracy, LiDAR-derived elevations when considering coastal habitat response to sea level rise. This dataset projects various scenarios of sea level rise over the coming 100 years. Much of the coast of Georgia is well situated for the next 30 years due to the predominance of high elevations, but the vast expanses of saltmarsh will begin fragmenting substantially over that period, and will be followed by marsh drowning on a large scale.
- Prioritize the conservation of diverse topographical areas on the coast. Account for sea level rise. Bias this approach towards land with substantial areas above 13 Foot Mean Sea Level, which is the initial zone of elevation, which enjoys the least amount of protection.

Understanding and adapting to the impacts of climate change is a process inherent with uncertainty and many questions remain before the path forward is clear. Fortunately, a large number of agencies, organizations, and academic institutions are working collaboratively to conduct climate change adaptation. Many of these institutions have overlapping responsibilities and geographic scopes, but each group plays a unique and vital role. One of the great challenges is coordinating efforts among groups so that

limited resources are utilized in the most effective manner possible. While there have been substantial individual and group efforts to coordinate adaptation actions, there is no established framework for regular fish and wildlife conservation planning in Georgia. Continue to meet with other states to discuss climate change adaptation, using existing agency committees and initiatives (e.g., Association of Fish and Wildlife Agencies Climate Change Committee, Southeastern Association of Fish and Wildlife Agencies, Landscape Conservation Cooperatives).

Other Emerging Issues

In addition to climate change, several other issues have emerged since the original version of the SWAP. Emerging issues addressed in this subsection include wildlife diseases and energy development. This subsection describes those issues and lists high priority conservation actions to address them. Renewable energy sources addressed include solar power, wind power, and bioenergy.

Wildlife Diseases

Several wildlife diseases have emerged or worsened since the 2005 version of the Georgia SWAP. Emerging wildlife diseases are often linked with global trade, climate shifts, habitat changes, and introductions of invasive species (e.g., introduced Ambrosia beetles spreading laurel wilt disease). Diseases caused by or carried by invasive species present a special case because wildlife may not have a natural immunity to them. Many of these invasive species are covered in the habitat restoration technical team report (see Appendix I).

Wildlife disease ecology is a rapidly growing field that is critical to the conservation of wildlife. In 1957, the Southeastern Cooperative Wildlife Disease Study (SCWDS) was founded by the Southeastern Association of Fish and Wildlife Agencies as the first diagnostic and research service to be established for the specific purpose of investigating wildlife diseases. SCWDS is a state-federal cooperative that provides expertise to the state and federal agencies responsible for managing the nation's wildlife and domestic livestock. Guidance on preventing or minimizing the spread of wildlife diseases has also been developed by organizations such as the Association of Fish and Wildlife Agencies and Partners in Amphibian and Reptile Conservation. Through collaboration with government agencies, non-governmental organizations, universities, and the public, research needs and conduct management actions related to emerging wildlife diseases will be identified.

Many wildlife diseases also present a threat to human health. Recent outbreaks of West Nile virus and avian influenza illustrate the link between wildlife disease and human health. As humans increase their contact with wildlife and their habitat, the risk of disease transmission increases. Healthy ecosystems are essentially for reducing the threat of wildlife disease for both human and wildlife health. For more information, visit http://vet.uga.edu/scwds.

White Nose Syndrome. White nose syndrome (WNS) is a disease that is devastating hibernating bat species in the U.S. The disease is linked to the fungus, *Pseudogymnaoascus destructans*, which manifests itself on the muzzles and wings of bats and thrives in the cold, humid conditions of caves. First documented in New York in 2006, the disease spread rapidly and was documented in Georgia in 2013. Bats at hibernacula in the northeastern U.S. have experienced 90 to 100 percent mortality, although mortality differs by site and species. As of 2014, at least 5.7 million bats have been killed by WNS since the disease was first documented in the U.S. Seven bat species have been confirmed with WNS, and the northern long-eared bat was federally listed as threatened in 2015 primarily due to the threat of WNS. Bat species that occur in Georgia and are known to be impacted by WNS include the northern long-eared bat, little brown bat, big brown bat, tricolored bat, Southeastern myotis, small-footed myotis, and the federally endangered Indiana bat. However, the only ones with documented cases of WNS in Georgia include the northern long-eared bat and tri-colored bat (Georgia Department of Natural Resources, n.d.).

Partners such as the U.S. Fish and Wildlife Service (USFWS) and Bat Conservation International (BCI) are assisting state fish and wildlife agencies with coping with the impacts of WNS. The USFWS developed the 2011 White Nose Syndrome National Plan. BCI provides funds for research, surveillance, and monitoring, as well as provides information to managers and decision-makers. The 2013 Georgia White Nose Syndrome Response Plan outlines steps for raising awareness, preventing or slowing the spread of the disease, reporting and analyzing bats, and managing related natural resources such as caves (Georgia Department of Natural Resources, 2013).

Avian Vacuolar Myelinopathy. Avian Vacuolar Myelinopathy (AVM) is a neurological disease that causes mortality in waterbirds in the southern U.S. Since it was discovered in 1994, the disease has killed at least 80 bald eagles and possibly thousands of American coots. The disease has also been confirmed as the cause of death of mallards, buffleheads, ring-necked ducks, Canada geese, killdeer, and a great horned owl. AVM causes a lesion in the myelin of the brain and spinal cord, which is linked to a lack of muscle coordination and difficulty flying and swimming. Cyanobacteria growing on submerged aquatic vegetation (primarily invasive hydrilla) are suspected to be the cause of AVM. Waterbirds consume the vegetation, and eagles consume the sick or dead waterbirds. According to the U.S. Army Corps of Engineers (USACE) Aquatic Nuisance Species Research Program, "AVM is the most significant unknown cause of eagle mortality in the history of the United States" (Warnell School of Forestry and Natural Resources, 2014).

In Georgia, the impacts of AVM are localized but significant in those areas where it occurs. AVM has likely resulted in the loss of at least eight bald eagle nesting territories in Georgia, and several dozen eagles, most at Lake Thurmond. The USACE is developing a hydrilla management strategy for Lake Thurmond with input from federal and state agencies and stakeholders (J. Ozier, personal communication, April 24, 2015).

Chytridiomycosis. Chytridiomycosis has been implicated in the decline and extinction of numerous amphibians. A species of chytrid fungus, *Batrachochytrium dendrobatidis*, or *Bd*, is linked to the disease. Chytrid is a type of fungus that lives in water or moist habitats worldwide. The fungus thickens the skin of amphibians with keratin, interfering with their ability to breathe or take up water through their skin. *Bd* is infecting and decimating populations of frogs and other amphibians around the world. The rapid speed at which populations can decline has disproportionately eliminated rare, specialized, and endemic species. In a study from 1999 to 2006, more than 1200 amphibians were sampled for *Bd* at 30 sites across the southeastern USA. Chytrid infection was confirmed in 10 species of aquatic-breeding amphibians. While no evidence was found of chytrid-associated declines in the region, the presence of the fungus is cause for concern and further study given global climate change and other stressors (Rothermel, 2008).

Another species of chytrid, *Batrachochytrium salamandrivorans,* is impacting salamanders overseas. This presents cause for concern: a) the disease is likely not yet present in the U.S., b) more salamander species occur in the U.S. than in any other country, and c) lessons learned from the impact of *Bd* (Martel et al., 2014). Results from Martel and colleagues demonstrate that native U.S. salamanders will be highly vulnerable to this new disease if it arrives. The Lacey Act can be implemented to impose an injurious listing for the import of salamanders until more information can be determined.

Snake Fungal Disease. Snake fungal disease (SFD) is a severe dermatitis that causes scabs and other abnormalities on a snake's skin. The disease is associated with the fungus, *Ophidiomyces ophiodiicola*. SFD was first documented in Georgia in 2014. Two clinical reports of SFD have been confirmed in wild Georgia snakes, including the federally threatened eastern indigo snake (J. Jensen, personal communication, April 24, 2015). At least eight species of snake have been infected but it is potentially harmful to all species of snake. The impact to snake populations is unclear but the disease has been implicated in declines in rattlesnake populations in Illinois and New Hampshire (Georgia Department of Natural Resources, 2014).

Ranavirus. Ranaviruses are emerging pathogens of amphibians, reptiles, and fish. They have been linked to die-offs in amphibians in the Americas, Europe, and Asia. Ranaviruses can be transmitted across amphibians, reptiles, and fish, and are moved regionally and internationally in the animal trade. In Georgia, they impact many amphibian species and some turtle species, including box turtles (J. Jensen, personal communication, April 24, 2015). Ranavirus has been found in Georgia's mountain streams, which poses a risk to salamanders. Gopher frogs are highly vulnerable based on laboratory trails. Ranaviruses pose a growing risk to global biodiversity (Global Ranavirus Consortium, n.d.).

Upper Respiratory Tract Disease. Upper respiratory tract disease (URTD) is characterized by a mild to severe nasal discharge. While the causative agent has not been identified, predisposing factors such as poor nutrition from habitat degradation, drought, and release of captive turtles and tortoises are likely involved (Jacobson, 1992). In

Georgia, the disease impacts gopher tortoise, which is a candidate species for federal listing, and box turtle. A population of gopher tortoise in Georgia with a historically high prevalence of antibodies to *Mycoplasma agassizii* was studied to assess long-term effects of URTD on tortoise behavior. The study showed that emigration of tortoises with severe clinical disease may play an important role in dispersal and persistence of pathogens (McGuire, 2014).

Chronic Wasting Disease. Chronic wasting disease (CWD) is a highly contagious, fatal neurological disease found in deer and elk. CWD has been confirmed in 18 states but has not been confirmed in the southeast U.S. Preventing the transmission of CWD into Georgia is a high priority. The first line of defense is to halt importation of all deer species. In Georgia, it is illegal to import any member of the deer family. Other preventative action includes continuing to prohibit canned hunting operations; prohibiting baiting of deer for hunting, which facilitates the transmission of wildlife disease agents by concentrating sick deer with healthy deer; and, discouraging management practices that result in high concentrations of deer over small areas (Georgia Department of Natural Resources, n.d.).

Highest Priority Conservation Actions

Highest priority conservation actions for wildlife diseases can be found in the Conservation Actions table in Appendix P under the goal of "Conserve high priority species."

- Implement the 2013 Georgia White Nose Syndrome Response Plan.
- Assess the need and feasibility of disease testing of potential or known-to-be vulnerable high priority species for emerging infectious diseases as a component of ongoing population surveys and monitoring efforts.
- Conduct outreach to decision-makers and the public about the impact, transmission, management, and prevention of wildlife diseases.
- Propose updates to legislation to address wildlife diseases.

Energy Development

Since the development of the Georgia SWAP, several national laws and initiatives have resulted in the scaling up of renewable energy development. In 2007, President Bush signed the Energy Independence and Security Act to, among other things, increase the production of clean renewable fuels. In 2011, Secretary of the Interior Ken Salazar announced initiatives to encourage rapid and responsible development of renewable energy on public lands. In 2014, Georgia was responsible for nearly three percent of new clean energy capacity installed in the U.S., ranking ninth in the country. That same year, private industry invested $477 million in Georgia's clean energy sector, the eighth-highest figure in the nation (Pew Charitable Trusts 2014). Renewable energy holds promise for reducing greenhouse gas emissions that contribute to climate change.

However, the development of renewable energy resources should be done with proactive plans in place to prevent unintended consequences and costs to native fish, wildlife, habitat, and public and private landowners and managers. Often, sites that are ideal for energy development are the same sites critical to high priority species, including federally listed and candidate species. The first step in energy project siting should be consultation with the Georgia Department of Natural Resources Nongame Conservation Section. Voluntary best practices and early coordination can help conserve fish and wildlife and ensure regulatory certainty. America's fish and wildlife are a public trust resource, and for more than 100 years state fish and wildlife agencies have upheld the primary responsibility for conserving those resources on public and private lands and waters within their borders.

Solar Power

Georgia is the fastest growing solar market in the nation (Solar Energy Industries Association [SEIA], 2015). In 2013, the Georgia Public Service Commission directed Georgia Power Company, the largest utility in Georgia, to add 525 megawatts (MW) of solar power between 2013 and 2016 (Pew Charitable Trusts 2014). This new requirement prompted an increase in solar development initiatives across the state. Now, Georgia has 161 MW of solar energy installed, ranking it 15th in the country, with more than 167 solar companies at work (SEIA, 2015).

Because of the speed of the development and lack of established regulatory procedures, development of large solar energy facilities has sometimes proceeded without implementation of proper precautions to minimize impacts to fish, wildlife, and habitat. Often, rural sites that are ideal for large solar power "farms" are the same sites critical to species of conservation concern, including federally endangered and candidate species, such as the gopher tortoise. The gopher tortoise is a keystone species that provides shelter for other high priority species. Some solar power developers in Georgia recognize that in keeping with the environmental benefits inherent to solar energy, the solar industry should consider impacts to fish, wildlife, and habitat when moving forward with projects. Coordination between the solar industry and fish and wildlife agencies to

develop and implement voluntary best practices and early coordination can help conserve fish and wildlife habitat and maintain biological diversity.

Solar power plants are typically built with private funds, and therefore not subject to regulation under the National Environmental Policy Act. Without a federal nexus, no formal process for engaging solar power developers exists. At the time of this writing, the Association of Fish and Wildlife Agencies is planning to identify a process to engage solar power developers in the absence of a regulatory pathway. Furthermore, lessons learned on federal land in the southwestern U.S. may be applicable. In 2012, the Approved Resource Management Plan Amendments/Record of Decision for Solar Energy Development in Six Southwestern States was completed, which evaluates solar energy development, develops agency-specific programs or guidance that would establish environmental policies and mitigation strategies for solar energy projects, and establishes a new Bureau of Land Management Solar Energy Program (K. Boydston, personal communication, April 22, 2015).

Highest Priority Conservation Actions

Highest priority conservation actions for solar power can be found in Appendix P under the goal of "Reduce impacts from development and other activities."

- Develop procedures for engaging with solar developers in the siting, permitting, mitigation, and implementation stages of solar energy development. Promote early consultation with the Nongame Conservation Section of Georgia Department of Natural Resources as the first step during the site selection process to avoid impacts to known species/habitats of conservation concern. Participate in meetings and workshops with solar industry and wildlife agency representatives to identify ways to engage in all stages of the solar development process.
- Develop a "Risk Map" with summarized information for rare species and sensitive habitats to be used as an early planning tool for energy project siting.
- Conduct studies on the impacts to wildlife and the effectiveness of mitigation efforts for solar power. Use standard protocols to improve comparability to other studies, enhance coordination among states, and provide a consistent message to managers, decision makers, and the public.
- Identify and apply applicable lessons from other states and regions, including siting and mitigating lessons from the desert tortoise.
- Participate in regional efforts to understand impacts to wildlife and develop strategies to minimize the impact of solar power development.
- Conduct outreach to the public and decision makers about the impacts to wildlife of solar power development and potential solutions.

Wind Power

The scaling up of wind power development preceded the scaling up of solar power development so more research is available on how to minimize the impact of wind energy

production on wildlife. However, a lack of information on wildlife mortality and the effectiveness of mitigation measures still leave wildlife at risk. Potential risks to wildlife include collisions with wind turbines and associated infrastructure, habitat loss, degradation, and fragmentation from turbines and infrastructure, displacement and behavioral changes, and impacts from increased predator populations or introduction of invasive plant species. In the U.S., wind energy development increased by 27% in 2006 and 45% in 2007. Fatalities of birds and bats have been reported at wind energy facilities worldwide, with large numbers of raptor kills in California and bat kills in the eastern U.S. (The Wildlife Society, 2008). Surveys at wind facilities demonstrate that across the states over half a million bats are killed per year. For more information, visit http://pubs.usgs.gov/of/2012/1110/OF12-1110.pdf

Developers and wildlife agencies worked together to develop guidance for siting and mitigating for wind energy projects. In 2012, the U.S. Fish and Wildlife Service (USFWS) developed two relevant guidance documents. The Land-based Wind Energy Guidelines provide a voluntary, scientific process for conserving wildlife at all stages of land-based wind energy development (USFWS, 2012a). The Eagle Conservation Plan Guidance provides guidance for conserving bald and golden eagles at the siting, constructing, and operating stages of wind energy facilities (USFWS, 2012b).

The guidelines provide a tiered approach to turbine construction, starting with preconstruction monitoring of the site to quantify the potential wildlife impacts of the project, and continuing with post-construction monitoring to determine the actual impact. This adaptive, iterative process incorporates lessons learned to generate new operating procedures to reduce mortality. Premonitoring can assist with determining whether a proposed site has a high risk of wildlife mortality. After premonitoring, if turbines are constructed, every effort should be made to minimize the chance of collision and monitor whether any wildlife mortality is occurring (USFWS, 2012a).

In 2013, the first offshore wind turbine on the east coast of the U.S. was constructed off the coast of Maine. The Association of Fish and Wildlife Agencies is monitoring offshore wind power development on the east coast and will provide any updates and recommendations to affected state fish and wildlife agencies. Potential impacts to wildlife from offshore wind development include impairing the ability of marine mammals to process and use sound due to anthropogenic sound, and collisions with turbines of marine, coastal, pelagic, and migratory birds and bats. Furthermore, shoreline habitat is dynamic and potentially subject to dynamic sea level rise. Permanent structures should be positioned so that they are minimally threatened by erosion and do not result in the construction of shoreline stabilization structures and loss of shoreline habitat (Yellin, 2014). Shoreline change rates are available to the public at the Georgia Coastal Hazards Portal at http://gchp.skio.usg.edu/.

In Georgia, staff from USFWS and the Georgia Department of Natural Resources (GADNR), and faculty from Georgia Southern University provide technical assistance to Georgia Power Company on implementation of a small-turbine wind energy

demonstration project planned for Skidaway Island. Several high priority bird species have been documented near the site, including the federally listed wood stork. In such cases, special attention must be paid to breeding seasons and flight paths. The coast also serves as nesting habitat for bald eagles and an important corridor for migratory landbirds, shorebirds, raptors and wading birds. To minimize potential impact to wildlife, surveys should be conducted prior to siting and construction of wind turbines and infrastructure (Yellin, 2014).

Bats that are most likely to be affected by coastal wind turbines in Georgia are migratory tree bats, although northern yellow bat and tri-colored bat may also be vulnerable. Georgia is not an area with abundant wind resources and successful operation of wind facilities will likely rely on lower wind speeds than other areas of the country. This could put the operation of these facilities in Georgia in direct conflict with bats during peak migration periods (Yellin, 2014). More information about bats and wind energy can be found at the bats and wind energy cooperative at http://www.batsandwind.org/.

Currently, the GADNR has no wind power siting authority, cannot require mitigation, and has no available wildlife guidelines for wind power siting. Local governments have primary authority through zoning authorities or county planning boards. GADNR provides reviews of state or federally funded projects and may enter into agreements to facilitate planning of other projects (Association of Fish and Wildlife Agencies and U.S. Fish and Wildlife Service, 2007).

Highest Priority Conservation Actions

Highest priority conservation actions for wind power can be found in the conservation actions table of Appendix P under the goal of "Reduce impacts from development and other activities."

- Develop procedures for engaging wind developers in the siting, permitting, mitigation, and implementation stages, including offshore sites should offshore wind projects start off of the coast of Georgia. Promote early consultation with the Nongame Conservation Section of Georgia Department of Natural Resources as the first step during the site selection process to minimize impacts to known species/habitats of conservation concern.
- Steer projects away from the areas of highest wildlife diversity. Consider potential shifts in wildlife ranges due to climate change. Minimize siting wind facilities in areas identified as high priority in Georgia's State Wildlife Action Plan.
- Develop a "Risk Map" with summarized information for many rare species and sensitive habitats to be used as an early planning tool for wind energy project siting should the rate of wind power development increase in Georgia.
- Conduct studies on impacts to wildlife of wind power and the effectiveness of mitigation efforts. Use standard protocols to improve comparability to other

studies, enhance coordination among states, and provide a consistent message to managers, decision makers, and the public.
- Identify and apply lessons from wind energy project development in other states and regions.
- Participate in regional efforts to understand impacts to wildlife and develop strategies to minimize the impact of wind power development.
- Conduct outreach to the public and decision makers about the impacts to wildlife of wind power development and potential solutions.

Bioenergy

Georgia ranks first in the country in commercial timberland, making woody biomass a large part of its renewable energy portfolio. In 2013, biomass was responsible for the second most renewable energy (following hydropower) in Georgia with 765 megawatts of power generation (Pew Charitable Trusts, 2014).

Since the original SWAP, federal legislation has stimulated the production of bioenergy. The Energy Independence and Security Act of 2007 increased the mandate for using ethanol through the Renewable Fuel Standard. In 2011, the White House issued the Blueprint for a Secure Energy Future to engage federal agencies, industry, agricultural producers, private organizations, and the public in the bioenergy discussion. The 2008 Farm Bill laid the groundwork for much of the federal bioenergy policy pertaining to agriculture and has now been reauthorized in the 2014 Farm Bill to provide $880 million for bioenergy programs and more inclusion of forestry products (McGuire, 2012).

Bioenergy development has the potential to contribute to energy independence and offset the use of fossil fuels. However, bioenergy development should proceed with consideration of wildlife conservation needs. Potential risks to wildlife from biomass energy development include land conversion, invasive plants, loss of plant diversity and habitat structure, and water quality and quantity impacts (McGuire, 2012).

Land conversion. Energy crops have potential to be grown on many land cover types, including those poorly suited for food production. Most undeveloped lands and areas not intensively farmed provide habitat for fish and wildlife species, especially when linked by conserved habitat corridors. Some areas, like longleaf pine savannas which have declined by 98 percent in the southeastern U.S., provide habitat vital to many native wildlife species. These same areas are also increasingly being viewed as grounds with the highest biomass potential.

Invasive plants. The list of potential bioenergy crops includes many nonnative plants with invasive tendencies and genetically modified native species that have a high likelihood of contaminating native plant communities that are important for native wildlife. Native feedstocks for energy use are better adapted to local environments and are more likely to provide adequate habitat for native fish, wildlife, and pollinators that

evolved with these natural biological systems. Already, the cost of managing and controlling invasive species is estimated at $120 billion per year (Pimentel et al. 2005).

Reduced Diversity. Dense and expansive monoculture crops are often used to maximize yield of energy crops. Habitat quality decreases on agricultural land that has single-species crops because of reduced diversity of natural plant species and lack of horizontal and vertical structure. When a forest is poorly managed and/or lacks structural and compositional diversity, there are fewer niches available which results in much less occupancy by wildlife species. When farmland is managed too intensely, horizontal space availability can be much reduced too. The more bioenergy crops mimic natural native habitats, the less impact bioenergy production will have on fish and wildlife populations. For example, harvesting trees from properly thinned forests for bioenergy allows more sunlight to reach a forest floor and conserves native groundcover plant species for wildlife, including burnable conditions for native species that are fire-dependent.

Management impacts. In general, fish and wildlife need plant matter for cover and food, like insects, seed, and browse, and for nesting sites that remain undisturbed during nesting seasons. Slight changes in these habitat components can have a large impact on populations. Impacts can be reduced by harvesting bioenergy crops after the nesting season, limiting pesticide and herbicide use, leaving crop stubble, and conserving field borders and hedgerows with plants native to those sites.

Water quantity and quality. Many aquifers are already being depleted, contributing to water quantity and quality issues. Irrigating bioenergy crops would further exacerbate these issues impacting aquatic habitat and Georgia's water sustainability. Bioenergy crops that use less water, fertilizer, and pesticides than crops they replace could help minimize this impact.

The Association of Fish and Wildlife Agencies developed guidelines for integrating biomass production with habitat maintenance. These guidelines were written by many natural resource professionals and reflect potential methods that could advance bioenergy production in conservation-friendly ways for wildlife. The guidelines focus on maintaining natural plant communities including those in aquatic habitats, biomass plantings on agricultural lands, and harvest procedures. Adherence to these and other guidelines and standards should be promoted. Other standards include the U.S. Department of Agriculture, Animal and Plant Health Inspection Service (APHIS) standards during the development of field trials of engineered high energy crops; and, any guidelines from NCS that are applicable to local conditions (McGuire, 2012).

Policy considerations for the development of biomass energy crops must be additive to, not replacements for, existing statutory priorities and objectives of federal and state fish and wildlife conservation programs. For example, the Conservation Reserve Program (CRP) within the Conservation Title of the Farm Bill is a potential source of land for biomass production. However, there is a lack of science informing how bioenergy crops

can be grown on CRP enrolled lands without compromising existing statutory priorities to conserve and improve the soil, water, and wildlife resources.

Highest Priority Conservation Actions

Highest priority conservation actions for bioenergy can be found in Appendix P under the goal of "Reduce impacts from development and other activities."

- Promote bioenergy production practices consistent with wildlife conservation.
- Develop voluntary best practices for bioenergy companies operating in Georgia.
- Conduct studies and distribute findings on the impacts to wildlife and the effectiveness of mitigation efforts for bioenergy.
- Identify and apply lessons from other states and regions.
- Participate in regional efforts to understand impacts to wildlife and develop strategies to minimize the impact of bioenergy development.
- Conduct outreach to agencies, organizations, landowners, and the public about the potential impacts to fish, wildlife, and habitat of bioenergy development and potential solutions.

Regional Conservation Partnerships

Emerging issues such as mega-petitions for species listings under the Endangered Species Act, and game changing issues such as climate change require new and innovative approaches to address them. Regional conservation partnerships such as the Atlantic Coast Joint Venture and the Southeast Partners in Amphibian and Reptile Conservation address needs for at-risk species across all or part of their range. The Southeastern At-Risk Species Program (SEARS) and the Landscape Conservation Cooperatives (LCCs) are regional conservation partnerships that have been developed since the original version of the SWAP. They provide resources and coordination for preventing wildlife from becoming endangered, climate change adaptation, and maximizing efficiency by reducing redundancy. This subsection describes how these new regional partnerships are achieving successes that could not be accomplished by individual states and proposes conservation actions to maximize their impact.

Southeastern At-Risk Species (SEARS) Program

From 1994-2006, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list an average of 20 species per year under the federal Endangered Species Act (ESA). However, since 2007, the Service has been petitioned to list more than 1,250 species, nearly as many species as the agency listed during the previous 30 years of administering the ESA. The Service was petitioned to list 695 species in 2007, 56 species in 2008, 63 species in 2009, and 451 species in 2010 (USFWS, n.d.).

In 2011, the Service reached a settlement with Wild Earth Guardians and the Center for Biological Diversity under a national multi-district litigation (MDL). Under the

agreement in the MDL, the Service must make a decision by 2018 on the list of 251 candidate species and make initial petition findings for more than 600 other species. The Service is under an extremely tight timeline to adequately assess the status of at-risk, candidate, and petitioned species for the ESA. Barriers include a lack of manpower, resources, and basic data on these species. In exchange, the USFWS gets a reprieve from listing litigation from those groups. However, the settlement does not preclude other groups from filing petitions (Smith, 2015).

The Southeast Region of the USFWS must evaluate whether to list more than 400 species as a result of the MDL, including 61 candidate species. More than 100 of the petitioned species occur within Georgia, amplifying the need for up-to-date status information to help inform the 12 month reviews and 90 day findings to determine whether the listing is warranted. But the need has not been matched by the funding required to conduct the work (Gwynn, 2015).

There is also a lack of regional data coordination. There is a need to harness the collective research potential of the states through the Southeastern Association of Fish and Wildlife Agencies (SEAFWA) to address these shortcomings, especially data gaps. SEAFWA's Wildlife Diversity Committee is responsible for advising the SEAFWA Directors and making recommendations on issues and matters regarding nongame and endangered species, both terrestrial and aquatic, which may affect the ability of member states to fulfill their fish and wildlife management responsibilities (Smith, 2015).

Myriad wildlife monitoring programs are carried out by numerous state and federal agencies, nongovernmental organizations, and universities. However, lack of coordination among institutions and programs has resulted in redundancy and inefficiency in data collection, data management, and analysis, affecting abilities to prioritize and evaluate the effects of management activities that cross jurisdictional or project borders. Some long-term data are in danger of being lost due to a lack of long term data management planning. In addition, many priority species remain poorly monitored, resulting in a lack adequate knowledge of population trends, sizes, and habitat requirements to understand their conservation status and the effects of management actions (Smith, 2015).

Working together with other states in the southeastern U.S. and with the USFWS is an effective way to address the large number of at-risk species included in the petitions, as well as candidate species and other high priority species across their range. As a result, the State Directors of SEAFWA approved the Wildlife Diversity Committee to work with the USFWS to develop plans and implement actions collectively that could preclude the need to federally list species.

At the 2012 SEAFWA meeting, State Directors also approved the development of a Species Action Plan to address MDL and petitioned species. The Southeastern At-Risk Species (SEARS) program was developed to implement the SEAFWA Action Plan. Successful implementation will be realized through the development of a method to

evaluate the status of at-risk species to prevent federal listings, identify species that are at risk but may preclude listing, and identify species that require federal protection. Working at the regional level is necessary to the issues that cannot be meaningfully addressed by individual states. The SEARS program is positioned to be the largest collaborative directed by state fish and wildlife agencies to effectively address critical landscape-scale wildlife conservation needs. It will complement work accomplished in individual states and through other regional efforts, while keeping the regional work relevant to member states.

Fundamental objectives for the SEARS program include:

- Develop and implement an effective information sharing system or framework that will help states and federal agencies communicate and coordinate activities on MDL species, species of conservation need, and at-risk species.
- Establish a framework of criteria to identify and prioritize which species to tackle together.
- Develop and implement a robust, coordinated and integrated research, inventory, monitoring and status assessment effort across the region to address data gaps and inform conservation planning for prioritized species
- Develop and implement a coordinated approach to addressing threats and overcoming barriers so as to ensure sustainable populations and habitats
- Speak with one voice. Instill public trust and confidence by presenting our science, developing a unified message, and having a clear outcome.

Highest Priority Conservation Actions

- Participate in the Wildlife Diversity and State Wildlife Action Plan Committees of the Southeastern Association of Fish and Wildlife Agencies.
- Help implement the Southeastern At-Risk Species Program (SEARS) program of the Wildlife Diversity Committee to identify the highest priority species, coordinate data, and identify funding mechanisms.
- Support secure funding for regional conservation.

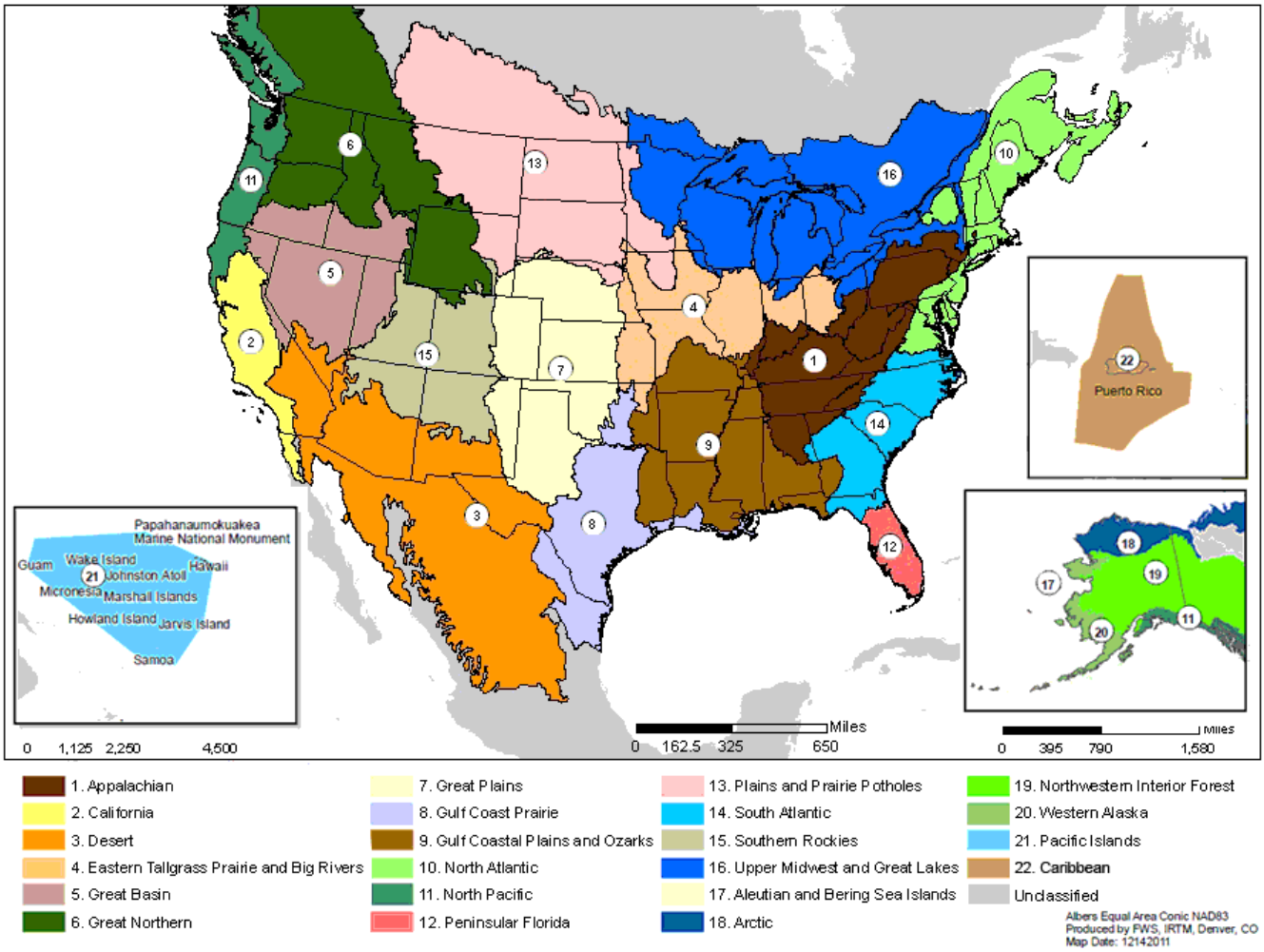
Landscape Conservation Cooperatives (LCCs)

The Landscape Conservation Cooperatives (LCCs) did not exist in 2005 when the Georgia SWAP was developed, and their establishment and support provides a new framework for conservation planning at the regional level. In 2010, the Department of the Interior (DOI) launched the LCCs to better integrate science and management to address climate change and other landscape scale issues. Collectively, the 22 LCCs form a network of resource managers and scientists from federal, state, and local governments, tribes and first nations, nongovernmental organizations, universities, and interested public and private organizations. These partners work together to identify best practices,

connect efforts, identify science gaps, and avoid duplication through conservation planning and design.

The mission of the network of cooperatives is to:

- Develop and provide integrated science-based information about the implications of climate change and other stressors for the sustainability of natural and cultural resources;
- Develop shared, landscape-level, conservation objectives and inform conservation strategies that are based on a shared scientific understanding about the landscape, including the implications of current and future environmental stressors;
- Facilitate the exchange of applied science in the implementation of conservation strategies and products developed by the Cooperative or their partners;
- Monitor and evaluate the effectiveness of LCC conservation strategies in meeting shared objectives;
- Develop appropriate linkages that connect LCCs to ensure an effective network.



Landscape Conservation Cooperatives

Secretarial Order No. 3289 to coordinate the DOI's response to climate change impact on resources, which enabled the launch of the LCCs, also enabled the launch of the DOI Climate Science Centers (CSCs). The CSCs are "regional hubs" of the U.S. Geological Survey's National Climate Change and Wildlife Science Center. The CSCs provide scientific information, tools, and techniques that fish and wildlife managers can use to anticipate, monitor, and adapt to climate change impacts. The research, ecological forecasting, and multi-scale modeling that the CSCs provide is in response to landscape-level priorities as identified by the LCCs, as well as other agencies and communities within each region. The GADNR Nongame Conservation Section participates in the Southeast CSC.

The LCCs were built partly on the Migratory Bird Joint Venture (JV) model. Established in 1987, JVs are self-directed partnerships of agencies, organizations, corporations, tribes, or individuals that conserve habitat for priority bird species, other wildlife, and people. JVs bring together diverse partners under the guidance of national and international bird conservation plans to design and implement landscape-scale conservation efforts. The Wildlife Resources Division of the Georgia Department of Natural Resources participates in the Atlantic Coast JV, which is a regional partnership focused on the conservation of habitat for native birds comprised of the 17 states and key federal and regional habitat conservation agencies and organizations in the Atlantic Flyway of the U.S. from Maine to Puerto Rico.

Three LCCs occur within Georgia: South Atlantic, Appalachian, and Gulf Coastal Plains and Ozarks. By working with the other state agencies and conservation partners within these LCCs, conservation issues can be addressed at the appropriate regional scale. This approach is particularly important when considering climate change impacts, large landscape features, migration corridors, and conservation of large groups of species and habitats. These efforts are important for achievement of longer term and larger scale goals, and working together with these regional partnerships should continue.

When used appropriately, regional coarse scale datasets provide good context for finer scale local datasets. For example, the South Atlantic LCC developed the Conservation Blueprint, a spatially-explicit, living plan that describes the places and actions needed to meet conservation objectives in the face of future change. The blueprint is the consistent, cross-boundary, cross-organization plan for how the conservation community can respond to change.

Climate change, urban growth, and increasing human demands on resources are reshaping the landscape, cutting across political and jurisdictional boundaries. In order to effectively prevent and mitigate for these forces, conservation planning and action must be proactive and address change across organizations, disciplines, and partnerships. The goal of the Southeastern Conservation Adaptation Strategy (SECAS) is to knit together the conservation blueprints of all of the LCCs in the southeastern U.S. to collaboratively define the conservation landscape of the future. SECAS is a shared, long-term vision for lands and waters that sustain fish and wildlife populations that unifies the delivery of conservation action and supports innovation that can be applied across the region. SECAS is a regional initiative led by members of SEAFWA, supported by federal leaders in the Southeast Natural Resources Leadership Group, and developed through a partnership of all of the LCCs in the southeastern U.S. Southeastern LCCs include South Atlantic, Peninsular Florida, Appalachians, Gulf Coastal Plains and Ozarks, and Caribbean and Gulf Coast Prairies LCCs. Involvement by GADNR in this effort to develop a regional strategy for the conservation of wildlife diversity should continue.

Highest Priority Conservation Actions

- Help revise and implement the South Atlantic Conservation Blueprint by providing data on Georgia conservation priorities, identifying research and conservation needs, soliciting new regional partners, and testing ecological indicators and species/habitat models.

Wildlife Conservation on Private Lands

Wildlife conservation tools include land protection action by a public agency or private conservation organization as well as provision of technical assistance or financial assistance to landowners to improve or restore wildlife habitat or meet other natural resource objectives. An array of programs is available to private landowners to help them achieve these objectives. However, landowners sometimes fail to take advantage of these programs simply because it is difficult to determine eligibility, availability, or the relative benefits of one program versus another.

In 1995 WRD began its Private Lands Initiative to intensify efforts in promoting, encouraging, and providing technical assistance for wildlife management on private lands. The Private Lands Initiative developed a strategy for delivering technical assistance to private landowners through USDA programs authorized under the Farm Bill and by developing a partnership with corporate forest landowners known as the Forestry for Wildlife Partnership. In 1998 the Bobwhite Quail Initiative was developed and formed into a separate technical and financial assistance program in the upper Coastal Plain of Georgia. In 1999, the Forest Stewardship Program was incorporated into the Private Lands Initiative to create the Private Lands Program. This program strives to serve private landowners by incorporating the landowner's objectives for their land into a comprehensive wildlife management plan.

Private Lands Program biologists provide information to landowners about federal and state natural resource programs that provide both technical and financial assistance. They also work with private landowners to identify programs best suited to meet these objectives and the agencies that can provide help with enrollment. WRD biologists also participate in the Sustainable Forestry Initiative (SFI) Implementation Committee for Georgia and assist member organizations (which include forest product companies and timber investment management organizations) to meet SFI standards for protection of rare species and natural communities. Georgia Forestry Commission staff provides training and technical assistance to SFI members to ensure compliance with Best Management Practices for forestry. Continued emphasis in this area will be critical to meeting objectives for conservation of natural habitats in Georgia.

The "Landowner's Guide to Conservation Incentives" developed and distributed by WRD staff provides information on a wide variety of programs that are available to Georgia residents. This booklet serves as an introduction to program objectives, funding levels, eligibility, administering agencies, specific benefits to landowners, stipulations for

continued support, and other elements. The document provides a matrix of programs and agencies, includes a glossary of program and agency acronyms, and categorizes incentive programs by type of assistance provided (e.g., direct payments, technical assistance, tax incentives, landowner recognition, regulatory relief). The "Landowner's Guide" is available from WRD offices in printed form and is also posted on the WRD website (www.georgiawildlife.com).

Since 2006, the USDA Farm Service Agency has overseen a Conservation Reserve Program (CRP) Longleaf Pine Initiative designed to reforest longleaf pine forests on former agricultural lands in nine southern states. The Wetlands Reserve Program (WRP) is a voluntary program administered by the USDA's Natural Resources Conservation Service offering landowners the opportunity to restore, protect, and enhance wetlands in exchange for retiring eligible land from agriculture. To ensure protection of wetlands that are restored through WRP restoration plans, conservation easements are placed on the properties that restrict certain uses; however, landowners retain ownership and recreation rights and control access to the land. The landowners also receive financial and technical assistance for restoring and protecting the wetlands' values and functions. Numerous other state and federally funded private landowner incentive programs, such as the Environmental Quality Incentive Program (EQIP), Partners for Fish and Wildlife, the Forest Stewardship Program, the Forest Land Enhancement Program, and the Bobwhite Quail Initiative, have been implemented to encourage restoration and maintenance of wildlife habitat and protection of water quality.

In addition to programs administered through the Farm Bill, there are numerous programs managed by other agencies and organizations, including non-governmental organizations. Some of these provide direct funding for land conservation, others provide technical assistance to landowners to achieve conservation goals, and still others provide public recognition for conservation successes.

The Georgia Land Conservation Center provides information and technical assistance to land trusts in the state and administers an in-lieu mitigation banking fund for stream and wetland mitigation projects. Founded in 1993 as the Georgia Environmental Policy Institute, this organization works to support and improve the capacity of land trusts to conserve land. It also works directly with landowners, concerned citizens, government agencies and other organizations to promote legislation, policies, and programs that conserve open space in Georgia.

The primary emphasis in this document is the conservation of natural habitats. However, a number of high priority species make use of habitats that are created or maintained by human activities. These include field edges, utility rights of way, harvested timberlands, and fallow agricultural lands ("old fields"). These anthropogenic habitats resemble natural habitats that have been greatly diminished in the Georgia landscape through fire suppression, the loss of native grazers, or other factors. Numerous opportunities exist to provide assistance to private landowners to maintain and enhance early successional habitats through the Bobwhite Quail Initiative and various Farm Bill related programs.

These programs provide means by which wildlife habitat can be improved with minimal impacts on ongoing agricultural or silvicultural operations. Priorities for restoration of pine savanna communities are incorporated into the SWAP as well as the Forest Action Plan developed by the Georgia Forestry Commission.

Funding levels, conservation emphasis, criteria for eligibility, and other elements of these programs vary over time, so periodic updates of the "Landowner's Guide" are necessary. In addition, public agencies should take advantage of opportunities to collaborate on projects that will focus financial and technical resources to provide the greatest benefit to habitats and species of greatest conservation need on private lands. In order to take advantage of these opportunities, WRD will continue to work with Natural Resources Conservation Service (NRCS), Farm Services Agency (FSA), Georgia Forestry Commission (GFC), land trusts, and other organizations to improve delivery of financial and technical assistance programs. By sharing resources and increasing the number of field staff, these organizations can significantly enhance the number and quality of wildlife conservation programs provided to private landowners. Descriptions of federal, state, and privately funded programs that support wildlife conservation on private lands can be found in the Habitat Restoration Team report.

Highest Priority Conservation Actions

Specific conservation actions that pertain to the enhancement of wildlife conservation practices on private lands and were rated "Very High" or "High" in priority are listed below. Information on lead organizations, partners, funding sources and other details for these and other recommended actions can be found in Appendix P.

- Coordinate utilization of and training for implementation of Georgia's Best Management Practices for Agriculture, and improve wildlife conservation guidelines. Provide technical assistance and information to develop a wildlife conservation component for agricultural BMPs that addresses needs and opportunities for wildlife habitat protection.
- Develop habitat-specific management guidelines to address conservation needs of high priority species in each ecoregion of the state, and provide these to landowners and managers.
- Encourage use of prescribed fire as a habitat management tool on private lands. Provide information and technical assistance to landowners to encourage appropriate use of prescribed fire as a management tool to enhance and maintain wildlife habitats.
- Assist DNR Private Lands Program biologists with technical support and outreach to private landowners owning significant botanical sites.
- Collaborate on the revision and implementation of the Georgia State Forest Action Plan.

Old Field Habitats

Old-field is a habitat type most often found after abandonment of pastureland or retirement of crop fields. This habitat type includes a meadow stage and a shrub stage depending on the site's physical characteristics, time since abandonment, and disturbance regime. In its early stages, the site is usually in a meadow-like condition and is dominated by grasses and forbs. As the site ages shrubs and small trees become established and it becomes a shrubland. Eventually, in the absence of a disturbance like fire, the site would succeed into a woodland. While man-made, these habitats mimic many of the conditions found in open pine forest, natural grasslands, open shrublands, and savannas, and are used by an extensive array of wildlife species including many of conservation concern (e.g., Northern Bobwhite, Golden-winged Warbler, Loggerhead Shrike). In some cases natural disturbance regimes that would have created habitat for these rare species no longer operate on a landscape-level scale (e.g., fire) and creation, maintenance, and augmentation of man-made old field habitats is necessary to support, or at least enhance populations of many of these species.

Field borders and similar lands created through Farm Bill programs, the Bobwhite Quail Initiative, and similar programs often have these old field characteristics and provide suitable habitat for rare and declining species that in many cases have lost significant portions of their natural habitat. A good example of this is the Northern Bobwhite (quail) that at one time was a very common species throughout the expansive areas of Longleaf Pine-Wiregrass habitat in the Coastal Plain, and also occurred in significant numbers in natural grassland and recently burned areas throughout much of the state. With the loss of the majority of acreage in these habitat types, anthropogenic habitats like old fields have become increasingly important to the well being of quail and many associated species.

While natural habitats are, and should be, emphasized in this plan, man-made habitats such as old fields should also be recognized as important and incorporated into measures used to conserve species of concern when appropriate.

Wildlife Conservation on Public Lands

Public land management to benefit high priority species and habitats is an important complement to conservation efforts on private lands. While only approximately 8% of the state is in public ownership, these public lands serve critical ecological support

National Park Service, U.S. Forest Service) have a specific mandate to conserve native wildlife species and their habitats. In addition, some public agencies whose primary mission is not wildlife conservation (e.g., U.S. Department of Defense) also manage ecologically significant lands containing high priority species and habitats. There is a need for all public land managing agencies to conduct thorough biological inventories of their properties and address wildlife conservation needs in an ecological landscape context. As impacts to natural communities from various land uses continue to mount, collaborative interagency efforts to restore and maintain natural habitats and populations of rare or declining species will be essential to the overall goal of maintaining biological diversity in Georgia. Biological inventory and management efforts conducted in

cooperation with private conservation and research organizations will be increasingly important as well.

Highest Priority Conservation Actions

Highest priority conservation actions (actions ranked "Very High" or "High") that relate to wildlife conservation efforts on public lands are listed below. Information on lead organizations, partners, funding sources and other details for these and other recommended actions can be found in the Conservation Actions table.

- Implement integrated resource management of state lands and waters (fresh, brackish, and salt), emphasizing restoration and maintenance of natural communities and rare species populations (i.e., ecosystem management). Work with other conservation organizations to address regional conservation needs.
- Revise and update management plans for state lands as needed to address specific management objectives for high priority species.
- Survey state-owned lands for federal and state protected species and other species of concern, and incorporate conservation objectives for these species into management plans.
- Continue to implement rare plant restoration, enhancement, and safeguarding program. Identify needs, develop horticultural guidelines, and initiate rare plant propagation efforts. Improve and implement safeguarding protocols and monitor populations.
- Implement integrated resource management of federal lands and waters (including oceanic habitats), emphasizing restoration and maintenance of natural communities and rare species populations. Work with DNR and other conservation organizations to enhance ecosystem functions and address regional conservation needs.
- Develop an adaptive management approach for high priority plants and natural communities on public lands

Assessments of High Priority Habitats and Species

Assessments of the status of high priority species and habitats represent important components of any wildlife conservation strategy. Several high priority research and survey projects relating to species or habitats within a given ecoregion or physiographic province have been mentioned in Section IV of this document. In addition to these projects, there are several highly ranked projects that are statewide in scope or include several ecoregions. These include priorities identified in recovery plans for federally listed species as well as other identified research needs. The highest priority conservation actions identified by the technical teams, Steering Committee, and other stakeholders that pertain to assessments of high priority habitats and species are found below. For more information, refer to the Conservation Actions table.

Highest Priority Conservation Actions

- Conduct assessments of federal petitioned and candidate species, as well as undersampled high priority species not currently under federal review.
- Implement a statewide habitat mapping effort and conduct assessments of rare natural communities and habitats that support species of conservation need.
- Conduct statewide assessments of aquatic communities to determine biotic integrity of streams. Expand biological survey efforts in high priority streams.
- Conduct surveys for rare plants known historically from Georgia.
- Conduct aerial surveys for federally listed birds (bald eagle nesting surveys and wood stork nesting and roosting surveys).
- Monitor populations of gray and southeastern bats in caves, and conduct surveys of high priority forest-roosting bats.
- Conduct midwinter waterbird survey and piping plover winter survey; conduct research and surveys on southeastern red knot and whimbrels; investigate American oystercatcher ecology and demographics
- Continue long-term monitoring of Pigeon Mountain salamander and other cave-inhabiting salamander populations; conduct surveys for other high priority cave and outcrop species.
- Assess the status of high priority bryophytes, lichens, and graminoids in Georgia.
- Evaluate the status and distribution of high priority snails.

Conservation of High Priority Habitats and Species

Wildlife conservation efforts may be focused on protection or management of natural habitat, management of populations, or management of stressors to those populations and habitats. Several important wildlife conservation themes that span ecoregions or apply to the entire Georgia landscape are described below. Other priorities will be identified through periodic assessments of conservation needs based on the best available data.

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. Opportunities exist to improve our management of these fire-dependent communities. 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 sensitive habitats.

State agencies play a major role in the administration of prescribed fire programs in Georgia. The Georgia Forestry Commission has the primary role in regulating and

issuing permits for prescribed fire activities in the state. It is also involved in fighting wildfires and promotes prescribed fire as the key tool in preventing catastrophic wild fire. This agency issues permits for approximately 1,000,000 acres in Georgia each year.

To expand its capacity for prescribed fire programs to benefit natural communities, the Wildlife Resources Division of Georgia DNR has invested state and federal funds to train its staff, members of partner organizations, and volunteers in prescribed burn methods. It has purchased fire equipment, protective gear, and supplies, and has established a roving fire team using trained volunteers from the Student Conservation Association, AmeriCorps, and other organizations. These efforts have resulted in prescribed burns on many thousands of acres of state land annually. The burns are conducted as components of habitat restoration projects involving cultivation and planting of native ground cover species, thinning of pine stands, removal of "off-site" species, and control of invasive exotic species. In addition, the Wildlife Resource Division conducts targeted outreach efforts to increase public awareness of the need for prescribed fires for habitat restoration and management (Georgia Department of Natural Resources 2010).

Other important outreach and advocacy programs are directed by the Georgia Prescribed Fire Council. This organization includes private landowners, land managers, state and federal agencies, and other nongovernmental conservation organizations. Its mission is to advocate for the use of prescribed fire and to promote public understanding of fire as a management tool. The council worked closely with the Georgia Forestry Commission and the Georgia Environmental Protection Division on revised state smoke management plans to help meet the new U.S. EPA air quality standards, and promotes public education, coordination among conservation organizations, and technical assistance for prescribed fire practitioners and legislators. It has facilitated the adoption of resolutions for the use of prescribed fire by the state and nearly all Georgia county governments.

Formed in 2002, the Interagency Burn Team (IBT) serves to coordinate efforts by public and private organizations to implement prescribed fire programs to benefit important habitats and suites of species in the state. Current member organizations include the U.S. Fish and Wildlife Service, The Nature Conservancy, the U.S. Forest Service, the Georgia Forestry Commission, the Georgia Department of Natural Resources, The Orianne Society, and The Longleaf Alliance. Private lands that harbor rare species and are in close proximity to conservation lands are the primary targets for IBT activities. Each agency nominates sites and provides planning and a qualified burn boss for specific prescribed burns.

All IBT burn crews must be certified by standards developed by the National Wildfire Coordinating Group (NWCG). Funding for the project, which covers staff time and firebreak construction, is provided through the USFWS. When weather conditions are right, the nominating agency calls in the IBT to assist in the burning. The nominator is also responsible for monitoring the effects of the fire and the benefits to rare species. A number of high priority habitats have benefited from this cooperative effort to date,

including calcareous prairies, montane longleaf pine-hardwood forest, granite outcrops, and longleaf pine-scrub oak woodlands.

To address the need for restoration of fire-maintained communities, Georgia DNR will continue to work with other agencies to share expertise and develop new methods for implementing prescribed fire in various Georgia habitats, encourage fire ecology research by public and private research institutions, and work with the Environmental Protection Division and the Georgia Prescribed Fire Council to provide reasonable burn windows in metropolitan counties. Fire-dependent habitats on all public lands will be identified and addressed in management plans, and additional fire training and equipment should be provided to managers of state parks and other facilities. Finally, financial and technical assistance and educational outreach efforts are needed to encourage restoration of fire-maintained communities on private lands.

Protection of Stream Buffers and Maintenance of Aquatic Habitat Connectivity

Establishment and maintenance of vegetated riparian buffers is one of the most important and cost-effective conservation measures for protection of water quality and aquatic ecosystem health. Many of Georgia's streams suffer from insufficient stream buffers and are thus at risk of water quality impairment resulting from land-disturbing activities, introduction of toxic chemicals or excess nutrients, and thermal impacts from lack of shading. Establishment of substantial vegetated buffers is highly recommended for all high priority streams. Breaches of these stream buffers should 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.

Strategies to protect and maintain healthy stream buffers include working with state and county road departments to improve placement and design of road turnouts, developing standards for stream corridor protection on public lands, and providing information on high priority streams to commercial and non-profit mitigation bankers to encourage restoration and enhancement of vegetated buffers. Other strategies include providing financial incentives to private landowners to fence livestock out of streams, working with local governments and developers to ensure protection of stream buffers when development plans are considered, and working with all-terrain vehicles (ATV) manufacturers to develop and disseminate messages discouraging ATV use in and adjacent to streams.

Mitigation of impacts on streams and rivers due to reservoir construction is required under the Clean Water Act. According to this regulation, any impacts must be compensated with restoration, creation, or preservation of similar habitat; however, monitoring and enforcement of mitigation requirements are often inadequate to ensure compliance (Cowie 2002). Growing pressures for additional water supply impoundments and evidence of increasing impacts from water impoundments and withdrawal suggest that a better understanding of cumulative effects of reservoirs of varying sizes and purposes on system-wide processes is needed. Emphasis on multiple approaches

(including water conservation) to meet water demands, as well as avoidance of watersheds with rare species and significant natural communities during reservoir site selection, are important considerations for minimizing environmental impacts.

For existing reservoirs, changes in dam operations that incorporate seasonally variable flows, low flow releases, periodic low flows, and aeration of release waters are potential methods to offset downstream impacts. These approaches have been applied to reservoirs in other states and have been evaluated for implementation in Georgia (Collier, Webb, and Schmidt 2000). Replacement of culverts that serve as barriers to fish passage should be an ongoing priority, especially in watersheds with imperiled stream biota. Finally, opportunities for full or partial dam removal to increase connectivity of stream habitats should be prioritized based on potential benefits to high priority aquatic species.

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 study of Carolina bays in Georgia indicated that the majority of the smaller bays showed evidence of hydrologic alterations or other forms of degradation (VandeGenachte and Cammack, 2002). Other examples of important isolated wetlands include solution pits on granite outcrops, shallow depressions in pine flatwoods, Grady ponds, limesink ponds, 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, ditching and draining, or conversion to agricultural uses.

It is more accurate to refer to these wetland systems as "geographically isolated" rather than hydrologically isolated, since research indicates that most of these systems are connected to streams or to other wetlands on a periodic basis, or are replenished by or discharge to underground aquifers (Comer et al., 2005). The level of protection for these wetlands under the federal Clean Water Act is currently being contested in the courts, as is the question of what constitutes a "significant nexus" or connection with jurisdictional waters of the U.S. Some provisions of the federal Food Security Act of 1985 provide financial disincentives for destruction of isolated wetlands. However, legal uncertainty over regulatory authority and agency jurisdiction, combined with the relative ease with which these wetlands can be degraded or obliterated provides a compelling case for increased emphasis on protection, restoration, and maintenance of a large number of each size class and habitat type.

Georgia DNR and other organizations should identify and protect the most significant examples of these wetland habitats through fee-simple acquisition or conservation easements. In addition, programs providing financial and other incentives should be directed to private landowners to encourage the protection, restoration, and management

of these important wetlands. Finally, permits for groundwater and surface water withdrawals should be administered with careful consideration of resulting impacts to these and other wetlands.

Protection of Headwater Streams

Headwater streams are found in the upper reaches of watersheds and may have flowing water for only a portion of the year. Headwater streams account for the majority of stream miles in a given watershed. Like isolated wetlands, these habitats are important for a wide variety of wildlife species, including several rare species of concern. These headwater systems are also important for maintenance of habitat quality in the higher-order perennial streams which they feed (Meyer et al 2003). Intermittent/ephemeral streams and associated seepage wetlands are often overlooked when streams and wetlands are mapped. In addition, they have received less research emphasis than perennial streams. In areas where development pressures are high or agricultural uses are prevalent, many of these habitats may be adversely affected by land disturbing activities.

Headwater streams are particularly vulnerable to removal or destruction of riparian buffers, and changes in these upper reaches can threaten the biological integrity of entire river networks through disruptions of food webs (Hutchens and Wallace 2002) and elevated stream temperatures (J. L. Meyer et al. 2005, 2007). Protection of headwater streams and associated wetlands is critical for protection of wildlife diversity and maintenance of water quality. Other states have found it useful to map stream networks with more precision than is provided by standard USGS topographic maps, and have found that a large percentage of small streams were either absent on these topographic maps, or were misclassified (e.g., streams shown as intermittent were actually perennial). Greater emphasis should be placed on accurate mapping and delineation of headwater streams (Ohio Environmental Protection Agency 2002). In addition, more research attention should be focused on these relatively unknown aquatic habitats. The effects of groundwater and surface water withdrawals on headwater streams and associated wetlands should be considered, and the overall contribution of these systems to biological diversity in a given watershed should be investigated in greater detail.

Control of Nonnative Invasive Species Populations

There are an estimated 50,000 nonnative species in the U.S., and the number is steadily increasing. Many of these nonnative species represent serious threats to agriculture, horticulture or forestry. Other nonnative species are more likely to impact natural communities and individual populations of native wildlife species. The long-term effects of nonnative species on native wildlife species are generally considered to be second only to direct habitat destruction or conversion. Approximately 42% of the species listed as Endangered or Threatened under the federal Endangered Species Act are significantly impacted by invasive exotic species. On a national basis, the economic losses and environmental damage caused by exotic species total approximately $120 billion per year (Pimentel et al. 2005). A recent survey of managers of 430 national wildlife refuges

indicated that 80% of the refuges recognized problems with invasive exotic organisms. Refuge managers reported more than 790 invasive organisms, including 507 nonnative plants, 208 nonnative animals, and 76 plant and animal diseases (Simonson et al. 2004).

Invasive exotic species constitute a significant threat to Georgia's biological diversity. Many native species are declining due to increasing competition or habitat degradation from invasive exotic species. Feral hogs, red shiners, and flathead catfish are examples of animals that can cause serious impacts to natural communities and native species. A great number of exotic plants such as Nepal browntop, hydrilla, Chinese tallow tree, hydrilla water hyacinth, autumn olive, coastal bermudagrass, and Chinese privet also pose serious threats to Georgia's natural communities. A nonnative forest pest in North Georgia, the hemlock wooly adelgid, has caused a drastic decline in eastern hemlock population. Other recent invaders include the emerald ash borer, kudzu bug, and an introduced ambrosia beetle that serves as a vector for laurel wilt disease. Problems with invasive exotic species have been documented on a number of public lands in Georgia, and control measures have been instituted.

Control efforts for invasive species are generally costly and time-consuming, and must be maintained for many years to be successful. Invasive plants must be physically removed or aggressively treated with herbicides. Plants that are dispersed by wind or animals or that have seeds that persist in the soil are particularly difficult to eradicate. Control of feral swine is challenging due to their fecundity and mobility and requires aggressive trapping and shooting programs. Fungal and insect invasions are difficult to contain because they often spread quickly and pervasively in the absence of natural biological controls. Invasive species management requires careful planning and implementation to provide effective control while minimizing impacts to non-target species and surrounding natural communities. It also requires focusing limited resources in areas that are likely to produce the most significant benefits.

The Georgia Invasive Species Task Force, a partnership formalized in 2009 between the Georgia Department of Natural Resources, the Georgia Forestry Commission, the Georgia Department of Agriculture, and the University of Georgia, was established to coordinate monitoring, reporting, control, and education efforts related to non-native invasive species on a statewide basis. More recently, the Coastal Georgia Cooperative Invasive Species Management Area was established. This partnership of public agencies, private organizations, and individuals is focusing attention on the many invasive species in the 11-county coastal region of Georgia, and may serve as the model for similar regional partnerships around the state. Additional funding and other resources are needed for assessment, monitoring, and control of invasive species throughout the state.

Protection of Caves and Other Karst Environments

Caves, limesinks, sagponds, and springs represent some of the most sensitive natural habitats in Georgia. These karst environments harbor many of Georgia's rarest and most imperiled species, and are susceptible to impacts from a wide variety of human activities,

from residential and commercial development to road and utility construction, excessive groundwater withdrawal, recreational activities, and altered water quality. Protection of caves and other karst environments is essential for maintenance of Georgia's biological diversity. Georgia's Cave Protection Act of 1977 (O.C.G.A. 12-4-140) provides for protection of caves, sinkholes, and speleothems (cave formations), prohibits the storage of hazardous materials and dumping of litter, garbage, or other materials in caves, and prohibits the harming, killing or removal of wildlife found within caves except by authorized personnel. It also provides protection against trespass and vandalism, and exempts landowners from liability for injuries sustained by individuals involved in recreational or scientific uses of caves.

There are more than 600 documented caves in Georgia, and the majority of these are located on private land. Established caving groups and experienced cave researchers respect the sensitivity of these habitats as well as the rights of property owners. However, some caves receive significant impacts from careless or unethical individuals. In addition, many of Georgia's caves are threatened by off-site land uses that result in inputs of sediments, excess nutrients, or toxins. Only a small percentage of Georgia's caves have received biological surveys. Additional survey efforts are needed to document the diversity of cave organisms in Georgia and to establish conservation priorities for individual caves. Abandoned mines and tunnels can also provide habitat for cave fauna and should be evaluated as well (Tuttle and Taylor 1994).

Since the arrival of white-nose syndrome (WNS) in Georgia in 2013, biologists from DNR, the U.S. Fish and Wildlife Service, and private consulting firms have been conducting surveys for this deadly disease and monitoring populations of bats in caves, crevices, mines and tunnels. This survey and monitoring work must be continued in the coming years to facilitate range-wide assessments of WNS impacts and to inform conservation plans for affected bats.

Restoration or Reintroduction of Wildlife Populations

This is an important but often overlooked aspect of wildlife conservation. In some cases, a species has been nearly or completed extirpated from a region or state, but suitable habitat exists for reintroduction of the species. In other cases, the extirpation was accompanied by a loss of suitable habitat, so habitat restoration is the necessary first step. Examples of species for which restoration/reintroduction is a primary conservation emphasis include Florida torreya, bog turtle, smooth purple coneflower, shoals spiderlily, spotfin chub, robust redhorse, lake sturgeon, Altamaha spinymussel, and Tennessee heelsplitter. These species require special emphasis on habitat protection and maintenance, propagation of individuals, and reintroduction of these individuals into protected habitat. A special case involves extirpated populations of freshwater mussels. For these species, attention must be paid not only to restoration of suitable habitat, but also to management of fish species that serve as hosts to these mussels. In some cases, the host fish(es) may have been eliminated from the watershed, and must be reestablished in order to provide an opportunity for restoration of the mussel populations.

The Georgia Plant Conservation Alliance member organizations coordinate a rare plant safeguarding program that focuses on conservation of the genetic diversity of rare plant populations and augmentation or restoration of these rare plants in appropriate natural habitats. Rare plant propagation projects are prioritized by the conservation status and needs of species and are linked to habitat restoration or enhancement efforts in the field. This group has been highly successful in restoring or reintroducing populations of globally imperiled species in many conservation sites across the state.

Highest Priority Conservation Actions

Specific conservation actions that relate to conservation of high priority habitats and species statewide or over several ecoregions include the following. Information on lead organizations, partners, funding sources and other details for these and other recommended conservation actions can be found in Appendix P.

- Develop a comprehensive action plan to control invasive exotic species on public and private lands. Increase public awareness of problems caused by invasive exotic plants; reduce use of exotic species and increase use of native plants in erosion control and landscaping
- Control populations of feral hogs to conserve high priority habitats and species. Increase hunting pressure on public and private lands and implement trapping and shooting programs in especially sensitive areas (e.g., barrier island beaches).
- Develop a comprehensive action plan to control exotic species on public and private lands. Increase public awareness of problems caused by invasive exotic species; reduce use of exotic plant species and increase use of native plants in erosion control and landscaping.
- Encourage use of prescribed fire as a habitat management tool on private lands. Provide information and technical assistance to landowners to encourage appropriate use of prescribed fire as a management tool to enhance and maintain wildlife habitats.
- Maintain a network of facilities (e.g., Atlanta Botanical Gardens, State Botanical Gardens, Coastal Plain Botanical Gardens) for propagation of rare plants and safeguarding of genetic resources.
- Continue efforts to restore and enhance populations of red-cockaded woodpeckers through implementation of the Conservation Plan for demographically isolated RCW populations.

Education, Outreach, and Communications

The health and well-being of Georgia's plants, wildlife, and people depends on the quality and integrity of the environment. Loss, degradation, and fragmentation of habitat are the greatest problems facing fish and wildlife. To effectively protect Georgia's natural heritage, the public must be aware of and engaged in conservation.

More than 400 organizations including private non-profit and for-profit entities, universities and governmental agencies provide environmental education programs for the citizens of Georgia. A statewide network of about 400 environmental educators, the Environmental Education Alliance (EEA) of Georgia, supports these organizations through their annual conference, an outdoor learning symposium, an accredited environmental education certification program, and networking opportunities. EEinGeorgia.org, the online guide to environmental education in Georgia, makes information about environmental education resources readily available. This comprehensive website is a collaborative effort of the Environmental Protection Division (EPD) of the Department of Natural Resources (DNR), the Department of Community Affairs, the Department of Education (DOE) and EEA. It includes EE lesson plans for all grades and subjects based on the state education standards, a searchable directory of EE organizations and their resources, facts about Georgia's environment, and a calendar of EE events.

The SWAP provides an opportunity to: 1) educate the citizens of Georgia about natural communities and the conservation priorities within their ecoregions; and 2) measure the effectiveness of the campaign. These goals can be accomplished by establishing a baseline of knowledge through a wildlife literacy survey, incorporating those findings into SWAP core concepts and messages, identifying and creating teaching resources that target specific audiences, and taking advantage of Georgia's strong and diverse network of environmental educators and other conservation organizations to effectively communicate how we can all play a role in protecting biodiversity. Future surveys and studies can aim to measure the long-term effectiveness of these efforts. The Education Technical Team report is found in Appendix K.

The Outreach and Communications Technical Team identified opportunities and priorities for communication of SWAP themes and ways that the efforts of the Education Team could be amplified through outreach and in-reach activities. This team report is found in Appendix L.

Highest Priority Conservation Actions

Highest priority conservation actions (actions ranked "Very High" or "High") that relate to improvement of SWAP-related education, outreach, and communications include the following. Information on lead organizations, partners, funding sources and other details for these and other recommended actions can be found in Appendix P.

- Assess the current level of Georgia citizens' awareness about native wildlife and wildlife conservation needs.
- Create educational core concepts with key messages that support the main SWAP themes.
- Improve communication of SWAP messages to regional education networks and community groups

- Identify and increase awareness of existing educational materials to facilitate delivery of SWAP conservation messages to the public. Provide resources and promote opportunities to engage people in the outdoors.
- Educate beachgoers and boaters about the plight of beach nesting birds and passage migrants that use Georgia beaches and offshore bars
- Conduct aquatic species outreach in high priority watersheds
- Work with the Education Team as needed to achieve its recommendations. Specifically: 1) Help create an online survey supporting an assessment of Georgians' wildlife conservation literacy; 2) help with the content of core educational concepts, related messaging and educational materials; 3) help identify SWAP stories per ecoregion for use in regional education networks and community groups.
- Promote the conservation actions, themes and goals of the SWAP to five priority stakeholder groups to increase stakeholders' support for wildlife conservation; awareness of the SWAP, its importance, themes and successes; and, awareness of the partnership effort involved.
- Increase awareness of the SWAP among partner organizations. This "in-reach" will mimic communications with the five stakeholder groups but with the focus on SWAP partner organizations. Work with individual partners will identify best ways to reach their staffs on specific messaging.

Increasing Capacity for Wildlife Conservation

The ability of any agency or organization to meet its objectives depends to a large extent on the availability of necessary resources (staff, funding, equipment, etc.). The various conservation objectives outlined in this document will require financial, technical and other resources well in excess of those available to the Georgia Department of Natural Resources and its conservation partners in 2015. For this reason, an assessment of actions related to increasing capacity for wildlife conservation in Georgia is warranted.

By participating in multi-state interagency conservation initiatives, Georgia DNR can help generate additional funding for high priority wildlife conservation projects. An example is the Southeast Aquatic Resources Partnership (SARP), a 13-state regional aquatic conservation partnership involving state and federal agencies as well as nongovernmental organizations. SARP, which focuses on protection, conservation, and restoration of aquatic resources, is considered a regional component of the National Fish Habitat Initiative (NFHI), which began in 2004 under the auspices of the Association of Fish and Wildlife Agencies. Other examples of regional partnerships, such as Landscape Conservation Cooperatives and Bird Joint Ventures, have been described in an earlier section of this chapter.

Regional partnerships are important for coordination of conservation efforts and development of greater capacity to address regional conservation needs. Other important approaches include development of in-state partnerships to share resources and expertise, reallocation of existing staff to address areas of greatest conservation need, and

exploration and development of new funding sources. Examples of important in-state partnerships include the Georgia Plant Conservation Alliance, the Interagency Burn Team, and the Coastal Georgia Cooperative Invasive Species Management Area.

One of the most important areas of collaboration for wildlife conservation is land acquisition. Over the past decade, the State of Georgia has acquired approximately 104,000 acres of land, using state appropriations, federal grants, and private donations. Nearly all of these land acquisition projects involved multiple fund sources and conservation partners. Establishment of a long-term, dedicated source of funding at the state level would help ensure that public agencies have an opportunity to protect critically important conservation lands. Similarly, additional funding at the federal level through the State Wildlife Grants, Land and Water Conservation Fund, North American Wetlands Conservation Act, Forest Legacy, Coastal Wetland Grants, and Recovery Land Acquisition Grants programs would provide greater land conservation capacity to state wildlife agencies and other conservation groups.

In addition to fee-simple acquisition (purchase of land with all property rights), effective preservation tools include long-term and permanent conservation easements on private lands. These are voluntary agreements that allow landowners to limit the type or amount of development on their properties or to protect sensitive natural habitats. In recent years, protection of land through conservation easements has increased dramatically in Georgia, in part due to federal and state tax incentive programs. State agencies such as the Georgia Department of Natural Resources and the Georgia Forestry Commission have partnered with land trust organizations and private landowners to protect thousands of acres of land through easements. Currently, more than 250,000 acres in Georgia are protected through conservation easements held by 52 different organizations. Continuation of federal and state incentives for conservation easements is critical for long-term conservation of wildlife habitats on private lands.

Members of the technical teams and other stakeholders provided recommendations regarding improvements in staffing, funding, database development and use, and other issues. Listed below are the highest rated action items relating to development or augmentation of resources needed for conservation of Georgia's wildlife. See the Conservation Actions table in Appendix P for more details.

<u>Highest Priority Conservation Actions</u>

- Strengthen the network of support for wildlife conservation programs and initiatives. Strengthen coalition of environmental organizations to communicate SWAP objectives and work for improvements in policies, funding, and capacity for wildlife conservation.
- Improve biodiversity databases and increase data-sharing with conservation partners. Develop protocol for electronic submission of rare species datasets to WRD. Establish formal data-sharing agreements with UGA and other conservation partners.

- Establish a consistent source of state funding for land protection to support wildlife conservation.
- Increase availability and use of federal funds for land acquisition (fee-simple and conservation easements) and land management.
- Increase state funding to support WRD's nongame wildlife conservation efforts.
- Facilitate DNR Law Enforcement Division officer training to address nongame wildlife law enforcement needs
- Expand DNR Nongame Conservation Section aquatic program so that each major basin in the state has an aquatic species conservation coordinator.
- Improve capacity to work with corporate landowners to protect wildlife habitat; provide enhanced technical support through additional staff or contractors.
- Improve biodiversity databases and increase data sharing with conservation partners. Establish formal data-sharing agreements with conservation partners.

Reducing Impacts from Development and Other Activities

Continued growth of Georgia's human population and associated loss or fragmentation of natural habitats will undoubtedly result in more impacts to native species. Of particular concern are habitat specialist species adapted to rare or sensitive habitats (e.g., cave-dwelling organisms or granite outcrop plants).

Every effort should be made to minimize impacts of development, recreation, and other activities on these organisms and their habitats. The highest rated conservation actions related to reduction or avoidance of impacts from development and other activities on high priority species and habitats are found below. See the Conservation Actions table in Appendix P for more information.

<u>Highest Priority Conservation Actions</u>

- Expand use of WRD biodiversity data for environmental review, public outreach, permitting, and development of site management plans to minimize impacts on rare species and sensitive habitats.
- Work with the Georgia Department of Transportation and federal agencies to minimize impacts from highway construction and facilitate protection and mitigation of high priority habitats.
- Continue working with the Georgia Department of Transportation, Federal Energy Regulatory Commission, and pipeline companies to minimize the impacts to high priority species and habitats from petroleum pipeline development.
- Work with the Bureau of Ocean Energy Management, developers, and regulators to minimize impacts to high priority species and habitats from the exploration and potential development of resources off the coast of Georgia.
- Conserve populations of rare plants in transmission line corridors; maintain or enhance native vegetation for pollinators and migratory birds.

- Reduce impacts of unpaved roads, parking lots, boat ramps, and camping areas on aquatic habitats.
- Implement targeted dam and culvert removal/replacement projects and mitigation projects to restore and conserve stream banks and channels.
- Provide technical assistance to farmers to protect streams in high priority watersheds
- Facilitate training for and compliance with Best Management Practices for erosion and sedimentation control, stormwater runoff, and stream buffer protection.
- Update Georgia Department of Transportation mussel sampling protocol.

Wildlife Laws and Regulations

State and federal laws pertaining to wildlife conservation provide mandates for state and/or federal agencies to protect natural resources for the benefit of society. These include regulations dealing with the conservation of rare species, natural areas, and specific natural habitats (e.g., caves, salt marshes, coastal dunes), regulation of take of game and nongame wildlife (e.g., hunting and fishing regulations, collecting permits), review and permitting of mining, dam construction, groundwater withdrawal, road construction, utility construction, and similar projects; adjustments to land valuation and taxation based on conservation easements; and laws relating to development of local or regional land use plans and greenspace protection plans. During the course of this planning effort, assessments of existing laws, regulations, and policies were made in order to assess the effectiveness of regulatory efforts in conserving Georgia's wildlife diversity. Some species of wildlife are impacted by direct take or commercial harvest, both of which are regulated by state or federal law.

The intent of this assessment was to examine existing laws and regulations and to determine where opportunities to protect biological diversity could be improved by increasing public awareness of existing laws, promoting interagency cooperation in law enforcement, ensuring appropriate consideration of wildlife impacts in environmental review procedures, and utilizing information on rare species and natural communities to inform local or regional land use plans and greenspace protection plans. Several areas of recommended improvement were identified during this assessment. The highest priority items are listed below.

<u>Highest Priority Conservation Actions</u>

Highest priority conservation actions pertaining to the regulatory aspects of wildlife conservation are listed below. Information on lead organizations, partners, funding sources and other details for these and other recommended actions can be found in the Conservation Actions table.

- Update the state-protected species list and work with partners to improve conservation and management of these species. Conduct a review of Georgia's

protected species list at least once every five years and engage key partners to improve management programs for these species.

- Enhance DNR Law Enforcement training and staffing to address nongame wildlife law enforcement needs. Provide additional training on laws and regulations established to protect nongame wildlife and additional staff resources to handle enforcement of nongame and protected species regulations.
- Improve coordination of environmental review procedures within DNR to ensure that potential impacts to rare species and sensitive natural habitats are adequately addressed for all major projects.
- Protect high priority species and habitats through the Statewide Water Planning Process
- Propose a list of species to supplement the list of wild animals set forth in Georgia Code for which a permit or license, or both, is required. The list could include non-native invasive species of the pet trade. Suggest recommendations on specific restrictions or guidelines for issuing permits.

Monitoring and Adaptive Management

One of the goals of this effort is development of plans to monitor high priority species and habitats as well as conservation actions for those elements of biodiversity. Monitoring programs are essential in order to assess the success of conservation programs and to facilitate adjustments in these programs to increase their efficacy; this ability to change management options based on an objective assessment of past efforts is known as adaptive management. The types of data needed for this conservation objective pertain to the quantity, distribution, and condition of habitats and populations.

Monitoring is a valuable conservation tool used by researchers, biologists, and conservation practitioners to help detect change or significant occurrences. From the collection of basic qualitative data by conservation site managers to the analysis of large long-term datasets by statisticians, monitoring can shape conservation and management efforts in a positive way. In Georgia, monitoring of species, natural communities, and landscapes has previously taken place at many scales by different conservation agencies and organizations. The efforts of the SWAP Revision Monitoring Technical Team included determining how individuals and groups are currently monitoring in Georgia and identifying ways to improve monitoring in the next five to ten years.

The 2005 SWAP discussed the importance of monitoring specific priority species and habitats. For the 2015 SWAP Revision, the team summarized priority monitoring projects provided by each SWAP Revision taxa technical team and made recommendations on how to improve monitoring in Georgia. The Monitoring Technical Team report is found in Appendix J.

Given the fact that monitoring is both time-consuming and relatively expensive in terms of labor costs, there is a need to place realistic limits on the number of species and habitats monitored. In addition, opportunities to use volunteer and "citizen scientist"

groups should be explored. High priority species for monitoring programs will be those that are readily identifiable in discernible populations large enough to be measured or estimated consistently over time. For habitats, the situation is similar but more complex and problematic. Habitats do not conform to a standard taxonomy, and there are relatively few standardized methods for measuring habitat quality. The creation of comprehensive habitat monitoring programs requires participation by a variety of partners, both public and private.

The approach taken in this planning effort has been to incorporate monitoring activities as components of each proposed conservation action. Focal species and habitats are indicated, lead and partner organizations are identified, and funding sources are listed. In addition, the types of data that will be collected and the relevant performance indicators have been described or outlined in this table. More work is needed in order to develop detailed monitoring programs for each conservation action. However, it is apparent from the diverse array of high priority conservation actions identified in this document that monitoring will take place at a variety of geographic and ecological levels and will involve partnerships with a number of organizations.

In addition, the following specific strategies will be employed as appropriate to improve the monitoring aspects of this conservation strategy.

- Strengthen and expand the fire photo monitoring program. Tasks for improvement include: develop efficient software mechanisms to submit, catalogue, view, and quantitatively analyze photos; expand sites to monitor different management types, WMA's, and reference habitats; and incorporate quantitative data into the protocol at high priority sites.
- Create a state-level matrix of conservation actions undertaken by all major conservation partners and use this as a benchmark to document progress toward conservation goals identified in this strategy (see Conservation Actions table)
- Include monitoring components and standards for conservation projects proposed for funding through the State Wildlife Grants program or other funding sources, and ensure that these include objective and measurable performance indicators.
- Improve citizen and volunteer involvement in monitoring projects. Technology should be used to increase efficiency of engaging and training citizens and volunteers to assist with monitoring projects. This includes using online tools, social media, and smart-devices to aid training, share protocols, and collect data.
- Conduct monitoring and research on white-nose syndrome.
- Assess populations of high priority terrestrial birds in the Coastal Plain (e.g. swallow-tailed kite, southeastern American kestrel, painted bunting, Henslow's sparrow).
- Continue calling frog survey routes as part of the North American Amphibian Monitoring Program
- Continue efforts by the WRD Stream Survey Team to monitor streams statewide using Index of Biotic Integrity protocols.

Public-Private Partnerships for Land Conservation

More than 90% of the land base of Georgia is in private ownership. Several programs that represent specific efforts to enlist and engage private landowners in wildlife conservation have been mentioned above. Like other wildlife agencies, WRD depends on support from private landowners to accomplish its mandated objectives. Georgia's wildlife cannot be conserved solely through the actions of public agencies, nor can fee simple land acquisition be the "silver bullet" in land conservation.

The Georgia Land Conservation Program provides loans for conservation projects by local governments and administers the Georgia Conservation Tax Credit Program, an incentive program that provides an income tax credit for donations of land or conservation easements. Other opportunities for public-private partnerships in conservation include the use of general obligation bonds to fund certain types of private ventures to protect "working landscapes" (i.e., forestry or agricultural lands) for specific wildlife conservation goals (Dechter, 2003), state leases of private lands for public recreational access, and application of development fees to rural land protection through application of conservation easements or fee simple acquisition. In the field of rare species recovery, Safe Harbor Agreements and Habitat Conservation Plans provide flexibility as well as regulatory relief for private landowners cooperating with public wildlife agencies.

A new area that has provided opportunities for land conservation is the application of federal funds to protect lands adjacent to military bases from development using conservation easements; this can serve a dual purpose of maintaining base operational viability and protecting important wildlife habitat. State wildlife agencies in Georgia North Carolina, South Carolina, and Florida are currently working with U.S. Department of Defense installations to identify potential areas of common interest in land acquisition and uses. Similar programs may be available for lands adjacent to national parks and other public propertie

Maintaining Georgia's Forest Lands

The success of the Georgia SWAP depends on the existence of healthy, well-managed forests. Presently, Georgia has nearly 24 million acres of forestland, 75% of which is owned by thousands of non-industrial private landowners. These landowners manage their forests for a variety of objectives, including timber production, recreation, wildlife habitat, aesthetics, or quite often for a combination of these.

Many factors will determine whether Georgia will continue to have an adequate, sustainable forested environment to support a diverse wildlife population. Landowners and state policy-makers, those who are in a position to protect the state's forested land from conversion to non-forest uses, must have a long-term view when planning for land management and creating statutory and regulatory policy. Today, there are a number of disturbing trends which over time threaten to reduce the state's forestland and thus diminish the number, range and quality of wildlife habitats. Among these trends are the need for new markets for wood and fiber grown on private forestland, corporate divestiture of timber property, global competition, federal estate tax laws, urban and suburban sprawl and ad-valorem tax policy that taxes forest land on its 'highest and best' use rather than its current use. The degree to which these trends are addressed will determine whether many landowners and tree farm families will keep their land in trees, sell them, or convert them to non-forest uses such as commercial developments.

Future Challenges

The changes that are occurring in the Georgia landscape as a result of population growth and increasing development pressures present daunting challenges to those involved in wildlife conservation. The trend of increasing fragmentation and degradation of natural habitats is likely to continue in the coming decades, driven by local, national, and global economic and demographic factors. Many scientists believe that the next fifty years will be a critical period in the struggle to protect our remaining biological resources.

The following elements are critical for conservation of Georgia's natural heritage: (1) increased emphasis on field research focused on the identification and assessment of species, biotic communities, and ecosystems; (2) greater commitment of resources to identify and protect those habitats that contribute most significantly to biodiversity; (3) further development and funding of conservation programs that emphasize public-private partnerships for broad-scale conservation of "working landscapes"; (4) greater emphasis on land use planning to minimize impacts of future developments on natural habitats; and (5) increased collaboration between researchers and educators to heighten public awareness of the magnitude and significance of biodiversity decline in the state. The Department of Natural Resources will continue to work with a wide array of public agencies, private conservation organizations, research institutions, sportsmen's groups, educators, local governments, and landowners in the coming years to address these critical elements of wildlife conservation.

VI. Procedures for SWAP Review and Revision

The State Wildlife Action Plan (SWAP) outlined in the preceding sections reflects an assessment of wildlife conservation needs and recommended programs to address those needs based on data available in 2013-2015. This picture of the conservation needs of Georgia's species and habitats may change based on the result of additional surveys, results of monitoring efforts associated with management efforts, or new trends in land uses. In addition, the development of new analytical techniques, funding programs, or legislative mandates may result in a need to reassess some of the conservation priorities described in this document. The essence of adaptive management is the ability to change priorities and approaches in respond to new information and/or changing conditions.

The intent of the Wildlife Resources Division is to begin a comprehensive review of the current version of the SWAP within the next eight years, and to adopt revisions to the strategy as deemed necessary based on this review. In order to do this, we propose to reconvene the technical teams and advisory committee to assess and address changing conservation needs for species and habitats in Georgia. The procedure for this review is outlined below:

1) Compile updated information on the current status of high priority plants and animals, as well as their associated habitats
2) Revise lists of high priority species based on updated information on status, condition, and distribution
3) Review conservation actions proposed and implemented during the preceding years and assess the effectiveness of these actions
4) Reassess problems affecting high priority species and habitats as well as research and survey needs
5) Reevaluate education, outreach, and monitoring needs
6) Develop revised strategies for high priority species and habitats based on reassessments of conservation needs and opportunities
7) Compile and summarize proposed strategies and submit these to the advisory committee for review and approval
8) Conduct stakeholder meetings as directed by advisory committee
9) Solicit public input via the WRD website and public meetings
10) Complete revision of the wildlife action plan and begin implementation

This comprehensive review and revision process will begin within eight years following the completion of this version of the SWAP, and the various assessments will be completed within one year. The revision of the SWAP will be completed within two years of the start of the assessment, or no later than August 2025. In addition, informal annual assessments will be undertaken to assess changes in funding levels, laws and regulations, successes and failures in species recovery efforts, and new research findings in order to determine what changes, if any, are warranted in implementation of this wildlife conservation strategy.

Acronyms and Abbreviations Used in This Document

AAS	Adopt-A-Stream
ACCG	Association County Commissioners of Georgia
AFT	American Farmland Trust
AFWA	Association of Fish and Wildlife Agencies
AMBUR	Analyzing Moving Boundaries Using R
APHIS	Animal and Plant Health Inspection Service
ATV	All-terrain vehicle
AVM	Avian Vacuolar Myelinopathy
BCI	Bat Conservation International
Bd	*Batrachochytrium dendrobatidis*
BMP	Best Management Practice
BQI	Bobwhite Quail Initiative
BR	Blue Ridge
CCRP	Continuous Conservation Reserve Program
CP	Coastal Plain
CPGL	Conservation of Private Grazing Lands
CRD	Coastal Resources Division
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CSC	Climate Science Center
CSP	Conservation Security Program
CU	Cumberland Plateau
CUVA	Current Use Valuation of Conservation Use Property
CWCS	Comprehensive Wildlife Conservation Strategy
CWD	Chronic Wasting Disease
DCA	Department of Community Affairs
DNR	Department of Natural Resources
DOD	U.S. Department of Defense
DOE	Georgia Department of Education
DOI	U.S. Department of Interior
EEA	Environmental Education Alliance of Georgia
ECP	Emergency Conservation Program
EO	Element Occurrence
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
EQIP	Environmental Quality Incentives Program
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FWHA	Federal Highway Administration
FLEP	Forest Land Enhancement Program
FLP	Forest Legacy Program
FRPP	Farm and Ranch Lands Protection Program
FSA	Farm Services Agency
FSP	Forest Stewardship Program

FWP	Forestry for Wildlife Partnership
GADNR	Georgia Department of Natural Resources
GAP	Gap Analysis Program
GDA	Georgia Department of Agriculture
GEFA	Georgia Environmental Facilities Authority
GEPI	Georgia Environmental Policy Institute
GDNR	Georgia Department of Natural Resources
GDOT	Georgia Department of Transportation
GFA	Georgia Forestry Association
GFC	Georgia Forestry Commission
GIS	Geographic Information System
GMA	Georgia Municipal Association
GMNH	Georgia Museum of Natural History
GNHP	Georgia Natural Heritage Program
GOS	Georgia Ornithological Society
GPC	Georgia Power Company
GPCA	Georgia Plant Conservation Alliance
GRP	Grassland Reserve Program
GSS	Global Significance Score
GSWCC	Georgia Soil & Water Conservation Commission
GWF	Georgia Wildlife Federation
HCP	Habitat Conservation Plan
HUC	Hydrologic Unit Code
IAFWA	International Association of Fish and Wildlife Agencies
IBI	Index of Biotic Integrity
IBT	Interagency Burn Team
JFSP	Joint Fire Science Program
JV	Joint Venture
LCC	Landscape Conservation Cooperative
LCP	Lower Coastal Plain
LiDAR	Light Detection and Ranging
LIP	Landowner Incentive Program
MDL	Multi-District Litigation
MEAG	Municipal Electric Authority of Georgia
MW	Megawatts
NARSAL	Natural Resources Spatial Analysis Laboratory
NCS	Nongame Conservation Section
NESPAL	National Environmentally Sound Agricultural Laboratory
NFHI	National Fish Habitat Initiative
NFWF	National Fish and Wildlife Foundation
NGO	Nongovernmental organization
NLCD	National Land Cover Dataset
NMFS	National Marine Fisheries Service
NNL	National Natural Landmark
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service

NRCS	Natural Resources Conservation Service
NWCG	National Wildfire Coordinating Group
NWF	National Wildlife Federation
NWNHS	Nongame Wildlife & Natural Heritage Section
OCGA	Official Code of Georgia
ORV	Off-road vehicle
PARC	Partners in Amphibian and Reptile Conservation
PD	Piedmont
PFW	Partners for Fish and Wildlife
PIF	Partners in Flight
PRHSD	Parks, Recreation, and Historic Sites Division
RC&D	Resource Conservation and Development Council
RCW	Red-cockaded woodpecker
ROW	Right-of-Way
RV	Ridge and Valley
SARP	Southeast Aquatic Resources Partnership
SA/RV	Southwestern Appalachians/Ridge and Valley
SCCI	Southeastern Cave Conservancy, Inc.
SCP	Southern Coastal Plain
SCWDS	Southeastern Cooperative Wildlife Disease Study
SEAFWA	Southeastern Association of Fish and Wildlife Agencies
SEARS	Southeastern At-Risk Species Program
SECAS	Southeastern Conservation Adaptation Strategy
SEIA	Solar Energy Industry Association
SEPARC	Southeast Partners in Amphibian and Reptile Conservation
SERDP	Strategic Environmental Research and Development Program
SFD	Snake Fungal Disease
SFI	Sustainable Forestry Initiative
SINERR	Sapelo Island National Estuarine Research Reserve
SIVVA	Standardized Index of Vulnerability and Value
SLAMM	Sea Level Rise Affecting Marshes Model
SP	Southeastern Plains
Strategy	National Fish, Wildlife, and Plants Climate Adaptation Strategy
SWAP	State Wildlife Action Plan
TCF	The Conservation Fund
TGC	The Georgia Conservancy
TDR	Transferable Development Rights
TMDL	Total Maximum Daily Load
TNARI	Tennessee Aquarium Research Institute
TNC	The Nature Conservancy
TPL	Trust for Public Land
UGA	University of Georgia
UCP	Upper Coastal Plain
URTD	Upper Respiratory Tract Disease
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture

USFS	U.S. Forest Service
USGS	U.S. Geological Survey
USFWS	U.S. Fish and Wildlife Service
VA	Vulnerability Assessments
VSU	Valdosta State University
WHIP	Wildlife Habitat Incentives Program
WINGS	Wildlife Incentives for Nongame and Game Species
WMA	Wildlife Management Area
WNS	White Nose Syndrome
WRD	Wildlife Resources Division
WRP	Wetlands Reserve Program
WSFR	Warnell School of Forest Resources

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