ALABAMA Wildlife Action Plan

2015 - 2025

Terwilliger Consulting Inc.
and
Conservation Southeast Inc.

Alabama Department of
Conservation and Natural Resources
Division of Wildlife and Freshwater Fisheries
Traci Wood, Habitat and Species Conservation Coordinator

Table of Contents

EXECUTIVE SUMMARY

This document is the 10-year update of Alabama's Comprehensive Wildlife Conservation Strategy (CWCS, now called the State Wildlife Action Plan [SWAP]), an effective strategy for wildlife conservation supported through the U.S. Fish and Wildlife Service's State Wildlife Grants (SWG) program. This opportunity enabled the Alabama Department of Conservation and Natural Resources (ADCNR) to assess and address its outstanding wildlife diversity on a comprehensive statewide scale.

Alabama surpasses all eastern states in plant and animal diversity, ranking fifth in the nation after California, Texas, Arizona, and New Mexico (Alabama Natural Heritage Program 2003). Alabama ranks first in the nation in freshwater species diversity, including more than 750 species of freshwater fishes, mussels, aquatic snails, and crayfishes. Unfortunately, no state east of the Colorado River has more wildlife species at risk than Alabama. Only Hawaii, California, and Nevada have more imperiled species, and only Hawaii has lost more species to extinction (Stein 2002). Mankind's alteration of Alabama's natural landscape and waterways has contributed to the extinction or extirpation of more than 100 animal species. The SWAP plays a key role in preventing further endangerment of wildlife.

The 2005 CWCS guided major accomplishments over the last 10 years, like restoration of priority habitats including longleaf and shortleaf pine and native grasses on Wildlife Management Areas, State Parks, and private lands. It helped establish the Aquatic Biodiversity Center which helps recover freshwater mussels and snails in Alabama's key rivers and streams. It supported important research on rare, aquatic life, removed barriers to fish migration and breeding, and reintroduced threatened species.

For the 2015 SWAP revision effort, the Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries (DWFF) compiled, coordinated and integrated the best available scientific information on the status of Alabama's wildlife and the concerns, recommendations and existing conservation priorities of a diverse array of public and private stakeholders. Regional and nation level coordination was maintained throughout this effort, as well as adhering to guidance from the Association of Fish and Wildlife Agencies (AFWA 2012). It built upon the solid framework of the 2002 and 2012 Nongame Conferences which assembled scientific experts and stakeholders to compile the best data on the full array of Alabama's wildlife and from that identify those species of greatest conservation need (SGCN). This SWAP updates and expands the Conference proceedings, *Alabama Wildlife* (Mirarchi et al. 2004), by engaging public and private stakeholders, including local, regional, state and federal agencies, organizations and tribes to identify priority conservation targets and actions for the next decade.

The SWAP revision process began with an update to the exhaustive inventory of existing natural resource information, programs and stakeholders. DWFF staff and contractors facilitated stakeholder participation in the development of the SWAP revision process as well

as identification of wildlife species and habitats, threats and conservation actions. Leading experts and conservation partners from the private and public sectors helped develop, refine and prioritize conservation actions. The process resulted in significant coordination of conservation priorities from this diversity of programs and engaged a broad network of individuals and partners to improve communication, coordination and integration. It fostered the "system" approach that addressed wildlife species in the context of broader habitat associations and more holistic assemblages representing biotic communities for more effective conservation.

Altogether, 366 aquatic and terrestrial wildlife species were identified as SGCN. These SGCN fauna include 27 mammals, 28 reptiles, 19 amphibians, 29 birds, 63 fish, 100 mussels, 52 aquatic snails, 44 crayfishes, and 4 species from other groups. Although significant progress has been made since the 2005 CWCS, there is still a lack of information regarding the status of several invertebrate groups, and they will be targeted for further research with the intent of incorporating them into future revisions of the SWAP.

SGCN were associated with 16 key habitats and 15 river basins, including several types of forest, wetlands, and other unique communities such as caves and coastal beaches. The location, distribution and condition of each of these habitats was researched and summarized along with the SGCN it supports. Problems or threats facing the habitat and/or its species; priority research, survey and monitoring needs; an itemized list of priority conservation actions and key partnerships opportunities for implementation; high priority areas of the state for conservation; anticipated products and/or performance measures for each research and conservation action item; and a list of sources for more information were developed for each key habitat.

Alabama's land and waterscapes are threatened by habitat loss and fragmentation, loss of natural community integrity, impacts from disturbance and exotic species, and lack of adequate protection or information. The current distribution and status, as well as various aspects of life history and biology are poorly known for most SGCN in most habitats. Insufficient conservation-related education and outreach about biologically significant areas and species also threatens many habitats and species.

To address these threats, a series of conservation actions were developed for SGCN and key habitats. In some cases, educational outreach is needed to improve the public's level of understanding and need for stewardship of Alabama's fish and wildlife resources and their habitats. In other instances, specific research or landowner and partner outreach and coordination are needed to protect threatened habitats and/or SGCN. Controlling exotic species, restoring the use of fire to certain communities and reintroducing certain extirpated or rare aquatic species were also identified as high priority conservation actions. Supporting the full implementation of numerous partners' plans, including river basin management plans, federally listed species' recovery plans, Partners in Flight bird conservation plans, and the USFS Revised Management Plans were found to be important conservation actions as well.

Overarching statewide conservation actions were also developed, as many actions recurred for many species and habitats, and in existing conservation plans. Alabama's conservation actions therefore addressed needs at multiple scales and levels. The implementation of conservation actions will be coordinated with key partners wherever possible, including the U.S. Fish and Wildlife Service, U.S. Forest Service, Natural Resources Conservation Service, U.S. Army Corps of Engineers, Tennessee Valley Authority, Alabama Forestry Commission, Tennessee Aquarium Research Institute, The Nature Conservancy, Partners in Flight, watershed groups, Forever Wild, land trusts, and many others.

Local, state and federal agencies and tribal partners were asked not only for input, but also to review the draft SWAP and their comments were incorporated into the final document. An effective measure of coordination success will be the degree to which each of these partners integrates SGCN, habitats and conservation actions into their plans and programs. One example of how this occurred in the 2005 CWCS is that of the U.S. Forest Service incorporating the SGCN and habitats into their Revised Land and Resource Management Plan.

The implementation of SWAP priority conservation actions will be monitored via a DWFF tracking system that is based upon collaboration between the DWFF and the State Lands Natural Heritage Section and GIS databases that track Alabama's fish and wildlife resources. As conservation actions are implemented, their effectiveness will be reviewed biennially by DWFF, and the status of species and habitats reassessed by the expert Taxa Committees and Technical Team. As needed, the conservation actions will be modified or new actions identified based on the effectiveness of the original actions in aiding the state's SGCN and habitats as intended. The SWAP will be updated every 10 years to reflect this adaptive management approach, allowing the document to remain current to Alabama's needs to comprehensively conserve its fish and wildlife resources and their habitats.

ACKNOWLEDGMENTS

An attempt to acknowledge all contributors to this plan would no doubt result in an incomplete list. We thank each one of them for the invaluable contributions of their knowledge, experience and time with Alabama's wildlife which enabled us to improve this SWAP revision. We would like to particularly thank the following key individuals who served on the Scientific Review and/or Advisory Committees:

James Agerton (Poarch Creek Tribe), Stan Cook (ADCNR-DWFF Fisheries), Carol Denhof (The Longleaf Alliance), Jason Dockery (AFC), David Elliott (Poarch Creek Tribe), Jeff Garner (ADCNR-DWFF Fisheries), Jim Godwin (ALNHP), Craig Guyer (AU), Judy Haner (TNC), Lisa Huff (ADEM), Paul Johnson (ADCNR-AABC), Stuart McGregor (GSA), Pat O'Neil (GSA), Ashley Peters (ADCNR-SLD), Ad Platt (The Longleaf Alliance), Jeff Powell (USFWS), Ryan Prince (AFC), Nicholas Sharp (ADCNR-DWFF Nongame), Ryan Shurette (USFS), Billy Smith (Poarch Creek Tribe), Eric Soehren (ADCNR-SLD), Eric Spadgenske (USFWS), David Steen (AU), Carrie Threadgill (ADCNR-DWFF Nongame).

Maps, except where otherwise indicated, were created by Ashley Peters of ADCNR- State Lands Division.

Photographers who generously donated their work include Sara Bright, Alan Cressler, John Dindo, Craig Guyer, Patric Harper, Fontaine Howard, John Jensen, Paul Johnson, Pat O'Neil, Malcolm Pierson, Nick Sharp, Eric Soehren, Bill Summerour, Guenter Schuster, Thomas Tarpley, Carrie Threadgill, John Trent, Traci Wood, and Beth Young.

The Alabama SWAP Team

Traci Wood, ADCNR-DWFF

Karen Terwilliger, Terwilliger Consulting, Inc.

Mark Bailey, Conservation Southeast, Inc.

Cover photographs: Mark Bailey (Gopher Tortoise); Sara Bright (Mitchell's Satyr); Fontaine Howard (Black Bear); John Jensen (Pine Barrens Treefrog); Paul Johnson (Tulotoma Snail); Pat O'Neil (Watercress Darter); Guenter Schuster (Tennessee Bottlebrush Crayfish); Bill Summerour (Red Knot); Thomas Tarpley (Alabama Pearlshell). Cover design and document layout by Mark Bailey.

Acronyms Used in this Document

ACJV	Atlantic Coast Joint Venture
ACRL	Aquatic Conservation Research Lab
ACWP	Alabama Clean Water Partnership
ADCNR	Alabama Department of Conservation and Natural Resources
ADECA	Alabama Department of Economic and Community Affairs
ADEM	Alabama Department of Environmental Management
AEC	Alabama Electric Cooperative
AFA	Alabama Fisheries Association
AFC	Alabama Forestry Commission
AFWA	Association of Fish and Wildlife Agencies
ALDOT	Alabama Department of Transportation
ARSN	Alabama Rivers and Streams Network
AU	Auburn University
AWW	Alabama Water Watch
BCI	Bat Conservation International
BCR	Bird Conservation Region
Bd	*Batrachochytrium dendrobatidis*
CA	Conservation Action
CMP	Conservation Measures Partnership
CPO	Citizen Participation by Objective
CWCS	Comprehensive Wildlife Conservation Strategy
DoD	Department of Defense
DWFF	Division of Wildlife and Freshwater Fisheries
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
EX	Extirpated
EXCAU	Extirpated/Conservation Action Underway
FERC	Federal Energy Regulatory Commission
FGDC	Federal Geographic Data Committee
GAP	Gap Analysis Program
GIS	Geographic Information System
GMFMC	Gulf of Mexico Fishery Management Council
GSA	Geological Survey of Alabama
HAPC	Habitat Area of Particular Concern
IBI	Index of Biotic Integrity
IBA	Important Bird Area
IP	Interior Plateau
IUCN	International Union for Conservation of Nature
MBNEP	Mobile Bay National Estuary Program
NABCI	North American Bird Conservation Initiative
NEP	National Estuary Program
NERR	National Estuarine Research Reserve

NFWPCAP	National Fish, Wildlife and Plants Climate Adaptation Partnership
NGO	Non-governmental organization
NHS	Natural Heritage System
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NS-ALNHP	NatureServe-Alabama Natural Heritage Program
NWR	National Wildlife Refuge
P	Priority
P	Piedmont
PAI	Potentially Affected Interests
PARC	Partners for Amphibian and Reptile Conservation
PIF	Partners in Flight
QC	quailty control
RV	Ridge and Valley
SA	Southwestern Appalachians
SAV	Submerged Aquatic Vegetation
SCP	Southern Coastal Plain
SDIC	Systematic Development of Informed Consent
SDM	Structured Decision-making
SFD	Snake Fungal Disease
SGCN	Species of Greatest Conservation Need
SHU	Strategic Habitat Units
SLD-NHS	State Lands Division Natural Heritage Section
SP	Southeastern Plains
SRRU	Strategic River Reach Units
SWAP	State Wildlife Action Plan
SWG	State Wildlife Grants
TED	Turtle Excluder Device
TNC	The Nature Conservancy
TRACS	Tracking and Reporting Actions for the Conservation of Species
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNVC	U.S. National Vegetation Classification
WDC	Wildlife Diversity Coordinator
WMA	Wildlife Management Area
WNS	White Nose Syndrome

ACCOMPLISHMENTS SINCE 2005

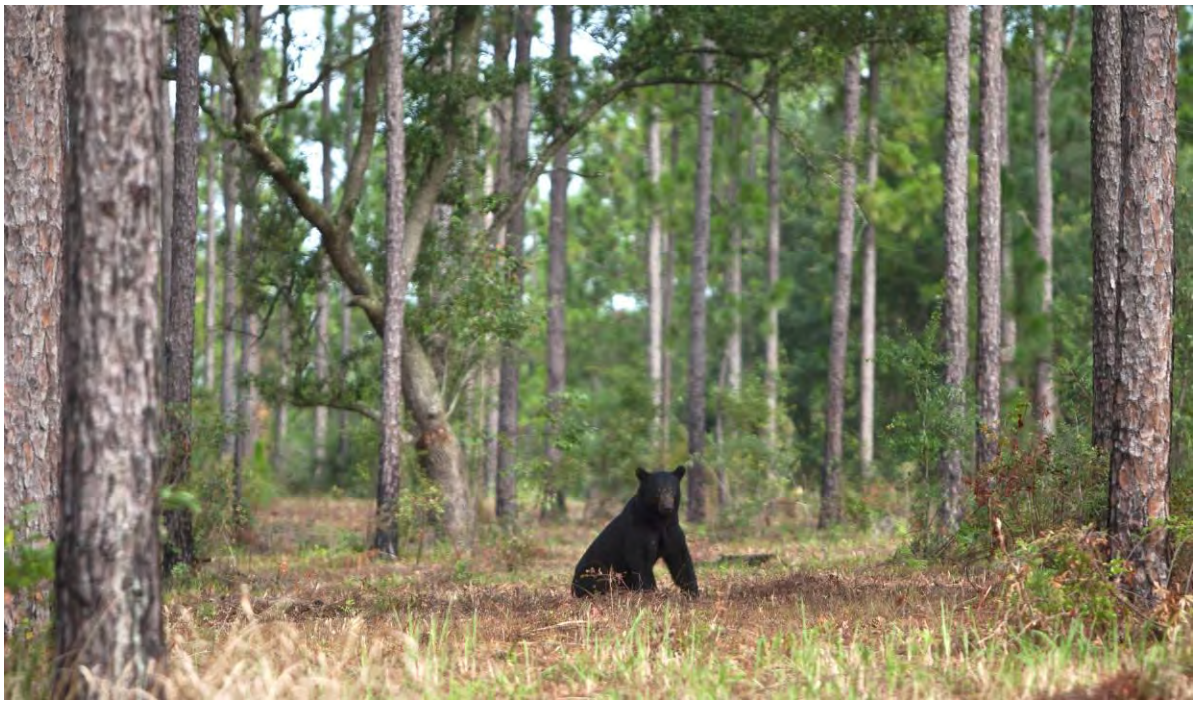
State Wildlife Grants have been critical in the implementation of the 2005 Alabama CWCS. SWG and the 2005 CWCS has allowed DWFF, in conjuction with many partners, to conserve, restore, and enhance the protection of SGCN. With a powerhouse of excellent conservation partners, the 2005 CWCS met goals and conservation actions beyond DWFF SWG funding. This cohesive effort afforded remarkable accomplishments over the past 10 years.

Terrestrial Accomplishments

Vertebrates

- Along with AU, AL A&M, and SLD-NHS, a monitoring program for biodiversity of terrestrial vertebrates on conservation lands within the Cumberland Plateau evaluated 63 high priority bird, mammal, amphibian and reptile species in the Skyline Wildlife Management Area and adjacent Forever Wild Land Trust properties. This information has been used to develop plans for timber management and wildlife conservation and management.

Mammals



Black Bear under Longleaf Pine, Mobile County Fontaine Howard

- In cooperation with AU, this current SWG funded project seeks to understand the abundance, distribution, ecology, diversity, population connectivity, habitat use, denning behavior, and viability of black bear populations in Alabama. Bears are captured and fit with GPS-enabled radio-telemetry collars to monitor their habitat use and denning behavior.

Amphibians and Reptiles

Indigo Snake at Gopher Tortoise Burrow, Conecuh National Forest Traci Wood

- Conecuh National Forest (CNF) is in the third year of a 30-year plan to restore the native longleaf pine ecosystem. This SWG funded project evaluated amphibian and reptile response to longleaf ecosystem restoration, compared current conditions to previous studies, identified potential reintroduction sites for rare and extirpated species, evaluated monitoring protocols of Partners in Amphibian and Reptile Conservation and provide educational opportunities for partners and resource managers.
- The ALNHP delineated Red Hill salamander habitat owned by International Paper; provided a status of the Red Hills salamander by estimating burrow density for each site; assessed and quantitatively describe Red Hills salamander habitat; assessed the ridgetops and provided restoration recommendations. Also, Florida State University, ALNHP, and UA prioritized land purchases within the Red Hills physiographic province that would maintain and promote the continued existence of rare and endemic species.
- A captive breeding program for the threatened Eastern Indigo Snake began in 2006 in cooperation with USFWS, USFS, ALNHP and AU for reintroduction into Conecuh National Forest. This project has expanded its partners to include Zoo Atlanta, Georgia DNR, The Orianne Society and the Orianne Center for Indigo Conservation (OCIC). Approximately 100 snakes have been released into Conecuh National Forest.
- Implementation of active tortoise management to enhance populations on the Conecuh National Forest is critical to the USFS for maintenance of longleaf herpetofauna. USFS, DWFF, AU, and ALNHP developed a plan for implementing herpetofauna repatriation projects, surveyed and mapped burrows of Gopher Tortoises for releases of Eastern Indigo Snakes, and established penned sites for relocation of adult Gopher Tortoises and juvenile Eastern Indigo Snakes.
- Threats were evaluated that may have contributed to the decline of the Diamondback Terrapin by UAB. Understanding the threats that contributed to the decline of the diamondback terrapin is critical for the development of optimal management strategy for enhancing the recovery of this depleted species.

- AU conducted a survey of Gopher Tortoise burrows which resulted in comprehensive maps of burrows on three key properties; a model that uses soil type, overstory vegetation structure, and understory vegetation cover to predict density of Gopher Tortoise burrows; and conducted an assessment of where on these three properties conservation banks for Gopher Tortoises might be established.

Birds

Golden Eagle Carrie Threadgill

- DWFF Nongame Wildlife Program assists with a Golden Eagle project with ADCNR State Lands, USFS, Friends of Talladega Group, and Tennessee Wildlife Resource Agency. Birds are captured and equipped with cellular transmitters to learn more about the movements of the eastern population.
- SWG assisted with the framework for the East Gulf Coastal Plain Joint Venture by employing a Coordinator, establishing a management board and technical committees, drafting a long-term strategy for comprehensively addressing bird conservation and worked with AU to implement conservation strategies for high priority bird habitats.
- An Alabama Breeding Bird Atlas lead by the Alabama Ornithological Society was completed with the active participation of hundreds of volunteers. Detailed distribution maps for 165 species were produced which added a significant planning resource to scientists, conservationists, land managers, and government agencies.
- The Appalachian Mountains Bird Conservation Region Initiative (AMBCRI) engaged in planning, implementation, monitoring and evaluation activities linked to the delivery of

continental and range-wide bird conservation goals expressed in the North American Waterfowl Management Plan, Flyway Plans, the Partners in Flight Plan, the U.S. Shorebird Conservation Plan, North American Woodcock Management Plan, Northern Bobwhite Conservation Initiative, and the North American Waterbird Conservation Plan. The AMBCRI has been an effective means of leveraging, coordinating and efficiently utilizing the fiscal and logistical resources of bird conservation stakeholders in the region.

Habitats

Lauderdale WMA Carrie Threadgill

- An ecological assessment and terrestrial vertebrate surveys for Black Belt prairies were conducted by ALNHP, which resulted in geo-referenced locations and GIS maps, management and restoration recommendations, sites suggested for long-term protection and restoration, and identification of potential threats to habitat and species.
- DWFF restored 2,000 acres of shortleaf pine-bluestem habitat on Freedom Hills and Lauderdale Wildlife Management Areas.
- TNC performed longleaf pine habitat restoration on TNC owned lands: Autauga Sandhills, Bibb County Glades, and Splinter Hill Bog. Activities included prescribed burning, invasive exotic species removal, mechanical removal of encroaching hardwood and/or pine species, native groundcover restoration and planting of native tree species.
- DCNR restored 128 acres of storm damaged mixed timber at Gulf State Park to longleaf pine savanna.
- Inventory and conservation planning for species of greatest conservation need on DCNR Lands was conducted by Alabama Cooperative Fish and Wildlife Research Unit and developed multi-species Inventory and Conservation Plans (ICPs).
- The Alabama Wildlife Federation restored 8,839 acres of longleaf pine on private lands.

- The Longleaf Alliance restored 1,802 acres, enhanced 58,904 acres by mechanical means and prescribed fire, and eradicated 135 acres of invasives on private lands, Conecuh National Forest and AFC owned property.
- DWFF restored over 10,000 acres of longleaf pine on private lands through The Landowner Incentive Program, which includes funding from USFWS Partners for Fish and Wildlife Program and a Competitive SWG grant.
- Barbour WMA and the Coosa Forever Wild Tract restored 633 acres of longleaf pine through an awarded Competitive SWG grant.

Aquatic Accomplishments

Development of the Alabama Aquatic Biodiversity Center (AABC)

Culture laboratory at AABC Paul Johnson

- The DWFF AABC was developed in 2005, and is the largest state non-game recovery program of its kind in the United States. The mission of AABC is to promote the conservation and restoration of rare freshwater species. The facilities include three aquatic culture buildings with over 7,500 square feet of space under roof, a 4,300-square-foot administration building with office and laboratory space, and approximately 30 surface acres of aquatic culture ponds.
- Total species propagated - 60
- Total threatened and endangered species propagated - 26
- GCN species propagated – 15
- Total mollusks reintroduced – 119,746
- Total threatened and endangered mollusks released – 69,234

Development of Strategic Habitat Units (SHUS)

- The USFWS in conjunction with the, ADCNR and the GSA have selected watersheds and river segments in the five HUC-4 subregions in Alabama to focus conservation activities for managing, protecting, restoring, and recovering populations of rare fishes, mussels, snails, and crayfishes. These SHUs and Strategic River Reach Units (SRRUs) include a substantial part of Alabama's remaining high-quality rivers and streams and reflect the variety of small stream to large river habitats occupied by these species historically and/or currently.
- SHUs and SRRUs facilitate and coordinate watershed management and restoration efforts as well as to focus funding to address habitat and water quality issues. All of the SHUs currently support one or multiple federally listed species and/or critical habitat designated by the U.S. Fish and Wildlife Service.

Statewide Crayfish Research

- To fill gaps in the knowledge of Alabama crayfishes, SWG has funded five crayfish projects and partnered with GSA, University of Alabama, Illinois Natural History Survey (Chris Taylor) and Guenter Schuster.
- Alabama crayfish holdings in natural history museums had 4,600 records from 1,500 stream locations in the state and identified drainages and habitats that have been poorly collected over the years and that need to be sampled before we can begin to understand the distribution, occurrence, and rarity of crayfishes in Alabama. This review revealed distributional information for most Alabama species was lacking. A current statewide crayfish survey has identified at least 90 species of crayfish in Alabama, of which 10 are undescribed.
- Over 1,100 lots of crayfishes have been collected statewide since 2009, greatly refining the known distributions of many species.

Statewide Aquatic Snail Survey

- This SWG funded project began in 2014 and is for a comprehensive survey of aquatic snails in the state by DWFF. The survey will encompass the state in its entirety and include all taxa. This survey will significantly increase the knowledge base with regard to freshwater snail distributions in Alabama and will also provide insight into the conservation status of some narrow-range endemic species. Such information is fundamental to conserving and managing the fauna in perpetuity.

Other Statewide Accomplishments

- An assessment of low-head dam impacts on mollusk, crayfish, and fish assemblages was performed by AU.
- An Aquatic Nuisance Species Management Plan was developed by the Alabama Aquatic Nuisance Species Task Force, created by former Governor Bob Riley.

Tennessee River Basin

Replacement of low water crossing/fish barrier by bridge, Estill Fork. Traci Wood

- Comprehensive mussel survey efforts have taken place in the Paint Rock River, Elk River, and Bear Creek. Quantitative monitoring has been completed and fixed monitoring stations established in each basin. This provides quantiative data for a number of mussel SGCN (at least 15 species). GSA has completed fish IBI monitoring, biotic, and habitat monitoring in Bear Creek. Annual qualitative and quantitative sampling has been completed in Wilson tailwaters. Mussel life history studies have been completed for Alabama Lampmussel, Pale Lilliput, and Cumberland Bean. GSA has carried out two localized surveys on Restone Arsenal and Cane Creek Preserve. In 2012-2013, AABC reintroduced the following: Alabama Lampmussel to Paint Rock (2,200) and Bear Creek (3,000); Cumberland Bean to Paint Rock (269); Rabbitsfoot to Limestone Creek (270), Painted Creekshell to Limestone Creek (430), Oyster Mussel to Paint Rock (1,007), and Cumberland Moccasinshell to Bear Creek (140).
- Qualitative monitoring was conducted for the Corpulent Hornsnail, Moss Pyrg, Engraved Elimia, Round-rib Elimia, Slender Campeloma, Rugged Hornsnail, Skirted Hornsnail, Armored Rocksnail, Muddy Rocksnail, Warty Rocksnail. Specimens were gathered and sent to Smithsonian Institution for systematics evaluation. A possible new population of Slender Campeloma was located in Beaverdam Creek.
- The USFWS has completed a fish obstruction survey in Bear Creek and GIS overlays are under development. Studies have been conducted on Slackwater Darter and environmental DNA techniques developed (Johnston and Janowsik 2013, Johnston et al. 2013). Conservation

genetics studies have been completed for Slackwater Darter and Tuscumbia Darter (Fluker et al. 2011). Nesting habitat studies conducted for Lollypop Darter and two other darters (Johnston et al. 2010).

- In partnership with USFWS, TVA, Corps of Engineers, County Commissions, and TNC the DWFF Landowner Incentive Program restored and protected over 5,000 linear feet of streambank on private lands, and removed five barriers.

Coosa River Basin

- Surveys conducted include: Terrapin, Choccolocco, Yellowleaf Creek Creeks; Big Canoe Creek drainage; quantitative assessment of Weiss Bypass mussels and qualitative survey of Coosa River below Logan-Martin and Jordan dams. Life history, propagation, and reintroduction of several species were undertaken by AABC. Partner organizations include ADCNR, USFWS, Alabama Power Company, GSA, Appalachian State University, and Auburn University.
- In 2012-2013, AABC reintroduced the Alabama Rainbow (2,762), Alabama Creekmussel (53), and Southern Rainbow (183) to Choccolocco Creek. One hundred and eighty-four Five-lined Pocketbooks were reintroduced at Little River, and 2,034 Interrupted Rocksnails were reintroduced at Weiss Bypass.
- DWFF conducts annual stream IBI sampling in the Coosa River basin.

Cahaba River Basin

- The Upper Cahaba River was surveyed in 2005, the Lower Cahaba River surveyed in 2010, and a Little Cahaba River survey is currently underway. Partners: ADCNR, USFWS, GSA, University of Alabama.
- In 2012-2013, AABC reintroduced 74 Southern Combshells and 25,727 Spotted Rocksnails to Cahaba River, and 59 Coosa Moccasinshells to Little Cahaba River.
- DWFF conducts annual stream IBI sampling in the Cahaba River basin.

Black Warrior River Basin

- GSA compiled and integrated available water-quality, biological, geological, and other geographically related natural resources information into a DVD-based GIS for the Locust Fork and Mulberry Fork watersheds.
- GSA completed a comprehensive mussel survey in the North River in 2008, and from 2009-2011 conducted a survey for all SGCN in the basin. Some mussels were also recorded during an ADCNR comprehensive snail survey 2012-2013.
- In 2012-2013, AABC reintroduced 4,022 Plicate Rocksnails to Locust Fork.
- DWFF conducts annual stream IBI sampling in the Black Warrior River basin.
- Monitoring for the Watercress Darter has been conducted by ADWFF/District 5 and USFWS related to recent fish by the City of Birmingham.

Tombigbee River Basin

- A survey of East Fork Tombigbee River (in Mississippi but impacts Alabama) was conducted for all SGCN by ACRL and a glochidia stream drift study in Sipsey River was conducted by University of Alabama (Jacob Culp) and USFS (Wendell Haag).
- Fish host trials completed, propagation program initiated, captive ark population established, and reintroduction efforts are underway for the Southern Combshell.
- ACRL (Mike Gangloff, Appalachian State) working on *Elliptio* phylogeography.
- Ptychobranchus systematics work was completed by Kevin Roe in 2013.
- Monitoring of the Ovate Clubshell on the Sipsey River (Haag) was completed.
- A mussel bed containing the only known remaining populaiton of Heavy Pigtoe was delineated and quantitatively assessed by ADCNR in 2010.
- Reintroduction of the Orangenacre Mucket was conducted in the Locust Fork in 2014.
- DWFF conducts annual stream IBI sampling in the Tombigbee River basin for all SGCN.
- A survey was completed for the Ironcolor Shiner, but few specimens were collected to establish a broodstock.

Alabama River Basin

- DWFF conducts annual stream IBI sampling in the Alabama River basin for all SGCN.
- DWFF continues to sample on a yearly basis for the Alabama Sturgeon, but only one specimen has been collected since 2005. This was a reproductively-inactive male; therefore, the decision was made to implant a sonic tag in this fish and track its movement and determine its habitat.
- A survey was completed for the Ironcolor Shiner.
- ACRL (Mike Gangloff, Appalachian State) is currently working on Elliptio phylogeography.
- Systematics evaluation of the Rayed Kidneyshell was completed (Roe 2013).
- The AABC completed the *Margaritifera* report 2013.
- In 2012-2013, AABC reintroduced 330 Orangenacre Muckets to Tallatchee Creek.
- The Alabama River was surveyed for *Tulotoma* in 2010 by ADCNR and all snail species encountered were collected for processing and identification.
- The Southeastern Aquatic GAP project was initiated by AU to identify conservation areas in river basins where aquatic biodiversity and endemism are higher than other temperate rivers. A decision support system was developed for natural resource agencies for use in conservation planning and land and water management.

Chattahoochee River Basin

- Chattahoochee tributaries were surveyed by GSA from 2006-07. Chipola headwaters were surveyed and quantitative assessment by ADCNR 2006-08. Chipola Slabshell was found in Chipola headwaters; Brother Spike not confirmed.
- DWFF annually conducts IBI stream sampling and reporting in the Chattahoochee River basin for all SGCN.
- A Halloween Darter survey was completed by Auburn University in the Uchee Creek system, but no specimens were collected.

- An Ironcolor Shiner survey was completed by GSA, but too few specimens collected (all from Mobile County) to establish a broodstock.

Conecuh River Basin

- Status review of Escambia (Conecuh), Pea, and Choctawhatchee River basin mussel fauna was completed prior to the 2010 listing package by Appalachia State University, University of Florida, FL Game and Fish Commission, and USFWS.
- DWFF annually conducts IBI stream sampling and reporting in the Conecuh River for all SGCN.
- GSA surveyed for the Ironcolor Shiner, but collected specimens at only 1 of 13 historic sites (all in Mobile County) in 2006, yielding too few to serve as a broodstock source. New information was obtained on 5 fish species.

Choctawhatchee River Basin

- An ACRL survey of the Fluted Elephantear and Tapered Pigtoe was published in 2013. ACRL also surveyed the Southern Kidneyshell and found it to be more common than previously thought (but still very rare), with very specific habitat requirements.
- Systematics review for the Downy Rainbow are nearing completion at Ohio State.
- Initial host and culture trials are being conducted for the Southern Sandshell at the AABC.
- Host fish trial for the Fuzzy Pigtoe are being conducted by AABC, Troy University.
- Systematics review by the University of Florida is being conducted for the Cho ctaw Bean.

Tallapoosa River Basin

- ACRL is working on *Elliptio* phylogeography. ACRL has also completed routine monitoring in the Tallapoosa River basin for the Ovate Clubshell, Alabama Creekmussel, Finelined Pocketbook, and Rayed Creekshell.
- AU monitored the faunal and ecosystem response to experimental flow regimes in the Tallapoosa River below R.L. Harris Dam.

Yellow River Basin

- An initial fish host and propagation trial for the Southern Sandshell was completed at AABC in 2010 in partnership with ACRL, USFWS, AABC, and Iowa State University. Cultured animals were deposited with University of Florida.
- A Southern Kidneyshell status survey was completed by ACRL and USFWS, but has not been found in the Yellow River basin in recent efforts.
- Fuzzy Pigtoe and Choctaw Bean status surveys have been completed by ACRL and USFWS, with host fish trial conducted by Troy University. A Choctaw Bean systematics review was conducted by University of Florida, FFWCC and initial host trials completed at AABC.
- DWFF annually conducts IBI stream sampling and reporting in the Yellow River basin.

Mobile and Tensaw Rivers/Mobile Bay Basin Accomplishments

- ADCNR delineated and quantitatively assessed one population (mussel bed) in 2010.
- Systematics evaluation completed by Roe in 2013 for the Rayed Kidneyshell.
- ADCNR surveyed the Alabama River for Tulotoma in 2010, all snail species encountered were collected and are awaiting processing/identification. Additional gastropod collections were completed during the 2009 mussel tributary survey.
- Initial culture efforts were completed for the Cylindrical Lioplax at AABC.
- Culture protocols for the Spotted Rocksnail were developed at AABC. The systematics study completed at University of Alabama and culture and reintroduction efforts are underway.
- ALDOT installed 3.6 miles of low barrier fencing along the Mobile Bay Causeway in 2008 to reduce road mortality for the Alabama Red-bellied Turtle.

Escatawpa River Basin

- DWFF annually conducts IBI stream sampling in the Escatawpa River basin for SGCN.

Marine Habitats

Vegetation restoration, Little Bay ADCNR-Marine Resources Division

- SLD-NHS, Alabama Marine Resources Division, and Dauphin Island Sea Lab completed 32 acres of new shoreline and marsh vegetation in Little Bay. This project restored habitat lost to erosion during recent hurricanes, and will protect the restored habitats from future storm events.

Land Acquisitions

Alabama Canebrake Pitcher Plant TNC

- TNC acquired 88,278.43 acres of critical habitat throughout the state.
- The Alabama Forever Wild Land Trust has acquired 246,308 acres of critical habitat, which will be managed and protected in perpetuity.

Down-listed Species

Since the 2005 CWCS, the following five federally listed or candidate species occurring in Alabama were down-listed or removed from Endangered Species Act protection.

Common Name	Scientific Name	2005 Status	2015 Status
Birds			
Bald Eagle	*Haliaeetus leucocephalus*	Threatened	Not listed
Wood stork	*Mycteria americana*	Endangered	Threatened
Invertebrates			
Tulotoma snail	*Tulotoma magnifica*	Endangered	Threatened
Plants			
Eggert's sunflower	*Helianthus eggertii*	Threatened	Not listed
Panhandle lily	*Lilium iridollae*	Candidate	Not listed

Chapter 1
ALABAMA'S WILDLIFE

FIGURES

TABLES

Introduction

Relative to the rest of the United States, Alabama is a hotspot of both aquatic and terrestrial native wildlife diversity. Although in area it comprises only 1.6% of the contiguous continental U.S., Alabama supports approximately 20% of the nation's species of mammals, 28% of birds, 28% of reptiles, 25% of amphibians, 38% of freshwater fishes, 60% of mussels, 43% of aquatic snails, and 25% of crayfishes (Figure 1-1).

This chapter describes the distribution and abundance of Alabama's fish and wildlife species, with emphasis on Species of Greatest Conservation Need (SGCN). The original 2005 Alabama Comprehensive Wildlife Conservation Strategy (CWCS) data sources were reviewed and updated through additional research to identify all relevant current available scientific data sources to assess the status of the full array of Alabama's wildlife. Appendix 1.1 lists these data sources. Information from the original CWCS and volumes 1 through 5 of *Alabama Wildlife* served as the primary data source.

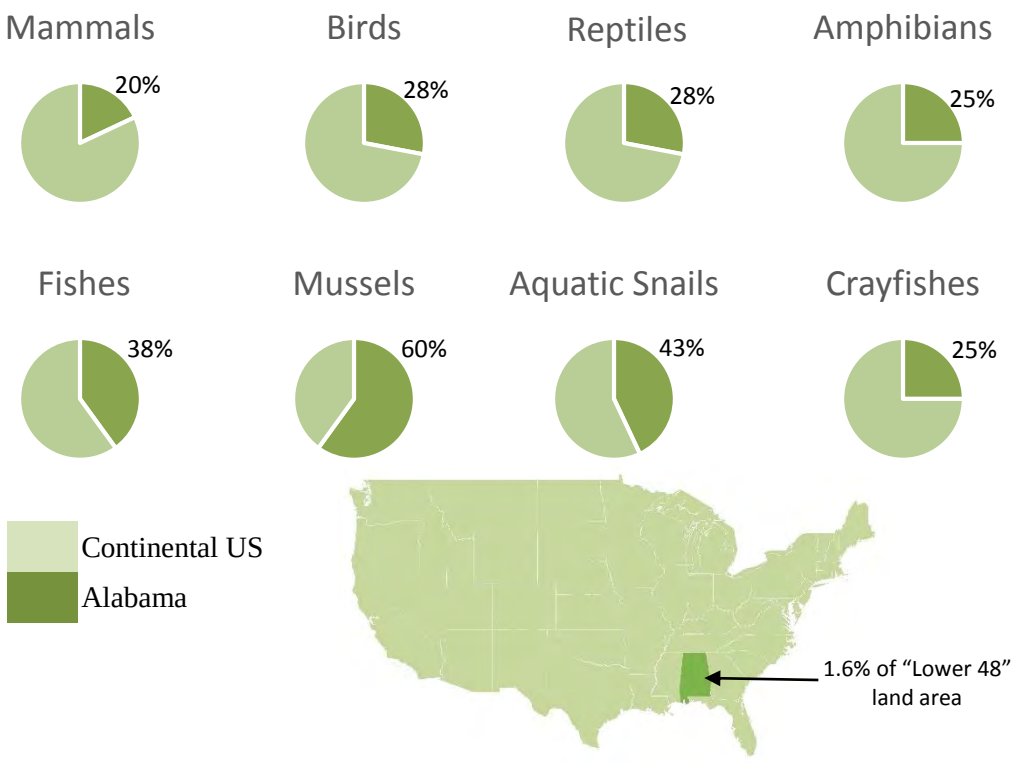


Figure 1-1. Alabama's Contribution to the Nation's Fauna

Alabama owes its wealth of biodiversity to a complex geological terrain and over 75,000 miles of streams spanning 15 river systems. Also, Alabama was not glaciated in the Pleistocene, enabling its flora and fauna to continue diversifying during this period. As a result, Alabama surpasses all eastern states in plant and animal diversity, ranking fifth in the nation after California, Texas, Arizona, and New Mexico (Stein 2002). Alabama ranks first in the nation in freshwater species diversity (Lydeard and Mayden 1995, Boschung et al. 2004, Williams et al, 2008, Henderson et al. 2014). No state east of the Colorado River has more wildlife species at risk than Alabama. Only Hawaii, California, and Nevada have more imperiled species, and only Hawaii has lost more species to extinction. Human alteration of Alabama's natural ecological systems has contributed to the extinction or extirpation of at least 111 animal species: 50 mussels, 42 freshwater snails, 10 fishes, five birds, and four mammals (Shelton-Nix *in press*).

Virtually all of Alabama's wildlife habitats have experienced some form of degradation, with natural areas existing as managed fragments of varying size in a matrix of agriculture, industrial forests, residential and industrial development, utility corridors, and roads. Fire, essential for the maintenance of a number of terrestrial habitats, can no longer occur at the landscape scale unless part of a prescribed burning strategy. Alabama's once-vast longleaf pine forests, and many of the species they support, are now reduced to a fraction of their former extent. Free-flowing rivers, with sand bars, alternating riffles and deep pools, are, with a few exceptions, interrupted by dams and deep reservoirs. Alabama has lost more than 50 % of its wetlands (Phillips 2002) and both terrestrial and aquatic habitats have been invaded by alien plant and animal species that compete with natives.

Value and Importance of Wildlife

Whether fishing, hunting, photographing, or observing wildlife, Alabamians derive many hours of enjoyment from wildlife-related recreation. Alabama's wildlife and natural habitats contribute to the quality of life experienced by residents and visitors alike. It is impossible to assign a dollar value to wildlife, wild places, and the ecosystem services they provide, but certain economic values of wildlife can be quantified. Wildlife-related recreation annually contributes over $2.7 billion to Alabama's economy. The twelfth National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (USDI et al. 2011) found that 1.7 million Alabamians and visitors 16 years old and older participated in Alabama's wildlife abundance and diversity in 2011. Of this number, 683 thousand fished, 535 thousand hunted, and 1.1 million participated in wildlife-watching activities, including observing, feeding, and photographing wildlife. Wildlife-related expenditures included trip-related expenses, equipment purchases, licenses, land leases and membership dues, etc.

Identifying Species of Greatest Conservation Need

The original 2005 In accordance with the Association of Wildlife and Fisheries Agencies' *Best Practices for State Wildlife Action Plans* (AFWA 2012) recommendations for prioritizing, the 2015 revision of the State Wildlife Action Plan's re-assessment of species of greatest conservation need (Element 1) and their habitats (Element 2) began in July 2012 by involving

key partners and stakeholders (Element 7) with Alabama's Third Nongame Wildlife Conference. Taking into consideration the species' abundance and distribution, six taxa committees led the discussion and evaluation of Alabama's more than 1,200 native species of 1) crayfishes, 2) mussels and aquatic snails, 3) fishes, 4) amphibians and reptiles, 5) birds, and 6) mammals. Each native species was assigned a status based on the expert opinion of the taxa committees, based on the following criteria:

- **Extinct -** taxa that historically occurred in Alabama, but are no longer alive anywhere within their former distribution.
- **Extirpated (EX) -** taxa that historically occurred in Alabama, but are now absent; may be rediscovered or be reintroduced from populations existing outside the state.
- **Extirpated/Conservation Action Underway (EXCAU) -** taxa that historically occurred in Alabama, were absent for a period of time, and currently are being reintroduced, or have a plan for being reintroduced, into the state from populations outside the state.
- **Priority 1/Highest Conservation Concern (P1) -** taxa critically imperiled and at risk of extinction/extirpation because of extreme rarity, restricted distribution, decreasing population trend/population viability problems, and specialized habitat needs/habitat vulnerability. Immediate research and/or conservation action required.
- **Priority 2/High Conservation Concern (P2) -** taxa imperiled because of three of four of the following: rarity; very limited, disjunct, or peripheral distribution; decreasing population trend/population viability problems; specialized habitat needs/habitat vulnerability. Timely research and/or conservation action needed.
- **Priority 3/Moderate Conservation Concern (P3) -** taxa with conservation problems because of insufficient data **or** because of two of four of the following: small populations; limited, disjunct, or peripheral distribution; decreasing population trend/population viability problems; specialized habitat needs/habitat vulnerability. Research and/or conservation action recommended.
- **Priority 4/Low Conservation Concern (P4) -** taxa that are secure, yet conservation concerns exist because of one of four of the following: relative abundance; limited, disjunct, or peripheral distribution; decreasing population trend/population viability problems; specialized habitat needs/increasing habitat vulnerability. Research on specific problem suggested.
- **Priority 5/Lowest Conservation Concern (P5) -** taxa that are demonstrably secure, with size of population stable/increasing, geographical distribution stable/expanding, population trend/ population viability stable/increasing, relatively limited habitat vulnerability, **or** an unusual visitor to the state. No specific monitoring or conservation action needed.

This evaluation resulted in the designation of 366 species (Table 1-1 and Appendix 1.2) as SGCN. There were 80 additions and 23 removals from the original 2005 list (Appendix 1.3). Definitions of status ranks are provided in Appendix 1.5.

Table 1-1 summarizes SGCN taxonomically by their status as either Extirpated, Extirpated/Conservation Action Underway, Priority 1/Highest Conservation Concern or Priority 2/High Conservation Concern). This includes five species (three mammals and two crayfishes) that their respective taxa committees determined merited inclusion during the post-2012 SWAP development process as well as four federally listed invertebrates belonging to groups not specifically addressed in 2012 (Table 1-10). Appendix 1.4 lists imperiled animals from groups not presently evaluated for SGCN status that should be considered in the next revision and Nongame Conference process. Species accounts including the status and distribution, threats, and conservation actions of SGCN are provided in volumes 2, 3, and 5 of *Alabama Wildlife*. Figure 1-2 shows all known SGCN occurrences in the state. As Table 1-1 indicates, nearly 40% of the state's extant mammals, birds, amphibians, reptiles, freshwater fishes, mussels, snails, and crayfishes are considered SGCN. Each taxonomic group is discussed further in the following sections.

The best available checklists and databases addressing status of the full array of wildlife in Alabama are those of the Alabama Department of Conservation and Natural Resources' (ADCNR) State Lands Division's Natural Heritage Section and NatureServe (ALNHP 2012). Additionally, an important component of the SWAP is ADCNR's Division of Wildlife and

Table 1-1. Alabama's Native Wildlife

			Species of Greatest Conservation Need (SGCN)			
	Total Species	**Extinct**	Extirpated (EXCAU)*	Priority One	Priority Two	**Federally Listed (T or E)**
Mammals	68	0	4 (0)	11 (16%)	12 (18%)	8[1]
Birds	256[2]	3	2 (0)	8 (3%)	19 (7%)	4
Amphibians	79[3]	0	0 (0)	10 (13%)	9 (11%)	3
Reptiles	115[4]	0	0 (0)	13 (11%)	15 (13%)	7[5]
Fishes	347	2	8 (2)	33 (10%)	22 (6%)	15
Mussels	182	24	21 (4)	53 (29%)	21 (12%)	54
Freshwater Snails	203	37	3 (1)	25 (12%)	24 (12%)	6
Crayfishes	84	0	0 (0)	13 (15%)	31 (37%)	0
Other	*thousands*	?	1	3	0	4
Total			38 (7)	168	150	75

* EXCAU = Extirpated, Conservation Action Underway species are presented as a subset of the total number.

[1] Includes two extirpated species, Cougar and Red Wolf. Excludes the accidental Jaguarundi.
[2] Regularly-occurring birds; excludes accidentals, "vagrants," etc.
[3] Includes 4 amphibian subspecies.
[4] Includes 21 reptile subspecies.
[5] Includes 5 marine turtles.

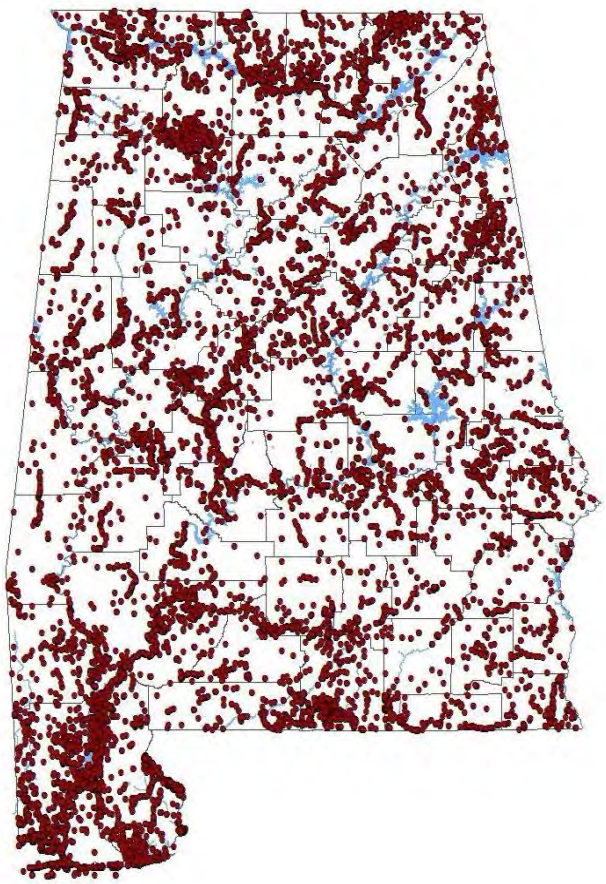


Figure 1-2. Known SGCN Occurrences

Freshwater Fisheries' (DWFF) development of a comprehensive database to capture and track information on SGCN and their key habitats.

The 2002 and 2012 Nongame Wildlife Conferences provided the opportunity for local, state and federal agencies, organizations and tribes to be involved in developing the SWAP. In addition, participation was solicited at academic and government institutions and invitations were extended to all key local, state, and federal entities with programs that significantly affected wildlife conservation in Alabama.

Involvement of the taxa committees continued through publication of *Alabama Wildlife*, a four-volume reference resulting from the 2002 Conference (Mirarchi 2004, Mirarchi et al. 2004a, b, and c). A fifth supplemental volume (Ericha-Nix, *in press*) provides a ten-year update to the first four volumes with the results of the 2012 Conference as well as full accounts for all SGCN crayfishes and additional species that were not covered in the previous volumes. In addition to DWFF, partners on the taxa committees included most of the key state and federal agencies in Alabama, including the Alabama Cooperative Fish and Wildlife Research Unit, U.S. Fish and Wildlife Service, U.S. Forest Service, ADCNR State Lands Division Natural Heritage Section, Geological Survey of Alabama, NatureServe-Alabama Natural

Heritage Program, and Tennessee Valley Authority. Additional participation came from a number of universities and individuals with expertise. These major stakeholders and partners developed the list of species and conservation recommendations, with DWFF playing an oversight role. This group of partner stakeholders ranked all species and developed conservation actions and species accounts for each of the high priority species. Thus, partner and expert participation has been critical to the process.

In developing this SWAP, the six taxa committees (mammals, birds, herpetofauna, fishes, aquatic mollusks, and crayfishes) were reengaged to serve the role of External/Expert Peer Review. Each taxa committee was asked to review and update the lists of SGCN and habitats as well as conservation actions. This group of 75 members represented a wide variety of academic institutions and conservation organizations, and provided essential peer review for technical quality control.

Overview of Alabama's Major Wildlife Groups

This section is a summary of all of Alabama's major groups of vertebrate and invertebrate wildlife addressed in this SWAP (Element 1). High Priority conservation needs of individual species and key habitats are summarized in Chapter 4 (Element 4). Detailed accounts of status, abundance, distribution, and threats can be found in the references cited below, with *Alabama Wildlife* generally providing the most current available scientific information. Detailed definitions of the four non-SGCN rank columns for tables 1-2 through 1-10 (Federally Protected, State Protected, Global Rank, State Rank) are provided in Appendix 1.5.

Mammals

Gray bats Alan Cressler

Sixty-eight native mammal species have occurred in Alabama in recent times, including one manatee, one opossum, one armadillo, 23 rodents (including two beach mouse subspecies), four rabbits, seven insectivores, 15 bats, 13 carnivores, and three ungulates. Four of these (Red Wolf, Florida Panther/Eastern Cougar, Elk, and Bison) have been extirpated. In addition to the 64 native mammals still maintaining populations in the state, there are introduced breeding populations of six exotic species (Black Rat, Norway Rat, House Mouse, Coypu [Nutria], Fallow Deer, and Feral Swine). Two species, Smoky Shrew and North American Deermouse, were discovered in the past 10 years. According to the best scientific information and consensus of numerous experts, there are 27 SGCN mammals (Table 1-2).

Detailed accounts of mammal diversity in Alabama are provided by Howell (1921) and Best and Dusi (2014). The most current and best available scientific information on the status and distribution of Alabama's GCN mammals is provided in the forthcoming revision to the *Alabama Wildlife* volumes.

The DWFF monitors the status of harvested mammal species, including deer, small game, and furbearers. The biology of White-tailed Deer and history of their management in Alabama has been summarized by the DWFF Wildlife Section (Cook and Gray 2003). The Furbearers Observation Survey and Fur Harvest Summary compile statewide data on road-killed and trapped mammals (Sievering 2004). The Alabama Black Bear Alliance is a joint effort of the Alabama Wildlife Federation, The Nature Conservancy, and DWFF, and works toward conservation of Black Bears in the state. DWFF Nongame Wildlife Program biologists frequently conduct bat and other small mammal surveys (Hudson 2004).

Recent State Wildlife Grant-funded projects that have involved mammal surveys or addressed mammal habitat conservation include Grand et al. 2008, Tassin 2008, Schotz and Barbour 2009, Sharp 2009, and Silvano et al. 2012.

A new threat to many of Alabama's cave-dwelling bats is White Nose Syndrome (WNS), the fungus *Pseudogymnoascus destructans*. First reported from New York in 2006, WNS has spread southward every year and was first found in Alabama in 2012 at Russell Cave. It has since been documented at Bankhead National Forest and at Collier and Fern Caves in the Tennessee Valley, the latter being the largest hibernacula in the entire range of the endangered Gray Bat. The extent of damage that WNS will bring to Alabama's bat fauna remains to be seen.

Marine mammals have been monitored through Alabama's DCNR coastal programs and Gulf-wide by NMFS and USFWS. The Bottle-nosed Dolphin and West Indian Manatee are the only two regularly occurring marine mammals in Alabama waters. The 2010 Deepwater Horizon Oil Spill affected bottlenose dolphins, with over 1,000 dead dolphins reported from Florida to Texas in the four years subsequent to the spill. The Dauphin Island Sea Lab coordinates the Alabama Marine Mammal Stranding Network as well as the Manatee Sighting Network. Recovery plans for the threatened, endangered, and protected species, as well as stock

assessments by NMFS, address the other marine mammals protected under the Marine Mammal Protection Act as they occur only accidentally in Alabama waters.

Table 1-2. SGCN Mammals of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
SIRENIA						
Trichechidae						
Trichechus manatus	West Indian Manatee	LE	SP	G2	S1	P1
RODENTIA						
Sciuridae						
Geomys pinetis	Southeastern Pocket Gopher	--	SP	G5	S3	P2
Cricetidae						
Peromyscus polionotus ammobates	Alabama Beach Mouse	LE	SP	G5T1	S1	P1
Peromyscus polionotus trissylepsis	Perdido Key Beach Mouse	LE	SP	G5T1	S1	P1
Neotoma magister	Allegheny Woodrat	--	--	G3G4	S3	P2
Zapus hudsonius	Meadow Jumping Mouse	--	SP	G5	S1	P2
LAGOMORPHA						
Leporidae						
Sylvilagus obscurus	Appalachian Cottontail	--	GA	G4	S1	P2
Sylvilagus palustris	Marsh Rabbit	--	GA	G5	S3	P2
SORICOMORPHA						
Soricidae						
Sorex fumeus	Smoky Shrew	--	--	G5	SU	P2
Sorex hoyi	American Pygmy Shrew	--	SP	G5	S1	P2
CHIROPTERA						
Molossidae						
Tadarida brasiliensis	Brazilian Free-tailed Bat	--	--	G5	S3	P2
Vespertilionidae						
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	--	SP	G3G4	S2	P1
Lasiurus intermedius	Northern Yellow Bat	--	SP	G4G5	S1	P2
Myotis austroriparius	Southeastern Myotis	--	SP	G3G4	S2	P1
Myotis grisescens	Gray Myotis	LE	SP	G3G2	S2	P1
Myotis leibii	Eastern Small-footed Myotis	--	--	G1G3	SNA	P1
Myotis lucifugus	Little Brown Myotis	--	SP	G3	S3	P1
Myotis septentrionalis	Northern Long-eared Bat	LT	SP	G1G3	S2	P1
Myotis sodalis	Indiana Bat	LE	SP	G2	S2	P1
Perimyotis subflavus	Tri-colored Bat	--	--	G3	S3	P2
CARNIVORA						
Felidae						
Puma concolor	Cougar	LE	GANOS	G5	SX	EX
Canidae						
Canis rufus	Red Wolf	LE	GANOS	G1Q	SX	EX
Ursidae						
Ursus americanus	Black Bear	--	GANOS	G5	S2	P1
Mustelidae						

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Mustela frenata	Long-tailed Weasel	--	SP	G5	S3	P2
Mephitidae						
Spilogale putorius	Eastern Spotted Skunk	--	SP	G5	S2S3	P2
ARTIODACTYLA						
Cervidae						
Cervus elaphus	Elk	--	--	G5	SX	EX
Bovidae						
Bison bison	American Bison	--	--	G4	SX	EX

Birds

Red Knot, Dauphin Island Bill Summerour

Alabama has 256 regularly wintering and/or breeding bird species. The Passenger Pigeon, Carolina Parakeet, and Bachman's Warbler are extinct, and the Ivory-billed Woodpecker, Common Raven, and Mississippi Sandhill Crane are no longer known to occur within the state's borders. The Ivory-billed Woodpecker was presumed extinct by most authorities until the announcement of its 2004 rediscovery in Arkansas (Fitzpatrick et al. 2005), but compelling evidence is lacking and the species' persistence is in doubt. According to the best scientific

information and consensus of the bird taxa committee comprised of Alabama's leading bird authorities, there are 29 SGCN birds (Table 1-3).

Detailed accounts of bird diversity in Alabama are provided by Howell (1924) and Imhof (1962), and the status of each GCN species is provided in *Alabama Wildlife*. A five-year statewide Breeding Bird Atlas (Haggerty 2009) was completed in 2006 and provided information on breeding bird distribution in far greater detail than has been previously available. This project found 168 species nesting in Alabama.

Recent State Wildlife Grant-funded projects that have involved bird surveys or addressed habitat conservation include Godwin 2008, Grand 2008, Haggerty 2009, Schotz and Barbour 2009, Sharp 2009, and Silvano et al. 2012.

The decline in abundance and distribution of many migratory landbirds is well documented regionally (Rich et al. 2004). Alabama falls within four North American Bird Conservation Initiative (NABCI) Bird Conservation Regions (BCRs): Central Hardwoods, Southeastern Coastal Plain, Appalachian Mountains, and Piedmont. Alabama also includes five Partners in Flight (PIF) physiographic provinces: the Interior Low Plateau, Northern Cumberland Plateau, Southern Ridge and Valley, Southern Piedmont, and East Gulf Coastal Plain. PIF identifies nine, 13, 16, 14, and 29 bird species, respectively, as conservation priorities for each region.

Similar regional trends for waterbirds have been documented, initiating the creation of a number of plans and partnerships aimed at waterbird conservation. Alabama is included in many of these, including: North American Waterbird Conservation Plan (Kushlan et al. 2002), U.S. Shorebird Conservation Plan (Brown et al. 2001), Waterbird Monitoring Partnership (coordinated by the USGS Patuxent Wildlife Research Center's Monitoring Program), and North American Waterfowl Management Plan East Gulf Coastal Plain Joint Venture. These programs share the best available species abundance and distribution data nationally and step conservation down to the regional and state levels.

The National Audubon Society administers the Important Bird Area (IBA) Program. Thirteen IBAs have been designated across Alabama. These are sites that provide essential habitat for one or more species of bird. They include sites for breeding, wintering, and/or migrating birds. IBAs may include public or private lands, or both, and they may be protected or unprotected.

Table 1-3. SGCN Birds of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
ANSERIFORMES						
Anatidae						
Anas fulvigula	Mottled Duck	--	SP	G4	S2N,S3B	P2
Anas rubripes	American Black Duck	--	GB	G5	S2B,S5N	P2
CICONIIFORMES						
Ciconiidae						
Mycteria americana	Wood Stork	LT	SP	G4	S2N	P2
PELECANIFORMES						
Ardeidae						
Egretta rufescens	Reddish Egret	--	SP	G4	S1B,S3N	P2
Ixobrychus exilis	Least Bittern	--	SP	G5	S2N,S4B	P2
ACCIPITRIFORMES						
Accipitridae						
Aquila chrysaetos	Golden Eagle	BGEPA[6]	SP	G5	SNRN	P2
Elanoides forficatus	Swallow-tailed Kite	--	SP	G5	S2	P2
GRUIFORMES						
Rallidae						
Coturnicops noveboracensis	Yellow Rail	--	GB	G4	S2N	P2
Laterallus jamaicensis	Black Rail	--	GB	G3G4	S2N	P2
Rallus elegans	King Rail	--	GB	G4	S2S3B,S4N	P2
CHARADRIIFORMES						
Haematopodidae						
Haematopus palliatus	American Oystercatcher	--	SP	G5	S1	P1
Charadriidae						
Charadrius melodus	Piping Plover	LT	SP	G3	S1N	P1
Charadrius nivosus	Snowy Plover	--	SP	G3	S1B,S2N	P1
Charadrius wilsonia	Wilson's Plover	--	SP	G5	S1	P1
Scolopacidae						
Calidris canutus	Red Knot	PT	SP	G4	S3N	P2
Laridae						
Gelochelidon nilotica	Gull-billed Tern	--	SP	G5	S2B,S4N	P2
STRIGIFORMES						
Strigidae						
Asio flammeus	Short-eared Owl	--	SP	G5	S2N	P2
FALCONIFORMES						
Falconidae						
Falco sparverius paulus	Southeastern American Kestrel	--	SP	G5	S3B,S5N	P2
PICIFORMES						
Picidae						

[6] Golden Eagle protected by the Bald and Golden Eagle Protection Act of 1940

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Campephilus principalis	Ivory-billed Woodpecker	LE	SP	G1	SX	EX
Picoides borealis	Red-cockaded Woodpecker	LE	SP	G3	S2	P1
PASSERIFORMES						
Laniidae						
Lanius ludovicianus	Loggerhead Shrike	--	SP	G4	S4	P2
Corvidae						
Corvus corax	Common Raven	--	SP	G5	SX	EX
Troglodytidae						
Thryomanes bewickii	Bewick's Wren	--	SP	G5	SHB,S1N	P1
Parulidae						
Setophaga cerulea	Cerulean Warbler	--	SP	G4	S1B	P1
Emberizidae						
Ammodramus henslowii	Henslow's Sparrow	--	SP	G4	S2N	P1
Ammodramus maritimus	Seaside Sparrow	--	SP	G4	S2	P2
Ammodramus nelsoni	Nelson's Sparrow	--	SP	G5	S3N	P2
Peucaea aestivalis	Bachman's Sparrow	--	SP	G3	S3	P2
Icteridae						
Euphagus carolinus	Rusty Blackbird	--	--	G4	S4N	P2

Amphibians and Reptiles

Tennessee Cave Salamander

Gopher tortoise

both by Alan Cressler

Alabama's amphibians and reptiles, collectively called the herpetofauna, include 73 native amphibians (30 frogs, 43 salamanders) and 93 reptiles (12 lizards, 49 snakes, 31 turtles, and alligator). Five established exotic species, one frog and four lizards, also are documented. The Southern Hognose Snake, Mississippi Gopher Frog, and Flatwoods Salamander have not been documented for many years, and may be extirpated. The Mimic Glass Lizard, thought possibly extirpated, was documented by two specimens in Covington County in 2005 (Guyer et al. 2006). The Eastern Indigo Snake, long extirpated, is being introduced in Covington County at

Conecuh National Forest. According to the best scientific information and consensus of numerous experts, there are 19 amphibian and 28 reptile SGCN taxa, or 28% of Alabama's extant species (Tables 1-4 and 1-5).

Mount (1975) provides the most comprehensive published treatment of the distribution, abundance, and natural history of Alabama's herpetofauna, and a 4-volume revision to this work is in preparation. The updated status of each species is provided in *Alabama Wildlife*. The Alabama Herpetological Atlas Project, administered by the Auburn University Natural History Museum, maintains a current database on distribution of the state's herpetofauna.

Recent State Wildlife Grant-funded projects that have included herpetofaunal surveys or addressed habitat conservation include Guyer et al. 2006, Godwin 2008, Godwin et al. 2008, Guyer and Johnson 2008, Schotz and Barbour 2009, Apodaca et al. 2010, Wibbels 2010, Godwin et al. 2011, Guyer et al. 2011, and Silvano et al. 2012.

Table 1-4. SGCN Amphibians of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
CAUDATA						
Ambystomatidae						
Ambystoma bishopi	Reticulated Flatwoods Salamander	LE	SP	G2	S1	P1
Ambystoma texanum	Smallmouth Salamander	--	--	G5	S3	P2
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	--	--	G5	S3	P2
Amphiumidae						
Amphiuma pholeter	One-toed Amphiuma	--	SP	G3	S1	P2
Cryptobranchidae						
Cryptobranchus a. alleganiensis	Eastern Hellbender	--	SP	G3G4	S2	P1
Plethodontidae						
Aneides aeneus	Green Salamander	--	SP	G3G4	S3	P2
Desmognathus aeneus	Seepage Salamander	--	SP	G3G4	S2	P2
Desmognathus auriculatus	Southern Dusky Salamander	--	SP	G5	S2	P1
Gyrinophilus palleucus	Tennessee Cave Salamander	--	SP	G2G3	S2	P2
Phaeognathus hubrichti	Red Hills Salamander	LT	SP	G2	S2	P1
Plethodon serratus	Southern Red-backed Salamander	--	--	G5	S2S3	P2
Proteidae						
Necturus alabamensis	Black Warrior Waterdog	C	SP	G2	S2	P1
ANURA						
Hylidae						

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Hyla andersonii	Pine Barrens Treefrog	--	SP	G4	S2	P1
Pseudacris ocularis	Little Grass Frog	--	--	G5	S1	P2
Ranidae						
Lithobates areolatus	Crawfish Frog	--	--	G4	NR	P1
Lithobates capito	Gopher Frog	--	SP	G3	S2	P1
Lithobates heckscheri	River Frog	--	SP	G5	S1	P1
Lithobates sevosus	Mississippi Gopher Frog	LE	SP	G1	SH	P1
Lithobates sylvaticus	Wood Frog	--	SP	G5	S2	P2

Table 1-5. SGCN Reptiles of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
SQUAMATA suborder Lacertilia						
Anguidae						
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	--	--	G5	S5	P2
Ophisaurus mimicus	Mimic Glass Lizard	--	SP	G3	S1	P1
Scincidae						
Plestiodon anthracinus	Coal Skink	--	SP	G5	S3	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	--	SP	G5	S3	P2
SQUAMATA suborder Serpentes						
Colubridae						
Drymarchon couperi	Eastern Indigo Snake	LT	SP	G3	S1	P1
Farancia erytrogramma	Rainbow Snake	--	SP	G4	S3	P1
Heterodon simus	Southern Hognose Snake	--	SP	G2	SH	P1
Lampropeltis getula	Eastern Kingsnake	--	SP	G5T5	S4	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	--	SP	G5T5	S3	P2
Liodytes (*Seminatrix*) *pygaea*	North Florida Swampsnake	--	--	G5	S1	P2
Nerodia clarkii	Gulf Salt-marsh Snake	--	SP	G4T4	S2	P2
Pituophis melanoleucus lodingi	Black Pinesnake	C	SP	G4T2T3	S2	P1
Pituophis m. melanoleucus	Northern Pinesnake	--	SP	G4T4	S3	P2
Pituophis m. mugitus	Florida Pinesnake	--	SP	G4T3	S2	P2
Elapidae						
Micrurus fulvius	Eastern Coral Snake	--	SP	G5	S3	P1
Viperidae						
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	--	--	G4	S3	P2
TESTUDINES						
Cheloniidae						
Caretta caretta	Atlantic Loggerhead	LT	SP	G3	S1	P1
Chelonia mydas	Green Sea Turtle	LT	SP	G3	S1	P1
Eretmochelys imbricata	Atlantic Hawksbill	LE	SP	G3	SNR	P1
Lepidochelys kempii	Kemp's Ridley	LE	SP	G1	S1	P1
Dermochelidae						
Dermochelys coriacea	Leatherback Sea Turtle	LE	SP	G2	SNA	P1
Emydidae						

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Graptemys barbouri	Barbour's Map Turtle	--	SP	G2	S2	P2
Graptemys ernsti	Escambia Map Turtle	--	SP	G2	S2	P2
Malaclemys terrapin pileata	Mississippi Diamondback Terrapin	--	SP	G4T3Q	S2	P1
Pseudemys alabamensis	Alabama Red-bellied Turtle	LE	SP	G1	S1	P1
Kinosteridae						
Sternotherus carinatus	Razor-backed Musk Turtle	--	--	G5	S1	P2
Sternotherus depressus	Flattened Musk Turtle	LT	SP	G2	S2	P2
Testudinidae						
Gopherus polyphemus	Gopher Tortoise	LT, C[7]	SP	G3	S3	P2

Fishes

Alabama Shiner Alan Cressler

The 2012 fish committee considered 347 fish species, many of which are newly described, newly discovered, or marine/estuarine species that have been collected in the Mobile Delta. Of this total, six species are extirpated and two are extinct. In addition to the 339 native fish species still maintaining populations in the state, there are now breeding populations of eighteen exotic species, 10 more than reported in the 2005 CWCS. According to the best scientific information and consensus of numerous experts, there are 63 SGCN fishes (Table 1-6).

[7] *Gopherus polyphemus* is listed by USFWS as Threatened west of the Mobile and Tombigbee rivers in Alabama (Choctaw, Mobile, and Washington counties). Eastern population is candidate for listing.

The committee also included 10 taxa recognized as unique, yet undescribed in the scientific literature. The Coastal Chub *Hybopsis* sp. cf. *winchelli*, Coosa Chub *Macrhybopsis* sp. cf. *aestivalis "A"*, Gulf Chub *Macrhybopsis* sp. cf. *aestivalis "B"*, Pallid Chub *Macrhybopsis* sp. cf. *aestivalis "C"*, Sawfin Shiner *Notropis* sp. cf. *spectrunculus*, Apalachicola Redhorse *Moxostoma* sp. cf. *poecilurum*, Sipsey Darter *Etheostoma* sp. cf. *bellator "A"*, Locust Fork Darter *Etheostoma* sp. cf. *bellator "B"*, Blueface Darter *Etheostoma* sp. cf. *zonistium*, and Southern Walleye *Sander* sp. cf. *vitreus*. However, since 2002, 13 fish species have been described that occur or formerly occurred in Alabama: the Warrior Shiner *Lythrurus alegnotus*, Longjaw Minnow *Notropis amplamala*, Chucky Madtom, Tallapoosa Sculpin *Cottus tallapoosae*, Cahaba Bass *Micropterus cahabae*, Alabama Bass *M. henshalli*, Tallapoosa Bass *M. tallapoosae*, Warrior Bass *M. warriorensis*, Chattahoochee Bass *M. chattahoochae*, Halloween Darter *Percina crypta*, Bankhead Darter *P. sipsi,* and Muscadine Darter *P. smithvanizi* (Burr et al. 2005, Pera and Armbruster 2006, Neely et al. 2007, Williams et al. 2007, Freeman et al. 2008, Baker et al. 2013).

Three fish species have been discovered in Alabama since 2002: Blackmouth Shiner *Notropis melanostomus* (Boschung et al. 2004), Mud Sunfish *Acantharchus pomotis* (Rider and Schell 2012), and Scaly Sand Darter *Ammocrypta vivax*. While the Trispot Darter *Etheostoma trisella* was once considered extirpated, it was rediscovered in 2008 (O'Neill et al. 2009).

Detailed accounts of Alabama's fish diversity is provided by Boschung and Mayden (2004) and Mettee et al. (1996) Additional information for SGCN fishes and the conservation status of all species is provided in *Alabama Wildlife*.

Recent State Wildlife Grant-funded projects that have involved fish surveys or addressed habitat conservation include Irwin et al. 2007, Maceina et al. 2007, Gangloff et al. 2009, Henderson 2009, Maceina and Hunter 2009, Mettee et al. 2009, O'Neil and Shepard 2009, Sammons and Maceina 2009, Fluker et al. 2011, and Irwin et al. 2011.

Table 1-6. SGCN Fishes of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
ACIPENSERIFORMES						
Acipenseridae						
Acipenser fulvescens	Lake Sturgeon	--	SP	G3G4	SX	EXCAU
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	SP	G3T2	S1	P2
Scaphirhynchus platorynchus	Shovelnose Sturgeon	--	SP	G4	SX	EX
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	SP	G1	S1	P1
LEPISOSTEIFORMES						
Lepisosteidae						
Lepisosteus platostomus	Shortnose Gar	--	CNGF	G5	SX	EX
HIODONTIFORMES						
Hiodontidae						
Hiodon alosoides	Goldeye	--	--	G5	SX	EX
CLUPEIFORMES						
Clupeidae						
Alosa alabamae	Alabama Shad	--	SP	G2G3	S2	P1
CYPRINIFORMES						
Cyprinidae						
Cyprinella caerulea	Blue Shiner	LT	SP	G2	S1	P1
Cyprinella callitaenia	Bluestripe Shiner			G2G3	S1S2	P1
Erimonax monachus	Spotfin Chub	LT, XN	SP	G2	SX	EXCAU
Erimystax dissimilis	Streamline Chub	--	--	G4	S1	P2
Macrhybopsis hyostoma	Shoal Chub	--	--	G5	S3	P1
Notropis albizonatus	Palezone Shiner	LE	SP	G1	S1	P1
Notropis ariommus	Popeye Shiner	--	--	G3	SX	EX
Notropis buchanani	Ghost Shiner	--	--	G5	S2	P2
Notropis cahabae	Cahaba Shiner	LE	SP	G2	S2	P1
Notropis chalybaeus	Ironcolor Shiner	--	SP	G4	SH	P1
Notropis cummingsae	Dusky Shiner	--	--	G5	S2	P1
Notropis hypsilepis	Highscale Shiner	--	--	G3	S2	P2
Notropis melanostomus	Blackmouth Shiner	--	SP	G2	S1	P2
Phenacobius mirabilis	Suckermouth Minnow	--	--	G5	S1	P1
Phenacobius uranops	Stargazing Minnow	--	--	G4	S1	P2
Pteronotropis euryzonus	Broadstripe Shiner	--	--	G3	S2	P1
Pteronotropis welaka	Bluenose Shiner	--	--	G3G4	S2	P2
SILURIFORMES						
Ictaluridae						
Noturus crypticus	Chucky Madtom	--	CNGF	G4	SX	EX

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Noturus eleutherus	Mountain Madtom	--	CNGF	G4	S1	P1
Noturus flavus	Stonecat	--	CNGF	G4	S1	P2
Noturus miurus	Brindled Madtom	--	CNGF	G5	S1	P2
Noturus munitus	Frecklebelly Madtom		CNGF, SP	G3	S2	P1
AMBLYOPSIFORMES						
Amblyopsidae						
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	SP	G1	S1	P1
CYPRINODONTIFORMES						
Fundulidae						
Lucania goodei	Bluefin Killifish	--	--	G5	S1	P2
SCORPAENIFORMES						
Cottidae						
Cottus paulus	Pygmy Sculpin	LT	SP	G1	S1	P1
PERCIFORMES						
Centrarchidae						
Acantharchus pomotis	Mud Sunfish	--	--	G4G5	SNR	P2
Micropterus cataractae	Shoal Bass	--	GF-HP	G3	S2	P1
Percidae						
Ammocrypta vivax	Scaly Sand Darter	--	--	G5	S1	P1
Etheostoma bellator	Warrior Darter	--	--	G2	S2	P2
Etheostoma sp. *cf. bellator "A"*	Sipsey Darter	--	--	G2	S2	P2
Etheostoma sp. *cf. bellator "B"*	Locust Fork Darter	--	--	GNR	S1	P2
Etheostoma boschungi	Slackwater Darter	LT	SP	G1	S1	P1
Etheostoma brevirostrum	Holiday Darter	--	SP	G2	S1	P1
Etheostoma camurum	Bluebreast Darter	--	--	G4	S1	P1
Etheostoma chermocki	Vermilion Darter	LE	SP	G1	S1	P1
Etheostoma cinereum	Ashy Darter	--	--	G2G3	SX	EX
Etheostoma ditrema	Coldwater Darter	--	SP	G2	S1	P2
Etheostoma lynceum	Brighteye Darter	--	SP	G5	S1	P1
Etheostoma neopterum	Lollypop Darter	--	SP	G3	S1	P1
Etheostoma nuchale	Watercress Darter	LE	SP	G1	S1	P1
Etheostoma phytophilum	Rush Darter	LE	SP	G1	S1	P1
Etheostoma trisella	Trispot Darter	--	SP	G1	S1	P2
Etheostoma tuscumbia	Tuscumbia Darter	--	SP	G2	S2	P2
Etheostoma wapiti	Boulder Darter	LE, XN	SP	G1	S1	P1
Etheostoma zonistium	Bandfin Darter	--	--	G4	G5	P2
Etheostoma sp. *cf. zonistium*	Blueface Darter	--	--	G1	S1	P2
Percina aurolineata	Goldline Darter	LT	SP	G2	S1	P2

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Percina brevicauda	Coal Darter	--	--	G2	S2	P2
Percina burtoni	Blotchside Darter	--	SP	G2G3	S1	P1
Percina crypta	Halloween Darter	--	SP	G2	S1	P1
Percina evides	Gilt Darter	--	--	G4	S2	P2
Percina phoxocephala	Slenderhead Darter	--	SP	G5	S2	P1
Percina sipsi	Bankhead Darter	--	SP	G1	S1	P1
Percina tanasi	Snail Darter	LT	SP	G2G3	S1	P1
Sander sp. *cf. vitreus*	Southern Walleye	--	GF	G3	S3	P1
Elassomatidae						
Elassoma alabamae	Spring Pygmy Sunfish	LT	SP	G1	S1	P1

Mussels and Aquatic Snails

Mountain Creekshell

Elimia sp.

Photos by Alan Cressler

One hundred eighty-two freshwater mussel species and 203 freshwater snails have been reported from Alabama. Due to degradation of streams and rivers, only 73% of the mussels and 80% of the freshwater snails can still be found in the state. Nationally and regionally many freshwater mollusk species have become extinct and others are in danger of extinction (Williams et al. 2008).

According to the best scientific information and consensus of numerous experts, there are 100 SGCN mussels and 52 SGCN aquatic snails (Tables 1-7 and 1-8). Although 80 (39% of the extant species) of the aquatic snails are ranked as Priority 3, their ranks reflect very limited information in many cases. The need for additional information on these species is acknowledged. Accounts for SGCN and the conservation status of all species are provided in *Alabama Wildlife*.

Recent State Wildlife Grant-funded projects that have involved mollusk surveys or addressed mollusk systematics, habitat, and conservation include Campbell and Harris 2005, Clark, 2007,

Grizzle and Brunner 2007, Irwin et al. 2007, Kennedy et al. 2007, Henderson 2009, O'Neil and Shepard 2009, and Gangloff et al. 2009.

From 2002 to 2014, the Alabama Aquatic Biodiversity Center released 61,155 lab-reared mussels and snails of 17 species at 15 locations across five river basins (Figure 1-3). Surveys have been conducted at 15 locations in five river basins.

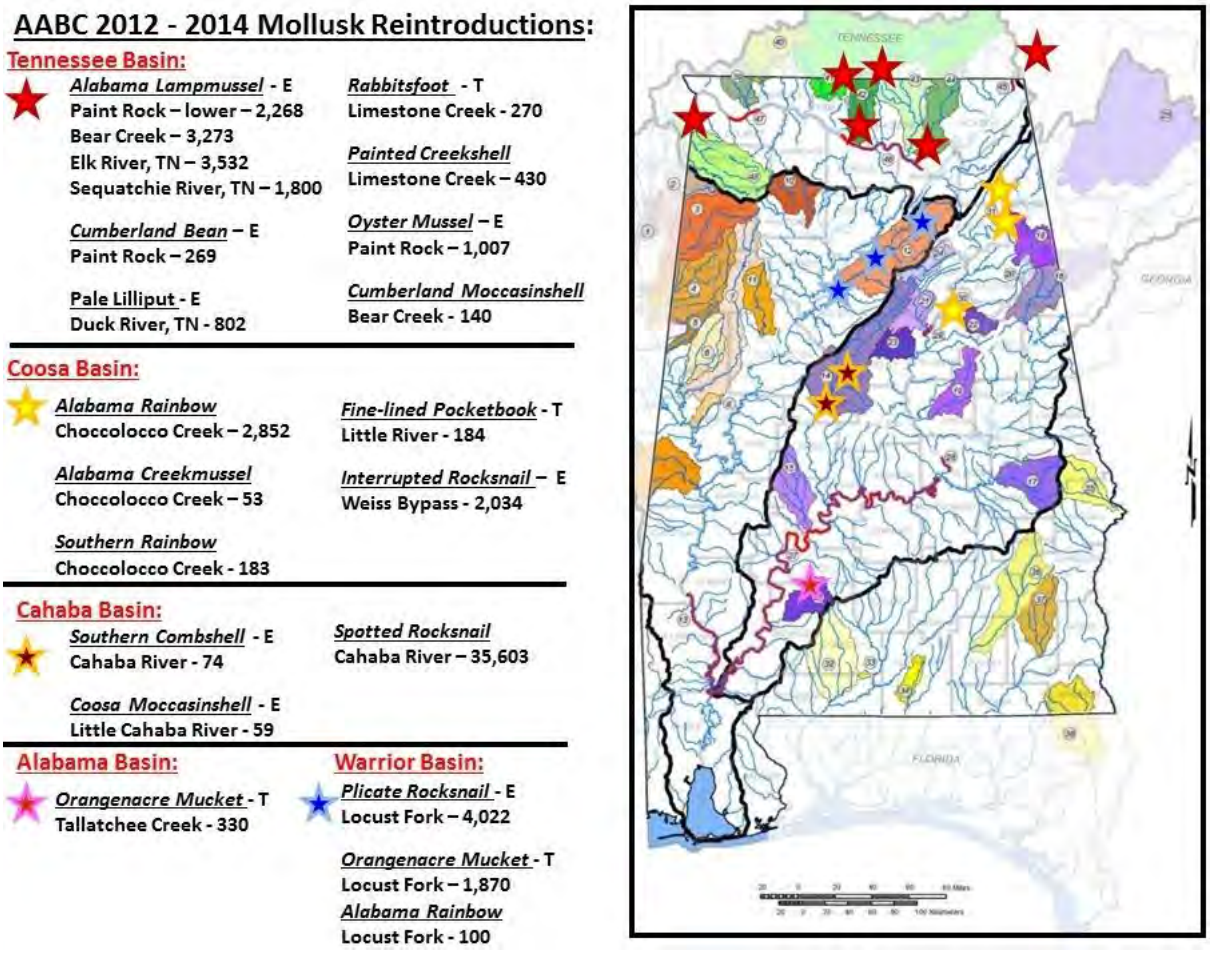


Figure 1-3. Alabama Aquatic Biodiversity Center Mussel and Snail Releases, 2012-2014

Table 1-7. SGCN Freshwater Mussels of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
UNIONOIDA						
Margaritiferidae						
Cumberlandia monodonta	Spectaclecase	LE	SP	G3	S1	P1
Margaritifera marrianae	Alabama Pearlshell	LE	SP	G1	S1	P1
Unionoidea						
Actinonaias ligamentina	Mucket	--	PSM	G5	S2	P1
Actinonaias pectorosa	Pheasantshell	--	PSM	G3	SX	EX
Alasmidonta marginata	Elktoe	--	PSM	G4	S1	P1
Alasmidonta triangulata	Southern Elktoe	--	PSM	G1Q	S1	P1
Alasmidonta viridis	Slippershell Mussel	--	SP	G4G5	S1	P1
Anodontoides radiatus	Rayed Creekshell	--	PSM	G3	S3	P2
Cyprogenia stegaria	Fanshell	LE	SP	G1Q	S1	P1
Dromus dromas	Dromedary Pearlymussel	LE	SP	G1	S1	EX
Elliptio arca	Alabama Spike	--	PSM	G2G3Q	S2	P1
Elliptio arctata	Delicate Spike	--	PSM	G2G3Q	S2	P2
Elliptio chipolaensis	Chipola Slabshell	LT	SP	G1	S1	P1
Elliptio dilatata	Spike	--	PSM	G5	S1	P1
Elliptio fraterna	Brother Spike	--	PSM	G1	SX	EX
Elliptio nigella	Winged Spike	--	PSM	G1	SX	EX
Elliptio purpurella	Inflated Spike	--	PSM	G2	S1	P1
Elliptoideus sloatianus	Purple Bankclimber	LT	SP	G2	S1	P1
Epioblasma ahlstedti	Duck River Dartersnapper	LE	SP	G1	SH	EX
Epioblasma brevidens	Cumberlandian Combshell	LE	SP	G1	S1	P1
Epioblasma capsaeformis	Oyster Mussel	LE	SP	G1	SX	EXCAU
Epioblasma obliquata	Catspaw	LE	SP	G1	SX	EX
Epioblasma penita	Southern Combshell	LE	SP	G1	SX	EXCAU
Epioblasma triquetra	Snuffbox	LE	SP	G3	S1	P1
Fusconaia burkei	Tapered Pigtoe	LT	SP	G2G3	S2	P2
Fusconaia cor	Shiny Pigtoe	LE	SP	G1	S1	P1
Fusconaia cuneolus	Finerayed Pigtoe	LE	SP	G1	S1	P1
Fusconaia escambia	Narrow Pigtoe	LT	SP	G2	S2	P2
Fusconaia subrotunda	Longsolid	--	PSM	G3	S1	P1
Hamiota altilis	Finelined Pocketbook	LT	SP	G2G3	S2	P2
Hamiota australis	Southern Sandshell	LE	SP	G2G3	S2	P2
Hamiota perovalis	Orangenacre Mucket	LT	SP	G2	S2	P2
Hamiota subangulata	Shinyrayed Pocketbook	LE	SP	G2	S1	P1
Hemistena lata	Cracking Pearlymussel	LT	SP	G1	S1	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Lampsilis abrupta	Pink Mucket	LE	SP	G2	S1	P1
Lampsilis virescens	Alabama Lampmussel	LT	SP	G1	S1	P1
Lasmigona etowaensis	Etowah Heelsplitter	--	PSM	G3	S2	P2
Lasmigona holstonia	Tennessee Heelsplitter	--	PSM	G3	S1	P2
Lasmigona subviridis	Green Floater	--	PSM	G3	SX	EX
Lemiox rimosus	Birdwing Pearlymussel	LE	SP	G1	S1	EX
Leptodea leptodon	Scaleshell	LT	SP	G1G2	SX	EX
Ligumia recta	Black Sandshell	--	PSM	G4G5	S2	P2
Medionidus acutissimus	Alabama Moccasinshell	LT	SP	G2	S2	P1
Medionidus conradicus	Cumberland Moccasinshell	--	SP	G3G4	S1	P1
Medionidus parvulus	Coosa Moccasinshell	LT	SP	G1Q	SX	EXCAU
Medionidus penicillatus	Gulf Moccasinshell	LE	SP	G2	S1	P1
Obovaria choctawensis	Choctaw Bean	LE	SP	G2G3	S2	P2
Obovaria jacksoniana	Southern Hickorynut	--	PSM	G2	S2	P1
Obovaria olivaria	Hickorynut	--	PSM	G4	SX	EX
Obovaria retusa	Ring Pink	LE	SP	G1	SH	EX
Obovaria subrotunda	Round Hickorynut	--	PSM	G4	S2	P1
Obovaria unicolor	Alabama Hickorynut	--	PSM	G3	S2	P2
Pegias fabula	Littlewing Pearlymussel	LE	SP	G1	SX	EX
Plethobasus cicatricosus	White Wartyback	LE	SP	G1	S1	P1
Plethobasus cooperianus	Orangefoot Pimpleback	LE	SP	G1	SH	EX
Plethobasus cyphyus	Sheepnose	LE	SP	G3	S1	P1
Pleurobema athearni	Canoe Creek Clubshell	--	PSM	G1	S1	P1
Pleurobema beadleianum	Mississippi Pigtoe	--	PSM	G3	SNR	P1
Pleurobema clava	Clubshell	LE	SP	G1G2	SX	EX
Pleurobema cordatum	Ohio Pigtoe	--	PSM	G4	S2	P1
Pleurobema decisum	Southern Clubshell	LE	SP	G2	S2	P2
Pleurobema georgianum	Southern Pigtoe	LE	SP	G1	S1	P1
Pleurobema hanleyianum	Georgia Pigtoe	LE	SP	G1	SX	P1
Pleurobema hartmanianum	Cherokee Pigtoe	--	PSM	G1	SX	EX
Pleurobema oviforme	Tennessee Clubshell	--	PSM	G2G3	S1	P1
Pleurobema perovatum	Ovate Clubshell	LE	SP	G1	S1	P1
Pleurobema plenum	Rough Pigtoe	LE	SP	G1	S1	P1
Pleurobema pyriforme	Oval Pigtoe	LE	SP	G1	S1	P1
Pleurobema rubellum	Warrior Pigtoe	LE	SP	G1G2	S1	P1
Pleurobema rubrum	Pyramid Pigtoe	--	SP	G2G3	S1	P1
Pleurobema sintoxia	Round Pigtoe	--	SP	G4G5	S1	P1
Pleurobema stabile	Coosa Pigtoe	--	--	GH	SX	EX

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Pleurobema strodeanum	Fuzzy Pigtoe	LT	SP	G2G3	S2	P2
Pleurobema taitianum	Heavy Pigtoe	LE	SP	G1	S1	P1
Pleuronaia barnesiana	Tennessee Pigtoe	--	PSM	G2G3	S1	P2
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	SP	G2	S1	P1
Potamilus inflatus	Inflated Heelsplitter	LT	SP	G1G2Q	S1S2	P2
Ptychobranchus fasciolaris	Kidneyshell	--	PSM	G4G4	S2	P1
Ptychobranchus foremanianus	Rayed Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus greenii	Triangular Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus jonesi	Southern Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus subtentus	Fluted Kidneyshell	LE	SP	G2	SX	EX
Quadrula cylindrica	Rabbitsfoot	LT	SP	G3G4	S1	P1
Quadrula infucata	Sculptured Pigtoe	--	PSM	G3	S1	P2
Quadrula intermedia	Cumberland Monkeyface	LE	SP	G1	SX	EX
Quadrula kieneriana	Coosa Orb	--	PSM	G3Q	SX	EX
Quadrula metanevra	Monkeyface	--	PSM	G4	S3	P2
Quadrula sparsa	Appalachian Monkeyface	LE	SP	G1	SX	EX
Reginaia rotulata	Round Ebonyshell	LE	SP	G1	S1	P1
Strophitus connasaugaensis	Alabama Creekmussel	--	PSM	G3	S3	P2
Strophitus undulatus	Creeper	--	PSM	G5	S1	P1
Toxolasma corvunculus	Southern Purple Lilliput	--	PSM	G1	S1	P1
Toxolasma cylindrellus	Pale Lilliput	LE	SP	G1	S1	P1
Utterbackia peggyae	Florida Floater	--	PSM	G3	S1	P1
Villosa fabalis	Rayed Bean	LE	SP	G2	SX	EX
Villosa nebulosa	Alabama Rainbow	--	PSM	G3	S3	P2
Villosa taeniata	Painted Creekshell	--	PSM	G4	S2	P2
Villosa trabalis	Cumberland Bean	LE	SP	G1	SX	EXCAU
Villosa umbrans	Coosa Creekshell	--	PSM	G2	S2	P2
Villosa villosa	Downy Rainbow	--	PSM	G3	S1	P1

Table 1-8. SGCN Freshwater Snails of Alabama

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
CAENOGASTROPODA						
Cochliopidae						
Pseudotryonia grahamae	Salt Spring Hydrobe	--	--	G1	S1	P1
Hydrobiidae						
Fontigens nickliniana	Watercress Snail	--	--	G5	S4	P1
Marstonia angulobasis	Angled Marstonia	--	--	G1	S1	P2
Marstonia hershleri	Coosa Pyrg	--	--	G1	S1	P2
Marstonia pachyta	Armored Marstonia	LE	SP	G1	S1	P1
Marstonia scalariformis	Moss Pyrg	--	SP	G1	S1	P2
Stiobia nana	Sculpin Snail	--	--	G1	S1	P1
Lithoglyphidae						
Antrorbis breweri	Manitou Cavesnail	--	--	G1	S1	P1
Clappia cahabensis	Cahaba Pebblesnail	--	--	G1	S1	P2
Lepyrium showalteri	Flat Pebblesnail	LE	SP	G1	S1	P1
Pleuroceridae						
Athearnia anthonyi	Anthony's Riversnail	LT	SP	G1	S1	P1
Elimia ampla	Ample Elimia	--	--	G1	S1	P2
Elimia annettae	Lilyshoals Elimia	--	--	G1	S1	P2
Elimia bellacrenata	Princess Elimia	--	--	G1Q	S1	P1
Elimia boykiniana	Flaxen Elimia	--	--	G2Q	SNR	P2
Elimia broccata	Brooch Elimia	--	--	G1	S1	P1
Elimia cochliaris	Cockle Elimia	--	--	G1	S1	P1
Elimia crenatella	Lacy Elimia	LT	SP	G1	S1	P1
Elimia dickinsoni	Stately Elimia	--	--	G5	S3	P2
Elimia exusta	Fire Elimia	--	--	G2	S2	P2
Elimia lachryma	Teardrop Elimia	--	--	G1	S1	P1
Elimia melanoides	Black Mudalia	C	SP	G2	S2	P2
Elimia mihalcikae	Latticed Elimia	--	--	G1	S1	P1
Elimia nassula	Round-ribbed Elimia	--	--	G1Q	S1	P1
Elimia perstriata	Engraved Elimia	--	--	G1	S1	P1
Elimia teretria	Auger Elimia	--	--	G1	S1	P1
Elimia vanuxemiana	Cobble Elimia	--	--	G1	S1	P1
Elimia varians	Puzzle Elimia	--	--	G1G2Q	S1S2	P2
Elimia variata	Squat Elimia	--	--	G2Q	S2	P2
Io fluvialis	Spiny Riversnail	--	--	G2	SX	EX
Leptoxis ampla	Round Rocksnail	LT	SP	G2	S2	P2
Leptoxis compacta	Oblong Rocksnail	--	--	G1	S1	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Leptoxis foremani	Interrupted Rocksnail	LE	SP	G1	SX	EXCAU
Leptoxis picta	Spotted Rocksnail	--	SP	G1	S1	P2
Leptoxis plicata	Plicate Rocksnail	LE	SP	G1	S1	P1
Leptoxis taeniata	Painted Rocksnail	LT	SP	G1	S1	P2
Leptoxis virgata	Smooth Mudalia	--	--	G2	SX	P2
Lithasia armigera	Armored Rocksnail	--	--	G3G4	S1	P2
Lithasia curta	Knobby Rocksnail	--	--	G1	SX	EX
Lithasia lima	Warty Rocksnail	--	--	G2Q	S1	P2
Lithasia salebrosa	Muddy Rocksnail	--	--	G2G3Q	S1	P2
Pleurocera alveare	Rugged Hornsnail	--	--	G3	S1	P2
Pleurocera corpulenta	Corpulent Hornsnail	--	--	G1	S1	P1
Pleurocera foremanii	Rough Hornsnail	LE	SP	G1	S1	P1
Pleurocera pyrenella	Skirted Hornsnail	--	--	G2	S2	P2
Pleurocera striatum	Striate Hornsnail	--	--	GNR	SNR	P2
Planorbidae						
Rhodacmea cahawbensis	Cahaba Ancylid	--	--	GNR	SNR	P1
Rhodacmea filosa	Wicker Ancylid	--	--	G1	S1	P1
Rhodacmea hinkleyi	Knobby Ancylid	--	--	G2G3	S2	EX
Viviparidae						
Campeloma decampi	Slender Campeloma	LE	SP	G1	S1	P1
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	SP	G1	S1	P1
Tulotoma magnifica	Tulotoma	LT	SP	G2	S2	P2

Crayfishes

Tennessee Bottlebrush Crayfish Guenter Schuster

Alabama is the center of global crayfish diversity, and has more species within its borders than any other state or province, with eight genera, 86 described species (two of which were found in the state subsequent to the 2012 Nongame Conference) and several undescribed forms. Many species known from Alabama have small ranges and restricted distributions, and several are known from only a single cave, stream, or river drainage.

At the Nongame Conference held in July 2012, 42 crayfish species known to occur in Alabama were determined to be in need of immediate conservation action. Two species subsequently discovered to occur in the state, the Longnose Crayfish (*Cambarus longirostris*) and Fireback Crayfish (*Cambarus pyronotus*), have been added to this list, for a total of 44 SGCN (Table 1-9). Rankings should be viewed preliminarily, because additional sampling is needed before crayfish distributions in the state are adequately understood. There are no federally protected species of crayfish in Alabama, but 11 crayfish species are known only from Alabama, eight of which are of immediate conservation concern, and five of these are restricted cave-dwelling species.

Recent State Wildlife Grant-funded projects that have involved crayfish surveys or addressed habitat conservation include Taylor and Schuster 2007, Huryn et al. 2011, and Smith et al. 2011.

Table 1-9. SGCN Crayfishes of Alabama

ORDER Family Species	*Common Name*	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
DECAPODA						
Cambaridae						
Barbicambarus simmonsi	Tennessee Bottlebrush Crayfish	--	--	G1G2	SU	P1
Cambarellus diminutus	Least Crayfish	--	--	G3	S3	P1
Cambarellus lesliei	Angular Dwarf Crayfish	--	--	G3	S3	P1
Cambarellus shufeldtii	Cajun Dwarf Crayfish	--	--	G5	S2	P2
Cambarus cracens	Slenderclaw Crayfish	--	--	G1	S1	P1
Cambarus distans	Boxclaw Crayfish	--	--	G5	S1	P1
Cambarus englishi	Tallapoosa Crayfish	--	--	G3	S3	P2
Cambarus halli	Slackwater Crayfish	--	--	G3G4	S3	P2
Cambarus hamulatus	Prickly Cave Crayfish	--	--	G3	S2	P2
Cambarus howardi	Chattahoochee Crayfish	--	--	G3	S2	P2
Cambarus jonesi	Alabama Cave Crayfish	--	--	G2	S2	P2
Cambarus laconensis	Lacon Exit Cave Crayfish	--	--	G1	S1	P1
Cambarus longirostris	Longnose Crayfish	--	--	G5	S2	P2
Cambarus manningi	Greensaddle Crayfish	--	--	G4	S2	P2
Cambarus parvoculus	Mountain Midget Crayfish	--	--	G5	S1	P2
Cambarus pecki	Phantom Cave Crayfish	--	--	G1G2	S1S2	P1
Cambarus pyronotus	Fireback Crayfish	--	--	G2	SNR	P1
Cambarus rusticiformis	Depression Crayfish	--	--	G5	S1	P2
Cambarus speleocoopi	Sweet Home Alabama Cave Crayfish	--	--	G1	S1	P2
Cambarus veitchorum	White Spring Cave Crayfish	--	--	G1	S1	P1
Fallicambarus burrisi	Burrowing Bog Crayfish	--	--	G3	S1	P1
Fallicambarus byersi	Lavender Burrowing Crayfish	--	--	G4	S2	P2
Fallicambarus danielae	Speckled Burrowing Crayfish	--	--	G2	S1	P2
Hobbseus prominens	Prominence Riverlet Crayfish	--	--	G4G5	S3	P2
Orconectes cooperi	Flint River Crayfish	--	--	G1	S1	P2
Orconectes durelli	Saddle Crayfish	--	--	G5	S1	P2
Orconectes lancifer	Shrimp Crayfish	--	--	G5	S1	P2
Orconectes sheltae	Shelta Cave Crayfish	--	--	G1	S1	P1
Procambarus capillatus	Capillaceous Crayfish	--	--	G3	S2	P2
Procambarus clemmeri	Cockscomb Crayfish	--	--	G5	S2	P2
Procambarus escambiensis	Escambia Crayfish	--	--	G2	S2	P1
Procambarus evermanni	Panhandle Crayfish	--	--	G4	S3	P2
Procambarus hagenianus hagenianus	Southeastern Prairie Crayfish	--	--	G4G5T4	S1	P2
Procambarus hayi	Straightedge Crayfish	--	--	G5	S1	P2
Procambarus hubbelli	Jackknife Crayfish	--	--	G4	S2	P2

ORDER Family Species	*Common Name*	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Procambarus hybus	Smoothnose Crayfish	--	--	G5	S4	P2
Procambarus lagniappe	Lagniappe Crayfish	--	--	G2	S1	P2
Procambarus lecontei	Mobile Crayfish	--	--	G3G4	S1	P2
Procambarus lewisi	Spur Crayfish	--	--	G4	S3	P2
Procambarus marthae	Crisscross Crayfish	--	--	G3	S2	P2
Procambarus okaloosae	Okaloosa Crayfish	--	--	G4	S2	P2
Procambarus paeninsulanus	Peninsula Crayfish	--	--	G5	S2	P2
Procambarus planirostris	Flatnose Crayfish	--	--	G4	SNR	P2
Procambarus viaevirdis	Vernal Crayfish	--	--	G5	S1	P1

Other Invertebrates

American Giant Millipede Alan Cressler

The SGCN invertebrate list is an incomplete and evolving list that currently includes the federally listed invertebrates as well as representatives of three major invertebrate taxa, the

freshwater mussels, gill-breathings snails, and crayfishes. Neither *Alabama Wildlife* nor this SWAP addresses terrestrial snails, spiders, harvestmen, pseudoscorpions, millipedes, beetles, springtails, mayflies, butterflies, skippers, moths, and other invertebrates. Many of these belong to poorly studied taxonomic groups and have not historically received sufficient attention. Because of this paucity of data it is premature to consider them as SGCN without additional information and stakeholder input. Therefore, they will be addressed systematically by taxa groups with expert input as funding and expertise become available. An example of how this may be accomplished is a recent (2004-2005) comprehensive review of crayfish, resulting in the addition of many species to the SGCN list. Candidate groups for future consideration include the better-studied butterflies, moths, tiger beetles, dragonflies, and damselflies.

Four federally listed invertebrates, three insects and a decapod crustacean, belong to groups that were not addressed by the Nongame Conference or *Alabama Wildlife*. These are included as SGCN for purposes of the SWAP, and are listed in Table 1-10.

Table 1-10. Other SGCN Invertebrates of Alabama

ORDER Family Species	*Common Name*	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Lepidoptera						
Nymphalidae						
Neonympha mitchellii	Mitchell's Satyr	LE	SP	G2	S1S2	P1
Coleoptera						
Silphidae						
Nicrophorus americanus	American Burying Beetle	LE	SP	G2G3	SH	EX
Odonata						
Corduliidae						
Somatochlora hineana	Hine's Emerald Dragonfly	LE	SP	G2G3	SH	P1
Decapoda						
Atyidae						
Palaemonias alabamae	Alabama Cave Shrimp	LE	SP	G2G3	S1	P1

Excluding the three invertebrate groups presently eligible for SGCN consideration, almost 500 additional invertebrate species (terrestrial and fresh water) are presently tracked in the Alabama Natural Heritage Database (ALNHP 2012). Insects are a diverse group that includes a number of species highly sensitive to perturbations in their habitats and selected species often serve as environmental indicators, but much of this incredible diversity is yet to be understood. Specialized relationships between insects and host plants can render some insects highly vulnerable to extinction should the host decline.

Additional emphasis may be placed on adding invertebrate groups to SWAPs in the future. In a June 20, 2014 Presidential Memorandum titled *Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators*, the decline of pollinators including honey bees, native bees, and butterflies was recognized. The Memorandum states, "Given the breadth, severity, and persistence of pollinator losses, it is critical to expand Federal efforts and take new steps to reverse pollinator losses and help restore populations to healthy levels. These steps should include the development of new public-private partnerships and increased citizen engagement." Section 3(a) of the Memorandum states: "Department of the Interior shall assist States and State wildlife organizations, as appropriate, in identifying and implementing projects to conserve pollinators at risk of endangerment and further pollinator conservation through the revision and implementation of individual State Wildlife Action Plans."

Plants

Greater Yellow Ladies-slipper Alan Cressler

Alabama has roughly 4,000 species of vascular plants, at least 100 of which are globally imperiled (NatureServe 2014). ADCNR does not have authority for conservation of plants. While conservation of SGCN animals and their habitats benefits many imperiled plant species, current funding obstacles to protecting Alabama's native flora poses a significant gap to biodiversity conservation in the state. According to the federal guidelines, states are not able to use federal funds to consider plant species in SWAPs, but they are not specifically prevented from addressing plant species of concern. A recent analysis of SWAPs by NatureServe recommended that states develop and add plant-specific components to

existing wildlife plans. Some states are integrating rare plant and wildlife SGCN management guidelines into their SWAPs for implementation, as practicable, with state and NGO conservation partners (Grunau et al. 2011, Penskar and Derosier 2012, Walz 2013). This Plan is intended to be a tool for conservation and management of Alabama's natural resources, and as such it may cover elements of biodiversity that are beyond the scope of the SWG program. This SWAP recognizes that without a demonstrable connection to SGCN, at-risk plants are not eligible for SWG funds, but their conservation and management could be paid for with other State funds or by another entity. Appendix 1.6 lists the plants of Alabama of highest conservation concern.

Chapter 2
ALABAMA'S ECOLOGICAL FRAMEWORK

FIGURES

TABLES

Climate and Weather

Alabama's stable, mild, humid climate has played a major role in determining the plant and animal assemblages occurring within its borders (Duncan 2013). Contributing to the state's biodiversity is its geographical position well south of the last glaciations, which allowed species to continue to diversify when much of the continent was buried beneath ice sheets.

Summers have high temperatures around 90°F and lows around 70°, and average winter temperatures range from highs of 45° to 50° and lows of 30° to 40°. The long growing season is up to 300 days near the coast. Snow is infrequent, with a moderately heavy snowfall every few years in the northern half of the state, and occasionally in the southern portion. Average annual temperature over the past 125 years is about 63°. Temperatures averaged warmer in the first half of the 20th century, cooled somewhat from the late 1950s to the late 1960s, and trended warmer the past four decades (NOAA 2014). Annual rainfall averages 55 inches and is generally well distributed throughout the year, with the December-March period receiving the most rain. Late summer to fall is the driest period.

Alabama is prone to tropical storms and hurricanes. Areas far from the coast are often affected by these storms as they dump tremendous amounts of rain as they move inland and weaken. Tornadoes are a relatively frequent occurrence statewide.

Physiography and Ecoregions

Over geologic time, roughly two-thirds of present-day Alabama was a shallow sea with shorelines as far inland as the present-day "fall line" extending from Phenix City, Tallassee, Montgomery, Tuscaloosa, and to the northwest corner of the state near Bear Creek. Mountains have risen and nearly eroded away, and major rivers have changed course. The resulting physiographic diversity has been a major force behind the processes that have created new species, driven others to extinction, and isolated some populations (Mettee et al. 1996). Areas of relative ecological homogeneity—based on physiography, soils, flora, fauna, and hydrology—can be classified as *ecoregions*. Ecoregions can be an effective unit for inventorying and assessing environmental resources and setting regional conservation goals. The distributional limits of Alabama's species frequently correspond to physiographic boundaries. Harper (1943) noted that Alabama's geological formations influence the soil and topography so directly that a map of Alabama's forest regions does not differ much from the geological map of the state. Howell (1921), Imhof (1962), Mount (1975), Mettee et al. (1996), and Smith et al. (2011) acknowledged the influence of physiographic boundaries on the distribution of Alabama's mammals, birds, amphibians and reptiles, fishes, and crayfishes, respectively.

At a coarse-scale level, this plan uses a revision of Omernik's (1987) system which identifies six Level III and 29 Level IV ecoregions for Alabama (Figure 2-1). This system is compatible with the species range maps used in *Alabama Wildlife* and also provides the framework for the Alabama Gap Analysis Program's effort to provide an assessment of the conservation status of native vertebrate species and natural land cover types. The following ecoregion

descriptions are consistent with the Griffith et al. (2001) classification depicted in Figure 2-1 and will be used throughout this plan.

Interior Plateau

Also known as the Highland Rim, this province extends from Alabama's Tennessee River northward to the Pleistocene glacial boundary in Indiana. Subdivisions include the Tennessee Valley, Western and Eastern Highland Rim, Outer Nashville Basin, and Little Mountain. Much of the area is underlain with highly erodible limestone that forms valleys, basins, and karst or sinkhole landscapes full of caves. Other portions are less worn down and more rugged due to the presence of erosion-resistant chert (some authors have called this the Chert Belt). The geology is diverse, typically with limestone at valley floors (around 500 feet elevation) and sandstone on ridges (to around 1000 feet).

Cities include Huntsville, Florence, and Decatur. Most of the region is devoted to farming and industry. Before clearing for agriculture, much of the valley floor was dominated by southern red oak. Remnants of that forest can be seen at protected areas like Wheeler National Wildlife Refuge. Open, rocky limestone environments feature glades or barrens supporting prairie-like environments of red cedar, grasses, and succulent plants.

The entire region is drained by the Tennessee River, which is almost entirely impounded and retains little free-flowing riverine habitat. Important streams include Cypress Creek, Limestone Creek, Shoal Creek, and Elk River. Significant wildlife species of the Interior Plateau include the Gray Myotis, Bewick's Wren, Northern Pine Snake, Hellbender, Spring Pygmy Sunfish, Tuscumbia Darter, Alabama Cavefish, White Wartyback, Rough Pigtoe, Armored Rocksnail, Tennessee Bottlebrush Crayfish, and Lacon Exit Cave Crayfish.

Southwestern Appalachians

Also known as the Appalachian Plateau and Cumberland Plateau, this is Alabama's largest upland province. It stretches northeastward all the way to New York. Subdivisions include the Cumberland Plateau, Sequatchie Valley, Plateau Escarpment, Southern Table Plateaus, Dissected Plateau, and Shale Hills. This ecoregion is composed of plateaus, mountain ridges, hills, and valleys. It developed as multiple layers of a sandy river delta. Sediments hardened into rock and were uplifted to form a plateau. Over millions of years, water eroded this surface, forming canyons and valleys. The top of the plateau is erosion-resistant sandstone, but the slopes and valleys are limestone and other more erodible rocks. The poor soils overlying the sandstone caps support oak-hickory and oak-pine forests, while the richer soils of north-facing limestone slopes contain a diverse mixed hardwood forest known as mixed mesophytic or cove hardwood.

Elevations range from 600 to nearly 1,700 feet. Cities include Jasper, Cullman, and Scottsboro. The majority of Bankhead National Forest lies within the region. Most of the coal deposits in Alabama are also here, and large areas have been altered by strip mining.

Much of the Shale Hills (or Warrior Basin) and Dissected Plateau subdivisions are drained by the Black Warrior River and its tributaries: Locust Fork, Sipsey Fork, and Mulberry Fork. Species endemic to this region include the Flattened Musk Turtle, Black Warrior Waterdog, Warrior, Tuskaloosa, Sipsey, and Rush Darters. Others, such as the Cerulean Warbler and Appalachian Cottontail, occur elsewhere but have their strongholds in Bankhead National Forest.

The Cumberland Plateau and Plateau Escarpment subdivisions are best represented in Jackson County, and this region is referred to by some authors as the Jackson County Mountains. Here, flat sandstone mountaintops are separated by deep valleys cut into limestone. Ruffed Grouse and Pygmy Shrews in Alabama are known only from this area of the state. Caves are abundant in the limestone valleys and serve as important habitat for the Gray Myotis, Allegheny Woodrat, Tennessee Cave Salamander, and Prickly Cave Crayfish. Also present is the Paint Rock River, which flows south into the Tennessee River and supports imperiled fishes and mollusks including the Snail Darter, Palezone Shiner, Alabama Lampshell, and Finerayed Pigtoe.

Ridge and Valley

The Ridge and Valley is a series of folded parallel valleys and ridges between the Southwestern Appalachians and the Piedmont, extending southwestward from Georgia to the Fall Line. Subdivisions include Southern Limestone/Dolomite Valleys and Low Rolling Hills, Southern Shale Valleys, Southern Sandstone Ridges, and Southern Dissected Ridges and Knobs. Soils are varied, derived from the sandstone ridges and limestone valleys, and range from clay to gravelly loams. Elevations range from 600 to 2,100 feet. Cities include Birmingham, Gadsden, and Anniston.

This region was heavily forested, but urban sprawl from greater metropolitan Birmingham and other cities has resulted in the loss of over half of the original forest. The dry ridge tops and south-facing slopes were dominated with longleaf pine, with hardwoods along the streams and in moist hollows; mixed forests created transition zones in between. Remaining forests are primarily mixed oak-pine, with pine composition shifting from longleaf to other species in the absence of fire. In Cherokee and Etowah counties of the upper Coosa Valley, sizeable areas of longleaf pine flatwoods formerly occurred, with a flora resembling that of coastal regions (Harper 1943). Mount (1975) noted that portions of the Ridge and Valley supported several amphibians and reptiles of Coastal Plain affinity that are not known to occur elsewhere above the Fall Line (the inland boundary of the Transition Hills, Figure 2-1).

The Ridge and Valley is drained by the Coosa and Cahaba rivers. The Coosa River is impounded along most of its length and has lost much of its original biodiversity as a result. The Cahaba River is largely free-flowing, but has suffered from pollution resulting from heavy residential and industrial development in the Birmingham area. Significant wildlife species of the Ridge and Valley include the Southern Hognose Snake, Coldwater Darter, Goldline Darter, Coosa Creekshell, and Greensaddle Crayfish.

Piedmont

This region of mostly rolling hills extends into central Alabama from Georgia. It becomes somewhat mountainous in the Talladega Upland subdivision along its northern boundary with the Ridge and Valley, and contains Alabama's highest point, Mount Cheaha (elevation 2,413 feet). The flora and fauna of this high elevation portion of the Piedmont are somewhat allied to those of Georgia's Blue Ridge, which extends into Alabama ecologically, if not physiographically (Arper 1943, Mount 1975). Longleaf pine grows on the drier ridges, but most of this region is deciduous forest. The Southern Inner Piedmont subdivision is moderately hilly, and the Southern Outer Piedmont subdivision is relatively flat.

Elevations typically range from 500 to 1,200 feet. Cities include Rockford, Dadeville, and Opelika. Clays and rocky soils are derived from granite, schist, and igneous rock. Soil productivity has been greatly decreased over much of the Piedmont due to poor farming practices in the 1800s and early 1900s. Many areas of depleted soils have reverted back to forest. Where not converted to loblolly pine plantation, ridge tops are predominantly loblolly-shortleaf pine, with hardwoods on the lower slopes and bottomlands. The Piedmont ends abruptly at the Fall Line. Significant wildlife species include the Meadow Jumping Mouse, Wood Frog, Shoal Bass, Finerayed Pocketbook, and Chattahoochee Crayfish.

Southeastern Plains

Also known as the Coastal Plain or East Gulf Coastal Plain, this ecoregion represents over half of the land area of the state, and is highly variable in topography, soils, and vegetation. The Southeastern Plains region is separated from the other regions to the north by the Fall Line, which curves from the northwestern corner of Alabama to the Georgia border in east central Alabama. The Fall Line (inland limit of Transitional Hills, Figure 2-1) is the most important physical feature affecting the distribution of a number of Alabama's amphibians, reptiles, fishes, and mollusks. Streams above the Fall Line are generally swift, with rocky bottoms. Streams below the Fall Line tend to be sluggish, with muddy or sandy bottoms.

Geologically, this region is much younger than the upland regions and it lacks well consolidated rocky formations. Most of the soils in this area are derived from marine and fluvial sediments eroded from the Southwestern Appalachian and Piedmont plateaus.

Topography is generally flat to gently rolling, but some portions have relief of 200 to 300 feet. Much of the forest in this region has been converted to pine plantations. Where natural forest remains, longleaf, shortleaf, and loblolly pines dominate most uplands, with slash pine in the lower areas and scattered areas of hardwoods. Floodplain forests contain oaks, ash, cypress, and tupelo gum. Prior to modern fire suppression, the upland forests naturally burned every few years and fire-adapted species such as longleaf pine were predominant over much of the area.

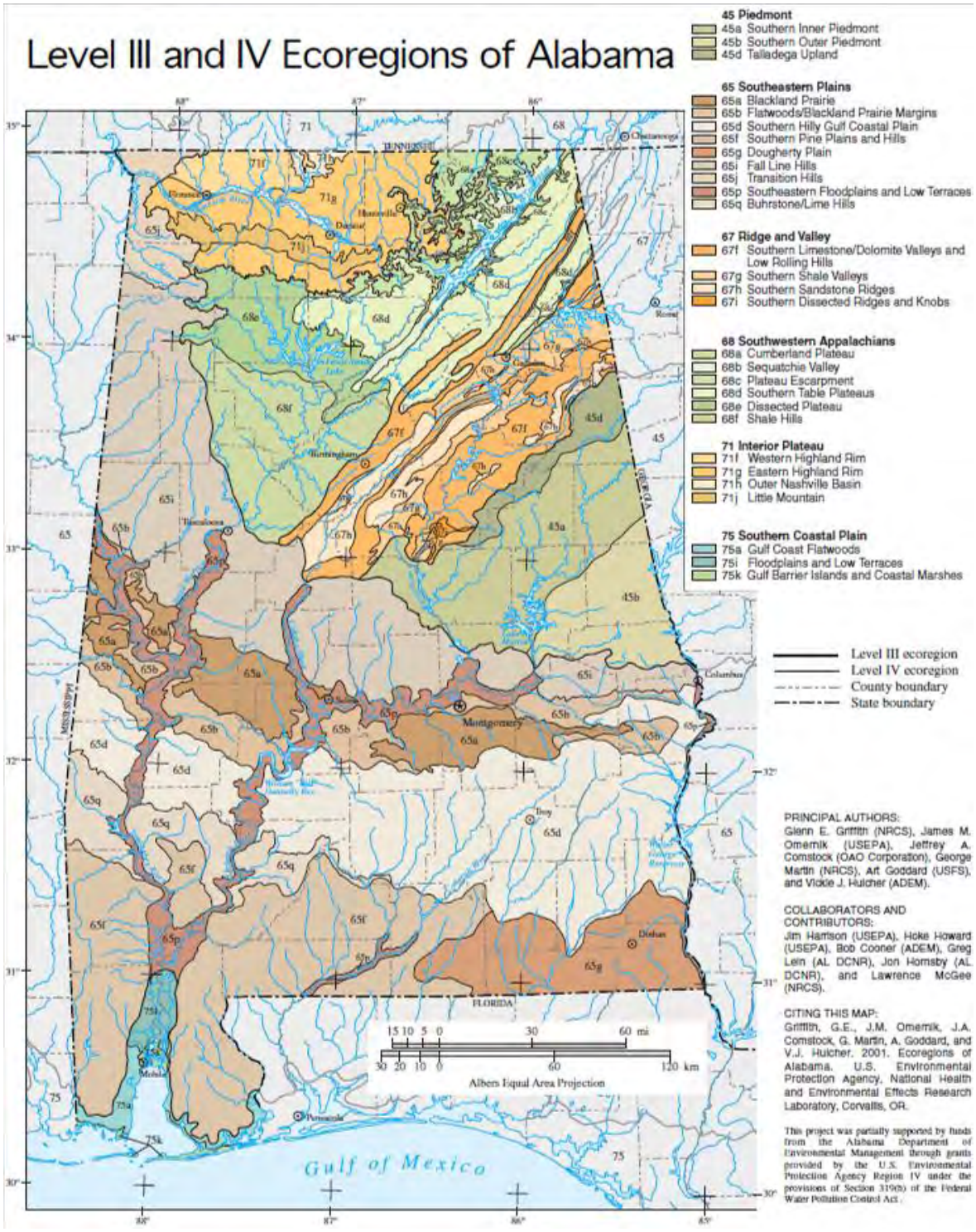


Figure 2-1. Ecoregions of Alabama. Griffith et al. 2001.

Eight subdivisions appear as transverse belts or bands, and a ninth is associated with southerly-flowing rivers. From north to south these are the Transition Hills, Fall Line Hills, Blackland Prairie, Flatwoods/Blackland Prairie Margins, Southern Hilly Gulf Coastal Plain, Buhrstone/Lime Hills, Southern Pine Plains and Hills, and Dougherty Plain.

- The **Transition Hills and Fall Line Hills** regions, also known as the Upper Coastal Plain and Central Pine Belt, lie between the Blackland Prairie and the Fall Line. Soils are Cretaceous in origin, ranging from clay to sand and gravel. Streams draining this area rarely go dry, because of the presence of sand and gravel aquifers. Pines predominate on the more well-drained soils, with hardwoods on the lower slopes.
- The **Blackland Prairie**, or Black Belt, extends in a crescent-shaped band across central Alabama. The region is named for the dark, calcareous, chalky soil, which is high in fertility. Most areas are highly alkaline and do not support pines, but eastern red cedar is abundant.

- The **Flatwoods/Blackland Prairie Margins and Southern Hilly Gulf Coastal Plain**, also called the Chunnenuggee Hills or Blue Marl Region, together form a narrow band lying mostly between the Blackland Prairie and the Buhrstone/Lime Hills. Terrain is generally hilly, with sandy loam topsoils over sandy clay to clay subsoil. Loblolly and shortleaf pines predominate in the eastern portion, with post oak historically predominating in the western portion, an area sometimes referred to as the Post Oak Flatwoods.

- The **Buhrstone/Lime Hills**, also known as the Red Hills, is a band of fertile soil approximately 30 to 40 miles wide extending from Mississippi to Georgia. Rocky bluffs and deep ravines characterize the region. Ridge tops and upper slopes support longleaf, loblolly, and shortleaf pines, with a mixture of oaks. Bluffs, ravines, and lower slopes are dominated by beech, magnolias, oaks, and hickories. The Red Hills Salamander is restricted to a portion of this region.

- The **Southern Pine Plains and Hills** and **Dougherty Plain** have sandy loam, sandy clay, or sandy soils. Most of this region is low in elevation and relatively flat. The fire-adapted longleaf pine community was here before extensive clearing for agriculture, conversion to loblolly plantations, and suppression of fire.

- **Southeastern Floodplains and Low Terraces** are the large floodplains and swamps bisecting each ecoregion of the Southeastern Plains along larger river systems, including those of the Mobile Bay drainage, the Conecuh River, the Choctawhatchee/Pea drainage, and the Chattahoochee River.

Southern Coastal Plain

Also known as the Coastal Strip, this region contains the Mobile-Tensaw Delta, coastal flatwoods, marshes, beaches, and barrier islands. The entire area is close to sea level. The Mobile-Tensaw Delta does not resemble a typical delta because it is bounded on the east and

west by high ground. It is roughly 10 miles wide and 40 miles long, and consists of rich alluvial soils deposited downstream of the confluence of the Tombigbee and Alabama rivers. Much of the delta has been protected in recent years, but most of Alabama's privately owned beach and dune habitats have been destroyed or heavily degraded by development. Dauphin Island is the largest barrier island. Significant wildlife species of the region include the Gulf Sturgeon, Alabama Beach Mouse, Mississippi Diamondback Terrapin, and Piping Plover.

Elements of the Natural Landscape

Features that are common to multiple ecoregions include forests, caves, lakes, rivers, streams, and wetlands.

Forests

Of the 48 contiguous states, only Georgia and Oregon have more forested land than Alabama (AFC 2010). Prior to settlement by Europeans, the area that is now Alabama was completely forested except for scattered prairies, glades, rocky outcrops, stream channels, ponds, and dunes. The state's 22.9 million acres of forestland (Hartsell 2013) accounts for 70% of the total land area of the state and of that, 80% is owned by non-industrial private landowners (AFC 2010). Alabama's forests are 45 percent deciduous (hardwood), 36 percent pine, and 18 percent mixed deciduous-pine (Hartsell 2013). Longleaf pine, slash pine, loblolly pine, and shortleaf pine are the principal pine species.

Human activities have altered Alabama's forested landscapes far more than most people realize. Large areas of former forestland are now devoted to agriculture, population centers, industry, transportation corridors, utility transmission rights of way, water reservoirs, and other uses. In age structure, appearance, and species composition, today's forest is very different from that described by early European settlers. The American chestnut blight in the early 1900s virtually extirpated a dominant and valuable species. Once-vast longleaf forests covered over 90 million acres of Alabama and adjacent states, but now are reduced to less than three percent of their former extent (Lopez et al. 2014). Artificially planted and often intensively managed stands of primarily loblolly pine comprise nearly a third of Alabama's forested area. Since 1972 these plantations have increased by over 300 percent, and now account for more than 7 million acres statewide (Hartsell 2013). Many areas that once were naturally dominated by pines—particularly longleaf—have either been converted to intensively managed and less biodiverse loblolly stands or have succeeded to deciduous or mixed forest as a result of fire suppression and/or abandonment of agricultural lands.

Today, most of Alabama's private forestlands are maintained with economic return from sale of timber as either a primary or secondary objective. Other major uses of private forestlands are as habitat for native game species and for hunting. Alabama's forests and the industry they support contribute in excess of $5 billion to the state's annual economy, and Alabama's forest industry directly provides employment for 66,800 people. The forest products industry is the largest industry in Alabama, and timber is the dominant crop harvested in more than half (34) of the state's 67 counties (AFC 2010).

As Alabama's population growth and urban development continues, the pressures on its forests will increase. National Land Cover Database imagery (Jin et al. 2013; Figures 2-2 and 2-3) of Alabama shows losses of forested lands are most conspicuous near the coast, in the southeastern region, on Sand Mountain, and in the Tennessee Valley. The expanding metropolitan areas of Huntsville, Birmingham, Tuscaloosa, Anniston, Montgomery, Mobile, and Dothan are clearly visible.

Caves and Karst

Discussed in greater detail in Chapter 4, Alabama's more than 6,000 caves are of tremendous importance to many species, including mammals (particularly bats), amphibians, fishes, crustaceans, insects, arachnids, and other invertebrates. Hundreds of species have evolved to survive in these dark, damp, stable habitats, and many are known from only one or two caves. Northeast Alabama, particularly Jackson County, is recognized as one of the major "hotspots" for cave animal diversity in the United States (White and Culver 2012). Newsome Sinks Karst Area (Morgan County), Shelta Cave (Madison County), and Cathedral Caverns (Jackson County) have been designated as National Natural Landmarks. Although Alabama's largest and most biodiverse caves are concentrated in the Tennessee Valley and Southwestern Appalachians, significant caves also occur in limestone karst terrain in the Southeastern Plains.

Rivers and Streams

Alabama's average annual rainfall of 55 inches supplies the water for over 77,000 miles of perennial and intermittent streams (Figure 2-4); 563,000 acres of ponds, lakes and reservoirs; and over 3 million acres of marshes and wetlands. In addition, Alabama has over 50 miles of coast with over 400,000 acres of estuaries, which are influenced directly by rainfall and stream flow. This diversity of habitats supports a corresponding diversity of wildlife.

The Mobile River basin, comprised of the Alabama, Black Warrior, Cahaba, Coosa, Mobile/Tensaw, Tallapoosa, and Tombigbee River systems, occupies the largest area and drains about 65 percent of the state and flows southward into Mobile Bay via the Mobile/Tensaw Delta. Other smaller stream systems drain directly into Mobile Bay as well. In north Alabama, the Tennessee River drainage of the Ohio River basin flows westward and drains about 13 percent of the state. The remainder of the state is drained by numerous smaller Coastal Plain systems, including, from west to east, the Escatawpa, Perdido, Conecuh, Blackwater, Yellow, Pea, Choctawhatchee, Chipola, and Chattahoochee systems, flowing southward toward the Gulf of Mexico and Mississippi Sound. About 60 percent of Alabama's streams flow year-round and the remainder flow intermittently. The larger rivers have been impounded for navigation, hydropower and flood control, resulting in the loss of many species[Error! Bookmark not defined.].

These river networks, flowing through a variety of geographic features and having a wide range of flows, elevations, stream gradients, and substrate compositions, result in a broad diversity of aquatic ecosystems. In addition to the lotic systems, a number of lentic systems

Figure 2-2. Forested land by type (NLCD 2011 data).

Figure 2-3. All land cover types (NLCD 2011 data).

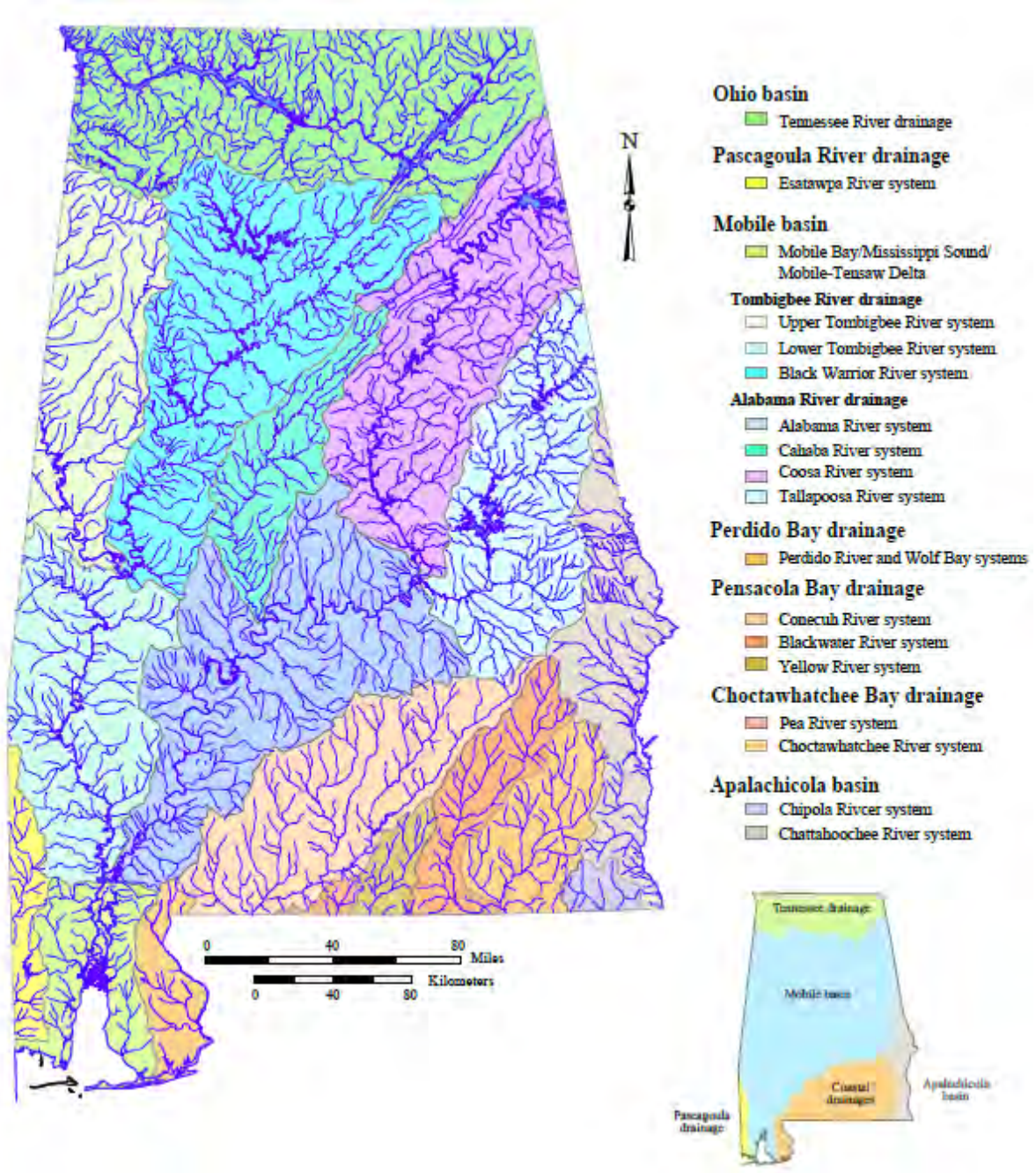


Figure 2-4. River basins, drainages, and systems of Alabama. From Smith et al. 2011.

are found throughout the state. Large areas of swamp and marsh wetlands border the major rivers, especially along the lower Tombigbee and lower Alabama Rivers and the vast Mobile-Tensaw Delta coastal wetlands along Mobile Bay and the Gulf of Mexico. Subterranean streams and pools are found in the abundant caves of the Tennessee River drainage.

The diverse and ancient geology of Alabama, in combination with a varied hydroscape, provide the framework from which Alabama's diverse aquatic ecosystems arose. Such boundaries as the Fall Line and divisions between major river basins often restricted gene flow within species, over time leading to speciation within a restricted area (Smith et al. 2011).

Some of Alabama's rivers and streams are noted for their uniqueness. The upper Sipsey Fork of the Black Warrior River was granted Wild and Scenic River status in 1988, and it is also known for harboring exceptional biodiversity. The Cahaba River has been designated one of North America's eight river "Biodiversity Hotspots" by The Nature Conservancy. The Paint Rock River is a free-flowing tributary of the Tennessee River and is one of the most biologically important regions in the state for both aquatic and terrestrial species. The river supports about 100 species of fish and 45 mussels, two of which are found nowhere else in the world. Portions of Little River, Sipsey Fork, Cahaba River, Hatchet Creek, and Tensaw River are designated Alabama Outstanding Waters.

Incidence of SGCN by river basin is a reflection of overall aquatic biodiversity and the cumulative anthropogenic impacts to each basin. Aquatic biodiversity is greatest in the Tennessee River basin, the most biologically diverse river basin in North America. This is followed by the primary drainages of the Mobile River basin (Coosa, Cahaba, Black Warrior, Tallapoosa, and Tombigbee). Endemism is also high in these basins. For example, Boschung and Mayden (2004) recognize 42 fish species endemic to the Mobile River basin.

Relative condition of Alabama's river basins is primarily related to dam construction and conversion of forests to agricultural, intensive silvicultural, mined, and urban landscapes. Low head dams were constructed on several rivers prior to 1900 to aid navigation. During the 20th century, many of these dams were replaced by larger structures and the system expanded, so that today Alabama leads the nation with 1,438 navigable miles controlled by 16 lock and dam structures. Some large hydroelectric dams were constructed that do not include navigation locks. Many of Alabama's largest dams were constructed between 1916 and 1939, including one on the Tallapoosa River, three on the Coosa River, and all four on the Tennessee River. Another period of dam building occurred during the 1960s, and no major dams have been constructed since 1983. Most hydroelectric facilities are operated to provide peaking power, and no major Alabama dam includes a dedicated fish passage structure.

Section 303(d) of the Clean Water Act requires that each state identify those waters that do not currently support designated uses, and to establish a priority ranking of these waters by taking into account the severity of the pollution and the designated uses of such waters. For each waterbody on the list, the state is required to establish a total maximum daily load

(TMDL) for the pollutant or pollutants of concern at a level necessary to implement the applicable water quality standards. Alabama's 2014 §303(d) List (Figure 2-5) includes segments of rivers, streams, lakes, reservoirs, and estuaries that do not fully support their currently designated use or uses.

Table 2-1 summarizes water quality, land use, and SGCN occurrence by river basin. Aquatic species of the Tennessee River basin account for about one-third of all Alabama SGCN (aquatic and terrestrial combined) including a very high number of extirpated species. This high incidence of SGCN is related to impoundment of the Tennessee River and some tributaries (Elk River and Bear Creek system). In addition, the Tennessee River basin has the lowest percent of forest cover and highest percent of agricultural lands of any Alabama basin, resulting in 650 miles of impaired streams.

Most of the other primary Alabama drainages (Tombigbee, Black Warrior, Alabama, Coosa, Tallapoosa and Apalachicola/Chattahoochee) are also impounded and although they are not as species rich as the Tennessee River basin, they exhibit a similar pattern of SGCN occurrence and extirpation. However, forest cover is relatively high in these basins and they have a relatively low incidence of impaired streams, except the Black Warrior system, which encompasses a portion of the Birmingham metropolitan area and includes 4 percent mined lands (no other basin includes more than 1 percent mined lands).

The Cahaba River system, the remaining primary Mobile basin drainage, is unimpounded. However, this extremely species rich basin has been impacted by the rapid urbanization of the upper watershed (Birmingham metropolitan area). The remaining coastal basins are not as species rich, include few metropolitan areas, and remain largely unimpounded. As a result, their faunas are largely intact and they harbor fewer SGCN.

Conservation Actions needed in each of the 15 river basins are provided in Chapter 4. This analysis evaluates the relative ecological condition of each basin. Any exemplary sites and priority areas within the basins have also been identified by ADCNR staff, expert advisory committees, and stakeholders. This information, combined with the SGCN, was used to guide the identification and prioritization of conservation actions.

Lakes and Ponds

Alabama has few large natural lakes, but 42 public impoundments, totaling nearly one half million acres, are larger than 500 acres. In addition to these, DWFF manages 23 public fishing lakes in 20 counties. These lakes range in size from 13 to 184 acres for a total of 1,912 surface acres.

Most large Alabama reservoirs are managed by the Tennessee Valley Authority and the U. S. Army Corps of Engineers for navigation, flood control, hydropower and recreation and by Southern Company (Alabama Power and Georgia Power) for hydropower production, flood control, and recreation.

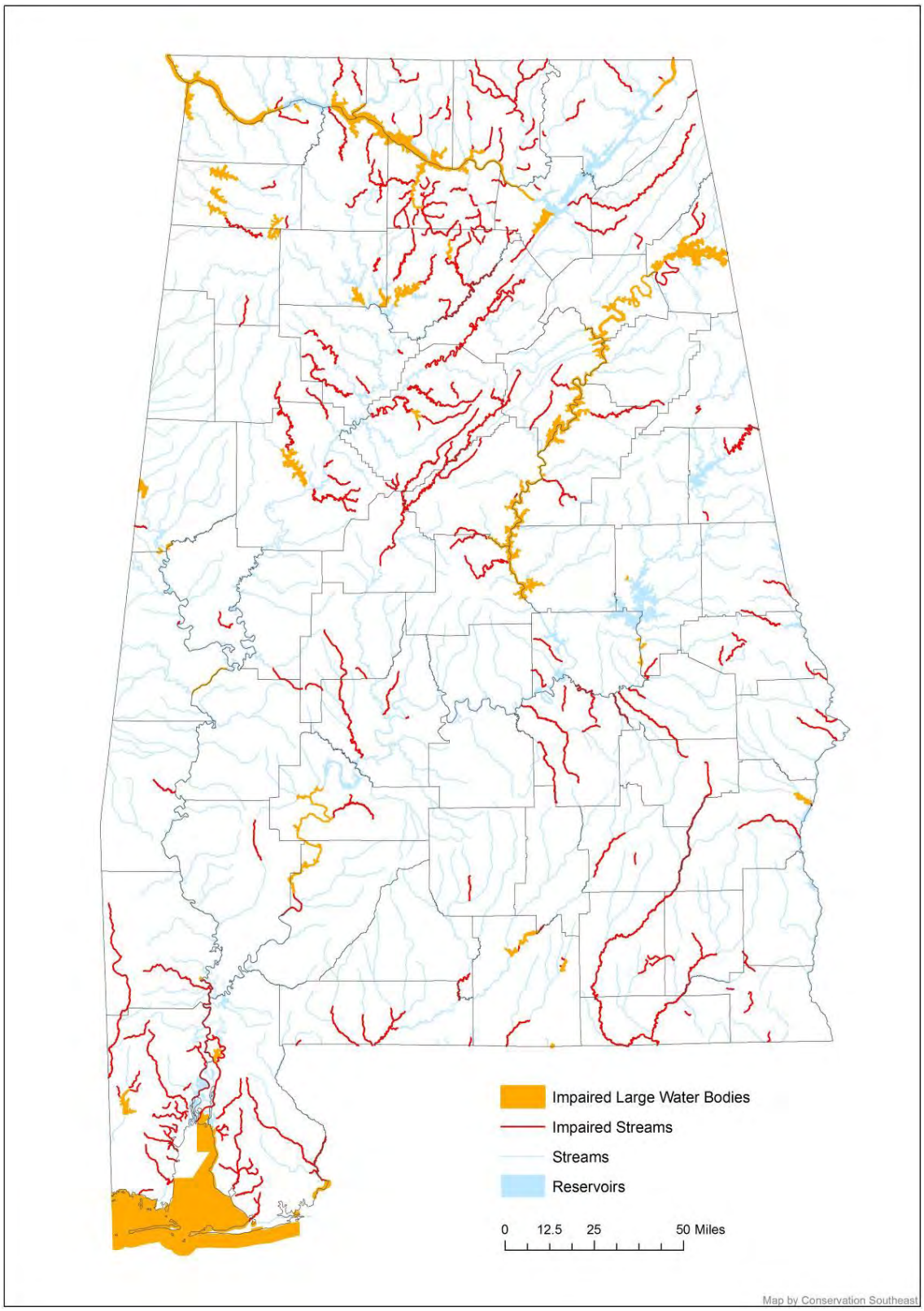


Figure 2-5. Impaired Streams of Alabama (ADEM, 2014)

Table 2-1. Condition and Status of Alabama's Major River Basins

Basin	Alabama Area (miles^2)	Impaired Streams (miles)	Number of Aquatic SGCN	Major Land Uses (%)		
				Forested	Agricultural	Urban
Tennessee	6826	650	102	49	41	5
Coosa	5353	62	51	70	19	5
Cahaba	1818	185	42	65	15	16
Black Warrior	6276	470	38	62	22	8
Alabama	5956	62	30	68	26	4
Tombigbee	7660	16	28	78	16	2
Apalachicola	2832	37	31	66	25	5
Conecuh	3848	53	20	81	15	2
Choctawhatchee	3130	20	16	54	39	4
Tallapoosa	3974	92	11	73	17	4
Yellow	507	0	16	71	24	3
Mobile	1013	207	13	63	14	18
Pascagoula	767	97	19	71	21	6
Blackwater	148	0	6	80	18	0
Perdido	841	32	5	69	19	7

Thousands of small farm ponds are scattered across the state. Most are impounded headwaters of small streams, but some are excavated catch basins. Many such ponds are managed for recreational fishing. Beaver ponds are a common feature on the landscape, and provide important habitat for waterfowl, fish, amphibians, reptiles, and other wildlife.

Estuaries and Marine Habitat

Alabama's marine area is important for commercially and recreationally valuable fisheries, as well as other finfish, crustaceans, shellfish, marine mammals, sea turtles, seabirds, and waterbirds. Mobile Bay is Alabama's largest estuary, encompassing 64,470 acres of water and 142 miles of shoreline (Crance 1971). The bay is the mouth of the Mobile River Basin, which is the nation's sixth largest watershed by area and fourth largest in terms of discharge volume. Ecosystems associated with Mobile Bay include barrier islands, tidal marshes, cypress

swamps, bottomland hardwoods, submerged aquatic vegetation (SAV) and oyster reefs. The average water depth in Mobile Bay is approximately 10 feet and the tidal marshes are located mostly at the northern end of the bay and along the shores of its tributary estuaries.

The Mobile Delta estuary is made up of a series of rivers, shallow bays and numerous interconnecting marshes and streams. Averaging about 11 feet in water depth and with 20,323 acres of open water, there are 55.4 miles of bay shoreline and in 1971 there were 15,257 acres of tidal marsh in the estuary. The current distribution of SAV is unknown but includes shoal grass (*Halodule wrightii*), southern naiad (*Najas guadalupenis*), wild celery (*Vallisneria spiralis*), slender pondweed (*Potamogeton pusillus*), *Nitella spp.* and widgeon grass (*Ruppia maritima*). Shoal grass is the dominant seagrass in Alabama (GMFMC 1998).

Weeks Bay is a small estuarine embayment off Mobile Bay and consists of approximately three square miles of open shallow water averaging 4.5 feet deep. Weeks Bay is fringed with marsh (*Spartina* spp. and *Juncus* spp.) and swamp (oak, maple, cypress and others). Forested wetlands form an extensive strip between floodplain swamps and upland pine-oak forest. Weeks Bay is a critical nursery for fish, crustaceans and shellfish, is classified as an Outstanding Alabama Water, and is designated a Habitat Area of Particular Concern (HAPC) by the Gulf of Mexico Fishery Management Council. The GMFMC (1998) describes Alabama's estuaries as "important in sustaining viable fisheries [throughout] the Gulf of Mexico."**Error! Bookmark not defined.**

Alabama's jurisdiction extends three miles from the coastline offshore into the Gulf of Mexico and includes marine benthic (including submerged sea grasses), pelagic and surface water ecosystems. The Mississippi-Alabama shelf extends from the Mississippi River delta to the west to DeSoto Canyon offshore from Pensacola, Florida, to the east. The inner shelf seafloor is relatively broad and flat to the west of Mobile Bay but characterized by sand ridges and swales east of the bay; a deepwater navigation channel bisects the underwater tidal delta directly off Mobile Pass. Several hardbottom areas of exposed rock occur in between 60 and 130 feet of water south of Mobile Pass and at the Alabama-Florida state boundary, creating several "reef-like knobs" of 1.5 to 16 feet of vertical relief.

Alabama's marine area also contains nearly 1,260 square miles (806,400 acres) approved for the construction of artificial reefs in the nation's first and largest organized artificial reef program. Artificial reefs in Alabama waters have been built in up to 2,760 feet of water and up to 56 miles offshore, consisting of vessels, concrete rubble, oil platforms, obsolete military tanks, boxcars, airplanes, barges, oyster shells, rock and other materials. Two hundred and fifteen offshore reefs have been constructed so far. The ADCNR has constructed 20 inshore artificial reefs within Mobile and Bon Secour bays and Mississippi Sound through the Roads to Reefs partnership that recycles bridge materials as artificial reef habitat.

Wetlands

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil all year or for varying periods of time during the year, including during the growing

season. Water saturation largely determines how the soil develops and the types of plant and animal communities living in and on the soil. Wetlands may support both aquatic and terrestrial species. The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetland soils (EPA 1995).

Approximately 3.5 million acres of wetlands exist in Alabama, but development, agriculture, draining, and other human activities have destroyed more than half of the estimated 7.5 million acres that were present before European settlement (Phillips 2002). The types of wetlands found in the state are varied and include salt marsh, forested swamps, and bogs. The tidally influenced Mobile-Tensaw Delta north of Mobile Bay is the state's largest wetland, and ranges from 5 to 10 miles wide along its 40-mile length.

Ecological Systems and Key Habitats

While ecoregions are a useful coarse-filter approach to managing biodiversity information, a finer level of precision is required for many conservation applications. *Ecological systems* are defined as groups of plant community types that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients (NatureServe 2004). A given ecological system will typically manifest itself in a landscape and persist for 50 or more years. Ecological system units are intended to provide "meso-scale" classification units for applications to resource management and conservation. The use of these standardized, named vegetation community systems, also called habitats, facilitates compilation of regional and national map and inventory data. For many wildlife species, the lack of distribution and abundance data requires the use of key habitats and associated vegetative communities as the best available scale for appropriate conservation planning and implementation.

Applications of ecological systems as key wildlife habitats include their use as units for conservation assessment, ecological inventory, mapping, land management, ecological monitoring, and species habitat modeling. With the possible exception of caves, these habitats have not yet been fully mapped at a fine scale in Alabama. This has been identified as a critical gap and has been captured as a conservation priority to meet this need to improve habitat information.

Identifying Habitats

Key Terrestrial Habitats

NatureServe has classified and described 66 primarily terrestrial ecological systems in Alabama based on the U.S. National Vegetation Classification (USNVC). The USNVC is the standard vegetation classification system for federal agencies (FGDC 2008) and it has received widespread support from state, federal, academic, and international partners. This classification serves many natural resource management purposes including conservation planning, biodiversity protection, scientific research, inventory, and mapping (NatureServe

2004), and was recommended by the Association of Fish and Wildlife Agencies (AFWA 2012) for regional and national consistency in the development of SWAPs. ADCNR Lands Division's Natural Heritage Section and The Nature Conservancy of Alabama also use this classification.

As with the identification of SGCN discussed in Chapter 1, the identification of key habitats involved input and analysis/review by ADCNR staff, scientific advisory committees, and stakeholders. Using information from the existing classification systems discussed above, an initial list of habitats important to wildlife in Alabama was developed. This list was then crosswalked with the USNVC and NatureServe ecological systems. ADCNR staff and the scientific advisory committee reviewed this foundational database for refinement and completion of missing data.

This process initially resulted in a list of 62 communities clustered into 14 key habitat types for conservation purposes. To this list were added additional habitat types that are not natural vegetative communities but are important to the taxa groups, for a total of 16 (Table 2-2). Each habitat may contain more than one natural community that is similar in structure and characteristics in terms of wildlife habitat.

Each key habitat is listed with its associated vegetative communities (where applicable) in Table 2-2. Summary tables of associated animal species, broken down by taxa, are also presented for each of the 16 key habitats (see Chapter 4). These tables were organized from the database developed by staff, expert advisors, and stakeholders, as discussed in Chapter 1. The AFWA Criteria for classification as SGCN were used to reveal species within each habitat that fit more than one SGCN criteria as well as for species distribution across the other habitats of conservation concern.

Estuarine and Marine Priority Areas:
An important partnership facilitated by the Mobile Bay National Estuary Program (NEP) brought together stakeholders to prioritize estuarine, marine, and coastal habitats in Alabama (TNC 2009). The MS-AL Habitat Mapper (http://habitats.disl.org/) is a spatial data tool created with input from the Coastal Habitat Coordinating Team, 60 state and local representatives concerned with habitat management and protection in coastal Alabama. The criteria included size of habitat, core area, perimeter–to-area ratio, proximity to other habitat patches, nearest neighboring habitat patch, distance to areas already protected, coincidence with ecologically important areas, threatened and endangered species, and potential migration area. While the effort prioritized a diversity of habitats in these coastal counties, of particular importance to Alabama's SWAP is geospatial information for estuarine and marine habitats. This information helped fulfill an important data gap from the 2005 CWCS. Priority marine and estuarine habitats include Intertidal Marshes and Flats, Submerged Aquatic Vegetation, and Oyster Reefs.

Table 2-2. Key Habitats and Associated Communities

Habitat	No. SGCN	Associated NatureServe Ecological Systems
Mesic Hardwood Forest		Southern Piedmont Mesic Forest CES202.342 South-Central Interior Mesophytic Forest CES202.887 East Gulf Coastal Plain Southern Mesic Slope Forest CES203.476 East Gulf Coastal Plain Northern Mesic Hardwood Forest CES203.477 East Gulf Coastal Plain / Central Florida Hydric Hammock CES203.501 East Gulf Coastal Plain Limestone Forest CES203.502 East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods CES203.557
Dry Hardwood Forest		Southern Piedmont Dry Oak-(Pine) Forest CES202.339 Allegheny-Cumberland Dry Oak Forest and Woodland CES202.359 Southern Ridge and Valley Dry Calcareous Forest CES202.457 Northeastern Interior Dry Oak Forest CES202.592 Southern Interior Low Plateau Dry Oak Forest CES202.898 East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest CES203.506 East Gulf Coastal Plain / Central Florida Upland Hardwood Forest CES203.560 East Gulf Coastal Plain Northern Dry Upland Hardwood Forest CES203.483
Floodplain Forest		Cumberland Riverscour CES202.036 Southern Piedmont Small Floodplain and Riparian Forest CES202.323 Southern Piedmont Large Floodplain Forest CES202.324 South-Central Interior Large Floodplain CES202.705 South-Central Interior Small Stream and Riparian CES202.706 East Gulf Coastal Plain Large River Floodplain Forest CES203.489 East Gulf Coastal Plain/Cent. FL Blackwater Riv. Floodplain Forest CES203.493 East Gulf Coastal Plain Small Stream and River Floodplain Forest CES203.559
Dry Longleaf Pine Forest		Southeastern Interior Longleaf Pine Woodland CES202.319 Southern Appalachian Low Mountain Pine Forest CES202.332 East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland CES203.496
Wet Pine Savanna and Flatwoods		East Gulf Coastal Plain Near-Coast Pine Flatwoods CES203.375 East Gulf Coastal Plain Treeless Savanna and Wet Prairie CES203.192 South-Central Interior/Upper Coastal Plain Wet Flatwoods CES203.480
Swamp		Southern Piedmont Upland Depression Swamp CES202.336 East Gulf Coastal Plain Tidal Wooded Swamp CES203.299 East Gulf Coastal Plain Non-riverine Basin Swamp CES203.384 East Gulf Coastal Plain / Central FL Seepage Swamp and Baygall CES203.505 Southern Coastal Plain Nonriverine Cypress Dome CES203.251
Maritime Forest and Coastal Scrub		East Gulf Coastal Plain Maritime Forest CES203.503
Glades and Prairie		Ridge and Valley Calcareous Valley Bottom Glade and Woodland CES202.024 Southern Piedmont Glade and Barrens CES202.328 Southern Piedmont Granite Flatrock CES202.329 Cumberland Sandstone Glade and Barrens CES202.337 Alabama Ketona Glade and Woodland CES202.338 Southern Ridge and Valley Patch Prairie CES202.453 Central Interior Highlands Calcareous Glade and Barrens CES202.691 East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland CES203.478
Bogs and Seepage Communities		Southern Piedmont Seepage Wetland CES202.298 Cumberland Seepage Forest CES202.361 East Gulf Coastal Plain Herbaceous Seepage Bog CES203.078 East Gulf Coastal Plain Interior Shrub Bog CES203.385
Caves and Mines		N/A
River and Stream *Strategic Habitat Units* and *River Reach Units* (SHUs and SRRUs)		N/A
Isolated Wetland		Cent. Interior Highlands & Appalachian Sinkhole & Depression Pond CES202.018 Atlantic and Gulf Coastal Plain Interdunal Wetland CES203.258

Habitat	No. SGCN	Associated NatureServe Ecological Systems
		East Gulf Coastal Plain Northern Depression Pondshore CES203.558
Artificial Habitats		N/A
Beach and Dune		Florida Panhandle Beach Vegetation CES203.266 East Gulf Coastal Plain Dune and Coastal Grassland CES203.500
Intertidal Marshes and Flats		Mississippi Sound Salt and Brackish Tidal Marsh CES203.303
Submerged Aquatic Vegetation		East Gulf Coastal Plain Northern Gulf of Mexico Seagrass Bed CES203.263
Cliffs and Rockhouses		Southern Interior Sinkhole Wall CES202.357 Southern Appalachian Spray Cliff CES202.288 Southern Interior Acid Cliff CES202.309 Southern Appalachian Montane Cliff and Talus CES202.330 Allegheny-Cumberland Sandstone Box Canyon and Rockhouse CES202.349 Southern Interior Calcareous Cliff CES202.356 Southern Piedmont Cliff CES202.386 East Gulf Coastal Plain Dry Chalk Bluff CES203.492

Key Aquatic Habitats: SHUs and SRRUs

A partnership of the Geological Survey of Alabama, U.S. Fish and Wildlife Service, and ADCNR has selected watersheds and river segments in the five HUC-4 subregions in Alabama to focus conservation activities for managing, protecting, restoring, and recovering populations of rare fishes, mussels, snails, and crayfishes. These Strategic Habitat Units (SHUs) and Strategic River Reach Units (SRRUs) include a substantial part of Alabama's remaining high-quality rivers and streams and reflect the variety of small stream to large river habitats occupied by these species historically and/or currently (Figure 2-6).

The SHUs were selected based on best available information about the essential habitat components required by these aquatic species including: (1) geomorphically stable stream and river channels; (2) stream flow regimes that support normal behavior, growth, and survival of the animals; (3) acceptable water-quality conditions necessary for normal behavior, growth, and viability of all life stages of the animals; (4) a diversity of channel substrate types, with minimal amounts of fine sediment and filamentous algae; (5) for mussels, the presence of fish hosts with adequate living, foraging, and spawning areas; and (6) few or no competitive or predaceous nonnative species. The SRRUs were selected based on the historical and/or current presence of rare species and include river reaches where species restoration and recovery actions are planned for the future or are already underway.

The purpose of designating SHUs and SRRUs is to facilitate and coordinate watershed management and restoration efforts as well as to focus funding to address habitat and water quality issues. All of the SHUs currently support one or more multiple federally listed species and/or critical habitat designated by the U.S. Fish and Wildlife Service.

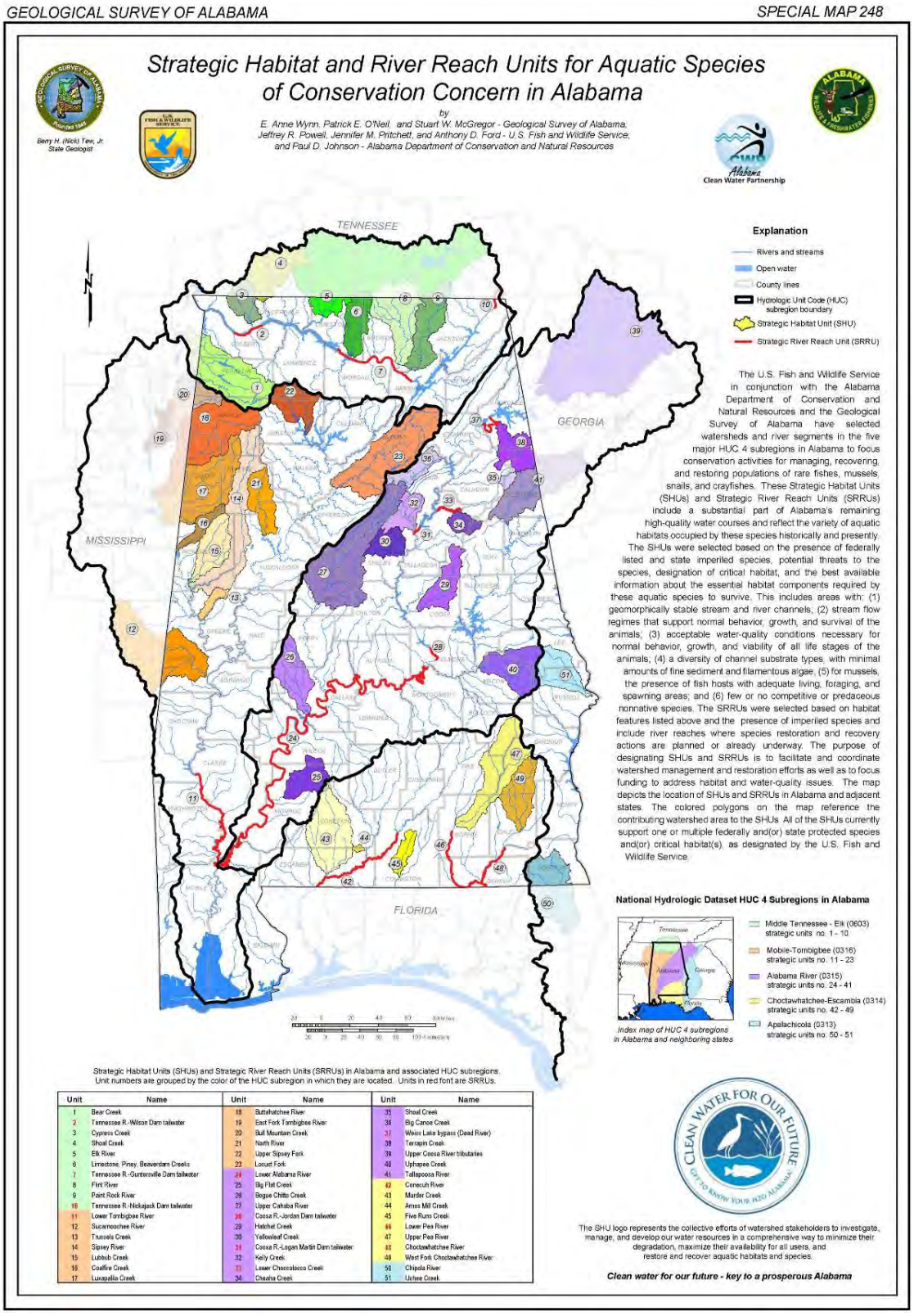


Figure 2-6. Strategic Habitat and River Reach Units (SHUs and SRRUs)

Chapter 3
STATEWIDE CONSERVATION ISSUES AND THREATS

FIGURES

TABLES

Introduction

Alabama faces the daunting challenge of protecting one of the nation's most biologically diverse and unique regions amid pressures imposed by a growing population. Alabama's SGCN and their key habitats face numerous threats that may adversely affect them and compromise their status. Some of these threats are global or national in scale, while others are regional, statewide, or local. With much of the landscape greatly modified for agriculture, silviculture, mining, and urban and industrial development, natural ecosystem processes such as fire and natural water flows are disrupted. Remaining natural communities are spatially disconnected and differ significantly in structure and species composition from when Alabama was granted statehood 195 years ago. Identifying these and other threats to Alabama's SGCN and key habitats is an important component in developing effective conservation actions for this SWAP. Once identified, threats can be addressed through actions that ADCNR-DWFF and its partners have developed throughout this SWAP process, and implemented for long-term conservation of SGCN and key habitats as resources and opportunities allow. The previous two chapters identified Alabama's SGCN (Element 1) and key habitats (Element 2); this chapter addresses the threats affecting these important conservation targets (Element 3).

SWAPs are required to identify the "problems which may adversely affect species of conservation need and their habitats." These "problems" include threats that stress wildlife species and habitats, as well as management challenges such as deficiencies in data or resources for particular species or habitats. Human activities and natural processes that affect wildlife species and habitats in negative or detrimental ways are threats, while the effects of these threats on particular wildlife species or habitats are known as stress responses or stressors. Threats may be species-specific, affecting a species by a direct action or through indirect impacts by limitation of a particular habitat condition, or limiting factor. Although terms are often used interchangeably, the word "threat" is used in this document as an umbrella term referring to all aspects of the process by which human actions or natural events may jeopardize fish and wildlife species and their habitats.

All species in Alabama have been affected to some degree by human activities. Some have taken advantage of altered and developed landscapes; alien and invasive species such as the Red Imported Fire Ant, Norway Rat, European Starling, Asian Clam, Chinese Privet, and many others have thrived. Some native species have found a surrogate habitat in urban areas as natural habitats have diminished. Some examples of these opportunists include Gray Squirrel, Northern Mockingbird, and Chimney Swift. The majority of Alabama's wildlife populations are vulnerable to multiple threats associated with human

activities, and the SGCN list identifies the most vulnerable. Following this chapter (Chapter 4), threats are targeted and addressed by actions to implement long-term conservation of SGCN and key habitats.

Alabama's 2005 SWAP (the Comprehensive Wildlife Conservation Strategy, or CWCS) identified five general threats as common to most SGCN:

- Habitat loss and fragmentation
- Loss of natural community integrity
- Impacts from disturbance
- Impacts from exotic species
- Lack of adequate protection or information

A 2011 survey of state fish and wildlife agencies, a review of the 2005 State Wildlife Action Plans, and discussions with state Wildlife Diversity Program Managers and State Wildlife Action Plan Coordinators (AFWA 2011) identified the following as the top ten national challenges to conserving the nation's at-risk fish and wildlife:

- Habitat loss due to residential, commercial, and industrial development
- Habitat loss from ecosystem modifications, such as fire suppression
- Impaired water quality
- Habitat conversion for agriculture, aquaculture, forestry, and mining
- Data gaps
- Introduction and spread of invasive species
- Collection and illegal harvest
- Human intrusion and disturbance
- Climate change impacts on fish, wildlife, and their habitats
- Insufficient conservation funding and capacity

To provide consistency in identifying threats to SGCN and key habitats, the International Union for Conservation of Nature (IUCN) standard lexicon of threats (and actions, described in Chapter 4) was adopted for use in SWAPs (Salafsky et al. 2008). "Threats" are defined as "the proximate human activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity targets." This standard terminology is applied in this document to outline and identify the specific threats to Alabama SGCN and key habitats.

Identifying Threats to Alabama's Wildlife and Key Habitats

To identify threats to SGCN and their key habitats (Element 3), all original sources used in the original 2005 SWAP were reviewed, along with a number of more current reports and updates. Volume 5 of *Alabama Wildlife* (Shelton-Nix, *in press*) provided substantial updated information from the 2012 Nongame Conference and was a primary source, along with supplemental input solicited in 2014 from experts.

The IUCN threat classification system, the foundation of the TRACs action drivers, (Appendix 3.1) was used to categorize threats at the state, taxa, habitat, and species levels. Through a series of workshops, teams of experts, partners, and stakeholders reviewed the latest information on threats to SGCN, building on the 2005 CWCS. Technical Teams comprised of leading experts (most of whom served on the Taxa Teams for the 2012 Nongame Conference) reevaluated the threats listed in the 2005 CWCS as well as additional updated threat information. Climate change and emerging diseases are examples of threats where more updated information was incorporated into the threats determination, assessment and ranking process. Teams then grouped and condensed these threats, where similar, for species suites, habitat associations, or broader taxa applicability. A similar process was conducted for identifying and updating threats to each key habitat. Habitat threats were also grouped and condensed to higher tier habitat groupings whenever possible to reduce redundancy and highlight common threats.

1. Residential and Commercial Development

Despite much of the landscape remaining relatively sparsely populated (Figure 3-1), a primary threat to SGCN is residential, commercial, and associated development. Alabama is the 30th largest yet 27th most densely populated state, with 4,779,736 estimated residents in 2014 occupying roughly 52,419 square miles, or about 91.2 people per square mile (U.S. Census 2010). Alabama's 2014 population estimate is 9.0% higher than that reported in the 2000 Census. Threats posed by human settlements or other nonagricultural land uses with a substantial footprint can be further broken down into three subcategories.

1.1 Housing and Urban Areas

Cities and towns including non-housing development associated with housing occupy an increasingly large area of former wildlife habitat. Alabama's overall recent population growth has not been dramatic, with some counties gaining and others losing population (Figure 3-2), but there has nevertheless been a trend of expansion and development (i.e., sprawl; Figure 3-3) around population centers. The cities and surrounding suburbs of Birmingham, Huntsville, Montgomery, and Mobile contain approximately half of the state's population. The amount of land conversion associated with urban growth varies across the state, but is correlated with these expanding metropolitan areas which are often adjacent to areas that are losing population or stagnant. For example, Shelby County, just southeast of Birmingham, grew 4.7% from 2000 to 2010 while Birmingham's Jefferson County grew only 0.2%. Increases in development in rural areas accounts for much of the losses in wildlife habitat and other natural resources.

Alan Cressler

Figure 3-1. Urban sprawl displacing wildlife habitat

1.2 Commercial and Industrial Areas

Factories and other commercial centers inevitably accompany housing, and recent trends in commercial development have been spacious “big box” developments, superstores, shopping villages, and regional distribution facilities that consume large areas of habitat.

1.3 Tourism and Recreation Areas

Tourism and recreation sites with a substantial footprint can affect SGCN. Alabama has over 300 golf courses and a number of motocross tracks, for example, which destroy or significantly alter natural wildlife habitats.

High density development of natural habitats can change local hydrology, increase recreation pressure, introduce invasive species either by design or by accident with the introduction of vehicles, and bring significant disturbance to the area. Urbanization and forest fragmentation are inextricably linked to the effects of climate change, because the dispersal and migration of forest plants and animals are disrupted by development and roads.

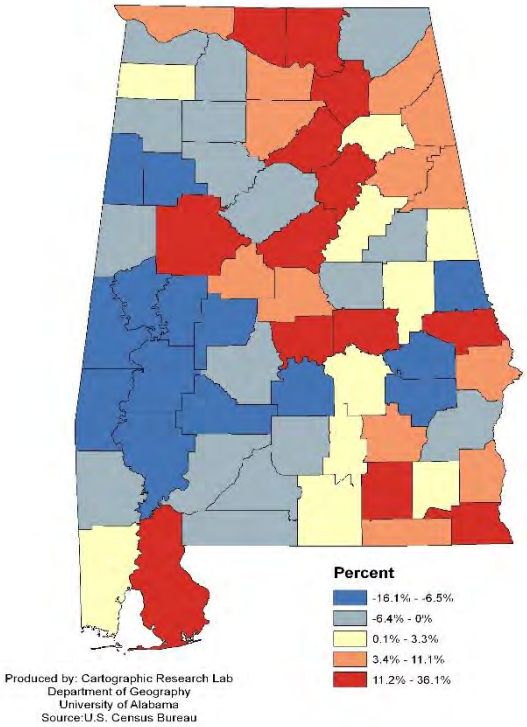


Figure 3-2. Population change by county, 2000-2010

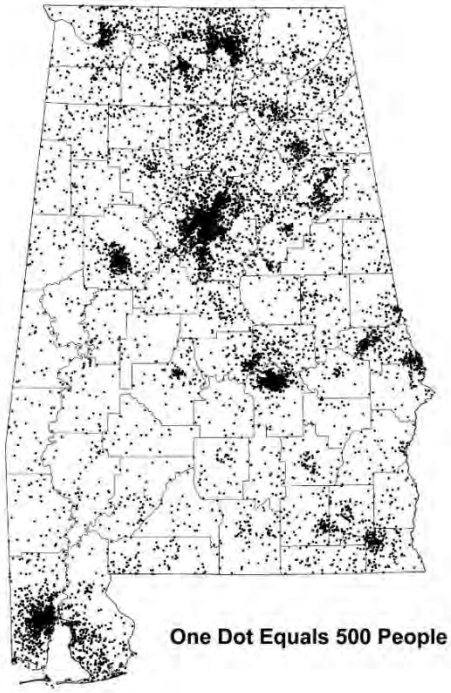


Figure 3-3. Population density and distribution, 2010

With only four percent of its area in public conservation lands and protected from development, Alabama trails the rest of the Southeast and the nation (Figure 3-4). The Forever Wild Land Trust (FWLT), managed by ADCNR through its State Lands, State Parks, and Wildlife and Freshwater Fisheries divisions, works to preserve natural areas, to guarantee their permanent protection, and to ensure proper management of land having high resource value. The FWLT prioritizes parcels of land whose resource value, size, location, and relationship to existing conservation land make them significant to the state's welfare. Since its establishment by constitutional amendment in 1992, the FWLT has purchased 245,726 acres of land.

2. Agriculture and Aquaculture

Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture, and aquaculture can be further broken down into four subcategories.

2.1 Annual and Perennial Non-timber Crops

Non-timber crops are those planted for food, fodder, fiber, fuel, or other uses on farms, plantations, orchards, vineyards, and mixed agroforestry systems. In 1950 Alabama had more than 200,000 farms covering more than 20 million acres, but by 2010 this figure had declined to 48,500 farms covering nine million acres, or about 28% of the state's total land area (USDA 2011). The top five farm commodities are: (1) poultry, (2) cattle and calves, (3) greenhouse, sod, and nursery, (4) cotton, and (5) soybeans. In the 1960s and 1970s significant expanses of bottomland hardwood forests were cleared for soybean production. With declines in farming in portions of the state, many areas are reforesting and supporting an increasing diversity of wildlife.

2.2 Wood and Pulp Plantations

Most of Alabama's terrestrial wildlife species occur in forested habitats, and approximately 95% of Alabama's 23 million forested acres are in private ownership (AFC 2010). Over the past 50 years, much of the area of natural forest has been converted to intensively managed, planted "tree farms" for producing timber or fiber. Although the 2012 Forest Inventory and Analysis of Alabama (Hartsell 2013) reported an all-time high forested acreage of 22.9 million acres in Alabama for 2012, and the area of land classified as "forested" has remained fairly stable since the 1972 survey, the area of planted stands, mostly loblolly pine (Figure 3-5), has increased by over 300 percent, now accounting for over seven million acres, or 30% of the total forested area. Establishment of pine plantations on former agricultural lands can be a net benefit to some species, but where natural stands are converted to plantation, negative impacts to SGCN species and their required habitats may occur.

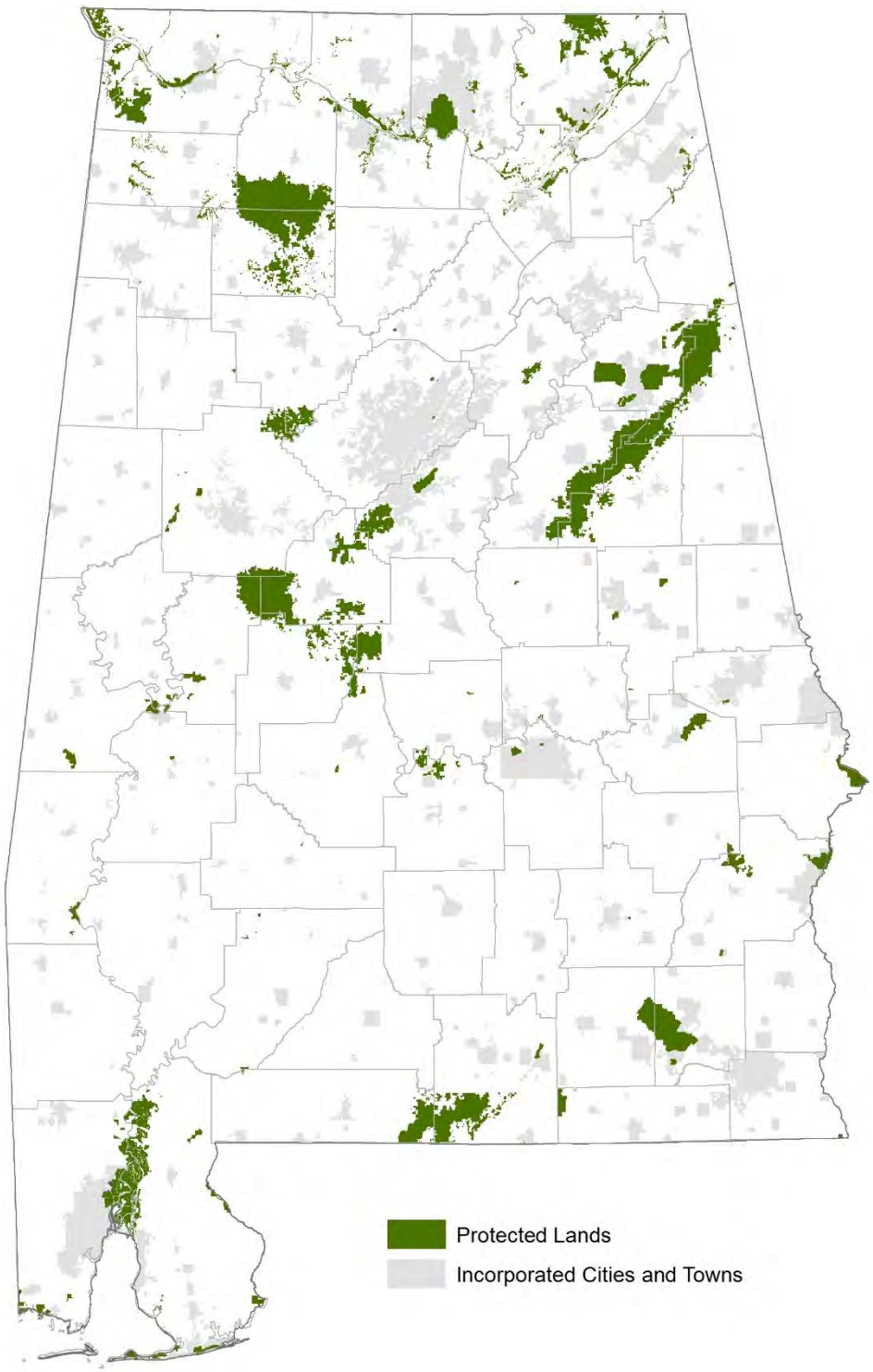


Figure 3-4. Protected lands and incorporated areas of Alabama

2.3 Livestock Farming and Ranching

This category includes cattle feed lots, hog operations, dairy farms, cattle ranching, and chicken farms. Effluent from livestock operations may degrade water quality, and livestock that are allowed into streams and wetlands may damage sensitive stream banks and ecotonal habitats important to some SGCN.

Mark Bailey

Figure 3-5. Intensively managed loblolly pine plantation, Monroe County AL

2.4 Marine and Freshwater Aquaculture

Production of aquatic animals raised in one location on farmed or nonlocal resources includes catfish ponds on farms and seeded oyster beds. In the past few decades, large areas of Black Belt prairie were converted to aquaculture (catfish farms). Wood Storks and other wading birds frequent catfish ponds, sometimes in such numbers they are considered a nuisance.

3. Energy Production and Mining

Threats from production of non-biological resources can be direct and indirect.

3.1 Oil and Gas Drilling

Exploring for, developing, and producing petroleum and other hydrocarbons in the form of oil and gas wells and offshore natural gas drilling can negatively affect SGCN. More than 17,000 oil and gas wells are scattered across Alabama's landscape, primarily in the west-central and southwestern portions (Figure 3-6). Access road construction to these sites further contributes to forest fragmentation (Figure 3-7).

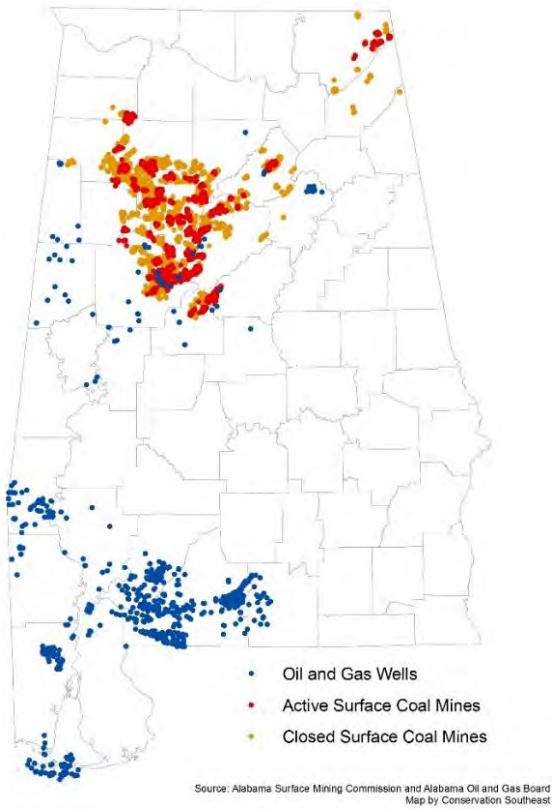


Figure 3-7. New well pads and access roads in a rural landscape, Conecuh County.

3.2 Mining and Quarrying

Exploring for, developing, and producing minerals and rocks in the form of coal mines, rock quarries, and sand and gravel pits can negatively affect SGCN. Currently, about two-thirds of Alabama's coal comes from deep underground mines in the Warrior Coal Field of the Southwestern Appalachians ecoregion, with the remainder coming from surface mines.

3.3 Renewable Energy

Exploring, developing, and producing renewable energy in the form of solar farms and wind farms can negatively affect SGCN. Direct mortality of birds and bats from wind turbines along flyways may occur, and large-scale solar farms on hundreds of contiguous acres can displace species such as Gopher Tortoises.

The first offshore discovery of oil in state waters was made in 1979, and by 2005 80 wells had been drilled in state water (Figure 3-8). The Deepwater Horizon oil rig exploded in Louisiana offshore waters on April 20, 2010, releasing more than 200 million gallons of oil into the Gulf of Mexico 100 miles from Alabama's shoreline. Since then, various government agencies and nonprofits have been studying the region's wildlife to track the impacts of the oil. It may be years, perhaps decades, before the impacts to all Gulf wildlife are known. Four years after the spill, a report by the National Wildlife Federation (Fikes, et al. 2014) examined 14 species that live in the Gulf. More than 900 bottlenose dolphins have been found dead or stranded in the oil spill area (not just Alabama) since April 2010. About 500 dead sea turtles of several species have been found in the spill region every year since 2011, a dramatic increase over normal rates.

The RESTORE Act, passed in 2012, directs 80% of Clean Water Act civil fines from the Deepwater Horizon oil spill to a Gulf Coast Restoration Trust Fund. From there, the RESTORE Act dollars will be split into five allocations:

- 35% will be shared equally among the five Gulf States;
- 30% will be dedicated to development and implementation of a Gulf-wide Comprehensive Ecosystem Restoration Plan;
- 30% will be used for state-specific restoration plans;
- 2.5% will provide grants for research; and
- 2.5% will be used for long-term fisheries monitoring and ecosystem science.

Alan Cressler

Figure 3-8. Offshore oil and gas platform, Fort Morgan

The Initial Comprehensive Ecosystem Restoration Plan was developed in 2013 by a federal-state council tasked with increasing the long-term ecological health of the Gulf. While Natural Resource Damage Assessment funds can only address damage directly connected to the oil spill, the RESTORE Council can address long-standing, large-scale, comprehensive ecological restoration.

Wind turbines pose a potential threat to birds, although compared to other sources of fatality (e.g., collisions with buildings and communication towers and predation by cats) wind turbines, at the current rate of development, appear to be a relatively minor source of mortality; however, these fatalities are cumulative and may become more pronounced over time. As turbine size increases and development expands into new areas with higher densities of birds, risk to birds could increase (The Wildlife Society 2007).

4. Transportation and Service Corridors

Threats from long, narrow transport corridors and the vehicles that use them include associated wildlife mortality and habitat fragmentation.

4.1 Roads and Railroads

Surface transport on roadways and dedicated tracks includes highways, secondary roads, logging roads, bridges and causeways, fencing associated with roads, and

Figure 3-9. Alabama's Federal highway system

railroads. Many economically depressed areas of the state, particularly the western portion, have limited access to major transportation corridors which are critical to their economic prosperity (Figure 3-9). Some of these areas are also where Alabama's best and most intact forest resource can be found (AFC 2010). Connecting these economically depressed areas to regional and national transportation corridors is viewed by many as a strategic tool to stimulate employment, education, leisure, and other services, but construction of new roads and expansion of existing transportation corridors consumes land and impacts forest and wildlife sustainability through increased sprawl, fragmentation, impervious pavement, air pollution, reduced water quality, direct wildlife mortality on roads (Figure 3-10), and obstructs travel corridors to breeding, spawning, and wintering habitats. Alabama averaged 196.25 new miles of rural roads constructed from 1992 to 2012, increasing from 72,695 miles to 76,620 miles during that period (USDOT 1992 and 2012).

ALDOT includes an economic development strategy in its Statewide Transportation Plan (2008). The plan identifies economic corridors that are priorities for transportation investments. One example is the West Alabama Corridor for Feasibility/ Alignment Studies. This potential project would construct a major transportation corridor connecting Mobile and Florence. This is in part due to the 2010 opening of the massive new ThyssenKrupp steel plant in north Mobile County where strategic north-south routes are lacking. The Northern Beltway, a proposed 52-mile bypass around Birmingham through largely forested land in the upper Black Warrior River basin, is another large construction project that may threaten a number of SGCN.

ALDOT prepares an Environmental Impact Statement (EIS) when a proposed project is known to have significant and direct impact on the quality of the environment. New highways, highway re-alignments, and other projects that involve acquisition of large amounts of new right-of-way require an EIS. The EIS fully documents the purpose and need of a new project, alternatives, the affected environment, impacts and consequences of proposed alternatives, extensive feedback from affected agencies and citizens, justification of the final project decision, and proposed impact mitigation activities. A

broad array of potential impacts are discussed including: land use, social and economic, bicycle and pedestrian interactions, air quality, noise, water quality, wetlands, wildlife and endangered species, and sites of cultural or historic importance.

4.2 Utility and Service Lines

Transport of energy and resources includes electrical and phone wires, aqueducts, oil and gas pipelines. Fragmentation of interior forest occurs when new rights-of-way are cleared. Transmission lines are often corridors for invasive species such as cogongrass. Despite some negative effects, mowed rights-of-way in some fire-suppressed areas are the only habitat supporting Gopher Tortoises and other species requiring open land that normally would be maintained by natural fires.

4.3 Shipping Lanes

Transport on and in freshwater and coastal waterways includes dredging stream bottoms which degrades habitat for a number of SGCN fishes and mollusks. Wakes from cargo ships and barges damage shorelines. Commercial and recreational boats may strike manatees.

4.4 Flight Paths

Air transport may result in noise disturbance and bird collisions. Most species become habituated to the sound and sight of aircraft, and this threat category was not considered significant by the Technical Teams.

5. Biological Resource Use

Threats from consumptive use of “wild” biological resources include both deliberate and unintentional harvesting effects as well as persecution and control of specific species.

5.1 Hunting and Collecting Terrestrial Animals

This subcategory includes the killing or trapping of terrestrial wild animals for commercial, recreation, subsistence, research or cultural purposes, or for predator control/ persecution reasons. It includes accidental mortality of non-target species. Regulated harvest of game species seldom affects SGCN, but some, while not typically sought by sportsmen, are technically game species. Appalachian Cottontail, Marsh Rabbit, American Black Duck, Yellow Rail, Black Rail, and King Rail are all listed as game birds and mammals with open seasons.

Figure 3-10. Large terrestrial snakes such as this Northern Pine Snake are at high risk to road mortality.

Snakes frequently suffer direct persecution and one annual public event exploits the declining population of Eastern Diamondback Rattlesnake by removing animals from the wild. In the past a frequent collection technique was to introduce gasoline fumes into Gopher Tortoise burrows to drive out the rattlesnakes. Due to concerns for tortoises and other SGCN such as Eastern Indigo Snakes and Gopher Frogs that also take shelter in the burrows, the Alabama Conservation Advisory Board in 2009 unanimously passed a motion to make it "illegal to introduce gasoline or any other noxious chemical or gaseous substance into wildlife burrows, dens or retreats." There is no other regulation or limit on taking Eastern Diamondback Rattlesnakes, however.

5.2 Logging and Wood Harvesting

Harvesting trees and other woody vegetation for timber, fiber, or fuel often includes clear cutting of both natural and planted stands (Figure 3-11) which alters habitat, destroys nests, and disrupts movement patterns. Alabama's voluntary Best Management Practices for forestry are written to protect water quality and do not directly address the needs of SGCN.

Mark Bailey

Figure 3-11. Recently logged former longleaf pine forest, Coosa County

5.3 Fishing and Harvesting Aquatic Resources

The harvesting of aquatic wild animals for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons may include accidental mortality and trawling bycatch. Regulated harvest of game species (Figure 3-12) seldom affects SGCN, but Shortnose Gar, five madtom (*Noturus*) species, Shoal Bass, and Southern Walleye are classified as game fish in Alabama. Of these, the latter two are occasionally sought by sportsmen.

One of the major threats to sea turtles in the marine environment is incidental capture, injury, and mortality during fishing operations, particularly shrimp trawling. Since 1987, the United States has required all shrimping boats to equip their nets with turtle excluder devices (TEDs). Crab traps often catch and drown Diamondback Terrapins, and the use of bycatch-reduction devices may help prevent terrapins from entering the traps (Dorcas et al. 2007).

In recent decades demand for turtle exports for both meat and pets drastically increased rates of unregulated freshwater turtle harvest from Alabama waters. In 2012 the Alabama Conservation Advisory Board approved regulations banning all commercial collection and killing of wild turtles and their eggs in public and private waters. The regulations are among the most protective state rules to prevent export-driven overharvest of native turtles in the southern United States.

Figure 3-12. Regulated consumptive use of game fish, mammals, and birds seldom affects SGCN.

6. Human Intrusion and Disturbance

Human activities associated with various non-consumptive uses of biological resources may alter, destroy and disturb habitats and species. The threat of human disturbance to many SGCN and their habitats can be considerable, and some species are particularly vulnerable.

6.1 Recreational Activities

People spending time in nature or traveling in vehicles outside of established transport corridors for recreational reasons may affect SGCN. This category includes off-road vehicles, motorboats, jet-skis, mountain bikes, hikers, birders, pets in recreation areas, temporary campsites, caving, and rock climbing, among others.

Alabama's Gulf beaches and dunes (Figure 3-13) and the unique suite of species they support are vulnerable because of their heavy use for human recreation. Beach-nesting sea turtles and birds, including Loggerhead Sea Turtles, American Oystercatchers, and Least Terns, are particularly vulnerable because human disturbance often curtails breeding success. Foot and vehicular traffic may crush nests or young and excessive disturbance may cause the parents to desert the nest, exposing eggs or chicks to the summer sun and predators. Interruption of feeding may stress juvenile birds during critical periods in their development. In addition pets, especially dogs, may harass the

birds, and developments near beaches provide food that attracts increased numbers of predators such as raccoons, skunks, and foxes. Dunes and dune vegetation may be damaged by foot traffic, degrading habitat for Alabama and Perdido Key beach mice.

A pastime for some is to ride all-terrain vehicles through streams and wetlands (Figure 3-14). This harmful activity disturbs soil and contributes to sedimentation, harming mussels, snails, and their predators. It also destroys nests of many species of fish, reptiles, and amphibians.

There is a well-organized and well-disciplined community of responsible cavers in Alabama and surrounding area. Members of this community are aware of and respect the sensitivity of bats to disturbance, both at hibernacula and maternity caves. Such caves can be entered seasonally with little if any disturbance to bats. However, ill-timed visits to caves by careless individuals can do great harm by rousing hibernating bats, causing them to expend critical energy, or by interfering with females caring for young, and even dropping them.

Figure 3-13. Beach recreation and development, Baldwin County.

Figure 3-14. ATV ruts in a sensitive wetland, Coldwater Mountain, Calhoun County.

6.2 Military Activities

While some military exercises and training activities can be disruptive to SGCN, Alabama's larger installations such as Redstone Arsenal and Fort Rucker have environmental programs to identify and manage habitats of many SGCN. One of Alabama's largest Gopher Tortoise populations is on Fort Rucker, with an estimated 10,000 individuals (CH2MHILL 2012). Wildfires resulting from artillery exercises helped maintain the mountain longleaf ecosystem at Fort McClellan for decades. Fort McClellan closed in 1999, but 9,016 acres of its frequently burned forest was subsequently established as the Mountain Longleaf National Wildlife Refuge in 2003.

6.3 Work and Other Activities

People spending time in natural environments for reasons other than recreation or military activities may impact SGCN. This category includes law enforcement, forest management, vandalism, and even research (Figure 3-15). The risk of spreading of chytrid fungus between amphibian breeding sites requires disinfecting boots and equipment, for example.

Figure 3-15. Biologists sampling fish in Hillabee Creek, Tallapoosa County.

7. Natural System Modifications

This threat category is defined as threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare (Salafsky et. al. 2008). In general, modifications tend to be associated with natural disturbances that if allowed to occur under normal frequencies and intensities could result in damage to property and/or loss of life; however, management of natural disturbance often results in the minimization or elimination of processes essential to the maintenance of natural communities.

7.1 Fire and Fire Suppression

Suppression or increase in fire outside of its natural range of frequency, intensity, and/or season may be in the form of fire suppression to protect homes, inappropriate prescribed fire, escaped agricultural and camp fires, and arson. Natural, lightning-caused fire is a dominant force in the southeastern U.S. that naturally perpetuates several community types, most notably pine savannas and prairies. Longleaf pine-dominated communities support a large share (34%) of terrestrial SGCN, and these forests evolved through frequent, low intensity, lightning ignited, surface fires (Brockway et. al. 2005). Today's remaining longleaf forests are altered through fire exclusion practices, such as fragmentation, fire suppression and wildfire prevention programs. As fire-excluded longleaf forests changed into more mixed forest types, highly flammable fuels produced by longleaf disappeared from the forest floor, and fire became an even less frequent event. The only means to restore and maintain remnant forests on today's landscape is

through a long-term, recurring, prescribed burning program (Figure 3-16). In recent years, government-supported prescribed burning programs have been made available to private landowners as part of region-wide restoration efforts.

Figure 3-16. Without regular prescribed fire, pine communities such as this will lose SGCN.

7.2 Dams and Water Management/Use

Changing water flow patterns from their natural range of variation, either deliberately or as a result of other activities, may be in the form of dam construction, lock and dam operations, sediment control, levees and dikes, surface water diversion, groundwater pumping, and channelization.

Alabama's major rivers are all interrupted by locks and/or dams for navigation, flood control, and/or hydropower. Their deep, sediment-laden impoundments are unsuitable for many SGCN fishes and mollusks. The construction of dams on these rivers has prevented the migration of anadromous fish to inland breeding locations, directly affecting some mussels with specific fish hosts. Even low crossings can block fish movements.

For over 40 years one of the most biologically important reaches of the Cahaba River was crossed by the "Marvel Slab," a concrete ford for hauling coal and timber that functioned ecologically like a dam (Figure 3-17). Its vertical drop of water was a physical barrier to fish migration. The pooling effect upstream and the scouring velocities downstream significantly altered habitat and disturbed the connectivity between populations of fish, mussels and snails that historically inhabited this stretch of the river in Bibb County. In October 2004 a partner coalition of eight government agencies, conservation groups and

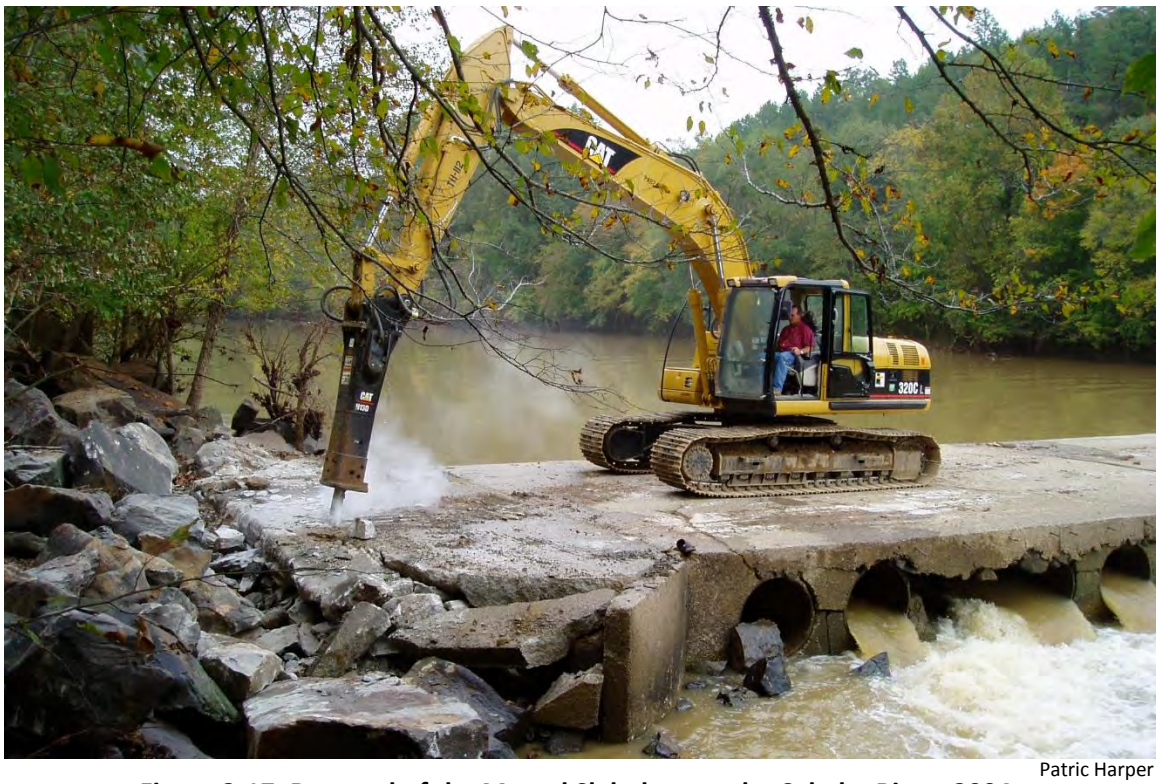
the landowners alongside the river mechanically removed the slab. Prior to removal, scientists worked to assess the fish and mollusk communities in nearby reaches. Before deconstruction, over 12,000 snails and mussels were collected from the demolition zone adjacent to the dam and moved to a nearby refuge shoal.

7.3 Other Ecosystem Modifications

Other actions that convert or degrade habitat in service of "managing" natural systems to improve human welfare include land reclamation projects, abandonment of managed lands, rip-rap along shoreline, mowing grass, tree thinning in parks, beach construction, and removal of snags from streams.

8. Invasive and Other Problematic Species and Genes

Many non-native and some native plants, animals, pathogens/microbes, or genetic materials have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance.



Patric Harper

Figure 3-17. Removal of the Marvel Slab dam on the Cahaba River, 2004.

8.1 Invasive Non-native/Alien Species

Harmful plants, animals, pathogens and other microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities. Includes feral hogs, household pets, zebra mussels, wooly adelgid, fire ants,

chestnut blight, cogongrass (Figure 3-18), Chinese privet, introduction of species for biocontrol, and fungi affecting amphibians (Chytrid), snakes (Snake Fungal Disease), and bats (White-nose Syndrome).

The spread of exotic invasive species poses a significant threat to SGCN throughout the Southeast. Invasive species are introduced, non-indigenous organisms that can aggressively usurp populations of native species and devastate natural habitats. Many SGCN are indirectly impacted by the spread of invasive plants. The changes most evident in an invaded community are declines

Wilson Faircloth, USDA Agricultural Research Service, Bugwood.org

Figure 3-18. Cogongrass infestation.

in native plant diversity and a consequent restructuring of the community that in many situations can negatively alter habitats. The Alabama SWAP Technical Committees determined that almost all of the key habitats in the state are threatened by invasive species. The Alabama Invasive Plant Council has identified the top ten worst invasive weeds in the state (Table 3-1).

Several aquatic invasive animals have also been documented in Alabama waters. Although aquatic invasive animals are often harder to find than large invasive plant populations, they can have devastating effects on freshwater ecosystems. The spread of invasive animals constitutes a serious threat facing river and lake habitats. Ecologically, aquatic invasive animals may cause the local extirpation of native aquatic species, degrade habitats, alter food webs, and degrade water quality. Moreover, aquatic invasive animals may reduce the numbers of sport fish by competing for food and destroying habitats, and invasive shellfish can foul boats and motors. The Zebra Mussel (*Dreissena polymorpha*) is a particularly damaging species that has been documented from the

Tennessee River. The Asian Clam (*Corbicula fluminea*) is found throughout the state's rivers and larger tributaries but does not appear particularly harmful to SGCN.

Invasive terrestrial animals having severe negative effects on SGCN include both Red and Black Imported Fire Ants (*Solenopsis invicta* and *S. richteri*), which arrived in North America through the port of Mobile in the early 1930s, and Feral Hogs (*Sus scrofa*), which first arrived with the Spanish explorers in the 1500s. Control measures for these species have met with limited success. Three species of parasitic flies (*Pseudacteon* sp.,) have been purposely introduced into Alabama as part of the Alabama Fire Ant Management Program based at Auburn Universtiy. These flies are thought to be important in regulating fire ant populations in South America. It is hoped that they will reduce the overall level of fire ants as they spread across Alabama. The recently formed Alabama Feral Hog Control Council's objectives are to disseminate information, to promote and conduct effective research, and to consult with policy makers and to give advice to people on feral hog control.

Table 3-1. Top Ten Invasive Plants of Alabama

Common Name	Scientific Name	Terrestrial/Aquatic
Kudzu	*Pueraria montana* var. *lobata*	Terrestrial
Cogongrass	*Imperata cylindrica*	Terrestrial
Tropical Soda Apple	*Solanum viarum*	Terrestrial
Tallowtree	*Triadica sebifera* or *Sapium sebiferum*	Terrestrial
Chinese Privet	*Ligustrum sinense*	Terrestrial
Japanese Climbing Fern	*Lygodium japonicum*	Terrestrial
Invasive Roses (3 species)	*Rosa multiflora*, *R. laevigata*, *R. bracteata*	Terrestrial
Hydrilla	*Hydrlla verticillata*	Aquatic
Eurasian Water Milfoil	*Myriophyllum spicatum*	Aquatic
Alligator Weed	*Alternanthera philoxeroides*	Aquatic

Source: Alabama Invasive Plant Council

Table 3-2. Key Habitats Negatively Impacted by Invasive Species with Representative SGCN

Key Habitat	Invasive Species	SGCN
Mesic Hardwood Forest	Chinese Privet	Cerulean Warbler, Green Salamander
Dry Hardwood Forest	Kudzu, Fire Ant	Appalachian Cottontail, Eastern Slender Glass Lizard
Floodplain Forest	Japanese climbing fern, Feral Swine	Black Bear, Rainbow Snake
Dry Longleaf Pine Forest	Cogongrass, Fire Ant	Gopher Tortoise, Southeastern Pocket Gopher
Wet Pine Savanna and Flatwoods	Cogongrass, Feral Swine	Henslow's Sparrow, Mimic Glass Lizard
Swamp	Alligator Weed, Eurasian Water Milfoil	Wood Stork, Long-Tailed Weasel
Maritime Forest and Coastal Scrub	Cogongrass, Feral Swine	Marsh Rabbit, Eastern Coral Snake
Glades and Prairie	Invasive Roses, Fire Ant	Meadow Jumping Mouse, Loggerhead Shrike
Rivers and Streams	Zebra Mussel, Hydrllla	Blue Shiner, Coosa Creekshell, Tulotoma
Isolated Wetland	Tallowtree, Alligator Weed	Gopher Frog, Reticulated Flatwoods Salamander
Beach and Dune	Cogongrass	Atlantic Loggerhead, Alabama Beach Mouse

The proliferation of invasive plants is principally abetted by anthropogenic disturbances. While disturbance is a normal part of natural ecosystem dynamics, in many systems the alteration of disturbance regimes and the introduction of novel disturbances produce increased opportunities for invasion (Hobbs 2000). The fragmentation of forest habitats by residential development and land management practices create patches of disturbed land and opportunities for invasion, and the linear openings formed by roads and utility rights-of-way serve as the pathways for spread of invasives. Invasive woody shrubs (e.g., Multiflora Rose, Autumn Olive, and Tallowtree) typically appear in forest openings because they produce abundant fruit and seeds carried long distances by birds. Other species produce abundant seeds or propagate by root fragments that are transported on vehicle tires or the soles of hiking shoes. Woody shrubs are also typical invaders in grassland habitats, especially old fields where mowing and other management mechanisms have been curtailed. In pastures, invasive shrubs with abundant thorns (e.g., Multiflora Rose) are mostly avoided by grazing animals and may eventually overrun some fields.

8.2. Disease

Several invasive alien fungal pathogens are affecting SGCN. A century ago Alabama's forests were drastically altered when American Chestnut, a keystone species, was virtually eradicated by an introduced fungus. A number of recently-arrived fungal pathogens are cause for concern today.

White-nose Syndrome in Bats

White-nose Syndrome (WNS) in bats (Figures 3-19 and 3-20) has killed over 6 million individuals and caused local extirpation of species in some states. It is named for a white fungus (*Pseudogymnoascus destructans*) that invades the skin of hibernating or otherwise torpid bats. Bats with WNS have been found to use twice as much energy as healthy bats during hibernation and have potentially life-threatening physiologic imbalances that could inhibit normal body functions (Verant et al. 2014). WNS was first documented in the United States in 2006 (New York), and in Alabama in 2012. It has since been documented at several Alabama caves, including Fern Cave, which contains the largest documented wintering colony of federally listed endangered gray bats, with over one million bats hibernating there. DWFF is working with USFWS to survey bat caves throughout the state to better understand the implications of WNS.

Figure 3-19. Tri-colored Bat with white-nose fungus, Russell Cave, Alabama

Alan Cressler

Figure 3-20. White-nose Syndrome sign at a Gray Bat cave, Jackson County

Chytrid Fungus in Amphibians

Chytridiomycosis is an emerging infectious disease of amphibians caused by an aquatic fungal pathogen, *Batrachochytrium dendrobatidis* (*Bd*). *Bd* appears to be specific to amphibians (Berger et al. 1998), and infections have been documented in numerous frog and salamander species worldwide. Bd has been documented in Alabama in Tallapoosa and Jefferson counties (Byrne et. al. 2008; Bakkegard and Pessier 2010).

Chytridiomycosis may be responsible for the greatest disease-caused loss of biodiversity in recorded history (Skerratt et al. 2007). Over just the past 30 years, *Bd* has caused the catastrophic decline or extinction (in many cases within a single year) of at least 200 species of frogs, even in pristine, remote habitats (Skerratt et al. 2007). While diseases have previously been associated with population declines and extinctions (Daszak et al. 2000), chytridiomycosis is the first emerging disease shown to cause the decline or extinction of hundreds of species not otherwise threatened (Skerratt et al. 2007). Currently over 350 amphibian species are known to have been infected by *Bd* (Fisher et al. 2009).

The highest risk of chytrid spread is likely through human transport of frogs and tadpoles, whether intentional or unintentional (Obendorf 2005). The two most common ways of spreading chytrid to new sites may be the use of amphibians as fishing bait and the collection and release of frogs and tadpoles as pets (Obendorf 2005). Amphibians should not be used as bait or released back into the wild once they have been taken into captivity.

Snake Fungal Disease

Snake Fungal Disease (SFD) is an emerging disease in certain populations of wild snakes in the eastern and midwestern United States (Rajeev et. al. 2009). The fungus *Ophidiomyces ophiodiicola* is consistently associated with SFD, but definitive evidence that *O. ophiodiicola* causes SFD is inconclusive. The USGS National Wildlife Health Center has confirmed fungal dermatitis (or the suspected fungal pathogen in association with skin lesions) in wild snakes from several states, including neighboring Florida and Tennessee and it is suspected that SFD is more widespread than is currently documented. Species native to Alabama that have been diagnosed with SFD include Northern Water Snake (*Nerodia sipedon*), Eastern Racer (*Coluber constrictor*), Rat Snake (*Pantherophis obsoletus* species complex), Timber Rattlesnake (*Crotalus horridus*), Pygmy Rattlesnake (*Sistrurus miliarius*), and Milk Snake (*Lampropeltis triangulum*).

The most consistent clinical signs of SFD include scabs or crusty scales, subcutaneous nodules, premature separation of the outermost layer of the skin from the underlying skin (or abnormal molting), white opaque cloudiness of the eyes (not associated with molting), or localized thickening or crusting of the skin (hyperkeratosis). While mortality has been associated with some cases of SFD, population-level impacts of the disease are not yet widely known and are difficult to assess due to the cryptic and solitary nature of snakes, and a general lack of long-term monitoring data. In New Hampshire, clinical signs consistent with SFD were associated with a 50 percent decline of an imperiled population of timber rattlesnakes from 2006 to 2007 (Clark et. al. 2010). In areas where susceptible snake species occur in small, isolated populations, the added threat of SFD may threaten viability of these populations. In other regions, SFD has been observed without suspected or, as yet, documented population declines.

8.3 Problematic Native Species

Harmful plants, animals, or pathogens and other microbes that are originally found within the ecosystem(s) in question, but have become “out of balance” or “released” directly or indirectly due to human activities. White-tailed deer have become overabundant in some areas, especially parks and the fringes of developed areas where hunting is not permitted. Game fish stocked into semi-permanent and normally fishless amphibian breeding ponds can prevent reproduction of some frog and salamander species. Fire-intolerant trees such as Sweetgum, Red Maple, and Eastern Redcedar may invade habitats such as longleaf pine forests, bogs, prairies, and glades if prescribed fire is not part of the management strategy.

8.4 Introduced Genetic Material

Human-altered or transported organisms or genes includes pesticide resistant crops, restoration projects using nonlocal seed stock, genetically modified insects for biocontrol, and genetically modified trees and crops. One concern about genetically engineered crops resistant to the herbicide glyphosate (Roundup) is the development of weeds and other

plants that are also resistant. Introduced genetic material can also be a conservation tool, as as the restoration of the American Chestnut (Newhouse et. al. 2014).

9. Pollution

Introduction of exotic and/or excess materials or energy from point and nonpoint sources can have detrimental effects on SGCN and their habitats.

9.1 Household Sewage and Urban Waste Water

Water-borne sewage and nonpoint runoff from housing and urban areas in the form of nutrients, toxic chemicals and/or sediments includes discharge from municipal waste treatment plants, leaking septic systems, untreated sewage, outhouses, oil or sediment from roads and parking lots, fertilizers and pesticides from lawns and golf courses.

9.2 Industrial and Military Effluents

Water-borne pollution from industrial and military sources such as mining, energy production, road building, and resource extraction industries includes nutrients, sediments (Figure 3-21), and toxic chemicals from factories, illegal dumping of chemicals, mine tailings, leakage from fuel tanks, PCBs in river sediments.

Alan Cressler

Figure 3-21. Failed erosion control at road construction site

9.3 Agricultural and Forestry Effluents

Water-borne pollution from agricultural, silivicultural, and aquaculture systems include nutrient loading from fertilizer runoff, herbicide runoff (Figure 3-22), manure from feedlots, nutrients from aquaculture, and soil erosion.

Alan Cressler

Figure 3-22. Aerial spraying of cotton field

9.4 Garbage and Solid Waste

Rubbish and other solid materials including those that entangle wildlife. Includes municipal waste, litter from cars, flotsam and jetsam from recreational boats, waste that entangles wildlife, erosion control fabric that entangles wildlife, construction debris (Figure 3-23).

Alan Cressler

Figure 3-23. Garbage in stream

9.5 Airborne Pollutants

Atmospheric pollutants from point and nonpoint sources. Includes acid rain, smog from vehicle emissions, excess nitrogen deposition, radioactive fallout, wind dispersion of pollutants or sediments.

Alabama's metropolitan areas, towns, and industries generate significant amounts of waste in the form of household sewage, solid waste, and industrial effluents. Pollutants from these sources impair key riparian, aquatic, and terrestrial habitats throughout the region. Changes in water quality and quantity now pose serious threats to many of the state's aquatic systems. Storm water runoff degrades water quality through erosion, and the ever-increasing amount of impervious surfaces in drainage areas poses a major threat to small streams and the aquatic communities they support. Roadway runoff, acid mine drainage, siltation/sedimentation, and acid deposition and mercury originating from coal-powered power plants causes water and soil chemistry degradation.

ADEM monitoring programs integrate chemical criteria, whole effluent toxicity evaluations, and biological assessments to evaluate the water quality of Alabama's surface waters, reported in the agency's annual Integrated Water Quality Assessment and Monitoring Report (ADEM 2014a). The Report combines information about Alabama's surface and ground water resource management programs with a comprehensive listing of State waters consistent with EPA guidance that asks states to report on the condition of all surface waters by categorizing rivers, streams, lakes, estuaries, and coastal waters according to their designated uses and the degree to which water quality is supporting those uses.

According to ADEM, Alabama's surface water is of generally high quality, but some rivers, streams, reservoirs, and estuaries are not supporting designated uses. Alabama's final 2014 §303(d) list (ADEM 2014b) indicates the total mileage for rivers and streams not supporting designated uses is 1,935 miles, or 2.5% of the state's 77,272 total river and stream miles and an increase of 120 miles since 2004 (Table 3-3, Figure 3-24). Approximately 71% of Alabama's publicly accessible lakes and reservoirs are fully supporting their designated uses. Much of the non-support acreage is related to historic as well as recent PCB contamination and eutrophic conditions in the Coosa River Basin reservoirs. The area of §303(d) impoundments and estuarine areas totals 160,844.82 acres. Listed sources for water quality impairment include agriculture, collection system failure, contaminated sediments, dam construction, flow regulation/ modification, erosion from highway/road/bridge construction, industrial, intensive animal feeding operations, land development, landfills, mill tailings (abandoned), mine tailings (abandoned), municipal, natural sources, non-irrigated crop production, onsite wastewater systems, pasture grazing, removal of riparian vegetation, subsurface mining (abandoned), surface mining, surface mining (abandoned), unknown sources, and urban runoff/sewers. The majority of estuaries are affected by a single pollutant category, pathogens.

Alabama's ground water is managed through efforts under the Underground Storage Tank (UST) Program, the Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the Underground Injection Control (UIC) Program, as well as the Wellhead Protection Program (WHPP). The lack of chronic detections of pollutants in public water supply groundwater sources is a good indication of Alabama's high ground water quality and effective management of the resource.

Table 3-3. Alabama's 2014 §303(d) List by Basin

Basin	Stream Miles
Alabama	111.12
Black Warrior	366.51
Cahaba	18.79
Chattahoochee	95.26
Chipola	8.11
Choctawhatchee	231.62
Coosa	135.59
Escatawpa	80.39
Mobile	270.91
Perdido-Escambia	167.86
Tallapoosa	150.03
Tennessee	245.42
Tombigbee	53.66
TOTAL	**1935.27**

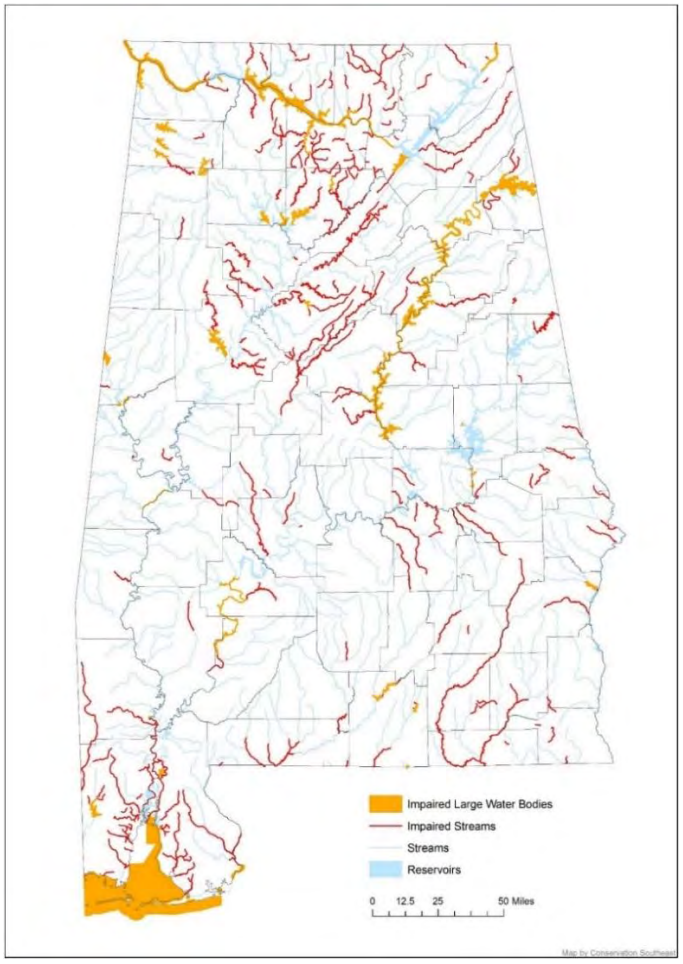


Figure 3-24. Alabama's 1,935 miles and 160,844.82 acres of §303(d) waters

In June 2014, the U.S. Environmental Protection Agency (EPA), Mobile Bay National Estuary Program (NEP), ADEM, other partners completed the Alabama and Mobile Bay Basin Integrated Assessment of Watershed Health (EPA 2014), a landmark statewide and basin-wide report on the status and vulnerability of watershed health. The assessment, supported by EPA's Healthy Watersheds Program, integrates the best available data from state and federal agencies to characterize relative landscape condition, watershed health, and watershed vulnerability to climate change, land use change, and water use. Recognizing the health of Mobile Bay is governed in part by the health of the waters it drains, the assessment team conducted an analysis of hydrologic connectivity between headwaters within Mobile Bay basin to the estuary itself. The watershed health, vulnerability, and connectivity assessment results are intended to help guide Alabama's and Mobile Bay NEP's efforts to protect their healthy watersheds and to enhance the condition of Mobile Bay (Figure 3-25).

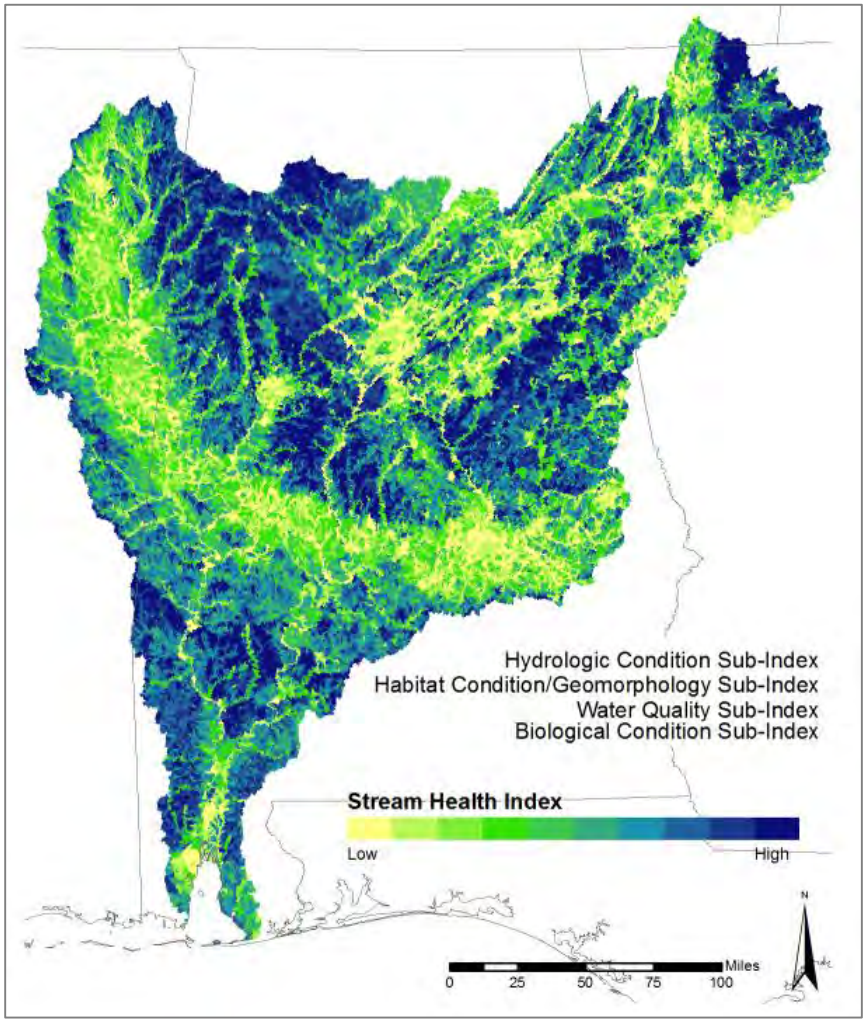


Figure 3-25. Stream Health Index Scores in Mobile Drainage (Source: EPA 2014)

Watershed Health Index scores were based on a collection of metrics that describe catchment land cover and the physical, chemical, and biological attributes of stream ecosystems. Scores were quantified from measured values of watershed health metrics (e.g., percent natural land cover, dam storage ratio) and from statistical models of stream conditions (e.g., stream habitat rating). Modeled metric values were based on a set of predictors that characterize both natural and anthropogenic watershed features across multiple scales.

Watershed Health Index scores reflect ecological condition gradients shaped by: 1) natural variation in soils, topography, geology, hydrology, etc.; 2) anthropogenic stressors that have influenced measured metric values; and 3) incremental and cumulative scale anthropogenic stressors determined to be relevant to watershed health through regression modeling. High scoring areas possess natural watershed characteristics that are shared by healthy aquatic ecosystems and lack anthropogenic features associated with degraded ecosystem health.

The Alabama Rivers and Streams Network (ARSN), a coalition of ADCNR, USFWS, GSA, AFC, and other non-profit organizations, private companies, and concerned citizens initiated an assessment of Alabama's streams and rivers, developing the Strategic Habitat Unit (SHU) approach to habitat restoration in 2006 (see Chapter 2, Figure 2-6). These SHUs have been designated to improve water quality and quantity, preserve biotic integrity, and promote restoration efforts for Alabama's critical waterways. The SHU concept promotes multi-agency/organizational partnerships for the purpose of addressing long-term habitat and water quality needs for Alabama's SGCN freshwater species. Biologists collect and analyze aquatic insects and fishes as part of non-point source pollution studies and watershed assessment projects.

10. Geological Events

This IUCN category was not considered by the Technical Teams when assessing threats. Alabama has negligible seismic and no volcanic activity. Small-scale landslides occur occasionally along very steep slopes after soaking rains, but these minor disturbances seldom significantly affect SGCN.

11. Climate Change and Severe Weather

Long-term climatic changes that may be linked to global warming and other severe climatic or weather events outside the natural range of variation could wipe out a vulnerable species or habitat. Species and populations likely to have greater sensitivities to climate change include those with highly specialized habitat requirements, native species already near temperature limits or having other narrow environmental tolerances, currently isolated, rare, or declining populations with poor dispersal abilities, and groups especially sensitive to pathogens. Species with these traits will be even more vulnerable if they have a small population, a low reproductive rate, long generation times, low genetic diversity, or are threatened by other factors (NFWPCAP 2014).

11.1 Habitat Shifting and Alteration

Major changes in habitat composition and location may include sea level rise and northward or upslope shifting of natural community types. Under rising global temperatures, sea water undergoes expansion, and ice caps and glaciers melt and contribute to rising sea levels. Sea level rise poses significant threats to coastal ecosystems that may become inundated, resulting in habitat changes and losses, and adverse impacts to species or communities that depend on these habitats. It is generally considered by climate scientists that coastal ecological resources are likely to be among the most sensitive to the changing climate, and that the climate change impacts to ecosystems over the next few decades will be most marked in the coastal zones (Frumhoff et al. 2007; Karl et al. 2009, IPCC 2007).

11.2 Droughts

Periods in which precipitation falls below the normal range of variation may result in loss of surface water sources. Amphibian breeding sites may not hold water for a sufficient length of time for metamorphosis to occur. Formerly permanent streams draining small watersheds may become intermittent, losing fish and mollusk species not adapted to such conditions.

11.3 Temperature Extremes

Periods in which temperatures exceed or go below the normal range of variation may manifest as heat waves, cold spells, and oceanic temperature changes, all of which can affect the distribution of species. Those occurring at the southern periphery of their range, such as the Wood Frog and Cerulean Warbler, may be most affected.

11.4 Storms and Flooding

Major shifts in intensity and/or seasonality of extreme weather may manifest as thunderstorms, tropical storms, hurricanes, tornados, hailstorms, ice storms or blizzards, dust storms, erosion of beaches during storms (Figure 3-26).

It is important for conservation agencies and organizations to consider the impacts of a changing climate. For example, preserved forest areas should be relatively large to function effectively as resilient reserves, and some larger organizations or partnerships of various groups are capable of assembling such acquisitions. The Nature Conservancy (Anderson. et al. 2014) estimated the resilience to climate change of distinct geophysical settings across the southeastern United States (Figure 3-27).

Mark Bailey

Figure 3-26. Beach erosion, Dauphin Island Audubon Bird Sanctuary

The methodology identified sites for every geophysical setting that are likely to retain species and functions longer under a changing climate, revealing places for future conservation that could correct the bias in current secured lands. Scientists have limited understanding of how climate-induced changes will interact with each other, how those interactions will play out on the landscape, and how systems will transform. By conserving all types of geophysical settings and using site resilience criteria to select places for conservation action, the variety of diversity conserved may be expanded with increased odds of probability of persistence over time. This approach is not intended to replace basic conservation principles such as the importance of reserve size, threat reduction, and appropriate land management; rather, it is a coarse-filter strategy for making informed decisions when facing large uncertainties.

Critical habitats – areas in which targeted species can persist and/or relocate over time – may provide a refuge from climate change impacts and become high-priority candidates for acquisition and enhanced conservation efforts. Research can be conducted to identify structurally diverse and species-rich habitats as well as important movement corridors. Monitoring for new invasive plants, insects and other pests may be implemented. Cool water streams and cold water fish habitat can be incorporated into buffer strategies in order to conserve connected water bodies and protect vegetative canopies over streams to help reduce impacts of warming temperatures. Local conservation groups have the ability and knowledge to take the lead in habitat and buffer restoration utilizing diverse native species, thereby increasing the resiliency of habitats to the stresses of climate change and shifting environmental condition.

Vulnerability of Alabama Habitats to Climate Change

Table 3-4 provides a summary of the vulnerability of key Alabama habitats to the impacts of climate change as determined by the SWAP Technical Teams. Habitats of highest vulnerability are coastal, primarily due to the combined impacts of sea level rise and increases in storm frequency and intensity. Alabama's coastline is recognized as being of ecological and conservation importance but only portions are protected in local, state, and federal reserves. This protection mosaic has conserved important populations of SGCN, such as the Alabama Beach Mouse, and their habitats. However, this reserve system was established during a time when the challenge of climate change and resulting shifting coastlines and habitats was not fully appreciated.

Table 3-4. Vulnerability of Alabama Habitats to Impacts of Climate Change

Degree of Vulnerability	Habitat Type
Highly Vulnerable	Maritime Forest and Coastal Scrub Beach and Dune Estuarine and Marine
Vulnerable	Mesic Hardwood Forest Floodplain Forest Dry Longleaf Pine Forest Wet Pine Savanna and Flatwoods Swamp Glades and Prairie Bogs and Seepage Communities River and Stream Strategic Habitat Units and River Reach Units (SHUs and SRRUs) Isolated Wetland Cliffs and Rockhouses
Less Vulnerable	Dry Hardwood Forest Artificial Habitats Caves and Mines

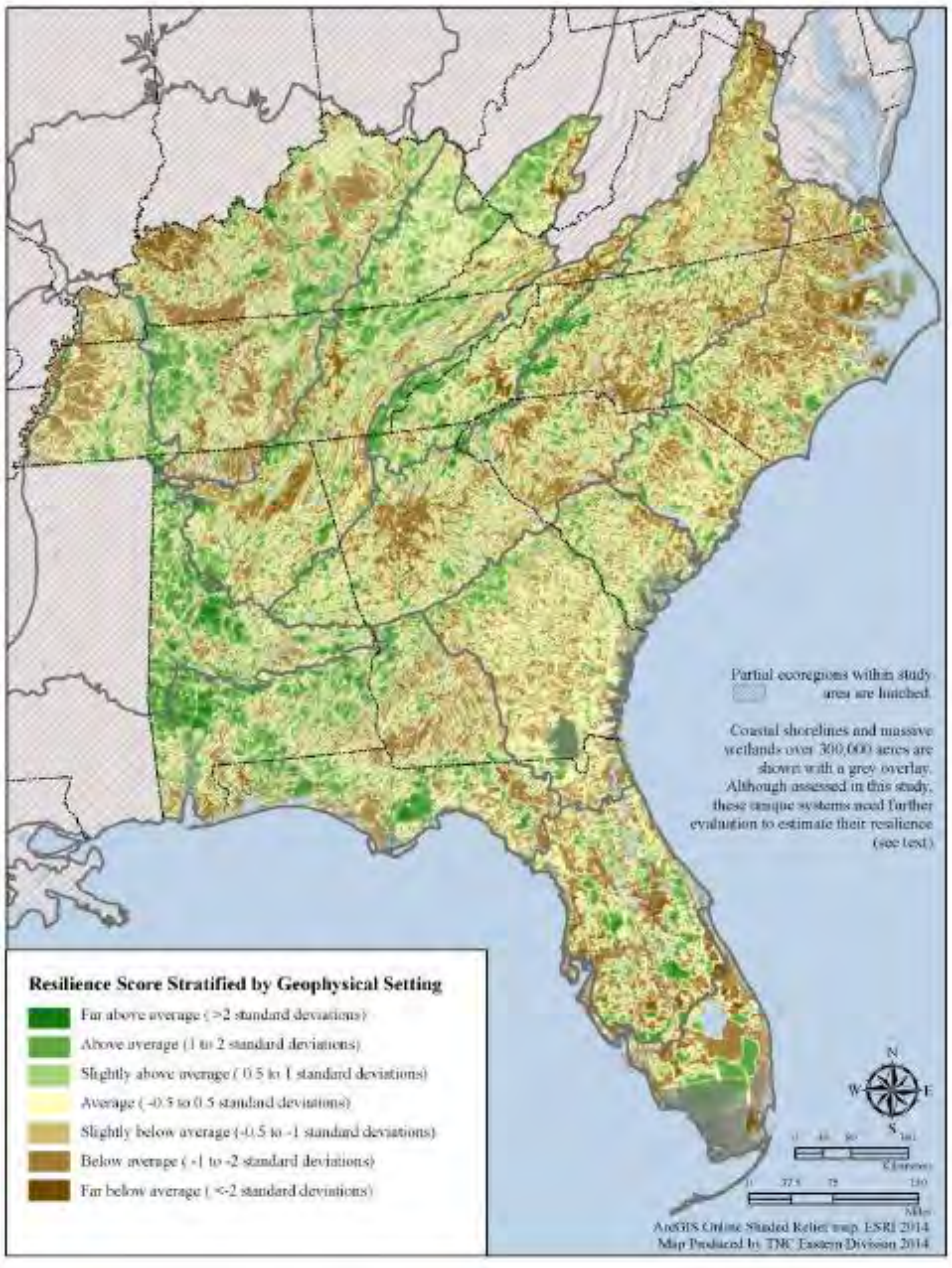


Figure 3-27. Estimated resilience by setting across the Southeast (From TNC 2014)

Areas in yellow are comprised of cells with an average estimated resilience score based on their geophysical setting, landscape diversity and local connectedness. Areas in green score above average and are estimated to be more resilient. Areas in brown are below average and are estimated to be vulnerable to climate change and other factors.

Lack of Information and Data Gaps

Few SGCN taxa are sufficiently understood so that acquisition of additional information is not desired. The Alabama Aquatic Biodiversity Center has prepared a prioritized breakdown of research needs (Figure 3-28) for freshwater mollusks. Similar prioritizations could be developed for other taxonomic groups.

The Healthy Watersheds assessment process (US EPA 2014) highlighted several data gaps that can be addressed through research, monitoring, and analysis. Example gaps include an understanding of ecological flow needs in Alabama, particularly for freshwater inflow to Mobile Bay for protecting oyster populations and other biota, and data to characterize the biological condition of lakes and large rivers.

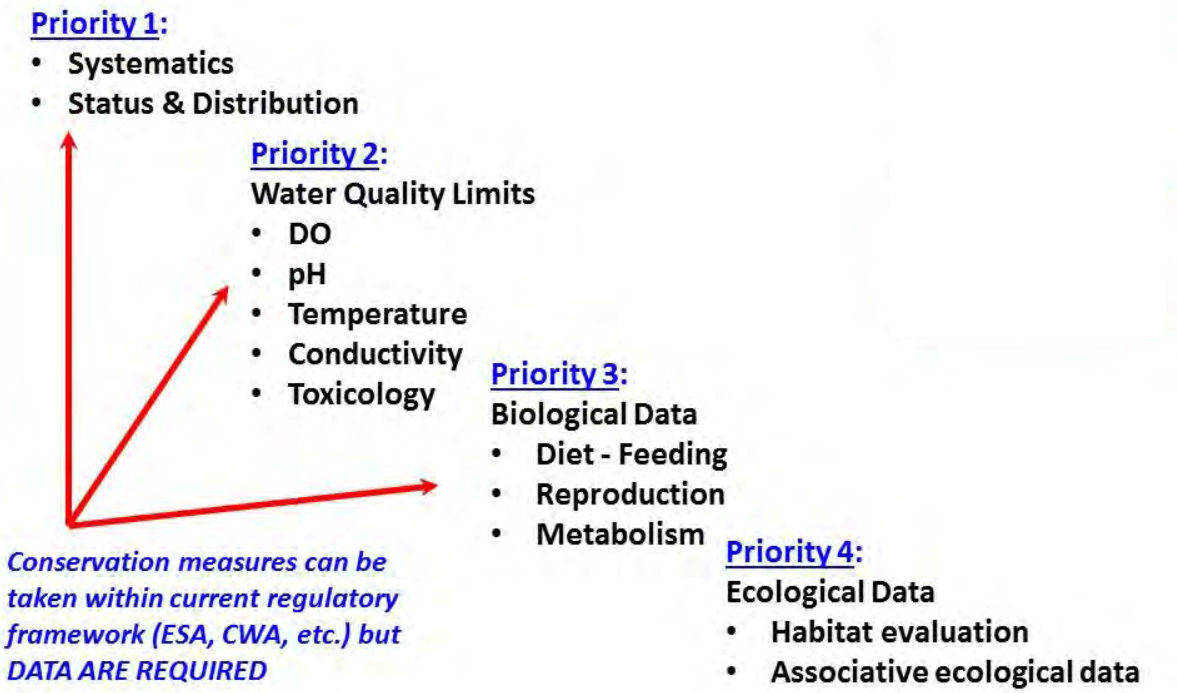


Figure 3-28. Research Needs Supporting Freshwater Mollusk Conservation

Chapter 4
CONSERVATION ACTIONS

FIGURES

TABLES

Implementing this Plan and the Importance of Partnering

Once Alabama's SGCN (Element 1, Chapter 1), key habitats (Element 2, Chapter 2), and threats to both (Element 3, Chapter 3) are determined, priority research and survey needs and conservation actions can be assessed. This chapter describes the methods used to identify priority needs, the status and condition of each key habitat (Element 2), the priority needs of each habitat (Elements 3 and 4), key conservation areas, partnerships for implementation (Element 7), and sources of additional information.

Alabama has the fifth greatest wildlife diversity in the nation, but this irreplaceable resource is declining and in many cases imperiled. This document presents an achievable plan for conservation of Alabama's wildlife. It identifies those species and habitats in greatest need of conservation attention and it describes strategies to implement their conservation. Significant effort and resources, much of it beyond the scope of ADCNR, will be required to achieve many objectives. Unless an alliance of partners works together for the shared goal of conserving our rich natural heritage resource, future generations of Alabamians will not experience the biodiversity and beauty we enjoy.

Declining species can be brought back with a focused effort, as demonstrated by the recovery in Alabama of not only nongame species such as the Bald Eagle and American Alligator, but also formerly rare game species such as White-tailed Deer and Wild Turkey. Had ADCNR, private landowners, neighboring state wildlife agencies, and other partners not mobilized and invested a tremendous effort in recovering these animals decades ago, they might well be treated as SGCN in this SWAP.

This document represents DWFF's approach to the demands of a modern, more ecologically-enlightened public for resource managers to expand their scope to address the full array of biodiversity. The task is immense, and while DWFF may be the lead state agency, success will depend on productive partnerships with public and private agencies, landowners, scientists, and others (Element 7). Partners are strongly encouraged to integrate the species, habitats, and priority conservation areas outlined in this document into their own conservation programs.

Our public partners are many and include local municipalities, other state agencies and institutions, and federal and regional agencies. Our private partners include nongovernmental organizations, community groups and private landowners, to name a few. Each of these play a critical role in implementing the many needed actions identified by this plan. Each partner has a special contribution and responsibility to steward Alabama's unique and diverse wildlife habitats. This plan offers a blueprint and guidance to all our partners on how they can use their strengths and resources to help implement these critically needed conservation actions over the next decade.

Identifying and Prioritizing Conservation Actions

This SWAP process used the 2002 and 2012 Nongame Conference recommendations as a foundation for identifying needed conservation actions, refining, updating and expanding them with the input of multiple partners and stakeholders (Element 4). In this chapter, SGCN are associated to one or more of 16 habitats (for non-riverine species) or one or more of 15 river basins (for riverine and stream/spring-dwelling species). Specific recommendations have been compiled from a number of sources including species recovery plans and watershed management plans. Many of the actions listed in this chapter are the result of the specific scientific consensus on SGCN and have been refined and prioritized from *Alabama Wildlife,* Volumes 2 and 3 (Mirarchi et al. 2004a, 2004b) as well as the more general and policy-based actions from Volume 4 (Mirarchi et al. 2004c) and a fifth volume presently in preparation, based on the 2012 Nongame Conference.

All conservation actions were compiled from recommendations in the 2012 Nongame Conference and numerous existing recovery and conservation plans. Of these hundreds of recommendations, only those recurrent high- and highest-priority actions are presented in this SWAP to be accomplished in the next ten years. Actual implementation will be largely dependent on external factors including availability of funding and resources as well as the development of effective relationships with local, state, regional, public and private stakeholders and partners. Those conservation actions that impacted the highest number of SGCN and/or their key habitats were considered "highest priority." These actions often covered suites of highest-priority (i.e., P1, P2) species and multiple SGCN. Those conservation actions that impacted fewer SGCN and, therefore, did not have as broad habitat implications, were considered "high priority" actions. These actions often were directed to a single species or to a suite of lower priority species and were more specific in nature.

The Forever Wild Amendment (no. 543) of the Constitution of the State of Alabama calls for Department of Conservation and Natural Resources to "develop a Natural Heritage Plan which suggests priorities for the protection, acquisition and management of dedicated natural area preserves." The Natural Heritage Plan is currently in preparation, and once completed, should be a useful tool to further guide conservation actions for SGCN and their habitats.

Conservation actions are organized in several ways to best address the needs of Alabama's wildlife and its conservation. Conservation occurs at multiple scales, from populations at the local level to broader, overarching taxa and statewide geographic scales. This chapter presents conservation actions across the spectrum of scales in order to capture the breadth of conservation needed in Alabama. First it presents the broadest, overarching, statewide actions, and then presents more specific taxa or habitat-focused actions for each of the 16 terrestrial and estuarine habitats and 15 river basins.

Statewide Conservation Actions

All Habitats

1. **ADCNR should continue to provide information on SGCN, their habitats, and conservation needs to appropriate water and land use decision-makers.** SWG funding and the SWAP process provide an opportunity for DWFF to expand its leadership role in the dissemination of information about good land and water stewardship. ADCNR should continue to coordinate with its local, state, regional, and federal partners to promote enhanced SGCN conservation and stewardship. This allows SGCN, habitats, and conservation actions from this SWAP to be incorporated and integrated into other agency and partner conservation plans to promote a coordinated Alabama conservation effort.

2. **DWFF should develop an effective data collection and management system to provide for efficient and web-enabled data input and monitoring of information on SGCN, key habitats, threats, and conservation actions in order to fully implement and update this SWAP.** DWFF should develop data-sharing agreements among the various agencies and organizations, both statewide and regionally, which maintain data on SGCN, and develop the SWAP into a web-enabled database accessible to conservation planners and managers. A partnership with State Lands Division's Natural Heritage Section has been formed to allow for timely updating of the SWAP and dissemination of information. The Natural Heritage database (https://heritage.dcnr.alabama.gov) now has query capabilities that allow researchers, scientists, and the public to search the information housed within it.

3. **ADCNR and other natural resource management agencies should implement an ecologically-sound approach to enhance SGCN and their habitats.** Decisions on how to manage public lands and waters should emphasize restoring and/or enhancing natural

habitats to maximize ecological benefits and achieve desired future wildlife habitat conditions, rather than solely maximizing economic returns.

4. **DWFF should produce a formal revision of this SWAP (an action plan for all SGCN and their key habitats) at least every ten years.** An effective framework should be developed to monitor and track the status, condition, and effectiveness of conservation actions. Revisions of the SWAP should also include a review and evaluation of conservation efforts during the preceding ten years. The revision process should be closely coordinated with the Nongame Conference, using the SWAP database. In addition to their review of SGCN status, the taxa committees should review and evaluate SWAP conservation action progress over the previous 10 years.

5. **DWFF should consider including as many imperiled taxa in updates and revisions of this SWAP as possible.** This SWAP includes wildlife species coverage for particular groups, commensurate with current knowledge and available funding. To be able to work fully and cooperatively with the federal government toward recovery of imperiled taxa, ADCNR should seek comprehensive information and additional funding for taxa not included in this SWAP, including invertebrates and plants. These taxa should be assessed and prioritized consistently through the Nongame Conference and SWAP processes.

6. **DWFF should continue to expand wildlife protection regulations to address all SGCN.** Some SGCN are currently not protected by state statute. DWFF should also work closely with other regulatory agencies to insure that adverse impacts on key habitats for SGCN is minimized. Excessive harvest and indiscriminate killing of native wildlife should be regulated by statute. Reptiles and amphibians are perhaps most affected (e.g., shooting of basking turtles and snakes for sport and unregulated frog gigging) and other groups such as crayfish may also be affected. These practices are believed to be widespread and may contribute to the decline of SGCN. The general public may not discern SGCN from other species. This action will increase conservation-related education and outreach about biologically significant areas and species, reducing the threat of their direct exploitation.

7. **ADCNR should coordinate wildlife management to most effectively conserve SGCN and their habitats on lands and waters under its jurisdiction.** ADCNR-managed lands and waters should be managed to benefit SGCN and their habitats and to provide demonstration areas of ecologically-sound stewardship. State-owned or regulated lands should be managed to minimize unnecessary, artificial, and/or unnatural structures and processes. Infrastructure improvements for public access should be built away from environmentally-sensitive areas.

8. **DWFF should expand its education and outreach programs regarding the importance and sensitivity of SGCN and key habitats.** Landowners should be provided information on habitat stewardship and wildlife conservation programs.

Terrestrial Habitats

Presented below are overarching conservation actions to benefit wildlife of Alabama's terrestrial habitats. Those listed below can be applied to multiple habitats occurring statewide. More specific management needs and conservation actions for SGCN are subsequently presented by habitat type. Conservation actions that are specific to certain habitats (e.g., bogs, caves, dunes, glades) are presented in the respective habitat sections appearing later in this chapter.

9. **Acquire better spatial data through remote sensing and ground truthing, and identify any extensive (at least 400-hectare; 1,000-acre) natural communities.** Contact landowners to seek protection through willing seller purchase and/or conservation easements. Secure and expand protected core areas when opportunities arise, assigning high priority to adjacent to, or intact tracts held by federal, state, and private organizations/agencies. This action will address the threat of habitat loss, fragmentation and degradation of habitats resulting from incompatible management or conversion to other uses.

10. **Maintain native community structure, function, and composition whenever possible.** Maintain the native, functioning plant and animal community structure in fire-maintained habitats through management goals based on desired burn effects followed by evaluation of results.

11. **Where absent, restore native community structure and composition.** Non-native invasive exotics, or native species that would not naturally occur on a site, should be removed over time. This can be accomplished to some extent through various silvicultural options that allow timber harvests that promote open canopies. The threat of loss of natural community integrity will be minimized by maintaining or restoring fire to appropriate communities.

12. **Allow downed trees and woody debris to decompose naturally on the ground.** Many reptiles, amphibians, and small mammals nest, forage, or seek shelter in or underneath rotten logs.

13. **Minimize soil disturbance and runoff associated with silvicultural, agricultural, or other disturbances of important wildlife habitat by operating during drier soil conditions and/or through use of low-tire-pressure equipment.** Heavy equipment can compact/disturb soil, increase erosion/sediment, provide corridors for invasive plant species along trails, and elevate vehicle-related mortality rates among low mobility wildlife species. Minimizing habitat disturbance by using appropriate timing and equipment will reduce potential impacts to fish and wildlife.

14. **Minimize development, road construction, off-road vehicle trails, concentrated recreation areas, foot trails, incompatible silvicultural and agricultural practices,**

grazing, and other erosion-generating activities uphill from biologically significant sites. Sediment from uphill can wash down, filling cracks and crevices that vertebrate species rely on for critical microhabitat needs. This will minimize the threats of non-point source pollution and habitat disturbance to these microhabitats. Following forestry and agriculture BMPs should avoid or minimize these threats.

15. **Identify, retain, and avoid damaging critical and unique habitats.** For example, many forest-related wildlife taxa require embedded, sensitive habitats for part of their life history and/or seasonal migration patterns. Both the embedded habitat and the surrounding forest matrix must be present for these species to survive. Where necessary, restore natural hydrology in embedded wetlands by filling ditches and removing berms and other drainage structures that have altered the natural hydrology of the area. These actions will reduce the loss of natural community integrity.

16. **Maintain or, where feasible, restore contiguous gradients (ecotones) into adjacent habitats such as floodplain forests.** High-intensity roads, development, agriculture, and intensive silvicultural activities that are placed between complementary habitats may alter seasonal movements and make natural dispersal patterns difficult or even impossible for species of low mobility, such as amphibians and reptiles and some small mammals. This action addresses the threat of loss of natural community integrity.

17. **Exclude, and when necessary and feasible, remove, control, or manage exotic plant and animal species.** Where herbicides are deemed necessary to remove exotic plants, choose the best chemical, application rate, and timing of treatment to minimize negative impacts to non-target species. Biological, mechanical, and chemical techniques that specifically target exotic species are recommended over techniques that may also impact native wildlife.

18. **If necessary to establish wildlife openings or other enhancements for wildlife, use sites of previous disturbance or choose new sites that mimic natural disturbances to avoid unwanted impacts.** Wildlife openings should be sized and located to mimic natural disturbances. While log landings may provide promising sites for such openings, they often are not ideal because they usually are close to roads and have compacted soil. Also, avoid introduction of plant species that can escape from the immediate area and into surrounding woodlands (e.g., bicolor lespedeza). These actions will minimize the threats of new habitat disturbance and spread of invasive species.

19. **Protect areas of high SGCN concentrations to prevent collecting, poaching, or indiscriminate killing.** Hibernating bats, nesting shorebirds, dense populations of salamanders, and other wildlife concentrations are extremely vulnerable to harvest or killing. Restrict access and avoid publicizing exact locations of such sensitive sites to minimize human disturbance.

20. **Protect sensitive habitat features such as seeps, ravines, coves, etc.** Direct foot and vehicular traffic so as to avoid and/or minimize soil disturbance and other impacts.

Aquatic Habitats

Presented below are overarching conservation actions to benefit the wildlife of Alabama's rivers, streams, springs, and estuarine submerged aquatic vegetation. Those listed below can be applied to multiple habitats occurring statewide. More specific management needs and conservation actions for SGCN are subsequently presented by river basin.

21. **Protect remaining free-flowing rivers and streams from impoundment**. Existing impoundments are the primary cause of aquatic species imperilment in Alabama. Remaining free-flowing river reaches (particularly on the Tennessee and Coosa rivers) are essential to restoration of a high number of SGCN. Preventing their impoundment will minimize the statewide impacts of habitat loss, fragmentation and degradation resulting from impoundments.

22. **Restore barriers to fish migration**. Dams and suspended culverts at stream crossings not only impede or prevent natural passage of SGCN fishes, they also have indirect effects on other SGCN (e.g., mussels that depend on anadromous/catadromous fish hosts, Rainbow Snakes that require American Eels as prey).

23. **Minimize activities that alter flow or temperature regimes.** Discharges from dams should mimic seasonal flow, temperature, and dissolved oxygen regimes. Water withdrawals and inter-basin transfer should be managed to minimize ecological harm.

24. **Minimize fish mortality at industrial cooling water intakes.** Cooling water intake structures can pull large numbers of fish or their eggs into cooling systems, and larger organisms may be killed or injured when they are trapped against screens at the front of intake structures. Follow the requirements of Section 316(b) of the Clean Water Act which address the design and operation of such intake structures.

25. **Operate dams and other water use facilities to minimize direct impacts to aquatic fauna.** Dams fragment habitat and create a direct barrier to the movement of aquatic species. Hydroelectric dams and other water use facilities are directly responsible for fish mortality by impingement and entrainment.

26. **Minimize point-source (industrial, municipal, agricultural) and nonpoint-source (residential, silvicultural, agricultural) pollution in waterways.** Point-source pollution can directly kill, or adversely impact, aquatic organisms. For non-point source pollution, management should meet or exceed forestry and agricultural best management practices. Identification of sediment sources will facilitate focused mitigation actions.

27. **Avoid the introduction of non-native aquatic species.** Educate and inform the public of state and federal regulations prohibiting both deliberate and unintentional introduction of aquatic species.

28. **Avoid disruptions to streambed integrity.** In-stream mineral extraction and vehicular traffic degrade aquatic habitats and should be excluded from all Alabama streams. Improper placement of culverts impair fish passage and can cause pooling upstream and scouring downstream. Natural movement of sand and gravel maintains natural community integrity.

29. **Allow the natural development and movement of woody and rocky structure. Avoid and/or minimize snag removal.** Woody and rocky structure provides important shelters, basking sites, and other microhabitats for aquatic fauna. Removal of these structures may alter stream channels and negatively affect aquatic SGCN.

30. **Minimize disturbance to riparian zones.** Restore native streambank vegetation composition and structure. Implement Best Management Practices for agriculture and forestry to maintain protective buffers. Limit livestock watering activities and/or develop alternative watering sites. Avoid planting crops to stream banks.

31. **Limit hydrological medication and restore natural processes such as bank dynamics, channel meanders, and flood regimes.** Periodic flooding revitalizes floodplains, deposits new sediments, and prevents the river channel from down-cutting. The ecological health and natural community integrity of associated swamp and bottomland forests requires natural flood regimes.

32. **Minimize or better manage use of fertilizers, herbicides, and pesticides near aquatic habitats.** Pollutants can harm aquatic SGCN.

33. **Provide educational materials to boaters, fishermen, and other recreational users of Alabama's rivers and streams.** This action will increase conservation-related education and outreach about biologically significant areas and SGCN .

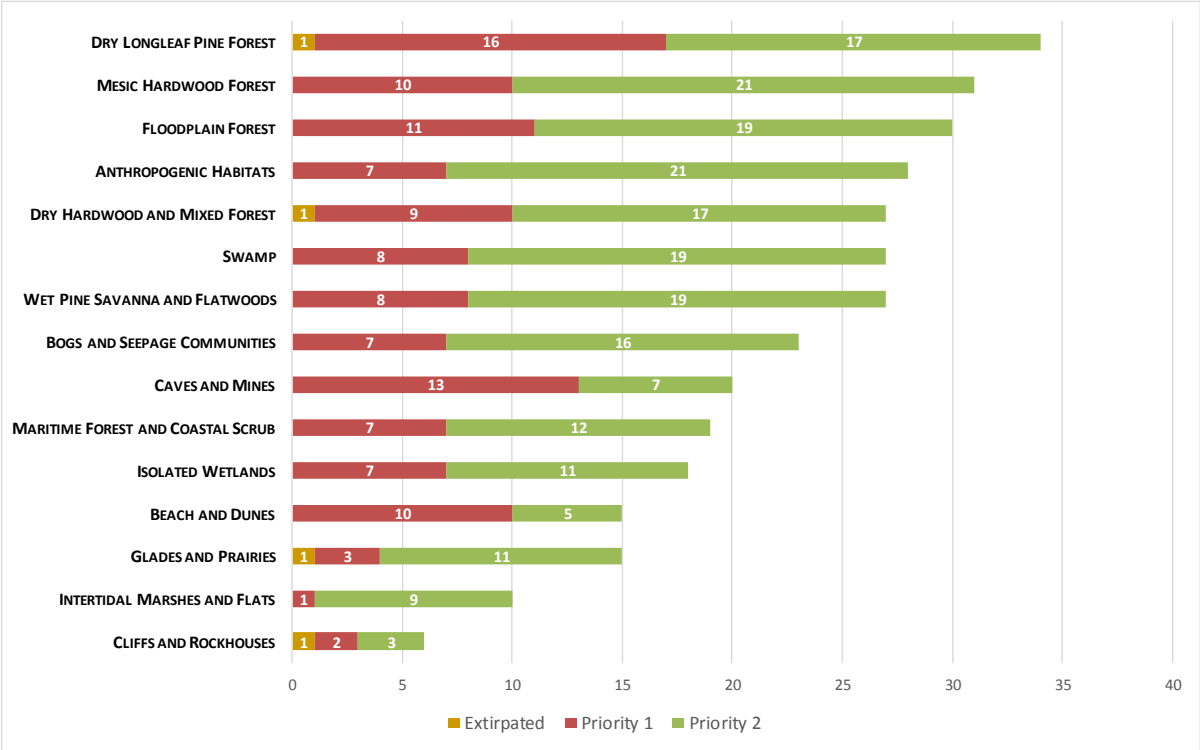
Conservation Actions for Terrestrial SGCN by Habitat

Presented below are overviews of Alabama's 15 terrestrial habitats (Element 2), including lists of SGCN (Element 1), their primary research and monitoring needs (Element 3), priority conservation actions to benefit SGCN and their habitats (Element 4), and additional sources of information. These habitats are presented in order, based on number of SGCN (Table 4-1). Most species are wholly terrestrial, but some are found in seasonally wet depressions, swamps, seeps, bogs, and caves.

Most maps of terrestrial habitats were prepared by the State Lands Division, using the 2007 Alabama GAP data, the best available at this time. The featured habitat is shaded green in all but the cave map. Some habitats are not readily detectable through remote sensing and are therefore not mapped. To obtain more accurate spatial data for all habitat types is recognized as an important conservation need.

To aid the reader in keeping track of the priority status of species in the text, a color-coding system is employed for species names. Gold denotes extirpated; red denotes Priority 1 (Highest Conservation Concern), and green denotes Priority 2 (High Conservation Concern).

Table 4-1. Number of SGCN by terrestrial habitat type



Dry Longleaf Pine Forest

Mark Bailey

Figure 4-1. Coastal Plain longleaf forest, Covington County

Description and Location

Longleaf pine (*Pinus palustris*) forest was historically widespread in Alabama, occuring in the Ridge and Valley, Piedmont, and Southeastern Plains. Longleaf pine habitats range from moist to very well-drained sites, including wet savanna and flatwoods (a separate SWAP habitat category), pine/scrub oak sandhill, xeric sandhill scrub, and rugged ridges north of the Fall Line, including some of Alabama's highest elevations. Frequent fire maintains a canopy dominated by longleaf pine, with wiregrass (*Aristida beyrichiana*) and/or other grass/herb ground cover. When fire is infrequent, scrub oaks, other hardwoods, and shrubs become common in the midstory and shade out native grasses and forbs. Embedded within longleaf pine habitats are fire-dependent herbaceous bogs and isolated wetlands that contribute much of the biodiversity of the region.

This habitat encompasses three NatureServe ecological systems (Table 4-2). Representative sites include Conecuh National Forest (Covington, Escambia counties), Perdido River Longleaf Hills Tract (Baldwin County), Fort Rucker (Dale and Henry counties), Fred T. Stimpson Wildlife Sanctuary (Clarke County), Geneva State Forest (Geneva County), Mountain Longleaf NWR (Calhoun County), and Talladega National Forest (all districts—Calhoun, Chilton, Clay, Cleburne, Bibb, Hale, Perry, Talladega, and Tuscaloosa counties).

Table 4-2. Ecological systems encompassed by Dry Longleaf Pine Forest

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Southeastern Interior Longleaf Pine Woodland			X	X		
Southern Appalachian Low Mountain Pine Forest		X				
East Gulf Coastal Plain Interior Upland Longleaf Pine Woodland					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

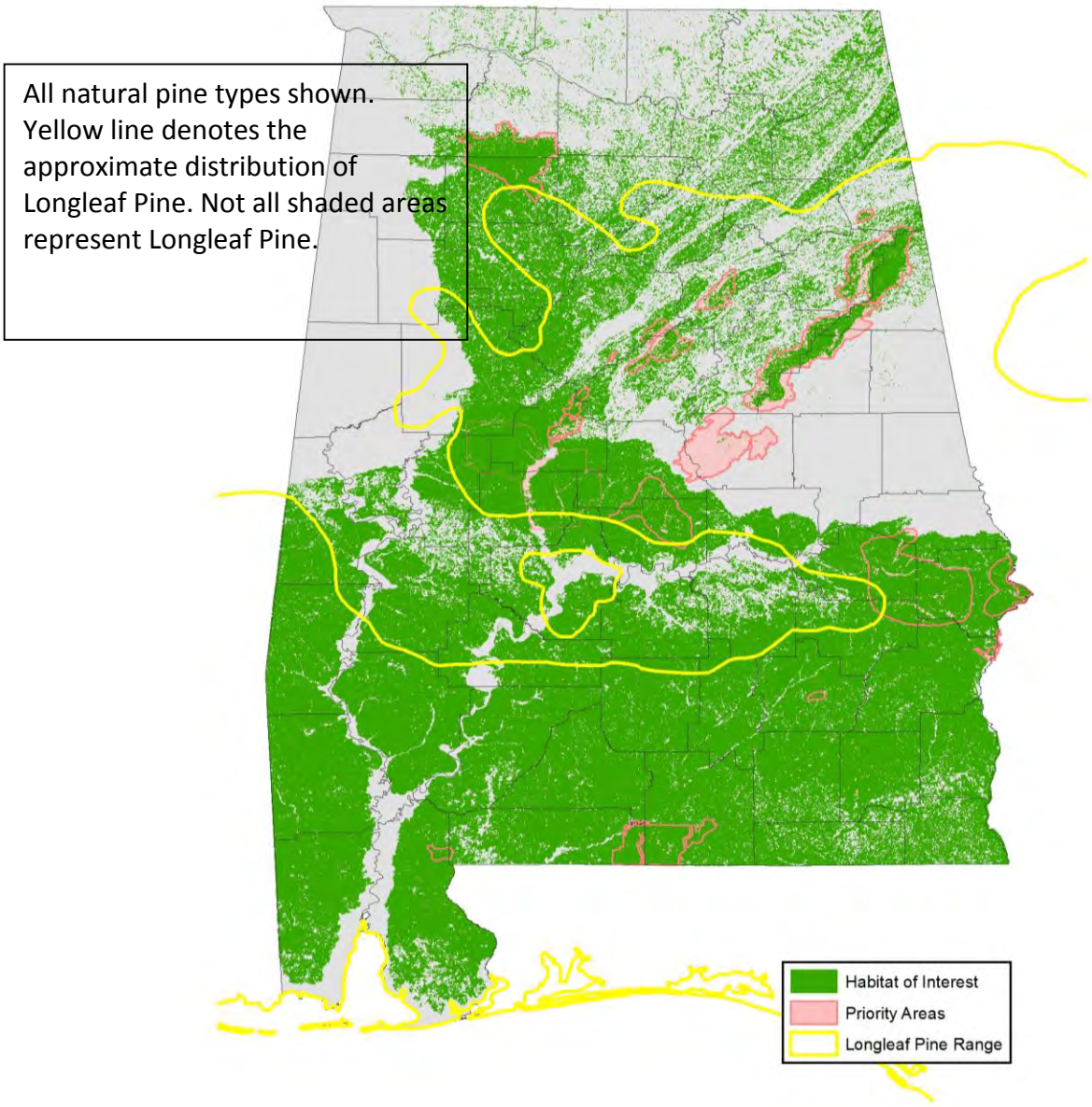


Figure 4-2. Mapped Dry Longleaf Habitat and Known Priority Areas (some are lacking GIS data)

Mark Bailey

Figure 4-3. Montane longleaf forest, Coosa County

Condition

Despite its recent listing as "endangered" on the IUCN Red List of Threatened Species, longleaf pine as a species is abundant and not of conservation concern; the remnants of the *longleaf ecosystem* are among North America's most threatened habitats. Longleaf pine was probably once Alabama's most abundant tree (Harper 1928), but it has been greatly reduced in extent, largely displaced by urbanization, agriculture, and/or silviculture. Longleaf pine communities now exist in just 3% of their previous range throughout the Southeast (Lopez et. al. 2009). Longleaf pine forest and savanna is considered one of the most endangered habitats in the country today (Noss and Peters 1995). Alabama has about 717,000 acres of longleaf pine, second in area only to Florida (Lopez et. al. 2009). On frequently burned public lands and some private hunting preserves, the habitat is in good condition. Habitat is in fair to poor condition on other public land and most private and industry lands.

It is important to maintain the native, functioning plant and animal community structure in these fire-maintained habitats through management goals based on desired burn effects (Hermann et al. 2015). Without the appropriate fire regime, canopy closure will increase along with shrub dominance, and grasses, forbs, and other finer-fuel components will decline, further altering the fire regime dynamics. Prescribed fire needs to increase dramatically in these systems, along with documentation that the fire regime is effective in reducing midstory and increasing groundcover. In systems where advanced hardwood competition exists, selective herbicide application should also be considered to effectively release fine fuels and restore basic functionality of the longleaf ecosystem. Loss of longleaf pine forest and the fragmented and degraded nature of many remaining tracts has resulted in the decline of a large number of terrestrial vertebrates that can be considered "longleaf specialists," found either primarily or exclusively in longleaf-dominated habitats.

This habitat supports 34 SGCN (Table 4-3).

Table 4-3. SGCN, Dry Longleaf Pine Forest

Scientific Name	Common Name	SGCN Rank
Insects – 1		
Nicrophorus americanus	American Burying Beetle	EX
Amphibians – 4		
Ambystoma bishopi	Reticulated Flatwoods Salamander	P1
Lithobates capito	Gopher Frog	P1
Lithobates sevosus	Dusky Gopher Frog	P1
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	P2
Reptiles – 12		
Drymarchon couperi	Eastern Indigo Snake	P1
Heterodon simus	Southern Hognose Snake	P1
Micrurus fulvius	Eastern Coral Snake	P1
Ophisaurus mimicus	Mimic Glass Lizard	P1
Pituophis melanoleucus lodingi	Black Pinesnake	P1
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	P2
Gopherus polyphemus	Gopher Tortoise	P2
Lampropeltis getula	Eastern Kingsnake	P2
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	P2
Pituophis melanoleucus melanoleucus	Northern Pinesnake	P2
Pituophis melanoleucus mugitus	Florida Pinesnake	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds – 5		
Ammodramus henslowii	Henslow's Sparrow	P1
Picoides borealis	Red-cockaded Woodpecker	P1
Falco sparverius paulus	Southeastern American Kestrel	P2
Lanius ludovicianus	Loggerhead Shrike	P2
Peucaea aestivalis	Bachman's Sparrow	P2
Mammals – 12		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis austroriparius	Southeastern Myotis	P1
Myotis lucifugus	Little Brown Myotis	P1
Myotis septentrionalis	Northern Long-eared Bat	P1
Myotis sodalis	Indiana Bat	P1
Ursus americanus	Black Bear	P1
Geomys pinetis	Southeastern Pocket Gopher	P2
Lasiurus intermedius	Northern Yellow Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Perimyotis subflavus	Tri-colored Bat	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern, EX = Extirpated

Problems Affecting Species/Habitat

- Lack of, and/or ineffective use of, fire; burning restrictions, smoke management, non-attainment near cities, liability involved with prescribed fire
- Urban development and habitat fragmentation
- Conversion to large-scale solar power operations (not yet occurring in Alabama, but already an issue in Georgia)
- Lack of old-growth characteristics (canopy gaps, red-heart fungus, cavities, snags)
- Habitat loss affecting species that rely on understory management and open pine ecosystems
- Exotic species, including cogongrass, bicolor lespedeza, and fire ants
- Intensive (especially mechanized) pine straw raking impacting understory habitat
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Insufficient conservation-related educational outreach about biologically-sensitive areas
- Impacts from excessive soil disturbances from site preparation activities (i.e., fire plow lines)
- Erosion from mechanized vehicle trails and other activities near biologically significant sites

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact longleaf pine communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Forest Inventory data, consultation with forestry and plant community authorities, and remote imagery should be used. Support and build on the East Gulf Coastal Plain Joint Venture's Open Pine Decision Support Tool to identify and prioritize conservation areas. Measure(s): Data to fill information gaps for mapping distribution of this key habitat; data to expand GIS coverages.

- **Reticulated Flatwoods Salamander**, **Dusky Gopher Frog**, and **Southern Hognose Snake** – Possibly extirpated. Intensive surveys are needed to determine whether these species still occur in Alabama. Develop a plan to restore each species to at least one site in the state. Measure(s): Results of surveys, list of candidate reintroduction sites, new populations established, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Gopher Frog** – Surveys are needed to identify previously unknown breeding sites as well as unoccupied lands suitable for reintroduction, which may require wetland creation as has successfully been done in Georgia. Measure(s): Assessment of breeding sites, lists of potential reintroduction sites, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Eastern Indigo Snake** – Maintain current reintroduction effort at Conecuh National Forest, develop a list of sites where ADCNR intends to establish and maintain viable populations. Evaluate Perdido River Longleaf Hills Tract, Fred T. Stimpson Wildlife Sanctuary, and Grand Bay Savanna as additional potential reintroduction sites. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Eastern Coral Snake**, **Black Pinesnake**, **Eastern Diamond-backed Rattlesnake**, **Eastern Kingsnake**, **Northern Pinesnake**, and **Florida Pinesnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Mimic Glass Lizard** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Since only two individuals have been seen in the state in the last 25 years, both from one location within Conecuh National Forest, further study of this site should be undertaken to determine local population size and obtain natural history information. Measure(s): Natural history data, information to expand GIS coverages, information to aid land managers.

- **Eastern Slender Glass Lizard** and **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Red-cockaded Woodpecker, Henslow's Sparrow**, **Southeastern American Kestrel**, **Bachman's Sparrow**, and **Loggerhead Shrike** – Implement inventory and monitoring programs in this habitat on key public and private lands. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

- **Southeastern Pocket Gopher** and **Gopher Tortoise** – Document commensal invertebrate and vertebrate burrow fauna in conjunction with range-wide surveys (which could be conducted concurrently) for these keystone burrowing animals. Measure(s): Data to fill information gaps for mapping distribution and commensal fauna; inclusion in the Natural Heritage database.

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Little Brown Myotis**, **Northern Long-eared Bat**, **Indiana Bat**, **Tri-colored Bat**, and **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Long-tailed Weasel** and **Eastern Spotted Skunk** – These small carnivores remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Wherever possible, seek to participate and actively engage with the three current longleaf pine Local Implementation Teams (LITs) and other established conservation partners (AFC, USFS, USFWS, NRCS, The Longleaf Alliance, Northern Bobwhite Conservation Initiative, PIF, PARC, AWF, etc.) to share resources and collaboratively improve the habitat

conditions on critical areas of managed or protected lands. Measure(s): Number of joint projects with LITs and other partners, acres of habitat enrolled in NBCI, NRCS, and other programs.

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect and promote large, intact tracts by protecting existing significant tracts. A high priority should be maintaining the largest and most threatened tracts in Mobile and Baldwin counties where development and sprawl is encroaching. Large holdings in Escambia and Washington counties are also at risk of conversion or degradation. Partner with Forest Legacy, Land Trusts, TNC, and other partners to identify, conserve and restore such tracts. Tracts containing isolated wetlands (i.e., ponds, bogs) and/or priority species should receive special priority for protection. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements, evidence of stable or increasing populations of SGCN.

- Restore existing longleaf pine on state-owned and private lands through the establishment of native groundcovers, planting longleaf pine, and allowing trees to reach old age. Some incentive programs and multiple-use ("silvi-pasture") practices do not dissuade the use of exotic pasture grass understories, or convey the importance of maintaining native understory vegetation in the functionality of the ecosystem. Without native groundcover recovery, acres planted in longleaf pine should not be counted as "restored." Measure(s): Acres restored and/or enhanced.

- Control midstory development and encourage understory development through effective prescribed burning. Acceptance of controlled burning can be enhanced through public education, programs to "fire-safe" properties, and cost-share programs to install fire lines and conduct controlled burns. Measure(s): Acres burned annually; periodic habitat assessments indicating that management goals are being met; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of properties made "fire-safe" annually; and number of cost-share programs to install fire lines and conduct controlled burns.

- Support full implementation of America's Longleaf, the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, Fort Rucker and Fort Benning INRMPs, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- **Red-cockaded Woodpecker** – Publicize and encourage landowner participation in Alabama's statewide Red-cockaded Woodpecker Safe Harbor Plan by working with USFWS, USFS, The Longleaf Alliance and AFC. Continue to work cooperatively with USFWS, USFS, and private landowners on recovery efforts including population augmentation (translocation) to appropriate recipient sites. Opportunities for recovery on state forests, wildlife management areas, military installations, and large private holdings should be identified and implemented to increase Alabama's role in the recovery of these species. Measure(s): Number of landowners participating in Red-cockaded Woodpecker Safe Harbor Plan; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of successfully translocated individuals; number of populatons and active Red-cockaded Woodpecker clusters on private lands; list of potential additional recovery sites; development of strategy for implementation.

- **Southeastern American Kestrel** – Strategically erect nest boxes in suitable habitat or where species is present to create additional nest sites to encourage use and aid in bolstering population. Measure(s): Number of sites with new nest boxes that become occupied by kestrels.

- **Gopher Frog** and **Dusky Gopher Frog** – Create breeding sites in suitable habitat where new populations can be established. Measure(s): Number of new populatons established.

- **Gopher Tortoise** – Publicize and encourage landowner participation in Alabama's statewide Gopher Tortoise initiative by working with Gopher Tortoise Council, USFWS, DoD, USFS, Longleaf Alliance**,** and AFC**.** Measure(s): Number of viable Gopher Tortoise populations on private lands, number of landowners participating in Gopher Tortoise conservation; completion of an outreach plan; and outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- **Black Bear** – Protect movement corridors, including placing signage and underpasses in areas of greatest use. Potential partners may include USFS and ALDOT.

- **Southeastern Pocket Gopher** – Extirpated from Conecuh National Forest, this species could be experimentally reintroduced in appropriate suitable locations provided a source population is available (Blackwater River State Forest in Florida could be considered for this). Measure(s): Number of new populations established.

Priority Areas for Conservation Action

- Autauga Sandhills
- Bald Rock Mountain
- Bankhead/Warrior Mountains
- Barbour County WMA
- Bibb County Glades
- Conecuh National Forest
- East Alabama Fall Line Hills
- Eufaula NWR
- Flag Mountain
- Fort Benning
- Fort Rucker
- Frank Jackson State Park
- Geneva State Forest
- Lower Hatchet Creek/Coosa WMA
- Little River State Forest
- Mobile Co. Tortoise Mitigation Banks
- Moss Rock
- Oak and Double Oak Mountains
- Talladega National Forest
- Tuskegee National Forest
- Perdido River Longleaf Hills Tract
- Pike County Pocosin Sandhills
- Solon Dixon Forestry Ed. Center
- Splinter Hill Bog
- Talladega Mountains
- Upper Cahaba Watershed
- Weisner Mountain

Mesic Hardwood Forest

Mark Bailey

Figure 4-4. Mesic hardwood forest, Monroe County

Description and Location

These mixed deciduous hardwood or occasionally hardwood-pine forests, with canopy closure typically exceeding 40 percent, occur on a variety of mesic sites virtually statewide. Most examples occur in somewhat protected landscape positions such as coves and lower positions on north-facing slopes where topography creates mesic moisture conditions. Others occur on slopes and ravines between dry uplands and stream bottoms. Due to the slopes and moist conditions, fire is much less frequent than in drier oak-pine forest types. American beech (*Fagus grandifolia*) is often prominent among a mix of magnolias, hickories, maples, oaks, and other mesophytic trees. This is distinguished from the Floodplain Forest habitat type by the absence of characteristic alluvial or bottomland species, along with its more upland position. Prior to canopy leaf-out, the early spring (March-April) herbaceous ground layer can be very rich, with abundant spring ephemeral wildflowers. Mesic forests generally exist naturally as old-growth, with canopy dynamics dominated by gap phase regeneration. Small canopy gaps created by wind are likely the primary form of natural disturbance. Most of the prevailing species are shade tolerant, but not very fire-tolerant.

This habitat encompasses seven NatureServe ecological systems (Table 4-4). Representative high-quality sites include Bankhead National Forest, J.D. Martin Skyline WMA, Walls of Jericho, Haines Island Park (Monroe County), Jones Bluff Park (Autauga County).

Table 4-4. Ecological systems encompassed by Mesic Hardwood Forest

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Southern Piedmont Mesic Forest				X		
South-Central Interior Mesophytic Forest	X	X	X			
East Gulf Coastal Plain Southern Mesic Slope Forest					X	
East Gulf Coastal Plain Northern Mesic Hardwood Forest					X	
East Gulf Coastal Plain / Central Florida Hydric Hammock					X	X
East Gulf Coastal Plain Limestone Forest					X	
East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods						X

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

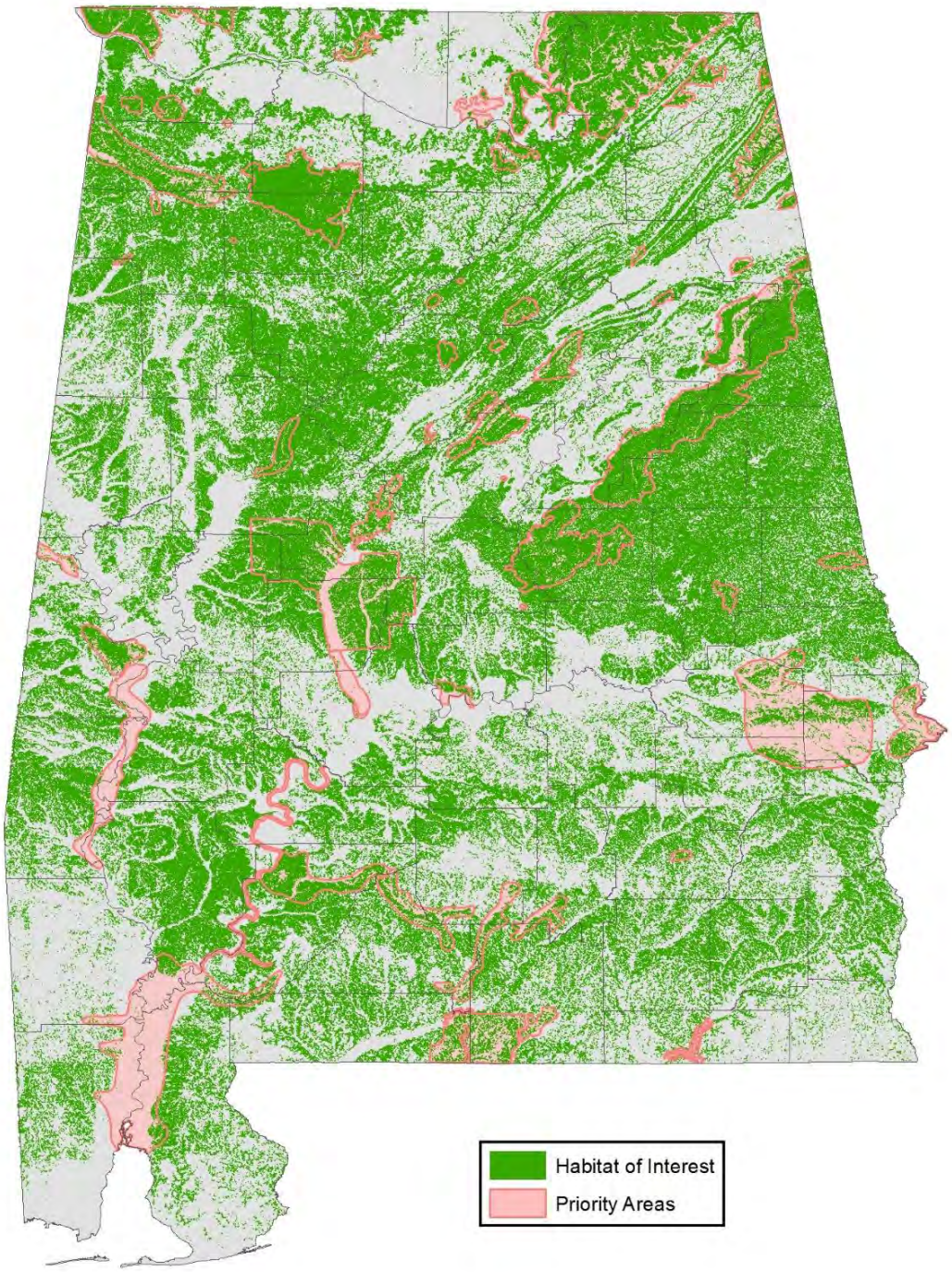


Figure 4-5. Mapped Mesic Hardwood Forest Habitat and Known Priority Areas (some lacking GIS data)

This habitat supports 31 SGCN (Table 4-5).

Table 4-5. SGCN, Mesic Hardwood Forest

Scientific Name	Common Name	SGCN Rank
Amphibians – 5		
Phaeognathus hubrichti	Red Hills Salamander	P1
Aneides aeneus	Green Salamander	P2
Desmognathus aeneus	Seepage Salamander	P2
Lithobates sylvaticus	Wood Frog	P2
Plethodon serratus	Southern Red-backed Salamander	P2
Reptiles – 5		
Micrurus fulvius	Eastern Coral Snake	P1
Lampropeltis getula	Eastern Kingsnake	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Plestiodon anthracinus	Coal Skink	P2
Plestiodon inexpectatus	Southeast ern Five-lined Skink	P2
Birds – 7		
Thryomanes bewickii	Bewick's Wren	P1
Setophaga cerulea	Cerulean Warbler	P1
Aquila chrysaetos	Golden Eagle	P2
Euphagus carolinus	Rusty Blackbird	P2
Asio flammeus	Short-eared Owl	P2
Falco sparverius paulus	Southeastern American Kestrel	P2
Elanoides forficatus	Swallow-tailed Kite	P2
Mammals – 14		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis austroriparius	Southeastern Myotis	P1
Myotis lucifugus	Little Brown Myotis	P1
Myotis septentrionalis	Northern Long-eared Bat	P1
Myotis sodalis	Indiana Bat	P1
Ursus americanus	Black Bear	P1
Lasiurus intermedius	Northern Yellow Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Perimyotis subflavus	Tri-colored Bat	P2
Sorex hoyi	American Pygmy Shrew	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Sylvilagus obscurus	Appalachian Cottontail	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Two SGCN salamanders are found only in this habitat type. The Seepage Salamander occurs in the Piedmont as well as the Fall Line Hills of the Southeastern Plains (it is included under Bogs and Seepage Communities as well, but the seeps it inhabits are typically embedded in mesic forest). The Red Hills Salamander is endemic to mesic forest in the Buhrstone/Lime Hills of the Southeastern Plains.

Condition

Much of this habitat in Alabama is currently highly fragmented and composed of young successional forests as the result of repeated cutting. Large areas have been converted to loblolly pine plantations, especially in the Southeastern Plains.

Problems Affecting Species/Habitat

- Loss of higher quality habitats from conversion to other forest types
- Reduction of habitat suitability due to urban development and fragmentation
- Invasive exotic plants (kudzu, privet, Japanese honeysuckle, etc.)
- Scarcity of mature forest characteristics (cavities, snags, hollows) due to harvest rotations
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- White-nose syndrome affecting bats

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of mesic hardwood forest communities are needed. Measure(s): Data to fill information gaps for mapping distribution of this key habitat; data to expand GIS coverages for this key habitat.Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Amphibians and Reptiles

- **Red Hills Salamander** – Reassessments of the status of populations and habitat should be undertaken at least every five years. Measure(s): Updated population status every five years; inclusion of monitoring data in the Natural Heritage database.

- **Green Salamander**, **Seepage Salamander**, and **Wood Frog** – These secretive amphibians remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Southern Red-backed Salamander** – Known only from two localities, a thorough survey for this species should be conducted to determine the exact extent of its distribution in Alabama. Nearby tracts of public land (e.g., Coldwater Mountain, Mountain Longleaf NWR, and Talladega National Forest) should be surveyed to determine if populations exist within properties already protected from development. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Eastern Coral Snake**, **Eastern Kingsnake**, and **Eastern Speckled Kingsnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Coal Skink** and **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Cerulean Warbler** – Monitor reproductive success to determine limiting factors for populations. Measure(s): Identification of limiting factors, habitat requirements and/or threats.

- **Bewick's Wren** – Investigate/determine cause(s) of precipitous regional decline. Measure(s): Identification of limiting factors, habitat requirements and/or threats.

- **Golden Eagle** – Continue cooperating with researchers to determine the full spectrum of migration corridors from Alabama to Canada and back, which may assist in mitigating for collision conflicts with wind energy plants along the Appalachian Mountain chain. Tracking efforts should be accompanied by modeling flight behavior patterns, which may provide a better understanding of direct risks from wind turbines. Measure(s): Identification of migration corridors, habitat requirements and/or threats.

- **Rusty Blackbird** – Perform late winter surveys in February and March (when males are vocal) to determine areas of most consistent foraging use. Participate in multi-

year Rusty Blackbird Spring Migration Blitz; a rangewide-coordinated citizen-science project. See Table 9.2 in Greenberg et al. 2011 for detailed actions/needs. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Short-eared Owl** and **Southeastern American Kestrel** – Survey mesic hardwood forest for these species, determining degree of importance as habitat. Measure(s): Determination of habitat use, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Swallow-tailed Kite** – Systematic pre-migratory roost surveys should be performed following recommendations of the Swallow-tailed Kite Conservation Alliance. *Updated roost survey recommendations to be released by the Alliance in late 2015*. See also Zimmerman 2010 for additional recommendations. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

Mammals

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Little Brown Myotis**, **Northern Long-eared Bat**, **Indiana Bat**, **Tri-colored Bat**, and **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Long-tailed Weasel, American Pygmy Shrew, Eastern Spotted Skunk, Appalachian Cottontail,** and **Meadow Jumping Mouse** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Avoid/discourage conversion to other forest types. Potential partners may include USFS, AFC, AFA. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage managers to favor mature and old-growth hardwood stands (because these are most often in shortest supply on a landscape scale). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Whenever possible, make the retention of snags, cavity trees, and mature live trees with exfoliating bark a fundamental principle of silvicultural practices. A potential partner is AFC. Measure(s): Forest management prescriptions that address and implement this action.

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect and promote large, unfragmented tracts by protecting existing significant tracts. Partner with Forest Legacy, Land Trusts, TNC, and others to acquire or purchase conservation easements to protect significant blocks (>1,000 acre parcels) of high quality examples of this habitat. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Control exotic species with potential partners NRCS, USFS, AFC, and others. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats.

Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- **Red Hills Salamander** – Through fee simple acquisition or conservation easements, secure conservation lands especially in the eastern and central components of the distribution where losses have been most severe and there have been no public acquisitions (for a list of suggested acquisitions see Apodaca et al. 2010). Partner with Forest Legacy, Land Trusts, TNC, and others to acquire or purchase conservation easements to protect significant blocks (>1,000 acre parcels) of high quality examples of habitat. Create and pursue new and binding private landowner agreements that encourage slope restoration efforts and habitat buffering, such as safe harbor agreements or conservation easements. Measure(s): Acres protected by fee-simple or easements.

- **Seepage Salamander** – Protect the seepage areas inhabited by this species by refraining from timber harvest in the deciduous streamhead seepages which are often exempted from Best Management Practices (BMPs) for forestry. Efforts should be made to locate seepage habitats and mark them out of any areas planned for timber harvest. Maintain upslope buffer areas within which—if timber is harvested-- careful selection cutting is conducted with minimal soil disturbance. Increased awareness of the habitat of this species and its fragility by officials of Talladega National Forest and Cheaha State Park would help in protecting the species. Measure(s): Incorporation of management needs of this species in land management plans.

- **Black Bear** – Protect movement corridors, including placing signage and underpasses in areas of greatest use. Potential partners include USFS and ALDOT. Measure(s): Movement corridors designated, signage/underpasses installed, incorporation of management needs of this species in land management plans.

- **Bats (all SGCN)** – Protect hibernacula and maternity caves from disturbance, provide artificial roost structures for species that will use them (USFWS, USFS). Measure(s): Caves protected/gated; artificial roost structures provisioned.

- **Golden Eagle** – Lead poisoning from spent lead ammunition consumed in carrion is of high concern. To the extent possible, sportsmen should be encouraged to use non-toxic ammunition when hunting, and to properly dispose of deer carcasses so scavengers cannot reach them. Outreach should be performed to increase public

awareness and appreciation, which may help reduce chronic illegal shooting and/or incidental poisoning. Measure(s): Development and distribution of educational materials.

- **Cerulean Warbler** – For populations located on private lands, incentives such as conservation easements or cooperative agreements should be offered to landowners to help protect sites. Acquisition considerations should focus on large, contiguous tracts of mature forest in northern Alabama whenever they become available for purchase, particularly those adjacent to public lands managed for conservation purposes. Identify and protect public lands that harbor breeding populations by establishing large buffer zones and restrict or strategically limit timber harvesting within them. Measure(s): Acres protected by fee-simple or easements.

- **Rusty Blackbird** – Adjust flood regimes of wooded wetlands to create foraging habitat; Reforestation efforts should emphasize preferred food plants such as oaks and hickories.

Priority Areas for Conservation Action

- Bald Knob
- Bald Rock Mountain
- Bankhead/Warrior Mountains
- Bear Creek Ravines
- Beaver Creek and School Creek Mountains
- Bibb County Glades
- Big Ridge
- Black Warrior River Bluffs
- Bogan Mountain
- Brindley Mountain
- Bryant Mountain
- Buttahatchee River Slopes
- Cane Creek/Little Mountain
- Chandler Mountain
- Cheaha Mountain
- Columbiana Mountain
- Conecuh National Forest
- Coon Gulf
- Cunningham Creek Hills
- Dugger/Talladega Mountains
- East Alabama Fall Line Hills
- Elk River Bluffs
- Fletcher's Hollow
- Fort Benning
- Fox Mountain
- Foxtrap Creek
- Franklin/Marion/Jackson Mountains
- Freedom Hills and Adjacent Lands
- Greens Creek Mountain
- Huntsville Mountains
- Indian Mountain
- Inland Lake/Blackburn Fork Woods
- Jones Bluff
- Little River Canyon
- Little Uchee Creek Ravines
- Lookout and Pigeon Mountains
- Lower Alabama River Bluffs and Swamps

- Lower Cahaba Bluffs and Swamps
- Lower Choctawhatchee River Bluffs
- Lower Hatchet Creek/Coosa WMA
- Moss Rock
- Natural Bridge
- Newsome Sinks
- Nickajack Cove
- North Fork Creek Glade
- Noxubee Prairies and Forests
- Oak and Double Oak Mountains
- Oakmulgee District, Talladega NF
- Old Bluffport
- Old Cahawba Prairies
- Oseligee Creek
- Patsaliga Creek
- Persimmon Creek
- Pike County Pocosin Sandhills
- Sandy Creek
- Sepulga River Slopes
- Shades Mountain
- Skyball Mountain
- Talladega Mountains
- Tallahatta Bluffs
- Tensaw Delta
- Transition Hills
- Turk's Cave
- Upper Cahaba Watershed
- Upper Gurley Creek
- Weisner Mountain
- Wheeler NWR

Floodplain Forest

Mark Bailey

Figure 4-6. Floodplain of Pigeon Creek, Covington County

Description and Location

This diverse, statewide habitat category includes a range of situations where periodic flooding and flood-related environmental factors (wetness, scouring, deposition of material, and input of nutrients) affect vegetational composition and dynamics. Scour-influenced systems occur on high-gradient streams in gorges of the Southwestern Appalachians and Ridge and Valley, where shrubs, perennial grasses, and forbs dominate. Elsewhere, forests of larger floodplains and bottomlands often include depositional landforms such as levees, sloughs, ridges, terraces, and abandoned channel segments. Floodplain forests above the Fall Line are generally quite distinct from those of the Southeastern Plains, because of steeper river gradients and harder rocks. Baldcypress and tupelo gum are common components below the Fall Line, but not above. Vegetation along the larger streams and rivers generally includes forests dominated by bottomland hardwood species and other trees tolerant of flooding.

This habitat encompasses eight NatureServe ecological systems (Table 4-6). Representative high-quality sites include Mobile-Tensaw river delta (Mobile and Baldwin counties), Sipsey River Tract (Tuscaloosa County), Wheeler NWR (Morgan County).

Table 4-6. Ecological systems encompassed by Floodplain Forest

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Cumberland Riverscour	X	X	X	X		
Southern Piedmont Small Floodplain and Riparian Forest				X		
Southern Piedmont Large Floodplain Forest				X		
South-Central Interior Large Floodplain	X	X	X			
South-Central Interior Small Stream and Riparian	X	X	X			
East Gulf Coastal Plain Large River Floodplain Forest					X	
East Gulf Coastal Plain Blackwater River Floodplain Forest					X	X
East Gulf Coastal Plain Small Stream and River Floodplain Forest					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

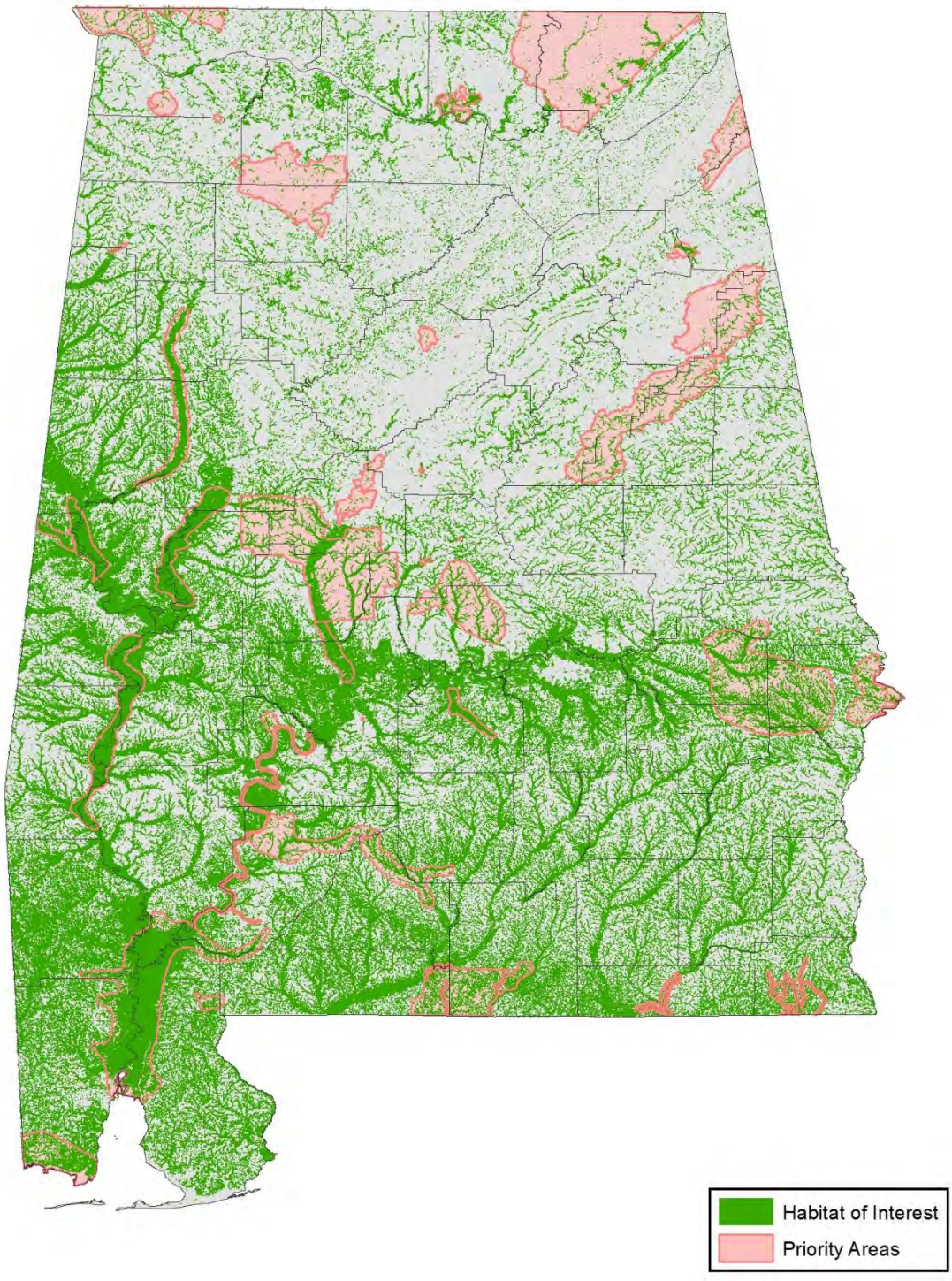


Figure 4-7. Mapped Floodplain Forest Habitat and Known Priority Areas

This habitat supports 30 SGCN (Table 4-7).

Table 4-7. SGCN, Floodplain Forest

Scientific Name	Common Name	SGCN Rank
Amphibians – 5		
Desmognathus auriculatus	Southern Dusky Salamander	P1
Lithobates heckscheri	River Frog	P1
Ambystoma texanum	Smallmouth Salamander	P2
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	P2
Amphiuma pholeter	One-Toed Amphiuma	P2
Reptiles – 5		
Farancia erytrogramma erytrogramma	Rainbow Snake	P1
Lampropeltis getula	Eastern Kingsnake	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Plestiodon anthracinus	Coal Skink	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds – 5		
Setophaga cerulea	Cerulean Warbler	P1
Euphagus carolinus	Rusty Blackbird	P2
Elanoides forficatus	Swallow-tailed Kite	P2
Anas rubripes	American Black Duck	P2
Mycteria americana	Wood Stork	P2
Mammals – 15		
Myotis austroriparius	Southeastern Myotis	P1
Ursus americanus	Black Bear	P1
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis lucifugus	Little Brown Myotis	P1
Myotis septentrionalis	Northern Long-eared Bat	P1
Myotis sodalis	Indiana Bat	P1
Myotis grisescens	Gray Myotis	P1
Zapus hudsonius	Meadow Jumping Mouse	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Lasiurus intermedius	Northern Yellow Bat	P2
Perimyotis subflavus	Tri-colored Bat	P2
Sylvilagus palustris	Marsh Rabbit	P2
Sorex hoyi	American Pygmy Shrew	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Condition

Much of this habitat has been lost to impoundments. Power generation and regulation of water flow create unnatural flood regimes, affecting large areas downstream from dams. Extensive erosion of uplands, caused by poor agricultural practices dating back to colonial times, transported large amounts of sediment into floodplains. Large floodplains often have substantial areas in cultivation. Many exotic plant species have invaded floodplains, perhaps more than in any other habitat type in Alabama.

Problems Affecting Species/Habitat

- Loss and fragmentation of higher quality habitats from impoundment and conversion to agriculture and/or intensive silviculture
- Change in vegetative structure and species composition due to alteration of the natural flood regime due to upstream dams, ditching, and draining
- Invasive exotic plants (Chinese tallow tree, Japanese climbing fern, privet, Nepal grass, etc.)
- Scarcity of mature forest characteristics (cavities, snags, hollows) due to harvest rotations
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.
- Insufficient conservation-related educational outreach about biologically-sensitive areas
- Loss of native community structure and composition due to fire suppression
- White-nose syndrome affecting bats

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact floodplain forest communities are needed. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Amphibians and Reptiles

- **Southern Dusky Salamander** – Intensive surveys of large river floodplains (Mobile, Tensaw, Conecuh, Yellow, Pea, Choctawhatchee, Chipola, and Chattahoochee rivers) and swampy creeks (in the Escatawpa, Mobile Bay, and Perdido drainage basins) near the Florida border should be made to define the species' explicit geographic distribution in

Alabama. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **River Frog** and **One-Toed Amphiuma** – Distribution and status very poorly known. A survey of likely swamp and baygall habitats should be conducted. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Smallmouth Salamander** and **Eastern Tiger Salamander** –These secretive amphibians remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Eastern Kingsnake** and **Eastern Speckled Kingsnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Coal Skink** and **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Cerulean Warbler** – Monitor reproductive success to determine limiting factors for populations. Measure(s): Identification of limiting factors, habitat requirements and/or threats.

- **Rusty Blackbird** – Perform late winter surveys in February and March (when males are vocal) to determine areas of most consistent foraging use. Participate in multi-year Rusty Blackbird Spring Migration Blitz; a rangewide-coordinated citizen-science project. See Table 9.2 in Greenberg et al. 2011 for detailed actions/needs. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Swallow-tailed Kite** – Systematic pre-migratory roost surveys should be performed following recommendations of the Swallow-tailed Kite Conservation Alliance. *Updated roost survey recommendations to be released by the Alliance in late 2015*. See also Zimmerman 2010 for additional recommendations. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

Mammals

- **Southeastern Myotis, Rafinesque's Big-eared Bat, Little Brown Myotis, Northern Long-eared Bat, Indiana Bat, Gray Myotis, Brazilian Free-tailed Bat, Tri-colored Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

- **Meadow Jumping Mouse, Eastern Spotted Skunk, Long-tailed Weasel, Marsh Rabbit, American Pygmy Shrew** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts. Partner with Forest Legacy, Land Trusts, TNC and others to protect significant blocks of high quality examples of this habitat. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Provide incentives and information to landowners for long-term conservation. Potential partners may include NRCS, USFWS and other granting agencies or institutions. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid/discourage conversion to agriculture or other forest types, and encourage restoration of altered habitats. Potential partners may include NRCS, USFS, AFC, AFA. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Minimize, to the extent feasible, impacts of altered flood regimes. Potential partners may include TVA, U.S. Army Corps of Engineers, and Alabama Power Company. Measure(s): Acres and/or stream miles restored or enhanced by use of natural flood regimes.

- Control exotic plant and animal species. Potential partners may include Alabama Invasive Pest Plant Council (ALIPPC) NRCS, USFS, AFC. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Encourage managers and landowners to favor mature and old-growth stands. A potential partner is AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Investigate effects of season and intensity of prescribed fire as a management technique. A potential partner is AFC. Measure(s): Research project(s) that determine effects of prescribed fire on this key habitat.

- **Black Bear** – Protect movement corridors, including placing signage and underpasses in areas of greatest use. Potential partners include USFS and ALDOT.

- **American Black Duck** – Conserve and restore forested and palustrine wetland habitats, especially in the Tennessee Valley. Continue restrictive harvest regulations in Alabama should be continued. Because Black Ducks and Mallards readily hybridize, releases of pen-raised Mallards in Alabama, especially in key wintering and the primary breeding areas (e.g., the Tennessee Valley) should certainly be discouraged, if not prohibited

Priority Areas for Conservation Action

- Autauga Sandhills
- Ballplay Swamp
- Bankhead/Warrior Mountains
- Bibb County Glades
- Big Swamp Creek
- Buttahatchee River Slopes
- Cane Creek/Little Mountain
- Cedar Creek – Highway 41
- Chipola River/Big Creek Woods
- Conecuh National Forest
- Cunningham Creek Hills
- Dugger/Talladega Mountains
- East Alabama Fall Line Hills
- Fort Benning
- Foxtrap Creek
- Franklin/Marion/Jackson Mountains
- Grand Bay Savanna
- Green's Pitcher Plant Bog-Yellow Leaf Creek
- Little River Canyon
- Little Uchee Creek Ravines
- Lower Alabama River Bluffs and Swamps
- Lower Black Warrior Swamps
- Lower Cahaba Bluffs and Swamps
- Lower Choctawhatchee River Bluffs
- Lower Tombigbee River
- Mulberry Creek
- Noxubee Prairies and Forests
- Oakmulgee District, Talladega National Forest
- Prairie Bluff – Millers Ferry Prairie
- Sepulga River Slopes
- Sipsey River
- Splinter Hill Bog
- Spring Creek
- Talladega Mountains
- Tallahatta Bluffs
- Tapawingo Springs
- Tensaw Delta
- Tom Cat Prairie
- Transition Hills
- Wheeler NWR / Redstone Arsenal

Anthropogenic Habitats

Mark Bailey

Figure 4-8. Pine plantation, Escambia County

Description and Location

Disturbed and altered habitats, resulting from human activity, occur in a wide variety of forms statewide and in every ecoregion. This category includes cropland, sod farms, farm ponds, ditches, orchards, pine plantations, pastures, utility and transportation rights-of-way, golf courses, and many others. Structures such as silos, barns, and abandoned buildings may support owls, bats, various reptiles, and other wildlife. Although these habitats support different plant and animal assemblages than formerly occurred, remnants of the original natural habitats may still be present. Embedded wetlands, vegetated stream banks, wooded slopes adjacent to fields, and other non-cultivated areas such as fencerows and roadside ditches may serve as important patches of "natural" habitats in which wildlife species can survive and from which they may disperse. Many wildlife species will disperse into agricultural lands to forage or to migrate to other natural habitats. For this reason, it is important to maintain and create corridors of suitable habitat connecting fragmented habitats within agricultural lands. Although this habitat is of low importance to most SGCN and none are dependent on it, several species may occur under certain conditions. For example, in the

Southeastern Plains, where some fire-suppressed pine forests have lost their herbaceous groundcover, Gopher Tortoises thrive in adjacent open transmission line rights-of-way.

Mark Bailey

Figure 4-9. Drainage ditch through former pine flatwoods, Baldwin County

Condition

These habitats are to varying degrees altered—some severely—and restoration to the original condition is generally not an option except when these lands are included in larger tracts specifically set aside for wildlife conservation. Invasive exotic species such as fire ants, kudzu, and privet are common in these disturbed areas. Pasture grasses such as Bermuda grass and Bahia may retard natural succession to woodland long after these habitats cease to be used for agriculture.

This habitat supports 28 SGCN (Table 4-8). The relatively large number of crayfishes may be encountered in ditches adjacent to other habitats.

Table 4-8. SGCN, Anthropogenic Habitats

Scientific Name	Common Name	SGCN Rank
Crayfishes - 11		
Cambarellus diminutus	Least Crayfish	P1
Procambarus escambiensis	Escambia Crayfish	P1
Procambarus viaevirdis	Vernal Crayfish	P1
Hobbseus prominens	Prominence Riverlet Crayfish	P2
Procambarus capillatus	Capillaceous Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2
Procambarus lewisi	Spur Crayfish	P2
Procambarus marthae	Crisscross Crayfish	P2
Procambarus okaloosae	Okaloosa Crayfish	P2
Procambarus paeninsulanus	Peninsula Crayfish	P2
Procambarus planirostris	Flatnose Crayfish	P2
Reptiles - 4		
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	P2
Gopherus polyphemus	Gopher Tortoise	P2
Lampropeltis getula	Eastern Kingsnake	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Birds - 8		
Ammodramus henslowii	Henslow's Sparrow	P1
Thryomanes bewickii	Bewick's Wren	P1
Euphagus carolinus	Rusty Blackbird	P2
Lanius ludovicianus	Loggerhead Shrike	P2
Asio flammeus	Short-eared Owl	P2
Falco sparverius paulus	Southeastern American Kestrel	P2
Mycteria americana	Wood Stork	P2
Peucaea aestivalis	Bachman's Sparrow	P2
Mammals - 5		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis leibii	Eastern Small-footed Myotis	P1
Lasiurus intermedius	Northern Yellow Bat	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Emphasis on "clean" agriculture (lack of weedy, brushy fencerows) reduces available habitats for many species.

- Invasive exotic plants (kudzu, Chinese tallow tree, cogongrass, privet, etc.) and animals (fire ants)
- Loss of older farm buildings which provide wildlife habitat
- Scarcity of cavities
- Improper use of fertilizers, herbicides and pesticides near streams and wetlands
- Habitat loss through draining of wetlands
- Loss of natural community integrity due to disturbance from livestock
- Mowing wetlands, shorelines, and ditches mid-spring through midfall during critical time of reproduction and rearing of young for most vertebrate taxa
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.

Priority Research/Survey/Monitoring Needs

Invertebrates

- **All SGCN Crayfishes** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Amphibians and Reptiles

- **Gopher Tortoise** – Conduct thorough surveys to determine current distribution and status on transmission line rights-of-way. Measure(s): Data to fill information gaps for mapping distribution; identification of habitat requirements; inclusion in the Natural Heritage database.
- **Eastern Diamond-backed Rattlesnake**, **Eastern Kingsnake**, and **Eastern Speckled Kingsnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Henslow's Sparrow**, **Bewick's Wren**, **Southeastern American Kestrel**, **Rusty Blackbird**, **Bachman's Sparrow** and **Loggerhead Shrike** – Conduct surveys for habitat use. Measure(s): Data to fill information gaps for mapping distribution; identification of habitat requirements; inclusion in the Natural Heritage database.
- **Short-eared Owl** – Survey suitable areas, determining degree of importance as wintering habitat. Measure(s): Determination of habitat use, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Wood Stork** – Maintain records on numbers of storks documented at aquaculture ponds. Measure(s): Data to fill information gaps for mapping distribution; inclusion in the Natural Heritage database.

Mammals

- **Rafinesque's Big-eared Bat**, **Eastern Small-footed Myotis**, and **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome

- **Northern Yellow Bat** and **Eastern Spotted Skunk** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

It is assumed that uses other than wildlife management are the primary management objective and any SGCN present are relicts. If restoration of the native habitats of these areas is unlikely to occur through purchase or signing of conservation easements, some of the following actions may prolong existence of populations until they can be protected, or ameliorate other negative aspects of the primary use of the land. NRCS is the most likely partnering agency, but organizations such as the Alabama Farmers Federation and Alabama Cattlemen's Association could also be involved. The Audubon Cooperative Sanctuary Programs (ACSP) assist landowners in maximizing habitat for wildlife and maintaining the biodiversity of local landscapes.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Encourage land managers to protect and buffer any remaining natural areas. These are the areas where most SGCN will persist, or visit. Measure(s): Acres of buffer restored, enhanced or created annually; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage land managers to develop naturally-vegetated corridors between habitat fragments. Measure(s): Number of vegetated corridors restored, enhanced or created; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage golf courses and other large land managers to adopt integrated pest management strategies to reduce chemical use. Measure(s): Number of golf courses and other managed lands utilizing integrated pest management; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage land managers to consider restoring natural hydrology to drained wetlands. Measure(s): Acres of wetland restored; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage land managers to avoid mowing wetlands, shorelines, and ditches mid-spring through mid-fall. This period is usually a critical time of reproduction and rearing of young for most vertebrate taxa. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Encourage land managers to avoid overgrazing and keep livestock out of wetlands. Measure(s): Acres of wetland protected from livestock; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Control/eradicate exotic plants and animals. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- **Southeastern American Kestrel** – Implement a nest box program in partnership with AOS, SABA. Agricultural lands afford excellent foraging, but cavities are limited. Measure(s): Number of nest boxes installed annually.

- **Loggerhead Shrike** – Roadside and field/pasture fenceline management should be aimed at maintaining shrubs (cover, perching, and nesting habitat). Manage for medium and tall grasses by reducing grazing, controlling mowing times, and implementing prescribed fire.

- **Gopher Tortoise** – Map current distribution on transmission line rights-of-way in partnership with major utilities including Alabama Power Company and others. Publicize and encourage landowner participation in Alabama's statewide Gopher Tortoise initiative by working with Gopher Tortoise Council, USFWS, DoD, USFS, Longleaf Alliance**,** and AFC**.** Measure(s): Number of viable Gopher Tortoise populations on private lands, number of landowners participating in Gopher Tortoise conservation; completion of an outreach plan; and outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

Priority Areas for Conservation Action
Not applicable

Dry Hardwood and Mixed Pine Forest

Mark Bailey

Figure 4-10. Dry hardood forest with some longleaf pine, Shelby County

Description and Location

Under natural conditions, this was the "oak-hickory" forest covering much of Alabama's Piedmont, Ridge and Valley, Southwestern Appalachians, and Interior Plateau, and also in fire-sheltered terrain of the Southeastern Plains where pine forests otherwise predominated. Occurring primarily on upland ridges and upper to mid slopes on a variety of soils, this habitat is highly variable in tree species composition and is typically dominated by combinations of oaks (*Quercus* spp.). In some cases, shortleaf pine (*Pinus echinata*) may comprise a significant, even dominant, component. Some of the dominant tree species may live for centuries, and the original forest was old growth with regeneration primarily occurring in canopy gaps created by wind and fire. A midstory layer is generally present in younger stands. Herbaceous groundcover is often sparse to absent, but a more developed herbaceous component was likely present when natural fires occurred more frequently in the past.

This habitat encompasses eight NatureServe ecological systems (Table 4-9). Representative high-quality sites include Talladega National Forest (Clay, Cleburne counties), J.D. Martin Skyline WMA, (Jackson County), Walls of Jericho (Jackson County), and Little River Canyon National Preserve (Dekalb and Cherokee counties).

Table 4-9. Ecological systems encompassed by Dry Hardwood and Mixed Pine Forest

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Southern Piedmont Dry Oak-(Pine) Forest				X		
Allegheny-Cumberland Dry Oak Forest and Woodland	X	X	X			
Southern Ridge and Valley Dry Calcareous Forest		X	X	X		
Northeastern Interior Dry Oak Forest		X	X	X		
Southern Interior Low Plateau Dry Oak Forest	X					
East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest					X	
East Gulf Coastal Plain / Central Florida Upland Hardwood Forest					X	
East Gulf Coastal Plain Northern Dry Upland Hardwood Forest					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

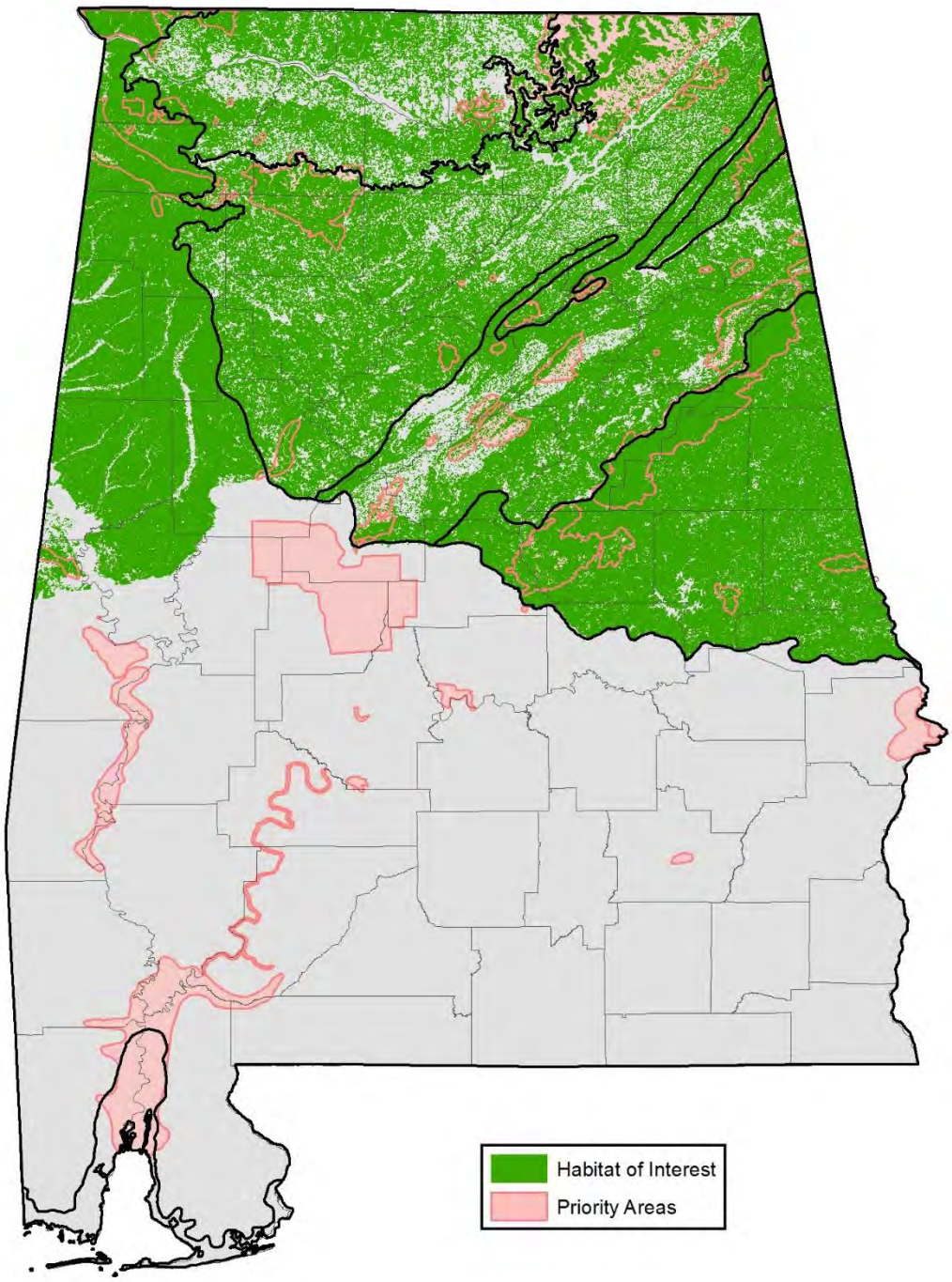


Figure 4-11. Mapped Dry Hardwood and Mixed Pine Forest Habitat and Known Priority Areas (some are lacking GIS data)

This habitat supports 27 SGCN (Table 4-10).

Table 4-10. SGCN, Dry Hardwood and Mixed Pine Forest

Scientific Name	Common Name	SGCN Rank
Insects – 1		
Nicrophorus americanus	American Burying Beetle	EX
Amphibians – 3		
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	P2
Aneides aeneus	Green Salamander	P2
Plethodon serratus	Southern Red-backed Salamander	P2
Reptiles – 6		
Micrurus fulvius	Eastern Coral Snake	P1
Lampropeltis getula	Eastern Kingsnake	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Pituophis melanoleucus melanoleucus	Northern Pinesnake	P2
Plestiodon anthracinus	Coal Skink	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds – 3		
Setophaga cerulea	Cerulean Warbler	P1
Thryomanes bewickii	Bewick's Wren	P1
Aquila chrysaetos	Golden Eagle	P2
Mammals – 14		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis austroriparius	Southeastern Myotis	P1
Myotis lucifugus	Little Brown Myotis	P1
Myotis septentrionalis	Northern Long-eared Bat	P1
Myotis sodalis	Indiana Bat	P1
Ursus americanus	Black Bear	P1
Lasiurus intermedius	Northern Yellow Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Perimyotis subflavus	Tri-colored Bat	P2
Sorex hoyi	American Pygmy Shrew	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Sylvilagus obscurus	Appalachian Cottontail	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern EX = Extirpated

Condition

A significant portion of this habitat in Alabama is composed of successional forests as the result of repeated cutting, clearing, and cultivation of the original oak-hickory forests. The distribution of this habitat has increased in recent decades as small farms have reverted to forest. Although fire is generally excluded or suppressed today, low-intensity surface fires were historically an important natural factor in species composition, and may have been important in favoring oaks and pines over other canopy trees. Large areas once dominated by oak-hickory forests now have successional pine forest due to previous cutting as well as conversion to agriculture. Most of the canopy species are only moderately tolerant of shade, but more shade-tolerant species appear to be increasing in many of these forests, particularly red maple. Before the chestnut blight a century ago, American chestnut was the dominant tree in many places, but it is absent as a canopy species today.

Problems Affecting Species/Habitat

- Loss of higher quality habitats from commercial and residential development, conversion to agriculture and/or intensive silviculture, and/or incompatible land uses (e.g., mining)
- Reduction of habitat suitability due to urban development and fragmentation
- Invasive exotic plants (autumn olive, Japanese honeysuckle, kudzu) and animals (fire ants, feral cats, etc.)
- Scarcity of mature forest characteristics (cavities, snags, hollows) due to harvest rotations
- Change in vegetative structure and species composition due to absence of the natural fire regime
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Impacts from excessive soil disturbances from site preparation activities
- Erosion from mechanized vehicle trails and other activities near biologically significant sites
- White-nose syndrome affecting bats

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of dry hardwood and mixed pine communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Forest Inventory data, consultation with forestry and plant community authorities, and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Amphibians and Reptiles

- **Eastern Tiger Salamander**, **Green Salamander**, and **Southern Red-backed Salamander** –These secretive amphibians remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Eastern Coral Snake**, **Eastern Kingsnake**, **Eastern Speckled Kingsnake**, and **Northern Pinesnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Coal Skink** and **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Bewick's Wren** – Investigate/determine cause(s) of precipitous regional decline. Measure(s): Identification of limiting factors, habitat requirements and/or threats.

- **Cerulean Warbler** – Monitor reproductive success to determine limiting factors for populations. Measure(s): Identification of limiting factors, habitat requirements and/or threats.

- **Golden Eagle** – Determining the full spectrum of migration corridors from Alabama to Canada and back may assist in mitigating for collision conflicts with wind energy plants along the entire Appalachian Mountain chain. Tracking efforts should be accompanied by modeling flight behavior patterns, which may provide a better understanding of direct risks from wind turbines. Measure(s): Data on migration routes and frequent use areas.

Mammals

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Little Brown Myotis**, **Northern Long-eared Bat**, **Indiana Bat**, **Tri-colored Bat**, and **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Long-tailed Weasel**, **American Pygmy Shrew**, **Eastern Spotted Skunk**, **Appalachian Cottontail**, and **Meadow Jumping Mouse** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect and promote large, unfragmented tracts by protecting existing significant tracts. Partner with Forest Legacy, Land Trusts, TNC and others to acquire or purchase conservation easements to protect significant blocks (>1,000 acre parcels) of high quality examples of this habitat. Work with NRCS, USFWS, USFS, AFC, and other granting agencies or institutions to provide incentives and information to landowners for long-term conservation. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g.,

website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid/discourage conversion to other forest types. Partners may include USFS, AFC, AFA, and others. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Whenever possible, make the retention of snags, cavity trees, and mature live trees with exfoliating bark a fundamental principle of silvicultural practices. A potential partner is AFC. Measure(s): Forest management prescriptions that address and implement this action.

- Promote low-intensity controlled burns where ecological, safety, and property protection considerations allow (AFC, AFA, and public/private landowners). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Control exotic plant and animal species (NRCS, USFS, and AFC). Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Encourage, through educational outreach and tax incentives or credits, managers and landowners to favor mature and old-growth hardwood stands (because these are most often in shortest supply on a landscape scale). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid or minimize plowed fire lines when possible; place fire lines where disturbance to sensitive natural groundcover can be avoided or minimized. Restore topography

and natural vegetation where emergency plowed fire lines disrupt natural areas. Partners may include AFC, USFS. Measure(s): Identification and mapping of sensitive habitats that should be avoided; acres restored, enhanced, and/or protected by fee-simple or easements.

- Investigate effects of season and intensity of prescribed fire as a management technique (AFC). Measure(s): Research project(s) that determine effects of prescribed fire on this key habitat.

- Participate in the Alabama Prescribed Fire Council. Measure(s): Number of Council meetings attended; number of partnerships with Council to fund and/or implement conservation projects involving prescribed fire.

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Little Brown Myotis**, **Northern Long-eared Bat**, **Indiana Bat**, **Northern Yellow Bat**, **Tri-colored Bat**, and **Brazilian Free-tailed Bat** – Install protective fencing or gating to control human ingress and protect maternity colony locations (USFWS, USFS); Provide educational materials to the recreational caving community (NSS). Provide artificial roosts (USFWS, USFS,); Develop and adopt Forestry Best Management Practices for Bats, especially retention of snags, large hollow trees, and trees with exfoliating bark (AFC); build away from important hibernacula, maternity colonies, foraging habitat, and migration routes; enforce/strengthen water quality standards (ADEM).

- **Black Bear** – Protect movement corridors, including placing signage and underpasses in areas of greatest use. Potential partners include USFS and ALDOT.

Priority Areas for Conservation Action

- Bald Rock Mountain
- Bankhead/Warrior Mountains
- Bear Creek Ravines
- Bibb County Glades
- Black Warrior River Bluffs
- Cane Creek/Little Mountain
- Chandler Mountain
- Cheaha Mountain
- Chitwood Barrens
- Coon Gulf
- Coosa Valley Prairies
- Cunningham Creek Hills
- Fort Benning
- Fox Mountain
- Franklin/Marion/Jackson Mountains
- Freedom Hills and Adjacent Lands
- Ft. Tombecbe – Jones Bluff
- Huntsville Mountains
- Indian Mountain
- Inland Lake/Blackburn Fork Woods
- Jones Bluff
- Little River Canyon
- Lookout and Pigeon Mountains

- Lower Alabama River Bluffs and Swamps
- Lower Hatchet Creek/Coosa WMA
- Moss Rock
- Noxubee Prairies and Forests
- Oak and Double Oak Mountains
- Oakmulgee District, Talladega National Forest
- Old Bluffport
- Old Cahawba Prairies
- Osborne Hill Barrens
- Oseligee Creek
- Pelham Range Prairie
- Pike County Pocosin Sandhills
- Prairie Grove Glades
- Rock Creek Barrens
- Sandy Creek
- Skirum Bluff
- Skyball Mountain
- Spring Valley
- Srygley Barrens
- Sunny Home Glades
- Talladega Mountains
- Tensaw Delta
- Thorne Glade
- Tilden Carlowville Prairie Complex
- Tom Cat Prairie
- Transition Hills
- Upper Cahaba Watershed
- Upper Gurley Creek
- Weisner Mountain
- Wheeler NWR / Redstone Arsenal

Swamp

Figure 4-12. Cypress-gum swamp, Clarke County

Mark Bailey

Description and Location

Swamps are regularly flooded forested areas dominated to varying degrees and composition by cypress, tupelo, and wetland oaks, often with substantial shrub or herbaceous vegetation. Many swamps develop in stream floodplains, where there is considerable overlap in this habitat and Floodplain Forests, but large peat-bottomed "bay" swamps of the Southeastern Plains are not associated with streams, and do not receive over-bank flooding. Floodplain swamps are often created by beaver dams. Coastal tidal-influenced swamps may be flooded twice daily. "Baygall" swamps are mostly evergreen forests generally found at the base of slopes or other habitats where seepage flow is concentrated. Swamps are prone to long-duration standing water, and are normally protected from fire except during extreme droughty periods.

This habitat encompasses three NatureServe ecological systems (Table 4-11). Representative high-quality sites include the Mobile-Tensaw river delta (Mobile, Baldwin counties), Sipsey River Tract Tuscaloosa County), Wheeler NWR (Morgan County), and Conecuh National Forest (Covington, Escambia counties).

Table 4-11. Ecological systems encompassed by Swamp

	Ecoregion					
	IP	SA	RV	P	SP	SCP
East Gulf Coastal Plain Tidal Wooded Swamp						X
East Gulf Coastal Plain Nonriverine Basin Swamp						X
Southern Coastal Plain Seepage Swamp and Baygall					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

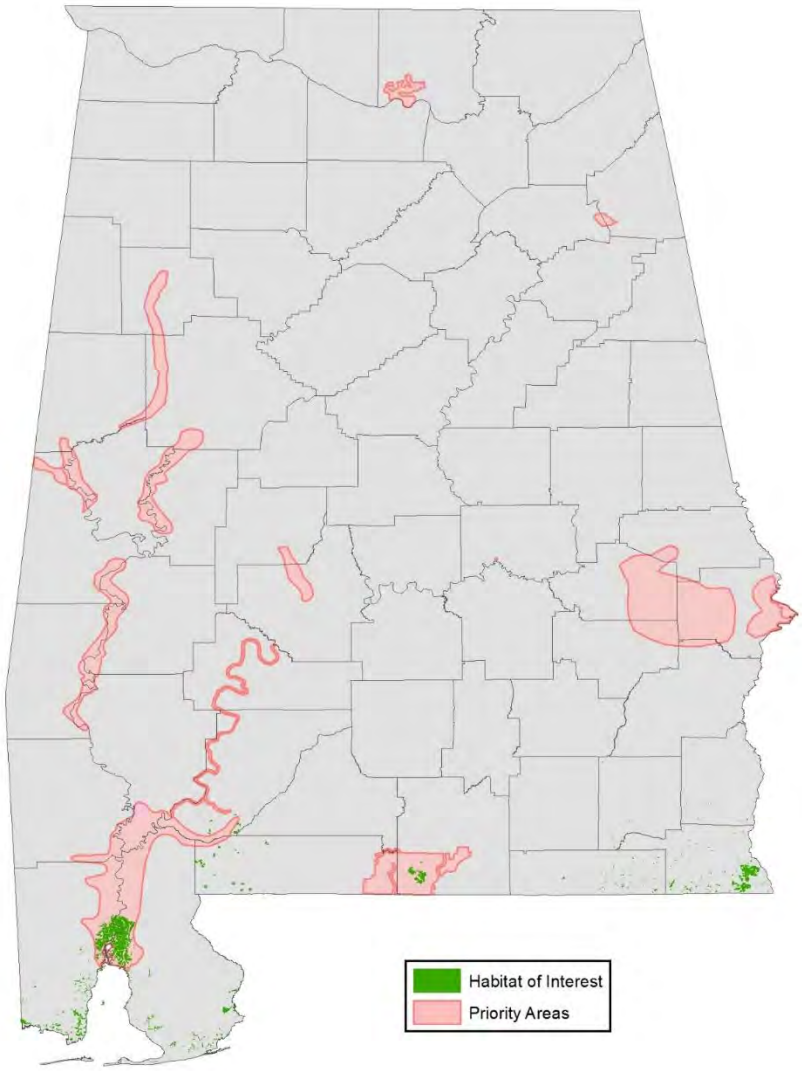


Figure 4-13. Mapped Swamp Habitat and Known Priority Areas (some are lacking GIS data)

Condition

Much of this habitat has been drained for agriculture or silviculture and inundated by reservoirs. Extensive erosion of uplands, caused by poor agricultural practices dating back to colonial times, transported large amounts of sediment into floodplains and associated swamps.

This habitat supports 27 SGCN (Table 4-12).

Table 4-12. SGCN, Swamp

Scientific Name	Common Name	SGCN Rank
Cravfishes – 6		
Orconectes lancifer	Shrimp Crayfish	P2
Procambarus hayi	Straightedge Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2
Procambarus marthae	Crisscross Crayfish	P2
Procambarus okaloosae	Okaloosa Crayfish	P2
Procambarus paeninsulanus	Peninsula Crayfish	P2
Amphibians – 3		
Desmognathus auriculatus	Southern Dusky Salamander	P1
Lithobates heckscheri	River Frog	P1
Amphiuma pholeter	One-Toed Amphiuma	P2
Reptiles – 4		
Drymarchon couperi	Eastern Indigo Snake	P1
Farancia erytrogramma erytrogramma	Rainbow Snake	P1
Lampropeltis getula	Eastern Kingsnake	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds – 5		
Ammodramus henslowii	Henslow's Sparrow	P1
Euphagus carolinus	Rusty Blackbird	P2
Elanoides forficatus	Swallow-tailed Kite	P2
Anas rubripes	American Black Duck	P2
Mycteria americana	Wood Stork	P2
Mammals – 9		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis austroriparius	Southeastern Myotis	P1
Ursus americanus	Black Bear	P1
Lasiurus intermedius	Northern Yellow Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Perimyotis subflavus	Tri-colored Bat	P2
Sylvilagus palustris	Marsh Rabbit	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Loss and fragmentation of higher quality habitats from impoundment and conversion to agriculture and/or intensive silviculture
- Change in vegetative structure and species composition due to alteration of the natural flood regime due to ditching and draining
- Invasive exotic plants (e.g., Chinese tallow tree, Japanese climbing fern, privet)
- Scarcity of mature forest characteristics (cavities, snags, hollows) due to harvest rotations
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.
- Insufficient conservation-related educational outreach about biologically significant areas
- White-nose syndrome affecting bats

Priority Research/Survey/Monitoring Needs

- Generally, better maps of the distribution of intact swamp communities are needed. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.
- **All SGCN Crayfishes** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.
- **Southern Dusky Salamander** – May be extirpated. Intensive surveys of large river floodplains (Mobile, Tensaw, Conecuh, Yellow, Pea, Choctawhatchee, Chipola, and Chattahoochee rivers) and swampy creeks (Escatawpa, Mobile Bay, and Perdido basins) near the Florida border should be conducted to determine whether this species still exists in Alabama and, if so, what its current distribution is. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.
- **River Frog** and **One-Toed Amphiuma** – Distributions and statuses very poorly known. A survey of likely swamp and baygall habitats should be conducted. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5-10-year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Swallow-tailed Kite** – Systematic pre-migratory roost surveys should be performed following recommendations of the Swallow-tailed Kite Conservation Alliance. *Updated roost survey recommendations to be released by the Alliance in late 2015*. See also Zimmerman 2010 for additional recommendations. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Rusty Blackbird** – Perform late winter surveys in February and March (when males are vocal) to determine areas of most consistent foraging use. Participate in multi-year Rusty Blackbird Spring Migration Blitz; a rangewide-coordinated citizen-science project. See Table 9.2 in Greenberg et al. 2011 for detailed actions/needs. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

- **Long-tailed Weasel**, **Marsh Rabbit**, **Meadow Jumping Mouse** – Conduct surveys to better determine life histories, population trends, distributions, abundances, and habitat uses. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Tri-colored Bat**, **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow,

and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts. Partner with NAWCA, Forest Legacy, Land Trusts, TNC and others to protect significant blocks of high-quality examples of this habitat. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Provide incentives and information to landowners for long-term conservation. Potential partners may include NRCS, USFWS and other granting agencies or institutions. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid/discourage conversion to agriculture or other forest types, and encourage restoration of altered habitats. Potential partners may include NRCS, USFS, AFC, AFA. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Control exotic plant and animal species. Potential partners may include Alabama Invasive Pest Plant Council (ALIPPC) NRCS, USFS, AFC. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually-identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Encourage managers and landowners to favor mature and old-growth stands. A potential partner is AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Whenever possible, make the retention of snags, cavity trees, and mature live trees with exfoliating bark a fundamental principle of silvicultural practices. A potential partner is AFC. Measure(s): Forest management prescriptions that address and implement this action.

- Investigate effects of infrequent prescribed fire as a management technique. A potential partner is AFC. Measure(s): Research project(s) that determine effects of prescribed fire on this key habitat.

- **Rusty Blackbird, Wood Stork** – Adjust flood regimes of wooded wetlands to create foraging habitat.
- **American Black Duck** – Conserve and restore forested and palustrine wetland habitats, especially in the Tennessee Valley. Continue restrictive harvest regulations in Alabama. Because Black Ducks and Mallards readily hybridize, releases of pen-raised Mallards in Alabama, especially in key wintering and the primary breeding areas (e.g., the Tennessee Valley) should be discouraged, if not prohibited.

Priority Areas for Conservation Action

- Ballplay Swamp
- Conecuh National Forest
- East Alabama Fall Line Hills
- Fort Benning
- Ft. Toulouse – Jackson Park
- Lower Alabama River Bluffs and Swamps
- Lower Black Warrior Swamps
- Lower Cahaba Bluffs and Swamps
- Lower Tombigbee River
- Noxubee Prairies and Forests
- Sipsey River
- Tensaw Delta
- Wheeler NWR / Redstone Arsenal

Wet Pine Savanna and Flatwoods

Mark Bailey

Figure 4-14. Longleaf-slash pine flatwoods, Covington County

Description and Location

These open pine woodlands occupy sandy flatlands principally in the Gulf Coast Flatwoods of the Southeastern Plains. Pine flatwoods also may be found in portions of the Southern Pine Plains and Hills and the Dougherty Plain subdivisions, where they may be a component of a landscape matrix of several other habitats including xeric pine and floodplain forest. Even though this habitat is subject to seasonally high water tables, fire frequency is high. Overstory vegetation is characterized by longleaf pine and to a lesser degree by slash pine. The understory ranges from dense shrubs to open and herbaceous-dominated, and is heavily influenced by fire history. This habitat shares many wildlife species with dry longleaf pine forest, but the flatwoods salamander is found only in this habitat.

This habitat encompasses three NatureServe ecological systems (Table 4-13). Representative high-quality sites include Grand Bay (Mobile County), Splinter Hill Bog (Baldwin County) and Conecuh National Forest (Escambia and Covington counties).

Table 4-13. Ecological systems encompassed by Wet Pine Savanna and Flatwoods

	Ecoregion					
	IP	SA	RV	P	SP	SCP
East Gulf Coastal Plain Near-Coast Pine Flatwoods					X	X
East Gulf Coastal Plain Treeless Savanna and Wet Prairie						X
South-Central Interior/Upper Coastal Plain Wet Flatwoods					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

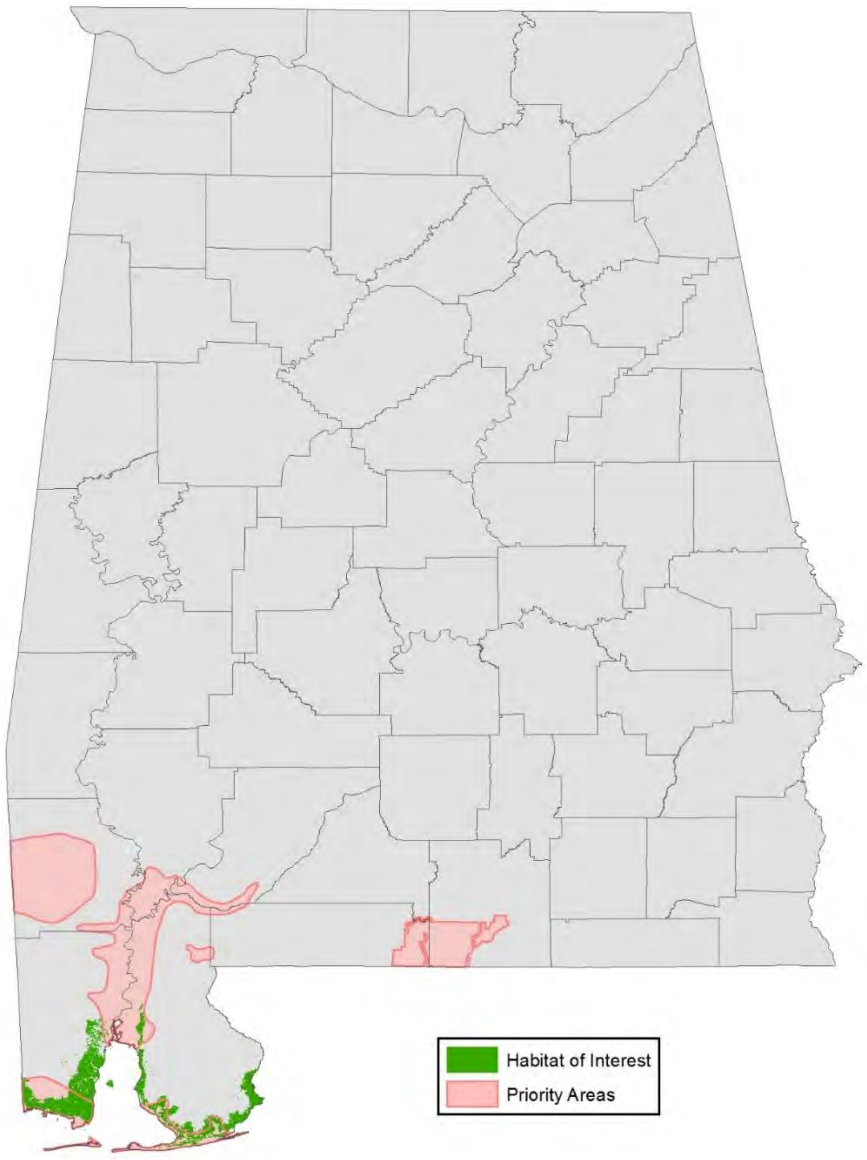


Figure 4-15. Mapped Wet Pine Savanna and Flatwoods Habitat and Known Priority Areas (some are lacking GIS data)

Condition

Much of this habitat has been lost to ditching (draining), development, agriculture, conversion to pine plantations, and fire suppression. This habitat is a component of a broader longleaf pine forest and savanna ecosystem, considered one of the most endangered ecosystems in the country today (Noss and Peters 1995). On some frequently burned federal lands (especially National Forests), the habitat is in good condition. Habitat is in fair to poor condition on other public land and most private and industry lands. Without the appropriate fire regime, canopy closure will increase along with shrub dominance, and grasses, forbs, and other finer-fuel components will decline, further altering the fire regime dynamics. Prescribed growing-season fire needs to increase dramatically in this habitat type.

Loss of quantity and quality of this habitat and the highly fragmented nature of remaining stands has resulted in the corresponding decline of a large number of terrestrial vertebrates that are found either primarily or exclusively in longleaf-dominated, fire-maintained habitats.

This habitat supports 27 SGCN (Table 4-14).

Table 4-14. SGCN, Wet Pine Savanna and Flatwoods

Scientific Name	Common Name	SGCN Rank
Amphibians – 1		
Ambystoma bishopi	Reticulated Flatwoods Salamander	P1
Reptiles – 8		
Drymarchon couperi	Eastern Indigo Snake	P1
Micrurus fulvius	Eastern Coral Snake	P1
Ophisaurus mimicus	Mimic Glass Lizard	P1
Pituophis melanoleucus lodingi	Black Pinesnake	P1
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	P2
Lampropeltis getula	Eastern Kingsnake	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Pituophis melanoleucus mugitus	Florida Pinesnake	P2
Birds – 10		
Ammodramus henslowii	Henslow's Sparrow	P1
Picoides borealis	Red-cockaded Woodpecker	P1
Euphagus carolinus	Rusty Blackbird	P2
Asio flammeus	Short-eared Owl	P2
Falco sparverius paulus	Southeastern American Kestrel	P2
Elanoides forficatus	Swallow-tailed Kite	P2
Peucaea aestivalis	Bachman's Sparrow	P2
Laterallus jamaicensis	Black Rail	P2
Lanius ludovicianus	Loggerhead Shrike	P2
Coturnicops noveboracensis	Yellow Rail	P2

Scientific Name	Common Name	SGCN Rank
Mammals – 8		
Myotis austroriparius	Southeastern Myotis	P1
Zapus hudsonius	Meadow Jumping Mouse	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Lasiurus intermedius	Northern Yellow Bat	P2
Perimyotis subflavus	Tri-colored Bat	P2
Sylvilagus palustris	Marsh Rabbit	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Fire suppression and lack of fire
- Altered hydrology due to drainage ditches, raised roadbeds, fire plow lines, etc.
- Conversion to other pine species
- Intensification of forestry practices (site preparation, heavy stocking densities) leading to closed canopy forests with little herbaceous groundcover
- Urban development and habitat fragmentation
- Lack of old growth characteristics (canopy gaps, red-heart fungus, cavities, snags)
- Habitat loss affecting species that rely on understory management and open pine ecosystems
- Exotic species (cogongrass; fire ants are occasionally present)
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.
- Erosion from mechanized vehicle trails and other activities near sensitive sites
- Insufficient conservation-related educational outreach about sensitive areas and species

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of wet pine savanna and flatwoods communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Forest Inventory data, consultation with forestry and plant community authorities, and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Amphibians and Reptiles

- **Reticulated Flatwoods Salamander** – Possibly extirpated. Intensively survey to determine whether this species still occurs in Alabama. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Mimic Glass Lizard** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Since only two individuals have been seen in the state in the last 25 years, both from one location within Conecuh National Forest, further study of this site should be undertaken to determine local population size and obtain natural history information. Measure(s): Natural history data, information to expand GIS coverages, information to aid land managers.

- **Eastern Indigo Snake** – Maintain current reintroduction effort at Conecuh National Forest, develop a list of sites where ADCNR intends to establish and maintain viable populations. Evaluate Perdido River Longleaf Hills Tract, Fred T. Stimpson Wildlife Sanctuary, and Grand Bay Savanna as additional potential reintroduction sites. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Eastern Coral Snake**, **Black Pinesnake**, **Eastern Diamond-backed Rattlesnake**, **Eastern Kingsnake**, **Eastern Speckled Kingsnake**, **Florida Pinesnake** – These large terrestrial snakes appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Red-cockaded Woodpecker, Henslow's Sparrow**, **Southeastern American Kestrel**, **Bachman's Sparrow**, and **Loggerhead Shrike** – Implement inventory and monitoring programs in this habitat on key public and private lands. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Short-eared Owl** – Survey this habitat, determining degree of importance as habitat. Measure(s): Determination of habitat use, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.
- **Swallow-tailed Kite** – Systematic pre-migratory roost surveys should be performed following recommendations of the Swallow-tailed Kite Conservation Alliance. *Updated*

roost survey recommendations to be released by the Alliance in late 2015. See also Zimmerman 2010 for additional recommendations. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Rusty Blackbird** – Perform late winter surveys in February and March (when males are vocal) to determine areas of most consistent foraging use. Participate in multi-year Rusty Blackbird Spring Migration Blitz; a rangewide-coordinated citizen-science project. See Table 9.2 in Greenberg et al. 2011 for detailed actions/needs. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Black Rail** – Survey potential marsh habitats. Measure(s): data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Yellow Rail** – Perform stratified, coast-wide surveys in habitats thought to be used to determine presence, particularly on public lands. Once identified, standardized surveys (stratified by habitat type) should be performed to determine population densities, specifically those under different management regimes (e.g., prescribed burn frequencies). Once individuals can be reliably captured, radio-telemetry studies should be initiated at stratified sites to determine microhabitat usage, home range sizes, spatial movements, and estimate winter survivorship. These same techniques should also be performed at inland historic sites where possible. Finally, surveys of managed wildlife openings during migration may help better understand their importance as temporary stopover sites in Alabama and Mississippi. Once these aspects are better understood, stewardship plans should be developed to help maintain and expand required habitat features at known sites, and enhance new areas where restoration potential exists. Measure(s): Data to shed light on distribution, abundance, and life history in Alabama, identify important wintering areas and migration routes, expand GIS coverages, and generate information to aid land managers.

Mammals

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Southeastern Myotis**, **Brazilian Free-tailed Bat**, **Tri-colored Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two

years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Meadow Jumping Mouse**, **Eastern Spotted Skunk**, **Long-tailed Weasel** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Marsh Rabbit** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts of unfragmented pine savanna and flatwoods. A high priority should be maintaining the largest and most threatened tracts in Mobile and Baldwin counties where development and sprawl is encroaching. Work with The Longleaf Alliance, USFWS, TNC and other land conservation partners to identify, conserve and restore such tracts. Tracts containing isolated wetlands (i.e., ponds, bogs) and/or priority species should receive special priority for protection. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Restore existing savanna and flatwoods on state-owned lands through the filling of drainage ditches, establishment of native groundcovers, planting longleaf pine, growing old pines, leaving natural stump holes and downed trees, removing cogongrass, and prescribed burning in May-July. Measure(s): Acres restored and/or enhanced.

- Control midstory development and encourage understory development through prescribed burning. Acceptance of controlled burning can be enhanced through public education, programs to "fire-safe" properties, and cost-share programs to install fire lines and conduct controlled burns. Measure(s): Acres burned annually; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of properties made "fire-safe" annually; and number of cost-share programs to install fire lines and conduct controlled burns.

- Coordinate and integrate existing initiatives and programs such as the Northern Bobwhite Conservation Initiative (NBCI) to influence habitat for birds and other wildlife by working with ADCNR, USFWS, and NRCS**.** Measure(s): Acres of habitat enrolled in NBCI and other programs; and number of joint projects with ADCNR, USFWS and NRCS.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- **Red-cockaded Woodpecker** – Publicize and encourage landowner participation in Alabama's statewide Red-cockaded Woodpecker Safe Harbor Plan by working with USFWS, USFS, Longleaf Alliance and AFC. Continue to work cooperatively with USFWS, USFS, and private landowners on recovery efforts including population augmentation (translocation) to appropriate recipient sites. Opportunities for recovery on state forests, wildlife management areas, military installations, and large private holdings should be identified and implemented to increase Alabama's role in the recovery of these species. Measure(s): Number of landowners participating in Red-cockaded Woodpecker Safe Harbor Plan; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of successfully translocated individuals; number of populatons and active Red-cockaded Woodpecker clusters on private lands; list of potential additional recovery sites; development of strategy for implementation.

- Avoid or minimize plowed fire lines when possible; place fire lines where disturbance to sensitive natural groundcover can be avoided or minimized. Restore topography and natural vegetation where emergency plowed fire lines disrupt natural areas. Partners may include AFC and USFS. Measure(s): Acres restored and/or enhanced; and identification and mapping of sensitive habitats that should be avoided.

- Participate in the Alabama Prescribed Fire Council. Measure(s): Number of Council meetings attended; number of partnerships with Council to fund and/or implement conservation projects involving prescribed fire.

- Encourage thinning of overstocked pine forests by working with AFC. Measure(s): Acres restored or enhanced by thinning of overstocked pines.

Priority Areas for Conservation Action

- Conecuh National Forest
- Grand Bay Savanna
- Gulf Islands
- MS-AL Stateline Bogs
- Splinter Hill Bog
- Tensaw Delta

Bogs and Seepage Communities

Figure 4-16. Splinter Hill Bog, Baldwin County

Eric Soehren

Description and Location

Several related community types are covered by this category. Seepage bogs, non-boggy seeps, and streamhead seeps occur in the Piedmont and Southeastern Plains. In the Southwestern Appalachians and Ridge and Valley, patches of seepage forests occur on streamhead swales or on broad sandstone ridges where soils are sandy and saturated due to a combination of perched water table and seepage flow. These range in condition from open woodlands to forests. Some may lack a canopy and are dominated by shrubs or herbs. Fire-maintained herbaceous seepage bogs, often containing a variety of carnivorous plants, occur in the Southern Coastal Plain and lower portions of the Southeastern Plains. These are generally found on gentle, almost imperceptible slopes maintained by constant seepage zones and/or perched water tables. Examples are typically grass and sedge dominated, and are often species-rich. Shrubs frequently encroach in the absence of fire. In portions of the Fall Line Hills of the Southeastern Plains, wet, shrub-dominated seepage communities occur in small patches on steep slopes within a matrix of longleaf pine-dominated vegetation. Wetland conditions are maintained by seepage flow from adjacent uplands. Examples of this habitat can vary between densely shrubby and fairly open and herbaceous, depending on frequency of fire and length of time since previous fires.

These are all readily distinguished from adjacent upland habitats by the presence of wetland flora and soils, as well as seepage. They may be somewhat less clearly distinguished from adjacent floodplain habitats, but they are saturated without having standing water as floodplain pools do. These differences are reflected in the vegetation.

This habitat encompasses four NatureServe ecological systems (Table 4-15). Representative high-quality sites include Conecuh National Forest (Covington County), Roberta Case Pine Hills Preserve (Autauga County), Grand Bay Savanna Nature Preserve (Mobile County)

Table 4-15. Ecological systems encompassed by Bogs and Seepage Communities

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Southern Piedmont Seepage Wetland				X		
Cumberland Seepage Forest		X	X			
East Gulf Coastal Plain Herbaceous Seepage Bog						X
East Gulf Coastal Plain Interior Shrub Bog					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

Henslow's Sparrow uses grassy bogs and other similar habitats in winter. The Pine Barrens Treefrog occurs exclusively in this habitat. The Seepage Salamander is restricted to streamhead seeps and open marshy habitats in the Fall Line Hills and Piedmont. Seepage habitats support two federally listed insects not associated with other habitat types, Mitchell's Satyr and Hine's Emerald Dragonfly. Several SGCN burrowing crayfishes are found in these habitats.

Condition

Many of Alabama's bog and seepage habitats have been degraded or lost to 1) drainage for agriculture and/or silviculture and 2) succession to other forest types resulting from fire suppression. Many have been converted into ponds and others have been damaged by hogs and cattle. Of the original Gulf Coast pitcher plant habitats of the southeastern United States, less than three percent remained as degraded habitat, and less than one percent remained as pristine habitat by the latter part of the twentieth century (Folkerts 1982). Remnant bogs on private and public lands are often in need of prescribed burning, and many may require mechanical removal of established woody species such as titi and red maple.

This habitat supports 23 SGCN (Table 4-16).

Table 4-16. SGCN, Bogs and Seepage Communities

Scientific Name	Common Name	SGCN Rank
Insects - 2		
Neonympha mitchellii	Mitchell's Satyr	P1
Somatochlora hineana	Hine's Emerald Dragonfly	P1
Crayfishes - 8		
Cambarellus diminutus	Least Crayfish	P1
Fallicambarus burrisi	Burrowing Bog Crayfish	P1
Fallicambarus byersi	Lavender Burrowing Crayfish	P2
Fallicambarus danielae	Speckled Burrowing Crayfish	P2
Procambarus evermanni	Panhandle Crayfish	P2
Procambarus hayi	Straightedge Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2
Procambarus planirostris	Flatnose Crayfish	P2
Amphibians - 2		
Hyla andersonii	Pine Barrens Treefrog	P1
Desmognathus aeneus	Seepage Salamander	P2
Reptiles - 3		
Ophisaurus mimicus	Mimic Glass Lizard	P1
Plestiodon anthracinus	Coal Skink	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds - 5		
Ammodramus henslowii	Henslow's Sparrow	P1
Lanius ludovicianus	Loggerhead Shrike	P2
Asio flammeus	Short-eared Owl	P2
Coturnicops noveboracensis	Yellow Rail	P2
Ixobrychus exilis	Least Bittern	P2
Mammals - 3		
Lasiurus intermedius	Northern Yellow Bat	P2
Sylvilagus palustris	Marsh Rabbit	P2
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Loss of habitat through draining and fire suppression
- Insufficient adjacent upland forested habitat left intact following timber harvest

- Lack of information on status, distribution, and classification of this habitat type
- Exotics: tallow tree, cogongrass
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.
- Insufficient conservation-related education about biologically significant areas and species
- Change in vegetative structure and species composition due to absence of the natural fire regime
- Impacts from excessive soil disturbances from site preparation activities (i.e., fire plow lines)
- Erosion from mechanized vehicle trails and other activities near biologically significant sites

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact bog and seepage communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Forest Inventory data, consultation with forestry and plant community authorities, and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Invertebrates

- **Mitchell's Satyr**, **Hine's Emerald Dragonfly** – Conduct additional surveys to delineate/expand known distribution of Mitchell's Satyr (Oakmulgee District, Talladega NF). Survey seeps and associated spring runs in northeast Alabama to determine whether Hine's Emerald Dragonfly still occurs in the state (occurrence is based on a single record).
- **All SGCN Crayfishes** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Amphibians and Reptiles

- **Pine Barrens Treefrog** – Continue regular monitoring of the Conecuh NF population; determine status on private lands in Geneva and Covington counties through calling male surveys; conduct studies on non-breeding ecology to better determine management needs. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Seepage Salamander** – Locate and map seepage habitats where this species occurs. Monitor known populations. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Mimic Glass Lizard** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Since only two individuals have been seen in the state in the last 25 years, both from one location within Conecuh National Forest, further study of this site should be undertaken to determine local population size and obtain natural history information. Measure(s): Natural history data, information to expand GIS coverages, information to aid land managers.

- **Coal Skink**, **Southeastern Five-lined Skink** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Henslow's Sparrow** and **Loggerhead Shrike** – Implement inventory and monitoring programs in this habitat on key public and private lands. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Short-eared Owl** – Survey to determine the degree of this habitat's importance as wintering habitat. Measure(s): Determination of habitat use, data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Yellow Rail** – Perform stratified, coast-wide surveys in habitats thought to be used to determine presence, particularly on public lands. Once identified, standardized surveys (stratified by habitat type) should be performed to determine population densities, specifically those under different management regimes (e.g., prescribed burn frequencies). Once individuals can be reliably captured, radio-telemetry studies should be initiated at stratified sites to determine microhabitat usage, home range sizes, spatial movements, and estimate winter survivorship. These same techniques should also be performed at inland historic sites where possible. Finally, surveys of managed wildlife openings during migration may help better understand their importance as temporary stopover sites in Alabama and Mississippi. Once these aspects are better understood,

stewardship plans should be developed to help maintain and expand required habitat features at known sites, and enhance new areas where restoration potential exists. Measure(s): Data to shed light on distribution, abundance, and life history in Alabama, identify important wintering areas and migration routes, expand GIS coverages, and generate information to aid land managers.

- **Least Bittern** – Conduct habitat studies of wetland vegetation, water levels, water quality, and minimum wetland needed during nesting, migration, and over-wintering seasons. Studies should examine movements and patterns of habitat use, causes and rates of juvenile and adult mortality, sources of nest failure, renesting ability, juvenile dispersal patterns, and diet. Major stopover sites for overwintering and migration need to be identified. Measure(s): Data to shed light on life history in Alabama, identify important areas, expand GIS coverages, and generate information to aid land managers.

Mammals

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile Counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Marsh Rabbit** and **Meadow Jumping Mouse** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts. Partners may include Forest Legacy, Forever Wild, TNC, and land trusts. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Avoid/discourage conversion to other forest types. Partners may include USFS, AFC, AFA. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Educate landowners and managers of the significance and sensitivity of bog habitats, and discourage their use as livestock areas and conversion to farm ponds. Partners may include NRCS, USFS, AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); and number of bogs restored by removal of livestock or farm ponds.

- Avoid emergency plowed fire lines through bogs when possible; place fire lines where disturbance to sensitive natural groundcover can be avoided or minimized. Restore topography and natural vegetation where emergency plowed fire lines disrupt natural areas. Partners may include AFC and USFS. Measure(s): Identification and mapping of sensitive habitats that should be avoided; acres restored, enhanced, and/or protected by fee-simple or easements.

- Participate in the Alabama Prescribed Fire Council**.** Measure(s): Number of Council meetings attended; number of partnerships with Council to fund and/or implement conservation projects involving prescribed fire.

- **Least Crayfish**, **Burrowing Bog Crayfish**, **Lavender Burrowing Crayfish**, **Speckled Burrowing Crayfish**, **Panhandle Crayfish**, **Straightedge Crayfish**, **Smoothnose Crayfish**, and **Flatnose Crayfish** – These species would benefit from the protection and maintenance of the natural hydrology and vegetation structure of coastal plain wetlands and bogs. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. The plugging of abandoned drainage ditches could also help to restore natural hydrology. Measure(s): Acres of wetlands protected, restored, and/or prescribe burned.

Priority Areas for Conservation Action

- Autauga Sandhills
- Bankhead/Warrior Mountains
- Bear Creek Ravines
- Bibb County Glades
- Boaz Pond
- Bryans Creek/Hugh's Bog
- Centre Bog
- Chitwood Barrens

- Conecuh National Forest
- Dillard Bog
- Dry Creek Barrens
- Dugger/Talladega Mountains
- East Alabama Fall Line Hills
- Fort Benning
- Franklin/Marion/Jackson Mountains
- Grand Bay Savanna
- Green's Pitcher Plant Bog-Yellow Leaf Creek
- Gulf Islands
- Huntsville Mountains
- Jock Creek
- Little River Canyon
- Longleaf Bog
- Lookout and Pigeon Mountains
- Lower Alabama River Bluffs and Swamps
- MS-AL Stateline Bogs
- Oakmulgee District, Talladega National Forest
- Splinter Hill Bog
- Spring Creek
- Talladega Mountains
- Tensaw Delta

Caves and Mines

Alan Cressler

Figure 4-17. Jess Elliott Cave, Jackson County

Description and Location

Caves are unique and sensitive environments that harbor rare animal life, as well as fragile mineral formations and valuable ground water resources. Caves in our region are generally created by water dissolving away limestone over millenia. Caves depend on outside sources of detritus (plant material) and bat guano for energy flow and are threatened by changes in the quantity and quality of water flowing from terrestrial sources (Kingsbury and Gibson 2002).

Over 6,000 caves have been documented in Alabama, primarily in the Southwestern Appalachians and Interior Plateau, but caves also occur in the Ridge and Valley and Southeastern Plains (Figure 4-18). Caves are of tremendous importance to many mammals, amphibians, fishes, crustaceans, insects, arachnids, and other invertebrates. Hundreds of animals--mostly invertebrates--have evolved to survive in these dark, damp, stable habitats, and many species are known from only one or two caves. Jackson County alone harbors 24 obligate cave species that exist no place else (NatureServe 2004b). Studies by Dr. David Culver and others at the Karst Waters Institute have identified northeast Alabama as one of the major "hotspots" for cave animal diversity in the United States.

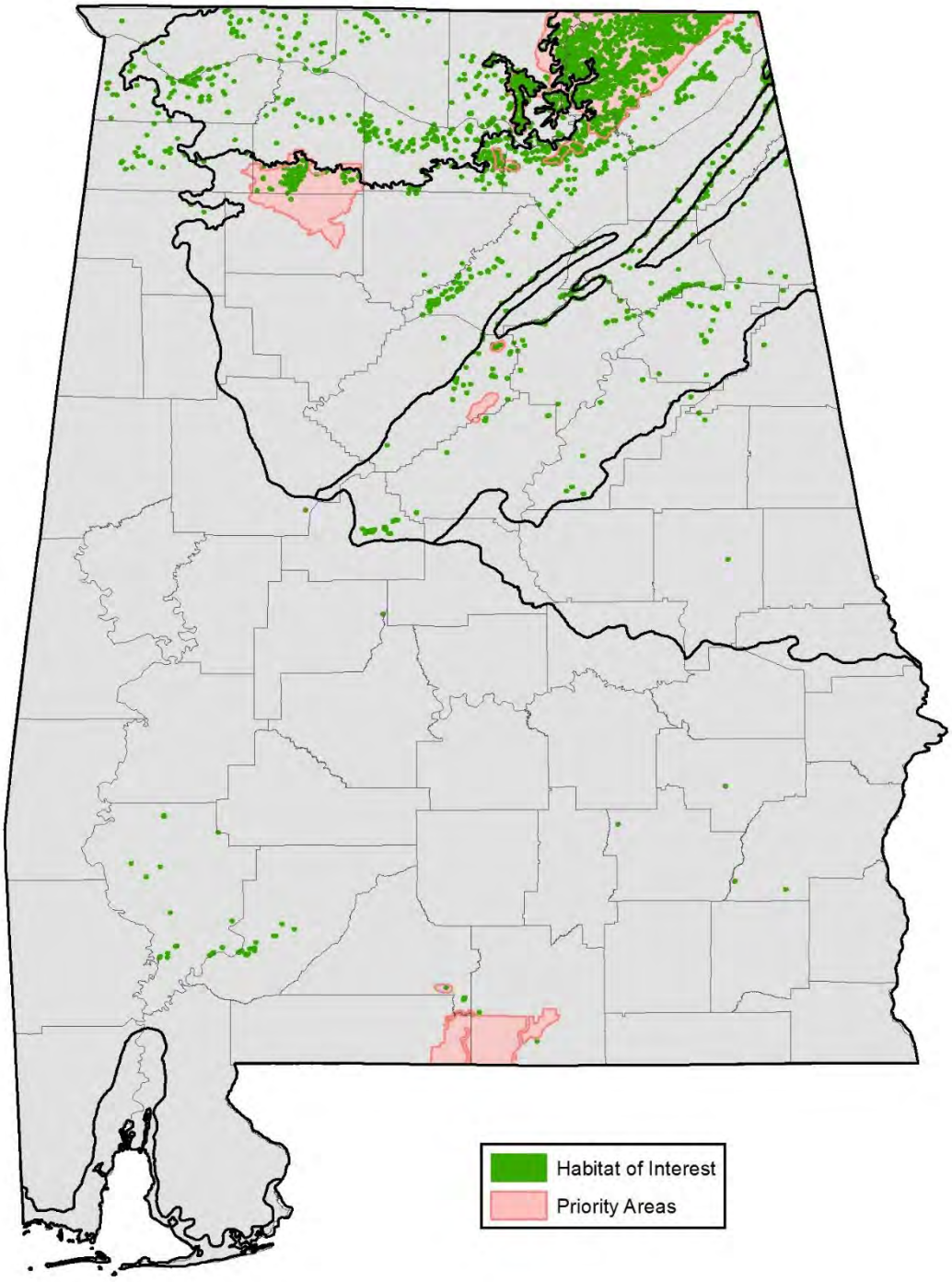


Figure 4-18. Mapped Cave Habitat and Known Priority Areas

Underground crevices, rock piles, pools, and streams provide critical habitat to invertebrates, salamanders, and fishes, some with extremely limited dispersal capabilities. The "twilight zones" near cave entrances are also utilized by a number of less specialized species. Seasonal bat and reptile hibernation is common. Transient and seasonal cave-related amphibians and reptiles require healthy dispersal and foraging habitat outside the cave itself.

Many species, such as blind fishes and salamanders, are vulnerable to extinction because of narrow physiological tolerances, long-delayed reproduction, and low reproductive outputs, traits that may have been selected because of their historically stable cave environments (White *et al*. 1995).

Abandoned mines and tunnels are not inhabited by most cave-dwelling species, but may provide "cave-like" conditions that are exploited by more mobile wildlife such as bats and some amphibians and reptiles.

Representative high-quality cave sites include Sauta Cave NWR (Jackson County), Key Cave NWR (Lauderdale County), Newsome Sinks (Morgan County).

This habitat supports 20 SGCN (Table 4-17).

Table 4-17. SGCN, Caves and Mines

Scientific Name	Common Name	SGCN Rank
Crayfish - 7		
Cambarus laconensis	Lacon Exit Cave Crayfish	P1
Cambarus pecki	Phantom Cave Crayfish	P1
Cambarus veitchorum	White Spring Cave Crayfish	P1
Orconectes sheltae	Shelta Cave Crayfish	P1
Cambarus hamulatus	Prickly Cave Crayfish	P2
Cambarus jonesi	Alabama Cave Crayfish	P2
Cambarus speleocoopi	Sweet Home Alabama Cave Crayfish	P2
Cave Shrimp - 1		
Palaemonias alabamae	Alabama Cave Shrimp	P1
Fishes - 1		
Speoplatyrhinus poulsoni	Alabama Cavefish	P1
Amphibians - 1		
Gyrinophilus palleucus	Tennessee Cave Salamander	P2
Mammals - 10		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis austroriparius	Southeastern Myotis	P1
Myotis grisescens	Gray Myotis	P1
Myotis leibii	Eastern Small-footed Myotis	P1
Myotis lucifugus	Little Brown Myotis	P1

Scientific Name	Common Name	SGCN Rank
Myotis septentrionalis	Northern Long-eared Bat	P1
Myotis sodalis	Indiana Bat	P1
Neotoma magister	Allegheny Woodrat	P2
Perimyotis subflavus	Tri-colored Bat	P2
Tadarida brasiliensis	Brazilian Free-tailed Bat	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Condition

The health of these underground habitats is heavily influenced by surface activities. Airflow, microclimate, water quality, organic influx, and hydrology can all be impacted by land management within the recharge area. Disturbances by human visitors can also influence the quality of subterranean systems. Survival of cave ecosystems depends on successful management of terrestrial systems and water quality.

Several caves have been acquired and/or gated for protection of federally listed bats. Sauta Cave, the most important summer cave known for gray bats, has been acquired by USFWS and a gate has been placed across the entrance. Fern Cave, the largest known gray bat hibernaculum, has also been purchased by USFWS and is being managed for protection of the bats. A list of priority gray bat caves is provided in the Gray Bat Recovery Plan (USFWS 1982).

Problems Affecting Species/Habitat

- White-nose syndrome affecting bats
- Water quality degradation in watershed
- Human disturbance to bat hibernacula and maternity roosts
- Interruption of normal air flow/temperature regimes
- Habitat loss due to development and conversion from natural habitats to intensively managed plantations and/or agriculture
- Lack of data on status, distribution, abundance, ecology, life history, threats and habitat requirements for this natural community and SGCN
- Insufficient conservation-related education about biologically significant areas and species
- Improper use of pesticides near streams and wetlands

Priority Research/Survey/Monitoring Needs

Invertebrates

- **Alabama Cave Shrimp** – Continued monitoring is needed at the known occurrences, including water availability and quality. Measure(s): Data to fill information gaps to determine the status and condition of cave shrimp, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.
- **All SGCN Crayfishes** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Specific needs include:

    - **Phantom Cave Crayfish** – Key Cave, one of the three caves supporting known populations, is within Key Cave National Wildlife Refuge. The water quality and hydrology of this cave remains subject to the effects of agricultural, urban, and industrial development (Kuhajda 2004). Little is known about potential threats to populations in McKinney Pit and Cave Spring caves. Known populations should be monitored to assess long-term population trends and identify habitat degradation.

    - **White Spring Cave Crayfish** – An intensive long- term survey of White Spring Cave and nearby caves is necessary to more accurately determine the status of this species.

    - **Shelta Cave Crayfish** – Entrances to Shelta Cave, the only location documented for this species, are gated and access is strictly controlled by the National Speleological Society. Nevertheless, this cave and its recharge area are in an urbanized region of Huntsville and potential threats due to groundwater contamination remain. Groundwater quality and supply to Shelta Cave should be monitored and periodically assessed for potential threats to cave biota. An intensive long-term survey of Shelta Cave and nearby caves should be initiated to more accurately determine the status of this species.

    - **Alabama Cave Crayfish** – Populations in cave systems with recharge areas potentiallyaffected by ongoing and future urbanization and suburbanization should be monitored to assess long-term trends and the potential for groundwater contamination or changes in supply.

    Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Fishes

- **Alabama Cavefish** – Continued monitoring is needed at Key Cave to address gaps in knowledge and to assess any negative impacts from urban developments within the recharge area. Any unsurveyed caves in the vicinity of Key Cave should be examined for additional populations. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Amphibians

- **Tennessee Cave Salamander** populations should be monitored every three to five years. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

Mammals

- **Rafinesque's Big-eared Bat**, **Southeastern Myotis**, **Gray Myotis**, **Eastern Small-footed Myotis**, **Little Brown Myotis**, **Northern Long-eared Bat**, **Indiana Bat**, **Eastern Pipistrelle**, and **Brazilian Free-tailed Bat** – Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome.

- **Allegheny Woodrat** – Survey cave habitats for this species to better determine status and distribution in Alabama. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Acquire and/or protect, through proper gating and restricted usage, high-priority caves. Partners may include USFWS, TNC, National Speleological Society, Southeastern Cave Conservancy, American Cave Conservancy, Karst Waters Institute, and other conservation partners to identify, monitor, conserve and restore such caves. Measure(s): Number of caves restored, enhanced, and/or protected by fee-simple or easements; number of caves protected by proper gates and restricted usage.

- Acquire and/or purchase conservation easements to protect surface habitats and watersheds of all caves supporting sensitive aquatic species such as Alabama Cavefish and Tennessee Cave Salamander, and areas of high cave density (such as Newsome Sinks) by partnering with Forest Legacy and land trusts such as TNC, the Alabama Forest

Resources Center, Alabama (Chattowah Open) Land Trust, and the Land Trust of Huntsville and North Alabama. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Exclude all but legitimate scientific access to those caves serving as critical habitat to imperiled species. Partner with landowners and caver's groups such as National Speleological Society to restrict recreational caving to sites and seasons that will result in minimal impacts. Some bat caves may be entered at certain seasons without causing harm. Measure(s): Number of caves restored, enhanced, and/or protected by restricting access by user and/or season.

- Encourage all people entering caves to practice the National White-nose Syndrome Decontamination Protocol" (http://whitenosesyndrome.org/topics/decontamination). Measures: Number of people reached, and number of caves at which outreach is achieved.

- Encourage owners of all public and commercial caves open to the public to implement procedures such as those used at Mammoth Cave (KY) National Park to prevent tourists from spreading WNS to new locations. Measures: Number of people reached, and number of caves at which outreach is achieved.

- Identify recharge areas for ecologically significant caves (surface disturbance and pollution distant from cave entrances can impact cave fauna). Partners may include NSS, AGS, NRCS, and USFWS. Measure(s): Number of caves with recharge areas identified.

- Encourage ecologically sensitive forestry practices on steep slopes around caves and sinks (AFA, AFC, NRCS). Measure(s): Number of forest management plans containing specific language addressing cave protection needs.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Educate spelunkers and other cave visitors who may unintentionally disturb bats and other cave-dwelling species. Partner with the National Speleological Society, Southeastern Cave Conservancy, and the American Cave Conservancy to create

outreach and education programs. Measure(s): completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Support/promote efforts to reduce persistent pesticides, sediments, and other pollutants in the surface groundwater recharge area by working with USFWS, NRCS, and local partners. Measure(s): ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing water quality monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Where absent, restore forested buffers around cave entrances to provide dispersal/foraging habitat for some species while improving water and air quality and temperature regimes. Partner with AFC and USFS among others. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Bankhead/Warrior Mountains
- Conecuh National Forest
- Franklin/Marion/Jackson Mountains
- Honeycomb Creek Karst
- Huntsville Mountains
- Lookout and Pigeon Mountains
- Newsome Sinks
- Nickajack Cove
- Turk's Cave
- Upper Cahaba Watershed
- Upper Gurley Creek

Maritime Forest and Coastal Scrub

Mark Bailey

Figure 4-19. Sand pine scrub at Gulf State Park, Baldwin County

Description and Location

This mosaic of woody vegetation, often dominated by live oak, is present on barrier islands and near-coastal strands. Such areas include relatively stabilized coastal dunes, sometimes with a substantial shell component. Vegetation structure and composition are influenced by salt spray, coastal winds, and extreme disturbance events, especially hurricanes. The most heavily salt-influenced examples may appear pruned or sculpted. Fire is infrequent.

Although spring migrant birds typically expend energy to fly farther inland before making first landfall, these coastal forests are of critical importance to bird survival during so-called “fallout” conditions--when weather is inclement and birds are near exhaustion. In Alabama, this habitat is primarily found south of the Intracoastal Waterway from Perdido Bay to Fort Morgan in Baldwin County, and along Mobile Bay and on Dauphin Island in Mobile County.

This habitat encompasses one NatureServe ecological system (Table 4-18). Representative high-quality sites include portions of Bon Secour NWR and the inland portion of Gulf State Park east of the golf course (Baldwin County).

Table 4-18. Ecological systems encompassed by Maritime Forest and Coastal Scrub

	Ecoregion					
	IP	SA	RV	P	SP	SCP
East Gulf Coastal Plain Maritime Forest						X

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

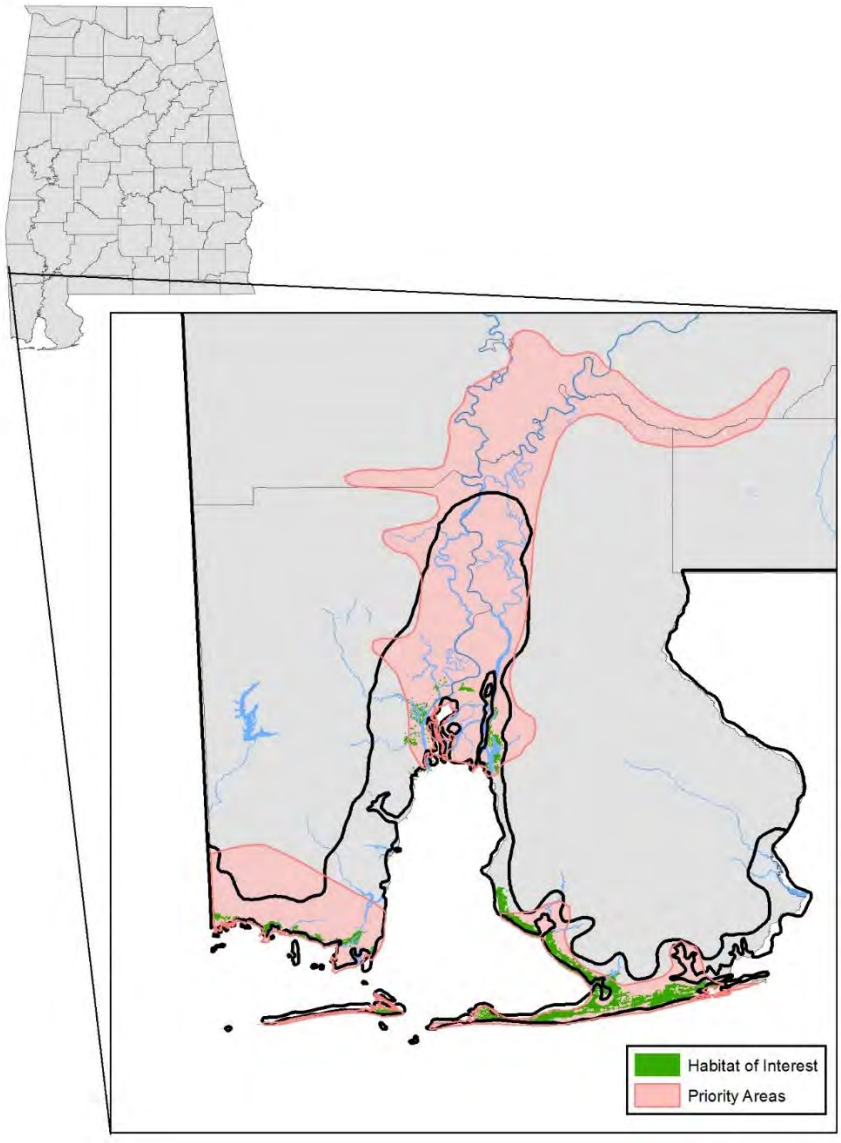


Figure 4-20. Distribution of Maritime Forest and Coastal Scrub

Condition

The location of Alabama's remaining maritime forest and coastal scrub habitats is fairly well known, and virtually all is highly fragmented. Most has either been lost to coastal development (i.e., homes, resorts, golf courses, shopping areas) or is interspersed with houses.

This habitat supports 19 SGCN (Table 4-19).

Table 4-19. SGCN, Maritime Forest and Coastal Scrub

Scientific Name	Common Name	SGCN Rank
Amphibians - 1		
Lithobates capito	Gopher Frog	P1
Reptiles - 8		
Drymarchon couperi	Eastern Indigo Snake	P1
Heterodon simus	Southern Hognose Snake	P1
Micrurus fulvius	Eastern Coral Snake	P1
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	P2
Gopherus polyphemus	Gopher Tortoise	P2
Lampropeltis getula	Eastern Kingsnake	P2
Pituophis melanoleucus mugitus	Florida Pinesnake	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	P2
Birds - 3		
Elanoides forficatus	Swallow-tailed Kite	P2
Lanius ludovicianus	Loggerhead Shrike	P2
Egretta rufescens	Reddish Egret	P2
Mammals - 7		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Peromyscus polionotus ammobates	Alabama Beach Mouse	P1
Peromyscus polionotus trissylepsis	Perdido Key Beach Mouse	P1
Lasiurus intermedius	Northern Yellow Bat	P2
Mustela frenata	Long-tailed Weasel	P2
Spilogale putorius	Eastern Spotted Skunk	P2
Sylvilagus palustris	Marsh Rabbit	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Loss of habitat to development
- Fragmentation of habitat by roads, development, utilities, etc.
- Predation by elevated urban populations of natural predators, especially raccoons

- Predation by free ranging and/or feral cats and dogs. Free-ranging cats are particularly a problem at the State Park property at Florida Point.

- Invasive exotic plants (cogongrass) and animals (fire ants)

- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN. However, with the exception of the beach mice, none has a special dependence on this habitat type.

- Insufficient conservation-related educational outreach about biologically significant areas

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact maritime forest and coastal scrub communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Forest Inventory data, consultation with forestry and plant community authorities, and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Birds

- **Neotropical migrant songbirds** – (all species, regardless of SGCN status) – determine/document extent of use of these habitats during both fall and spring migration. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of neotropical migrant songbirds and their habitats.

Mammals

- **Alabama Beach Mouse** and **Perdido Key Beach Mouse** – The extent to which these species utilize Coastal Scrub (as opposed to Beach and Dune) needs further investigation. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of beach mice and their habitats.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts of undeveloped coastal lands. Partners may include MBNEP, Bon Secour NWR, Forest

Legacy, TNC, Land Trusts and others. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Provide incentives and information to landowners for long-term conservation (NRCS, USFWS, and other granting agencies or institutions). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid/discourage additional development. Partners may include MBNEP, ADEM, SLD-Coastal, Baldwin and Mobile Counties.

- Control exotic plant and animal species. Partners may include NRCS, USFS, AFC, USDA, ABC. The feral cat population at Florida Point needs immediate attention. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Support full implementation of the NMEP Comprehensive Conservation and Management Plan, PIF and PARC bird and herpetofauna conservation plans and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with NMEP, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop and disseminate educational materials, brochures, videos, etc. to educate the public of the value of coastal habitats. Partners may include MBNEP, NRCS, USFWS, AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

Priority Areas for Conservation Action

- Grand Bay Savanna
- Gulf Islands
- Tensaw Delta

Isolated Wetlands

Alan Cressler

Figure 4-21. Isolated Wetland on Keel Mountain, Madison County

Description and Location

Wetlands surrounded by upland and not drained by streams may be found almost anywhere in Alabama, with somewhat higher densities in the Interior Plateau and Southeastern Plains regions. These are "embedded" habitats in that they may be surrounded by other habitats discussed in this document, such as Dry Longleaf Pine Forest, Mesic Forest, Maritime Forest and Coastal Scrub, Agricultural and Disturbed, and others. These highly variable habitats form in depressions where precipitation collects (e.g., sinkholes, Citronelle ponds), on former floodplains no longer inundated by seasonal river flows (e.g., oxbow lakes), in swales between coastal dunes (e.g., interdunal ponds) and in other seasonally wet sites. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Many become dry in the summer and do not support fish, making them particularly valuable to certain pond-breeding amphibians. Depending on hydrology and soils, isolated wetlands may vary from open water ponds to herb-, shrub-, or tree-dominated wetlands.

Isolated wetlands are vital habitats for numerous wildlife species, including endangered and threatened birds, reptiles, amphibians, invertebrates, and plants (Moler and Franz 1987, Phillips 2002). Many thousands of isolated wetlands exist in Alabama, but they have not been

inventoried, so the actual number is unknown. The loss or degradation of these wetlands negatively impacts native fauna, flora, soils, and water quality.

This habitat encompasses four NatureServe ecological systems (Table 4-20). Representative high-quality sites include Conecuh National Forest (Covington County), Bon Secour NWR (Baldwin County), J.D. Martin Skyline WMA (Jackson County).

Table 4-20. Ecological systems encompassed by Isolated Wetlands

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Central Interior Highlands and Appalachian Sinkhole and Depression Pond	X	X	X			
Atlantic and Gulf Coastal Plain Interdunal Wetland						X
East Gulf Coastal Plain Northern Depression Pondshore					X	
Southern Piedmont/Ridge and Valley Upland Depression Swamp			X	X		

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

This habitat type also includes many water bodies produced by human actions. Most are ponds built for a variety of reasons including aesthetic appreciation, livestock watering, irrigation, aquaculture, and storm water management. Other isolated wetlands have been created by fragmentation from development where they represent remnants of once larger wetland complexes.

This habitat supports 18 SGCN (Table 4-21).

Table 4-21. SGCN, Isolated Wetlands

Scientific Name	Common Name	SGCN Rank
Crayfish - 1		
Procambarus viaevirdis	Vernal Crayfish	P1
Amphibians - 5		
Ambystoma bishopi	Reticulated Flatwoods Salamander	P1
Lithobates capito	Gopher Frog	P1
Lithobates sevosus	Dusky Gopher Frog	P1

Scientific Name	Common Name	SGCN Rank
Ambystoma texanum	Smallmouth Salamander	P2
Pseudacris ocularis	Little Grass Frog	P2
Reptiles - 3		
Drymarchon couperi	Eastern Indigo Snake	P1
Farancia erytrogramma erytrogramma	Rainbow Snake	P1
Liodytes (Seminatrix) pygaea pygaea	North Florida Swampsnake	P2
Birds - 6		
Ammodramus henslowii	Henslow's Sparrow	P1
Ixobrychus exilis	Least Bittern	P2
Euphagus carolinus	Rusty Blackbird	P2
Anas rubripes	American Black Duck	P2
Laterallus jamaicensis	Black Rail	P2
Rallus elegans	King Rail	P2
Mammals - 3		
Lasiurus intermedius	Northern Yellow Bat	P2
Sylvilagus palustris	Marsh Rabbit	P2
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Condition

Statewide, many isolated wetlands have been ditched, filled, deepened, or otherwise altered. Those surrounded by development, agriculture, or intensive silviculture generally lose much of their biodiversity. Even when "buffers" are left around ponds as a part of Best Management Practices (designed primarily for water quality protection), sufficient upland habitat of amphibians, reptiles, and other wildlife is seldom provided. Because ephemeral ponds are seasonally dry, they may not be recognized as wetlands by land managers and regulatory agencies, and therefore are subject to disturbance and destruction. Many of the most productive and intact isolated wetlands are on publicly owned lands, but good examples occur on private holdings, as well. Until a thorough inventory of isolated wetlands is conducted, their overall status and condition will remain poorly known.

Problems Affecting Species/Habitat

- Loss of habitat through draining and/or filling
- Lack of recognition (of some wetland types) and therefore protection by managers and regulatory agencies
- Insufficient upland habitat provided undisturbed for pond-dependent yet upland-dwelling wildlife following timber harvest, conversion to agriculture, development

- Introduction of game fish to naturally fishless ponds impacts amphibian populations
- Lack of information on status, distribution, and classification of this habitat type
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Impacts from erosion from mechanized vehicle trails uphill from biologically significant sites
- Failure to identify and protect critical and unique habitats embedded in a forest matrix
- Change in vegetative structure and species composition due to absence of natural fire regime
- Erosion from mechanized vehicle trails and other activities near biologically significant sites
- Insufficient conservation-related education about biologically significant areas and species

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact isolated wetland communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. NRCS soil maps, USGS topographic maps (incorporating existing National Wetlands Inventory maps which exist for some quadrangles), and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.
- Investigate habitat use and seasonal importance of isolated wetlands to SGCN and other migratory shorebirds. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of isolated wetlands and their fish and wildlife.
- Establish baseline species data for amphibians and other wildlife at key representative wetlands to monitor long-term trends. Measure(s): Data to fill information gaps to assess the long-term status and/or condition of amphibians and other wildlife; inclusion in the Natural Heritage database

Invertebrates

- **Vernal Crayfish** – Life history data are needed for this species. Further sampling is necessary to determine the extent of its range in Alabama. Further research needed to determine specialized needs and impacts or threats to habitat. Measure(s): Data to fill information gaps for mapping distribution; data to expand GIS coverages.

Amphibians and Reptiles

- **Reticulated Flatwoods Salamander** – Possibly extirpated. Intensively survey to determine whether this species still occurs in Alabama. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Dusky Gopher Frog** – Possibly extirpated. Intensive surveys in Mobile and Washington counties are needed to determine whether this species still occurs in Alabama. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Gopher Frog** – Annual monitoring of known breeding sites, along with surveys for new populations and assessment of threats, is needed. The area between Montevallo and Columbiana in Shelby County needs particular attention, since the only known population from that region of the state has been extirpated. Measure(s): Data to fill information gaps for mapping distribution and; identification of limiting factors, habitat requirements and/or threats; inclusion in the Natural Heritage database.

- **Little Grass Frog** – Annual monitoring of known breeding sites, along with surveys for new populations and assessment of threats, is needed. Alabama populations appear to be confined to southeastern Houston County. Measure(s): Data to fill information gaps for mapping distribution and; identification of limiting factors, habitat requirements and/or threats; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Historic but possibly extirpated from some areas due to dams restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **North Florida Swampsnake** –This small aquatic snake appears to be in decline and present status is poorly known. Conduct surveys to better determine life history,

population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Henslow's Sparrow** – Implement inventory and monitoring programs in this habitat on key public and private lands. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Least Bittern** – Conduct habitat studies of wetland vegetation, water levels, water quality, and minimum wetland needed during nesting, migration, and over-wintering seasons. Studies should examine movements and patterns of habitat use, causes and rates of juvenile and adult mortality, sources of nest failure, renesting ability, juvenile dispersal patterns, and diet. Major stopover sites for overwintering and migration need to be identified. Measure(s): Data to shed light on life history in Alabama, identify important areas, expand GIS coverages, and generate information to aid land managers.

- **Rusty Blackbird** – Perform late winter surveys in February and March (when males are vocal) to determine areas of most consistent foraging use. Participate in multi-year Rusty Blackbird Spring Migration Blitz; a rangewide-coordinated citizen-science project. See Table 9.2 in Greenberg et al. 2011 for detailed actions/needs. Measure(s): Data to expand GIS coverages, information to aid land managers.

- **Black Rail** – Survey potential marsh habitats. Measure(s): data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **King Rail** – Research is needed to identify potential benefits of natural disturbance regimes, including fires, to King Rails and other wetland species.

Mammals

- **Northern Yellow Bat** – Field surveys should be focused on coastal areas in Baldwin and Mobile Counties, along with forested habitats along the Mobile, Tensaw, Conecuh, Yellow, and Pea river corridors along the southern border of the state. Habitats dominated by cabbage palm and Spanish moss in these areas should be of particular interest. More information is needed on general biology, ecology, and reproduction in Alabama before management guidelines can be developed. Measure(s): Data to expand GIS coverages, life history information to aid land managers.

- **Black Bear** – Identify movement corridors, document all sightings, and monitor distribution and habitat use. Measure(s): Identification of important migration corridors, areas inhabited, habitat requirements, data to expand GIS coverages, information to aid land managers.

- **Meadow Jumping Mouse, Marsh Rabbit** – These secretive mammals remain poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and *Key Partnership* Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant wetlands. Protect high-quality tracts of forest that contain isolated wetlands. Partners may include Longleaf Alliance, USFWS, TNC and other land conservation partners to identify, conserve and restore such tracts. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Ensure that isolated wetlands on all publicly owned lands are fully protected from sedimentation (including from graded road "wing ditches"), draining, and destruction. Partners include ADCNR-SLD, AFC, EPA, USFWS, USFS, and DoD. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Remove fish from, and/or prevent stocking of fish in, natural isolated ponds on public lands, and encourage private landowners to maintain some fishless ponds. Partners may include NRCS and USFS, whose 2004 Land and Resource Management Plan states, "Do not introduce fish into seasonal or sinkhole ponds." Measure(s): Number of ponds restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Partner with large private and industrial timberland owners to encourage identification and protection of significant wetlands and adjacent uplands. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an

outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Avoid placing plowed fire lines through dry wetlands when possible; restore topography and natural vegetation where emergency plowed fire lines disrupt wetland basins. Partners may include AFC and USFS. Measure(s): Identification and mapping of sensitive habitats that should be avoided; acres restored, enhanced, and/or protected by fee-simple or easements.

- Participate in the Alabama Prescribed Fire Council**.** Measure(s): Number of Council meetings attended; number of partnerships with Council to fund and/or implement conservation projects involving prescribed fire.

- Develop educational materials (brochures, videos, etc.) to inform the public of the importance of ephemeral wetlands. Partners may include Legacy, AFC, TNC, PARC, PIF, and others. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Create artificial wetlands (Biebighauser, 2004) where wetlands have been lost. Partner with NRCS, USFS, USFWS, PARC. Measure(s): Acres of artificial wetlands created.

- **American Black Duck** – Conserve and restore forested and palustrine wetland habitats, especially in the Tennessee Valley. Continue restrictive harvest regulations in Alabama should be continued. Because Black Ducks and Mallards readily hybridize, releases of pen-raised Mallards in Alabama, especially in key wintering and the primary breeding areas (e.g., the Tennessee Valley) should certainly be discouraged, if not prohibited.

- **King Rail** – Protect and restore quality habitat on both public and private lands. Conservation planning should target permanent protection of high quality landscapes that currently have, or can be restored to support populations. Areas with populations should be protected from significant modification including dredging, draining, filling and other impacts from development.

Priority Areas for Conservation Action

- Boaz Pond
- Cane Creek/Little Mountain
- Conecuh National Forest
- Fort Benning
- Franklin / Marion / Jackson Mountains
- Grand Bay Savanna
- Huntsville Mountains
- Indigo Pond
- Lookout and Pigeon Mountains
- Mystery Worm Pond
- Talladega Mountains

Beach and Dune

Eric Soehren

Figure 4-22. Inner dunes on Dauphin Island, Mobile County

Description and Location

Beach and dune complexes are dynamic systems of constantly changing habitats characterized by sandy soils, sparse, saltwater-adapted grasses and shrubs, and interdunal pools and swales. Winds, tides, salt spray and hurricanes impact these habitats as the sands and the vegetation that they support constantly ebb and flow in response. Vegetated coastal dunes consist largely of herbaceous and embedded shrublands on barrier islands and other near-coastal areas where salt spray, saltwater overwash, and sand movement are important ecological forces. Wildlife species of Alabama's beaches and dunes include beach mice, sea turtles, and nesting and wintering shorebirds that are incapable of surviving (or reproducing, in the case of sea turtles) in other habitats, and their welfare is tied to the welfare of this narrow coastal strip.

This habitat encompasses two NatureServe ecological systems (Table 4-22). Representative high quality sites include portions of Bon Secour NWR, Gulf State Park, Dauphin Island Bird Sanctuary, and Pelican Island.

Table 4-22. Ecological systems encompassed by Beach and Dune

	Ecoregion					
	IP	SA	RV	P	SP	SCP
East Gulf Coastal Plain Dune and Coastal Grassland						X
Florida Panhandle Beach Vegetation						X

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

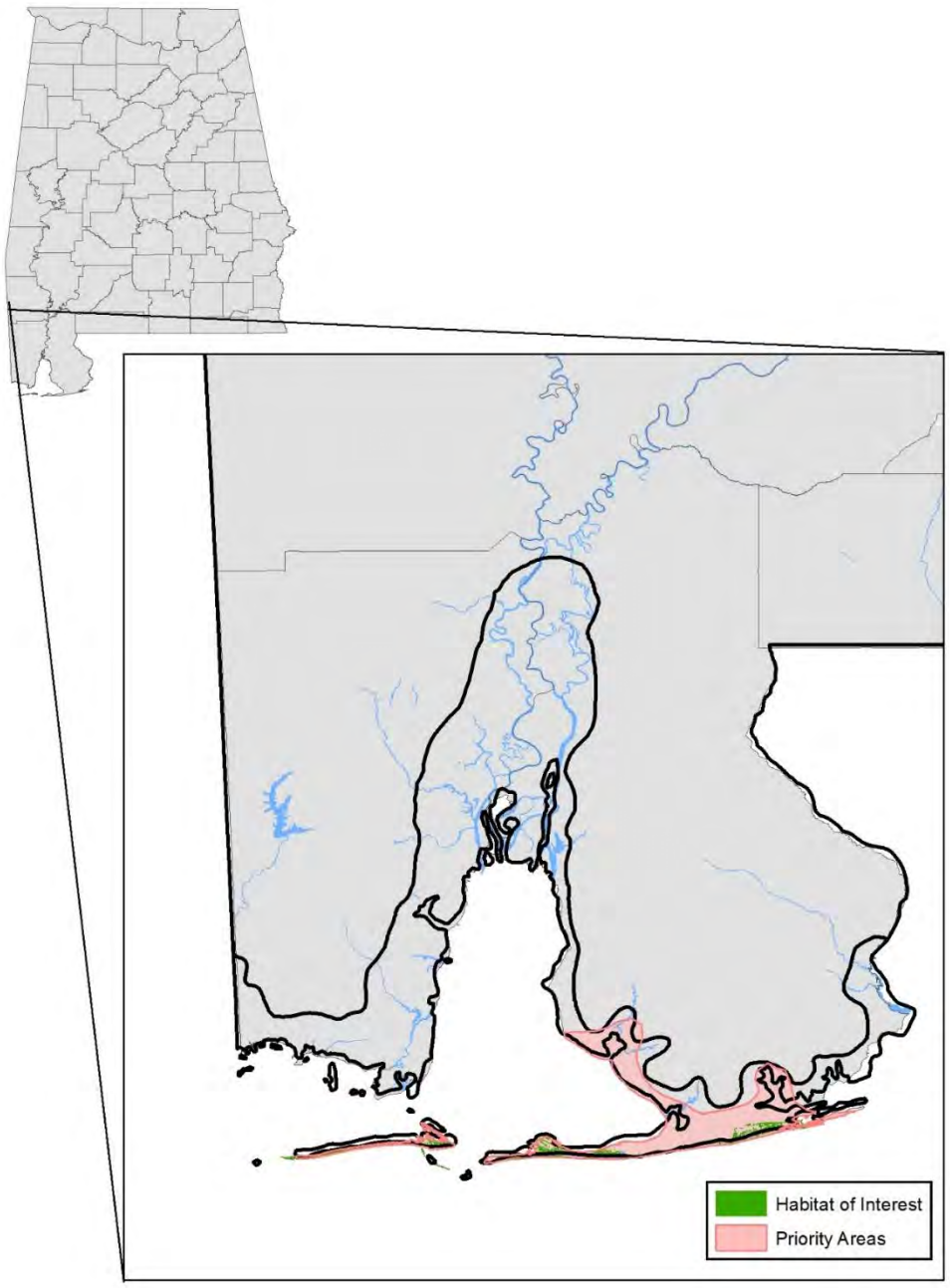


Figure 4-23. Distribution of Beach and Dune Habitat in Alabama

Condition

Alabama's beach and dune systems are extremely attractive to tourists and vacationers. Prior to the landfall of Hurricane Frederick in 1979, development along the Alabama coastline was intermittent and slow. The development of beachfront property over the last quarter century has been dramatic and has driven land prices to extremely high levels. As a result, little undeveloped beachfront property exists in Alabama outside of state and federal ownership.

This habitat supports 15 SGCN (Table 4-23).

Table 4-23. SGCN, Beach and Dune

Scientific Name	Common Name	SGCN Rank
Reptiles - 5		
Caretta caretta	Atlantic Loggerhead	P1
Chelonia mydas	Green Sea Turtle	P1
Lepidochelys kempii	Kemp's Ridley	P1
Malaclemys terrapin pileata	Mississippi Diamondback Terrapin	P1
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	P2
Birds - 7		
Haematopus palliatus	American Oystercatcher	P1
Charadrius melodus	Piping Plover	P1
Charadrius nivosus	Snowy Plover	P1
Charadrius wilsonia	Wilson's Plover	P1
Egretta rufescens	Reddish Egret	P2
Gelochelidon nilotica	Gull-billed Tern	P2
Calidris canutus	Red Knot	P2
Mammals - 3		
Peromyscus polionotus ammobates	Alabama Beach Mouse	P1
Peromyscus polionotus trissylepsis	Perdido Key Beach Mouse	P1
Sylvilagus palustris	Marsh Rabbit	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Because beach and dune complexes are both highly valued for development and also provide critically important habitat for a variety of unique plant and animal assemblages, conflicts have arisen between conservationists and developers regarding the future use of the remaining lands, and those private developments that currently impact the nearby public lands. For example, light pollution from nearby development is particularly disruptive to sea turtle nesting behavior, and free-ranging pets, such as house cats, impose direct mortality on beach mice.

Problems Affecting Species/Habitat

- Loss of habitat to development
- Fragmentation of habitat by roads, development, utilities, etc.
- Nest predation by elevated urban populations of natural predators, especially coyotes
- Predation (especially on beach mice) by free ranging and/or feral cats. Free-ranging cats are particularly a problem at the State Park property at Florida Point.
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN. However, with the exception of the beach mice, none has a special dependence on this specific location.
- Impacts from disturbance caused by allowing foot and vehicle traffic through sensitive habitat features such as nest sites
- Insufficient conservation-related education about biologically significant areas and species

Priority Research/Survey/Monitoring Needs

Reptiles

- **Nesting sea turtles** (**Atlantic Loggerhead**, **Green Sea Turtle**, and **Kemp's Ridley**) – Expand annual nesting surveys, continue the annual stranded turtle monitoring program. Implement other priority actions in the Recovery Plans to conserve this species and improve important wintering habitat in Alabama. Measure(s): data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Mississippi Diamondback Terrapin** – The exact distribution is still relatively unknown. Further systematic field surveys are needed to identify areas where terrapins occur and nest. Several years of field research are needed to locate and assess the distribution of present populations and monitor recruitment and mobility. Conduct basic life history studies, including identification of habitat and activities of juveniles. Investigate the impact of crab traps on this species. The repatriation project currently being condocted by UAB should continue. Measure(s): Data to fill information gaps on ecology and habitat use; threats assessment of crab traps initiated and completed; data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **Eastern Diamond-backed Rattlesnake** –Historically occurred on Dauphin Island, but may have been extirpated. Heavily persecuted in coastal areas receiving heavy recreational and/or development use. Conduct surveys in this habitat to better determine distribution and abundance. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Wilson's Plover** and **Snowy Plover** – Expand nesting surveys beyond public lands and to include other nesting shorebirds such as Least Tern to better determine nesting status in Alabama. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **American Oystercatcher** – Conduct periodic nesting surveys. Any major hurricane events affecting Alabama should be followed by nesting season surveys. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Piping Plover** and **Red Knot** – Conduct annual nonbreeding surveys on Pelican Island and Little Dauphin Island, add other sites as opportunity allows (other inlets and shorelines such as Fort Morgan State Historic Park, Little Lagoon Pass, Perdido Pass and Lake Shelby); participate in the International Piping Plover Survey. Implement other priority actions in the Recovery Plan to conserve this species and improve important wintering habitat in Alabama. Measure(s): data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Reddish Egret** – Monitoring programs should be developed and initiated. Surveys of potential nesting habitat during peak nesting activity should be conducted every three to five years. Precise set-back distances to protect nesting birds from human disturbance need to be determined. Measure(s): data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Gull-billed Tern** – Existing breeding colonies should be monitored yearly to assess population numbers and trends. Annual surveys along the coast should be performed to identify new breeding locations, especially Blakeley Island where nesting once occurred.

Mammals

- **Alabama Beach Mouse** and **Perdido Key Beach Mouse** – Monitor annually. Measure(s): Data to fill information gaps to assess status and/or condition; inclusion in the Natural Heritage database.

- **Marsh Rabbit** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property, and acquire or purchase conservation easements to protect undeveloped beaches, including the critically important west end of Dauphin Island in partnership with Dauphin Island Bird Sanctuary (DIBS) MBNEP, Bon Secour NWR, Forest Legacy, TNC, Land Trusts and other partners. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Protect all remaining beach mouse, plover, and sea turtle nesting habitat, by supporting dune restoration on public and private lands, requiring dune-walkovers at all public and private access points, prohibiting all vehicle access to dune habitats, encouraging the use of native planting and landscaping for all areas, removal of exotic plants such as congongrass and beach vitex, and developing bio-friendly tourism initiatives. Partners may include MBNEP, Bon Secour NWR, TNC, and others. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of regulatory protections implemented to require dune walkovers and prohibit vehicle traffic on dunes.

- Cooperate with federal agencies to reestablish Alabama Beach Mouse populations where possible. Partners may include USFWS and NRCS. Measure(s): Number of partnerships and/or joint projects with USFWS, NRCS and others to fund and/or implement beach mouse population introductions; beach mouse population status and trends.

- Develop and enforce feral/free-roaming domestic cat control measures as recently was done in the state of Florida. Measure(s): Number of regulatory protections implemented to control feral/free-roaming domestic cat populations.

- Work to limit all future construction on Fort Morgan Peninsula; examine permitting requirements for single family dwellings (ADEM, other appropriate state agencies). Measure(s): Number of regulatory protections implemented to limit future construction; number of plans/permits commented on.

- Regulate future construction that would result in actual or potential take of beach mice or their habitat (ADEM, other appropriate state agencies). Measure(s): Number of

regulatory protections implemented to limit future construction; number of plans/permits commented on.

- Identify developed areas that can be returned to native habitat following catastrophic events. Partners may include MBNEP, Bon Secour NWR, Forest Legacy, and TNC. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Declare all habitat south of Alabama State Highways 180 and 182 as non-redevelopment zones. Measure(s): Acres restored, enhanced, and/or protected by creation of a non-redevelopment zone.

- Develop plans to identify and to return four to five miles of habitat south of Alabama Highway 182 on Perdido Key to a natural state following future hurricane events (ADEM, other appropriate state agencies). Measure(s): identification of habitat to be restored; key habitats with GIS data compiled; acres restored, enhanced, and/or protected by fee-simple or easements.

- Use Gulf State Park as a state example of wise and responsible use of beach property. To that end, the following steps are suggested: convert the dune habitat at Gulf State Park to day use, , retrofit lighting to be sea turtle friendly, and return the dune habitat to its native state. Measure(s): Limitation of Gulf State Park dunes to day use; lights retrofitted; acres of dune habitat restored.

- Post signs directing the public away from sensitive plover and turtle nesting sites. Partners may include MBNEP, Bon Secour NWR, Gulf State Park**,** USFWS. Measure(s): Number of signs posted annually.

- Provide incentives and information to landowners for long-term conservation (NRCS, USFWS, and other granting agencies or institutions). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

- Cooperate with other agencies and partners to survey shorebird nesting areas for Alabama's coastline. Develop protocols, survey sites, data management, site protection and public education to contribute to Gulf-wide shorebird monitoring and protection.

- Restore natural coastal processes such as tidal overwash, beach accretion and erosion, dune development, and deposition of wrackline materials. The ecological health and natural community integrity of sandy, oceanfront beach and dune habitat requires natural flood regimes. Periodic flooding and tidal processes deposit new materials, creating and maintaining beach, dune, and marsh habitats.

- Dispose of dredge material to benefit nesting turtles. Although dredging degrades habitat quality for some species, spoil piles that are high in sand content can serve as important turtle nesting habitat. Sand can be infrequently deposited outside of the nesting season above the high-water mark mimicking the natural sloped beach and dune profile along the shore, or as created islands.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop and disseminate educational materials, brochures, videos, etc. to educate the public of the value of coastal habitats. Partners may include MBNEP, NRCS, USFWS, and AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

Priority Areas for Conservation Action

- Gulf Islands (including Dauphin Island and Fort Morgan Peninsula)

Glades and Prairies

Alan Cressler

Figure 4-24. Ketona dolomite glade, Bibb County

Description and Location

Naturally treeless areas called glades and prairies support plants and animals not typically found in surrounding forests. Glades, sometimes called barrens, are open habitats dominated by herbaceous plant communities occurring on uplands, typically on the thin soils of bedrock, and bare rock outcrops may also be present. Historically they had little agricultural value but have been used as rough pasture and for home sites, quarries, and dumps. Limestone (calcareous) glades and barrens are the most widespread type in Alabama, particularly in the Interior Plateau, but glades and barrens also form over sandstone, granite, and other bedrock in the Southwestern Appalachians, Ridge and Valley, and Piedmont. The absence of a tree canopy exposes the ground to considerable sunlight, resulting in very hot surface temperatures in summer. The thin soils of some glades and barrens often hold little water and produce a highly xeric habitat that is inhabited by a highly adapted plant and animal species. Although few vertebrate wildlife species are dependent upon glades and barrens, these habitats support a high number of endemic plants. Representative high-quality limestone glade sites include TNC's Bibb County Glade Preserve, Prairie Grove Glades Preserve (Lawrence County); sandstone glade sites include Little River Canyon (DeKalb and Cherokee counties), Guntersville State Park (Marshall County). There are no permanently protected granite outcrops in Alabama.

Eric Soehren

Figure 4-25. Black Belt prairie, Sumter County

Prairies are grasslands on deeper, fertile soils with herbaceous vegetation maintained by fire and grazing. These natural grasslands generally were treeless and supported a mix of grasses and forbs. Besides having few, if any, large trees, they differ from wet pine savanna and flatwoods communities in having less sandy soil and drier site characteristics. In Alabama, prairies are primarily associated with the Blackland Prairie subdivision of the Southeastern Plains (Figure 4-26), which contains fertile alkaline soils derived from chalk, marl, and limestone. In most cases individual prairie openings are small and isolated from one another, but they were more extensive prior to European settlement, forming a mosaic of grasslands and woodlands under frequent fire regimes. The fertile "Black Belt" prairie soils of Alabama and Mississippi were one of the most important agricultural areas of the antebellum South, and much of the natural vegetation of the region has been converted to pasture and agricultural uses, but even old-field vegetation reflects the distinctive composition of the flora and ecological dynamics. The flora has much in common with the Midwestern prairies, but locally endemic vertebrates are absent. Many eastern animals, however, including rare birds and reptiles, often use these open habitats. Representative high-quality blackland prairie sites include Jones Bluff Corps of Engineers Park (Autauga County), Old Bluffport Nature Preserve (Sumter County), China Bluff Corps of Engineers Park (Sumter County). Coosa Valley prairie sites are on Pelham Range (Calhoun County). No permanently protected Jackson prairies are in Alabama.

Glade and prairie habitats encompass eight NatureServe ecological systems (Table 4-24).

Table 4-24. Ecological systems encompassed by Glades and Prairies

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Ridge and Valley Calcareous Valley Bottom Glade and Woodland			X			
Southern Piedmont Glade and Barrens				X		
Southern Piedmont Granite Flatrock				X		
Cumberland Sandstone Glade and Barrens		X				
Alabama Ketona Glade and Woodland			X			
Southern Ridge and Valley Patch Prairie			X			
Central Interior Highlands Calcareous Glade and Barrens	X	X				
East Gulf Coastal Plain Black Belt Calcareous Prairie and Woodland					X	

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

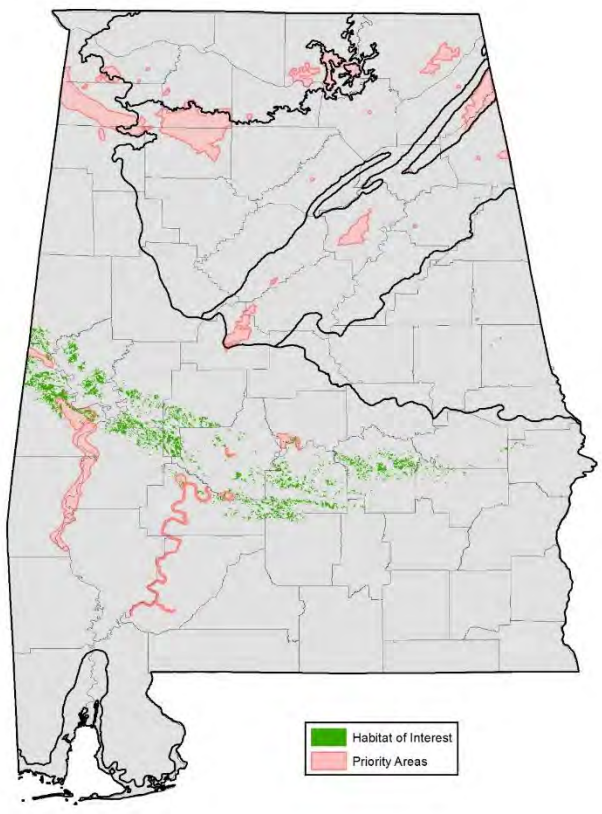


Figure 4-26. Mapped Black Belt Prairie Habitat (other glades and prairies unmapped) and Known Priority Areas

This habitat supports 14 SGCN (Table 4-25).

Table 4-25. SGCN, Glades and Prairies

Scientific Name	Common Name	SGCN Rank
Insects - 1		
Nicrophorus americanus	American Burying Beetle	EX
Crayfishes - 1		
Procambarus hagenianus hagenianus	Southeastern Prairie Crayfish	P2
Amphibians - 1		
Lithobates sevosus	Crawfish Frog	P1
Reptiles - 3		
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	P2
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	P2
Pituophis melanoleucus melanoleucus	Northern Pinesnake	P2
Birds - 7		
Ammodramus henslowii	Henslow's Sparrow	P1
Thryomanes bewickii	Bewick's Wren	P1
Lanius ludovicianus	Loggerhead Shrike	P2
Asio flammeus	Short-eared Owl	P2
Coturnicops noveboracensis	Yellow Rail	P2
Falco sparverius paulus	Southeastern American Kestrel	P2
Aquila chrysaetos	Golden Eagle	P2
Mammals - 1		
Zapus hudsonius	Meadow Jumping Mouse	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern, EX = Extirpated

Condition

Prior to European settlement, glades and barrens were more widespread and adjoined forests with more open understories than those found today. By the end of the twentieth century, these treeless areas were greatly reduced because of conversion to agriculture, quarrying, altered fire regimes, and the extirpation of two large native grazers, the bison and eastern elk.

Only remnants (perhaps less than 1 percent) of Alabama's Blackland Prairie grasslands existed intact by the end of the twentieth century, because almost all of the region's fertile soils were converted to agriculture. Historically, a combination of fire and grazing (first by native ungulates including bison and elk, and then by free-ranging cattle) kept prairies open. Two centuries of cultivation and disturbance has left few prairies remaining. Range enclosure and fire suppression increased during the twentieth century, changing the dynamics of the landscape, and the coverage of fire-intolerant woody species increased. The formerly extensive Blackland Prairie grassland habitats are now reduced to patches, or its flora persists in pastures which are under more continuous grazing pressure than the former processes would have allowed. Some of the

lands are now reverting back to prairie after being abandoned. More recently, lands are being converted to fescue pasture; other abandoned lands have become cedar glades.

Problems Affecting Species/Habitat

- Fire suppression
- Conversion of prairie grasslands to pasture
- Concentrated grazing pressure on prairie grasses by fenced livestock
- Quarrying of bedrock at glades and barrens
- Use of glades as illegal garbage dump sites
- Urban development and habitat fragmentation
- Exotic species: bermudagrass, bahia, tall fescue, cogon grass
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN.
- Impacts from excessive soil disturbances from site preparation activities (i.e., fire plow lines)
- Erosion from mechanized vehicle trails and other activities near biologically significant sites

Priority Research/Survey/Monitoring Needs

- Although many Black Belt prairies are now mapped, these need further refining and better maps of the distribution of other prairies and glades are also needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. NRCS soils data, consultation with forestry and plant community authorities, and remote imagery should be used. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Invertebrates

- **American Burying Beetle** – Believed extirpated; no urgent research or conservation actions recommended but surveys for this species (using carrion-baited traps) could be included incidental to fieldwork for other SGCN.

- **Southeastern Prairie Crayfish** – Virtually nothing known about this species. Survey work is needed to determine the distribution and status of this species in Alabama. Measure(s): Data to fill information gaps for mapping distribution; data to expand GIS coverages.

Amphibians and Reptiles

- **Crawfish Frog** – Very recently (March 2015) discovered in the state; presently known from just two breeding populations in Sumter County. Virtually nothing is known of habitat use or status of Alabama populations. Conduct intensive breeding season (February-March) surveys in areas of likely habitat to better delineate distribution in the state, and to characterize habitat. Measure(s): Data to fill information gaps for on status and habitat use; data to expand GIS coverages.

- **Eastern Speckled Kingsnake**, **Northern Pinesnake**, and **Eastern Slender Glass Lizard** – These species appear to be in decline and present status is poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Birds

- **Henslow's Sparrow**, **Bewick's Wren**, **Loggerhead Shrike**, **Short-eared Owl**, and **Southeastern American Kestrel** – Survey glades and prairies for these species, determining degree of importance as habitat. Measure(s): Data to fill information gaps for mapping distribution; identification of habitat requirements s; inclusion in the Natural Heritage database.

- **Yellow Rail** – Perform stratified surveys in habitats thought to be used to determine presence, particularly at inland sites where the species has been reported historically. Once identified, standardized surveys (stratified by habitat type) should be performed to determine population densities, specifically those under different management regimes (e.g., prescribed burn frequencies). Once individuals can be reliably captured, radio-telemetry studies should be initiated at stratified sites to determine microhabitat usage, home range sizes, spatial movements, and estimate winter survivorship. Finally, surveys of managed wildlife openings during migration may help better understand their importance as temporary stopover sites in Alabama and Mississippi. Once these aspects are better understood, stewardship plans should be developed to help maintain and expand required habitat features at known sites, and enhance new areas where restoration potential exists. Measure(s): Data to shed light on distribution, abundance, and life history in Alabama, identify important wintering areas and migration routes, expand GIS coverages, and generate information to aid land managers.

- **Golden Eagle** – Determining the full spectrum of migration corridors from Alabama to Canada and back may assist in mitigating for collision conflicts with wind energy plants along the entire Appalachian Mountain chain. Tracking efforts should be accompanied by

modeling flight behavior patterns, which may provide a better understanding of direct risks from wind turbines. Measure(s): Data on migration routes and frequent use areas.

Mammals

- **Meadow Jumping Mouse** – This species remains poorly known. Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect existing significant tracts. Promote large, unfragmented tracts by working with USFWS, TNC and other land conservation partners to identify, conserve and restore such tracts. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Encourage maintenance of grassland through prescribed burning. Acceptance of controlled burning can be enhanced through public education, programs to "fire-safe" properties, and cost-share programs to install fire lines and conduct controlled burns. Measure(s): Acres burned annually; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets); number of properties made "fire-safe" annually; and number of cost-share programs to install fire lines and conduct controlled burns.

- Coordinate and integrate existing initiatives and programs such as the Northern Bobwhite Conservation Initiative (NBCI) to influence habitat for birds and other wildlife by working with ADCNR, USFWS, and NRCS**.** Measure(s): Acres of habitat enrolled in NBCI and other programs; and number of joint projects with ADCNR, USFWS and NRCS.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Avoid or minimize plowed fire lines when possible; place fire lines where disturbance to sensitive natural groundcover can be avoided or minimized. Restore topography and

natural vegetation where emergency plowed fire lines disrupt natural areas. Partners may include AFC and USFS. Measure(s): Identification and mapping of sensitive habitats that should be avoided; acres restored, enhanced, and/or protected by fee-simple or easements.

- Participate in the Alabama Prescribed Fire Council**.** Measure(s): Number of Council meetings attended; number of partnerships with Council to fund and/or implement conservation projects involving prescribed fire.

- Encourage thinning of overstocked pine forests by partnering with AFC. Measure(s): Acres restored or enhanced by thinning of overstocked pines.

- Discourage/avoid conversion of glades and barrens to mine sites and illegal garbage dump sites. Restore topography and natural vegetation where possible. Measure(s): Acres restored; completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

- **Southeastern Prairie Crayfish** – Protection and maintenance of the natural hydrology and vegetation structure of prairies would benefit. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. Measure(s): Acres of prairies protected, restored, and/or prescribe burned.

- **Southeastern American Kestrel** – Nest box programs should be started where breeding cavities are an obvious limiting factor in habitats undergoing restoration, or in other appropriate foraging habitats.

- **Loggerhead Shrike** – Roadside and field/pasture fenceline management should be aimed at maintaining shrubs (cover, perching, and nesting habitat). Manage for medium and tall grasses by reducing grazing, controlling mowing times, and implementing prescribed fire.

- **Golden Eagle** – Lead poisoning from spent lead ammunition consumed in carrion is of high concern. To the extent possible, sportsmen should be encouraged to use non-toxic ammunition when hunting, and to properly dispose of deer carcasses so scavengers cannot reach them. Outreach should be performed to increase public awareness and appreciation, which may help reduce chronic illegal shooting and/ or incidental poisoning. Measure(s): Development and distribution of educational materials.

Priority Areas for Conservation Action

- Almond Outcrop
- Bald Rock Mountain
- Bankhead/Warrior Mountains
- Bear Creek Ravines
- Bibb County Glades
- Black Creek Sandstone Glade
- Blake's Ferry Outcrop
- Buck Island Glades
- Cane Creek/Little Mountain
- Cedar Plains Glades
- Chitwood Barrens
- Coon Gulf
- Coosa Valley Prairies
- Dry Creek Barrens
- Ellisville Prairie
- Ft. Tombecbe – Jones Bluff
- Huntsville Mountains
- Jones Bluff
- Little River Canyon
- Lookout and Pigeon Mountains
- Lower Alabama River Bluffs and Swamps
- Moss Rock
- North Fork Creek Glade
- Noxubee Prairies and Forests
- Old Bluffport
- Old Cahaba Prairies
- Osborne Hill Barrens
- Pelham Range Prairie
- Prairie Bluff – Millers Ferry Prairie
- Prairie Grove Glades
- Rock Creek Barrens
- Skirum Bluff
- Spring Valley
- Srygley Barrens
- Sunny Home Glades
- Thorne Glade
- Tilden Carlowville Prairie Complex
- Tiller's Outcrop
- Wheeler NWR / Redstone Arsenal

Intertidal Marshes and Flats

John Trent

Figure 4-27. Tidal Marsh at Point Aux Pins, Mobile County

Description and Location

Restricted to Alabama's coastal counties of Baldwin and Mobile, this habitat includes salt and brackish tidal marshes. Salt marshes and adjacent shallow waters support many fish species of commercial interest, and are important to a number of other terrestrial and aquatic wildlife species. These habitats are typically associated with mud-bottomed bays behind barrier islands. Some of Alabama's most extensive brackish needlerush marshes are associated with lower Mon Louis Island, Dauphin Island, and Mississippi Sound.

This habitat encompasses one NatureServe ecological system (Table 4-26). Representative high-quality intertidal marshes and flats sites include Weeks Bay NERR (Baldwin County), Bon Secour NWR (Mobile County), W.L. Holland WMA (Baldwin County).

Table 4-26. Ecological systems encompassed by Intertidal Marshes and Flats

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Mississippi Sound Salt and Brackish Tidal Marsh						X

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

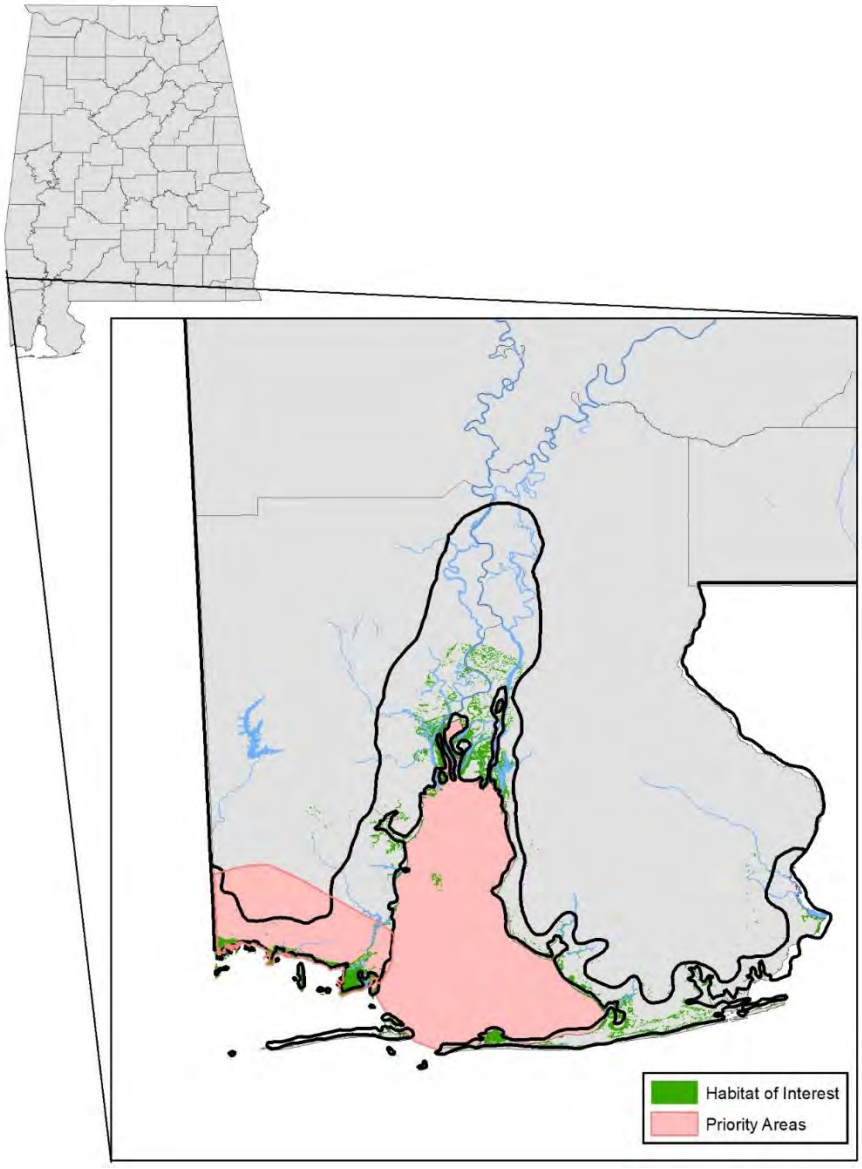


Figure 4-28. Mapped Intertidal Marshes and Flats Habitat and Priority Areas

This habitat supports 10 SGCN (Table 4-27).

Table 4-27. SGCN, Intertidal Marshes and Flats

Scientific Name	Common Name	SGCN Rank
Birds - 8		
Gelochelidon nilotica	Gull-Billed Tern	P2
Ixobrychus exilis	Least Bittern	P2
Laterallus jamaicensis	Black Rail	P2
Rallus elegans	King Rail	P2
Coturnicops noveboracensis	Yellow Rail	P2
Anas fulvigula	Mottled Duck	P2
Ammodramus nelsoni	Nelson's Sparrow	P2
Ammodramus maritimus	Seaside Sparrow	P2
Mammals - 2		
Trichechus manatus	West Indian Manatee	P1
Sylvilagus palustris	Marsh Rabbit	P2

Condition

Non-freshwater marshes surrounding Mobile Bay declined by more than 10,000 acres from 1955 to 1979, representing a loss of 35% (Roach et al. 1987), but that decline has slowed in recent years. The environmental quality of the habitat has deteriorated with increased turbidity and decreases in water quality resulting from dredging, boating activities, and other development pressures.

Problems Affecting Species/Habitat

- Water quality degradation as a result of habitat degradation, nutrient enrichment, pathogens, and toxic chemicals
- Loss of estuarine habitat from sedimentation, hydrologic modifications, filling, trawling, dredging, and invasive species
- Exotic species: tallow tree, torpedo grass, Eurasian water milfoil
- Loss of wetland and shoreline habitat due to weak regulatory monitoring, enforcement and inadequate mitigation practices, and inadequate coastal engineering
- Mortality due to crab traps (diamond-backed terrapins) and trawling (sea turtles)

- Lack of current information on status and distribution of this habitat type
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Impacts from disturbance by allowing foot traffic through sensitive nesting areas
- Insufficient conservation-related education about biologically significant areas and species
- Loss of and disturbance to marine habitat from marine construction projects (e.g., oil and gas pipelines and platforms), dredge material disposal, and bottom tending fishing gear

Priority Research/Survey/Monitoring Needs

Reptiles

- **Mississippi Diamondback Terrapin** – The exact distribution is still relatively unknown. Further systematic field surveys are needed to identify areas where terrapins occur and nest. Several years of field research are needed to locate and assess the distribution of present populations and monitor recruitment and mobility. Conduct basic life history studies, including identification of habitat and activities of juveniles. Investigate the impact of crab traps on this species. The repatriation project currently being condocted by UAB should continue. Measure(s): Data to fill information gaps on ecology and habitat use; threats assessment of crab traps initiated and completed; data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

Birds

- **Black Rail** – Survey potential marsh habitats for this poorly known species. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.
- **Yellow Rail** – Perform stratified, coast-wide surveys in habitats thought to be used to determine presence, particularly on public lands. Once identified, standardized surveys (stratified by habitat type) should be performed to determine population densities, specifically those under different management regimes (e.g., prescribed burn frequencies). Once individuals can be reliably captured, radio-telemetry studies should be initiated at stratified sites to determine microhabitat usage, home range sizes, spatial movements, and estimate winter survivorship. These same techniques should also be

performed at inland historic sites where possible. Finally, surveys of managed wildlife openings during migration may help better understand their importance as temporary stopover sites in Alabama and Mississippi. Once these aspects are better understood, stewardship plans should be developed to help maintain and expand required habitat features at known sites, and enhance new areas where restoration potential exists. Measure(s): Data to shed light on distribution, abundance, and life history in Alabama, identify important wintering areas and migration routes, expand GIS coverages, and generate information to aid land managers.

- **King Rail** – Research is needed to identify potential benefits of natural disturbance regimes, including fires, to King Rails and other wetland species.

- **Gull-billed Tern** – Existing breeding colonies should be monitored yearly to assess population numbers and trends. Annual surveys along the coast should be performed to identify new breeding locations, especially Blakeley Island where nesting once occurred.

- **Nelson's Sparrow** – Identify areas with potential wintering habitat and systematically survey for this species. Relatively easy areas to initiate surveys include coastal marshes associated with Dauphin Island, Heron Bay, and Fort Morgan Peninsula. Conduct research to identify the important features of wintering habitat. Areas that contain populations should be surveyed every two to five years to assess health.
- **Seaside Sparrow** – A population study is needed. Systematic surveys should be conducted to identify breeding locations and estimate population densities of seaside sparrows. Salt marshes to be surveyed should include those in south Mobile County, specifically those of the Dauphin Island Causeway, Heron Bay, Dauphin Island Airport and West End, Saint Andrew's Bay, Oyster Bay near Gulf Shores, and Point Aux Pins.

- **Least Bittern** – Conduct habitat studies of wetland vegetation, water levels, water quality, and minimum wetland needed during nesting, migration, and over-wintering seasons. Studies should examine movements and patterns of habitat use, causes and rates of juvenile and adult mortality, sources of nest failure, renesting ability, juvenile dispersal patterns, and diet. Major stopover sites for overwintering and migration need to be identified. Measure(s): Data to shed light on life history in Alabama, identify important areas, expand GIS coverages, and generate information to aid land managers.

Mammals

- **West Indian Manatee** – Continue partnering with the Mobile Manatees Sighting Network to monitor spatial and temporal habitat occurrence in Alabama waters. Measure(s): Data to fill information gaps to determine abundance, distribution, status

and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Marsh Rabbit** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect, enhance, restore, and manage undeveloped coastal wetlands (EPA 2014). Partners may include MBNEP, Grand Bay NWR, TNC, Coastal Land Trust, Forever Wild, SLD-Coastal and other partners. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Improve water quality by developing allowable water quality-based loadings sufficient to maintain water quality standards (or total maximum daily loads) for pathogens, nutrients, toxic chemicals, and other conventional pollutants, and by support habitat restoration efforts where needed. Partners may include MBNEP, ADEM, NRCS**,** EPA, USACOE**.** Measure(s): ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; effective monitoring protocols established; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Restore natural coastal processes such as tidal overwash, beach accretion and erosion, dune development, and deposition of wrackline materials. The ecological health and natural community integrity of sandy, oceanfront beach and dune habitat requires natural flood regimes. Periodic flooding and tidal processes deposit new materials, creating and maintaining beach, dune, and marsh habitats.

- Dispose of dredge material to benefit nesting turtles. Although dredging degrades habitat quality for some species, spoil piles that are high in sand content can serve as important turtle nesting habitat. Sand can be infrequently deposited outside of the nesting season above the high-water mark mimicking the natural sloped beach and dune profile along the shore, or as created islands.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Maintain and protect all types of coastal wetlands within the MBNEP study area (including quality, function, and value) and increase acreage by 5% of those types that

have declined (EPA 2014). Measure(s): Acres of coastal wetland restored, enhanced, and/or protected by fee-simple or easements.

- Maintain and protect nesting habitat for colonial and migratory birds and reduce declines in nesting habitat due to human disturbance and alteration (EPA 2014). Measure(s): Acres restored, enhanced, and/or protected by fee-simple, easements, or restriction/removal of human disturbance.

- Protect existing natural shoreline, beach and dune habitat and restore previously altered habitats, where feasible, including the rehabilitation of altered shoreline (EPA 2014). Measure(s): Acres of shoreline, beach and dune restored, enhanced, and/or protected by fee-simple or easements.

- Develop and disseminate educational materials, brochures, videos, etc. to educate the public of the value of coastal habitats. Partners may include MBNEP, NRCS, USFWS, and AFC. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets.

- Evaluate and, if appropriate, recommend marine habitats for designation as Marine Protected Areas. Partners may include National Park Service, USFWS, NMFS, GMFMC, GSMFC, and TNC). Measure(s): Acres of habitat protected through Marine Protected Area designation.

- Control/eradicate exotic species such as tallow tree, torpedo grass and Eurasian milfoil. Measure(s): Number of control and/or eradication projects; abundance and distribution of exotic species.

- Designate sanctuaries where crabbing and trawling are prohibited and remove abandoned crab traps to reduce mortality of diamond-backed terrapins and sea turtles. Measure(s): Acres of estuarine and marine habitat protected by prohibition of crab traps and/or trawling; mortality rates of diamond-backed terrapins and sea turtles due to crab traps and trawling.

- Map current distribution of estuarine and marine habitats including coastal wetlands, SAV and shorelines. Measure(s): GIS coverages for this key habitat; data to complete or expand aquatic GAP; data to fill information gaps for mapping abundance and distribution of this key habitat; inclusion in and/or expansion of the Natural Heritage Database.

- **Seaside Sparrow** – Conservation efforts should focus on protecting and maintaining tidal marshes greater than 100 hectares. Habitat management practices should involve creation of a mosaic of nesting and feeding sites. Prescribed burning of marshes (in a mosaic pattern, on a two- to three- year rotation, in fall and winter) may provide optimal breeding habitat, but annual burning of entire marshes to improve waterfowl or other game species habitat should be avoided. Sites with high densities should be protected with conservation easements or direct purchase if not already publicly owned. These include salt marshes of Dauphin Island Airport, south of Alabama Port, Point aux Pins, and the various islands in Mississippi Sound, and others depending on results of surveys. Habitat improvement should be initiated on marginal salt marsh habitats to see if they can be made productive. These may include areas in Perdido Bay.

- **King Rail** – Protect and restore quality habitat on both public and private lands. Conservation planning should target permanent protection of high quality landscapes that currently have, or can be restored to support populations. Areas with populations should be protected from significant modification including dredging, draining, filling and other impacts from development.

- **West Indian Manatee** – Raise public awareness and increase caution by boaters while operating in manatee habitats. Measure(s): Information (signage, flyers); reduction in boat-manatee collisions.

Priority Areas for Conservation Action

- Grand Bay Savanna
- Mobile Bay

John Trent

Seaside and Nelson's Sparrows, Isle Aux Herbes

Cliffs and Rockhouses

Eric Soehren

Figure 4-29. Limestone cliffs at Walls of Jericho, Jackson County

Description and Location

A variety of habitats include rocky cliffs in the mist zones of waterfalls, dry sandstone and limestone escarpments and bluffs above river gorges, talus fields on steep slopes, sheltered, cave-like "rockhouses" of the Southwestern Appalachians, and chalk river bluffs of the Blackland Prairie. Portions of the Southeastern Plains may be nearly lacking these habitats, but the Buhrstone/Lime Hills and Blackland Prairie subdivisions contain numerous examples. Difficult to detect from aerial or satellite imagery, some can be identified from topographic maps. Vegetation is usually sparse, and may consist primarily of lichens, ferns, and small woody shrubs. Where trees occur, they are often stunted, and may represent "hidden old growth" that does not appear to be as old as it is. Occasional rock falls and scouring related to flash floods are natural catastrophic disturbances. Fire probably has little effect on cliffs, which have too little vegetation to carry fire and which tend to occur in topography that is not conducive to fire spread.

This habitat encompasses two NatureServe ecological systems (Table 4-29). Representative high-quality sites include Bankhead National Forest (Winston County), Monte Sano State Park (Madison County), Little River Canyon National Preserve (Dekalb and Cherokee counties), and Walls of Jericho (Jackson County). No SGCN are restricted to this habitat, and relatively few use it, but it is of primary importance to at least three: Allegheny Woodrat, Rafinesque's Big-eared Bat, and Green Salamander.

Condition

These diverse habitats have not received significant study in Alabama, so condition is poorly known. Although some have been impacted by quarrying, impoundments, and development, many remain in good condition due to the ruggedness of the terrain and lack of suitability for agriculture or logging. Some areas are beginning to receive "brow development" pressure, with home sites being placed at the top of cliffs for maximum view. Because of the limited natural disturbance and the fragility of soil and vegetation, human disturbance by trampling edges and by climbing may be particularly destructive.

This habitat supports six SGCN (Table 4 -28).

Table 4-28. SGCN, Cliffs and Rockhouses

Scientific Name	Common Name	SGCN
Amphibians - 1		
Aneides aeneus	Green Salamander	**P2**
Birds - 1		
Corvus corax	Common Raven	EX
Mammals - 4		
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	P1
Myotis leibii	Eastern Small-footed Myotis	P1
Neotoma magister	Allegheny Woodrat	P2
Sorex hoyi	American Pygmy Shrew	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern, EX = Extirpated

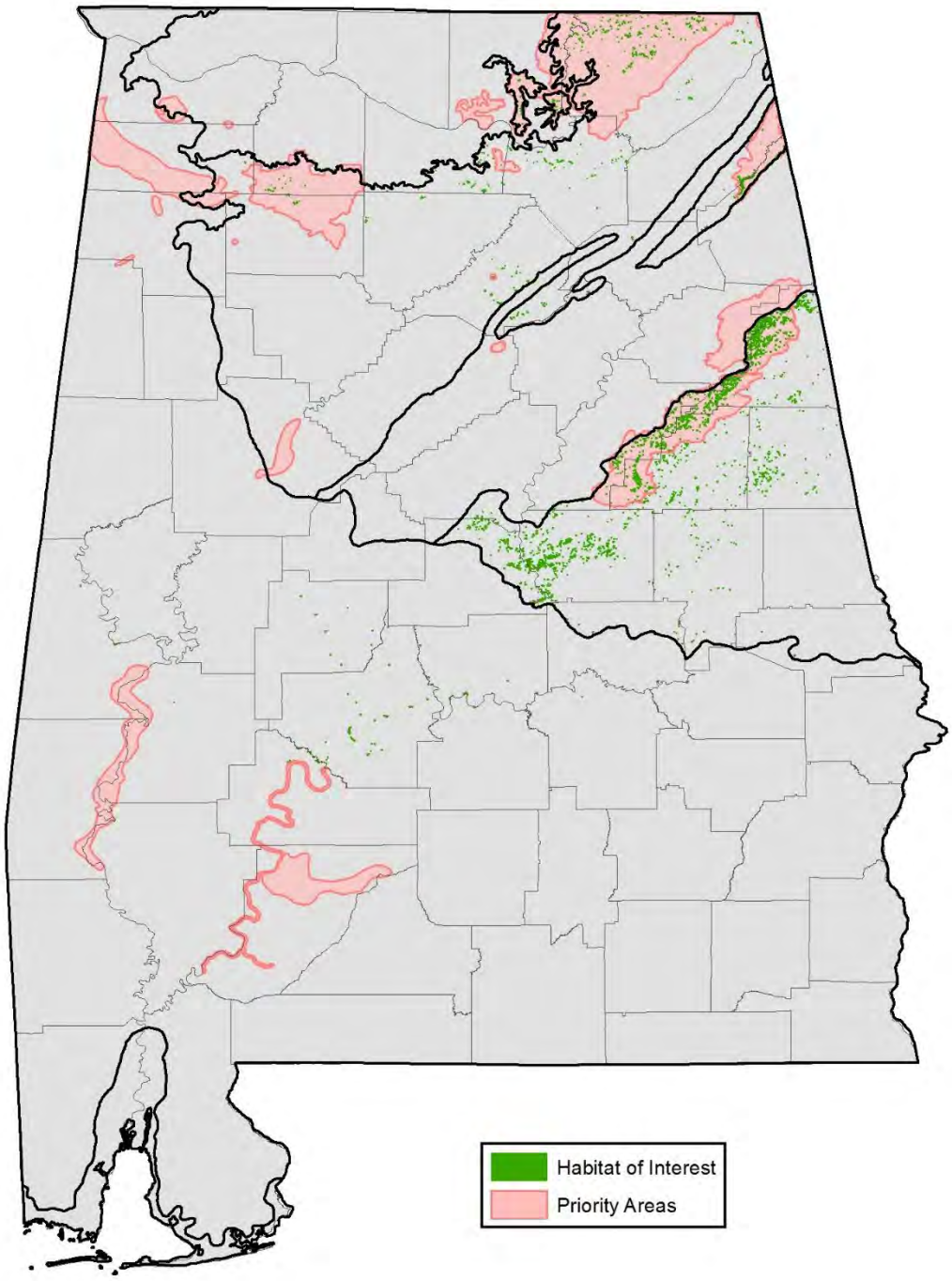


Figure 4-30. Mapped Cliffs and Rockhouses Habitat and Known Priority Areas (some are lacking GIS data)

Table 4-29. Ecological systems encompassed by Cliffs and Rockhouses

	Ecoregion					
	IP	SA	RV	P	SP	SCP
Southern Appalachian Spray Cliff		X	X			
Southern Interior Acid Cliff		X				
Southern Appalachian Montane Cliff and Talus		X				
Allegheny-Cumberland Sandstone Box Canyon and Rockhouse		X				
Southern Interior Calcareous Cliff	X	X				
Southern Interior Sinkhole Wall	X	X	X			
Southern Piedmont Cliff				X		

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

Problems Affecting Species/Habitat

- White-nose syndrome affecting bats
- Quarrying of bedrock from cliff faces
- Impacts to cliffs from recreational climbers
- Impacts to cliff edges from hikers
- Impacts from home construction at tops of escarpments
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Habitat loss and fragmentation due to development

Priority Research/Survey/Monitoring Needs

- Better maps of the distribution of intact cliff and rockhouse communities are needed. A full inventory, classification, and mapping of these habitats should be undertaken as a high priority. Measure(s): Data to fill information gaps for mapping distribution of this habitat; data to expand GIS coverages.

Amphibians

- **Green Salamander** – Surveys of Etowah, Blount, Cullman, Morgan, Limestone, Lauderdale, and Franklin counties are needed to fill gaps in known distribution for this

species. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

Mammals

- **Rafinesque's Big-eared Bat** and **Eastern Small-footed Myotis** – Survey rockhouses, determining degree of importance as roosting/feeding habitat. Conduct surveillance for white-nose syndrome; survey for maternity colony locations; conduct/support research to find a cure/treatment for white-nose syndrome. All species are in need of distribution surveys, investigations of habitat requirements and life histories and long-term quantitative monitoring. Known populations should be censused at least every two years to monitor population trends. Measure(s): Data on population status and distribution to expand GIS coverages, information to ameliorate effects of white-nose syndrome. Measure(s): Data to fill information gaps for mapping distribution; identification of habitat requirements; inclusion in the Natural Heritage database.

- **Allegheny Woodrat** – Survey bluff habitats for this species to better determine status and distribution in Alabama. Measure(s): Data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.

- **American Pygmy Shrew** – Conduct surveys to better determine life history, population trends, distribution, abundance, and habitat use. Measure(s): Data to expand GIS coverages, information to aid land managers.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

- Protect best examples of this habitat (or of lands containing significant examples of this habitat) through acquisition or easement. Partner with USFWS, TNC and other land conservation partners to identify, conserve and restore such tracts. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

- Discourage residential development of bluff lines. Work with local governments to promote restrictive zoning, or to purchase scenic easements, as has been done in other parts of the country. Measure(s): Acres restored, enhanced, and/or protected by easements or restrictive zoning; number of regulatory protections implemented to restrict residential development.

- Support full implementation of the USFS Revised Management Plan, PIF and PARC bird and herpetofauna conservation plans, and all applicable USFWS species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s):

Number of partnerships and/or joint projects with USFS, PIF, PARC, USFWS, and others to fund and/or implement conservation projects for mutually identified species, habitats or needs.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Discourage careless destruction of cliff vegetation by recreational users. Partner with USFS, NPS, and other land managing partners to educate the public of the fragility and significance of these habitats. Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets).

Priority Areas for Conservation Action

- Bankhead/Warrior Mountains
- Bear Creek System
- Black Warrior River Bluffs
- Buttahatchee River Slopes
- Cane Creek/Little Mountain
- Dugger/Talladega Mountains
- Foxtrap Creek
- Franklin/Marion/Jackson Mountains
- Huntsville Mountains
- Little River Canyon
- Lookout and Pigeon Mountains
- Lower Alabama River Bluffs and Swamps
- Natural Bridge
- Newsome Sinks
- Nickajack Cove
- North Fork Creek Glade
- Skirum Bluff
- Talladega Mountains
- Tallahatta Bluffs
- Upper Gurley Creek
- Wheeler NWR / Redstone Arsenal

Conservation Actions for Aquatic SGCN by River Basin

Alabama is home to an unprecedented diversity of aquatic wildlife. Relative to the North American fauna, Alabama harbors 60 percent of all mussel species, 52 percent of all freshwater turtles, 43 percent of all gill-breathing snails, 38 percent of all freshwater fishes, and 20 percent of all crayfishes (Lydeard and Mayden 1995, Schuster and Taylor 2004). Overall, Alabama's aquatic biodiversity is probably greater that any area of comparable size worldwide. This gives the state a central role in the conservation of this North American aquatic fauna.

Unfortunately, Alabama also leads the nation in the extinction of aquatic species. Most of these extinctions are associated with the construction of major navigation and hydroelectric dams in the 20th century. Most major Alabama rivers (Tennessee, Coosa, Tallapoosa, Alabama, Black Warrior, and Tombigbee) are impounded, resulting in loss and fragmentation of riverine habitat and a high incidence of SGCN. Many of these species were formerly widespread but now have highly restricted and isolated distributions. More than 30 species of mussels, snails, and fishes are extirpated from the state.

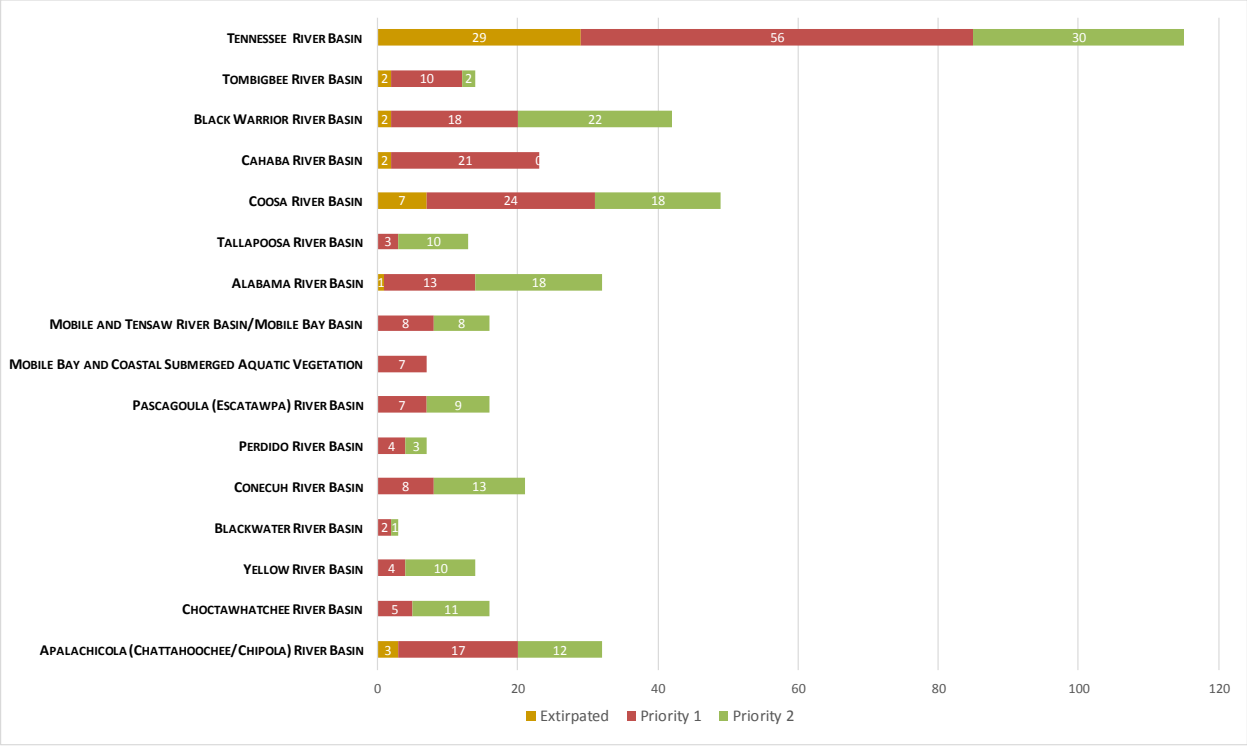
Because degradation of aquatic habitats are a direct threat to freshwater fauna, species recovery is dependent on habitat restoration efforts. Additionally, ADCNR created the Alabama Aquatic Biodiversity Center (AABC) to address long-term research and management needs for imperiled aquatic species (Figure 4-31). A critical mission of the AABC is to initiate new populations of SGCN and threatened and endangered species in improved habitats throughout Alabama. Only by establishing new populations of rare species can recovery truly be achieved. The mechanisms responsible for aquatic habitat loss that directly affect rare aquatic species are outlined below. Improving aquatic habitats is essential for the AABC to fulfill its conservation mission of restoring rare aquatic species.

Figure 4-31. The Alabama Aquatic Biodiversity Center at Marion, Alabama

The river basins of Alabama are generally characterized based on three drainage groups. The Tennessee River basin drains more than 40,000 square miles, including portions of seven states. In Alabama, it drains all or parts of 15 northern counties, encompassing only 13 percent of the state but harboring roughly a third of the state's total SGCN. The Mobile basin also drains an area greater than 40,000 square miles but most of the drainage is within Alabama, making it the state's principal drainage (63 percent of the state). To facilitate conservation planning, the Mobile basin is presented below based on seven sub-basins. The remaining coastal rivers (Chattahoochee, Chipola, Choctawhatchee, Yellow, Blackwater, Conecuh, Perdido, and Escatawpa) drain to the Gulf of Mexico outside of Mobile Bay. Jointly, these coastal rivers drain 24 percent of the state and harbor fewer SGCN than the larger Mobile and Tennessee basins.

Presented below are overviews of Alabama's 15 river basins and estuarine habitat, (Table 4-30) including lists of SGCN, their primary research and monitoring needs, priority conservation actions to benefit SGCN and their habitats, and additional sources of information. The basins are grouped by drainage from north to south and west to east, beginning with the Tennessee basin, then the seven sub-basins of the Mobile basin, then Mobile Bay and coastal estuarine habitats, followed by the remaining seven coastal river basins. All aquatic SGCN are included with the exception of cave dwellers, inhabitants of swamps and ephemeral wetlands, and burrowing crayfishes, which are included in the terrestrial habitats. As in the preceding section, to aid the reader in keeping track of the priority status of species in the text, a color coding system is employed for species names. Gold denotes extirpated; red denotes Priority 1 (Highest Conservation Concern), and green denotes Priority 2 (High Conservation Concern).

Table 4-30. Aquatic SGCN by River Basin and Estuarine Habitat



Overarching conservation actions to benefit aquatic SGCN were presented on pages 104-105. The following actions are broken down into 15 river basins and one estuarine habitat.

Tennessee River Basin

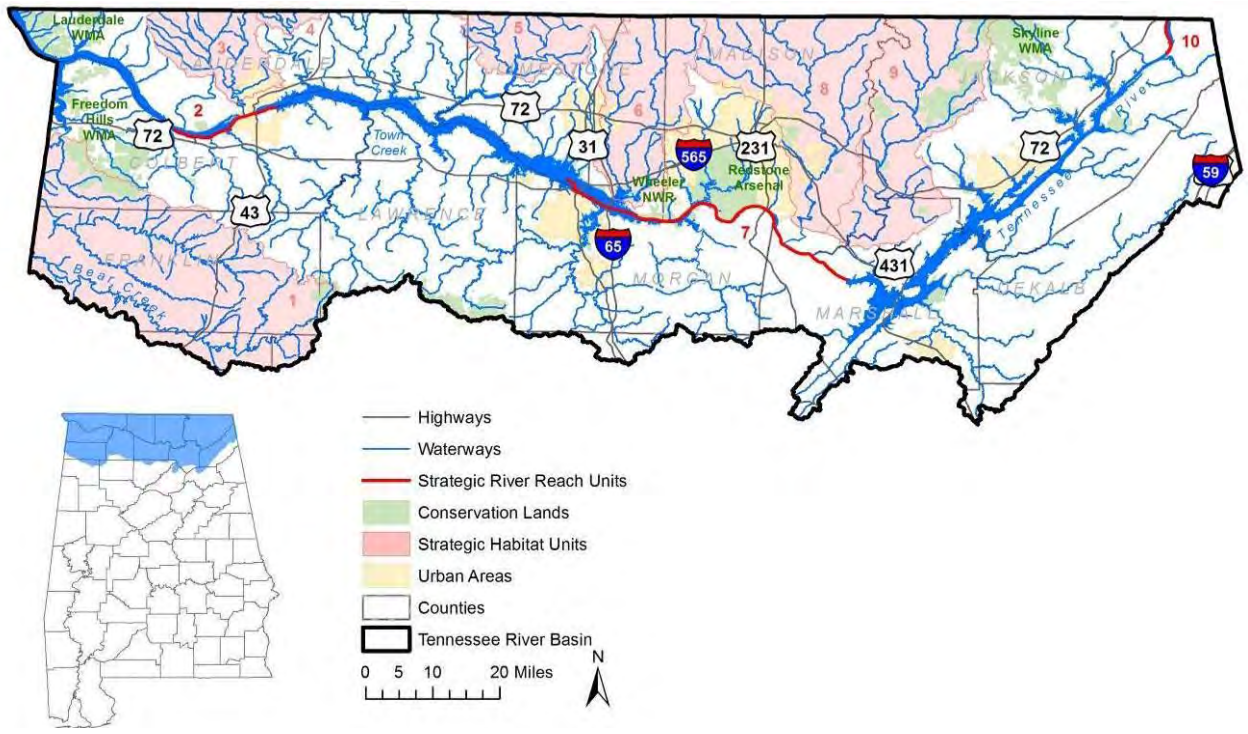


Figure 4-32. Tennessee River Basin

Description and Location

The Tennessee River basin encompasses portions of seven states and drains more than 40,000 square miles. In Alabama, the basin drains 6,826 square miles of 15 northern counties and is largely confined to the Southwestern Appalachians and Interior Plateau. Construction of the Tennessee-Tombigbee Waterway created a link between these two basins, allowing barges to pass from the Tennessee River, through the Tombigbee River, and on to the Gulf of Mexico via the Mobile River and Mobile Bay.

Condition

The Tennessee River basin in Alabama includes seven Strategic Habitat Units and three Strategic River Reaches for aquatic SGCN (Figure 4-32). Impoundment and degradation of the Tennessee River and tributary streams has had a major effect on the aquatic fauna, and this basin supports roughly one-third of all SGCN (terrestrial and aquatic combined) in Alabama. Conservation of this fauna will require enhanced water quality in all major tributary streams and remaining large river habitat, particularly the tailwaters of Wilson and Guntersville dams.

Alan Cressler

Figure 4-33. Hester Creek, Madison County

The 2014 ADEM 303(d) list identifies 24 Tennessee drainage stream segments, encompassing 245 stream miles, as partially or not supporting designated uses. Most impairment is caused by organic enrichment, siltation, and pathogens, and is of agricultural origin.

Impoundments and Other Barriers – All of the mainstem is dammed, with four major impoundments in Alabama: Guntersville (69,100 acres), Wheeler (68,300 acres), Wilson (15,930 acres), and Pickwick (41,515 acres). Four dams are in the Bear Creek sub-basin: Bear (670 acres), Little Bear (1,560 acres), Upper Bear (1,850 acres), and Cedar Creek (4,200 acres). The National Dam Inventory (USACOE 2014) recognizes 85 dams throughout the basin in Alabama. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 49.3% forested, 36.7% agriculture and pasture, 9.5% urban, 4.5% other

Aquatic Taxa

This basin supports 115 SGCN, which is roughly one-third of all SGCN in the state (terrestrial and aquatic combined) (Table 4-31). Boschung and Mayden (2004) recognized 163 fish species native to the Alabama portion of the basin, 73 of which are endemic to the Tennessee River basin. A total of 93 species of freshwater mussels are historically known from Alabama reaches of the Tennessee River basin (Williams et al. 2009) and Smith et al. (2011) recognized 37 crayfish species in the basin.

Table 4-31. Aquatic SGCN, Tennessee River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 50		
Actinonaias pectorosa	Pheasantshell	EX
Dromus dromas	Dromedary Pearlymussel	EX
Epioblasma ahlstedti	Duck River Dartersnapper	EX
Epioblasma capsaeformis	Oyster Mussel*	EX
Epioblasma obliquata	Catspaw*	EX
Lemiox rimosus	Birdwing Pearlymussel*	EX
Leptodea leptodon	Scaleshell	EX
Obovaria olivaria	Hickorynut	EX
Obovaria retusa	Ring Pink	EX
Pegias fabula	Littlewing Pearlymussel*	EX
Plethobasus cooperianus	Orangefoot Pimpleback	EX
Pleurobema clava	Clubshell*	EX
Ptychobranchus subtentus	Fluted Kidneyshell*	EX
Quadrula intermedia	Cumberland Monkeyface*	EX
Quadrula sparsa	Appalachian Monkeyface	EX
Villosa fabalis	Rayed Bean	EX
Villosa trabalis	Cumberland Bean	EXCAU
Actinonaias ligamentina	Mucket	P1
Alasmidonta marginata	Elktoe	P1
Alasmidonta viridis	Slippershell Mussel	P1
Cumberlandia monodonta	Spectaclecase	P1
Cyprogenia stegaria	Fanshell	P1
Elliptio dilatata	Spike	P1
Epioblasma brevidens	Cumberlandian Combshell	P1
Epioblasma triquetra	Snuffbox	P1
Fusconaia cor	Shiny Pigtoe	P1
Fusconaia cuneolus	Finerayed Pigtoe	P1
Fusconaia subrotunda	Longsolid	P1
Hemistena lata	Cracking Pearlymussel	P1
Lampsilis abrupta	Pink Mucket	P1
Lampsilis virescens	Finerayed Pigtoe	P1
Medionidus conradicus	Cumberland Moccasinshell	P1
Obovaria subrotunda	Round Hickorynut	P1
Plethobasus cicatricosus	White Wartyback	P1
Plethobasus cyphyus	Sheepnose	P1
Pleurobema cordatum	Ohio Pigtoe	P1
Pleurobema oviforme	Tennessee Clubshell	P1
Pleurobema plenum	Rough Pigtoe	P1
Pleurobema rubrum	Pyramid Pigtoe	P1
Pleurobema sintoxia	Round Pigtoe	P1

Scientific Name	Common Name	SGCN Rank
Pleuronaia dolabelloides	Slabside Pearlymussel	P1
Ptychobranchus fasciolaris	Kidneyshell	P1
Quadrula cylindrica	Rabbitsfoot	P1
Strophitus undulatus	Creeper	P1
Toxolasma cylindrellus	Pale Lilliput	P1
Lasmigona holstonia	Tennessee Heelsplitter	P2
Ligumia recta	Black Sandshell	P2
Pleuronaia barnesiana	Tennessee Pigtoe	P2
Quadrula metanevra	Monkeyface	P2
Villosa taeniata	Painted Creekshell	P2
Snails – 18		
Io fluvialis	Spiny Riversnail	EX
Leptoxis virgata	Smooth Mudalia	EX
Lithasia curta	Knobby Rocksnail	EX
Rhodacmea hinkleyi	Knobby Ancylid	EX
Athearnia anthonyi	Anthony's Riversnail	P1
Campeloma decampi	Slender Campeloma	P1
Elimia nassula	Round-Ribbed Elimia	P1
Elimia perstriata	Engraved Elimia	P1
Marstonia pachyta	Armored Marstonia	P1
Pleurocera corpulenta	Corpulent Hornsnail	P1
Lithasia armigera	Armored Rocksnail	P2
Lithasia lima	Warty Rocksnail	P2
Lithasia salebrosa	Muddy Rocksnail	P2
Marstonia angulobasis	Angled Marstonia	P2
Marstonia scalariformis	Moss Pyrg	P2
Pleurocera alveare	Rugged Hornsnail	P2
Pleurocera pyrenella	Skirted Hornsnail	P2
Pleurocera striatum	Striate Hornsnail	P2
Crayfishes – 16		
Barbicambarus simmonsi	Tennessee Bottlebrush Crayfish	P1
Cambarus cracens	Slenderclaw Crayfish	P1
Cambarus distans	Boxclaw Crayfish	P1
Cambarus laconensis	Lacon Exit Cave Crayfish	P1
Cambarus pecki	Phantom Cave Crayfish	P1
Cambarus veitchorum	White Spring Cave Crayfish	P1
Orconectes sheltae	Shelta Cave Crayfish	P1
Procambarus viaevirdis	Vernal Crayfish	P1
Cambarus hamulatus	Prickly Cave Crayfish	P2
Cambarus jonesi	Alabama Cave Crayfish	P2
Cambarus longirostris	Longnose Crayfish	P2
Cambarus parvoculus	Mountain Midget Crayfish	P2
Cambarus rusticiformis	Depression Crayfish	P2

Scientific Name	Common Name	SGCN Rank
Cambarus speleocoopi	Sweet Home Alabama Cave Crayfish	P2
Orconectes cooperi	Flint River Crayfish	P2
Orconectes durelli	Saddle Crayfish	P2
Fishes – 30		
Etheostoma cinereum	Ashy Darter	EX
Hiodon alosoides	Goldeye	EX
Lepisosteus platostomus	Shortnose Gar	EX
Notropis ariommus	Popeye Shiner	EX
Noturus crypticus	Chucky Madtom	EX
Scaphirhynchus platorynchus	Shovelnose Sturgeon	EX
Acipenser fulvescens	Lake Sturgeon	EXCAU
Erimonax monachus	Spotfin Chub	EXCAU
Elassoma alabamae	Spring Pygmy Sunfish	P1
Etheostoma wapiti	Boulder Darter	P1
Etheostoma boschungi	Slackwater Darter	P1
Etheostoma camurum	Bluebreast Darter	P1
Etheostoma neopterum	Lollypop Darter	P1
Macrhybopsis hyostoma	Shoal Chub	P1
Notropis albizonatus	Palezone Shiner	P1
Noturus eleutherus	Mountain Madtom	P1
Percina burtoni	Blotchside Darter	P1
Percina phoxocephala	Slenderhead Darter	P1
Percina tanasi	Snail Darter	P1
Phenacobius mirabilis	Suckermouth Minnow	P1
Speoplatyrhinus poulsoni	Alabama Cavefish	P1
Erimystax dissimilis	Streamline Chub	P2
Etheostoma sp. cf. zonistium	Blueface Darter	P2
Etheostoma tuscumbia	Tuscumbia Darter	P2
Etheostoma zonistium	Bandfin Darter	P2
Notropis buchanani	Ghost Shiner	P2
Noturus flavus	Stonecat	P2
Noturus miurus	Brindled Madtom	P2
Percina evides	Gilt Darter	P2
Phenacobius uranops	Stargazing Minnow	P2
Amphibians – 1		
Cryptobranchus alleganiensis	Eastern Hellbender	P1

* Thought to be extirpated from the Tennessee River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundments on the Tennessee River and in the Bear Creek watershed are responsible for loss of most riverine habitat, fragmentation and isolation of streams and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Current distribution and status, as well as knowledge of various aspects of life history and biology, are poorly known for many species.

- Introduction of, or failure to eradicate or control, non-native crayfish, mussels, and fishes.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Annual quantitative monitoring is needed in Wilson Dam tailwaters, a Paint Rock River survey, and permanent mussel sampling stations on Bear Creek and Elk River. Conduct life history investigations and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, and continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, and upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Birdwing Pearlymussel**, **Dromedary Pearlymussel**, **Oyster Mussel**, and **Duck River Dartersnapper** - Tennessee basin endemics, extirpated from Alabama portion of the basin. Continue monitoring efforts for the reintroduced Oyster Mussel populations in the Paint Rock River. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Assessment of status and/or condition of transplanted mussels; identification of needed conservation actions including additional population augmentation and/or reintroduction; inclusion in the Natural Heritage database.

- **Cumberland Monkeyface**, **Catspaw**, **Clubshell**, **Cumberland Bean** – Extirpated from Alabama portion of Tennessee basin. Approved for Wilson Dam Nonessential Experimental Population. Basic life history studies are needed to determine if appropriate habitat and glochidial host(s) exist in Wilson Dam tailwaters. If warranted, a captive propagation program will be necessary using parent stock from the nearest source. Cumberland Bean reintroduction efforts are underway in the Paint Rock River. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection; identification and mapping of remaining habitats and identification of potential glochidial host(s) in Wilson Dam tailwaters; assessment of need for a captive propagation program, and if necessary, establishment of such a program.

- **Hickorynut** – Historically located in the mainstem Tennessee River, with sturgeon (Lake, Shovelnose) as the only known host fishes. Elimination of host fishes is likely cause of loss in Tennessee River basin. Lake Sturgeon reintroduction effort is ongoing, which if successful could make future Hickorynut reintroductions a possibility.

- **Pheasantshell** – Recently found in Paint Rock RIver and Elk River (TN) monitoring. Continue periodic evaluation of populations in the Paint Rock and Elk rivers. Measure(s): Data to fill information gaps for identification and GIS mapping of key habitats for possible reintroduction.

- **Duck River Dartersnapper** – Survey Wilson Dam tailwaters for potential host fishes and continue reintroduction efforts if deemed feasible.

- **Birdwing Pearlymussel** – Survey Wilson Dam tailwaters for potential host fishes.

- **Clubshell** – Most likely broodstock is in Pennsylvania and there is currently no cooperative aggreement with that state for mussel conservation. The phylogenetic relationship between Clubshell and Tennessee Clubshell needs to be resolved.

- **Fluted Kidneyshell**, **Cumberland Monkeyface**, **Appalachian Monkeyface** – Partner with TWRA to find sufficient broodstock for life history and if feasible captive propagation. Study life history to determine glochidial hosts and perfect culture techniques at AABC. Survey Wilson Dam tailwater for potential hosts. Measure(s): Knowledge of species' life history and biology to allow managers, field biologists, and others to identify conservation actions and make informed decisions regarding protection; determination of feasibility of establishing a perpetual population in Wilson Dam tailwaters; assessment of need for a captive propagation program, and if so, establishment of such a program.

- **Orangefoot Pimpleback**, **Ring Pink**, **Clubshell**, **Pyramid Pigtoe**, **Sheepnose**, **White Wartyback**, **Longsolid**, **Ohio Pigtoe**, **Rough Pigtoe**, **Round Pigtoe** – Study nutritional and

water quality requirements of these big-river habitat specialists to develop techniques for maintaining adults and juveniles in captivity. Study life history and perfect culture techniques at AABC. Determine factors causing mussel decline in Guntersville Dam tailwater. Survey tailwaters of Wilson, Guntersville, and Nickajack dams for suitable host fishes. Measure(s): Kowlege of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection and potential reintroductions.

- **Alabama Lampmussel**, **Cumberlandian Combshell**, **Cracking Pearlymussel**, **Shiny Pigtoe**, **Finerayed Pigtoe**, **Pale Lilliput** – In Alabama, extant at only one stream or stream reach in the Tennessee basin. Approved for Wilson Dam Nonessential Experimental Population. Basic life history studies are needed to determine if appropriate habitat and glochidial host(s) exist in Wilson Dam tailwaters. If warranted, a captive propagation program will be necessary (one is already underway for Alabama Lampmussel). Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection; identification and mapping of remaining habitats and identification of glochidial host(s) in Wilson Dam tailwaters; assessment of need for a captive propagation program, and if necessary, establishment of such a program.

- **Slippershell Mussel** – Study life history and work out propagation techniques. Assess status of Flint River population and collect broodstock if possible.

- **Fanshell** – Determine if this species is extant in Wilson Dam tailwaters, consider augmentation if sufficient native broodstock can be found.

- **Cumberlandian Combshell** – Survey Wilson and Guntersville dam tailwaters for host fishes. Address sedimentation and water quality issues in Bear Creek. TVA and partners have an initiative to improve habitat and water quality underway.

- **Snuffbox** – Continue monitoring Elk and Paint Rock populations. Assess feasibility of reintroduction into lower Bear Creek, Colbert County.

- **Shiny Pigtoe**, **Slabside Pearlymussel**, **Tennessee Clubshell**, **Spectaclecase** – Perfect culture techniques at AABC.

- **Finerayed Pigtoe** – Perfect culture techniques at AABC, assess the status in Paint Rock River.

- **Longsolid** – Determine the status of this species in Wilson Dam tailwaters, where it may no longer occur.

- **Round Pigtoe** – Perfect culture techniques at AABC. Search Wilson Dam tailwaters for broodstock. Assess status of this species in Wilson and Guntersville dam tailwaters.

- **Tennessee Heelsplitter** – Determine systematic relationships within this species complex (Tennessee Heelsplitter, Barrens Heelsplitter, Etowah Toesplitter). Complete survey/status review. Measure(s): Data to fill information gaps to determine systematic relationships, abundance, distribution, status, and condition, allowing identification of needed conservation actions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database

- **Tennessee Pigtoe** – Study life history and determine hosts. Perfect culture techniques at AABC. Assess systematic relationships among various morphological forms from different drainages. If cryptic species are discovered with the systematic assessment, determine their geographical ranges.

- **Monkeyface** – Perfect culture techniques at AABC. Determine systematic relationships between Tennessee drainage and Mobile Basin populations.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Spiny Riversnail** – Tennessee basin endemic of which Alabama was on the periphery of its historical range; extirpated from the Alabama portion of the basin. An attempt to reintroduce to Nickajack Dam tailwaters was apparently unsuccessful and there are no plans to continue culture or releases.

- **Knobby Rocksnail** – Tennessee basin endemic, extirpated from Alabama portion of the basin and possibly extinct. In cooperation with other interested parties, conduct a survey of Kentucky Dam and Pickwick Dam tailwaters to determine if it is extant. If a population is found and it proves to be specifically valid, initiate a captive breeding program to reintroduce to Wilson Dam tailwaters and Shoal Creek. Recovery work is contengent on final taxonomic determination. Measure(s): Determination of its continued existence and systematic relationships with similar species; establishment of captive propagation

program if warranted; number of snails produced and reintroduced into Wilson Dam tailwaters and Shoal Creek.

- **Anthony's Riversnail** – Extant at only two locations in Alabama portion of Tennessee basin. Approved for Wilson Dam Nonessential Experimental Population and initial reintroductions made. Continue to monitor NEP and augment with additional transplants from Limestone Creek. Measure(s): Assessment of status and/or condition of transplanted snails; identification of needed conservation actions including additional population augmentation and/or reintroduction and a captive propagation program; inclusion in the Natural Heritage database.

- **Corpulent Hornsnail** – Conduct a thorough survey of Nickajack Dam tailwaters to determine its extent and status. Develop culture protocols and initiate captive propagation at AABC. Conduct trial reintroductions in Guntersville and Wilson Dam tailwaters to test feasibility large-scale reintroductions for establishment of new populations. *Products(s)*: Data to fill information gaps for mapping distribution; establishment of a captive rearing program; number of snails produced and reintroduced into Guntersville and Wilson Dam tailwaters.

- **Corpulent Hornsnail, Engraved Elimia, Round-Ribbed Elimia, Warty Rocksnail, Skirted Hornsnail, Muddy Rocksnail** – Clarify taxonomic status relative to similar species using morphological and genetic analyses. Measure(s): Clarified taxonomic status.

Crayfishes

- **All SGCN** have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and investigate life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

    - **Tennessee Bottlebrush Crayfish** – More survey work needed to determine additional localities in the unimpounded section of Shoal Creek. Targeted sampling in large rock habitats in nearby Cypress Creek may reveal additional populations. Excessive sediment inputs can be detrimental because this species often lives beneath large slab rock boulders. Agricultural land use requires maintenance of riparian areas along Shoal Creek and tributaries to reduce sediment.

    - **Slenderclaw Crayfish** – An in-depth canoe and/or wading survey in each of the streams where it was historically collected is desperately needed. Kilburn et al. (2012) sampled all of the bridge crossings in 2009 and 2011; however, it is necessary to survey longer reaches of these streams.

- **Phantom Cave Crayfish** – Key Cave, one of the three caves supporting known populations, is within Key Cave National Wildlife Refuge. The water quality and hydrology of this cave remains subject to the effects of agricultural, urban, and industrial development (Kuhajda 2004). Little is known about potential threats to populations in McKinney Pit and Cave Spring caves. Known populations should be monitored to assess long-term population trends and identify habitat degradation.

- **White Spring Cave Crayfish** – An intensive long- term survey of White Spring Cave and nearby caves is necessary to more accurately determine the status of this species.

- **Shelta Cave Crayfish** – Entrances to Shelta Cave, the only location documented for this species, are gated and access is strictly controlled by the National Speleological Society. Nevertheless, this cave and its recharge area are in an urbanized region of Huntsville and potential threats due to groundwater contamination remain. Groundwater quality and supply to Shelta Cave should be monitored and periodically assessed for potential threats to cave biota. An intensive long-term survey of Shelta Cave and nearby caves should be initiated to more accurately determine the status of this species.

- **Alabama Cave Crayfish** – Populations in cave systems with recharge areas potentially affected by ongoing and future urbanization and suburbanization should be monitored to assess long-term trends and the potential for groundwater contamination or changes in supply.

- **Longnose Crayfish** – Maintenance of riparian buffers is important since this species seems to primarily occur in cavities beneath slab rock in riffle areas.

- **Mountain Midget Crayfish** – Additional sampling in appropriate habitats would likely reveal additional populations within the currently known range in Alabama.

- **Flint River Crayfish** – Urbanization of the Flint River system by the rapidly expanding Huntsville and Madison metropolitan areas should be monitored and steps taken to minimize impacts to the drainage.

Fishes

- **All SGCN –** Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fishes, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Ashy Darter** – Extirpated from Alabama portion of Tennessee basin. Conduct a comprehensive survey for potential reintroduction sites. If sites are found, a captive propagation program will be needed to supply individuals for reintroduction. Measure(s): Data to fill information gaps for site identification and GIS mapping of key habitats for possible reintroduction.

- **Blotchside Darter, Palezone Shiner, Boulder Darter, Lollypop Darter, Snail Darter, Bluebreast Darter** – Extant in the Alabama portion of the Tennessee basin at only one known sub-watershed each. Conduct a comprehensive inventory and evaluate population viability. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; a population viability analysis; inclusion in the Natural Heritage database.

- **Slackwater Darter, Slenderhead Darter, Bandfin Darter, Blueface Darter, Gilt Darter** – Extant in the Alabama portion of the Tennessee basin at fewer than ten known locations each. Conduct a comprehensive inventory, and evaluate population viability. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; a population viability analysis; inclusion in the Natural Heritage database.

- **Blueface Darter, Tuscumbia Darter** – Determine systematic relationships among populations of Blueface and Tuscumbia Darters using morphological and genetic analyses. Measure(s): Determination of systematic relationships among populations of Blueface and Tuscumbia Darters.

Amphibians

- **Eastern Hellbender** – Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of this species, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Tennessee River Basin Management Plan (TRCWP 2003), including all existing Tennessee drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of SGCN and their habitats. Measure(s): Number of Management Plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes and full compliance with water quality standards by TVA at Tennessee River, Elk River, and Bear Creek watershed dams. In particular, the tailwaters of Wilson and Guntersville dams are critical to the recovery of more SGCN than any other sites in Alabama. Measure(s): Number of dams operated with more natural flow regimes; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by TVA, ADEM, local governments, Clean Water Partnership, ARSN, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Support expansion of the Wheeler National Wildlife Refuge to include lower reaches of Limestone and Piney creeks by working with the USFWS, Forever Wild, TNC, and other partners. Measure(s): Acres and stream miles added to the refuge and/or protected by fee-simple or easements.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The most critical sites for the conservation of mussels in the Tennessee basin are the tailwaters of Wilson and Guntersville dams, the Paint Rock River, and Bear Creek. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, TVA, USFWS, and other partners. Habitat in Shoal Creek has improved and could be an important stream for reintroductions, but without navigable waterway designation the bottom is not state-owned and reintroductions cannot occur without landowner cooperation. Measure(s): Population status and condition of SGCN mussels in the river basin; number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

    - **Dromedary Pearlymussel**, **Littlewing Pearlymussel**, **Cumberland Monkeyface**, **Fluted Kidneyshell** – Establish two or more reproducing populations.

- **Duck River Dartersnapper** – Establish two or more reproducing populations. Reintroduce wild-caught adults and/or captive-propagated juveniles into Bear and Shoal creeks.

- **Oyster Mussel** – Reintroduce wild-caught adults and/or captive-propagated juveniles into Elk and Paint Rock rivers (including Estill Fork as part of the latter).

- **Catspaw** – Establish a cooperative agreement with Ohio culture facilities in order to procure broodstock or cultured juveniles.

- **Birdwing Pearlymussel** – Establish a reproducing population in Wilson Dam tailwater.

- **Scaleshell** – Establish partnership with agencies in Missouri for broodstock and establish a captive propagation program.

- **Ring Pink**, **Orangefoot Pimpleback** – Reintroduce into Wilson Dam tailwaters; determine and mitigate causal factors responsible for mussel declines in Guntersville Dam tailwaters and test feasibility of reintroductions there.

- **Clubshell** – Establish a reproducing population in Wilson Dam tailwaters. Most likely broodstock is in Pennsylvania and there is currently no cooperative aggreement with that state for mussel conservation.

- **Appalachian Monkeyface** – Reintroduce captive-propagated juveniles into Elk River and other streams if deemed warranted. Establish one or more reproducing populations.

- **Pheasantshell**, **Mucket**, **Snuffbox**, **Shiny Pigtoe**, **Finerayed Pigtoe**, **Longsolid**, **Rough Pigtoe**, **Pyramid Pigtoe**, **Slabside Pearlymussel**, **Alabama Lampmussel**, **Tennessee Heelsplitter**, **Rabbitsfoot**, **Cumberland Moccasinshell** – Establish two or more additional reproducing populations.

- **Elktoe** – Establish reproducing populations in Elk River and possibly Bear Creek. Augment Paint Rock River population if broostock from that stream can be found.

- **Slippershell Mussel** – Augment Flint River population (and establish in additional tributaries) if sufficient broodstock can be found.

- **Fanshell** – Consider augmentation in Wilson Dam tailwaters if sufficient native broodstock can be found. Reintroduce captive-propagated juveniles into Elk River.

- **Spike** – Increase density in Paint Rock River and Wilson Dam tailwater populations. Establish one or more additional reproducing populations, potentially in Bear Creek.

- **Cumberlandian Combshell** – Establish two or more additional reproducing populations. Elk and Paint Rock rivers have highest potential for success. Address sedimentation and water quality issues in Bear Creek. TVA and partners have an initiative underway for water quality and habitat improvements.

- **Cracking Pearlymussel** – Reintroduce captive-propagated juveniles into Wilson Dam tailwaters and other selected areas.

- **Pink Mucket** – Reintroduce captive-propagated juveniles into lower reaches of Paint Rock River, where species presently occurs. Establish one or more additional reproducing populations.

- **Round Hickorynut** – Determine the necessity of augmenting the Paint Rock River population. Establish two or more additional reproducing populations.

- **White Wartyback**, **Sheepnose**, **Ohio Pigtoe**, **Round Pigtoe**, **Pyramid Pigtoe**, **Rough Pigtoe**, **Kidneyshell**, **Monkeyface** – Increase population densities in Wilson Dam tailwaters using captive-propagated juveniles; determine and mitigate causal factors responsible for mussel declines in Guntersville Dam tailwaters and test feasibility of reintroductions there.

- **Creeper** – Augment Bear Creek population. Establish one or more additional reproducing populations using juveniles propagated from Bear Creek broodstock.

Snails

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. Critical sites for the conservation of snails in the basin are some tributaries and the tailwaters of the Tennessee River dams. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, University of Alabama, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN snails in the basin; if necessary, number of snails reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfish in the river basin; number of known interbasin transfers.

Fishes

- **Ashy Darter**, **Blotchside Darter**, **Palezone Shiner**, **Boulder Darter**, **Lollypop Darter**, **Snail Darter**, **Bluebreast Darter**, **Slackwater Darter**, **Slenderhead Darter**, **Bandfin Darter**, **Blueface Darter**, **Gilt Darter** – These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN fishes in the river basin; if necessary, number of fish reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Bear Creek Strategic Habitat Unit (SHU #1)
- Tennessee River-Wilson Dam Tailwater Strategic River Reach Unit (SRRU #2)
- Cypress Creek Strategic Habitat Unit (SHU #3)
- Shoal Creek Strategic Habitat Unit (SHU #4)
- Elk River Strategic Habitat Unit (SHU #5)
- Limestone, Piney, Beaverdam Creeks Strategic Habitat Unit (SHU #6)
- Tennessee River-Guntersville Dam Tailwater Strategic River Reach Unit (SRRU #7)
- Flint River Strategic Habitat Unit (SHU #8)
- Paint Rock River Strategic Habitat Unit (SHU #9)
- Tennessee River-Nickajack Dam Tailwater Strategic River Reach Unit (SRRU #10)

Tombigbee River Basin

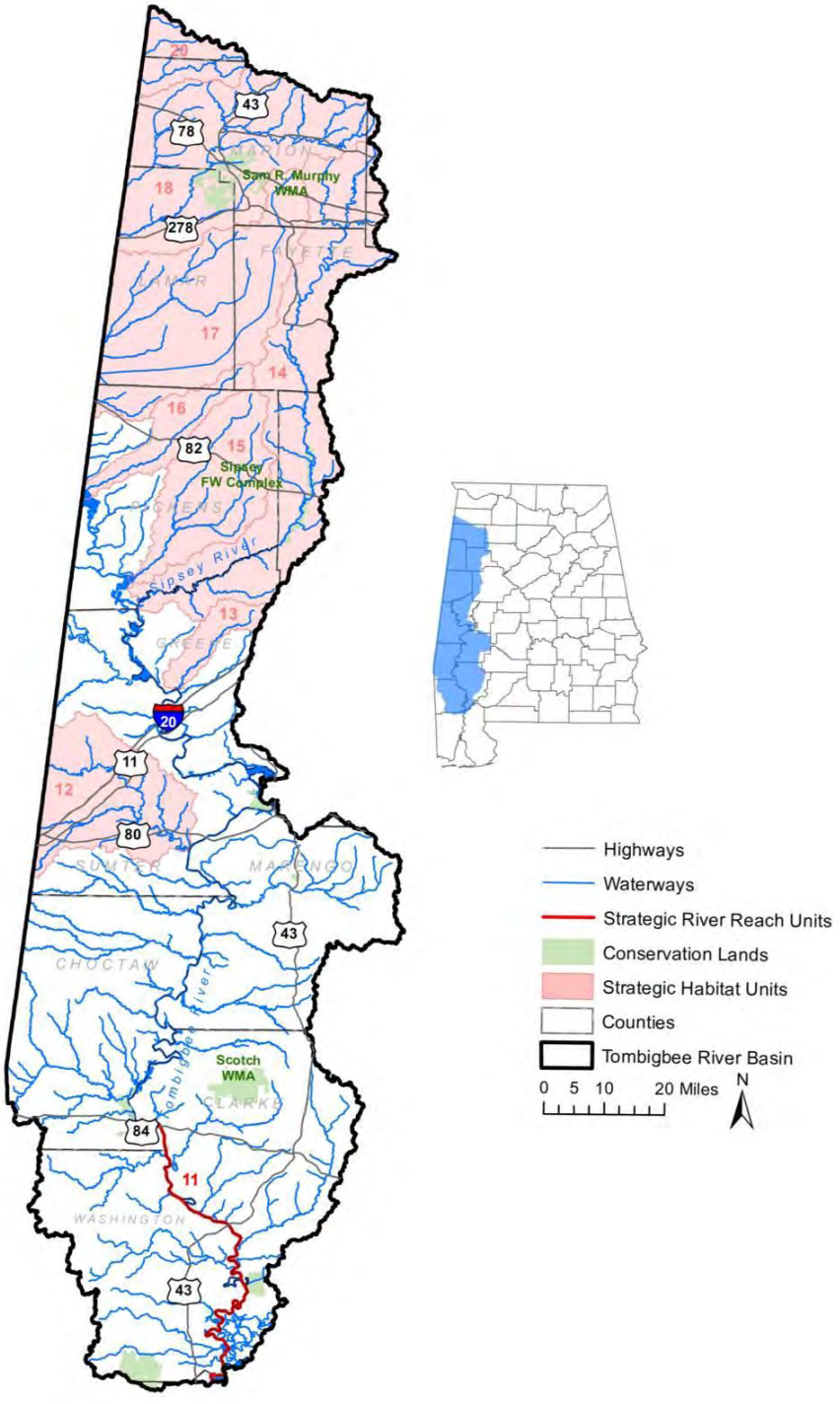


Figure 4-34. Tombigbee River Basin

Eric Soehren

Figure 4-35. Tombigbee River chalk bluffs, Sumter County

Description and Location

The Tombigbee River flows generally south through east Mississippi and west Alabama, is joined by the Black Warrior River at Demopolis, and at its confluence with the Alabama River, forms the Mobile River. The Tombigbee River Basin drains 13,756 square miles, of which 7,660 square miles are in Alabama. The basin is almost entirely contained within the Southeastern Plains. Construction of the Tennessee-Tombigbee Waterway created a link between these two basins, allowing barges to pass from the Tennessee River through the Tombigbee River to the Gulf of Mexico via the Mobile River and Mobile Bay.

Condition

The Tombigbee River basin in Alabama includes eight Strategic Habitat Units and one Strategic River Reach for aquatic SGCN (Figure 4-34). The 2014 ADEM 303(d) list identifies 54 miles of six streams in the Tombigbee basin that only partially support their designated uses, due to organic enrichment, metals and pH. Portions of Gainesville and Coffeeville reservoirs are impaired due to atmospheric deposition of mercury and the 86-acre Olin Basin in Washington County is impaired due to mercury and pesticides (DDT) in contaminated sediments.

Impoundments and Other Barriers – Four impoundments are on the mainstem in Alabama; Aliceville (8,300 acres), Gainesville (6,400 acres), Demopolis (10,000 acres), and Coffeeville (8,800

acres). Three additional impoundments and five locks are upstream in Mississippi. The National Dam Inventory (USACOE 2014) recognizes 792 dams throughout the basin in Alabama. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 80.8% forested, 13.5% agriculture and pasture, 4.2% urban, 1.5% other

Aquatic Taxa

There are 31 aquatic SGCN in the Tombigbee River basin in Alabama (Table 4-32). Boschung and Mayden (2004) recognized 139 fish species native to the basin, seven of which are marine and frequently enter the lower reaches. A total of 40 and 51 mussel taxa are historically known from the lower and upper Tombigbee basins, respectively (Williams et al. 2008). Smith et al. (2011) recognized 31 native crayfish species in the basin.

Table 4-32. Aquatic SGCN, Tombigbee River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 15		
Epioblasma penita	Southern Combshell	EXCAU
Pleurobema curtum	Black Clubshell*	EX
Elliptio arca	Alabama Spike	P1
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema perovatum	Ovate Clubshell	P1
Pleurobema taitianum	Heavy Pigtoe*	P1
Ptychobranchus greenii	Triangular Kidneyshell	P1
Anodontoides radiatus	Rayed Creekshell	P2
Elliptio arctata	Delicate Spike	P2
Hamiota perovalis	Orangenacre Mucket	P2
Ligumia recta	Black Sandshell	P2
Obovaria unicolor	Alabama Hickorynut	P2
Pleurobema decisum	Southern Clubshell	P2
Potamilus inflatus	Inflated Heelsplitter	P2
Quadrula metanevra	Monkeyface	P2
Snails – 1		
Pseudotryonia grahamae	Salt Spring Hydrobe	P1
Crayfishes – 8		
Cambarellus lesliei	Angular Dwarf Crayfish	P1
Hobbseus prominens	Prominence Riverlet Crayfish	P2
Procambarus clemmeri	Cockscomb Crayfish	P2
Procambarus h. hagenianus	Southeastern Prairie Crayfish	P2
Procambarus hayi	Straightedge Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2

Scientific Name	Common Name	SGCN Rank
Procambarus lagniappe	Lagniappe Crayfish	P2
Procambarus lecontei	Mobile Crayfish	P2
Fishes – 6		
Alosa alabamae	Alabama Shad*	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Scaphirhynchus suttkusi	Alabama Sturgeon	P1
Acantharchus pomotis	Mud Sunfish	P2
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

* Thought to be extirpated from the Tombigbee River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundment of the Tombigbee River in conjunction with the construction of the Tennessee-Tombigbee Waterway is responsible for loss of most riverine habitat, excessive bank erosion, fragmentation and isolation of streams and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management and urbanization of the watershed.

- Habitat degradation and alteration from river dredging operations and dredged material disposal, channelization, and desnagging.

- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for many species.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host

assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; host fish population availability assessment; inclusion in the Natural Heritage database.

- **Black Clubshell** – Tombigbee River endemic, likely extinct, with no suitable habitat remaining in Alabama. East Fork Tombigbee River (in Mississippi) is apparently the last potential stream for supporting this species but it was surveyed by ACRL in 2013 and not found. USFWS 5-year review (2009) recommended monitoring East Fork Tombigbee River (Mississippi) for another 10 years before declaring extinct. No inventory, monitoring, or research activities are recommended in Alabama at this time.

- **Southern Combshell** – Only extant in Lower Buttahatchee River but a reintroduction effort (in Cahaba River) is underway. Periodic monitoring was completed during brood stock collection. Quantitative assessment planned for 2014. Fish host trials completed, propagation program initiated, captive ark population established, Conduct a comprehensive inventory to determine its upstream extent, including evaluation of population viability and identification of potential reintroduction sites. Measure(s): Data to fill information gaps for mapping distribution; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions.

- **Triangular Kidneyshell** – Outside the Warrior Basin, Coalfire Creek is the only recent Tombigbee River Basin locality, and monitoring efforts should be focused outside the Warrior Basin. Conduct and inventory to determine extent of populations, including quantitative assessments to determine viability, potential reintroduction sites, and host fish availability. Measure(s): Data to fill information gaps for mapping distribution and identification of glochidial host(s); a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction.

- **Ovate Clubshell** – A new population in Wilson Creek, Lamar County, was located. Population density / dynamics is completed for Sipsey River population. Host fish work is completed. Conduct distribution-wide inventory of species. Conduct life history and ecology studies to determine optimum habitat parameters. Survey for potential reintroduction sites and host fish availability. Measure(s): Data to fill information gaps for mapping distribution of this GCN mussel; knowledge of species' life history, biology and habitat requirements to allow land managers, field biologists, and others to

identify needed conservation actions and make informed decisions regarding protection; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction.

- **Heavy Pigtoe** – This large river species has not been encountered in the Tombigbee River since shortly after completion of Tenn-Tom Waterway, and deleting this species from Tombigbee River monitoring and assessment is recommended. The mussel bed containing the only known remaining populatiton (Alabama River) was delineated and quantitatively assessed in 2010.

- **Delicate Spike** – Resolve taxonomic problems regarding similar species populations in Gulf Coast drainages (this is being conducted by ACRL). Improve monitoring efforts within the Tombigbee Basin, focusing monitoring efforts outside the Warrior and Sipsey river basins, the only basins where the species has recently been found. Conduct an inventory of populations to determine distribution; include quantitative assessment to ascertain viability. Conduct life history and ecological studies. Measure(s): Resolution of taxonomic issues; data to fill information gaps for mapping distribution of this GCN mussel; knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of Delicate Spike; a population viability analysis.

- **Rayed Creekshell**, **Orangenacre Mucket** – Assessment in basin was completed by GSA and U.S. Forest Service in 2004. Host fish work is completed for Orangenacre Mucket. Initial fish host identification for Rayed Creekshell was completed at AABC. Artificial propagation is completed for Orangenacre Mucket. Survey for potential reintroduction sites and host fish availability. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection; identification and GIS mapping of key habitats for possible reintroduction.

Snails

- **Salt Spring Hydrobe** – Described in 2001, known from a single population on ADCNR's Fred T. Stimpson Wildlife Sanctuary in Clarke County. Periodically monitor the Salt Spring population, collect habitat, demographic, and life history data, and search for additional populations in Tombigbee River basin. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Crayfishes

- **All SGCN** have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

    - **Angular Dwarf Crayfish** – Inventory work is needed to determine the current status and range of this species and other dwarf crayfishes in Alabama.

    - **Prominence Riverlet Crayfish** – Most records are over 35 years old. All of the historic locations should be surveyed and an effort to find potential new sites be undertaken.

    - **Smoothnose Crayfish** – Further research on potential threats, population trends, and extent of range are needed due to its limited distribution and possible decline in Alabama.

    - **Cockscomb Crayfish** – Life history data are needed. Additional sampling in appropriate habitats within known range could provide population information for the species

    - **Southeastern Prairie Crayfish** – Virtually nothing known about this species. Survey work is needed to determine the distribution and status of this species in Alabama.

    - **Straightedge Crayfish** – Life history data are badly needed for this species. Further sampling is necessary to determine the extent of its current range in Alabama. Further research needed to determine specialized needs and impacts or threats to habitat.

    - **Lagniappe Crayfish** – Life history data are badly needed for this species. Additional sampling in appropriate habitat could update information on the current distribution and abundance.

    - **Mobile Crayfish** – No life history data currently available. Additional sampling and surveys specifically in streams in Mobile and Washington counties is needed.

Fishes

- **All SGCN** should be comprehensively surveyed at 5 to 10 year intervals, including investigations of life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN fishes, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Alabama Sturgeon** – Continue to sample for this species; use eDNA to target additional sites for collection; establish a broodstock if reproductively active adults can be collected. Measure(s): Establishment of captive population; number of fish propagated and reintroduced.

- **Ironcolor Shiner** – Continue efforts to locate a population to serve as a broodstock source for possible propagatons and re-introductions. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Rainbow Snake** – Historic but possibly extirpated from the basin due to dams on the lower Tombigbee restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Mobile Basin Recovery Plan and the Alabama-Tombigbee Basins Management Plan Draft. Measure(s): Number of management plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes and full compliance with water quality standards by COE at Tombigbee River dams. Measure(s): Number of dams operated with more natural flow regimes; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed, particularly bank stabilization of Tombigbee River impoundments, by COE, ADEM, AFC, NRCS, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs

utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- Most SGCN may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

- **Alabama Sturgeon, Alabama Shad** – Fish passage should be provided by COE at Tombigbee River dams to provide access to historic habitat. Measure(s): Number of fish passages installed at dams on the Tombigbee River.

- **Alabama Sturgeon, Ironcolor Shiner** – These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition, number reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Gulf Sturgeon** – Fish passage should be provided by COE at Tombigbee River dams to provide access to historic habitat. Measure(s): Number of fish passages installed at dams on the Tombigbee River.

- **Bluenose Shiner** – May require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition, number reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Lower Tombigbee Strategic River Reach Unit (SRRU #11)
- Sucarnochee River Strategic Habitat Unit (SHU #12)
- Trussells Creek Strategic Habitat Unit (SHU #13)
- Sipsey River Strategic Habitat Unit (SHU #14)
- Lubbub Creek Strategic Habitat Unit (SHU #15)
- Coalfire Creek Strategic Habitat Unit (SHU #16)
- Luxapallila Creek Strategic Habitat Unit (SHU #17)
- Buttahatchee River Strategic Habitat Unit (SHU #18)
- Bull Mountain Creek Strategic Habitat Unit (SHU #20*)

* SHU #19 lies entirely in Mississippi

Black Warrior River Basin

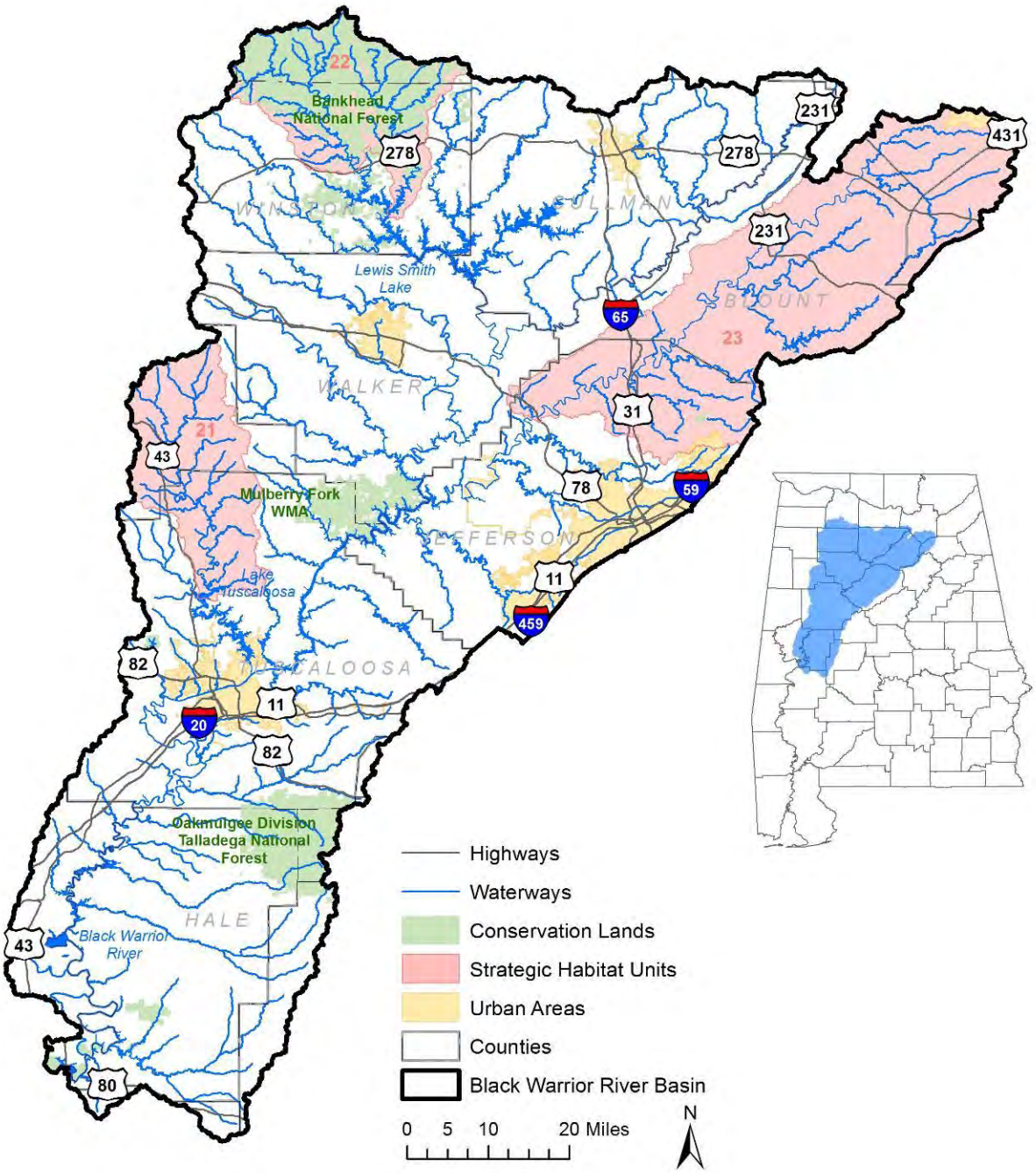


Figure 4-36. Black Warrior River Basin

Alan Cressler

Figure 4-37. Sipsey Fork of Black Warrior River, Winston County

Description and Location

The Black Warrior River originates in the Southwestern Appalachians and is formed by the confluence of the Mulberry and Locust forks, which, along with the Sipsey Fork (a tributary to Mulberry Fork) are the major drainages of the upper basin. The river then flows south to the Fall Line at Tuscaloosa and through the Southeastern Plains to its confluence with the Tombigbee River at Demopolis. The basin covers an area of 6,276 square miles and is completely within Alabama.

Condition

The Black Warrior River Basin includes three Strategic Habitat Units for aquatic SGCN (Figure 4-36). The river is impounded throughout most of its length and provides barge navigation upstream to Birmingham. Loss of riverine habitat has isolated most SGCN to tributary streams, particularly the Sipsey and Locust forks. Extensive coal deposits are present in the basin and it encompasses the largest coal producing area in the southeastern United States. This legacy of mining has resulted in an unusually high proportion of impaired streams. The 2014 ADEM 303(d) list identifies 352 miles of streams in the Black Warrior Basin that either do not support or only partially support their designated uses. Many of these impairments are related to

abandoned mines, but additional sources of impairment include agricultural and urban run-off. A large portion of the Birmingham metropolitan area is located within the Locust Fork sub-watershed.

Impoundments and Other Barriers – Five major dams are on the mainstem: Bankhead (9,200 acres), Holt (3,296 acres), Oliver (2,200 acres), Warrior (9,100 acres), and Demopolis (10,000 acres); two are in the Locust Fork sub-basin: Bayview (554 acres) and Inland (1,536 acres); one is on Sipsey Fork: Lewis Smith (21,200 acres); one is on North River: Tuscaloosa (5,885 acres), and one, Duck River Reservoir (650 acres), is under construction in the Mulberry Fork sub-basin. The National Dam Inventory (USACOE 2014) recognizes 1,494 dams throughout the basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 67.7% forested, 20.7% agriculture and pasture, 8.9% urban, and 2.7% other

Aquatic Taxa

There are 42 aquatic SGCN in the Black Warrior River basin (Table 4-33). This basin harbors a rich native aquatic fauna. Boschung and Mayden (2004) recognized 119 fish species native to the basin. A total of 51 mussel taxa are historically known (Williams et al. 2008). Smith et al. (2011) recognized 21 native crayfish species in the Black Warrior River basin.

Table 4-33. Aquatic SGCN, Black Warrior River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 18		
Epioblasma penita	Southern Combshell*	EXCAU
Medionidus parvulus	Coosa Moccasinshell*	EXCAU
Elliptio arca	Alabama Spike*	P1
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema perovatum	Ovate Clubshell	P1
Pleurobema rubellum	Warrior Pigtoe	P1
Pleurobema taitianum	Heavy Pigtoe*	P1
Ptychobranchus greenii	Triangular Kidneyshell	P1
Toxolasma corvunculus	Southern Purple Lilliput	P1
Anodontoides radiatus	Rayed Creekshell	P2
Elliptio arctata	Delicate Spike	P2
Hamiota perovalis	Orangenacre Mucket	P2
Lasmigona etowaensis	Etowah Heelsplitter	P2
Ligumia recta	Black Sandshell*	P2
Obovaria unicolor	Alabama Hickorynut*	P2
Pleurobema decisum	Southern Clubshell*	P2

Scientific Name	Common Name	SGCN Rank
Potamilus inflatus	Inflated Heelsplitter	P2
Villosa nebulosa	Alabama Rainbow	P2
Snails – 5		
Leptoxis plicata	Plicate Rocksnail	P1
Lioplax cyclostomaformis	Cylindrical Lioplax*	P1
Rhodacmea filosa	Wicker Ancylid	P1
Elimia melanoides	Black Mudalia	P2
Pleurocera striatum	Striate Hornsnail	P2
Crayfishes – 5		
Procambarus viaevirdis	Vernal Crayfish	P1
Cambarus hamulatus	Prickly Cave Crayfish	P2
Hobbseus prominens	Prominence Riverlet Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2
Procambarus marthae	Crisscross Crayfish	P2
Fishes – 11		
Alosa alabamae	Alabama Shad*	P1
Etheostoma chermocki	Vermilion Darter	P1
Etheostoma nuchale	Watercress Darter	P1
Etheostoma phytophilum	Rush Darter	P1
Notropis cahabae	Cahaba Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon*	P2
Etheostoma bellator	Warrior Darter	P2
Etheostoma sp. cf. bellator "A"	Sipsey Darter	P2
Etheostoma sp. cf. bellator "B"	Locust Fork Darter	P2
Etheostoma sp. cf. zonistium	Blueface Darter	P2
Percina brevicauda	Coal Darter	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Sternotherus depressus	Flattened Musk Turtle	P2
Amphibians – 1		
Necturus alabamensis	Black Warrior Waterdog	P1

* Thought to be extirpated from the Black Warrior River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundment of the Black Warrior River and major tributaries is responsible for loss of large river habitat, fragmentation and isolation of streams and modification of the natural flow regime.

- Water quality degradation, particularly related to abandoned surface mines, and poor land management.

- Current distribution and status, as well as knowledge of various aspects of life history and biology, are poorly known for many SGCN.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

    - **Southern Combshell**, **Coosa Moccasinshell**, **Heavy Pigtoe**, **Alabama Spike**, **Southern Clubshell**, **Black Sandshell**, **Alabama Hickorynut** – Extirpated from Black Warrior drainage. Mussel reintroduction in the Black Warrior are limited by ongoing water quality problems. Restoration efforts cannot proceed without water quality improvements. Conduct a comprehensive survey for potential reintroduction sites. If sites are found, a captive propagation program will be needed to supply individuals for reintroduction. Measure(s): Data to fill information gaps for identification and GIS mapping of key habitats for possible reintroduction.

    - **Alabama Spike**, **Triangular Kidneyshell**, **Delicate Spike** – Determine systematic relationships among populations from different parts of the Mobile basin using morphological and genetic analyses. Promote research efforts on water quality limits (temperature, pH, DO, conductivity). Measure(s): Determination of systematic relationships among these populations in the river basin; results of studies on water quality limits.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

    - **Cylindrical Lioplax** – Apparently extirpated from Black Warrior drainage. Initiate a captive rearing program using Cahaba River stock to produce juveniles for reintroduction into suitable Black Warrior drainage habitat. Reintroductions should not proceed without substantial water quality improvements, however. Measure(s): Data to fill information gaps for mapping distribution of this GCN snails; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of animals propagated and reintroduced.

    - **Plicate Rocksnail** – Black Warrior endemic presently restricted to Locust Fork. Since 2003, that population has been augmented by juveniles produced by the Tennessee Aquarium Research Institute. A previously unknown stable population remains upstream of the Interstate 65 crossing. Reintroduction efforts have been hampered by continuing water quality problems. Discontinue reintroduction efforts pending water quality improvements. Continue evaluation of population and identify additional reintroduction sites. Promote research efforts on water quality limits (temperature, pH, DO, conductivity). Continue periodic monitoring. Measure(s): Assessment of status and/or condition of introduced snails; identification of needed conservation actions including additional population augmentation and/or reintroduction; inclusion in the Natural Heritage database; identification of water quality limits.

    - **Black Mudalia** – Black Warrior endemic presently restricted to Locust Fork. Status survey completed and quantitative population data were collected in 2012 from three sites. Possible reintroduction localities identified in upper Locust Fork watershed. Promote research efforts on water quality limits (temperature, pH, DO, conductivity). Measure(s): identification of water quality limits.

Crayfishes

- **All SGCN** have very limited and poorly understood distributions. Conduct distribution surveys, determine habitat requirements, investigate life histories, and develop and

implement long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Fishes

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fishes, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

    - **Watercress Darter** – Population limited to several springs and spring runs in Jefferson County. Monitor water quality at all sites. Investigate possible gas bubble disease at Roebuck Spring. Measure(s): Effective monitoring protocols established or existing monitoring programs utilized/modified to meet SWAP evaluation needs; determination of existence and/or extent of gas bubble disease at Roebuck Spring.

    - **Vermilion Darter** – Black Warrior basin endemic. A detailed life history study is needed, including determination of microhabitat requirements for different life stages. Measure(s): Knowledge of species' life history, biology, and microhabitat requirements to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of Vermilion Darter.

    - **Blueface Darter** – Determine systematic relationship between Tennessee and Black Warrior populations using morphological and genetic analyses. Measure(s): Determination of systematic relationship between Tennessee and Black Warrior populations.

Amphibians

- **Black Warrior Waterdog –** Conduct comprehensive surveys at 5 to 10 year intervals, including investigations of life history requirements, evaluation of population viability and identification of potential reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

Reptiles

- **Rainbow Snake** – Historic but possibly extirpated from the basin due to dams on the lower Tombigbee restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Flattened Musk Turtle –** Conduct comprehensive surveys at 5 to 10 year intervals to ascertain status. Conduct studies to further assess the extent of population levels and long-term viability in impoundment situations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; long-term population viability analysis in impoundments; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Black Warrior River Basin Management Plan and the Mobile Basin Recovery Plan, including all existing Black Warrior drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, USFS, AFC, NRCS, Black Warrior Riverkeeper, Clean Water Partnership, local governments, and other partners. These activities are most critical in: the Locust Fork drainage, which contains a high number of SGCN and encompasses a large portion of the Birmingham metropolitan area; the Sipsey Fork drainage, where Smith Lake has isolated SGCN to Bankhead National Forest and surrounding areas; and the coal producing areas of the central basin. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Snails

- **All SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability, beginning with the Plicate Rocksnail, which is already being augmented in the Locust Fork. This work should be a cooperative effort of AABC, USFWS, GSA, University of Alabama, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN snails in the river basin; if necessary, number of animals reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

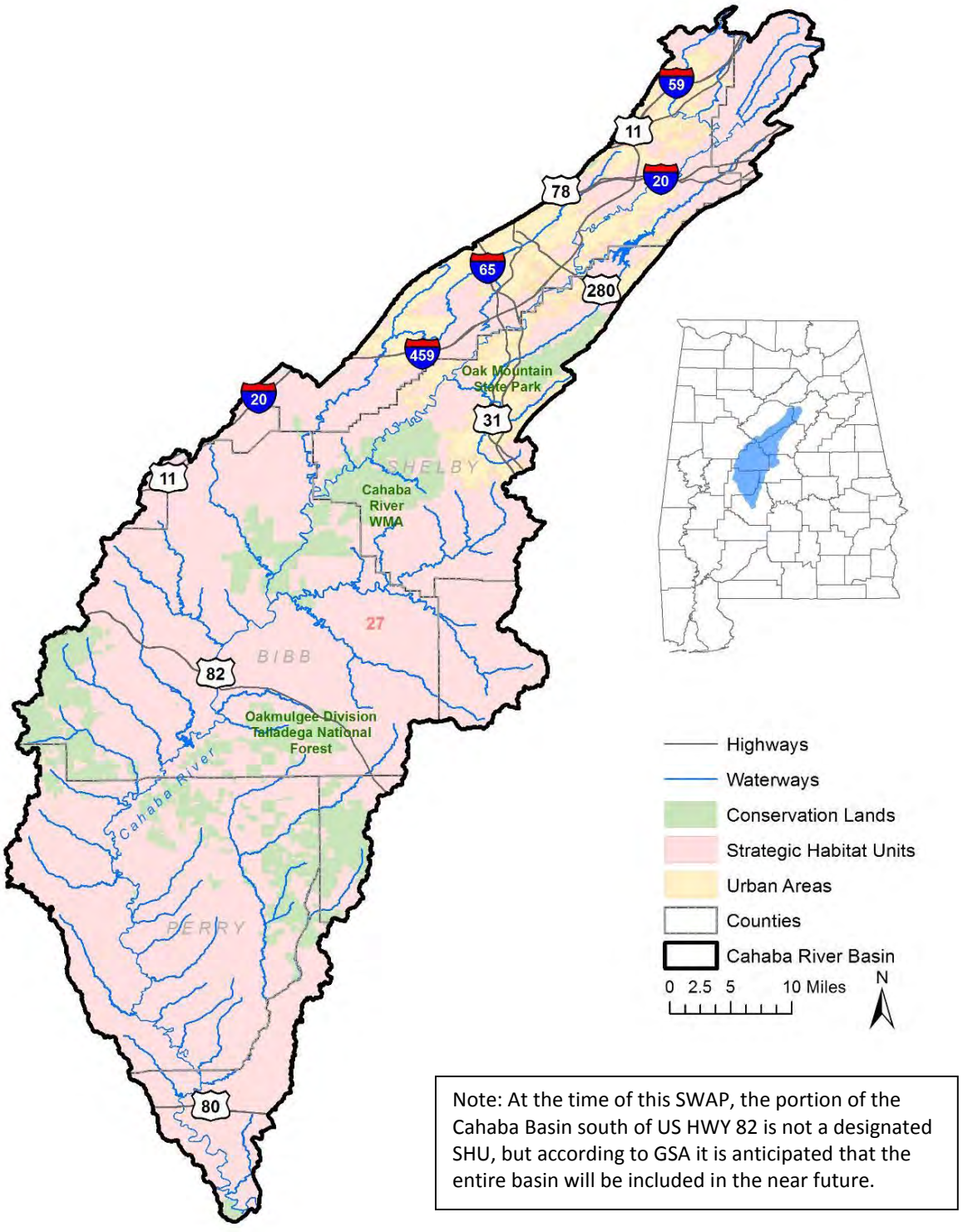
- **Cahaba Shiner, Rush Darter, Vermilion Darter –** These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition of SGCN fish in the river basin; if necessary, number of fish reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Watercress Darter** – Glen Spring should be purchased for inclusion in the Watercress Darter National Wildlife Refuge by the USFWS, Forever Wild, TNC, and other partners. Measure(s): Acres added to the refuge and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- North River Strategic Habitat Unit (SHU #21)
- Upper Sipsey Fork Strategic Habitat Unit (SHU #22)
- Locust Fork Strategic Habitat Unit (SHU #23)

Cahaba River Basin



Note: At the time of this SWAP, the portion of the Cahaba Basin south of US HWY 82 is not a designated SHU, but according to GSA it is anticipated that the entire basin will be included in the near future.

Figure 4-38. Cahaba River Basin

Alan Cressler

Figure 4-39. Cahaba River, Bibb County

Description and Location

The Cahaba River originates northeast of Birmingham and flows southwest through the Birmingham metropolitan area to join the Alabama River downstream of Selma. It is the longest free flowing river in Alabama and is about equally divided between the Ridge and Valley and the Southeastern Plains. The basin covers an area of 1,818 square miles and is completely within Alabama.

Condition

The upper Cahaba River basin constitutes a single Strategic Habitat Unit for aquatic SGCN (Figure 4-38). In recent years water quality has been improving in the basin. The 2014 ADEM 303(d) list identifies only 18.8 miles of one stream, Childers Creek, as having impaired water quality, down from 185 miles (mostly the Cahaba River and Shades Creek) that were listed in 2002. Some sedimentation is directly related to development in the Birminghan metropolitan area.

Impoundments and Other Barriers – Other than several low head dams at and below U.S. Highway 280 near Birmingham, no dams are on the mainstem; Lake Purdy (1,050 acres) is in the upper Little Cahaba River sub-basin. The Marvel Slab, a low dam in Bibb County, was removed in 2004. The National Dam Inventory (USACOE 2014) recognizes 309 dams throughout the basin.

An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.
Land Use – 74.0% forested, 11.4% agriculture and pasture, 13.1% urban, 1.5% other

Aquatic Taxa

There are 44 aquatic SGCN in the Cahaba River basin (Table 4-34). Boschung and Mayden (2004) recognized 125 fish species native to the Cahaba River basin, and Mayden and Kuhajda (1989) note that the Cahaba is the most ichthyologically diverse river for its size in North America. A total of 50 mussel taxa are historically known from the basin (Williams et al. 2008) but recent surveys document only 33 species (Shepard et al. 1994, McGregor et al. 2000). Smith et al. (2011) recognized 18 native crayfish species in the basin.

Table 4-34. Aquatic SGCN, Cahaba River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 18		
Epioblasma penita	Southern Combshell	EXCAU
Medionidus parvulus	Coosa Moccasinshell	EXCAU
Elliptio arca	Alabama Spike*	P1
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema perovatum	Ovate Clubshell	P1
Pleurobema rubellum	Warrior Pigtoe*	P1
Pleurobema taitianum	Heavy Pigtoe*	P1
Ptychobranchus foremanianus	Rayed Kidneyshell	P1
Toxolasma corvunculus	Southern Purple Lilliput	P1
Anodontoides radiatus	Rayed Creekshell	P2
Elliptio arctata	Delicate Spike	P2
Hamiota altilis	Finelined Pocketbook	P2
Lasmigona etowaensis	Etowah Heelsplitter	P2
Ligumia recta	Black Sandshell*	P2
Obovaria unicolor	Alabama Hickorynut	P2
Quadrula metanevra	Monkeyface	P2
Strophitus connasaugaensis	Alabama Creekmussel	P2
Villosa nebulosa	Alabama Rainbow	P2
Snails – 13		
Elimia bellacrenata	Princess Elimia	P1
Elimia cochliaris	Cockle Elimia	P1
Fontigens nickliniana	Watercress Snail	P1
Leptoxis compacta	Oblong Rocksnail	P1
Lepyrium showalteri	Flat Pebblesnail	P1
Lioplax cyclostomaformis	Cylindrical Lioplax	P1

Scientific Name	Common Name	SGCN Rank
Rhodacmea cahawbensis	Cahaba Ancylid	P1
Clappia cahabensis	Cahaba Pebblesnail	P2
Elimia ampla	Ample Elimia	P2
Elimia annettae	Lilyshoals Elimia	P2
Elimia varians	Puzzle Elimia	P2
Elimia variata	Squat Elimia	P2
Leptoxis ampla	Round Rocksnail	P2
Crayfishes – 3		
Hobbseus prominens	Prominence Riverlet Crayfish	P2
Procambarus hybus	Smoothnose Crayfish	P2
Procambarus marthae	Crisscross Crayfish	P2
Fishes – 9		
Alosa alabamae	Alabama Shad*	P1
Cyprinella caerulea	Blue Shiner*	P1
Notropis cahabae	Cahaba Shiner	P1
Noturus munitus	Frecklebelly Madtom	P1
Percina aurolineata	Goldline Darter	P1
Scaphirhynchus suttkusi	Alabama Sturgeon*	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon*	P2
Percina brevicauda	Coal Darter	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

* Thought to be extirpated from the Cahaba River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management and urbanization of the upper watershed.
- Migrations of some fishes are impeded by Alabama River dams.
- Current distribution and status, as well as knowledge of various aspects of life history and biology, are poorly known for many SGCN.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Southern Combshell**, **Coosa Moccasinshell** – Extirpated from Cahaba drainage; 74 Southern Combshell and 59 Coosa Moccasinshell individuals were reintroduced by AABC in 2012-13. Continue monitoring transplanted mussels. Measure(s): Assessment of status and/or condition of transplanted mussels; identification of needed conservation actions including additional population augmentation and/or reintroduction; inclusion in the Natural Heritage database.

- **Warrior Pigtoe**, **Heavy Pigtoe**, **Alabama Spike** – Extirpated from Cahaba drainage; Conduct a comprehensive survey for potential reintroduction sites. If sites are found, a captive propagation program will be needed to supply individuals for reintroduction. Measure(s): Data to fill information gaps for identification and GIS mapping of key habitats for possible reintroduction.

- **Alabama Spike**, **Rayed Kidneyshell**, **Finelined Pocketbook** – Determine systematic relationships among populations from different parts of the Mobile basin using morphological and genetic analyses. Conduct comprehensive inventories, determine life history requirements, evaluate population viability, and identify potential reintroduction sites. Measure(s): Determination of systematic relationships among populations in the Mobile basin; data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction.

- **Delicate Spike** – The best remaining population appears to be in the Cahaba River. The species is rarely encountered alive, and populations are small. Alabama River animals have been in holding at the AABC since 2010. Initial host trails also completed. Conduct a comprehensive inventory, evaluate population viability, and identify potential reintroduction sites. Measure(s): Data to fill information gaps for mapping

distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Cockle Elimia**, **Princess Elimia**, **Lilyshoals Elimia**, **Squat Elimia**, **Puzzle Elimia**, **Ample Elimia** – Cahaba basin endemics. Comprehensively survey at 5 to 10 year intervals, determine life history requirements, evaluate population viability, and identify potential reintroduction sites. Monitoring and systematics reviews are currently underway. Promote research efforts on water quality limits (temperature, pH, DO, conductivity). Continue systematic / taxonomic revisions for multiple families of freshwater gastropods. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Cylindrical Lioplax**, **Flat Pebblesnail**, **Round Rocksnail** – Extant in Cahaba basin but extirpated from other drainages. Conduct comprehensive surveys at 5-10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Cockle Elimia**, **Princess Elimia** – Cockle Elimia is currently extant only at two sites; Princiess Elimia is extant at a single site. Systematic reviews underway at Smithsonian Institution. A survey for potential reintroduction sites is needed. Initiate a captive rearing program to produce juveniles for reintroduction into suitable Cahaba drainage habitat. Measure(s): Data to fill information gaps for mapping distribution;

identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of snails propagated and reintroduced.

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

    - **Prominence Riverlet Crayfish** – Most records are over 35 years old. All of the historic locations should be surveyed and an effort to find potential new sites be undertaken.

    - **Smoothnose Crayfish** – Further research on potential threats, population trends, and extent of range are needed due to its limited distribution and possible decline in Alabama.

    - **Crisscross Crayfish** – Life history data are lacking for this species and further survey work is needed.

Fishes

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

    - **Blue Shiner** – Apparently extirpated from Cahaba drainage. Initiate a captive rearing program using Coosa drainage stock to produce juveniles for reintroduction into suitable Cahaba drainage habitat. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Rainbow Snake** – Historic but possibly extirpated from the basin due to dams on the lower Alabama restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Cahaba River Basin Management Plan and the Mobile Basin Recovery Plan, including all existing Cahaba drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, local governments, Cahaba River Society, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Support expansion of the Cahaba River National Wildlife Refuge to fulfill its acquisition boundaries by working with the USFWS, Forever Wild, TNC, and other partners. Measure(s): Acres added to the refuge and/or protected by fee-simple or easements.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

Most SGCN may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to

suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Snails

All SGCN may require population augmentation and/or reintroduction to suitable habitats to maintain their viability, beginning with Cockle Elimia and Princess Elimia. This work should be a cooperative effort of AABC, USFWS, GSA, University of Alabama, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN snails in the river basin; if necessary, number of snails reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

All SGCN – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

- **Alabama Sturgeon** – This species may require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC**,** USFWS, and other partners. Measure(s): Population status and condition in the river basin; if necessary, number of sturgeon reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Alabama Sturgeon, Alabama Shad, Gulf Sturgeon** – Fish passage should be provided by COE at Alabama River dams to provide access to historic habitat in the Alabama, Cahaba, Coosa and Tallapoosa rivers. Measure(s): Number of fish passages installed at dams on the Alabama River.

Priority Areas for Conservation Action

- Entire basin: Upper Cahaba River Strategic Habitat Unit (SHU #27)

Coosa River Basin

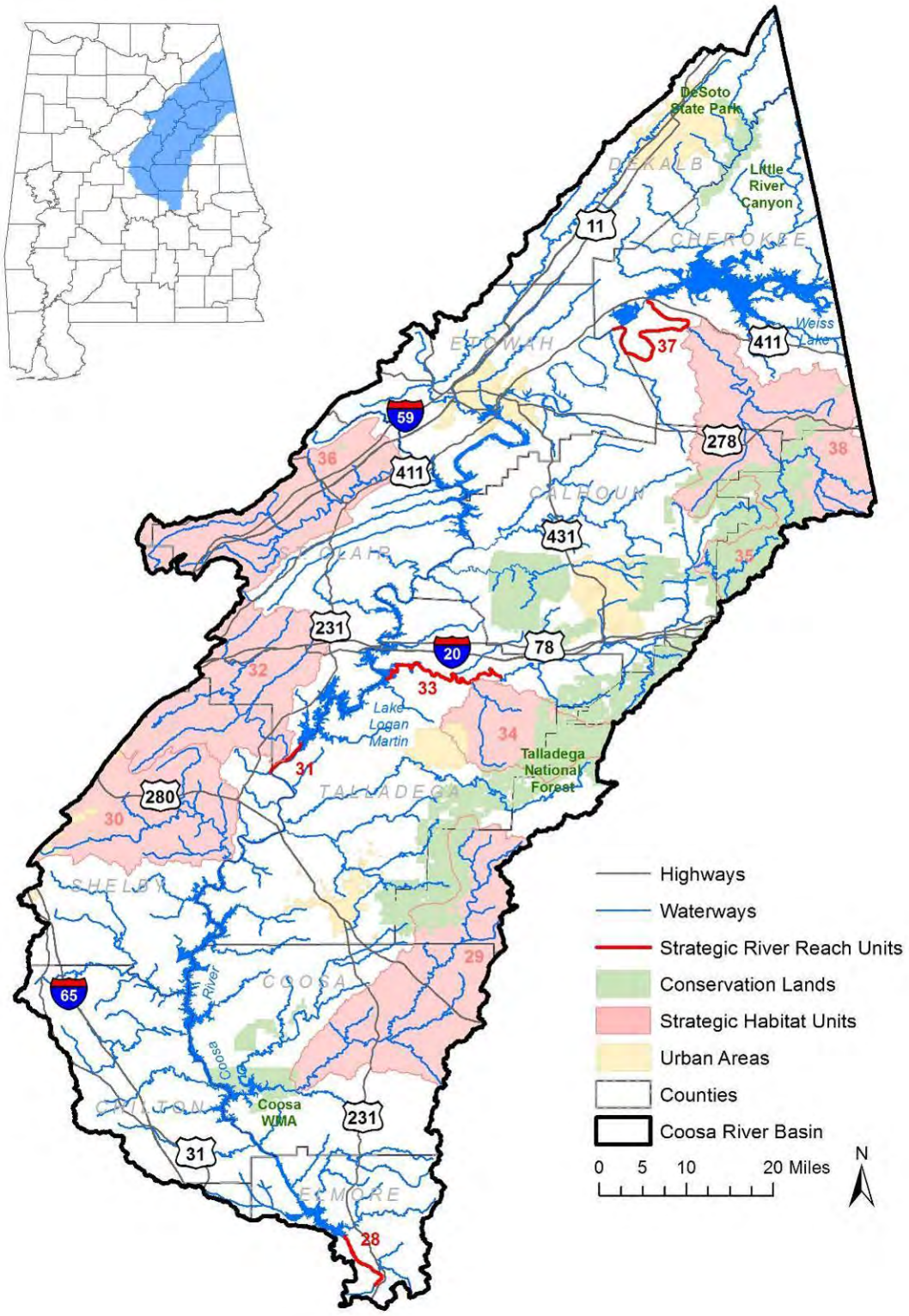
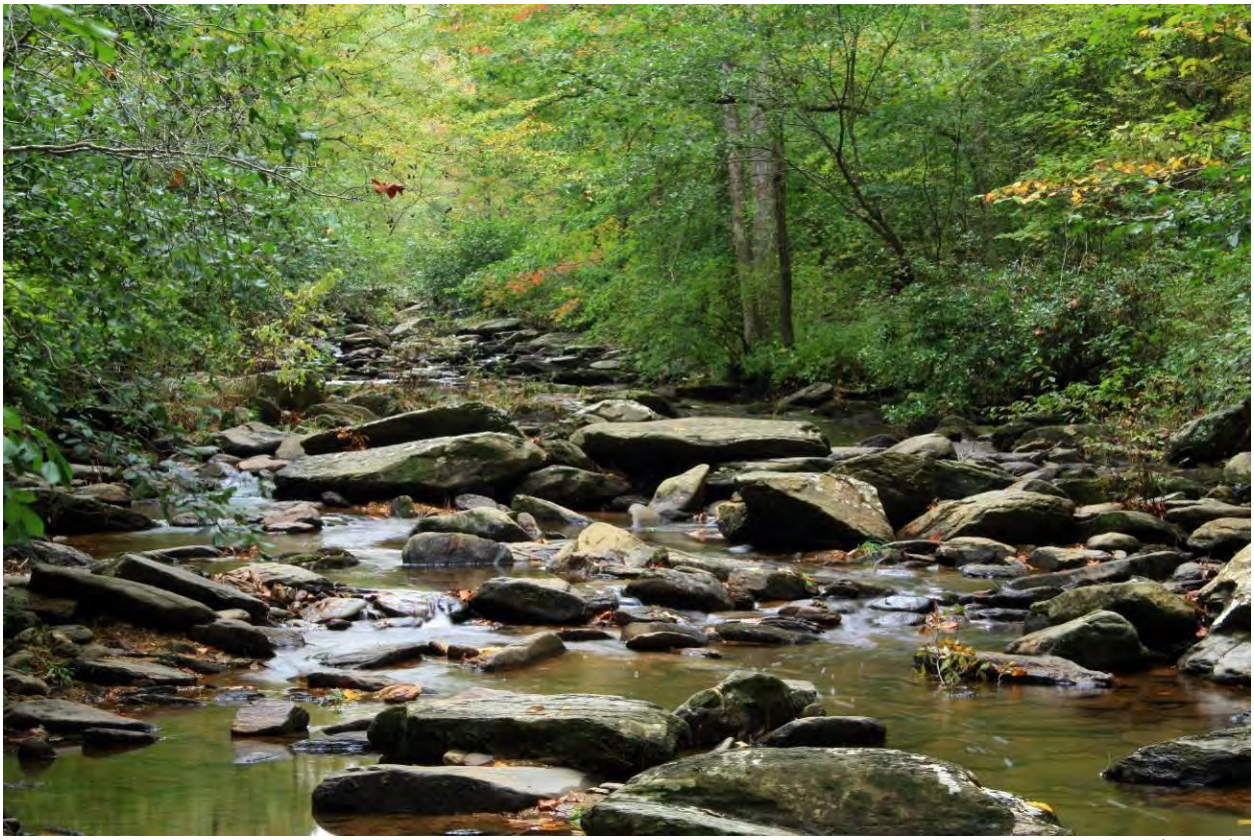


Figure 4-40. Coosa River Basin



Alan Cressler

Figure 4-41. Cheaha Creek, Clay County

Description and Location

The Coosa River basin originates in the Blue Ridge and Ridge and Valley ecoregions of northwest Georgia and a small portion of southeast Tennessee. The river flows southwest to join the Tallapoosa River to form the Alabama River. The Coosa River in Alabama is largely impounded. The total drainage area is 10,161 square miles, of which 5,353 square miles are in Alabama.

Condition

The Coosa River basin in Alabama includes seven Strategic Habitat Units and four Strategic River Reaches for aquatic SGCN (Figure 4-40). Three hydroelectric dams were constructed by APC on the lower river between 1916 and 1928, followed by three dams in the 1960s that extended impoundment upstream to the Alabama-Georgia state line. Remaining free-flowing riverine habitats are limited to short reaches below Weiss, Neely Henry, Logan Martin, Lay, Mitchell, and Jordan dams. Aquatic biodiversity has declined significantly as a result of riverine habitat loss due to modification and fragmentation by impoundments, and resulting water quality degradation. In particular, impoundment of the Coosa River resulted in the extinction of more than 40 species of mussels and snails.

The 2014 ADEM 303(d) list identifies 136 miles of streams in the Coosa basin that either do not support or only partially support their designated uses. Gravel mining, feedlots, cropland erosion,

and hydroelectric power production are sources for organic enrichment and low DO concentrations in the basin. Portions of Neely Henry, Logan Martin, and Lay reservoirs either do not support or only partially support their designated uses. Priority organics, nutrients, pH, organic enrichment, DO, and flow alteration are listed as some of the causes for the impairment. Sources of these impairments range from flow regulation to industrial discharges to urban and rural non-point source pollution.

Impoundments and Other Barriers – Six major dams are on the mainstem in Alabama: Weiss (30,200 acres), Neely Henry (11,235 acres), Logan Martin (15,260 acres), Lay (12,000 acres), Mitchell (5,850 acres), and Jordan (6,800 acres). The National Dam Inventory (USACOE 2014) recognizes 840 dams throughout the basin in Alabama. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 67.7% forested, 20.5% agriculture and pasture, 8.7% urban, 3.1% other

Aquatic Taxa

There are 48 aquatic SGCN in the Coosa River basin in Alabama (Table 4-35), and it is the largest and most biologically diverse subwatershed of the Mobile River basin in terms of overall number of fishes, mussels, and aquatic snails. Boschung and Mayden (2004) recognized 112 fish species native to the basin. A total of 54 mussel taxa are historically known (Williams et al. 2008), and Smith et al. (2011) recognized 17 native crayfish species in the basin.

Table 4-35. Aquatic SGCN, Coosa River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 20		
Epioblasma penita	Southern Combshell*	EXCAU
Medionidus parvulus	Coosa Moccasinshell	EXCAU
Pleurobema hanleyianum	Georgia Pigtoe*	EX
Quadrula kieneriana	Coosa Orb	EX
Elliptio arca	Alabama Spike	P1
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema athearni	Canoe Creek Clubshell	P1
Pleurobema georgianum	Southern Pigtoe	P1
Pleurobema taitianum	Heavy Pigtoe*	P1
Ptychobranchus foremanianus	Rayed Kidneyshell	P1
Toxolasma corvunculus	Southern Purple Lilliput	P1
Elliptio arctata	Delicate Spike	P2
Hamiota altilis	Finelined Pocketbook	P2
Lasmigona etowaensis	Etowah Heelsplitter	P2
Ligumia recta	Black Sandshell*	P2
Pleurobema decisum	Southern Clubshell	P2

Scientific Name	Common Name	SGCN Rank
Quadrula metanevra	Monkeyface	P2
Strophitus connasaugaensis	Alabama Creekmussel	P2
Villosa nebulosa	Alabama Rainbow	P2
Villosa umbrans	Coosa Creekshell	P2
Snails – 17		
Leptoxis foremani	Interrupted Rocksnail	EX
Rhodacmea hinkleyi	Knobby Ancylid	EX
Antrorbis breweri	Manitou Cavesnail	P1
Elimia broccata	Brooch Elimia	P1
Elimia crenatella	Lacy Elimia	P1
Elimia lachryma	Teardrop Elimia	P1
Elimia mihalcikae	Latticed Elimia	P1
Elimia teretria	Auger Elimia	P1
Elimia vanuxemiana	Cobble Elimia	P1
Lioplax cyclostomaformis	Cylindrical Lioplax	P1
Pleurocera foremanii	Rough Hornsnail	P1
Rhodacmea filosa	Wicker Ancylid	P1
Stiobia nana	Sculpin Snail	P1
Leptoxis picta	Spotted Rocksnail	P2
Leptoxis taeniata	Painted Rocksnail	P2
Marstonia hershleri	Coosa Pyrg	P2
Tulotoma magnifica	Tulotoma	P2
Crayfishes – 1		
Cambarus manningi	GreenSaddle Crayfish	P2
Fishes – 10		
Acipenser fulvescens	Lake Sturgeon	EXCAU
Alosa alabamae	Alabama Shad*	P1
Cottus paulus	Pygmy Sculpin	P1
Cyprinella caerulea	Blue Shiner	P1
Etheostoma brevirostrum	Holiday Darter	P1
Sander sp. cf. vitreus	Southern Walleye	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon*	P2
Etheostoma ditrema	Coldwater Darter	P2
Etheostoma trisella	Trispot Darter	P2
Percina brevicauda	Coal Darter	P2

* Thought to be extirpated from the Coosa River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundment of the Coosa River is responsible for loss of most riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for many species.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

    - **Georgia Pigtoe** – Coosa River endemic. Apparently only extant in Georgia and Tennessee headwaters. Terrapin Creek and Weiss Bypass inventory projects failed to locate the species in Alabama but this mussel is routinely sampled by ADCNR / TWRA during Conasauga River brood stock acqusitions in Polk County, TN. Conduct a comprehensive inventory, including evaluation of population viability and identification of potential reintroduction sites. Basic life history information, including identification of glochidial host(s), is lacking. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of Georgia Pigtoe; identification of glochidial host(s); a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction.

- **Coosa Moccasinshell, Alabama Moccasinshell, Black Sandshell** – Extirpated from Coosa drainage, except for Georgia and Tennessee headwaters. Propagation and reintroduction efforts are underway with Coosa Moccasinshell (Little Cahaba River, Bibb County) and brood stock acquisition is underway with Black Sandshell. Potential reintroduction localities determined. Continue captive propagation program to supply individuals for reintroduction. Measure(s): Data to fill information gaps for identification and GIS mapping of key habitats for possible reintroduction.

- **Heavy Pigtoe, Delicate Spike** – Both thought possibly extirpated from the Coosa River basin 10 years ago. Extensive subsequent monitoring efforts have identified only Delicate Spike populations extant in the basin. Continue inventory, evaluate population viability, and identify potential reintroduction sites. Measure(s): Data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction.

- **Southern Combshell** – Extensive monitoring efforts in the Coosa River basin have not identified an extant population. Remains extant in Buttahatchee River in Tombigbee basin. Identify potential reintroduction sites. Basic life history information, including identification of glochidial host(s), is lacking. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions; identification of glochidial host(s).

- **Alabama Spike, Rayed Kidneyshell, Finelined Pocketbook** – AABC monitoring in Terrapin Creek in 2013 found Alabama Spike and Finelined Pocketbook present, and AABC has reintroduced Finelined Pocketbook into the Little River. A review of *Ptychobranchus* (Roe 2013) does not support recognition of Rayed Kidneyshell, but more study is needed. Determine systematic relationships among populations from different parts of the Mobile basin using morphological and genetic analyses. Conduct comprehensive inventories, evaluate population viability, and identify potential reintroduction sites. Measure(s): Determination of systematic relationships among these populations in the river basin; data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroductions.

- **Southern Clubshell** – Continue monitoring populations in Big Canoe Creek and Weiss Lake bypass, which is probably the last remaining functional population of this species in a large-river habitat. Evaluate large Coosa tributaries as possible reintroduction sites. Measure(s): Data to fill information gaps to assess status and/or condition; identification and GIS mapping of key habitats in large Coosa and Tallapoosa tributaries for possible reintroductions.

- **Etowah Heelsplitter** – Regular monitoring of the South Fork of Terrapin Creek popualtion has been completed by the AABC. Conduct a comprehensive inventory, evaluate population viability, and identify potential reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Interrupted Rocksnail** – Believed extinct until rediscovered in the Oostanaula River in Georgia in 1997. Reintroduced to Jordan Dam tailrace beginning in fall 2003. Small test population reintroduced into Weiss Bypass. Systematics review nearly completed. Formal life history study completed. Captive propagation colony established. Continue evaluation of introduced populations and identify additional reintroduction sites. Support captive propagation program for this species, using propagated individuals to augment the reintroduced population in Jordan Dam tailwater. Measure(s): Assessment of status and/or condition of introduced snails; identification of needed conservation actions including additional population augmentation and reintroduction sites; inclusion in the Natural Heritage database.

- **Teardrop Elimia, Cobble Elimia** – Believed extinct until rediscovered by J. Garner in Logan Martin tailrace in summer 2004. Routine monitoring of populations conducted in 2007 and 2013. Conduct monitoring, evaluate population viability, and identify potential reintroduction sites. Measure(s): Data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroductions.

- **Cylindrical Lioplax** – Thought extirpated from Coosa drainage, discovered in Yellowleaf Creek and Choccolocco Creek since 2005 CWCS. Culture methods are completed, but reintroduction habitats are rare. Reintroduction into Weiss Bypass may be possible after flow restoration is intiated. This effort would utilize Yellowleaf Creek brood stock. Initiate a captive rearing program to produce juveniles for reintroduction into suitable habitat. Measure(s): Identification and GIS mapping of

key habitats for possible reintroduction; establishment of a captive propagation program; number of snails propagated and reintroduced.

- **Spotted Rocksnail** – The extent of this species in Coosa River is uncertain. Using historically-collected material, determine if it occurred upstream of the Fall Line. If so, evaluate feasibility of reintroductions using transplanted and/or captive-propagated snails. Systematic and life history review nearly completed. Conduct a comprehensive inventory, evaluate population viability and identify potential reintroduction sites. If Alabama River populations are found suitable to support transplants, move individuals to appropriate sites; if Alabama River populations are found to be unsuitable for supporting transplants, initiate a captive propagation program. A propagation program is established and reintroduction effort initated (for Cahaba River). Measure(s): Data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction.

Crayfishes

- **All SGCN** have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocol. Initiate research into captive holding and propagation of crayfishes. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Longnose Crayfish** – Periodic monitoring of known populations should be conducted. Further research of life history aspects is needed.

- **GreenSaddle Crayfish** – Life history data are badly needed for this species. Additional sampling in appropriate habitat could update information on the current distribution and abundance.

Fishes

- **All SGCN** – should be comprehensively surveyed at 5 to 10 year intervals, and life history requirements determined. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Holiday Darter** – Coosa River endemic. Conduct a comprehensive inventory of springs and spring-fed streams in Shoal Creek and the upper Choccolocco Creek basin, evaluate population viability, and identify potential reintroduction sites. These populations are

genetically distinct from populations in the Georgia portion of the Coosa basin. Measure(s): Data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction.

- **Pygmy Sculpin** – Population limited to Coldwater Spring and spring run, Calhoun County. Continue developing a captive propagation program. Reintroduction into non-historical sites is not recommended. Begin an annual monitoring program based on season to determine if TCE leaching into the spring from Anniston Army Depot is impacting this species. Measure(s): Annual monitoring reports, establishment of a captive propagation program; number of Pygmy Sculpin propagated.

- **Trispot Darter** – Coosa River basin endemic, thought extirpated in Alabama until rediscovered in 2008. Virtual population analysis is needed along with a comprehensive inventory and identification of additional sites. Measure(s): Data to fill information gaps for mapping distribution; population viability analyses; identification and GIS mapping of key habitats for possible reintroductions.

- **Coldwater Darter** – The stream form is a different species from the spring form; needs a formal description. Survey streams in Coosa and Talladega counties to identify additional populations. Measure(s): Data to fill information gaps for mapping distribution; determination of systematic relationships between stream and spring forms.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Lower, Middle, and Upper Coosa River Basins Management Plans and the Mobile Basin Recovery Plan, including all existing Coosa drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes and full compliance with water quality standards by APC at Coosa River dams. Ongoing continuous flows from Jordan Dam and initiation of continuous flows from Weiss Dam will be critical to the recovery of more than 20 species of Coosa basin mussels and snails. Measure(s): Number of dams operated with more natural flow regimes; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, local governments, Coosa River Basin Initiative, Coosa River Society, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

Most SGCN may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Southern Clubshell** – Provision of continuous flows from Weiss Dam by APC would greatly improve habitat conditions for what is probably the last remaining functional large-river population of this species. Measure(s): Establishment of continuous clean water flows from Weiss Dam.

Snails

All SGCN may require population augmentation and/or reintroduction to suitable habitats to maintain their viability, beginning with the Interrupted Rocksnail, which has already been reintroduced to the Jordan Dam tailrace. This work should be a cooperative effort of AABC, USFWS, GSA, University of Alabama, Troy University, Auburn University, and other partners. Provision of continuous flows from Weiss Dam and improvement of the physical habitat by APC would create a high quality reintroduction site for these species. Measure(s): Population status and condition of SGCN snails in the river basin; number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements; establishment of continuous flows from Weiss Dam.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

- **Longnose Crayfish** – Maintenance of riparian buffers is important since this species seems to primarily occur in cavities beneath slab rock in riffle areas. Measure(s): Number and extent of riparian buffers maintained/protected.

Fishes

- **Blue Shiner** and **Holiday Darter** – These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN fish in the river basin; if necessary, number of fish reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Pygmy Sculpin** – Establishment of a captive population and introduction to additional springs is needed to insure survival of the species. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Establishment of captive population; number of Pygmy Sculpins propagated and introduced to springs.

- **Trispot Darter** – Conservation and restoration of both breeding and non-breeding habitat will require a cooperative effort between willing landowners, local watershed conservation organizations, NRCS, Alabama Forestry Commission, land trusts, and others. Main channel (non-breeding) habitat is threatened by sedimentation from urban growth in the headwaters of Little Canoe Creek so better application of construction best management practices should also benefit this species. Consistent implementation of forestry Best Management Practices (BMPs) can result in a lower sediment load entering streams and can maintain the integrity of small, off-channel, breeding sites as well. Maintaining a wide riparian zone near Little Canoe Creek and establishing a sufficient streamside management zone (SMZ) around the smaller intermittent tributaries should help conserve darter populations. Another strategy would be the purchase or establishment of a conservation easement for land around a breeding site.

- **Gulf Sturgeon** – Fish passage should be provided by COE at Alabama River dams to provide access to historic habitat in the Alabama and Cahaba rivers. Measure(s): Number of fish passages installed at dams on the Alabama River.

- **Coldwater Darter** – Management plans are needed for each of the seven management units. Habitat protection, targeting conservation easements are needed for most of the springs supporting extant populations of this species. Measure(s): Management plans prepared, acres of spring habitat restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Coosa River-Jordan Dam Tailwater Strategic River Reach Unit (SRRU #28)
- Hatchet Creek Strategic Habitat Unit (SHU #29)
- Yellowleaf Creek Strategic Habitat Unit (SHU #30)
- Coosa River-Logan Martin Dam Tailwater Strategic River Reach Unit (SRRU #31)
- Kelly Creek Strategic Habitat Unit (SHU #32)
- Lower Choccolocco Creek Strategic Habitat Unit (SRRU #33)
- Cheaha Creek Strategic Habitat Unit (SHU #34)
- Shoal Creek Strategic Habitat Unit (SHU #35)
- Big Canoe Creek Strategic Habitat Unit (SHU #36)
- Weiss Lake Bypass (Dead River) Strategic River Reach Unit (SRRU #37)
- Terrapin Creek Strategic Habitat Unit (SHU #38)

Tallapoosa River Basin

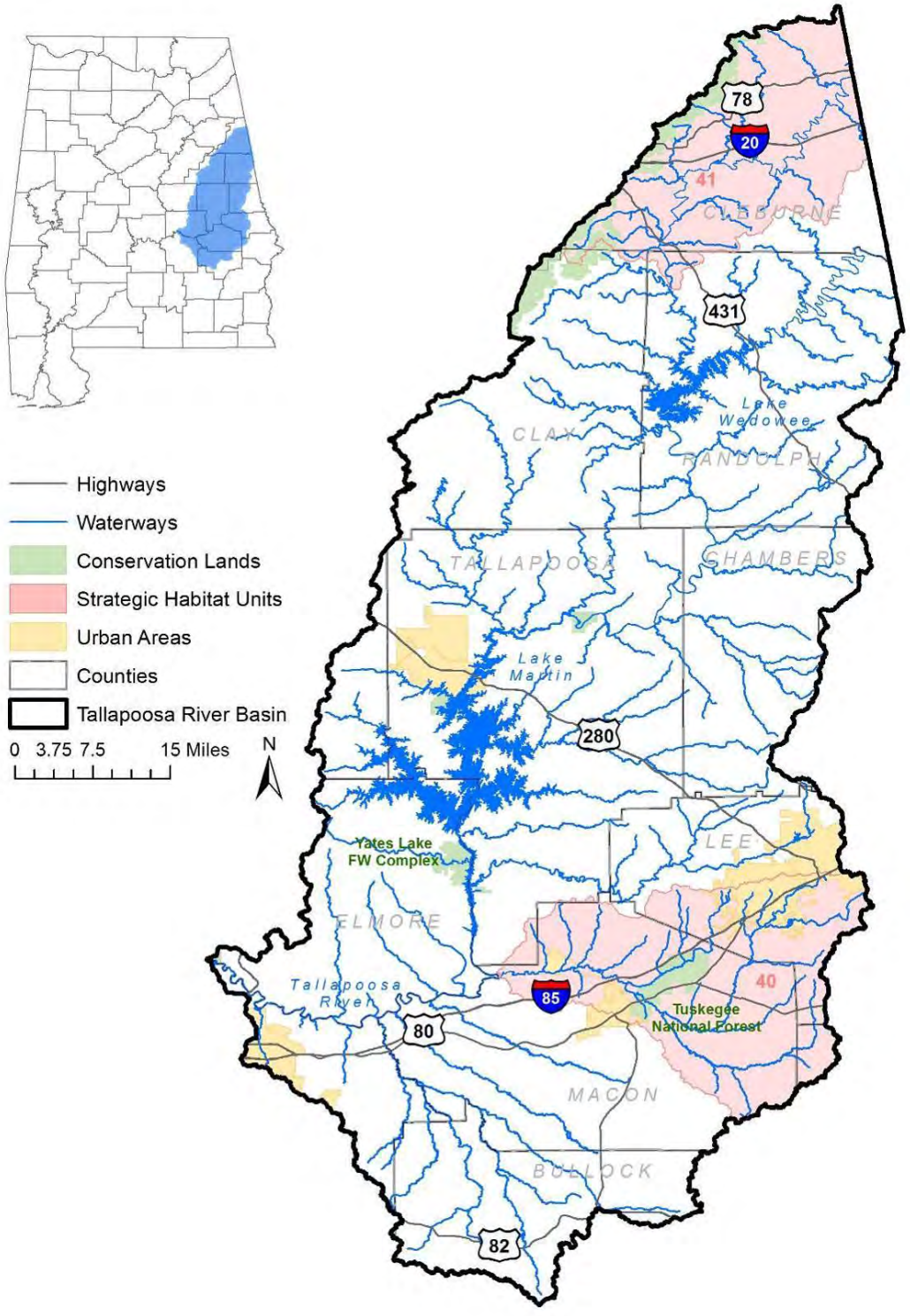


Figure 4-42. Tallapoosa River Basin

Alan Cressler

Figure 4-43. Hillabee Creek, Tallapoosa County

Description and Location

The Tallapoosa River basin originates in west-central Georgia and flows generally southwest to join the Coosa River north of Montgomery, forming the Alabama River. The Tallapoosa basin is largely contained within the Piedmont, except the lower 60 miles of the Tallapoosa River and drainage are within the Southeastern Plains. The basin has a total area of 4,675 square miles, 85% of which is in Alabama.

Condition

The Tallapoosa River basin in Alabama includes two Strategic Habitat Units for aquatic SGCN (Figure 4-42). The 2014 ADEM 303(d) list identifies 150 miles of streams in the Tallapoosa basin that either do not support or only partially support their designated uses, primarily due to siltation related to sand and gravel mining and agriculture. Portions of Yates Lake, Thurlow Reservoir, and Lake Martin are impaired due to atmospheric deposition of mercury and organic enrichment.

Impoundments and Other Barriers – Four dams are on the mainstem: Harris (10,661 acres), Martin (39,000 acres), Yates (1,980 acres), and Thurlow (585 acres). The National Dam Inventory (USACOE 2014) recognizes 714 dams throughout the basin. An undetermined

number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 71.3% forested, 19.2% agriculture and pasture, 6.2% urban, 3.3% other

Aquatic Taxa

There are 13 aquatic SGCN in the Tallapoosa River basin in Alabama (Table 4-36). Boschung and Mayden (2004) recognized 120 fish species native to the Tallapoosa River basin. A total of 36 mussel taxa are historically known (Williams et al. 2008) and Smith et al. (2011) recognized 17 native crayfish species in the basin.

Table 4-36. Aquatic SGCN, Tallapoosa River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 8		
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema perovatum	Ovate Clubshell	P1
Anodontoides radiatus	Rayed Creekshell	P2
Elliptio arctata	Delicate Spike	P2
Hamiota altilis	Finelined Pocketbook	P2
Ligumia recta	Black Sandshell	P2
Pleurobema decisum	Southern Clubshell	P2
Strophitus connasaugaensis	Alabama Creekmussel	P2
Crayfishes – 3		
Cambarus englishi	Tallapoosa Crayfish	P2
Cambarus halli	Slackwater Crayfish	P2
Procambarus lewisi	Spur Crayfish	P2
Fishes – 1		
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Impoundment of the Tallapoosa River is responsible for loss of most riverine habitat, fragmentation, and isolation of streams and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for many species.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – In addition to synoptic surveys, conduct more comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigations and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on biological responses to basic water quality conditions and thresholds (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, and continue fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of GCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroductions; inclusion in the Natural Heritage database.

    - **Ovate Clubshell**, **Alabama Creekmussel** – Periodic monitoring of Tallapoosa basin populations is needed. Conduct life history and ecology studies to determine glochidial host(s) and optimum habitat parameters. Survey for potential reintroduction sites and host fish availability. Measure(s): Data to fill information gaps for mapping distribution; knowledge of species' life history, biology and habitat requirements to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions; identification of glochidial host(s); identification and GIS mapping of key habitats for possible reintroduction.

    - **Delicate Spike** – This species has been located in several tributaries of the Tallapoosa River basin (Mobile Basin Recovery Plan 2010), and ACRL is working on phylogeography. Resolve taxonomic and distributional questions between Mobile Basin and Gulf Coast drainage populations. Conduct an inventory of populations to determine distribution, include quantitative assessment to ascertain viability. Conduct life history and ecological studies, include identification of glochidial host. Measure(s): Resolution of taxonomic issues; data to fill information gaps for mapping distribution of this GCN mussel; knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed

conservation actions and make informed decisions regarding protection of Delicate Spike; a population viability analysis; identification of glochidial host.

- **Finelined Pocketbook** – Determine taxonomic status of possible cryptic species; data to fill information gaps for mapping distribution; host fish availability assessment; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction. Measure(s): Determination of taxonomic status of possible cryptic species; data to fill information gaps for mapping distribution; host fish availability assessment; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction.

- **Rayed Creekshell** – Conduct life history and ecology studies, including identification of glochidial host(s). Survey for potential reintroduction sites and host fish availability. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions; identification of glochidial host(s); host fish availability assessment; identification and GIS mapping of key habitats for possible reintroduction.

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Slackwater Crayfish** – Life history information, particularly reproductive biology, growth, and general ecology are needed.

- **Tallapoosa Crayfish** – Life history information, particularly reproductive biology, growth, and general ecology are needed. A riffle specialist, it is at risk to increases in sedimentation through channel incision, impoundments, and urbanization.

- **Spur Crayfish** – A survey of appropriate habitats within range is needed along with protection of temporary water bodies from drainage.

Reptiles

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps

to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Mobile Basin Recovery Plan (USFWS 2000), Population Restoration and Conservation of Freshwater Mollusks of the Mobile River Basin (2010) and Tallapoosa Basin Management Plan. Measure(s): Number of management plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes and temperatures, and full compliance with water quality standards as determined by the Clean Water Act requirements in Tallapoosa River dams. Continuing flow regimes at Thurlow Dam and initiating a flow regime at Harris Dam mimicking historical flows are of particular importance. Measure(s): Number of dams operated with more natural flow regimes; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, local governments, Clean Water Partnership, ARSN, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

- **Tallapoosa Crayfish** – Maintenance of riffle habitat is critical and restoration goals should include addition and/or augmentation of riffle habitat. Measure(s): Number of riffle habitats successfully restored and occupied.

Fishes

- **Gulf Sturgeon** – Fish passage should be provided by USACOE at Alabama River dams to provide access to historic habitat in the Alabama, Cahaba, Coosa and Tallapoosa rivers. Measure(s): Number of fish passage methods utilized at dams on the Alabama River.

Priority Areas for Conservation Action

- Uphapee Creek Strategic Habitat Unit (SHU #40)
- Tallapoosa River Strategic Habitat Unit (SHU #41)

Alabama River Basin

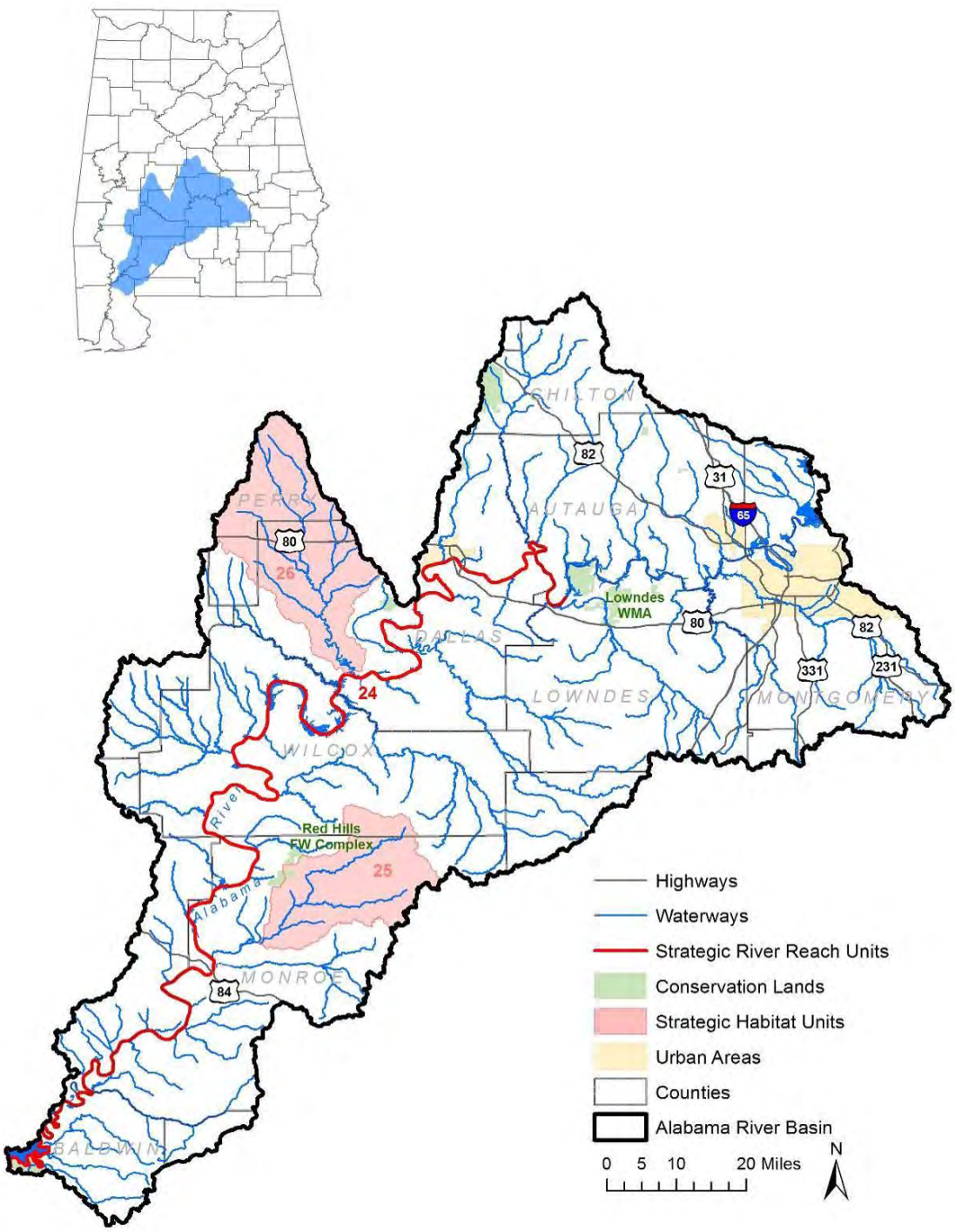


Figure 4-44. Alabama River Basin

Mark Bailey

Figure 4-45. Alabama River at Choctaw Bluff, Clarke County

Description and Location

The Alabama River is formed by the confluence of the Coosa and Tallapoosa rivers north of Montgomery. It meanders westward and then southwestward through the Southeastern Plains for 315 miles to its confluence with the Tombigbee River to form the Mobile River. The basin covers an area of 5,956 square miles and is completely within Alabama.

Condition

The Alabama River basin includes two Strategic Habitat Units and one Strategic River Reach for aquatic SGCN (Figure 4-44). All of the Alabama River mainstem except the lower 82 miles is impounded by three COE lock and dam facilities constructed between 1969 and 1974. Dedicated fish passage is not provided at these facilities and fish can pass only under limited circumstances: during lockage, which is infrequent, and when the lowermost dam (Claiborne) is inundated by spring rains, which does not occur every year. This has had obvious detrimental impacts on anadromous species and less well understood impacts on freshwater species, some of which have recently been found to make long migrations. In addition, flows in the Alabama River are partially regulated by upstream impoundments on the Coosa and Tallapoosa rivers.

The 2014 ADEM 303(d) list identifies 111 miles of streams and portions of Claiborne Reservoir in the Alabama basin that indicate water quality impairment and either do not support or only partially support their designated uses.

Impoundments and Other Barriers – Three major dams are on the mainstem: Jones Bluff (12,500 acres), Millers Ferry (17,200 acres), and Claiborne (5,930 acres). The National Dam Inventory (USACOE 2014) recognizes 365 dams throughout the Alabama River basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 72.6% forested, 20.2% agriculture and pasture, 5.3% urban, 1.9% other

Aquatic Taxa

There are 32 aquatic SGCN in the Alabama River basin (Table 4-37). Boschung and Mayden (2004) recognized 136 fishes native to the basin. A total of 51 mussel taxa are historically known from the basin (Williams et al. 2008) and Smith et al. (2011) recognized 26 native crayfish species in the Alabama River basin.

Table 4-37. Aquatic SGCN, Alabama River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 16		
Epioblasma penita	Southern Combshell*	EXCAU
Elliptio arca	Alabama Spike	P1
Margaritifera marrianae	Alabama Pearlshell	P1
Medionidus acutissimus	Alabama Moccasinshell	P1
Pleurobema perovatum	Ovate Clubshell	P1
Pleurobema taitianum	Heavy Pigtoe	P1
Ptychobranchus foremanianus	Rayed Kidneyshell*	P1
Anodontoides radiatus	Rayed Creekshell	P2
Elliptio arctata	Delicate Spike	P2
Hamiota altilis	Finelined Pocketbook*	P2
Hamiota perovalis	Orangenacre Mucket	P2
Ligumia recta	Black Sandshell	P2
Obovaria unicolor	Alabama Hickorynut	P2
Pleurobema decisum	Southern Clubshell	P2
Potamilus inflatus	Inflated Heelsplitter	P2
Quadrula metanevra	Monkeyface	P2
Snails – 3		
Lioplax cyclostomaformis	Cylindrical Lioplax	P1
Leptoxis picta	Spotted Rocksnail	P2
Tulotoma magnifica	Tulotoma	P2
Crayfishes – 6		

Scientific Name	Common Name	SGCN Rank
Cambarellus lesliei	Angular Dwarf Crayfish	P1
Hobbseus prominens	Prominence Riverlet Crayfish	P2
Orconectes lancifer	Shrimp Crayfish	P2
Procambarus evermanni	Panhandle Crayfish	P2
Procambarus lewisi	Spur Crayfish	P2
Procambarus marthae	Crisscross Crayfish	P2
Fishes – 6		
Alosa alabamae	Alabama Shad	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Noturus munitus	Frecklebelly Madtom	P1
Scaphirhynchus suttkusi	Alabama Sturgeon	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

* Thought to be extirpated from the Alabama River basin but extant elsewhere in its range
P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundment of the Alabama River is responsible for loss of most riverine habitat, fragmentation, altered flow regimes, and restricted access to spawning habitats. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for many SGCN is a major problem.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal

limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Southern Combshell, Rayed Kidneyshell, Alabama Pearlshell, Finelined Pocketbook** – Extirpated from Alabama drainage. Consider deleting from monitoring list.

- **Delicate Spike** – Monitoring has revealed a population in the Alabama River below Claiborne Dam, but this species is not known from any basin tributary. Evaluate Big Flat Creek near AL Hwy 265, which is the best live mussel site encountered in the basin. Resolve taxonomic and distributional problems between Mobile basin and Gulf Coast drainage populations (phylogeography study underway by ACRL). Conduct an inventory of populations and a quantitative assessment to ascertain their viability. Conduct basic life history and ecological studies. Measure(s): Resolution of taxonomic issues; data to fill information gaps for mapping distribution of this GCN mussel; knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of Delicate Spike; a population viability analysis.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Cylindrical Lioplax** – Believed to be extirpated from Alabama drainage. Check museum records for verifiable specimens. There are no historic records from the Alabama River basin at FLMNH or UMMZ, but other collections should be checked. Search for potential reintroduction sites throuout the basin. If suitable sites are found, initiate a captive-propagation program using Cahaba River brood stock. Measure(s): Data to fill information gaps for mapping distribution and; identification and GIS mapping of key habitats for possible reintroduction; establishment of a captive propagation program; number of animals propagated and reintroduced.

Crayfishes

- **All SGCN** have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

    - **Angular Dwarf Crayfish** – Inventory work is needed to determine the current status and range of this species and other dwarf crayfishes in Alabama.

    - **Prominence Riverlet Crayfish** – Most records are over 35 years old. All of the historic locations should be surveyed and an effort to find potential new sites be undertaken.

    - **Spur Crayfish** – A survey of appropriate habitats within range is needed along with protection of temporary water bodies from drainage.

    - **Crisscross Crayfish** – Life history data are lacking for this species and further survey work is needed.

    - **Speckled Burrowing Crayfish** – Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology are needed.

    - **Shrimp Crayfish** – Survey work is needed to determine if this species persists at the historic locations, and an effort should be made to find new locations with similar habitat to confirm the distribution status.

    - **Panhandle Crayfish** – Additional sampling, specifically in tributaries, seasonal ditches, and pitcher plant bogs on protected lands in Mobile and Baldwin counties, could yield new occurrence and abundance data.

Fishes

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

    - **Alabama Sturgeon** – Continue to sample for Alabama Sturgeon; use eDNA to target additional sites for collection; establish a broodstock if reproductively active adults can be collected. Measure(s): Establishment of captive population; number of fish propagated and reintroduced.

    - **Ironcolor Shiner** – Continue efforts to locate a population to serve as a broodstock source for possible propagatons and re-introductions. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Rainbow Snake** – Historic but possibly extirpated from the basin due to dams on the lower Alabama restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Alabama-Tombigbee Rivers Basin Management Plan and the Mobile Basin Recovery Plan, including all existing Alabama drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes and full compliance with water quality standards by Corps of Engineers at Alabama River dams. Measure(s): Number of dams operated with more natural flow regimes; ADEM water quality monitoring

results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of animals reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Snails

- **All SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, GSA, University of Alabama, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN snails in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

    - **Speckled Burrowing Crayfish** –The protection and maintenance of the natural hydrology and vegetation structure of coastal plain swamps, wetlands and pitcher plant bogs would be beneficial. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. The plugging of abandoned drainage ditches could also help to restore natural hydrology.

Fishes

- **Alabama Sturgeon, Alabama Shad** – Fish passage should be provided by Corps of Engineers at Alabama River dams to provide access to historic habitat in the Alabama, Cahaba, Coosa and Tallapoosa rivers. To improve habitat conditions, the natural flow regime in the Alabama River below Miller's Ferry Lock and Dam should be restored by providing acceptable ecological continuous releases and effective fish passage structure or by removing Claiborne Lock and Dam (river mile 72.6) to allow unobstructed spawning migrations, larvae to complete their early-life stage, increased spawning sites, reduced sedimentation, and dredging should be eliminated in the Alabama River. Measure(s): Number of fish passages installed at dams; dams removed on the Alabama River.

- **Alabama Sturgeon, Ironcolor Shiner** – These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS and other partners. Measure(s): Population status and condition in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Gulf Sturgeon** – Fish passage should be provided by Corps of Engineers at Alabama River dams to provide access to historic habitat in the Alabama, Cahaba, Coosa and Tallapoosa rivers. To improve habitat conditions, the natural flow regime in the Alabama River below Miller's Ferry Lock and Dam should be restored by providing acceptable ecological continuous releases and effective fish passage structure or by removing Claiborne Lock and Dam (river mile 72.6) to allow unobstructed spawning migrations, larvae to complete their early-life stage, increased spawning sites, reduced sedimentation, and dredging should be eliminated in the Alabama River. Measure(s): Number of fish passages installed at dams; dams removed on the Alabama River.

- **Bluenose Shiner** – May require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS and other partners. Measure(s): Population status and condition in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Lower Alabama River Strategic River Reach Unit (SRRU #24)
- Big Flat Creek Strategic Habitat Unit (SHU #25)
- Bogue Chitto Creek Strategic Habitat Unit (SHU #26)

Mobile and Tensaw River Basin/Mobile Bay Basin

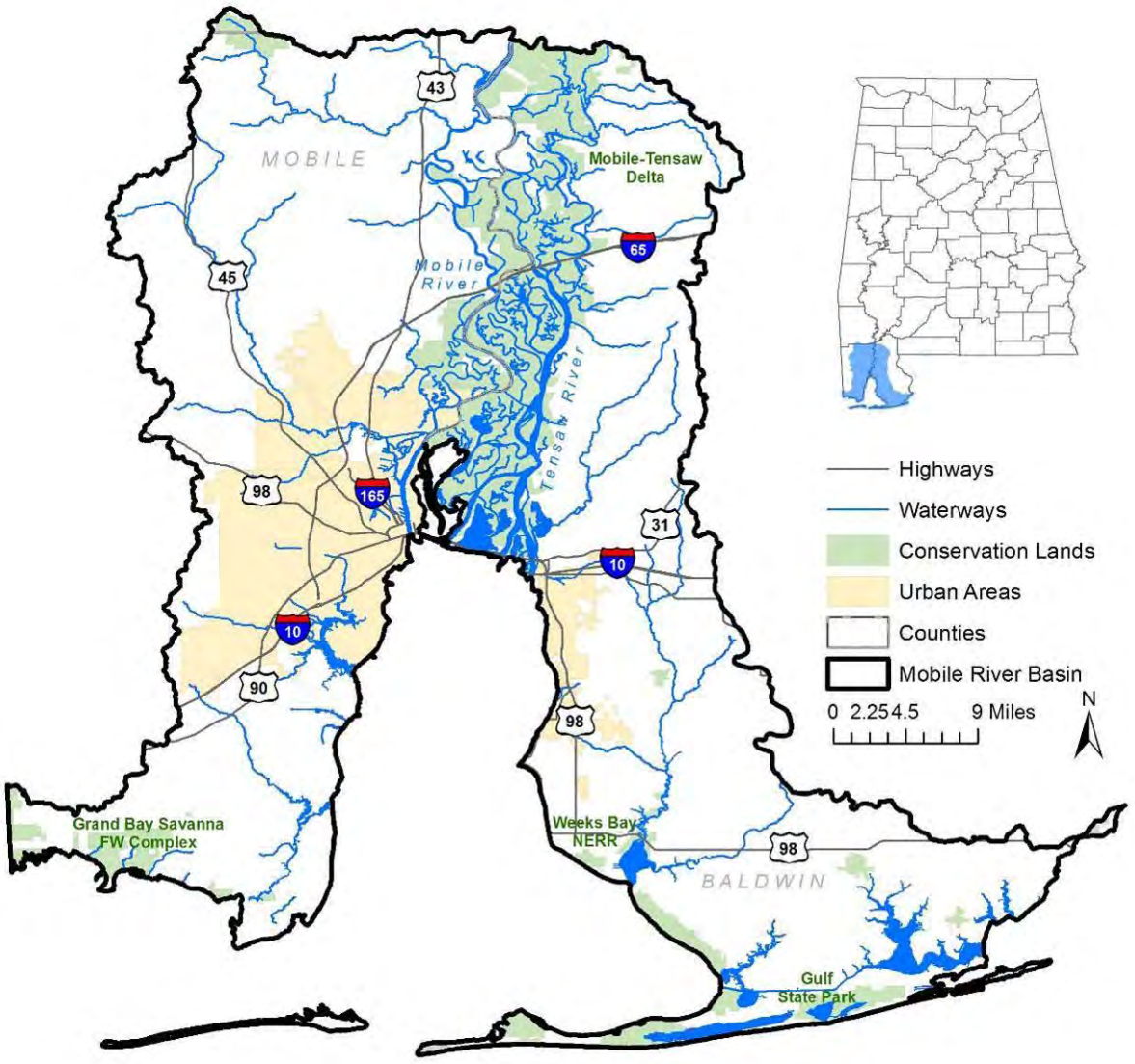


Figure 4-46. Mobile and Tensaw Rivers/Mobile Bay Basin

Description and Location

The Mobile and Tensaw river basin/Mobile Bay basin is the 1,013 square mile lowermost portion of the Mobile basin downstream of the confluence of the Tombigbee and Alabama rivers. Included are the Mobile and Tensaw rivers and the independent drainages of Mobile Bay and adjacent Mississippi Sound, including Fish River, Magnolia River, Fowl River, and Dog River.

Malcolm Pierson

Figure 4-47. Byrnes Lake, Baldwin County

Condition

No Strategic Habitat Units or Strategic River Reaches for aquatic SGCN are in the Mobile-Tensaw Delta/Mobile Bay basin (Figure 4-46). This basin includes a high proportion of impaired waters due to urbanization and industrial development associated with Mobile Bay.

The 2014 ADEM 303(d) list identifies 271 miles of streams that either do not support or only partially support their designated uses. Causes of stream impairment include atmospheric deposition of mercury, pathogens, organic enrichment, and nutrients. All of Mobile Bay and Bon Secour Bay are impaired due to pathogens and organic enrichment from urban runoff and storm sewers. Offshore, 201 square miles of the Gulf of Mexico are impaired due to atmospheric deposition of mercury.

Impoundments and Other Barriers – No dams are on the mainstem. The National Dam Inventory (USACOE 2014) recognizes 81 dams throughout the basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 59.2% forested, 15.8% agriculture and pasture, 19.9% urban, 5.1% other

Aquatic Taxa

There are 16 aquatic SGCN in the Mobile-Tensaw Delta/Mobile Bay basin in Alabama (Table 4-38). Boschung and Mayden (2004) recognized 135 fish species native to the Mobile-Tensaw River basin, 29 of which are marine but enter fresh water on a regular basis. A total of 14 mussel taxa are historically known (Williams et al. 2008) and Smith et al. (2011) recognized 17 native crayfish species in the basin. The West Indian Manatee, not listed for this basin in the 2005 SWAP, is included as it has been regularly documented over the past decade.

Table 4-38. Aquatic SGCN, Mobile-Tensaw Delta/Mobile Bay Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 1		
Quadrula metanevra	Monkeyface	P2
Crayfishes – 7		
Cambarellus diminutus	Least Crayfish	P1
Cambarellus lesliei	Angular Dwarf Crayfish	P1
Cambarellus shufeldtii	Cajun Dwarf Crayfish	P2
Fallicambarus danielae	Speckled Burrowing Crayfish	P2
Orconectes lancifer	Shrimp Crayfish	P2
Procambarus evermanni	Panhandle Crayfish	P2
Procambarus lecontei	Mobile Crayfish	P2
Fishes – 5		
Alosa alabamae	Alabama Shad	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Scaphirhynchus suttkusi	Alabama Sturgeon	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Notropis melanostomus	Blackmouth Shiner	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Pseudemys alabamensis	Alabama Red-bellied Turtle	P1
Mammals – 1		
Trichechus manatus	West Indian Manatee	P1

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly pathogens, sedimentation, and nutrient enrichment related to poor land management, and widespread mercury contamination.
- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for most SGCN is a major problem.
- Vehicle mortality on the U.S. Highway 90 causeway of female and hatchling Alabama Red-bellied Turtles.
- Crab trap mortality to Mississippi Diamond-backed Terrapins.

Priority Research/Survey/Monitoring Needs

Crayfishes

- **All SGCN** have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.
    - **Angular Dwarf Crayfish** – Inventory work is needed to determine the current status and range of this species and other dwarf crayfishes in Alabama.
    - **Speckled Burrowing Crayfish, Lavender Burrowing Crayfish** – Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology are needed. Known populations should be monitored every three years.
    - **Shrimp Crayfish** – Survey work is needed to determine if this species persists at the historic locations, and an effort should be made to find new locations with similar habitat to confirm the distribution status.
    - **Panhandle Crayfish** – Additional sampling, specifically in tributaries, seasonal ditches, and pitcher plant bogs on protected lands in Mobile and Baldwin counties, could yield new occurrence and abundance data.
    - **Mobile Crayfish** – No life history data currently available. Additional sampling and surveys specifically in streams in Mobile and Washington counties is needed.

- **Least Crayfish** – Almost nothing is known about the life history. Survey work is needed immediately to determine the current status and range in Alabama.

- **Cajun Dwarf Crayfish** – Little is known about the current status and distribution in Alabama, therefore survey work is badly needed. Five of the nine records are over 35 years old, and the last collection was in 2003.

Fishes

- **All SGCN** – Distribution surveys, life history investigations, and long-term quantitative monitoring are need for all species. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Alabama Sturgeon** – Continue to sample for individuals; use eDNA to target additional sites for collection; establish a broodstock if reproductively active adults can be collected. Measure(s): Establishment of captive population; number of fish propagated and reintroduced.

- **Ironcolor Shiner** – Continue efforts to locate a population to serve as broodstock for re-introduction purposes. Measure(s): Data to fill information gaps for mapping distribution of this GCN fish; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

- **Blackmouth Shiner** – Only 132 specimens have been collected from three sites from 2004-06. Resolve taxonomic and distribution problems regarding populations of this species in Alabama, Florida, and Mississippi. Conduct an inventory of populations in backwaters and oxbows, including basic life history and ecological studies. Measure(s): Data to fill information gaps for mapping distribution; data to determine genetic and life history differences between the Alabama population and those in Florida and Mississippi.

Reptiles

- **Alabama Red-bellied Turtle** – Conduct intensive surveys at 5 to 10 year intervals to determine distribution and abundance. Conduct basic life history studies, including identification of habitat and activities of juveniles. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of this GCN reptile,

allowing identification of needed conservation actions; knowledge of species' life history, biology, and habitat requirements to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Mammals

- **West Indian Manatee** – Continue partnering with the Mobile Manatees Sighting Network to monitor spatial and temporal habitat occurrence in Alabama waters. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Mobile Basin Recovery Plan and Coastal Basins Management Plan Draft. Measure(s): Number of management plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Fishes

- **Alabama Sturgeon**, **Ironcolor Shiner** – These species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, ARSN, and other partners. Measure(s): Population status and condition in the river basin; if necessary, number of animals reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Reptiles

- **Alabama Red-bellied Turtle** – Maintain the turtle exclusion fencing along the U.S. Highway 90 Mobile Bay Causeway. In 2008, in cooperation with ADCNR-DWFF, ALDOT constructed a 3.4-mile low-barrier fence along both sides of the Causeway to prevent access by mature females and their hatchlings and also displayed banners along to remind passing motorists of turtle nesting and hatching seasons. Measure(s): Number and length of turtle barriers or other devices installed/maintained.

Crayfishes

All SGCN – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

- **Lavender Burrowing Crayfish**, **Speckled Burrowing Crayfish** – Protection and maintenance of the natural hydrology and vegetation structure of coastal plain swamps, wetlands and pitcher plant bogs would be beneficial. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. The plugging of abandoned drainage ditches could also help to restore natural hydrology. Measure(s): Acres of wetlands protected, restored, and/or prescribe burned.

Priority Areas for Conservation Action – None designated.

Mobile Bay and Coastal Submerged Aquatic Vegetation

John Dindo

Figure 4-48. Grass beds at Perdido Pass, Baldwin County

Description and Location

Restricted to Alabama's coastal counties of Baldwin and Mobile (Figure 4-49), this habitat includes seagrass beds and other submerged aquatic vegetation. Seagrass meadows are among the most productive habitats in estuarine waters of the Gulf Coast. Seagrasses provide food for wintering waterfowl and important spawning and foraging habitat for commercially important finfish and shellfish. Seagrass communities also support endangered and threatened species, including sea turtles and manatees. Submerged seagrass beds are found in a patchy distribution behind protective barrier islands and in near-shore areas. Beds occur in greater numbers in Perdido Bay, Wolf Bay, and Mississippi Sound, but have become scarce in Mobile Bay, where salinity is relatively low and water quality has declined more markedly. Wigeongrass (*Ruppia maritime*) is tolerant of freshwater and consequently is an important component of this habitat. American wildcelery (*Vallisneria americana*) is also a component. Other species such as shoal grass (*Halodule wrightii*), southern naiad (*Najas guadalupenis*) and slender pondweed (*Potamogeton pusillus*) may be present, usually in small beds.

This habitat encompasses one NatureServe ecological system (Table 4-39). Representative high-quality estuarine sites include Weeks Bay NERR (Baldwin County), Bon Secour NWR (Mobile County), W.L. Holland WMA (Baldwin County).

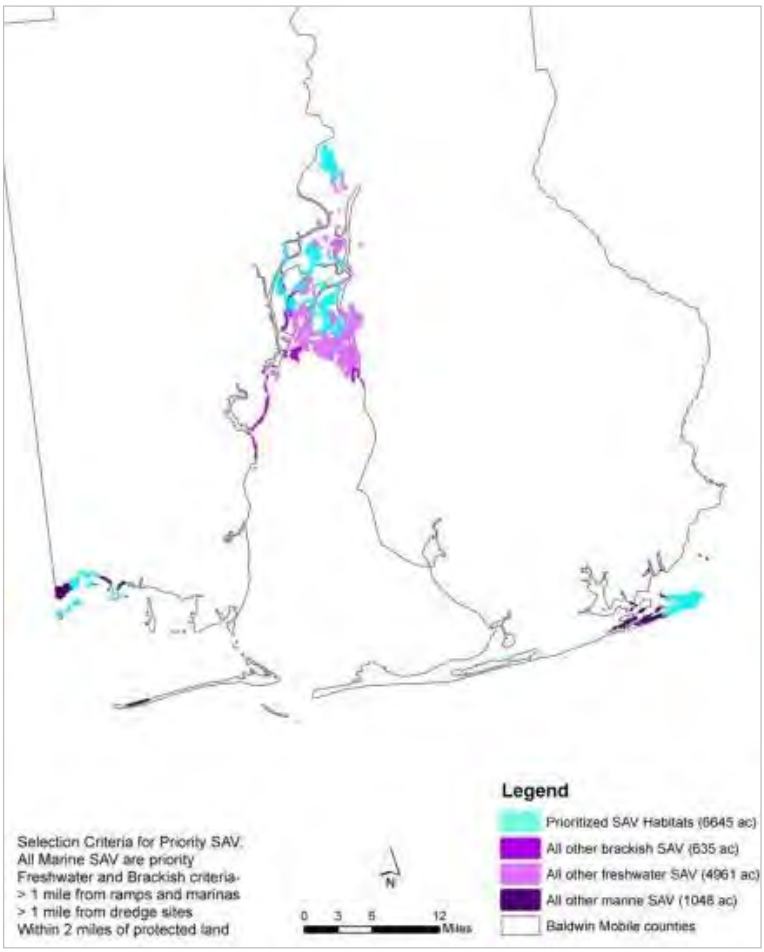


Figure 4-49. Distribution of Submerged Aquatic Vegetation habitat (from TNC 2009)

Table 4-39. Ecological systems encompassed by Submerged Aquatic Vegetation

	Ecoregion					
	IP	SA	RV	P	SP	SCP
East Gulf Coastal Plain Northern Gulf of Mexico Seagrass Bed						X

IP = Interior Plateau SA = Southern Apalachians RV = Ridge and Valley P = Piedmont SP = Southern Plains SCP = Southern Coastal Plain

This habitat supports 7 SGCN (Table 4-40).

Table 4-40. Aquatic SGCN, Submerged Aquatic Vegetation

Scientific Name	Common Name	SGCN Rank
Reptiles - 6		
Caretta caretta	Atlantic Loggerhead	P1
Chelonia mydas	Green Sea Turtle	P1
Dermochelys coriacea	Leatherback Sea Turtle	P1
Lepidochelys kempii	Kemp's Ridley	P1
Malaclemys terrapin pileata	Mississippi Diamondback Terrapin	P1
Pseudemys alabamensis	Alabama Red-bellied Turtle	P1
Mammals - 1		
Trichechus manatus	West Indian Manatee	P1

Condition

Losses of submerged aquatic vegetation (SAV) in the northern Gulf of Mexico over the last 50 years have been extensive. Most estuaries have lost from 20 to 100 percent of their seagrass beds. Although precise numbers are unknown, it is estimated that 50% or more of Alabama's seagrass beds were lost from the 1940s to 1979 (GMFMC 1998). Coastal population growth and accompanying municipal, industrial, and agricultural development has been recognized as a contributing factor (Neckles 1993). The environmental quality of the habitat has deteriorated with increased turbidity and decreases in water quality resulting from dredging, boating activities, and other development pressures. Losses of seagrasses may signal water quality problems in Alabama's coastal waters.

- Water quality degradation as a result of habitat degradation, nutrient enrichment, pathogens, and toxic chemicals
- Loss of habitat from sedimentation, hydrologic modifications, filling, trawling, and dredging
- Loss of wetland and shoreline habitat due to weak regulatory monitoring, enforcement and inadequate mitigation practices, and inadequate coastal engineering
- Mortality due to crab traps (diamond-backed terrapins) and trawling (sea turtles)

- Lack of current information on status and distribution of this habitat type
- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for most SGCN
- Insufficient conservation-related education about biologically significant areas and species
- Loss of and disturbance to marine habitat from marine construction projects (e.g., oil and gas pipelines and platforms), dredge material disposal, and bottom tending fishing gear

Priority Research/Survey/Monitoring Needs

Reptiles

- **Atlantic Loggerhead**, **Green Sea Turtle**, and **Kemp's Ridley** – Identify foraging areas in Alabama waters. Measure(s): Data to expand GIS coverages for sea turtle foraging habitat.
- **Mississippi Diamondback Terrapin** – The exact distribution is still relatively unknown. Further systematic field surveys are needed to identify areas where terrapins occur and nest. Several years of field research are needed to locate and assess the distribution of present populations and monitor recruitment and mobility. Conduct basic life history studies, including identification of habitat and activities of juveniles. Investigate the impact of crab traps on this species. The repatriation project currently being condocted by UAB should continue. Measure(s): Data to fill information gaps on ecology and habitat use; threats assessment of crab traps initiated and completed; data to fill information gaps for mapping distribution and inclusion in the Natural Heritage database.
- **Alabama Red-bellied Turtle** – Monitor nest mortality of eggs and hatchlings on Gravine Island and elsewhere, and the effectiveness of the causeway barrier on mortality of adults and hatchlings. Measure(s): Data to fill information gaps on mest mortality and habitat use; data for mapping distribution and inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

Develop a coordinated plan with local and federal agencies with regard to acquisition of property or purchase of conservation easements to protect, enhance, restore, and manage undeveloped coastal wetlands (EPA 2014). Partner with MBNEP, Grand Bay NWR, TNC,

Coastal Land Trust, Forever Wild, SLD-Coastal and others. Measure(s): Acres restored, enhanced, and/or protected by fee-simple or easements.

Improve water quality by developing allowable water quality-based loadings sufficient to maintain water quality standards (or total maximum daily loads) for pathogens, nutrients, toxic chemicals, and other conventional pollutants, and by support habitat restoration efforts where needed. Partners may include MBNEP, ADEM, NRCS, EPA, USACOE. Measure(s): ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; effective monitoring protocols established; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

- Maintain and protect all types of coastal wetlands within the MBNEP study area (including quality, function, and value) and increase acreage by 5% of those types that have declined (EPA 2014). Measure(s): Acres of coastal wetland restored, enhanced, and/or protected by fee-simple or easements.

- Maintain existing native SAVs at 2001 levels and increase acreage of known areas where native SAVs occur (EPA 2014). Measure(s): Acres of SAV restored, enhanced, and/or protected by fee-simple or easements.

- Develop and disseminate educational materials, brochures, videos, etc. to educate the public of the value of coastal habitats (MBNEP, NRCS, USFWS, AFC). Measure(s): Completion of an outreach plan; outreach products produced (e.g., website, frequent website updates, periodic workshops and symposia and resulting publications, maps and information packets.

- Evaluate and, if appropriate, recommend marine habitats for designation as Marine Protected Areas (National Park Service, USFWS, NMFS, GMFMC, GSMFC, TNC). Measure(s): Acres of habitat protected through Marine Protected Area designation.

- Designate sanctuaries where crabbing and trawling are prohibited and remove abandoned crab traps to reduce mortality of diamond-backed terrapins and sea turtles. Measure(s): Acres of estuarine and marine habitat protected by prohibition of crab traps and/or trawling; mortality rates of diamond-back terrapins and sea turtles due to crab traps and trawling.

- Map current distribution of estuarine and marine habitats including coastal wetlands, SAV and shorelines. Measure(s): GIS coverages for this key habitat; data to complete or expand aquatic GAP; data to fill information gaps for mapping abundance and

distribution of this key habitat; inclusion in and/or expansion of the Natural Heritage Database.

- **West Indian Manatee** – Raise public awareness and increase caution by boaters while operating in manatee habitats. Measure(s): Information (signage, flyers); reduction in boat-manatee collisions.

Priority Areas for Conservation Action

- Grand Bay Savanna
- Gulf Islands
- Gulf of Mexico
- Mobile Bay

Pascagoula River Basin (Escatawpa River and Red Creek)

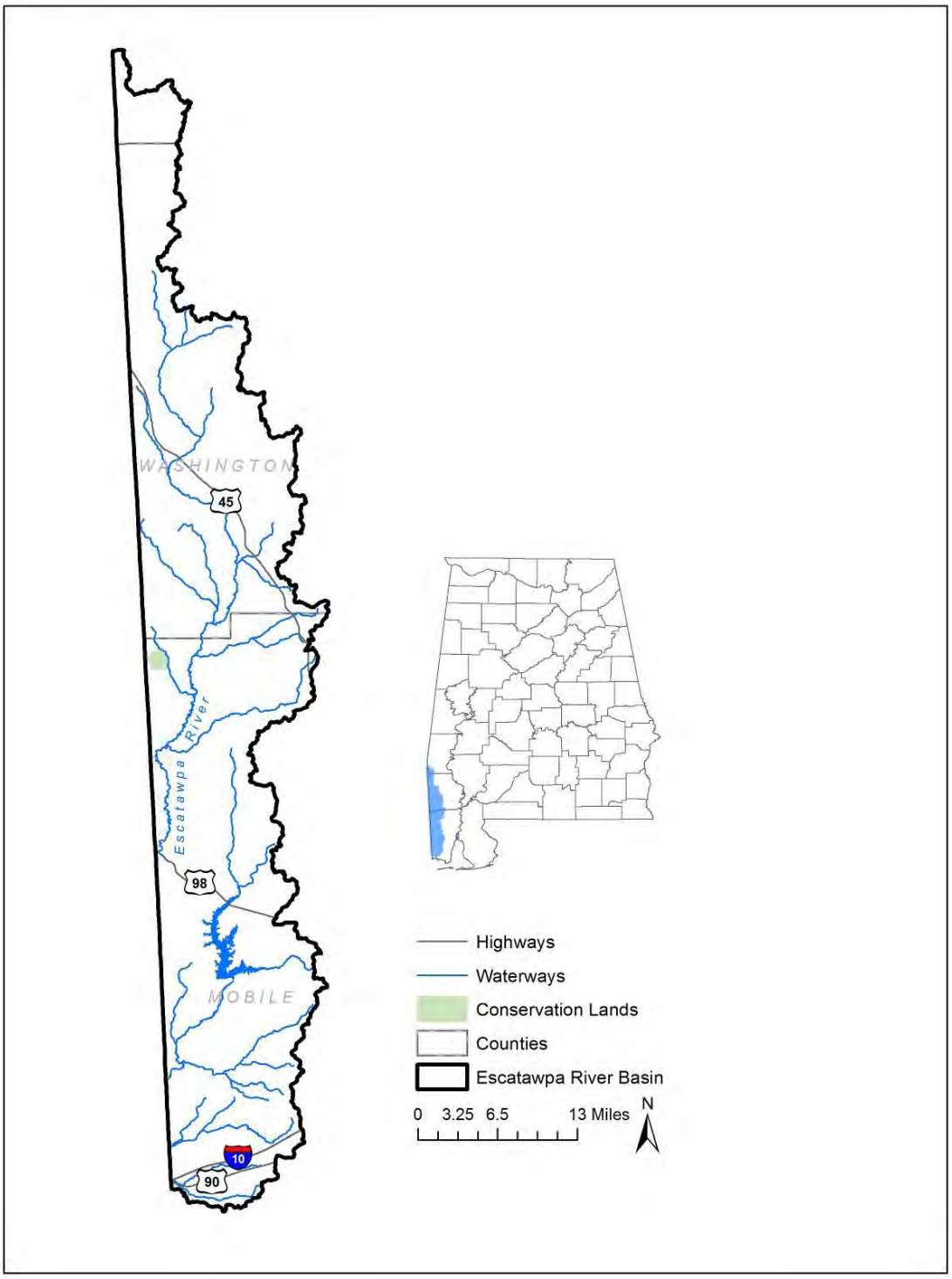


Figure 4-50. Pascagoula River Basin

Beth Young

Figure 4-51. Escatawpa River, Mobile County

Description and Location

The Escatawpa River originates in extreme southwest Alabama and straddles the Alabama-Mississippi state line. Its basin covers 1,031 square miles of the Southeastern Plains, of which 767 square miles are in Alabama. The Escatawpa River is a tributary of the Pascagoula River and drains to Mississippi Sound. Red Creek, a small tributary of Mississippi's Chickasawhay River (also a Pascagoula tributary), drains a small portion of northwest Washington County.

Condition

No Strategic Habitat Units are designated in the basin. In Alabama, the upper basin is primarily forested and the lower basin (Big Creek watershed) includes considerable agricultural lands and urban encroachment from the Mobile metropolitan area. The 2014 ADEM 303(d) list identifies 80 miles of streams (Escatawpa River, Boggy Branch, and Collins Creek) in the Escatawpa basin that either do not support or only partially support their designated uses primarily due to the presence of metals (mercury, lead, iron, and arsenic). In addition, much of Mississippi Sound, Portersville Bay, and Grand Bay are impaired due to pathogens of municipal and industrial origin.

Impoundments and Other Barriers – Big Creek Lake, also known as Converse Reservoir, is the largest impoundment at 3,600 acres. The National Dam Inventory (USACOE 2014) recognizes

54 dams throughout the basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 71.7% forested, 20.9% agriculture and pasture, 6.1% urban, 1.3% other

Aquatic Taxa

There are 16 aquatic SGCN in the Escatawpa River basin in Alabama (Table 4-41). Despite limited habitat diversity in this small basin, Boschung and Mayden (2004) recognized 57 native fish species from the Alabama portion of the basin, including two that do not occur in other Alabama drainages. There are no mussels or aquatic snails native to the Alabama reaches of the Escatawpa River Basin. Smith et al. (2011) recognized 15 native crayfish species in the Alabama portion of the basin and two more have since been discovered.

Table 4-41. Aquatic SGCN, Pascagoula River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 1		
Pleurobema beadleianum	Mississippi Pigtoe	P1
Crayfishes – 9		
Cambarellus diminutus	Least Crayfish	P1
Fallicambarus burrisi	Burrowing Bog Crayfish	P1
Cambarellus shufeldtii	Cajun Dwarf Crayfish	P2
Fallicambarus byersi	Lavender Burrowing Crayfish	P2
Fallicambarus danielae	Speckled Burrowing Crayfish	P2
Procambarus clemmeri	Cockscomb Crayfish	P2
Procambarus evermanni	Panhandle Crayfish	P2
Procambarus lecontei	Mobile Crayfish	P2
Procambarus planirostris	Flatnose Crayfish	P2
Fishes – 4		
Ammocrypta vivax	Scaly Sand Darter	P1
Etheostoma lynceum	Brighteye Darter	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Sternotherus carinatus	Razor-backed Musk Turtle	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for most SGCN is a major problem.

Priority Research/Survey/Monitoring Needs

Mussels

- **Mississippi Pigtoe –** Recently discovered in Red Creek (tributary to Pascagoula River); the only location in the state. Monitor on a 5-10 year basis. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Crayfishes

All SGCN have very limited and poorly documented distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Least Crayfish –** Almost nothing is known about the life history. Survey work is needed immediately to determine the current status and range in Alabama.

- **Burrowing Bog Crayfish –** Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology needed.

- **Cajun Dwarf Crayfish –** Little is known about the current status and distribution in Alabama, therefore survey work is badly needed. Five of the nine records are over 35 years old, and the last collection was in 2003.

- **Lavender Burrowing Crayfish –** Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology are needed. Known populations should be monitored every three years.

- **Speckled Burrowing Crayfish –** Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology are needed.

- **Cockscomb Crayfish** – Life history data are needed. Additional sampling in appropriate habitats within known range could provide population information for the species.

- **Panhandle Crayfish –** Additional sampling, specifically in tributaries, seasonal ditches, and pitcher plant bogs on protected lands in Mobile and Baldwin counties, could yield new occurrence and abundance data.

- **Mobile Crayfish –** No life history data currently available. Additional sampling and surveys specifically in streams in Mobile and Washington counties is needed.

- **Flatnose Crayfish –** Recently discovered in the state; additional surveys needed to better determine distribution in Alabama.

Fishes

- **All SGCN** – Distribution surveys, life history investigations, and long-term quantitative monitoring are need for all species. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Brighteye Darter** – Alabama distribution limited to Escatawpa basin. Only two specimens were collected in a 2006 GSA survey; additional surveys are warranted. Conduct a distribution survey and determine abundance throughout basin. Life history and ecological studies are needed for Alabama population. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition , allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Ironcolor Shiner** – Collected in Mobile County at one of only 19 historical sites (Franklin Creek) in a 2006 GSA survey. Continue efforts to locate a population to serve as a broodstock source for possible propagatons and re-introductions. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

- **Scaly Sand Darter** – Known in Alabama only from Red Creek, a tributary of Mississippi's Chickasawhay River (Pascagoula River basin). A thorough survey of the Escatawpa River system in Alabama is needed to accurately determine the species' distribution and abundance. Detailed studies of the species' life history including reproductive biology, specific habitat requirements, age and growth, and food habits are needed to provide information necessary to develop management plans. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

Reptiles

- **All SGCN** – Distribution surveys, life history investigations, and long-term quantitative monitoring are need for all species. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

- **Razor-backed Musk Turtle** – Conduct comprehensive surveys at 5 to 10 year intervals, including life history investigations and long-term quantitative monitoring. Measure(s): Data to fill information gaps for mapping distribution; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Coastal Basins Management Plan. Measure(s): Number of management plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

    - **Speckled Burrowing Crayfish, Lavender Burrowing Crayfish, Burrowing Bog Crayfish**– Protection and maintenance of the natural hydrology and vegetation structure of coastal plain swamps, wetlands and pitcher plant bogs would be beneficial. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. The plugging of abandoned drainage ditches could also help to restore natural hydrology. Measure(s): Acres of wetlands protected, restored, and/or prescribe burned.

Fishes

- **Ironcolor Shiner** – This species may require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition; if necessary, number of shiners reintroduced to suitable habitats.

Priority Areas for Conservation Action

- No Strategic Habitat Units are identified.

Perdido River Basin

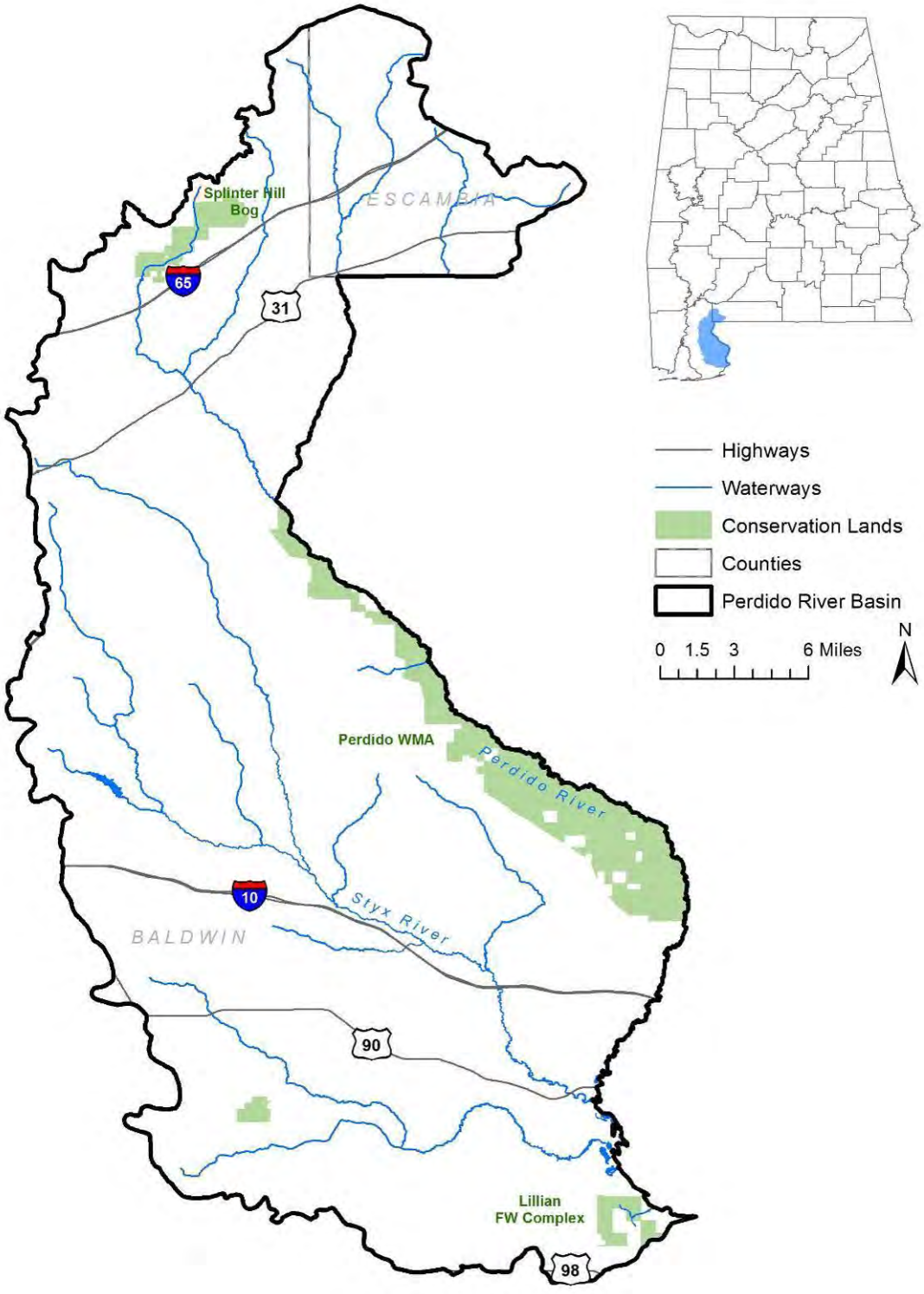


Figure 4-52. Perdido River Basin

Craig Guyer

Figure 4-53. Styx River, Baldwin County

Description and Location

The Perdido River forms the boundary between the western edge of the Florida panhandle and Alabama. In Alabama, the basin drains 841 square miles of the Southeastern Plains in eastern Baldwin County and a small portion of Escambia County (Figure 4-52).

Condition

No Strategic Habitat Units are designated in the Perdido River basin. The 2014 ADEM 303(d) list identifies 22 miles of the Perdido River and 41 miles of the Styx River, a Perdido River tributary, as impaired due to mercury contamination from atmospheric deposition.

Impoundments and Other Barriers – No dams are on the mainstem. The National Dam Inventory (USACOE 2014) recognizes 42 dams throughout the basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land use – 69.6% forested, 25.0% agriculture and pasture, 4.9% urban. 0.5% other

Aquatic Taxa

There are seven aquatic SGCN in the Perdido River basin in Alabama (Table 4-42). Boschung and Mayden (2004) recognized 58 fish species native to the basin. There are no native mussels (Williams et al. 2008) and Smith et al. (2011) recognized ten native crayfish species in the Perdido River basin.

Table 4-42. Aquatic SGCN, Perdido River Basin

Scientific Name	Common Name	SGCN Rank
Crayfishes – 4		
Fallicambarus burrisi	Burrowing Bog Crayfish	P1
Procambarus escambiensis	Escambia Crayfish	P1
Fallicambarus byersi	Lavender Burrowing Crayfish	P2
Procambarus okaloosae	Okaloosa Crayfish	P2
Fishes – 2		
Notropis chalybaeus	Ironcolor Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.
- Habitat degradation and alteration from river dredging operations and drainage of bottomland forests and swamps.
- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for most SGCN is a major problem.
- Construction of new dams within the Perdido River basin would result in loss of riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime.

Priority Research/Survey/Monitoring Needs

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database and/or other ADCNR databases/ coverages.

    - **Burrowing Bog Crayfish, Lavender Burrowing Crayfish** – Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology needed. Known populations should be monitored every three years.

    - **Escambia Crayfish, Okaloosa Crayfish** – Survey work is necessary to determine the current range and integrity of populations in Alabama.

Fishes

- **Ironcolor Shiner** – Collected at one of only 19 historical sites (Franklin Creek, Mobile County) in a 2006 GSA survey. Continue efforts to locate a population to serve as a broodstock source for possible propagatons and re-introductions. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Rainbow Snake** – Rarely encountered, but recently confirmed from the Perdido, which notably has no dams and therefore presumably a stable population of American Eels, an important prey species. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, local governments, Clean Water Partnership, and other partners**.** Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Construction of new dams within the basin would be highly detrimental to most SGCN and should be discouraged. Measure(s): Number of new dams constructed; number of plans/permits commented on.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

    - **Speckled Burrowing Crayfish, Lavender Burrowing Crayfish** – protection and maintenance of the natural hydrology and vegetation structure of coastal plain swamps, wetlands and pitcher plant bogs would be beneficial. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. The plugging of abandoned drainage ditches could also help to restore natural hydrology. Measure(s): Acres of wetlands protected, restored, and/or prescribe burned.

Fishes

- **Ironcolor Shiner** – May require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition; if necessary, number of shiners reintroduced to suitable habitats.

Priority Areas for Conservation Action – None designated.

Conecuh River Basin

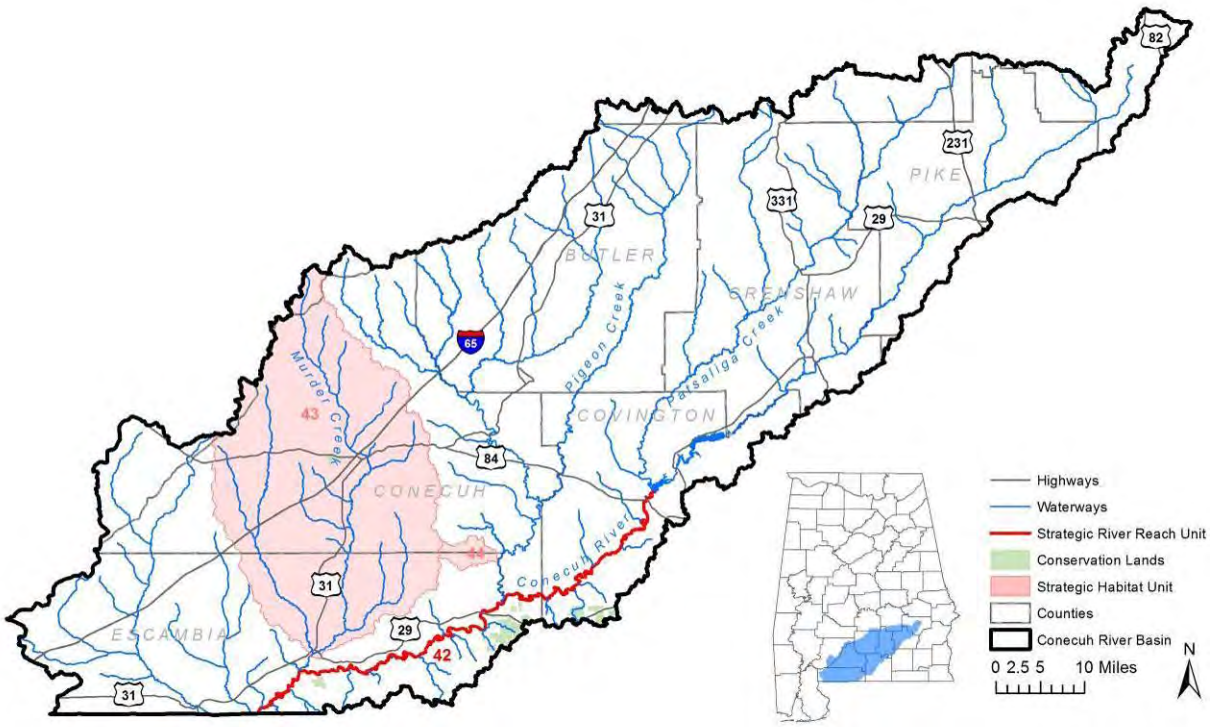


Figure 4-54. Conecuh River Basin

Description and Location

The Conecuh River Basin originates in south central Alabama and extends through the Southeastern Plains to the Florida panhandle, where it becomes the Escambia River at the state line. The Conecuh basin forms the principal drainage of Pensacola Bay and covers an area of 4,223 square miles, 90 percent of which is in Alabama. The basin is characterized by sandy, well-drained soils. The primary flow results from rainfall with some groundwater influence.

Condition

The Conecuh River basin includes two Strategic Habitat Units and one Strategic River Reach for aquatic SGCN (Figure 4-54). Two hydroelectric dams were constructed on the Conecuh River near Andalusia in the 1920s. The watershed upstream of the dams drains 1,259 square miles, about one-third of the Alabama portion of the Conecuh basin. The dams were originally constructed by the River Falls Power Company but are currently operated by PowerSouth / Covington Electric Cooperative under a renewed FERC license that, in 2005, specified a continuous flow from Point A Dam to enhance aquatic resources. Although fish passage was an important issue during the FERC re-licensing process, agencies reserved their right to recommend fish passage at that time.

Mark Bailey

Figure 4-55. Conecuh River, Escambia County

The Conecuh basin has a history of water quality impacts from agricultural, industrial, and municipal sources. However, water quality has improved substantially over the past 40 years. The 2014 ADEM 303(d) list identifies portions of the Conecuh River mainstem along with major tributaries (Sepulga River, Murder Creek, Burnt Corn Creek, Little Escambia Creek, Big Escambia Creek) that either do not support or only partially support their designated uses due to atmospheric deposition of mercury. Other impairment is due to siltation and organic enrichment from agricultural sources.

Impoundments and Other Barriers – There are two dams on the mainstem—Gantt (2,747 acres) and Point A (700 acres). The National Dam Inventory (USACOE 2014) recognizes 294 dams throughout the basin. An undetermined number of low water crossings and culverts also impede or prevent fish migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 77.8% forested, 17.0% agriculture and pasture, 4.4% urban, 0.8% other

Aquatic Taxa

There are 21 aquatic SGCN in the Conecuh River basin in Alabama (Table 4-43). Boschung and Mayden (2004) recognized 84 fish species native to the Alabama waters draining to Pensacola Bay, primarily the Conecuh basin but also the Yellow and Blackwater basins. A total of 30

mussels are known from the Alabama portion of the basin (Williams et al. 2008). Smith et al. (2011) recognized 16 native crayfish species in the Alabama portion of the basin.

Table 4-43. Aquatic SGCN, Conecuh River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 9		
Margaritifera marrianae	Alabama Pearlshell	P1
Ptychobranchus jonesi	Southern Kidneyshell	P1
Reginaia rotulata	Round Ebonyshell	P1
Villosa villosa	Downy Rainbow	P1
Anodontoides radiatus	Rayed Creekshell	P2
Fusconaia escambia	Narrow Pigtoe	P2
Hamiota australis	Southern Sandshell	P2
Obovaria choctawensis	Choctaw Bean	P2
Pleurobema strodeanum	Fuzzy Pigtoe	P2
Snails – 1		
Elimia exusta	Fire Elimia	P2
Crayfishes – 5		
Procambarus escambiensis	Escambia Crayfish	P1
Fallicambarus byersi	Lavender Burrowing Crayfish	P2
Procambarus capillatus	Capillaceous Crayfish	P2
Procambarus lewisi	Spur Crayfish	P2
Procambarus okaloosae	Okaloosa Crayfish	P2
Fishes – 4		
Alosa alabamae	Alabama Shad	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Graptemys ernsti	Escambia Map Turtle	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Impoundments on the Conecuh River are responsible for loss of some riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution, low dissolved oxygen, and lack of fish passages.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Current distribution and status, as well as knowledge of various aspects of life history and biology, are poorly known for many species.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigations and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

    - **Southern Kidneyshell** – Conduct intensive surveys to determine extent of the range in the basin. Conduct life history and ecology studies, including identification of glochidial host(s). Survey for potential reintroduction sites and host fish availability. Measure(s): Data to fill information gaps for mapping distribution of this GCN mussel; identification of glochidial host(s); a population viability analysis; host fish population availability assessment; identification and GIS mapping of key habitats for possible reintroduction.

    - **Southern Sandshell** – Endemic to Gulf Coast drainages. Conduct an inventory of populations, including quantitative assessments to ascertain population viability and availability of potential fish hosts. Measure(s): Data to fill information gaps for mapping distribution; identification of glochidial host(s); a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction.

- **Choctaw Bean** – Conduct quantitative assessments to ascertain population viability, include life history and ecology studies, and identification of glochidial host. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection; identification of glochidial host(s); a population viability analysis.

- **Round Ebonyshell** – Conecuh basin endemic, currently believed to be confined to the main channel of Conecuh River. Perform qualitative survey to determine exact range of species. Assess the need for augmentation using propagated juveniles. Conduct life history and ecological studies, including identification of glochidial host(s). Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection of Round Ebonyshell; identification of glochidial host(s).

- **Rayed Creekshell**, **Fuzzy Pigtoe**, **Alabama Pearlshell**, **Narrow Pigtoe** – Conduct life history and ecology studies, including identification of glochidial host(s). Survey for potential reintroduction sites and host fish availability. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to identify needed conservation actions and make informed decisions regarding protection; identification of glochidial host(s); host fish population availability assessment; identification and GIS mapping of key habitats for possible reintroduction.

- **Downy Rainbow** – Support an ongoing systematic revision, at Ohio State University, of the genus to which this species belongs. Conduct a thorough survey to determine distribution within the Conecuh River basin, include quantitative assessment to determine viability. Measure(s): Data to fill information gaps for mapping distribution; population viability analysis.

Snails

- **Fire Elimia** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Lavender Burrowing Crayfish** –Life history information, particularly reproductive biology, growth, population genetic analyses, burrowing behavior, and general ecology are needed. Known populations should be monitored every three years.

- **Spur Crayfish** – A survey of appropriate habitats within range is needed along with protection of temporary water bodies from drainage.

- **Escambia Crayfish** – So little is known about the life history and ecology that additional survey work is necessary to determine the current range and status of populations in Alabama.

- **Capillaceous Crayfish** – Life history data are badly needed for this species. Further sampling within and adjacent to the known range is needed to confirm the distribution status (Smith et al. 2011), but also research is needed to determine whether preferred habitat is being impacted by any major threats.

- **Okaloosa Crayfish** – Survey work is required to determine the extent of range and integrity of Alabama populations.

Fishes

- **All SGCN** should be comprehensively surveyed at 5 to 10 year intervals, including investigations of life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fishes, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database and/or other ADCNR databases/ coverages.

    - **Ironcolor Shiner** – Continue efforts to locate a population to serve as broodstock for re-introduction purposes Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Escambia Map Turtle** – Conduct comprehensive surveys at 5 to 10 year intervals, monitoring abundance and distribution. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Confirmed extant below Point A Dam in 2013 but rarely encountered. Possibly extirpated from the upper basin due to dams restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Conecuh-Sepulga-Blackwater Rivers Watershed Protection Plan. Measure(s): Number of watershed protection plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Support implementation of more natural flow regimes, fish passages, and full compliance with water quality standards at Conecuh River dams. Measure(s): Number of dams operated with more natural flow regimes and fish passages; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs and new monitoring programs developed.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Construction of new dams within the basin (including downstream in Florida) would be highly detrimental to most SGCN and should be discouraged. Measure(s): Number of new dams constructed; number of plans/permits commented on.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- Some species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University**,** and other partners**.** Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Rayed Creekshell**, **Narrow Pigtoe**, **Southern Sandshell**, **Choctaw Bean**, **Fuzzy Pigtoe**, **Round Ebonyshell** – Following completion of a thorough phylogenetics study, release captive-propagated juveniles in selected streams. Measure(s): Number of mussels reintroduced or added to suitable habitats.

- **Southern Kidneyshell** – Survey Conecuh River system for potential reintroduction sites. Release captive-propagated juveniles if a site can be found. Measure(s): Report(s) determining availability of reintroduction sites; number of mussels reintroduced or added to suitable habitats.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

    - **Lavender Burrowing Crayfish** – Protection and maintenance of the natural hydrology and vegetation structure of coastal plain swamps, wetlands and pitcher plant bogs would be beneficial. Prescribed fire should be employed to protect habitats from the encroachment of woody and invasive vegetation. Partners may include ADCNR and AFC. The plugging of abandoned drainage ditches could also help to restore natural hydrology. Measure(s): Acres of wetlands protected, restored, and/or prescribe burned.

Fishes

- **Ironcolor Shiner**, **Bluenose Shiner** – Species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition of these GCN fish in the river basin; if necessary, number of fishs reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Conecuh River Strategic River Reach Unit (SRRU #42)
- Murder Creek Strategic Habitat Unit (SHU #43)
- Amos Mill Creek Strategic Habitat Unit (SHU #44)

Blackwater River Basin

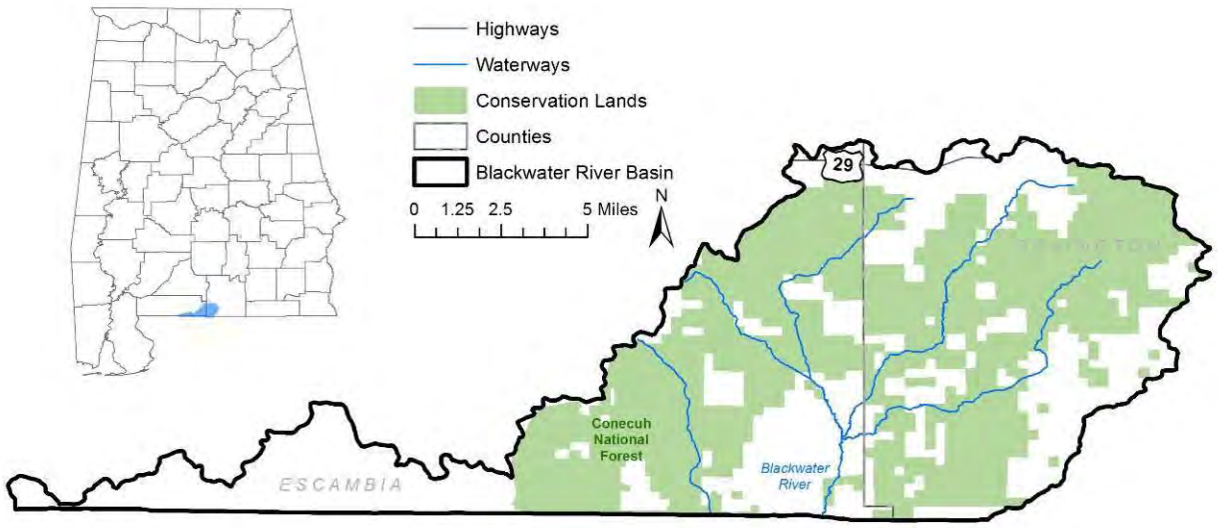


Figure 4-56. Blackwater River Basin

Description and Location

The Blackwater River Basin originates in the Southeastern Plains in Conecuh National Forest and flows south through the Florida panhandle to Pensacola Bay. This system has small contributions from surface runoff but the primary source is groundwater. Although only 148 square miles of the basin's 860 square miles are within Alabama, it provides an important corridor between the Conecuh National Forest and the adjacent 297 square mile Blackwater River State Forest in Florida.

Condition

No Strategic Habitat Units are designated in the basin. Protection afforded this basin by Conecuh National Forest and Blackwater River State Forest result in nearly 50 miles of the river corridor in Alabama and Florida being remote and undeveloped. The Blackwater River is considered one of Florida's most pristine waterways and has been designated an Outstanding Florida Water. Public use facilities include the 31-mile Blackwater River Canoe Trail and Blackwater River State Park. The pristine nature of the Blackwater River and associated recreational facilities make it one of the most popular canoeing streams in Florida. No streams in the Alabama portion of the basin are included in the 2014 ADEM 303(d) list of impaired waters.

Impoundments and Other Barriers – No dams are on the mainstem. The National Dam Inventory (USACOE 2014) recognizes no dams in the Alabama portion of the basin. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 84.8% forested, 12.0% agriculture and pasture, 2.8% urban, 0.4% other

Mark Bailey

Figure 4-57. Blackwater River Headwaters, Escambia County

Aquatic Taxa

The Alabama portion of this small basin has only three aquatic SGCN (Table 4-44). Boschung and Mayden (2004) recognized 84 fish species native to the Alabama waters draining to Pensacola Bay, primarily the Conecuh basin, but also the smaller Yellow and Blackwater river basins. There are no native mussels in the Blackwater River basin (Williams et al. 2008).

Table 4-44. Aquatic SGCN, Blackwater River Basin

Scientific Name	Common Name	SGCN Rank
Fishes – 1		
Notropis chalybaeus	Ironcolor Shiner	P1
Crayfishes – 1		
Procambarus okaloosae	Okaloosa Crayfish	P2
Reptiles – 1		
Farancia erytrogramma	Rainbow Snake	P1

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for many SGCN is a major problem.

- Construction of dams within the Blackwater River basin would result in loss of riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime.

Priority Research/Survey/Monitoring Needs

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database and/or other ADCNR databases/ coverages.

    - **Okaloosa Crayfish** – Survey work is necessary to determine the current range and integrity of populations in Alabama.

Fishes

- **Ironcolor Shiner** – Collected at one of only 19 historical sites (Franklin Creek, Mobile County) in a 2006 GSA survey. Continue efforts to locate a population to serve as a broodstock source for possible propagatons and re-introductions. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Conecuh-Sepulga-Blackwater rivers Watershed Protection Plan. Measure(s): Number of watershed protection plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, AFC, NRCS, USFS, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Construction of new dams within the basin (including downstream in Florida) would be highly detrimental to SGCN and should be discouraged. Measure(s): Number of new dams constructed; number of plans/permits commented on.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Fishes

- **Ironcolor Shiner** – This species may require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners**.** Measure(s): Population status and condition; if necessary, number of shiners reintroduced to suitable habitats.

Priority Areas for Conservation Action – None designated.

Yellow River Basin

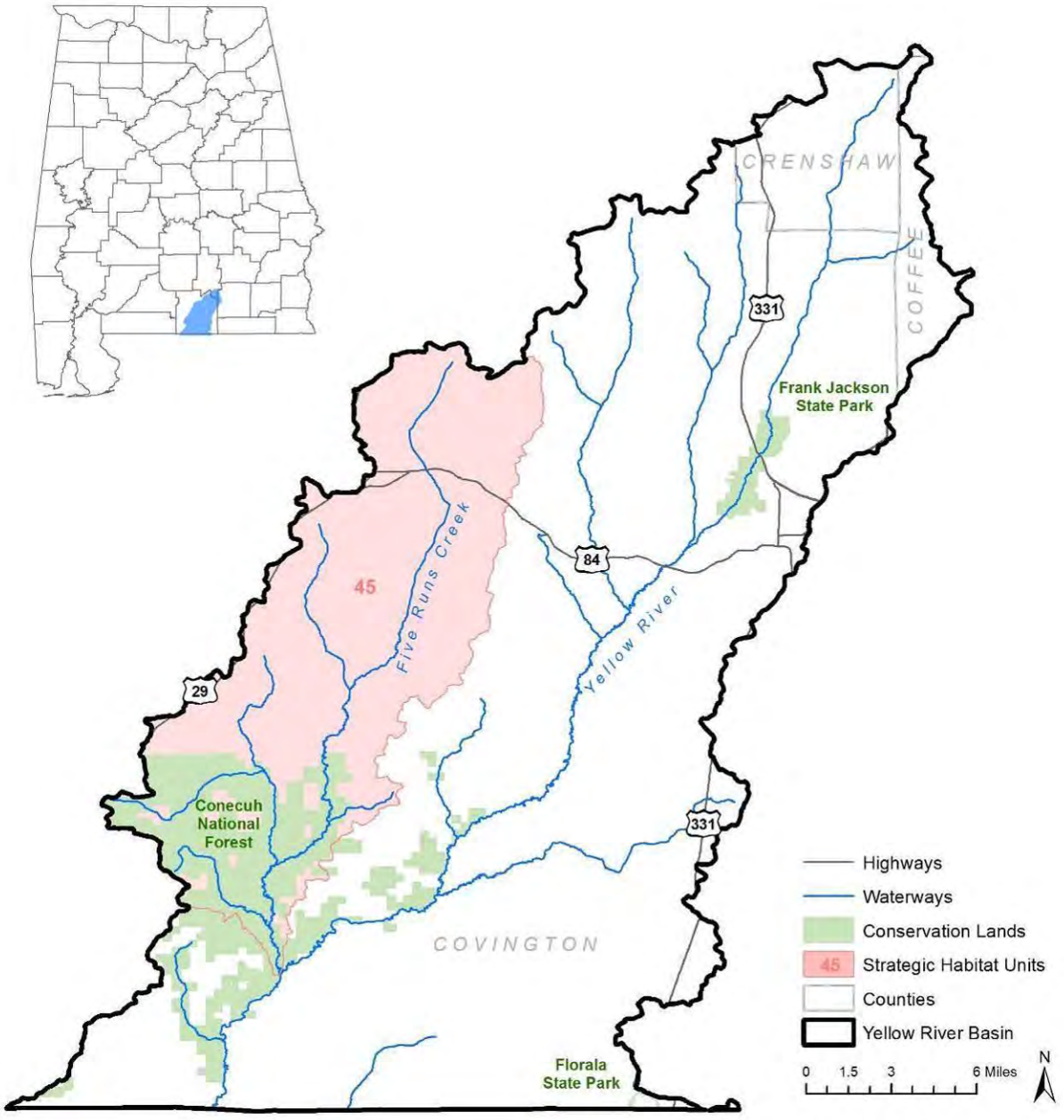


Figure 4-58. Yellow River Basin

Mark Bailey

Figure 4-59. Five Runs Creek, Covington County

Description and Location

The Yellow River basin has a total area of 1,365 square miles in Alabama and Florida. In Alabama, the basin is limited primarily to the eastern half of Covington County and encompasses an area of 507 square miles in the Southeastern Plains. The Yellow River then flows southwest through the Florida panhandle for 61 miles, forms the northern boundary of Eglin Air Force Base, and empties into Pensacola Bay.

Condition

The Yellow River basin in Alabama includes one Strategic Habitat Unit (Figure 4-58) for aquatic SGCN. Land use in the basin is primarily silviculture and agriculture, and water quality is fair to good. Lake Frank Jackson (a tributary of Lightwood Knot Creek) and tributaries are negatively affected by organic enrichment from feedlots and pasture, and 15 miles of the main channel of the Yellow River are included in the 303(d) list of impaired waters due to atmospheric deposition of mercury (ADEM 2014).

Impoundments and Other Barriers – No dams are on the mainstem, although a feasibility study has been conducted by the Corps of Engineers for a proposed site at Milligan, Florida. The National Dam Inventory (USACOE 2014) recognizes 30 dams throughout the basin. An

undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.
Land use – 67.9% forested, 24.7% agriculture and pasture, 6.4% urban.

Aquatic Taxa

There are 14 aquatic SGCN in the Yellow River basin in Alabama (Table 4-45). A total of 25 mussel species are historically known from the basin (Williams et. al. 2008). Boschung and Mayden (2004) recognize 84 freshwater fish species native to the Alabama waters draining to Pensacola Bay, primarily the Conecuh basin but also the smaller Yellow and Blackwater basins. Of the 19 crayfishes known from the three Pensacola Bay drainages, Smith et. al. (2011) recognized six species specifically from the Yellow River basin.

Table 4-45. Aquatic SGCN, Yellow River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 6		
Ptychobranchus jonesi	Southern Kidneyshell	P1
Anodontoides radiatus	Rayed Creekshell	P2
Fusconaia escambia	Narrow Pigtoe	P2
Hamiota australis	Southern Sandshell	P2
Obovaria choctawensis	Choctaw Bean	P2
Pleurobema strodeanum	Fuzzy Pigtoe	P2
Crayfishes – 2		
Procambarus clemmeri	Cockscomb Crayfish	P2
Procambarus hubbelli	Jackknife Crayfish	P2
Fishes – 4		
Alosa alabamae	Alabama Shad	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Graptemys ernsti	Escambia Map Turtle	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation, and nutrient enrichment related to poor land management.
- Maintenance of stream connectivity.

- Water shortages due to declining groundwater levels and increasing demands.

- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for most SGCN.

  Construction of a dam within the Yellow River basin (such as the one proposed at Milligan, FL) would result in loss of riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime.

Priority Research/Survey/Monitoring Needs

Mussels

- **All GCN species** should be comprehensively surveyed at at 5-10 year intervals, including evaluation of population viability and identification of potential reintroduction sites (Southern Sandshell, Alabama Moccasinshell, Choctaw Bean, Southern Kidneyshell). Conduct life history investigations and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

  - **Southern Sandshell** – Conduct an inventory of populations including quantitative assessments to ascertain population viability and availability of potential fish hosts. Measure(s): Data to fill information gaps for mapping distribution of Southern Sandshell; a population viability analysis; identification and GIS mapping of key habitats for possible reintroductions; host fish availability assessment.

  - **Narrow Pigtoe**, **Rayed Creekshell** – Continue comprehensive inventories and basic life history and ecology studies. Include evaluation of population viability and identification of glochidial host(s) and potential reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); host fish population availability assessments.

Crayfishes

- **Jackknife Crayfish** has a very limited and poorly documented distribution. Because temporary types of aquatic habitats are often overlooked, a survey specifically for these

habitats is necessary to determine the current distribution in Alabama Conduct distribution surveys, determine habitat requirements and life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats for GCN species population; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Cockscomb Crayfish** – Life history data are needed. Additional sampling in appropriate habitats within known range could provide population information for the species

Fishes

- **All GCN Species** – Distribution surveys, life history investigations and long-term quantitative monitoring are needed for all species. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN fishes, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

    - **Ironcolor Shiner** – A captive rearing program may be needed to produce juveniles for reintroduction into suitable habitat. Measure(s): Data to fill information gaps for mapping distribution of this GCN fish; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Escambia Map Turtle** – Conduct comprehensive surveys at 5 to 10 year intervals, monitoring abundance and distribution. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Choctawhatchee-Pea-Yellow River Basins Management Plan. Measure(s): Number of management plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Construction of new dams within the basin (including downstream in Florida) would be highly detrimental to most SGCN and should be discouraged. Measure(s): Number of new dams constructed; number of plans/permits for which comments were provided.

- Improve water quality and habitat throughout the basin, support habitat and riparian restoration where needed by ADEM, local governments, Clean Water Partnership and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- Most species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, ARSN, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

- **Ironcolor Shiner** – Continue to search for a source population for reintroduction purposes or if necessary establish a captive breeding program. Species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, ARSN, and other

partners. Measure(s): Population status and condition; if necessary, number of animals reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Bluenose Shiner** – Continue to search for a source population for reintroduction purposes or if necessary establish a captive breeding program. Species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. This work should be a cooperative effort of AABC, USFWS, ARSN, and other partners. Measure(s): Population status and condition; if necessary, number of animals reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Five Runs Creek Strategic Habitat Unit (SHU #45)

Choctawhatchee River Basin

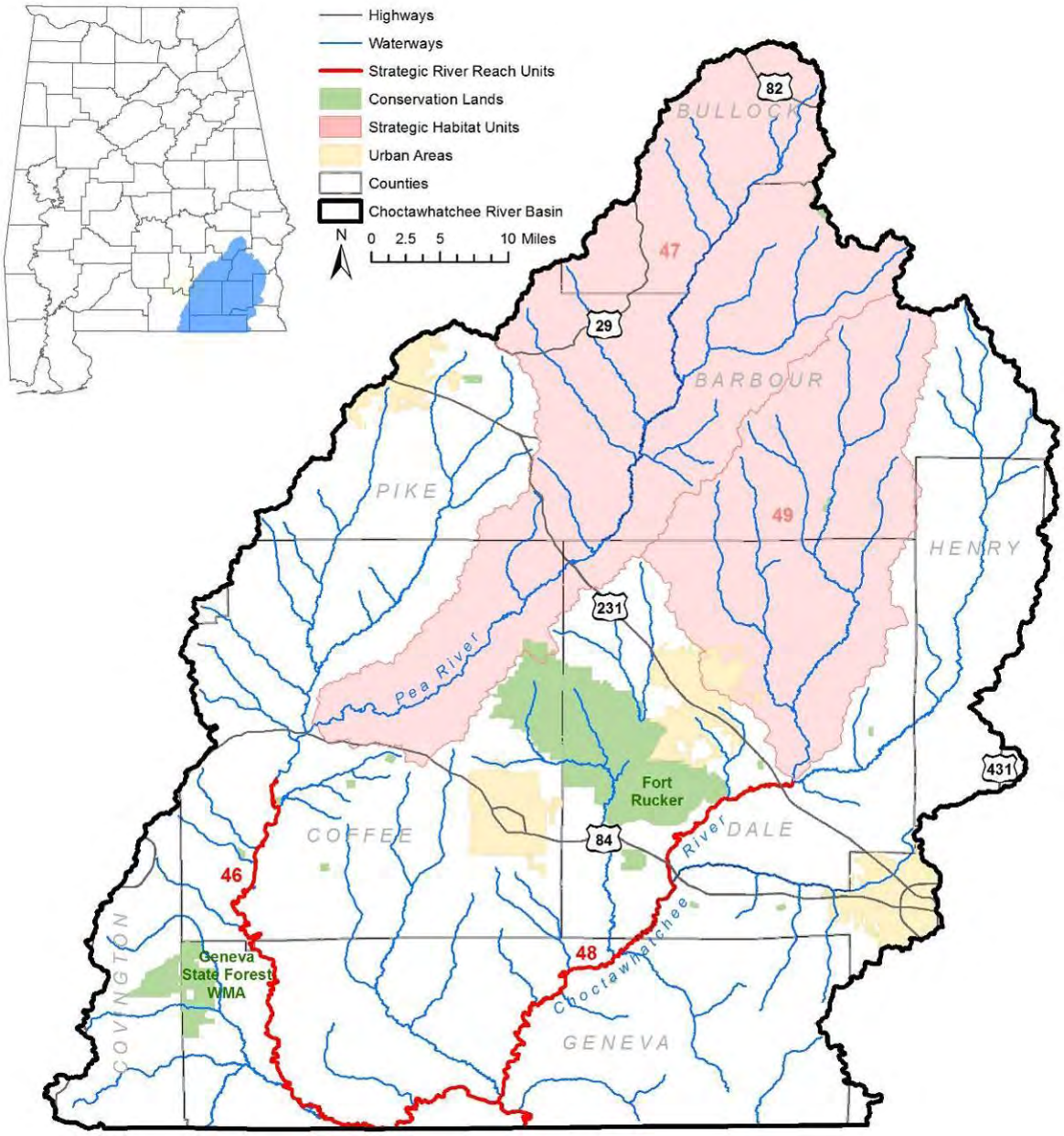


Figure 4-60. Choctawhatchee River Basin

Description and Location

The Choctawhatchee River Basin originates in southeast Alabama and flows through the Southeastern Plains across the Florida panhandle to Choctawhatchee Bay. The 3,130 square miles of the basin in Alabama is about equally divided between the Choctawhatchee River and the Pea River drainages.

Beth Young

Figure 4-61. Choctawhatchee River

Condition

The Choctawhatchee River basin in Alabama includes two Strategic Habitat Units and two Strategic River Reaches for aquatic SGCN (Figure 4-60). The aquatic fauna of the Choctawhatchee basin is largely intact due to the absence of large impoundments in the drainage. The 2014 ADEM 303(d) list identifies 232 miles of streams in the Choctawhatchee basin with impaired water quality that either do not support or only partially support their designated uses. Most impairment is due to nutrients and siltation from urban and agricultural sources and atmospheric deposition of mercury. GSA is developing a Watershed Management Plan.

Impoundments and Other Barriers – Elba Dam is on Pea River. The National Dam Inventory (USACOE 2014) recognizes 291 dams throughout the basin. An undetermined number of low

water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 67.5% forested, 24.8% agriculture and pasture, 6.7% urban, 0.9% other

Aquatic Taxa

There are 16 aquatic SGCN in the Choctawhatchee River basin in Alabama (Table 4-46). Boschung and Mayden (2004) recognized 119 fish species native to the Alabama portion of the basin. A total of 21 mussel taxa are known from the Alabama portion of the basin (Williams et al. 2008). Smith et al. (2011) recognized 12 native crayfish species in the Alabama portion of the basin.

Table 4-46. Aquatic SGCN, Choctawhatchee River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 7		
Ptychobranchus jonesi	Southern Kidneyshell	P1
Villosa villosa	Downy Rainbow	P1
Anodontoides radiatus	Rayed Creekshell	P2
Fusconaia burkei	Tapered Pigtoe	P2
Hamiota australis	Southern Sandshell	P2
Obovaria choctawensis	Choctaw Bean	P2
Pleurobema strodeanum	Fuzzy Pigtoe	P2
Snails – 1		
Elimia dickinsoni	Stately Elimia	P2
Crayfishes – 1		
Procambarus hubbelli	Jackknife Crayfish	P2
Fishes – 4		
Alosa alabamae	Alabama Shad	P1
Notropis chalybaeus	Ironcolor Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 3		
Farancia erytrogramma	Rainbow Snake	P1
Graptemys barbouri	Barbour's Map Turtle	P2
Graptemys ernsti	Escambia Map Turtle	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern

Problems Affecting Species/Habitat

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management.

- Habitat degradation and alteration from river dredging operations and drainage of bottomland forests and swamps.

- Lack of knowledge of various aspects of life history and biology, as well as poorly known distribution and status for most SGCN is a major problem.

- Elba Dam on the Pea River impedes passage of anadromous fish species and mussel host species. Construction of new dams within the Choctawhatchee basin would result in loss of more riverine habitat, fragmentation and isolation of streams, and modification of the natural flow regime.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

    - **Southern Kidneyshell** – Only recent records are from West Fork Choctawhatchee. Conduct intensive survey and quantitative assessment to determine true distribution and population viability. Conduct basic life history studies, and identify glochidial host(s) and potential reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of Southern Kidneyshell, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s).

- **Downy Rainbow** – Possibly extant in Eightmile Creek. Conduct a thorough survey to determine if species is extant, and a quantitative assessment to determine viability. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of this GCN mussel, allowing identification of needed conservation actions; a population viability analysis; inclusion in the Natural Heritage database.

- **Tapered Pigtoe** – Endemic to Choctawhatchee drainage. Conduct a quantitative assessment to determine viability, conduct basic life history and ecology studies, determine identity of glochidial host(s) and potential reintroduction sites. Measure(s): Knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions and identify needed conservation actions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s).

- **Southern Sandshell** – Endemic to Gulf Coast drainages. Conduct an inventory of populations and a quantitative assessments to ascertain population viability and availability of potential fish hosts. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of this GCN mussel, allowing identification of needed conservation actions; a population viability analysis; host fish population availability assessment.

- **Rayed Creekshell**, **Fuzzy Pigtoe**, **Choctaw Bean** – Conduct a comprehensive inventory followed by basic life history and ecology studies. Evaluate population viability, determine identity of glochidial host(s), and survey for potential reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s).

Snails

- **Stately Elimia** – New descriptions reduced the known distribution of this species. Determine distribution in Big and Cowarts creeks. Survey Choctawhatchee drainage for additional populations. Monitor all populations at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land

managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

Crayfishes

- **Jacknife Crayfish** – Has very limited and poorly defined distribution. Because temporary types of aquatic habitats are often overlooked, a survey specifically for these habitats is necessary to determine the current distribution in Alabama. Continue distribution surveys, determine habitat requirements and life histories, and develop and implement long-term quantitative monitoring protocols. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements, and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

Fishes

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Alabama Shad** – Abundance in the Choctawhatchee River has declined. Continue monitoring to obtain additional life history, age and growth, habitat, water quality and flow information.

- **Ironcolor Shiner** – Continue to sample to establish a broodstock for re-introduction purposes. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Reptiles

- **Barbour's Map Turtle** and **Escambia Map Turtle** – Conduct comprehensive surveys at 5 to 10 year intervals, including life history investigations and long-term quantitative monitoring. Determine systematic relationships among populations from different Gulf Coast drainages using morphological and genetic analyses. Measure(s): Data to fill information gaps for mapping distribution; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; effective monitoring protocols established and implemented; determination of systematic relationships among populations.

- **Rainbow Snake** – Rarely encountered. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Choctawhatchee-Pea-Yellow River Basins Management Plan, including all existing Choctawhatchee drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of SGCN and their habitats. Measure(s): Number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, Choctawhatchee-Pea Rivers Watershed Management Authority, Fort Rucker, local governments, Clean Water Partnership, and other partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Fish passage should be provided at Elba Dam on the Pea River to provide Gulf Sturgeon and Alabama Shad access to historic habitat and allow free movement of mussel host species. Measure(s): Fish passage installed at Elba Dam.

- Construction of new dams within the basin (including downstream in Florida) would be highly detrimental to most SGCN and should be discouraged. Measure(s): Number of dams constructed; number of plans/permits commented on.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- Most species may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number

of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Fuzzy Pigtoe, Tapered Pigtoe** – Release captive-propagated juveniles in selected streams. Measure(s): Number of mussels reintroduced.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

- **Ironcolor Shiner** – May require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

Priority Areas for Conservation Action

- Lower Pea River Strategic River Reach Unit (SRRU #46)
- Upper Pea River Strategic Habitat Unit (SHU #47)
- Choctawhatchee River Strategic River Reach Unit (SRRU #48)
- West Fork Choctawhatchee River Strategic Habitat Unit (SHU #49)

Apalachicola (Chattahoochee and Chipola) River Basin

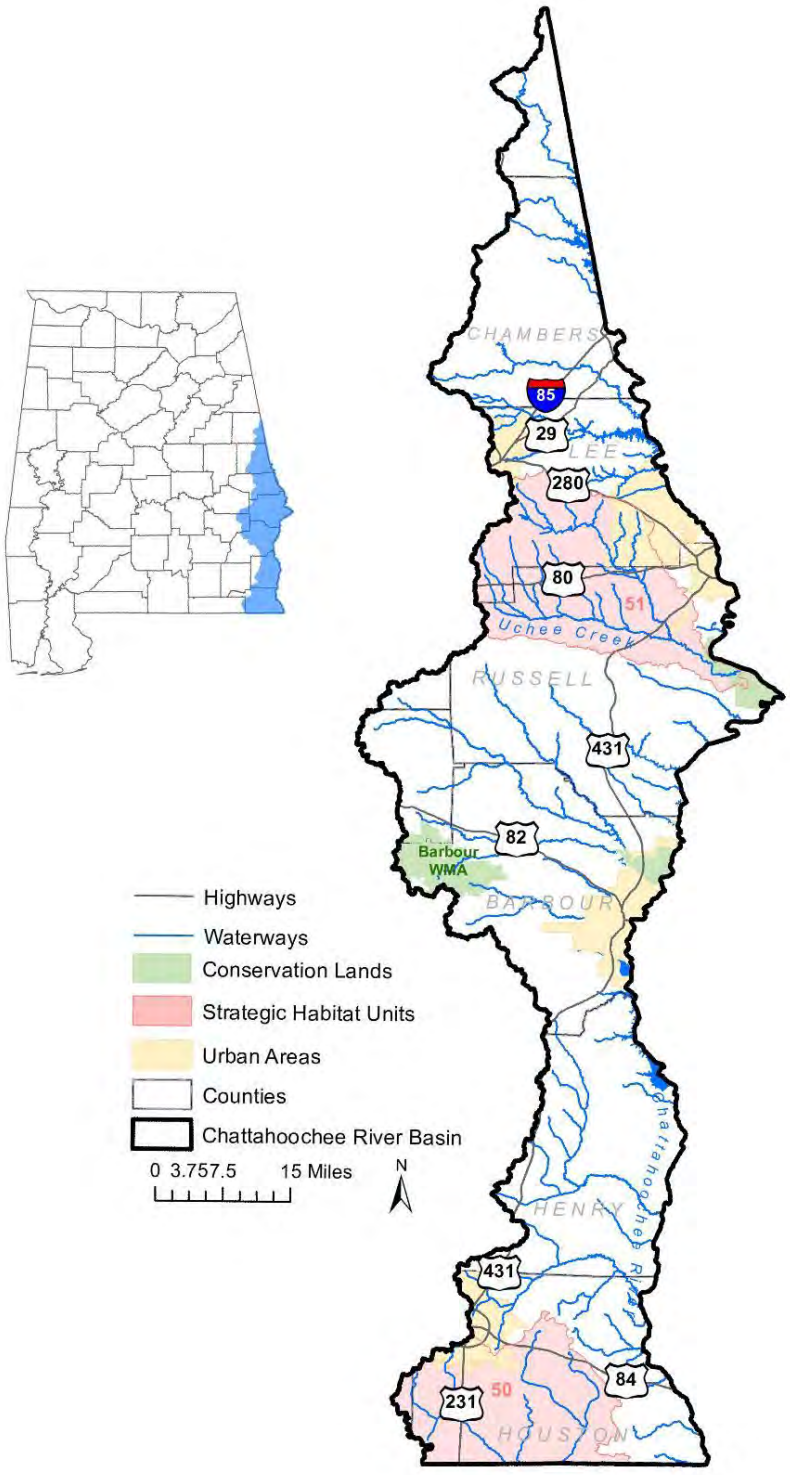
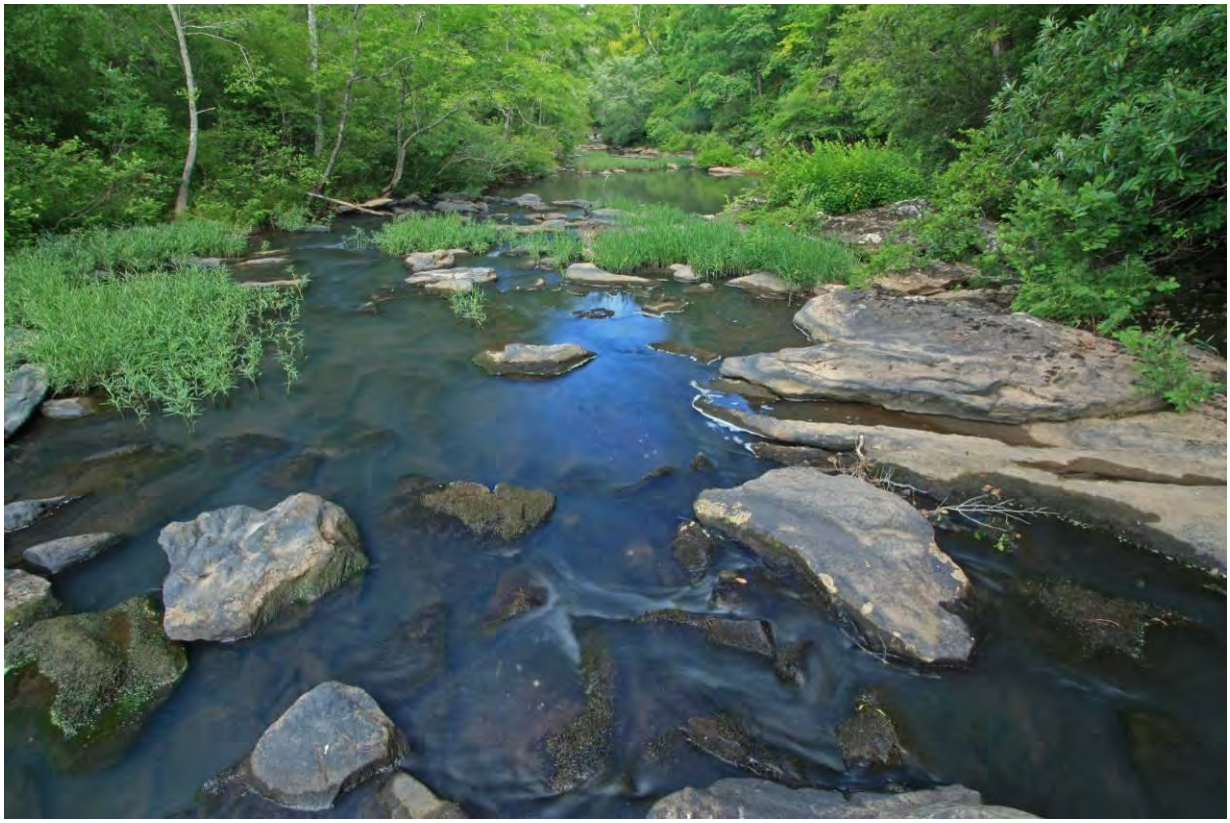


Figure 4-62. Chattahoochee River Basin



Alan Cressler

Figure 4-63. Halawakee Creek, Lee County

Description and Location

The Chattahoochee River originates in the Piedmont of northeast Georgia and flows southwest through the Atlanta metropolitan area. Just downstream of West Point Dam, it forms the border of Alabama and Georgia, crosses the Fall Line into the Southeastern Plains at Phenix City, and continues on to the Florida panhandle where its confluence with the Flint River in Lake Seminole forms the Apalachicola River. The Chipola River is an Apalachicola River tributary with its headwaters in extreme southeast Alabama (Houston County). The Chattahoochee River has a drainage area of 8,700 square miles, of which 2,832 square miles are in Alabama.

Condition

The Apalachicola River basin in Alabama includes two Strategic Habitat Units for aquatic SGCN (Figure 4-62). The 2014 ADEM 303(d) list identifies 103 miles of streams with impaired water quality that do not support or only partially support their designated uses. Siltation from urban development and agriculture are the primary contributing factors. Sufficient flow for wastewater assimilation in the Chattahoochee is most critical in the reach between Atlanta and West Point Reservoir.

Impoundments and Other Barriers – Major dams on the mainstem of the Chattahoochee River include West Point (25,864 acres) and Eufaula (45,180 acres). The National Dam Inventory

(USACOE 2014) recognizes 372 dams throughout the basin in Alabama. An undetermined number of low water crossings and culverts also impede or prevent migration, resulting in fragmented populations, restricted gene flow, and local extirpations.

Land Use – 68.7% forested, 22.2% agriculture and pasture, 7.1% urban, 2% other

Aquatic Taxa

There are 32 aquatic SGCN in the Apalachicola River basin in Alabama (Table 4-47). Boschung and Mayden (2004) recognized 86 native fish species. Williams et al. (2008) report 29 mussels historically occurring in the basin, and Smith et al. (2011) recognized 10 native crayfish species in the Alabama portion of the basin.

Table 4-47. Aquatic SGCN, Apalachicola (Chattahoochee and Chipola) River Basin

Scientific Name	Common Name	SGCN Rank
Mussels – 13		
Elliptio fraterna	Brother Spike	EX
Elliptio nigella	Winged Spike	EX
Lasmigona subviridis	Green Floater	EX
Alasmidonta triangulata	Southern Elktoe	P1
Elliptio chipolaensis	Chipola Slabshell	P1
Elliptio purpurella	Inflated Spike	P1
Elliptoideus sloatianus	Purple Bankclimber	P1
Hamiota subangulata	Shinyrayed Pocketbook	P1
Medionidus penicillatus	Gulf Moccasinshell	P1
Pleurobema pyriforme	Oval Pigtoe	P1
Villosa villosa	Downy Rainbow	P1
Anodontoides radiatus	Rayed Creekshell	P2
Quadrula infucata	Sculptured Pigtoe	P2
Snails – 2		
Elimia boykiniana	Flaxen Elimia	P2
Elimia dickinsoni	Stately Elimia	P2
Crayfishes – 4		
Cambarus pyronotus	Fireback Crayfish	P1
Cambarus howardi	Chattahoochee Crayfish	P2
Procambarus lewisi	Spur Crayfish	P2
Procambarus paeninsulanus	Peninsula Crayfish	P2
Fishes – 11		
Alosa alabamae	Alabama Shad	P1
Cyprinella callitaenia	Bluestripe Shiner	P1
Micropterus cataractae	Shoal Bass	P1
Notropis chalybaeus	Ironcolor Shiner	P1

Scientific Name	Common Name	SGCN Rank
Notropis cummingsae	Dusky Shiner	P1
Percina crypta	Halloween Darter	P1
Pteronotropis euryzonus	Broadstripe Shiner	P1
Acipenser oxyrinchus desotoi	Gulf Sturgeon	P2
Lucania goodei	Bluefin Killifish	P2
Notropis hypsilepis	Highscale Shiner	P2
Pteronotropis welaka	Bluenose Shiner	P2
Reptiles – 2		
Farancia erytrogramma	Rainbow Snake	P1
Graptemys barbouri	Barbour's Map Turtle	P2

P1 = Highest Conservation Concern, P2 = High Conservation Concern
EX = Extirpated, EXCAU = Extirpated, Conservation Action Underway

Problems Affecting Species/Habitat

- Impoundment of the Chattahoochee River is responsible for the loss of most riverine habitat, causing fragmentation and isolation of streams and modification of the natural flow regime. The impoundments also exacerbate problems with nutrient pollution and low dissolved oxygen.

- Water quality degradation, particularly sedimentation and nutrient enrichment related to poor land management, wastewater treatment, and urbanization of the watershed. This is a critical problem in Uchee Creek.

- Current distribution and status, as well as knowledge of various aspects of life history and biology are poorly known for many species.

Priority Research/Survey/Monitoring Needs

Mussels

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Promote research efforts on water quality limits (temperature, pH, DO, conductivity), juvenile and adult diet and metabolism, continued fish host assessment for specific taxa. Evaluate tolerance limits to DO, pH, upper lethal thermal limit for prominent host fishes. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition of SGCN mussels, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions;

a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

- **Brother Spike –** Chattahoochee basin endemic. Extirpated from Alabama and may be extinct. Conduct a comprehensive survey to determine if it is extant in Alabama. Measure(s): Data to fill information gaps to determine the abundance and distribution, allowing identification of needed conservation actions; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); inclusion in the Natural Heritage database.

- **Green Floater** – Apparently extirpated from the entire basin. This species was apparently of marginal distribution and there is only one Alabama record. The ACF population may have represented a different species but is apparently gone now. If found, an evaluation of population viability and identity of glochidial host(s) and potential reintroduction sites should be carried out. Measure(s): Data to fill information gaps to determine the abundance and distribution of Green Floater, allowing identification of needed conservation actions; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); inclusion in the Natural Heritage database.

- **Chipola Slabshell –** Chattahoochee basin endemic. Confined to Chipola River headwaters. Monitor and evaluate population in headwaters of Chipola River at 5-10 year intervals. Study life history and develop captive-propagation protocols in case augmentation becomes necessary. Measure(s): Data to fill information gaps to determine the abundance and distribution, allowing identification of needed conservation actions; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); inclusion in the Natural Heritage database and/or other ADCNR databases/ coverages.

- **Gulf Moccasinshell, Inflated Spike** – Now apparently restricted to Chipola River headwaters. Determine the viability of the populations of these species and assess the need for augmentation. Study life history and initiate a captive-propagation program if needed. Monitor the population at 5-10 year intervals. Search for potential reintroduction sites. Measure(s): Data to fill information gaps to determine abundance and distribution, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); inclusion in the Natural Heritage database.

- **Southern Elktoe** – Endemic to Chattahoochee basin. Now apparently restricted to Uchee Creek system. Determine the viability of the population and assess the need for augmentation. Study life history and initiate a captive-propagation program if needed. Monitor the population at 5-10 year intervals. Search for potential reintroduction sites. Measure(s): Data to fill information gaps to determine abundance and distribution, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; identification of glochidial host(s); inclusion in the Natural Heritage database.

- **Oval Pigtoe**, **Purple Bankclimber**, **Shinyrayed Pocketbook**, **Downy Rainbow**, **Sculptured Pigtoe** – Very limited distribution in Alabama portion of Chattahoochee basin. Conduct a thorough survey to determine extent and viability of populations. Include assessment of potential host fishes and reintroduction sites. Measure(s): Data to fill information gaps to determine the abundance and distribution, allowing identification of needed conservation actions; population viability analyses; identification and GIS mapping of key habitats for possible reintroduction; host fish population availability assessment; inclusion in the Natural Heritage database.

Snails

- **All SGCN** – Conduct comprehensive surveys at 5 to 10 year intervals, including evaluation of population viability and identification of potential reintroduction sites. Conduct life history investigation and develop culture protocols for those species found to be uncommon or decreasing. Measure(s): Data to fill information gaps to determine the abundance, distribution, status, and condition, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; a population viability analysis; identification and GIS mapping of key habitats for possible reintroduction; inclusion in the Natural Heritage database.

Crayfishes

- **All SGCN** have very limited and poorly defined distributions. Conduct distribution surveys, determine habitat requirements and investigate life histories, and develop and implement a long-term quantitative monitoring protocol. Measure(s): Data to fill information gaps for mapping distribution; identification of limiting factors, habitat requirements and/or threats; effective monitoring protocols established and implemented; inclusion in the Natural Heritage database.

- **Fireback Crayfish** – Recently discovered in Alabama. Conduct distribution survey, determine habitat requirements and investigate life history, and develop and implement a long-term quantitative monitoring protocol.

- **Chattahoochee Crayfish –** Taxonomic and phylogenetic work is needed to resolve issues concerning its range and possible habitat associations. Targeted life history and ecological studies are also needed. Continued maintenance of free-flowing streams appears to be critical.

- **Spur Crayfish –** A survey of appropriate habitats within range is needed along with protection of temporary water bodies from drainage (Schuster et al. 2008).

- **Peninsula Crayfish –** Further sampling within and adjacent to the known range is needed to confirm the distribution status (Smith et al. 2011). Research is needed to determine whether it is being impacted by any major threats and whether populations are stable or declining in Alabama.

Fishes

- **All SGCN –** Conduct comprehensive surveys at 5 to 10 to 10 year intervals, and determine life history requirements. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition of SGCN fish, allowing identification of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Broadstripe Shiner** – Conduct distribution survey to determine extent of populations (a study is being funded by USFWS). Determine genetic structure within and among populations. Measure(s): Data to fill information gaps for mapping distribution; determination of genetic structure within and among populations.

- **Halloween Darter** – In Alabama, restricted to Uchee and Little Uchee creeks, where recent surveys failed to detect it. Continue sampling to determine existence of this species in Alabama. Measure(s): Data to fill information gaps for mapping distribution; a population viability analysis.

- **Ironcolor Shiner** – Continue to sample to establish a broodstock for re-introduction purposes. Measure(s): Data to fill information gaps for mapping distribution; identification and GIS mapping of key habitats for possible reintroduction; if necessary, establishment of a captive propagation program; number of fish propagated and reintroduced.

Amphibians and Reptiles

- **Escambia Map Turtle** – Conduct comprehensive surveys at 5 to 10 year intervals, monitoring abundance and distribution. Measure(s): Data to fill information gaps to determine the abundance, distribution, status and condition, allowing identification

of needed conservation actions; knowledge of species' life history and biology to allow land managers, field biologists, and others to make informed decisions; inclusion in the Natural Heritage database.

- **Rainbow Snake** – Historic but possibly extirpated from the basin due to dams on the lower Chattahoochee restricting upstream movement of American Eels, the principal prey of adults. New survey techniques have been developed and should be implemented as part of multi-basin surveys conducted at 5 to 10 year intervals to assess the extent of populations. Measure(s): Data to fill information gaps to determine abundance, distribution, status and condition, allowing identification of needed conservation actions; inclusion in the Natural Heritage database.

Highest Priority Conservation Actions Needed and Key Partnership Opportunities

All SGCN

- Support full implementation of the Chattahoochee-Chipola Rivers Basin Management Plan, including all existing Chattahoochee drainage species recovery plans and relevant recovery or management plans developed within the next ten years that promote conservation of these SGCN and their habitats. Measure(s): Number of management and recovery plan needs or projects funded or completed; number of project partnerships established; number of cooperative habitat protection projects.

- Improve water quality and habitat quality throughout the basin, support habitat and riparian restoration where needed by ADEM, local governments, Clean Water Partnership, and other Alabama and Georgia partners. Measure(s): Stream miles restored, enhanced, and/or protected by fee-simple or easements; ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings; existing monitoring programs utilized/modified to meet SWAP evaluation needs; and new monitoring programs developed.

- Support proposed removal of City Mills and Eagle/Phenix dams to restore riverine habitat under Section 206 of Water Resources Act of 1996 by Corps of Engineers, cities of Phenix City, Alabama and Columbus, Georgia. Measure(s): Removal of City Mills and Eagle/Phenix dams; stream miles restored.

High Priority Conservation Actions Needed and Key Partnership Opportunities

Mussels

- **Most SGCN** may require population augmentation and/or reintroduction to suitable habitats to maintain their viability. The genetic integrity of populations among

drainages should be maintained. This work should be a cooperative effort of AABC, USFWS, GSA, Troy University, Auburn University, and other partners. Measure(s): Population status and condition of SGCN mussels in the river basin; if necessary, number of mussels reintroduced or added to suitable habitats; stream miles restored, enhanced, and/or protected by fee-simple or easements.

- **Brother Spike** – If rediscovered, determine systematic and taxonomic relationships with its congeners and initiate a captive-propagation program should brood stock become available. Determine feasibility of reintroduction into Chattahoochee River.

- **Chipola Slabshell** – Develop captive-propagation protocols in case augmentation becomes necessary.

Crayfishes

- **All SGCN** – Continue monitoring populations; finalize draft regulations on crayfish transport and release, and prepare and distribute educational materials to inform the public. Measure(s): Population status and condition of native and non-native crayfishes in the river basin; number of known interbasin transfers.

Fishes

- **Ironcolor Shiner, Broadstripe Shiner** – May require population augmentation and/or reintroduction to suitable habitats to maintain viability. This work should be a cooperative effort of AABC, USFWS, and other partners. Measure(s): Population status and condition; if necessary, number of shiners reintroduced to suitable habitats.

Priority Areas for Conservation Action

- Chipola River Strategic Habitat Unit (SHU #50)
- Uchee Creek Strategic Habitat Unit (SHU #51)

Priority Areas for Conservation

Chapter 4 to this point has presented individual habitats and river basins as units, listing threats and recommended actions to conserve them and the SGCN they support. Priority areas for freshwater aquatic species are provided in the basin maps as Strategic Habitat Units and Strategic River Reach Units. This section identifies those most critical terrestrial and estuarine areas of the state containing key habitats and species most in need of conservation.

The process of identifying priority areas for conservation began with the review of existing relevant plans and programs that have identified such areas or sites in Alabama. Numerous plans and programs exist, but few have identified sites on a statewide scale. Those that have are used here as primary sources, and include *Alabama Wildlife*, Forest Legacy's *Assessment of Need* for Alabama (Boyce et al. 2002) and TNC's "blueprint" for conservation. This SWAP was strongly guided by TNC's Priority Areas for Conservation not only because TNC's areas are inclusive of the other areas recognized by other programs such as Forest Legacy, but also because of the process used to identify them.

The Nature Conservancy has worked with public and private partners to design portfolios of conservation areas within and across ecoregions following general principles and specific methods outlined in The Nature Conservancy's *Designing a Geography of Hope* (Groves et al. 2000). Ecoregional portfolios represent the full distribution and diversity of native species, natural communities and ecosystems. The results of the first step in the conservation approach include a portfolio of areas that collectively represent a "blueprint" for biodiversity conservation. This blueprint provides a means to engage different organizations, state and federal agencies, academic institutions, and other partners. Increasingly, detailed information is also being collected to help conservation practitioners develop the most effective, highest leverage approaches to facilitate conservation.

Designing ecoregion-based portfolios is a complex, iterative process based on five steps:

- Identifying the species, communities and ecosystems in an ecoregion;
- Setting specific goals for the number and distribution of these conservation targets to be captured in the portfolio;
- Assembling information and relevant data on the location and quality of conservation targets;
- Designing a network of conservation areas that most effectively meets the goals; and
- Identifying the highest priority conservation areas, wide-ranging targets and pervasive threats for conservation action.

For each of the ecoregions that include parts of Alabama, an ecoregional plan was developed with teams of expert biologists from TNC, State Natural Heritage Programs, State Conservation Departments, Tennessee Valley Authority, U.S. Fish and Wildlife Service, U.S. Forest Service, U.S. Geological Survey, Alabama Power Company, academic institutions and other partner

organizations that identifies a suite of conservation areas that represent the full distribution and diversity of native species, natural communities and ecosystems. Ecoregions which include portions of Alabama are: the Interior Low Plateaus, the Cumberlands & Southern Ridge & Valley, the Piedmont, the East Gulf Coastal Plain and the Upper East Gulf Coastal Plain. Similar planning processes were followed to identify high priority marine and estuarine sites in the Northern Gulf of Mexico marine ecoregion.

The key components of this general process were as follows:

- Stratify the ecoregion
- Select conservation targets
- Identify target locations
- Set numeric goals
- Assess viability
- Delineate conservation areas
- Identify data gaps (throughout)

Teams of experts addressed each of these components, and the resulting Priority Conservation Areas for terrestrial SGCN are presented below in Figure 4-64.

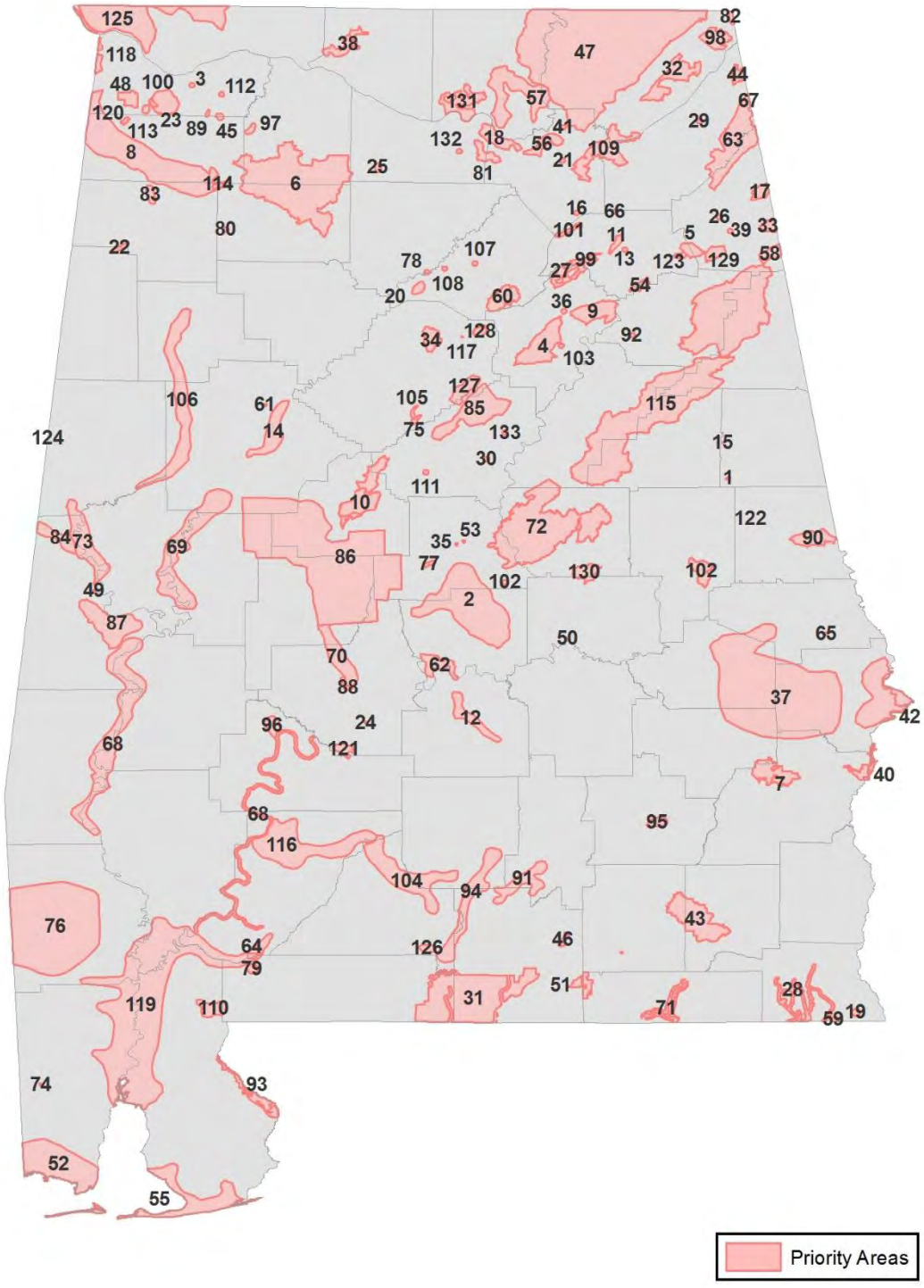


Figure 4-64. Priority Areas for Conservation of Terrestrial SGCN

Key to Priority Areas Map

Priority Area	Map Number
Almond Outcrop	1
Autauga Sandhills	2
Bald Knob	3
Bald Rock Mountain	4
Ballplay Swamp	5
Bankhead/Warrior Mountains	6
Barbour WMA	7
Bear Creek Ravines	8
Beaver Creek & School Creek Mountains	9
Bibb County Glades	10
Big Ridge	11
Big Swamp Creek	12
Black Creek Sandstone Glade	13
Black Warrior River Slopes	14
Blake's Ferry	15
Boaz Pond	16
Bogan Mountain	17
Brindley Mountain	18
Bryans Creek/Hugh's Bog	19
Bryant Mountain	20
Buck Island Glades	21
Buttahatchee River Slopes	22
Cane Creek/Little Mountain	23
Cedar Creek - Highway 41	24
Cedar Plains Glades	25
Centre Bog	26
Chandler Mountain	27
Chipola River/Big Creek Woods	28
Chitwood Barrens	29
Columbiana Mountain	30
Conecuh NF Megasite	31
Coon Gulf	32
Coosa Valley Prairies	33
Cunningham Creek Hills	34
Dillard Bog	35
Dry Creek Barrens	36
East Alabama Fall Line Hills	37
Elk River Bluffs	38
Ellisville Prairie	39
Eufaula NWR	40
Fletcher's Hollow	41
Fort Benning	42
Fort Rucker	43
Fox Mountain	44
Foxtrap Creek	45

Priority Area	Map Number
Frank Jackson State Park	46
Franklin/Marion/Jackson Mountains	47
Freedom Hills and Adjacent Lands	48
Ft. Tombecbe - Jones Bluff	49
Ft. Toulouse - Jackson Park	50
Geneva State Forest WMA	51
Grand Bay Savanna	52
Green's Pitcher Plant Bog-Yellow Leaf Creek	53
Greens Creek Mountain	54
Gulf Islands	55
Honeycomb Creek Karst	56
Huntsville Mountains	57
Indian Mountain	58
Indigo Pond	59
Inland Lake/Blackburn Fork Woods	60
Jock Creek	61
Jones Bluff	62
Little River Canyon	63
Little River State Forest	64
Little Uchee Creek Ravines	65
Longleaf Bog	66
Lookout & Pigeon Mountains	67
Lower Alabama River Bluffs & Swamps	68
Lower Black Warrior Swamps	69
Lower Cahaba Bluffs & Swamps	70
Lower Choctawhatchee River Bluffs	71
Lower Hatchet Creek/Coosa WMA	72
Lower Tombigbee River	73
Mobile County Gopher Tortoise Mitigation Bank	74
Moss Rock	75
MS-AL Stateline Bogs	76
Mulberry Creek	77
Mulberry Fork	78
Mystery Worm Pond	79
Natural Bridge	80
Newsome Sinks	81
Nickajack Cove	82
North Fork Creek Glade	83
Noxubee Prairie and Bluff	84
Oak & Double Oak Mountains	85
Oakmulgee District, Talladega N.F.	86
Old Bluffport	87
Old Cahaba Prairies	88
Osborne Hill Barrens	89
Oseligee Creek	90
Patsaliga Creek	91
Pelham Range Prairie	92

Priority Area	Map Number
Perdido WMA	93
Persimmon Creek	94
Pike County Pocosin	95
Prairie Bluff - Millers Ferry Prairie	96
Prairie Grove Glades	97
Raccoon Creek	98
Red Mountain	99
Rock Creek Barrens	100
Sand Mountain	101
Sandy Creek	102
Savages Crossing	103
Sepulga River Slopes	104
Shades Mountain	105
Sipsey River	106
Skirum Bluff	107
Skyball Mountain	108
South Sauty Creek	109
Splinter Hill Bog	110
Spring Creek	111
Spring Valley	112
Srygley Barrens	113
Sunny Home Glades	114
Talladega Mountains	115
Tallahatta Bluffs	116
Tapawingo Springs	117
Tennessee River Bluffs	118
Tensaw Delta	119
Thorne Glade	120
Tilden Carlbill Prairie Complex	121
Tiller's Outcrop	122
Tom Cat Prairie	123
Tombigbee River Levee Old Field Mouse Site	124
Transition Hills	125
Turk's (Sander's) Cave	126
Upper Cahaba Watershed	127
Upper Gurley Creek	128
Weisner Mountain	129
Weoka Creek	130
Wheeler NWR / Redstone Arsenal	131
Yellow Bluff	132
Yellowleaf Creek Bog	133

Chapter 5
MONITORING, EVALUATION, AND ADAPTIVE MANAGEMENT

Introduction

Monitoring Alabama's SGCN, their habitats, and the effectiveness of the conservation actions identified in the previous chapters is important and necessary information for Alabama Department of Conservation and Natural Resources Division of Wildlife and Freshwater Fisheries (ACDNR DWFF) and its partners (Element 5). It provides the opportunity to determine the effectiveness of conservation actions and to reduce and eliminate threats facing the state's fish and wildlife resources. Monitoring is also necessary to track the success of conservation actions, ensuring the most efficient use of limited staffing and funds. As conditions change (e.g., land use patterns, climate change, global or national population trends, new data and information), adaptive management and implementation of the conservation actions identified in Chapter 4 will allow DWFF to respond appropriately. Adaptive management has received attention in the conservation community as an effective method for long-term conservation (e.g., Johnson and Case 2000, The Nature Conservancy [TNC] 2000, Brown et al. 2001, Groves et al. 2002, Pew Oceans Commission 2003, USFWS 2004, and Salafsky et al. 2001, 2002, and 2003). Structured decision-making (SDM, Martin et al. 2009) is a useful process to analyze problems, create objectives, and explore tradeoffs, consequences and alternative paths within a framework that is based on science, values and policy.

This chapter describes how the state of Alabama will use tools for information management and conservation planning to track the implementation and effectiveness of conservation actions. Examples of these tools include the State Wildlife Grants Effectiveness Measures Project (AFWA 2012) funded by the Doris Duke Foundation and the national Wildlife Tracking and Reporting Actions for the Conservation of Species (TRACS) database funded by U.S. Fish and Wildlife Service (USFWS). The framework starts with a specific conservation action, then a basic results chain is created linking the action to relevant threats, habitats and species. Next, indicators and measures are selected for each step in the chain, and monitoring data are used to track and populate those indicators. Information about the results chain, indicators, and measures will be captured in the *Wildlife TRACS* database. Taken together, the measurements of these indicators will provide the essential information needed for evaluating the effectiveness of conservation action. Conservation actions will be monitored and measured throughout the 10-year implementation of the SWAP.

State Wildlife Grants Effectiveness Measures Project

The Association of Fish and Wildlife Agencies (AFWA) led an effort to develop an approach for measuring the effectiveness of wildlife conservation activities funded under the USFWS's State Wildlife Grants (SWG) program. In 2009, AFWA's Teaming with Wildlife Committee formed the Effectiveness Measures Working Group. This working group included representatives from state fish and wildlife agencies as well as private, academic, and non-governmental conservation partners with expertise in wildlife conservation and performance management.

In 2011, the working group released a final report that outlines a comprehensive approach to measure the effectiveness of the activities funded under the SWG program. The report

recommends a set of common indicators for measuring status, trends, and/or effectiveness of thirteen general types of conservation actions that are commonly supported by SWG.

These actions include direct management of natural resources, species restoration, creation of new habitat, acquisition/easement/lease, conservation area designation, environmental review, management planning, land use planning, training and technical assistance, data collection and analysis, education, conservation incentives, and stakeholder involvement. The report includes sample templates and forms that could be used for reporting the results of conservation activities, as well as a discussion of the specific methods by which these reporting methods could be incorporated into in the USFWS's grants management database. For more information and to review the project final report, visit:
www.fishwildlife.org/files/Effectiveness-Measures-Report_2011.pdf.

Wildlife TRACS Database

The State Wildlife Grants Effectiveness Measures Project has informed the development of *Wildlife TRACS*, a database designed by the USFWS to record information about conservation activities funded through the Wildlife and Sport Fish Restoration Program, including SWG. When fully functional, *Wildlife TRACS* is intended to track and report project outputs, effectiveness measures, and species and habitat outcomes. *Wildlife TRACS* has the potential to track long-term outcomes for species and habitats, above and beyond the types of short-term output measures commonly tracked by funding agencies (e.g., number of publications, number of workshops, number of people contacted). Because it is being designed to be responsive to the needs of the state agencies receiving SWG funding, *Wildlife TRACS* includes its own customized classifications of conservation actions and threats. These classifications are based, at least in part, on the classifications developed jointly by the International Union for Conservation of Nature (IUCN) and the Conservation Measures Partnership (CMP, see Salafsky et al. 2008). For more information about the development of *Wildlife TRACS*, visit:
wsfrprograms.fws.gov/Subpages/TRACS/TRACS.html.

Alabama's Monitoring Framework

Alabama's monitoring strategy uses the SWAP conservation objectives to guide monitoring of SGCN, key habitats, and the results of conservation actions. This chapter describes the framework for adapting the conservation actions listed in Chapter 4 to changing conditions and new information, particularly the information derived as the Priority Research, Survey and Monitoring Needs are met. Table 5-1 summarizes the type of evaluation or monitoring action, the planned accomplishment measures, and short and long-term outcomes. Appendix 5.1 summarizes existing monitoring efforts in Alabama acknowledged by this SWAP as overall monitoring mechanisms for these actions and partners. Adaptive management is a useful mechanism that will continually improve Alabama's conservation of SGCN and key habitats by incorporating lessons learned from successful and unsuccessful management actions. The performance measures and products described in the previous chapter will provide a feedback loop in which

the degree of success of each action will be measured. Monitoring is the critical link in the feedback loop, connecting the implementation of conservation actions with management objectives.

Alabama's monitoring strategy considers the appropriate geographic scale to evaluate the status of species or species groups and the effectiveness of conservation actions. Implementation of this SWAP involves monitoring at a variety of geographic scales, including local, state, regional, national, and international, according to their appropriateness and the recommendations of relevant partners' plans and programs. For example, PARC recommends herpetofaunal monitoring with standardized protocols for the southeast region, similar to bird plans (i.e., Table 5-1 was adapted from the Atlantic Coast Joint Venture [ACJV] Strategic Plan). As a result, Alabama's monitoring strategy will use the standardized regional protocols for amphibian and reptile monitoring in order to place Alabama's populations in the appropriate context. Other standardized monitoring protocols, such as those of the Breeding Bird Survey, International Shorebird Survey, North American Bat Conservation Partnership Strategic Plan, and American Fisheries Society, will be utilized wherever appropriate so that Alabama's data will be compatible with regional and national conservation efforts.

Alabama's monitoring strategy also incorporates several time scales (short-term, interim and long-term) to monitor the implementation and effectiveness of conservation actions and the status and condition of key habitats. In the short-term, the monitoring strategy is to determine whether conservation actions have been implemented. In the interim, the monitoring strategy seeks to evaluate whether the conservation actions were successful in improving the status and/or condition of SGCN and key habitats – did the conservation actions work as theorized? Long-term objectives of the monitoring strategy are to spatially track the abundance and distribution (both historic and current) of key habitats, their condition and conservation status, and to adaptively manage the desired amount, distribution and condition of each habitat.

Monitoring SGCN and Key Habitats

Monitoring is to be accomplished at several biological levels including individual species, guilds, or natural communities. Plans for monitoring SGCN and their key habitats are listed under the Priority Research, Survey and Monitoring Needs sections for each habitat in Chapter 4. Within each habitat, the most appropriate level of monitoring has been identified and prioritized by the technical and taxa committees to best monitor that "system." These monitoring actions are the result of the recommendations from the consensus of experts from the Nongame Conference and taxa committees (Mirarchi 2004, Mirarchi et al. 2004a, b, c) as well as from many existing conservation and recovery plans from partners' programs. Wherever possible this SWAP recommends and supports the full implementation of such partners plans, i.e., USFWS, U.S. Forest Service, Partners In Flight Bird Conservation Regions (BCR), Partners in Amphibian and Reptile Conservation (PARC), Bat Conservation International (BCI), NatureServe Systems, ACJV Strategic Plan, Forever Wild Land assessments, etc., that have recommended or identified standardized monitoring actions for regional or national consistency.

If monitoring is not identified for a SGCN or species group/taxa, Chapter 4 of this SWAP describes monitoring actions for other species which occupy the same habitats; these recommendations are prioritized to benefit the overall habitat, community, or assemblage, including many other SGCN. In cases where not enough information exists to monitor a species or group, or monitoring protocols have not yet been developed, this need is documented and followed by a conservation action to address that information need. This is true for some taxa groups such as small mammals and invertebrate groups for which standardized protocols need to be developed, and where baseline data do not exist to form the basis of a monitoring protocol. In these cases, these overarching taxa needs are described in Chapter 1 under the appropriate taxa.

The status and trends of individual SGCN will be tracked by complementing the existing State Lands Division Natural Heritage Section (SLD-NHS) database. The database includes two million species occurrence records for flora and fauna that occur in Alabama, with information such as protection status (federal and state), rankings (SGCN and TNC) and Natural Heritage System (NHS) scores (NHS Sensitive or NHS Watchlist). This scoring system is approved by the Forever Wild Board. The status and ranking of a species is updated on an as-needed basis.

The database has a web front-end that is used by researchers and scientists doing work in Alabama (https://heritage.dcnr.alabama.gov). The scientific collection permitting system has been tied into the database since 2009. For a researcher to renew their permit each year, they must submit the previous year's data into the database. From the website, users can also query the database for a particular species, species group, or geographic area that they are interested in. The database includes information from protected and unprotected lands, public and private lands. The database is a clearinghouse and contains data collected by ADCNR personnel, other state agency researchers, academics, and the general public. All data includes a citation, which allows the user of the data to ask additional questions to the collector of the data and gives credit to the collector.

Monitoring the status and/or condition of key habitats will be accomplished primarily through existing monitoring programs such as the watershed protection and river basin management plans. Long-term monitoring of the key habitats will be accomplished using existing and new geographic information system (GIS) programs. The existing GAP will be utilized for terrestrial habitats. For aquatic, the Strategic Habitat Units (SHUs) and Strategic River Reach Units (SRRUs) monitoring system will be used. It was developed jointly with the USFWS, Geological Survey of Alabama (GSA), Alabama Department of Environmental Management (ADEM) and the other Alabama Rivers and Streams Network (ARSN) partners (see Alabama H20). Monitoring efforts by the Environmental Protection Agency, ADEM, U.S. Geological Survey and Alabama Water Watch will help DWFF track the status and trends of Alabama's key aquatic habitats. A new partnership with AL Department of Transportation offers additional monitoring opportunities as project activities and mitigation efforts will be input in conjunction with the ARSN collaboration. Periodic updates of the land use and land cover in the state will allow the abundance and distribution of each habitat to be monitored as conservation actions and SWG projects are implemented. Areas where additional efforts are needed will be identified and adaptively incorporated as the SWAP is updated. Utilizing landscape-level remote sensing and other mapping techniques will be

particularly valuable given the proportion of key habitats and SGCN that are located on private lands.

Effectiveness of Conservation Actions

The purpose of tracking effectiveness measures is to obtain the information needed to adaptively manage fish and wildlife species and habitats in the state. Alabama is committed to an adaptive management approach to fish and wildlife conservation. The next sections of this chapter describe a conceptual model for the SWAP with corresponding results chains and illustrate how the SWG effectiveness measures function within an adaptive management context. The effectiveness of conservation actions described in this SWAP will be measured using a set of standardized effectiveness measures that have been developed by AFWA and described in their 2011 *Measuring the Effectiveness of State Wildlife Grants Final Report* (AFWA 2011). Actual values for these measures will be entered into the USFWS *Wildlife TRACS* database, and comparisons of the values of these measures over time will be used to establish the degree of effectiveness of individual projects as well as broader conservation programs. Terms and standard definitions are derived from Margoluis and Salafsky (1998) and Salafsky et al. (2008).

Conceptual Model for the Alabama State Wildlife Action Plan

Conceptual models are at the heart of adaptive management approaches for species and habitat conservation. Models illustrate what is called the "theory of change" for a project: the causal pathways by which managers believe that a project will achieve its desired results. Although there are many different kinds of conceptual models, Margoluis and Salafsky (1998) introduced a simple form of box-and-arrow diagram that shows causal linkages between the basic conservation elements for an individual project, including targets, threats, and conservation actions. While originally developed as a tool for developing individual conservation projects, conceptual models can also be developed for a larger conservation program. The following conceptual model (Figure 5-1) for the SWAP illustrates the linkages between the core plan elements, including species and habitats, threats and actions. This conceptual model is intended to be a generalized representation of the interactions between the plan elements. Not all of the threats and actions shown in the diagram will apply to every species or habitat. What the diagram shows is the set of possible threats and actions that could affect a particular species or habitat.

Conservation actions are shown in yellow hexagons; threats or information needs are shown in lavender boxes, and targets are shown in blue ovals. Arrows indicate the logical causal linkages between the elements. Arrows between actions and threats show that the action is intended to remediate or ameliorate the threat. Arrows between threats and targets show that the threat affects that target.

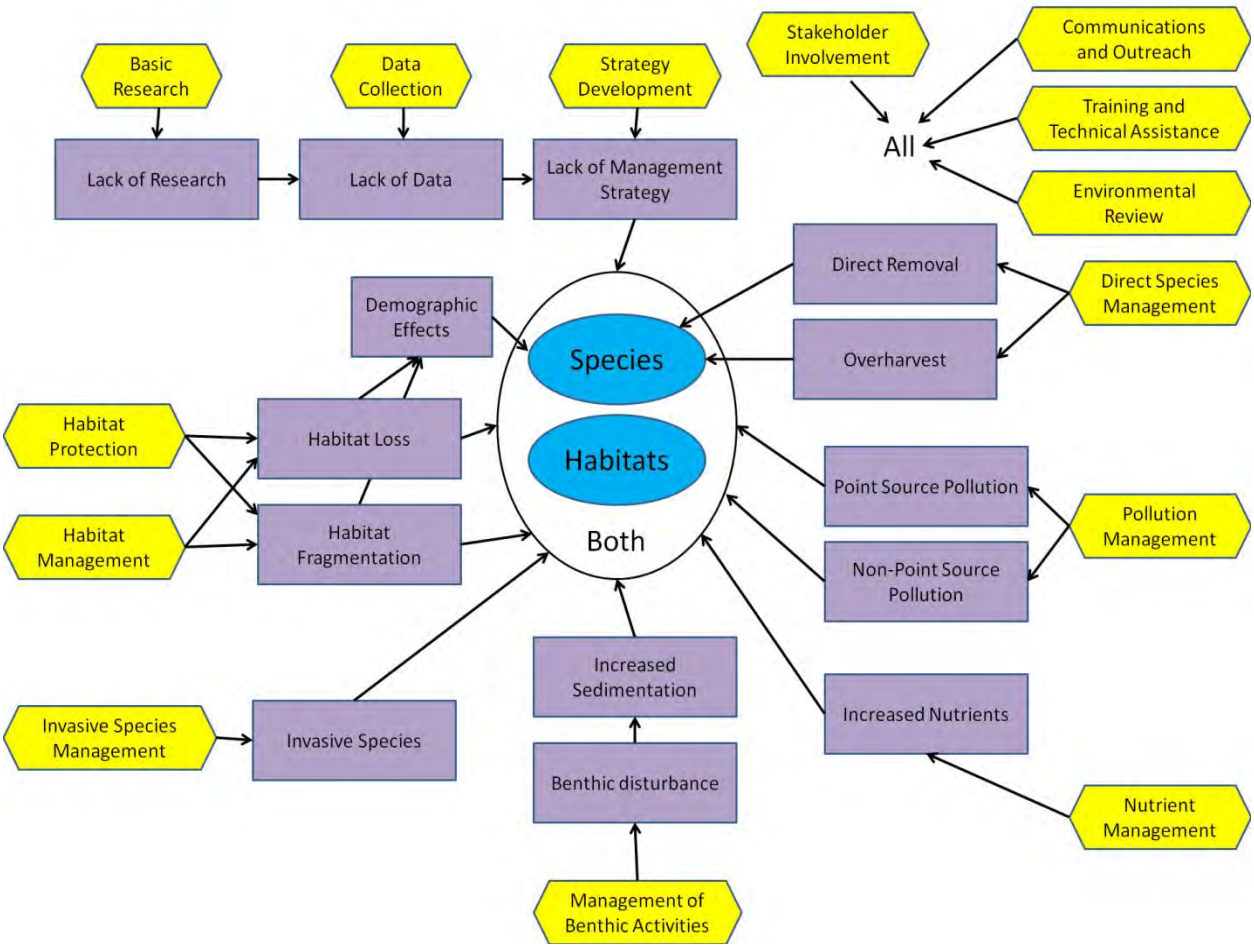


Figure 5-1. Conceptual Model Showing Linkages between SWAP Elements

From Conceptual Model to Results Chains

The conceptual model above can be used to construct a set of results chains for each of the different conservation actions in the yellow hexagons. A results chain (Figure 5-2) shows the logical linkages between a conservation action and the target that is the intended beneficiary of that action. Results chains also include threats, in cases when the conservation action is intended to reduce a specific threat, and may also include intermediate outcomes between the action and its intended benefits to the target.

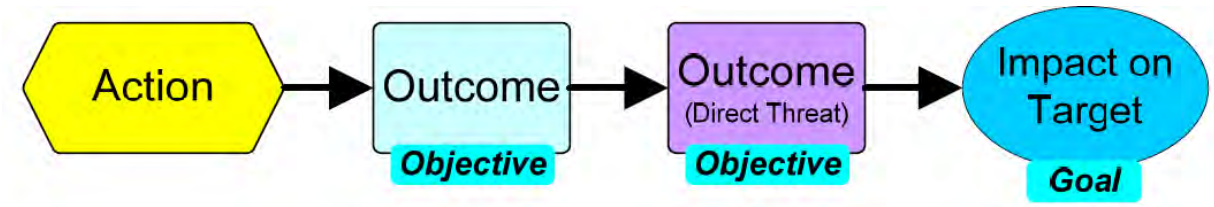


Figure 5-2. Sample Results Chain Showing the Linkages between these Basic Elements

Fully developed results chains also incorporate indicators for each of the individual elements (e.g., action, threat, outcome, and target). A specific measure is then identified for each indicator, showing how exactly that indicator will be measured over time. Data from existing monitoring programs can be used to track the values of these measures over time. Reviewing data from monitoring programs can help managers adjust their management prescriptions and adaptively manage wildlife species and their habitats.

DWFF and its partners will develop project-specific results chains for the individual conservation actions that are selected for implementation. At the same time, the state will be using existing results chains that have been developed by AFWA to identify potential indicators and effectiveness measures for the categories of conservation actions in the conceptual model presented above.

Results Chains and Effectiveness Measures for Conservation Actions

Results chains were originally developed as tools for developing an individual conservation project. It is also possible to develop generalized results chains that show the relationships between the basic classes of elements (e.g., actions, threats, outcomes, and targets) for particular types or classes of conservation projects. These generalized results chains can be very helpful in identifying indicators and measures that can be used to track progress towards conservation goals across a broader suite of similar projects. If projects are tracked using identical or compatible indicators and measures, the information about project accomplishments can then be "rolled up" across the suite of projects in order to report broader progress to funding agencies and the general public.

AFWA developed sets of generalized results chains for common conservation actions described in the SWAPs. The AFWA report on SWG Effectiveness Measures (AFWA 2011) also included a set

of recommended indicators for each of a set of generalized results chains. Because these indicators are intended to track progress on conservation projects, they are also known as "effectiveness measures" or "performance measures."

Effectiveness measures will be tracked by Alabama for particular classes of conservation actions. These effectiveness measures have been developed by the AFWA SWG Effectiveness Measures Working Group (AFWA 2011) and will be reported and tracked as part of Alabama's regular reporting to the USFWS via the *Wildlife TRACS* database.

Scenario: Habitat Management for Endangered Southern Pigtoe

The following aquatic example describes a proposed approach for Alabama's framework for monitoring and effectiveness measures.

The Southern Pigtoe, an SGCN mussel, occurs in the Coosa River watershed but is believed to be extirpated from the Cahaba River watershed. The Southern Pigtoe is ranked as a P1 SGCN, has a state status of S1, is federally-endangered, and has a global status of G1 (Element 1; Chapter 1). The Coosa River watershed where the Southern Pigtoe is found is the largest and most biologically diverse subwatershed in the Mobile River basin, but it has been significantly altered by six dams impounding the mainstem river in Alabama and is also threatened by degraded water quality (Elements 2 and 3; Chapters 2, 3 and 4). A priority monitoring need for the Southern Pigtoe is to conduct a comprehensive survey in the Cahaba River drainage for potential reintroduction sites (Element 3). The anticipated products of fulfilling this monitoring need are data to fill information gaps to identify and map possible reintroduction sites for this SGCN mussel (Elements 1, 2 and 3). These data will also be incorporated into regional and national efforts such as the federal recovery plan for the Southern Pigtoe, the Lower, Middle and Upper Coosa River Basin Management Plans, Cahaba River Basin Management Plan, Mobile Basin Management Plan (Element 7; Chapter 7). Reciprocally, any updates to these regional and national plans will be incorporated into this SWAP as updates are made available (Element 6; Chapter 6).

Priority conservation actions (Element 4; Chapter 4) that have been identified to improve the conservation of Southern Pigtoes and their riverine habitat include: (1) support implementation of more natural flow regimes and full compliance with water quality standards at Coosa River dams; (2) improve water and habitat quality by supporting riparian and habitat restoration projects; (3) supporting the full implementation of the Coosa River Basin Management Plan, federal recovery plan, and other applicable management plans; and (4) population augmentation and/or reintroduction to suitable habitats. Key partners to implement these conservation actions include the Alabama Power Company, Aquatic Resource Recovery Center, USFWS, Alabama Aquatic Biodiversity Center, Tennessee Aquarium Research Institute, ADEM, Alabama Forestry Commission, Natural Resources Conservation Service (NRCS), Alabama Clean Water Partnership (ACWP), Alabama Water Watch (AWW), Coosa River Basin Initiative, local governments and the Cahaba River Society (Element 7; Chapter 7).

In this example, NRCS and private land managers in Alabama identify the following specific conservation action: plant riparian buffers to improve water quality, to help make the habitat more suitable for Southern Pigtoes.

For this action, this example basic results chain (Figure 5-3), a diagram which shows the logical connections between the four basic conservation elements is developed: action, objectives, threats, and targets (species and habitats). In this case, these elements are defined as follows:

- **Action:** Plant riparian buffers by planting trees and shrubs along rivers;
- **Objective:** Restore riparian buffers to improve water quality in support of Southern Pigtoe populations;
- **Threat:** Sedimentation from land uses near the river result in poor water quality; and
- **Targets:** Habitat- riparian habitats, Species- Southern Pigtoe.

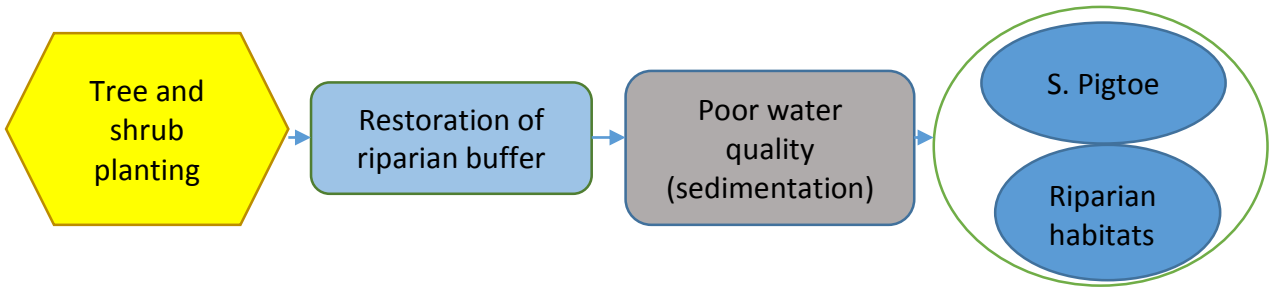


Figure 5-3. The Logical Relationships between these Elements in the Standard Results Chain Format

For each element in the results chain, an indicator and a method or measure by which that indicator will be tracked is identified.

AFWA's 2011 report on effectiveness measures for SWGs classifies restoring riparian buffers as a "Direct Management of Natural Resources." Recommended indicators and performance measures for projects that involve Direct Management of Natural Resources include the following:

- Percent Management Actions Implemented As Planned;
- Evidence that Direct Management Action is Reducing Key Threats;
- Degree to which target SGCNs respond as expected from direct management actions;
- Degree to which target habitats/processes respond as expected from direct management actions;
- Species Measures (e.g. population size, reproductive success); and
- Habitat Measures (e.g. size, condition).

For the specific management action (tree and shrub planting), the indicator "miles that have received riparian buffer restoration," will be measured by tracking the number of miles that are subjected to tree and shrub planting each year. For the objective (restoration of riparian buffer), the indicator "stream miles that have sufficient riparian buffer," will be measured by tracking the stream miles meeting certain vegetation requirements (NRCS 2015). For the threat (poor water

quality - sedimentation), the indicator "number of stream miles impacted by sedimentation/siltation" will be measured by tracking water quality through ADEM and partner monitoring efforts. For the targets (riparian habitat and Southern Pigtoe), the indicators "number of sites with Southern Pigtoe populations" and "acres of high quality riparian habitat" can be measured. The indicator for the Southern Pigtoe populations will be measured using presence-absence surveys conducted. High quality riparian habitat will be tracked by AWW, ACWP, Coosa River Basin Initiative, and the Cahaba River Society the same measures used to track habitat condition (Chapter 4).

To implement and track these indicators, managers will need to record basic information about these indicators including: the description of a specific measure for the indicator, the values of that measure in 2005 and 2015, the units for the measure, and the name of any monitoring program that provides data on that measure and indicator.

Data can also be reported to the USFWS, using the *Wildlife TRACS* database to record progress towards achievement of conservation objectives as individual projects are completed.
In 2025, managers will present the basic results chain shown above and a chart or diagram showing how the values of each indicator for the chain have changed over the years since the project was implemented. The following charts (Figure 5-4) are provided as examples of how these data might be presented in the 2025 SWAP.

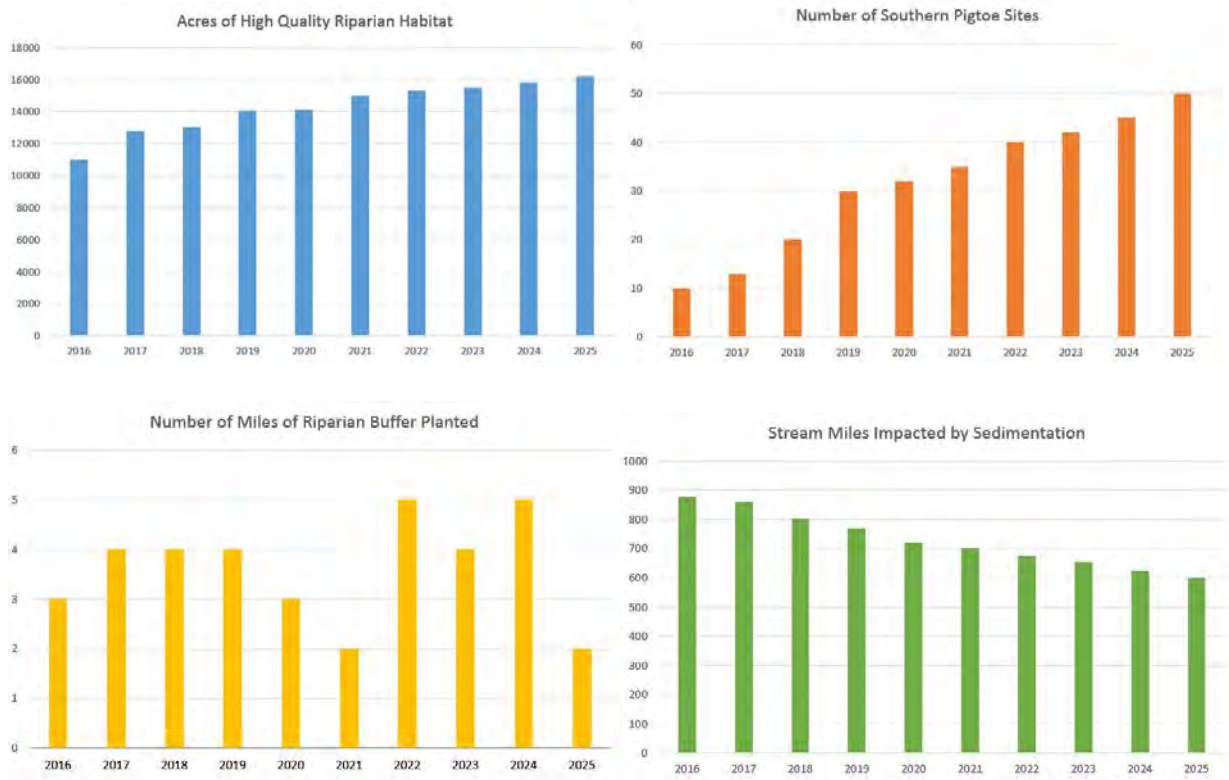


Figure 5-1. Examples of How Data Would Be Presented in the 2025 SWAP

These four charts graphically illustrate progress towards the conservation goals for riparian habitats and the Southern Pigtoe populations. By restoring riparian buffers for a relatively small number of miles each year, the water quality greatly improves (decreases sedimentation) over ten years, and the number of acres of high quality riparian habitat is increased. Note that there is a time lag evident between the time when a management treatment is applied and when a response in the habitat variable is observed. This is typical for many management situations, which is one important reason why multi-year monitoring may be necessary to see the effects of conservation projects. The number of sites occupied by Southern Pigtoes also increases over time, demonstrating progress towards the overall goal of conserving this species in the state. Based on these charts, this would appear to be a successful conservation management action. These charts illustrate one way to track and report project effectiveness over time for this example project.

This adaptive management approach will allow ADCNR to not only quantify these performance measures, but also compare the results of the species monitoring to infer whether the conservation actions are improving the Southern Pigtoe population each year (Element 5). If the status and condition of Southern Pigtoes shows no significant improvement (Elements 1 and 3), then the conservation actions can be modified to intensify habitat protection measures (Element 4), or target key areas and cooperative projects with partners (Element 7).

Scenario: Habitat Management for Longleaf Pine and Gopher Tortoises

The following terrestrial example describes a proposed approach for Alabama's framework for monitoring and effectiveness measures.

Loss of quantity and quality of longleaf pine forest and the highly fragmented nature of remaining tracts has resulted in the corresponding decline of a large number of terrestrial vertebrates that can be considered "longleaf specialists," found either primarily or exclusively in longleaf-dominated habitats. More P1 species occur in this habitat type than any other (Mirarchi 2004). The Gopher Tortoise is identified as an SGCN in the 2015 SWAP.

Frequent fire maintains a canopy dominated by longleaf pine, with wiregrass (*Aristda beyrichiana*) or other grass/herb ground cover. When fire is infrequent, scrub oaks, other hardwoods, and shrubs become common in the midstory and shade out native grasses and forbs. Without the appropriate fire regime, canopy closure will increase along with shrub dominance, and grasses, forbs, and other finer-fuel components will decline, further altering the fire regime dynamics. Prescribed growing-season fire needs to increase dramatically in these systems; midstory reduction is essential.

both by Mark Bailey

Gopher tortoise and fire-managed longleaf pine habitat

To prevent the loss of ecological integrity and Gopher Tortoises from the longleaf pine community, land managers in Alabama identify the following specific conservation action: use prescribed fire to manage longleaf pine, burning each acre to reduce the mid-story vegetation of hardwoods and shrubs.

For this action, this example basic results chain, a diagram which shows the logical connections between the four basic conservation elements is developed: action, objectives, threats, and targets (species and habitats). In this case, these elements are defined as follows (Figure 5.5):

- **Action:** Use prescribed fire to manage longleaf pine communities;
- **Objective:** Restoration of all acres of longleaf pine to support Gopher Tortoise populations;
- **Threat:** Hardwoods and shrubs crowd out native longleaf pine vegetation; and
- **Targets:** Habitat- High-quality longleaf pine sites, Species- Gopher Tortoise.

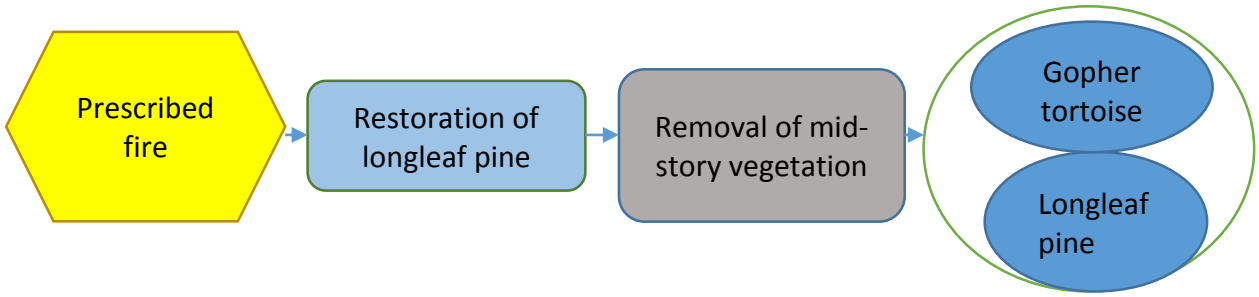


Figure 5-2. The Logical Relationships between these Elements in the Standard Results Chain Format

For each element in the results chain, an indicator and a method or measure by which that indicator will be tracked is identified.

AFWA's 2011 report on effectiveness measures for SWGs classifies "Prescribed Fire" as a "Direct Management of Natural Resources." Recommended indicators and performance measures for projects that involve Direct Management of Natural Resources include the following:

- Percent Management Actions Implemented As Planned;
- Evidence that Direct Management Action is Reducing Key Threats;

- Degree to which target SGCNs respond as expected from direct management actions;
- Degree to which target habitats/processes respond as expected from direct management actions;
- Species Measures (e.g. population size, reproductive success); and
- Habitat Measures (e.g. size, condition).

For the specific management action (Prescribed fire), the indicator "number of acres burned per year," will be measured by tracking the number of acres that are subjected to prescribed fire management each year.

For the objective (Restoration of longleaf pine), the indicator "number of acres of longleaf pine in high quality condition," will be measured by tracking the number of acres of longleaf pine communities meeting certain vegetation composition and stand characteristics typical of high quality longleaf pine.
For the threat (Removal of mid-story vegetation), the indicator "number of acres of longleaf pine with mid-story vegetation," will be measured by tracking the number of acres of longleaf pine dominated by hardwoods and shrubs.

For the targets (Longleaf pine and Gopher Tortoise), the indicators "number of sites with Gopher Tortoise populations" and "number of acres of longleaf pine in high quality condition" can be measured. Note that the target and objective for this particular conservation action will be tracked using the same indicator, which will be used as both a status and effectiveness measure. The indicator for the Gopher Tortoise populations will be measured using line transect distance sampling (Smith et al. 2009).
To implement and track these indicators, managers will need to record basic information about these indicators including: the description of a specific measure for the indicator, the values of that measure in 2005 and 2015, the units for the measure, and the name of any monitoring program that provides data on that measure and indicator.

Data can also be reported to the USFWS, using the *Wildlife TRACS* database to record progress towards achievement of conservation objectives as individual projects are completed.
In 2025, managers will present the basic results chain shown above and a chart or diagram showing how the values of each indicator for the chain have changed over the years since the project was implemented. The following charts (Figure 5-6.) are provided as examples of how these data might be presented in the 2025 WAP.

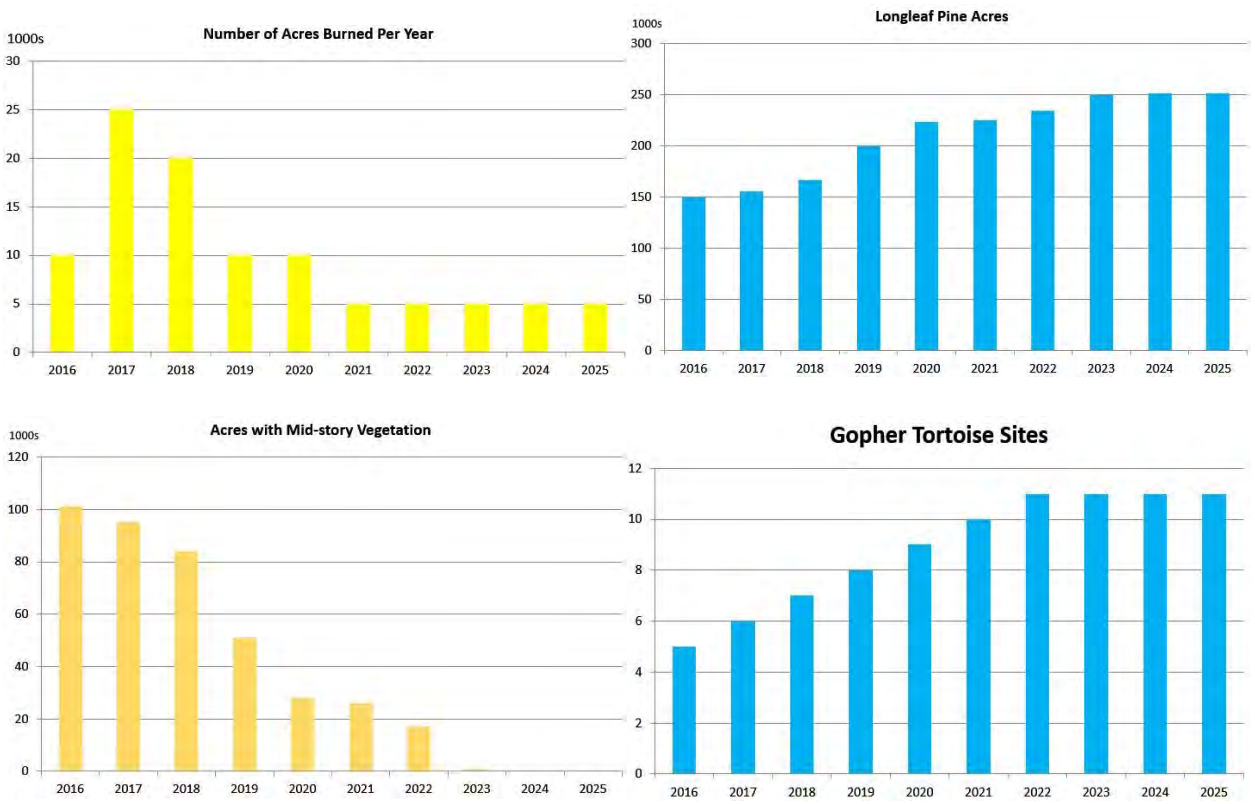


Figure 5-3. Examples of How Data Would Be Presented in the 2025 SWAP

Taken together, these four charts graphically illustrate progress towards the conservation goals for the longleaf pine habitat and Gopher Tortoise populations. By burning a relatively small number of acres each year, the number of acres with mid-story vegetation is greatly reduced over ten years, and the number of acres of high quality longleaf pine habitat is increased. Note that there is a time lag evident between the time when a management treatment is applied and when a response in the habitat variable is observed. This is typical for many management situations, which is one important reason why multi-year monitoring may be necessary to see the effects of conservation projects. The number of sites occupied by Gopher Tortoises also increases over time, demonstrating progress towards the overall goal of conserving this species in the state. Based on these charts, this would appear to be a successful conservation management action. These charts illustrate one way to track and report project effectiveness over time for this example project. Tracking indicators and effectiveness measures will put Alabama in an excellent position to show the effectiveness of SWAP implementation efforts in the future.

Criteria for Measuring SWAP Success

Evaluating the successful implementation of the SWAP conservation actions will take several forms. The SWAP planning team has identified distinct success criteria that will allow the DWFF to continually assess the status of each conservation action. The performance outputs will accomplish the SWAP objectives and have quantifiable accomplishment measures, which are outlined in Table 5-1, as adapted from the ACJV Strategic Plan (ACJV 2004).

Table 5-1. Evaluation Objectives, Performance Outputs and Annual Accomplishment Measures to Assess the Success of the SWAP Conservation Measures.

Objective	Overall Performance Output	Annual Accomplishment Measures
Overall	Habitat conserved for SGCN and key habitats	• Acres/stream miles protected by fee-simple • Acres/stream miles protected by easements • Acres/stream miles restored • Acres/stream miles enhanced • Management capabilities improved
Biological Planning	Biological needs assessment	• Biological needs assessment updated
	Threats assessment	• Threats assessment updated
	Status, trends, limiting factors	• SGCN with status, trends and limiting factors assessed
	Population and habitat objectives	• SGCN population and key habitat objectives determined/updated • State population and habitat objectives determined/updated
Research	Science Advisory Committee	• Advisory committee meetings held • Research proposals reviewed/prioritized
	Applied research projects	• Annual list updated • Research proposals written, projects funded
Conservation Design	Conservation planning	• Workshops hosted • Conservation plans written or revised • Key habitats with GIS data compiled
	Conservation tools	• Aquatic GAP developed • Terrestrial GAP updated

Objective	Overall Performance Output	Annual Accomplishment Measures
Monitoring and Evaluation	Monitoring programs	• Existing monitoring programs utilized/modified to meet SWAP evaluation needs • ADEM water quality monitoring results coordinated with watershed plans and this SWAP annually through meetings, etc. • Monitoring expanded • New monitoring programs developed
Information Management	Web-based data	• Data Web pages developed
	Accomplishment tracking	• Accomplishment tracking data entered and available electronically
	Specific information products	• Natural Heritage Database updated • ADCNR databases/coverages updated
Project Funding	Priority projects	• Up-to-date inventory of priority projects maintained
	Federal grants	• NAWCA projects submitted, projects approved, acres conserved • National Coastal Wetland projects submitted, projects approved, acres conserved • Neotropical Migratory Bird Conservation projects submitted, projects approved, acres conserved • National Fish and Wildlife Foundation projects submitted, projects approved, acres conserved
	State Wildlife Grants and other state grants	• SWG project applications submitted, projects approved, acres/stream miles conserved
	Other funding programs	• Other programs receiving information/assistance, projects funded, acres/stream miles conserved
Partners Outreach	Outreach plan	• Plan completed or updated
	Web site	• Web pages created or updated
	Newsletter	• Quarterly electronic newsletter produced

Objective	Overall Performance Output	Annual Accomplishment Measures
	Partner meetings and presentations	• Meetings with and presentations to NGOs, field units of federal agencies, ecosystem teams and others
Public Outreach	Bleiker Input Plan implemented to target PAIs	• Objectives met through appropriate outreach techniques employed
Implement Bleiker CPO Plan	Objective-based Educational products, meetings and events	• Products produced (e.g., website, website frequent updates, periodic workshops and symposia and resulting publications. Other materials such as: maps and information packets)

MODIFIED AND UPDATED FROM ACJV (2004).

State Fish and Wildlife Agencies are required to use the Tracking and Reporting Actions for the Conservation of Species (TRACS) system. Wildlife TRACS is the tracking and reporting system for conservation and related actions funded by the US Fish and Wildlife Services (USFWS), Wildlife and Sport Fish Restoration (WSFR) Program. It provides standard classification codes for the key actions and services that agencies provide and can be viewed at http://tracs.fws.gov/public . The following table has been adapted for use from the TRACS system for the AL SWAP.

Annual accomplishment measures include tracking the acres/stream miles of habitat protected or improved through various means (i.e., acquisition, conservation easements, restoration or enhancement), biological assessments of SGCN, research to fill data gaps, monitoring programs, information management, funding of conservation projects, and outreach to partners and the public.

Specific proposed criteria to measure the success of the SWAP conservation actions are measurable to be most effective in evaluating the performance of each action. Success criteria identified by the SWAP Steering Committee include the following:

1. A net increase in the acreage/stream miles of key habitat protected through acquisition, restoration, enhancement and/or creation.
2. A net increase in scientific knowledge of SGCN and key habitats.
3. Successful funding of the highest priority conservation project(s).
4. Successful completion of the highest priority conservation project(s).
5. An increase in partner and public involvement in achieving protection of fish and wildlife resources in Alabama.
6. The removal of threats to SGCN and key habitats through avoidance, minimization and mitigation measures.
7. The long-term reduction in the number of SGCN and threats.

In addition to these measurable criteria, the ability of the conservation actions to address the needs of the fish and wildlife resources of Alabama will be monitored qualitatively. An improvement in the coordination of similar monitoring projects conducted by disparate sources would be one such qualitative measure. Coordination of all the avian monitoring projects, for example, through regional resources such as the Gulf Coast Joint Venture Plan, would enhance the efficiency of each project. This would lead to a qualitative improvement towards successfully implementing the SWAP goals and objectives for avifauna. Another qualitative measure of monitoring success may be the increased involvement of DWFF in other statewide or regional conservation initiatives. By utilizing both quantitative and qualitative success criteria, the DWFF will be responsive to the diverse nature, scope and scale of the SWAP conservation actions.

The effectiveness of the conservation actions to meet the SWAP goals and objectives will be monitored via several reporting and review requirements. First, the DWFF Steering and Technical Committees will annually report on the progress to implement and complete the SWAP conservation actions to the DWFF. Second, the DWFF will report SWAP accomplishments to the USFWS as per SWG funding requirements. The status of implementing the conservation actions will be reviewed annually by DWFF staff and an advisory committee of experts will determine when the success criteria are not being met and adaptive management measures are needed. The DWFF staff and the SWAP Steering and Technical committees will then engage the Taxa committees or other experts/partners to identify appropriate revisions to the conservation actions and implement them as a form of adaptive management. This will be completed as often as necessary, as the effectiveness of the conservation measures will be measured on various time scales depending on their scope and duration, but at a minimum of once per year.

Important Data Gaps in Alabama

With the finite resources available to support monitoring programs, it is simply not possible to monitor many aspects of the natural or human environment relevant to fish and wildlife conservation efforts. However, it is possible to identify high-priority target areas where additional data would be helpful for developing management prescriptions for fish and wildlife species and their habitats in Alabama. Chapter 1 and chapter 4 both include the high priority data gaps identified by taxa experts, planners, and stakeholders through the SWAP review process. DWFF plans to work with partners to develop monitoring programs to address these gaps including species, taxa, habitat and community-level monitoring. This will be an important step towards providing wildlife managers in Alabama with the information they need.

SWAP Review and Revision

DWFF proposes to complete a comprehensive revision of the SWAP in ten years, and to review, evaluate and update sections annually through the existing Federal Assistance reporting system and grant administration. The USFWS requires establishment of procedures to review the SWAP at intervals not to exceed ten years. DWFF will comprehensively revise this SWAP again in 2025. To adequately prepare for this 10-year revision, DWFF will sponsor

workshops and symposia as needed and utilize this extensive scientific review and update of SGCN, key habitats, and conservation actions as the foundation for the next SWAP. Committing to such a significant effort indicates that DWFF will continue to involve its many conservation partners and interested stakeholders in the SWAP development.

In the interim, DWFF will utilize both short and long-term iterative, existing mechanisms and processes with built-in review and evaluation to maximize opportunities for both internal and external implementation. Each Division/program has a set operational timeframe for program evaluation and reporting. For example, the existing Federal Assistance process requires annual reporting and input into the *Wildlife TRACS* database and a 5-year review of AFA work plans and evaluations. The Fisheries and Wildlife Sections of DWFF, as well as most other DWFF agency programs, have annual reporting requirements from their granting federal or other funding source. Annual or project-end results that indicate any changes or new information, including information from periodic review by the Taxa Committees will be integrated into the SWAP for each annual review by the Technical Team.
Perhaps the most efficient and effective outcome of this plan will result from the SGCN, key habitats and priority conservation strategies being actively integrated into the revision processes of DWFF and its many partners' plans and programs (as listed in Appendices 2.1 and 5.1). This integration effort alone produces the ripple effect for conservation efforts across the state, providing a consistent and unified approach for conservation of Alabama's wildlife.

An iterative, adaptive process will require the incorporation of results of research, monitoring and surveys that provide for refinement of the priorities and actions of this plan. Each revision of this SWAP document and conservation partners' planning documents should reciprocally integrate the updates of partners' plans. This will ensure that each revision includes the most current scientific and administrative information for the key conservation partners in the state and institutionalizes these important coordination and revision efforts.

Habitat Use by Terrestrial and Aquatic Species on State-managed Lands in Alabama

A study conducted by Silvano et al. (2012) used the SDM process to identify the most important objectives for fish and wildlife populations and habitats that could help guide and monitor management activities. The study created models to estimate the probability of habitat use, and determined local and landscape level attributes of sites related to the occurrence of non-game terrestrial birds, reptiles, amphibians, and mammals on selected state lands managed by the ADCNR. The models developed showed species occurrence (i.e., occupancy) in major land cover types. Silvano et al. developed detection and occupancy models for 149 species (detected on at least 5 survey occasions), 15 of which were SGCN identified in the Alabama 2005 Comprehensive Wildlife Conservation Strategy.

An example of the utility of this information can be found in the results for crayfish: 13 species of crayfish were encountered on stream surveys. *Procambarus clarkii* and *P. acutus* were the most commonly encountered species by at least an order of magnitude. Probability of use

was estimated for 11 species; however, there was little difference in the probability of occurrence among habitats or species. The exceptions were *Cambarus latimanus*, *Cambarus striatus*, and *Orconectes alabamensis* which had some affinity for streams in disturbed areas. In addition, *Cambarus latimanus* was also likely to occur in streams associated with young pine, *Cambarus striatus* and *Orconectes alabamensis* were more likely occur in streams in mature hardwoods.

Key results like the crayfish example inform land managers that in turn, will be able to target where management action should take place or management actions to avoid (harvest of mature hardwoods for the latter two species) in order to ensure these species persist on the management area. For each habitat the study predicted which species were most likely to use it.

Chapter 6
SWAP COORDINATION

Introduction

This chapter describes how the Alabama Department of Conservation and Natural Resources Division of Wildlife and Freshwater Fisheries (ACDNR DWFF) conducted the ecological assessment summarized in the previous chapters with the assistance of numerous partners both inside and outside the agency. Building on the initial 2005 CWCS outreach plan, DWFF coordinated with federal, tribal, state and local partners and stakeholders throughout the development of the 2015 State Wildlife Action Plan (SWAP, formerly called the Comprehensive Wildlife Conservation Strategy or CWCS). This chapter discusses that coordination, the involvement of the public, and plans to continue working with each as the SWAP is implemented and adaptively managed over the next decade (Elements 7 and 8). Appendix 6.1 lists the individual partners and stakeholders contacted throughout the SWAP revision.

The original (2005) SWAP guided major accomplishments over the last 10 years, like restoration of priority habitats including longleaf and shortleaf pine and native grasses on Wildlife Management Areas, State Parks, and private lands. It helped establish the Aquatic Biodiversity Center which helps recover freshwater mussels and snails in Alabama's key rivers and streams. It supported important research on rare, aquatic life, removed barriers to fish migration and breeding, and reintroduced threatened species.

Starting in 2013, DWFF and its partners worked with wildlife experts and other key stakeholders throughout the state to revise the SWAP. Distinct habitats identified as those in greatest need of conservation in Alabama were reviewed by experts across the state. In addition, updated information rankings of the state's Species of Greatest Conservation Need (SGCN) from Alabama's Non-Game Conference of 2012 helped to prioritize SGCN and their habitats.

SWAP Organizational Infrastructure

In order to coordinate with its partners effectively DWFF first had to establish an internal administrative framework to communicate about the SWAP (see Table 6-1, Figure 6-1). DWFF has a Wildlife Diversity Coordinator (WDC) position to oversee the SWAP and State Wildlife Grants (SWG) program. This position was strategically placed in the Director's office to liaison with Fisheries and Wildlife Sections of DWFF as well as other ADCNR Divisions and staff.

Using a similar approach to 2005, DWFF contracted a consultant to develop the 2015 SWAP process and document. A general scope of work was developed to guide the effort, identifying key tasks to be accomplished. Specific guidance provided by the Association of Fish and Wildlife Agencies (AFWA) SWAP Best Practices (AFWA 2012) was considered throughout the planning process. With this guidance in mind, and with the input of a broadening circle of stakeholders and conservation community, Alabama developed its SWAP revision approach, providing for general and technical input throughout the process.

A SWAP Steering Committee was formed with key DWFF staff. This committee met with the consultant to compile existing resources and develop the initial timeline and framework for the development of the SWAP. A series of organizational and input solicitation meetings were held to involve first key staff and then all DWFF staff. The effort to obtain input was then expanded through a series of meetings with other ADCNR Divisions, i.e., Marine Resources, State Parks, and State Lands Division Natural Heritage Section (SLD-NHS). A Technical Team was established to deal with the substantial technical, scientific data, issues and correspondence with experts and stakeholders consisting of key Non-game staff, the WDC, and contractor.

All levels of DWFF staff were engaged through initial internal SWG/SWAP informational presentations with question/answer sessions and Section meetings and feedback sessions. Additional input was sought individually at informal meetings and follow-up correspondence. DWFF input was then solicited at the program level, where priority setting and conservation needs were discussed. Meetings with each Section were held to inform and update internal staff/partners on SGCN, key habitats, threats and conservation actions. A Habitat Committee was then established to address the need for external expert input on habitat and ecological communities for the SWAP.

Coordination with Federal, State, Local and Tribal Partners

Once an internal framework had been established, the coordination effort expanded with outreach to major local, state, federal, and tribal partners (Element 7). Building on the 2005 process, DWFF inventoried and identified its federal, state, local agency and tribal partners. DWFF employed the Bleiker Systematic Development of Informed Consent (SDIC) and Citizen Participation by Objective (CPO) to develop a process to inform, involve, and engage partners throughout the revision of the SWAP (Bleiker and Bleiker 2000).

These methods helped to identify Potentially Affected Interests (PAI) or stakeholders, the objectives of ADCNR's SWAP process, and the most effective ways to inform stakeholders.

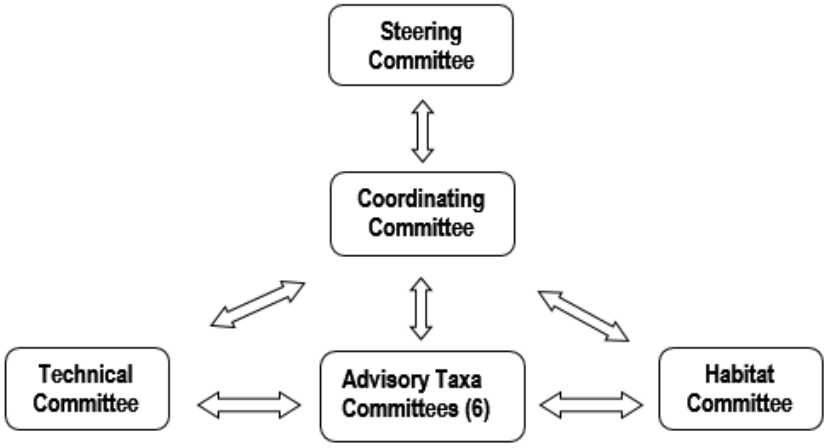


Figure 6-1. SWAP Organizational Flow Chart

Table 6-1. Alabama Swap Coordinating Committees and Structure

Committee	Members	Role	Meeting
SWAP Steering Committee- Wildlife and Freshwater Fisheries Division	Section Chiefs, Asst. Chiefs, Non-game staff, accountant, WDC, contractor	Initiate and develop process and product, oversee and direct process	Every other month meetings, monthly updates
Technical Committee	Wildlife Section Asst. Chief and Non-game program coordinator, Fisheries Section Asst. Chief and Non-game program coordinator, WDC, contractor	Provide input and feedback on process and species/habitat identification (technical QC)	Every other month meetings, monthly updates
Coordinating Committee	WDC, Contractor staff (3), SLD-NHS database manager	Coordination and progress evaluation (administrative and technical QC)	Monthly during process and priority development, then Quarterly, or as input required
Taxa/Scientific Advisory Committees 6 faunal taxa committees	External experts (=University, Partner Agency and NGO, key Stakeholder participation)	Technical input, scientific evaluation and peer review (technical QC)	Monthly or more frequent
Habitat Committee	External experts (University, Partner Agency and NGO, key Stakeholder participation)	Technical input, scientific evaluation and peer review (technical QC)	Monthly or more frequent

NGO = Nongovernmental organization, QC= quality control

Partners were included in each major phase of the SWAP and participated in the development of the SGCN and habitat lists and provided and exchanged valuable information and input throughout the document development. Initial contacts with each partner were followed by informal meetings and then continued information exchange. Small, informal focused meetings were held with key local, state, federal and tribal partners around the state to encourage more detailed and more meaningful input during each step (per Bleiker CPO). Initial introductory meetings were held to inform them of the SWAP and solicit input on the process and recommendations for SGCN and key habitats. Follow up correspondence occurred on a regular basis throughout 2013-2015 to exchange technical information, coordinate activities, and provide updates to keep them informed and involved. Key partners then participated in additional meetings with other partners and tribes in order to present a coordinated approach to wildlife diversity conservation in Alabama. One example was the meeting with the Poarch Band of Creek Indians, where USFWS staff participated and provided information on USFWS programs to further coordinate and plan for the long term implementation of the SWAP on Tribal Lands. CPO objectives were to share and integrate program information so that the SWAP could be used by partners to help implement their programs, and vice versa.

A key objective agreed upon by these partners was to integrate the results of this SWAP into their plans developed over the next 10 years. This step was taken to insure that there would be maximum SWAP coordination, implementation and buy-in by partners for the next decade. An example of how this will maximize SWAP effectiveness and implementation by partners can be found in the National Forests in Alabama - Resource and Management Plan (USFS 2015). This 10-year plan incorporates the Alabama Wildlife priority species (including the SWAP SGCN) and their conservation actions. This step significantly adds to the input process, as the National Forest plans employ a formal public input process and comment period and is regularly reviewed and revised (USFS 2015).

In the same manner, federal partners including USFWS Ecological Services, Private Lands Program and National Wildlife Refuge staff were asked to incorporate the SGCN and key habitat conservation targets identified in the SWAP into their programs and plans. Similarly, other key federal partners including Mobile Bay National Estuary Program (NEP), Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), Tennessee Valley Authority (TVA), etc. were all contacted early in the SWAP process and asked to incorporate SWAP targets into their programs and plans. Especially relevant and promising was the synergy and opportunities between SWAP targets and NRCS Farm Bill programs and the TVA and USACE projects as they impact SGCN and key habitats.

DWFF employed the same approach, as driven by the Bleiker SDIC/CPO process, with all relevant state agency and local partners. SWAP staff met with state agencies including

Department of Transportation and Department of Environmental Management (ADEM) to outline specific programs and projects where SWAP should be incorporated. Follow-up exchange of information and updates established a new level of coordination between these agencies and partners. Each partner was informed of the SWAP targets, process, and schedule and was asked to incorporate the SWAP information in to their appropriate programs and plans.

Coordination with the federally recognized tribal partners, the Poarch Band of Creek Indians, consisted of correspondence and meetings that provided information and literature on the SWG state and tribal programs and funding. Coordination included a presentation of relevant state and federal programs that might assist the Tribe in wildlife conservation both short and long term as mutually beneficial to SGCN and habitats. Coordination with the USFWS provided for their staff to assist in this effort and resulted in a complementary partnership approach to available programs at both the state and federal levels. Alabama has eight additional state-recognized Tribal Nations: the Cherokee Tribe of Northeast Alabama, Cherokees of Southeast Alabama, Echota Cherokee Tribe of Alabama, Machis Lower Creek Indian Tribe, Mowa Band of Choctaw Indians, Piqua Sept of Ohio Shawnee, Star Clan of Muscogee Creeks, and United Cherokee Ani-Yun-Wiya Nation. These Tribal Nations were given the opportunity to review and comment on the draft SWAP. As partnership opportunities with state recognized Tribes arise during the implementation stage, DWFF will coordinate with these Tribes on joint conservation projects.

The 2002 Nongame Conference represented the initial foundation for local, state and federal agencies and tribal involvement in the 2005 SWAP process and likewise the 2012 Nongame Conference provided updated information to the 2015 SWAP revision. Participation was solicited at academic and government institutions and invitations were extended to all key local, state and federal entities with programs that significantly affected wildlife conservation in Alabama. Partners included most of the key state and federal agencies in Alabama, including the USFWS: NWR staff, Ecological Services, Partners; NRCS, USFS, USACE, Mobile Bay NEP, ADEM, SLD-NHS, TVA, Alabama Department of Economic and Community Affairs (ADECA), etc.
The six taxonomic committees (mammals, birds, amphibians and reptiles, fish, crayfish, and aquatic mollusks) represented a balanced mix of agency partners and stakeholders from a wide variety of academic institutions and conservation organizations. For the SWAP, the Taxa Committees were reengaged to serve the role of External/Expert Peer Review. The committees identified and ranked all SGCN, and developed conservation actions and detailed accounts for each of the high priority species. Four volumes of *Alabama Wildlife* (Mirarchi et al. 2004a-c) were published from the 2002 Nongame Conference and a fifth supplemental volume provided a ten-year update with the results of the 2012 Conference as well as full accounts for all SGCN crayfishes and additional species that were not covered in the previous volumes.

Local, state and federal agencies and tribal partners were asked to review the draft SWAP and their comments were incorporated into the final document. An effective measure of coordination success will be the degree to which each of these partners integrates SGCN, habitats and conservation actions into their plans and programs. One example of how this occurred early on in the SWAP process is that of the USFS incorporating the SGCN and habitats into their Revised Land and Resource Management Plan. To that end, each partner will receive final copies of this SWAP with the request that they incorporate SGCN and habitats and implement the appropriate conservation actions identified in this document.

Contact early in the process focused on informing and engaging these collaborators in the SWAP process, as well as inventorying their existing programs. An assortment of outreach techniques (Bleiker SDIC/CPO) was used to maximize input, including personal contact and correspondence, meetings, topical advisory groups and an interactive website. Relevant target species, habitats and conservation actions from their existing programs were captured, compiled and integrated into the SWAP process. Follow-up correspondence kept them informed of SWAP progress and solicited their additional input and feedback at each major phase of the process. Information on existing programs was reviewed during the process to identify opportunities for collaboration/partnership in the implementation, evaluative review, and adaptive modification of the SWAP. The SWAP Steering Committee will continue to lead in monitoring the progress of the SWAP implementation and communicating this information with the network of agency and tribal partners involved in the development of the SWAP.

DWFF plans for the continued coordination with these agencies and tribes in the implementation, review and revision of its SWAP. By employing the Bleiker CPO method, an input plan was developed with the major objective of securing partner buy-in and implementation of the document. To address this implementation objective, that message was communicated to each partner and they were asked to support the implementation of the plan. In addition, DWFF pointed out specific ways the SWAP supported their programs and how it could be integrated into their plans. Clear examples of how the SGCN and habitat conservation information could be adapted into and used by their plans were provided in order to maximize implementation of the SWAP. Partners were informed of the review schedule so that this information and their input could be used to revise the plan.

Public and Stakeholder Participation

DWFF first began its process of involving the public and stakeholders in the SWAP in 2002 with the Nongame Conference (Element 8). In 2012, the Third Nongame Conference attracted 160 participants and represented a significant step for public and stakeholder involvement in the SWAP revision process. The Nongame Conference was designed to encourage broad participation of interested publics and stakeholders as they were asked to compile and review existing information on the full array of Alabama's wildlife and identify and recommend priority species deemed to be most in need of conservation.

The SWAP Steering Committee and contractor worked to actively involve the public at different levels and at each stage of the revision process (Appendix 6.1). Information on each major public and private program was researched. This resulted in an updated inventory of all significant existing local, state, and regional/national programs, data sources, tools and information compiled from meetings, correspondence, and research from literature and the Internet (See Appendix 1.1 and 5.1). This pool of knowledge was then used as the foundation for public outreach strategy development.

With this new information, DWFF updated the public/stakeholder input plan (see Appendices 6.1 and 6.2) and actively involved stakeholders through meetings and correspondence, and the public through website and magazine/newsletters/public meetings. The Bleiker CPO process was employed to identify and target the Potentially Affected Interests (PAIs), the specific messages and objectives to be communicated, and the most effective techniques to reach these targeted publics. Worksheets were completed using this method, and the results identified seven highly recommended techniques to employ for the SWAP development and implementation (Appendix 6.1) phases. A series of meetings was held to solicit input and feedback. The draft was also posted to the DWFF website for public review, and was made available to stakeholders early on for technical review.

For the purposes of this SWAP effort, the "public" was categorized into 3 external tiers:

Tier 1- Partners/collaborators with significant role/program

- Key public agencies and private (NGOs) conservation groups, such as Alabama Forestry Commission, Alabama Wildlife Federation, The Nature Conservancy, NatureServe-Alabama Natural Heritage Program, Alabama Ornithological Society, TVA, USFS, USFWS
- Leaders/staff/programs that can contribute significant data/scientific knowledge base to be incorporated directly into SWAP
- Leaders/staff/programs that can collaborate on implementation, monitoring and assessment/re-evaluation of the SWAP

Tier 2- Interested groups and individuals with limited role/program

- Many NGOs with little or no technical data, such as small private preserves, watershed groups, advocacy groups
- Staff/members with limited/no data/scientific knowledge base that is directly applicable to the SWAP, but have a potential role in outreach/general input into the development and future implementation

Tier 3- General, uninvolved Public

- Citizens not directly involved in a Tier 1 or 2 group project
- Able to benefit from the development and implementation of the SWAP as related to economic, recreational and quality of life benefits from effective statewide wildlife conservation

Tier 1 individuals and groups were contacted for input throughout the SWAP revision process. Regular correspondence and sharing of technical information was critical to assist in the development of the SWAP. Input and feedback from Tier 1 groups was solicited through personal, informal meetings with organization representatives and staff. Per the input plan and CPO techniques, input was solicited at each stage of the project. Expert Committee working meetings and additional follow-up for committee and individual feedback provided "peer review" and refinement during each of the processes of identifying SGCN and key habitats with their associated vegetative communities, of evaluating the most critical problems and threats to species and their habitats, and of selecting and prioritizing effective conservation actions. Use of various programs' existing target species/habitats and recommended conservation strategies were important in focusing existing DWFF programs and projects to benefit from and complement potential collaborative efforts.

Tier 2 and 3 publics (individuals and groups) were informed about the SWAP process and goals. They were kept informed of on-going progress through information posted on the web, articles, and by utilizing their scheduled meetings and newsletters to provide presentations and updates through their existing mechanisms. Input was then solicited from Tier 2 individuals and groups after DWFF staff had sufficiently developed the document to a "Draft" product stage, ready for external review.

One important objective identified through the Bleiker CPO was to maintain stakeholder and public involvement through the implementation stage. The various levels of involvement that were solicited from all these groups during revision were designed to continue input and feedback from these informed stakeholders/publics during implementation and review of the SWAP. The SWAP and CPO processes included both short and long-term input from stakeholders and to keep these publics informed of SWG projects and results through annual reports, magazine articles, meetings, organization newsletters and web site progress reports.

Specific techniques to be utilized during SWAP implementation and review are similar to those identified as most effective during the SWAP development and revision stages. PAIs will be informed and involved through active committee and working meetings, website updates and interaction, and by utilizing existing stakeholder organization meetings and newsletters. Informal meetings with key partners and Tier 1 and 2 stakeholders will be an ongoing, regular part of annual program updates and evaluation.

Tier 1 and 2 stakeholders will be intimately involved in the 10-year revision of this document, as they will continue to play a major role in identifying SGCN and key habitats, as well as updating and identifying new threats and actions for the next decade of SWAP implementation. Solicitation of input and technical information from expert taxa committees as peer review and evaluation will occur on a biennial basis to provide

updates to the ADCNR database and SGCN status review. Their expert advice will be consulted regularly during the process of SWG proposal solicitation and selection review.

The general public (Tier 3) and PAIs will be kept informed and educated about the SWAP, its projects and results through a variety of existing public outreach mechanisms. These mechanisms include a website, progress reports, educational materials, magazine articles, newsletters, and newspaper articles. ADCNR established a Citizens Conservation Forum that uses the internet to continually survey the public about conservation issues and concerns. In addition, public outreach can utilize environmental centers to host public outreach events on the SWAP, SGCN and habitats, and how ADCNR and its partners are implementing conservation actions to improve Alabama's fish and wildlife resources and their habitats.

Both private and public partners' existing facilities and programs can serve as valuable tools to disseminate conservation education and public outreach materials into classrooms throughout the state. Universities, laboratories and other conservation centers undergraduate and graduate programs can integrate SWAP priorities and activities into ongoing and new research and education efforts at the collegiate level. One such example, the Marine and Estuarine Environmental Education Resource Center, has community education and distance learning programs that also provide an opportunity for public outreach on Alabama's wildlife and conservation. The Center is a partnership between the Gulf States Fisheries Management Commission, ADCNR, several academic institutions, the USDA Cooperative Extension Service, NGOs and local governments. Utilizing this existing partnership to educate the public also involves these partner PAIs.

Outreach to PAIs and the public can also occur through educational booths and displays at the many festivals and events throughout Alabama each year. Existing centers, like the Wehle Nature Center operated by ADCNR, provide educational programs, activities and displays that can further citizen's knowledge of SGCN and the key habitats in Alabama. Information about caves, their SGCN and threats can be incorporated into existing tour programs at state parks like Cathedral Caverns. By incorporating information about Alabama's wildlife and state conservation programs into existing environmental education programs, the SWAP will reach a much larger audience and be coordinated with partner agencies and organizations. This level of outreach will ensure that Alabama has considerable support for the SWAP in the future.

LITERATURE CITED

AFC (Alabama Forestry Commission). 2002. Alabama Forest Legacy Program Assessment of Need. 79 pp.

ACJV (Atlantic Coast Joint Venture). 2004. Atlantic Coast joint venture strategic plan. North American Waterfowl management plan.

ADEM (Alabama Department of Environmental Management). 2014. Integrated Water Quality Monitoring and Assessment Report. ADEM Water Division - Water Quality Branch. Montgomery, Alabama

ADEM (Alabama Department of Environmental Management). 2014. 2014 Alabama §303(d) List. ADEM Water Division - Water Quality Branch. Montgomery, Alabama

AFC (Alabama Forestry Commission). 2010. Forests at the Crossroads: Alabama's Forest Assessment and Resource Strategy. Alabama Forestry Commission, Montgomery, Alabama.

AFWA (Association of Fish and Wildlife Agencies). 2011. Measuring the Effectiveness of State Wildlife Grants Final Report. 186 pp.

ALDOT (Alabama Department of Transportation). 2008. Alabama Statewide Transportation Plan. Report by Jacobs Carter Burgess.

ALNHP (Alabama Natural Heritage Program). 2012. Alabama Inventory List: the Rare, Threatened and Endangered Plants & Animals of Alabama. Alabama Natural Heritage Program, Auburn University, AL 36849.

Anderson, M.G., A. Barnett, M. Clark, C. Ferree, A. Olivero Sheldon, and J. Prince. 2014. Resilient Sites for Terrestrial Conservation in the Southeast Region. The Nature Conservancy, Eastern Conservation Science. 127 pp.

Anthes, R.A., R.W. Corell, G. Holland, J.W. Hurrell, M.C. MacCracken, and K.E. Trenberth, 2006: Hurricanes and Global Warming—Potential Linkages and Consequences. Bulletin of the American Meteorological Society, 87, 623–628.

Apodaca, J.J., L.J. Rissler, J. Godwin, J. Travis. 2010. Combining biotic surveys, GIS modeling, and ecological genetics to prioritize land purchases for the conservation of the federally threatened Red Hills salamander (*Phaeognathus hubrichti*). Final report to Alabama Department of Conservation and Natural Resources State Wildlife Grants Program.

Association of Wildlife and Fisheries Agencies, Teaming with Wildlife Committee, State Wildlife Action Plans (SWAP) Best Practices Working Group. 2012. Best Practices for State Wildlife Action Plans—Voluntary Guidance to States for Revision and Implementation. Washington (DC): Association of Wildlife and Fisheries Agencies. 80 pages.

Baker, W.H., C.E. Johnston, and G.W. Folkerts. 2008. The Alabama Bass, Micropterus henshalli (Teleostei: Centrarchidae), from the Mobile River basin. Zootaxa 1861:57-67.

Baker, W.H., R. E. Blanton, and C. E. Johnston. 2013. Diversity within the Redeye Bass, Micropterus coosae (Perciformes: Centrarchidae) species group, with descriptions of four new species. Zootaxa 3653:379-401.

Best, T.L. and Dusi, J.L. 2014. Mammals of Alabama. University of Alabama Press, Tuscaloosa, Alabama.

Bleiker, A., and Bleiker, H. 2000. Citizen Participation Handbook for Public Officials and Other Professionals Serving the Public (13th ed.). Monterey, CA: Institute for Participatory Management and Planning.

Boschung, H.T., Jr. R.L. Mayden, J.R. Tomelleri, and E.O. Wilson. Fishes of Alabama. 2004. Smithsonian Books. 960 pp.

Brockway, D.G., K.W. Outcalt, D.J. Tomczak, E.E. Johnson. 2005. Restoration of longleaf pine ecosystems. Gen. Tech. Rep. SRS-83. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 34 p.

Brown, S., C. Hickey, B. Harrington, and R. Gill (eds.). 2001. United States Shorebird Conservation Plan. Manomet Center for Conservation Sciences, Manomet, Massachusetts.

Burr, B.M., D.J. Eisenhour, and J.M. Grady. 2005. Two new species of Noturus (Siluriformes: Ictaluridae) from the Tennessee River Drainage: distribution, and conservation status. Copeia 4:783-802.

Campbell, D. and P. Harris. 2005. Report on Molecular Systematics of Poorly-Known Freshwater Mollusks of Alabama. Report to ADCNR-DWFF.

CH2MHILL. 2012. Fort Rucker (Alabama) Gopher Tortoise Baseline Survey Technical Report. Unpublished report to DPW-ENRD Natural Resources Branch, U.S. Army Garrison Fort Rucker by CH2MHILL, Tampa, FL.

Cheatwood, J.L., E.R. Jacobson, P.G. May, T.M. Farrell, B.L. Homer, D.A. Samuelson, and J.W. Kimbrough. 2003. An Outbreak of Fungal Dermatitis and Stomatitis in a Free-ranging Population of Pigmy Rattlesnakes (*Sistrurus milliarius barbouri*) in Florida. Journal of Wildlife Diseases: April 2003, Vol. 39, No. 2, pp. 329-337.

Clark, R.W., M.N. Marchand, B.J. Clifford, R. Stechert, and S. Stephens. 2010. Decline of an isolated timber rattlesnake (*Crotalus horridus*) population: Interactions between climate change, disease, and loss of genetic diversity. Biological Conservation 144:886-891.

Clark, S.A. 2007. Preliminary survey of the Hydrobiidae of Alabama. Report to ADCNR-DWFF.

Cook, C. and B. Gray. 2003. Biology and management of the White-tailed deer in Alabama. ADCNR Division of Wildlife and Freshwater Fisheries, Montgomery, Alabama.

Crance, J. H. 1971. Description of Alabama estuarine area -- Cooperative Gulf of Mexico Inventory. Alabama Marine Resources Bulletin 6.

Daszak, P., A.A. Cunningham, A.D. Hyatt. 2000. Emerging Infectious Diseases of Wildlife--Threats to Biodiversity and Human Health. Science: Vol. 287 no. 5452 pp. 443-449.

Davenport, L. J. 2007. Climate Change and Its Potential Effects 0n Alabama's Plant Life. Vulcan Materials Center for Environmental Stewardship and Education, Birmingham, AL.

Dorcas, M.E., JD. Willson, J.W. Gibbons. 2007. Crab trapping causes population decline and demographic changes in diamondback terrapins over two decades. Biological Conservation 137 (2007) 334 – 340.

Duncan, R. S. 2013. Southern Wonder: Alabama's Surprising Biodiversity. University of Alabama Press, Tuscaloosa, Alabama.

EPA (U.S. Environmental Protection Agency). 1995. America's wetlands: our vital link between land and water. EPA843-K-95-001.

EPA (U.S. Environmental Protection Agency). 2014. Alabama and Mobile Bay Integrated Assessment of Watershed Health. EPA 841-R-14-022.

EPA (U.S. Environmental Protection Agency). 2014. Alabama and Mobile Bay Basin Integrated Assessment of Watershed Health. 44 p.

FGDC. 2008. National Vegetation Classification Standard, Version 2 FGDC-STD-005-2008 (version 2). Vegetation Subcommittee, Federal Geographic Data Committee, FGDC Secretariat, U.S. Geological Survey. Reston, VA. 55 pp. + Appendices

Fikes, R., McCormick, L., Inkley, D.B., Kronenthal, S.G. 2014. Four years into the gulf oil disaster: still waiting for restoration. National Wildlife Federation, Washington, D.C.

Fitzpatrick, J.W. M. Lammertink, M.D. Luneau Jr., T.W. Gallagher, B.R. Harrison, G.M. Sparling, K.V. Rosenberg, R.W. Rohrbaugh, E.C.H. Swarthout, P.H. Wrege, S.B. Swarthout, M.S. Dantzker, R.A. Charif, T.R. Barksdale, J.V. Remsen Jr., S.D. Simon, and D. Zollner. Ivory-billed Woodpecker (Campephilus principalis) Persists in Continental North America. 2005. Science: Vol. 308 no. 5727 pp. 1460-1462

Fluker, B.L., B.R. Kuhajda, and P.M. Harris. 2011. Conservation Genetics of Spring Associated Darters in Alabama. Report to ADCNR-DWFF.

Folkerts, G. W. 1982. The Gulf Coast pitcher plant bogs. American Scientist 70:260–267

Freeman, M.C., B.J. Freeman, N.M. Burkhead and C.A. Straight. 2008. A new species of Percina (Perciformes: Percidae) from the Apalachicola River drainage, southeastern United States. Zootaxa 1963:25-42.

Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, and D.J. Wuebbles. 2007. Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS). 147pp.

Gangloff, M.M., E. Hartfield, B. Helms, D. Werneke, K. White, and J.W. Feminella. 2009. Alabama Mill Dam Inventory. Report to ADCNR-DWFF.

GMFMC (Gulf of Mexico Fishery Management Council). 1998. Generic amendment for addressing essential fish habitat requirements in the following fmps: Gulf coral and coral reef resources, coastal migratory pelagics, red drum, reef fish, shrimp, spiny lobster, stone crab. Gulf of Mexico Fishery Management Council, Tampa, Florida. 238 p. + appendices.

Godwin, J.C. 2008. Red Hills Salamander Habitat Delineation, Breeding Bird Surveys, and Habitat Restoration Recommendations on Commercial Timberlands. Alabama Natural Heritage Program, Auburn. Report to ADCNR-DWFF.

Godwin, J.C., M. Wines, J. Stiles, S. Stiles, C. Guyer, and M. Rush. 2011. Reintroduction of the Eastern Indigo Snake (*Drymarchon couperi*) into Conecuh National Forest, 2008-2011 Final Report to ADCNR-DWFF.

Godwin, J.C., V.M. Johnson, C. Guyer, and M. Rush. 2008. Captive Propagation of the Threatened Eastern Indigo Snake for Reintroduction into Alabama. Report to ADCNR-DWFF.

Grand, J. B., Y. Wang, and E.C. Soehren, 2008. Monitoring Program for Biodiversity of Terrestrial Vertebrates on Conservation Lands within the Cumberland Plateau Region of Alabama. Report to ADCNR-DWFF.

Greenberg, R., D. W. Demarest, S. M. Matsuoka, C. Mettke-Hofmann, D. Evers, P. B. Hamel, J. Luscier, L. L. Powell, D. Shaw, M. L. Avery, K. A. Hobson, P. J. Blancher, and D. K. Niven. 2011. Understanding declines in Rusty Blackbirds. Pp. 107– 126 in J. V. Wells (editor). Boreal birds of North America: a hemispheric view of their conservation links and significance. Studies in Avian Biology (no. 41), University of California Press, Berkeley, CA.

Griffith, G. E., J. M. Omernik, J. A. Comstock, G. Martin, A. Goddard, and V. J. Hulcher. 2001. Ecoregions of Alabama. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Corvallis, Oregon.

Grizzle, J.M. and C.J. Brunner. 2007. Assessment of Current Information Available for Detection, Sampling, Necropsy, and Diagnosis of Diseased Mussels. Report to DWFF.

Groves, C.R., D.B. Jensen, L.L. Valutis, K.H. Redford, et al. 2002. Planning for Biodiversity Conservation: Putting Conservation Science into Practice. Bioscience 52(6): 499-512

Grunau, Lee, J. Handwerk, and S. Spackman-Panjabi (eds.). 2011. Colorado Wildlife Action Plan: proposed rare plant addendum. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Guyer, C. and V.M. Johnson. 2008. Use of Gopher Tortoises (*Gopherus polyphemus*) in restoration of the upland longleaf fauna on the Conecuh National Forest. Report to DWFF.

Guyer, C., Glenos, S., Hermann, S., and Stober, J. 2011. The Status of Gopher Tortoises (*Gopherus polyphemus*) in Alabama, with Special Reference to Three Important Public Properties. Report to DWFF.

Guyer, C., M.A. Bailey, J.N. Holmes, J. Stiles, and S. Stiles. 2006. Herpetofaunal Response to Longleaf Pine Ecosystem Restoration, Conecuh National Forest, Alabama. Unpublished

report to Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries. 92 pp.

Haggerty, T.M. (ed.). 2009. Alabama Breeding Bird Atlas 2000-2006 Homepage. Alabama Ornithological Society. Accessed 03 March 2014. http://www.una.edu/faculty/thaggerty/BBA%20Homepage.htm.

Harper, R. M. 1943. Forests of Alabama. Monograph 10, Geological Survey of Alabama, Tuscaloosa, Alabama.

Harper, R.M. 1928. Economic botany of Alabama. Monograph 9. Part 2. Alabama Geological Survey, Tuscaloosa, Alabama.

Hartsell, Andrew A. J. 2013. Alabama, 2012—forest inventory and analysis factsheet. e-Science Update SRS–067. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 5 p.

Henderson, A. 2009. Application of the Index of Biotic Integrity for Assessing Biological Conditions of Wadeable Streams. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, 23 p.

Henderson, A.R., and J.B. Smith. 2014. Crayfishes. In Alabama Wildlife, Vol. V, Proceedings of Alabama's Third Nongame Wildlife Conference. Shelton-Nix, E. (ed.). Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries. Montgomery, Alabama.

Hermann, J.S. Kush, J.C. Gilbert, and R.J. Barlow. 2014. Burning for conservation values: should the goal be to mimic a natural fire regime? Pages 164-171 in Holley, A. Gordon, Connor, Kristina F., and Haywood, James D., eds. 2014. Proceedings of the 17th biennial southern silvicultural research conference. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station.

Hobbs, R.J. 2000. Land use changes and invasions. Pages 55-64, In: Mooney, H.A. and R.J. Hobbs. Invasive species in a changing world. Island Press, Washington, D.C.

Howell, A. H. 1921. A biological survey of Alabama. North American fauna. No. 45. Part I. Physiography and life zones of Alabama. Part II. Report on the mammals of Alabama. USDA Division of Biological Survey. Washington: Government Printing Office.

Howell, A.H. 1924. Birds of Alabama. Montgomery, AL. 384 pp.

Hudson, M.K. 2004. Alabama endangered bats cave survey: recovery plan, priority, and other caves. 2003 report. Unpublished report submitted by Non-game Wildlife Program, Alabama Department of Conservation and Natural Resources to Department of the Interior, U.S. Fish and Wildlife Service.

Huryn, A.D., M.P. Venarsky & B.J. Kuhjada, 2011. Assessment of Population Dynamics for Cave-Inhabiting Crayfish in Alabama: a Request for Continuing Funds.

Imhof, T. A. 1962. Alabama birds. State of Alabama, Department of Conservation, Game and Fish Division, University of Alabama Press, Tuscaloosa, Alabama.

IPCC (Intergovernmental Panel on Climate Change). 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Irwin, E., G. Turner, K. Mickett and K. Pier. 2007. ACT (Alabama-Coosa-Tallapoosa) Aquatic Gap and water quality monitoring. Report to DWFF.

Irwin, E., K.M Kennedy, T.P. Goar, B. Martin, and M.M. Martin. 2011. Adaptive management and monitoring for restoration and faunal recolonization of Tallapoosa River shoal habitats. ALCFWRU Report 2011-1 to ADCNR-DWFF.

Johnson, F.A., and D.J. Case. 2000. Adaptive regulation of waterfowl harvests: lessons learned and prospects for the future. Transactions of the North American Wildlife and Natural Resource Conference 65:94-108. Available online at http://migratorybirds.fws.gov/reports/ahm02/johnson-case-2000.pdf.

Karl, T.R., J.M. Melillo, and T.C. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press.

Kennedy, T.B., S.A. Pugh, J.J. Culp, and A.C. Benke. 2007. Quantifying and identifying unionid larvae in drift and on fishes of the Sipsey River, Alabama. Report to DWFF.

Kilburn, S.L., Taylor, C.A., Schuster, G.A. 2012. Status Survey for three rare Alabama crayfishes, Cambarus cracens, Cambarus scotti, and Cambarus unestami. INHS Technical Report 2012 (21). Prepared for U.S. Fish & Wildlife Service

Kuhajda B.R. 2004. The impact of the proposed Eddie Frost commerce park on Speoplatyrhinus poulsoni, the Alabama Cavefish, a federally endangered species restricted to Key Cave, Lauderdale County, Alabama. Endangered Species Update 21:57–65.

Kushlan, J.A., M.J. Steinkamp, K.C. Parsons, J. Capp, M.A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R.M. Erwin, S. Hatch, S. Kress,R.Milko, S.Miller, K.Mills, R. Paul, R. Phillips, J.E. Saliva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird conservation for the Americas: the North American waterbird conservation plan, Version 1. Waterbird Conservation for the Americas. Washington, DC.

Lopez, R., N. Burns, D. Gjerstad, G. Burger, T. Ivey, T. George, L. Hayes, R. Hatten, R. Sutter, C. Bohn, J. Dondero, and T. Ward. 2014. Range-wide Conservation Plan for Longleaf Pine. America's Longleaf.

Loss, S.R., T. Will and P.P. Marra. 2013. The impact of free-ranging cats on wildlife of the United States. Nature Communications. Article No. 1346.

Loss, S.R., T. Will, S.S. Loss, and P.P. Marra. 2014. Bird-building collisions in the United States: Estimates of annual mortality and species vulnerability. The Condor. 116(1):8-23.

Lydeard, C. and Mayden, R.L. 1995. A Diverse and Endangered Aquatic Ecosystem of the Southeast United States. Conservation Biology 9: 800–805

Maceina, M.J. and R.W. Hunter. 2009. Protocol for Fish Data Collection to Develop a Tailwater Fish Index on the Coosa River, Alabama. Alabama Division of Wildlife and Freshwater Fisheries, Montgomery, 21 p.

Margolius, R.A., and Salafsky, N. 1998. Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington, DC, USA.

Martin, J. M. C. Runge, J. D. Nichols, B. C. Lubow, and W. L. Kendall. 2009. Structured decision making as a conceptual framework to identify thresholds for conservation and management. Ecological Applications, 19(5): 1079–1090.

McGregor S.W., O'Neil, P.E. and Pierson, J.M. 2000. Status of the freshwater mussel (Bivalvia: Unionidae) fauna in the Cahaba River system, Alabama. Walkerana 11(26): 215-239.

Mettee, M.F., P.E. O'Neil, and J.M. Pierson. 1996. Fishes of Alabama and the Mobile Basin. Oxmoor House, Inc. Birmingham, AL. 820 pp.

Mettee, M.F., T.E. Shepard, J.B. Smith, S.W. McGregor, C.C. Johnson, and P.E. O'Neil. 2009. A Survey for the Gulf Sturgeon in the Mobile and Perdido Basins, Alabama. Open-File Report 0903. Geological Survey of Alabama, Tuscaloosa, Alabama.

Mirarchi, R. E., editor. 2004. Alabama Wildlife. Volume 1. A checklist of vertebrates and selected invertebrates: aquatic mollusks, fishes, amphibians, reptiles, birds, and mammals. The University of Alabama Press, Tuscaloosa, Alabama.Tuscaloosa.

Mirarchi, R. E., J. T. Garner, T. M. Haggerty, M. F. Mettee, and P. E. O'Neil, editors. 2004a. Alabama Wildlife. Volume 2. Imperiled aquatic mollusks and fishes. The University of Alabama Press, Tuscaloosa, Alabama.Tuscaloosa.

Mirarchi, R. E., M. A. Bailey, J. T. Garner, T. M. Haggerty, T. L. Best, M. F. Mettee, and P. E. O'Neil, eds. 2004. Alabama Wildlife. Volume 4. Conservation and management recommendations for imperiled wildlife. The University of Alabama Press, Tuscaloosa.

Mirarchi, R. E., M. A. Bailey, T. M. Haggerty, and T. L. Best, editors. 2004. Alabama Wildlife. Volume 3. Imperiled amphibians, reptiles, birds, and mammals. The University of Alabama Press, Tuscaloosa, Alabama.Tuscaloosa.

Mitsch, W. J., and J. G. Gosselink. 1993. Wetlands. John Wiley and Sons, Inc., New York.

Moler, P.E., and Franz, R. 1987. Wildlife values of small, isolated wetlands in the southeastern coastal plain. P. 234-241 in R.R. Odum, K.A. Riddleberger, and J.C. Ozier (eds). Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium. Georgia Department of Natural Resources, Atlanta, Georgia.

Mount, R. H. 1975. The reptiles and amphibians of Alabama. Auburn University Agriculture Extension Station. Auburn, Alabama.

National Fish, Wildlife and Plants Climate Adaptation Partnership (NFWPCAP). 2014. National Fish, Wildlife and Plants Climate Adaptation Strategy. Association of Fish and Wildlife agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC.

Natural Resources Conservation Service (NRCS) 2015. Guidance on Forested Riparian Buffers. http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/landuse/forestry/sustain/guidance/?cid=nrcsdev11_009302 Web site accessed February 20, 2015.

NatureServe. 2004. International ecological classification standard: terrestrial ecological systems of the United States. Natural Heritage Central Databases. NatureServe, Arlington, Virginia.

NatureServe. 2004. Summary report on vegetation classification development for USDA Forest Service, Region 8 NatureServe, Arlington, Virginia and NatureServe-South Community Ecology Group, Durham, North Carolina.

NatureServe. 2014. NatureServe Explorer: An online encyclopedia of life [web application]. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: May 16, 2014).

Neely, D.A., J.M. Williams, and R.L. Mayden. 2007. Two new sculpins of the genus *Cottus* (Teleostei: Cottidae) from the rivers of eastern North America. Copeia 3:641-655.

Newhouse, A.E., Polin-McGuigan, L.D., Baier, K.A., Valletta, K.E.R., Rottmann, W.H., Tschaplinski, T.J., Maynard, C.A., and Powell, W.A. 2014. Transgenic American chestnuts show enhanced blight resistance and transmit the trait to T1 progeny. Plant Science (228):88–97.

NOAA National Climatic Data Center. 2014. http://www.ncdc.noaa.gov/cag/ Accessed 12 April 2014.

O'Neil, P.E. and T.E. Shepard. 2009. Calibration of the Index of Biotic Integrity for the Southern Plains Ichthyoregion in Alabama. Geological Survey of Alabama Open-File Report 0908, Tuscaloosa, 122 p.

O'Neil, P.E., T.E. Shepard, C.C. Johnson, E. Spadgenske, and J.R. Powell. 2009. Rediscovery of the Trispot Darter, *Etheostoma trisella*, in Alabama. Geological Survey of Alabama Open-file Report 0909, Tuscaloosa. 23pp.

Oakley, K.L., L.P. Thomas, and S.G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin 31:1000-1003.

Omernik, J. M. 1987. Ecoregions of the conterminous United States. Map (scale 1:7,500,000). Annals of the Association of American Geographers 77(1):118-125.

Penskar, M.R. and A.L. Derosier. 2012. Assisting the Michigan Wildlife Action Plan: Tools and Information for Incorporating Plants. Final Report to NatureServe. Michigan Natural Features Inventory Report No. 2012-, Lansing, MI. 26 pp. + appendices.

Pera, T.P. and J.W. Armbruster. 2006. A new species of Notropis (Cypriniformes: Cyprinidae) from the southeastern United States. Copeia 6:423-430.

Pew Oceans Commission. 2003. America's living oceans: charting a course for sea change. A report to the nation, recommendations for a new ocean policy. Pew Oceans Commission, Arlington, Virginia. Available online at http://www.pewoceans.org.

Phillips, D.J. 2002. Discovering Alabama wetlands. University of Alabama Press, Tuscaloosa. 113 pp.

Rich, T.D., C.J. Beardmore, H. Berlanga, P.J. Blancher, M.S. Bradstreet, G.S.Butcher, D.W. Demarest, E.H. Dunn, W.C. Hunter, E.E. Iñigo-Elias, J.A.Kennedy, A.M. Martell, A.O. Panjabi, D.N. Pashley, K.V. Rosenberg, C.M. Rustay, J.S. Wendt, T.C. Will. 2004. Partners in flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, New York.

Rider, S.J. and W. Schell. 2012. First record of *Acantharchus pomotis* (Mud Sunfish) from Alabama. Southeastern Naturalist 11(1):145-148.

Salafsky, N., D Salzer, A. Stattersfield, C. Hilton-Taylor, R. Neugarten, S. Butchart, B. Collen, N. Cox, L. Master, S. O'Connor, and D. Wilkie. 2008. A standard lexicon for biodiversity conservation: Unified classifications of threats and actions. Conservation Biology 22 (4): pp.897–911

Salafsky, N., D. Salzer, J. Ervin, T. Boucher, and W. Ostlie. 2003. Conventions for defining, naming, measuring, combining, and mapping threats in conservation: an initial proposal for a standard system. Foundations of Success, The Nature Conservancy Measures and Audit Team and Global Priorities Group, Bethesda, Maryland.

Salafsky, N., R. Margoluis, and K. Redford. 2001. Adaptive management: a tool for conservation practitioners. The Biodiversity Support Program, World Wildlife Fund, Inc. Available online at: http://www.bsponline.org/bsp/publications/aam/112/titlepage.htm

Salafsky, N., R. Margoluis, K.H. Redford, and J.G. Robinson. 2002. Improving the practice of conservation: a conceptual framework and research agenda for conservation science. Conservation Biology 16:1469-1479.

Sammons, S.M. and M.J. Maceina. 2009. Conservation status of shoal bass in Alabama: distribution, abundance, stocking efficacy, and possible effects of sympatric congeneric black bass in selected tributaries of the Chattahoochee River, Alabama. Report to DWFF.

Schotz, A.R. and M.S. Barbour. 2009. Ecological assessment and terrestrial vertebrate surveys for Black Belt Prairies in Alabama. Unpublished report submitted to the Alabama Department of Conservation and Natural Resources, Division of Wildlife & Freshwater Fisheries, Montgomery, Alabama. Alabama Natural Heritage Program, Auburn, Alabama. 139 pages.

Schuster, G. A. and C. A. Taylor. 2004. Report on the crayfishes of Alabama: Literature and museum database review, species list with abbreviated annotations and proposed

conservation statuses. Illinois Natural History Survey, Center for Biodiversity Technical Report 2004.

Sharp, N. 2009. Restoration and Enhancement of the Longleaf Pine Ecosystem and Mixed Mesophytic Forest Floodplains on Applicable Forever Wild Land Trust Lands. State Lands Division Report to DWFF.

Shelton-Nix, E. *in press*. Alabama Wildlife. Volume 5. Alabama Department of Conservation, Montgomery, Alabama.

Sievering, M.E. 2004. Alabama furbearer status and harvest report: 2002-2003. Unpublished report to Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries, Wildlife Section. Montgomery, AL.

Silvano, A.L., Grand, J.B., Guyer, C., Steury, T.D., Loewenstein, E., McKenzie, M.D., Allgood, D., Irwin, E.R., Johnston, C., Gangloff, M. 2012. Habitat Use by Terrestrial and Aquatic Species on State-Managed Lands in Alabama. Report to DWFF.

Skerratt, L.F, L. Berger, R. Speare, S. Cashins, K.R. McDonald, A.D. Phillott, H.B. Hines, and N. Kenyon. 2007. Spread of Chytridiomycosis Has Caused the Rapid Global Decline and Extinction of Frogs. EcoHealth.

Smith, L.S., J. Stober, H. E. Balbach, and W. D. Meyer. 2009. Gopher tortoise Survey Handbook. US Army Corps of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory. Champaign, IL.

Smith. J. B., G. A. Schuster, C. A. Taylor, E. A. Wynn, and S. W. McGregor. 2011. A Preliminary preliminary Report report on the Distribution distribution and Conservation conservation Status status of the Alabama Crayfish crayfish Faunafauna. Open-File Report 1102. Geological Survey of Alabama, Tuscaloosa, Alabama.

Smith. J.B., G.A. Schuster, C.A. Taylor, E. A. Wynn, and S.W. McGregor. 2011. A Preliminary Report on the Distribution and Conservation Status of the Alabama Crayfish Fauna. Open-File Report 1102. Geological Survey of Alabama, Tuscaloosa, Alabama.

Stein, B.A. 2002. States of the union: ranking America's biodiversity. Arlington, Virginia: NatureServe.

Stein, B.A. and K. Gravuer. 2008. Hidden in Plain Sight: The Role of Plants in State Wildlife Action Plans. Arlington, VA: NatureServe. 27 pp

Tassin, K. 2008. Sharp-Bingham Mountain Preserve Management and Protection Plan. Unpublished document, The Nature Conservancy of Alabama, Birmingham.

Taylor, C.A. and Schuster, G.A. 2007. Compilation of Alabama Crayfish Museum Holdings and Construction of a Geo-referenced Database

TNC (The Nature Conservancy) 2000. The five-S framework for site conservation: a practitioner's handbook for site conservation planning and measuring conservation success. The Nature Conservancy, Arlington, Virginia.

TNC (The Nature Conservancy). 2009. Prioritization guide for coastal habitat protection and restoration in Mobile and Baldwin counties, Alabama. 37 pgs.

TWS (The Wildlife Society). 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Technical Review 07-2. 1-50.

U.S. Census Bureau. 2010. http://www.census.gov/2010census/. Accessed December 10, 2014.

U.S. DOT (U.S. Department of Transportation) Federal Highway Administration. 1992. Highway Statistics 1992. U.S. Government Printing Office, Washington DC.

U.S. DOT (U.S. Department of Transportation) Federal Highway Administration. 2013. State Statistical Abstracts 2012.

U.S. Energy Information Administration. 2014. Natural gas data. http://www.eia.gov/naturalgas/ Accessed December 10, 2014.

USDA (U.S. Department of Agriculture). 2011. Alabama Agriculture Statistics. Bulletin 53. U.S. Department of Agriculture National Agricultural Statistics Service, Alabama Field Office, Montgomery.

USDI, USFWS, and U.S. Department of Commerce, and U.S. Census Bureau. 2011. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

USFS (U.S. Forest Service). 2015. National Forests in Alabama: Revised Land and Resource Management Plan.

USFWS (U.S. Fish and Wildlife Service). 2004. Writing refuge management goals and objectives: a handbook. U.S. Department of the Interior, Washington, D.C. Available online at http://library.fws.gov/pubs3.html

USFWS (U.S. Fish and Wildlife Service). 2000. Mobile basin aquatic ecosystem recovery plan. USFWS Southeast Region, Atlanta, Georgia.

Verant, M.L, C.U. Meteyer, J.R. Speakman, P.M. Cryan, J.M. Lorch, and D.S. Blehert. 2014. White-Nose Syndrome Initiates a Cascade Of Physiologic Disturbances in the Hibernating Bat Host. BMC Physiology 2014, 14:10

Walz, Kathleen S. 2013. Integrating the Conservation of Plant Species of Concern in the New Jersey State Wildlife Action Plan. New Jersey Department of Environmental Protection, Office of Natural Lands Management, MC501-04, Trenton, NJ 08625 for NatureServe #DDCF-0F-001a, 12p

White, W.B. and D. C. Culver. 2012. Encyclopedia of Caves. Academic/ Elsevier Press. Amsterdam, Netherlands.

Wibbels, T. 2010. The Diamondback Terrapin in Alabama: Causes for Decline and Strategy for Recovery. Final Performance Report to DWFF.

Williams, J.D., A.E. Bogan, and J.T. Garner. 2008. Freshwater Mussels of Alabama and the Mobile Basin in Georgia, Mississippi, and Tennessee. University of Alabama Press, 2008.

Williams, J.D., D. A. Neely, S. J. Walsh, and N. M. Burkhead. 2007. Three new percid fishes (Percidae: Percina) from the Mobile Basin Drainage of Alabama, Georgia, and Tennessee. Zootaxa 1549:1-28.

Zimmerman, G. M. 2010. Priorities for research and monitoring, management, and outreach as determined by the Swallow-tailed Kite Conservation Alliance—a partnership to advance conservation of a vulnerable species. Pages 599-604 in Proceedings of the Fourth International Partners in Flight Conference, 13-16 February 2008, McAllen, Texas, USA.

Appendix 1.1. Sources of Information

This appendix lists by general topic information sources that were researched, compiled, and reviewed in order to best determine and present the status of the full array of wildlife and its conservation in Alabama. A wide diversity of literature and programs was consulted and compiled through extensive research and coordination efforts. Some of these sources are referenced in the Literature Cited section of this document, and other sources are provided here as a resource for users/implementing parties of this document as well as for future revisions. Sources include published and unpublished data and reports.

Title	Reference
MAMMALS	
Furbearers of Alabama	ADCNR Game and Fish Div. 1989
Alabama Endangered Bats Cave Survey: Recovery Plan, Priority, and Other Caves	ADCNR Nongame Wildlife Program 2004
Bats of America	Barbour 1969
Bats in Eastern Woodlands	Bat Conservation International 2001
Mammals of Alabama	Best and Dusi 2014
Alabama Furbearers Status and Harvest Report: 2002-2003	DWFF
Biology and Management of White-Tailed Deer in Alabama	DWFF 2003
A Biological Survey of Alabama. North American Fauna. No. 45. Part II. Report on the Mammals of Alabama	Howell 1921
Gray Bat Population Surveys (annual report by DWFF-Nongame Staff)	Sharp 2014
Alabama Wildlife. Volume 3. Imperiled Amphibians, Reptiles, Birds, and Mammals	Mirarchi et al. 2004
the Land Manager's Guide to Mammals of the South	Trani et al. 2007
Recovery Plan for the Gray Bat	USFWS 1982
Recovery Plan for the Alabama Beach Mouse	USFWS 1987
Recovery Plan for the Florida Panther	USFWS 1987
Recovery Plan for the Red Wolf	USFWS 1990
Recovery Plan for the Florida Manatee	USFWS 2001
Recovery Plan for the Indiana Bat (Revised)	USFWS 1996
Threatened Species Status for the Northern Long-Eared Bat With 4(d) Rule	USFWS 2015
Birds	
North American Waterfowl Management Plan	Atlantic Coast Joint Venture 2004
U.S. Shorebird Conservation Plan	Brown et al. 2001
Effects of Management Practices on Grassland Birds (Series)	Dechant et al. 2003
Ducks Unlimited's Conservation Plan: Meeting the Annual Life Cycle Needs of North America's Waterfowl	Ducks Unlimited 2001
Ivory-Billed Woodpecker (*Campephilus Principalis*) Persists in Continental North America	Fitzpatrick et al. 2005

Title	Reference
Partners in Flight Bird Conservation Plan: Physiographic Area 14: the Interior Low Plateaus	Ford et al. 2000
Understanding Declines in Rusty Blackbirds	Greenburg et al. 2011
Gulf Coast Joint Venture Landbird Conservation Plan	Gulf Coast Joint Venture 2012
Alabama Breeding Bird Atlas 2000-2006	Haggerty 2009
Bird-Habitat Relationships on Southeastern Forest Lands	Harnell 1992
Birds of Alabama	Howell 1924
Alabama Birds	Imhof 1962
Adaptive Regulation of Waterfowl Harvests: Lessons Learned and Prospects for the Future	Johnson and Case 2000
Waterbird Conservation for the Americas: the North American Waterbird Conservation Plan, Version 1	Kushlan et al. 2002
Bird-Building Collisions in the United States: Estimates of Annual Mortality and Species Vulnerability	Loss et al. 2014
Alabama Wildlife. Volume 3. Imperiled Amphibians, Reptiles, Birds, and Mammals	Mirarchi et al. 2004
Appalachian Cooperative Grouse Research Project Report	Reynolds et al. 2000
Partners in Flight North American Landbird Conservation Plan	Rich et al. 2004
East Gulf Coastal Plain Joint Venture Final Performance Report	Rideout 2009
North American Waterfowl Management Plan Update 1998: Expanding the Vision	USDI 1998
Management Guidelines for Western Snowy Plover	USFWS 1985
Recovery Plan for the Mississippi Sandhill Crane	USFWS 1991
Recovery Plan for the Piping Plover, Atlantic Coast Population (Revised)	USFWS 1996
Recovery Plan for the U.S. Breeding Population of the Wood Stork (Revised)	USFWS 1996
Expanding the Vision: 1998 Update, North American Waterfowl Management Plan	USFWS 1999
Atlas of Cerulean Warbler Populations	USFWS 2000
Loggerhead Shrike Status Assessment	USFWS 2000
Management Recommendations for Marshbirds (Summary from the Marshbird Conservation Workshop)	USFWS 2001
Birds of Conservation Concern 2002	USFWS 2002
Adaptive Harvest Management: 2003 Duck Hunting Season	USFWS 2003
Recovery Plan for the Red-Cockaded Woodpecker	USFWS 2003
Waterfowl Population Status 2003	USFWS 2003
Waterfowl Population Status 2003	USFWS 2003
Birds of Conservation Concern	USFWS 2008
Status Assessment and Conservation Plan for the Henslow's Sparrow	USFWS 2012
A Conservation Action Plan for the American Oystercatcher for the Atlantic and Gulf Coasts of the United States	Western Hemisphere Shorebird Reserve Network 2010
Red Knot Conservation Plan for the Western Hemisphere	Western Hemisphere Shorebird Reserve Network 2010
Conservation Plan for the Wilson's Plover	Western Hemisphere Shorebird Reserve Network 2013
Priorities for Research and Monitoring, Management, and Outreach as Determined by the Swallow-Tailed Kite Conservation Alliance—a Partnership to Advance Conservation of a Vulnerable Species	Zimmerman 2010

Title	Reference
Fishes	
the Alabama Bass, *Micropterus Henshalli* (Teleostei: Centrarchidae), from the Mobile River Basin	Baker et al. 2008
Diversity Within the Redeye Bass, *Micropterus Coosae* (Perciformes: Centrarchidae) Species Group, with Descriptions of Four New Species	Baker et al. 2013
Fishes of Alabama	Boschung and Mayden 2004
Two New Species of *Noturus* (Siluriformes: Ictaluridae) from the Tennessee River Drainage: Distribution, and Conservation Status	Burr et al. 2005
Conservation Genetics of Spring Associated Darters in Alabama	Fluker et al. 2011
A New Species of *Percina* (Perciformes: Percidae) from the Apalachicola River Drainage, Southeastern United States	Freeman et al. 2008.
Red Drum Fishery Management Plan	GMFMC 1986
Generic Amendment for Addressing Essential Fish Habitat Requirements in the Gulf of Mexico	GMFMC 1998
Reef Fish Fishery Management Plan	GMFMC and NMFS 2005
Fishery Management Plan for Coastal Migratory Pelagic Resources in the Atlantic and Gulf of Mexico	GMFMC et al. 2004
Striped Bass Fishery Management Plan	GSMFC 1992
Conservation Status of Imperiled North American Freshwater and Diadromous Fishes	Jelks et al. 2008
Status Survey of the Trispot Darter, *Etheostoma trisella*, in Alabama, 2008-10	Johnson et al. 2011
the Impact of the Proposed Eddie Frost Commerce Park on *Speoplatyrhinus Poulsoni*, the Alabama Cavefish, a Federally Endangered Species Restricted to Key Cave, Lauderdale County, Alabama	Kuhajda 2004
the Striped Mullet Fishery of the Gulf of Mexico, United States: a Regional Management Plan	Leard et al. 1993
the Black Drum Fishery of the Gulf of Mexico, United States: a Regional Management Plan	Leard et al. 1993
the Spanish Mackerel Fishery of the Gulf of Mexico, United States: a Regional Management Plan	Lukens 1989
Protocol for Fish Data Collection to Develop a Tailwater Fish Index on the Coosa River, Alabama	Maceina and Hunter 2009
Distribution, Abundance, Biology and Habitat Use of Shoal Bass and Species Associates in Selected Tributaries of the Chattahoochee River, Alabama	Maceina et al. 2007
Fishes of Alabama and the Mobile Basin	Mettee et al. 1996
A Survey for the Gulf Sturgeon in the Mobile and Perdido Basins, Alabama	Mettee et al. 2009
Alabama Wildlife. Volume 2. Imperiled Aquatic Mollusks and Fishes	Mirarchi et al. 2004
Marine, Estuarine, and Diadromous Fish Stocks At Risk of Extinction in North America	Musick et al. 2000
A Plan for the Population Restoration and Conservation of Freshwater Mollusks of the Mobile River Basin	Mobile River Basin Mollusk Restoration Committee 2010
Two New Sculpins of the Genus *Cottus* (Teleostei: Cottidae) from the Rivers of Eastern North America	Neely et al. 2007
Striped Bass Fishery Management Plan (Gulf of Mexico)	Nicholson 1986
Atlantic Billfish Fishery Management Plan	NMFS 1999
Our Living Oceans: the Status of Habitat for U.S. Living Marine Resources	NMFS 2001

Title	Reference
Fishery Management Plan for Atlantic Tunas, Swordfish and Sharks	NMFS 2003
Status of U.S. Fisheries – 2001	NOAA 2002
Calibration of the Index of Biotic Integrity for the Southern Plains Ichthyoregion in Alabama	O'Neil and Shepard 2009
Rediscovery of the Trispot Darter, *Etheostoma Trisella*, in Alabama	O'Neil et al. 2009
A New Species of *Notropis* (Cypriniformes: Cyprinidae) from the Southeastern United States	Pera and Armbruster 2006
First Record of *Acantharchus Pomotis* (Mud Sunfish) from Alabama	Rider and Schell 2012
Conservation Status of Shoal Bass in Alabama: Distribution, Abundance, Stocking Efficacy, and Possible Effects of Sympatric Congeneric Black Bass in Selected Tributaries of the Chattahoochee River, Alabama	Sammons and Maceina 2009
Recovery Plan for the Palezone Shiner	USFWS 1997
Recovery Plan for the Snail Darter	USFWS 1983
Recovery Plan for the Spotfin Chub	USFWS 1983
Recovery Plan for the Slackwater Darter	USFWS 1984
Recovery Plan for the Boulder Darter	USFWS 1989
Recovery Plan for the Alabama Cavefish	USFWS 1990
Recovery Plan for the Pygmy Sculpin	USFWS 1991
Recovery Plan for the Cahaba Shiner	USFWS 1992
Recovery Plan for the Watercress Darter	USFWS 1993
Recovery Plan for the Blue Shiner	USFWS 1995
Recovery Plan for the Goldline Darter	USFWS 2000
Recovery Plan for the Vermilion Darter	USFWS 2007
Recovery Plan for the Alabama Sturgeon	USFWS 2013
Gulf Sturgeon Recovery/Management Plan	USFWS and NMFS 1995
the Flounder Fishery of the Gulf of Mexico, United States: A Regional Management Plan	VanderKooy 2000
the Spotted Seatrout Fishery of the Gulf of Mexico, United States: a Regional Management Plan	VanderKooy 2001
the Menhaden Fishery of the Gulf of Mexico, United States: a Regional Management Plan, 2002 Revision	VanderKooy and Smith 2002
Diversity, Distribution, and Conservation Status of the Native Freshwater Fishes of the Southern United States	Warren et al. 2000
Potential Impact of Road-Stream Crossings (Culverts) on the Upstream Passage of Aquatic Macroinvertebrates	Vaughan 2002
Fishes of North America Endangered, Threatened, Or of Special Concern: 1989	Williams et al. 1989
Three New Percid Fishes (Percidae: *Percina*) from the Mobile Basin Drainage of Alabama, Georgia, and Tennessee	Williams et al. 2007
Herpetofauna	
Combining Biotic Surveys, GIS Modeling, and Ecological Genetics to Prioritize Land Purchases for the Conservation of the Federally Threatened Red Hills Salamander (*Phaeognathus Hubrichti*)	Apodaca et al. 2010
Habitat Management Guidelines for Amphibians and Reptiles of the Southeastern United States	Bailey et al. 2006
fort Rucker (Alabama) Gopher Tortoise Baseline Survey Technical Report	CH2MHILL 2012

Title	Reference
Crab Trapping Causes Population Decline and Demographic Changes in Diamondback Terrapins Over Two Decades	Dorcas et al. 2007
Gopher Tortoise Management Plan	Florida Fish and Wildlife Conservation Commission 2012
Reptiles in Decline: the Global Decline of Reptiles, Déjà Vu Amphibians	Gibbons et al. 1999
Red Hills Salamander Habitat Delineation, Breeding Bird Surveys, and Habitat Restoration Recommendations on Commercial Timberlands	Godwin 2008
Captive Propagation of the Threatened Eastern Indigo Snake for Reintroduction Into Alabama	Godwin et al. 2008
Reintroduction of the Eastern Indigo Snake (Drymarchon Couperi) Into Conecuh National Forest, 2008-2011	Godwin et al. 2011
Use of Gopher Tortoises (Gopherus Polyphemus) in Restoration of the Upland Longleaf Fauna on the Conecuh National Forest	Guyer and Johnson 2008
Herpetofaunal Response to Longleaf Pine Ecosystem Restoration, Conecuh National Forest, Alabama	Guyer et al. 2006
the Status of Gopher Tortoises (*Gopherus Polyphemus*) in Alabama, with Special Reference to Three Important Public Properties	Guyer et al. 2011
Habitat Management Guidelines for Amphibians and Reptiles of the Midwestern United States	Kingsbury and Gibson 2001
Alabama Wildlife. Volume 1. a Checklist of Vertebrates and Selected Invertebrates: Aquatic Mollusks, Fishes, Amphibians, Reptiles, Birds, and Mammals	Mirarchi 2004
Alabama Wildlife. Volume 3. Imperiled Amphibians, Reptiles, Birds, and Mammals	Mirarchi et al. 2004
the Reptiles and Amphibians of Alabama	Mount 1975
Recovery Plan for U.S. Population of Atlantic Green Turtle	NMFS and USFWS 1998
Recovery Plan for U.S. Population of Loggerhead Turtle	NMFS and USFWS 2008
Recovery Plan for the Leatherback Turtle in the U.S. Caribbean, Atlantic, and Gulf of Mexico	NMFS and USFWS 1998
Recovery Plan for the Hawksbill Turtle in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico	NMFS and USFWS 1998
Conserving Amphibians and Reptiles in the New Millennium	PARC 1999
Spread of Chytridiomycosis Has Caused the Rapid Global Decline and Extinction of Frogs	Skerratt et al. 2007
Gopher Tortoise Survey Handbook	Smith et al. 2009
Land Manager's Guide to the Amphibians and Reptiles of the South	TNC 1995
Recovery Plan for the Eastern Indigo Snake	USFWS 1982
Recovery Plan for the Red Hills Salamander	USFWS 1983
Recovery Plan for the Alabama Red-Bellied Turtle	USFWS 1988
Recovery Plan for the Flattened Musk Turtle	USFWS 1990
Recovery Plan for the Gopher Tortoise	USFWS 1990
Recovery Plan for the Kemp's Ridley Sea Turtle	USFWS and NMFS 2011
The Diamondback Terrapin in Alabama: Causes for Decline and Strategy for Recovery	Wibbels 2010
Crayfishes	
Crayfishes. in Alabama Wildlife, Vol. V, Proceedings of Alabama's Third Nongame Wildlife Conference	Henderson and Smith 2014

Title	Reference
Assessment of Population Dynamics for Cave-Inhabiting Crayfish in Alabama	Huryn et. al. 2011
Status Survey for Three Rare Alabama Crayfishes, *Cambarus Cracens, Cambarus Scotti,* and *Cambarus Unestami*	Kilburn et. al. 2012
Report on the Crayfishes of Alabama: Literature and Museum Database Review, Species List with Abbreviated Annotations and Proposed Conservation Statuses	Schuster and Taylor 2004
A Preliminary Report on the Distribution and Conservation Status of the Alabama Crayfish Fauna	Smith et. al. 2011
A Reassessment of the Conservation Status of Crayfishes of the United States and Canada After 10+ Years of Increased Awareness	Taylor et al. 2007
Compilation of Alabama Crayfish Museum Holdings and Construction of a Geo-Referenced Database	Taylor and Schuster 2007
Freshwater Mollusks	
Report on Molecular Systematics of Poorly-Known Freshwater Mollusks of Alabama	Campbell and Harris 2005
Preliminary Survey of the Hydrobiidae of Alabama	Clark 2007
Plan for the Population Restoration and Conservation of Freshwater Mollusks of the Cumberlandian Region	Cumberlandian Region Mollusk Restoration Committee 2010
A Survey of the Primary Tributaries of the Alabama and Lower Tombigbee Rivers for Freshwater Mussels, Snails, and Crayfish	McGregor et al. 1999
Assessment of Current Information Available for Detection, Sampling, Necropsy, and Diagnosis of Diseased Mussels	Grizzle and Brunner 2007
Comprehensive Watershed Management Plan for the Choctawhatchee, Pea, and Yellow Rivers	Hinson, A., A. Rogers, and M. Cook. 2015 (in press)
Assessment of Population Dynamics for Cave-Inhabiting Crayfish in Alabama: a Request for Continuing Funds	Huryn et al. 2011
Conservation Status of Freshwater Gastropods of Canada and the United States	Johnson et al. 2013
Quantifying and Identifying Unionid Larvae in Drift and on Fishes of the Sipsey River, Alabama	Kennedy et al. 2007
Status of the Freshwater Mussel (Bivalvia: Unionidae) Fauna in the Cahaba River System, Alabama	McGregor et al. 2000
Alabama Wildlife. Volume 2. Imperiled Aquatic Mollusks and Fishes	Mirarchi et al. 2004
Southern Appalachian and Other Southeastern Streams At Risk: Implications for Mayflies, Dragonflies and Damselflies, Stoneflies, and Caddisflies	Southeast Aquatic Research Institute 1997
Plan for the Population Restoration and Conservation of Imperiled Freshwater Mollusks of the Mobile River Basin	Mobile River Basin Mollusk Restoration Committee 2010
Status of Aquatic Mollusks in the Southeastern United States: a Downward Spiral in Diversity	Southeast Aquatic Research Institute 1997
Recovery Plan for Anthony's Riversnail	USFWS 1997
Little-Wing Pearlymussel Recovery Plan	USFWS 1989
Recovery Plan for Five Tombigbee River Mussels	USFWS 1989
Recovery Plan for the Cracking Pearlymussel	USFWS 1990
Recovery Plan for the Ring Pink Mussel	USFWS 1991
Recovery Plan for the Inflated Heelsplitter	USFWS 1992
Clubshell and Northern Riffleshell Recovery Plan	USFWS 1994

Title	Reference
Mobile River Basin Aquatic Ecosystem Recovery Plan	USFWS 2000
Recovery Plan for Fat Threeridge, Shinyrayed Pocketbook, Gulf Moccasinshell, Ochlockonee Moccasinshell, Oval Pigtoe, Chipola Slabshell, and Purple Bankclimber	USFWS 2003
Recovery Plan for Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot	USFWS 2004
Recovery Plan for Six Mobile River Basin Aquatic Snails	USFWS 2005
Recovery Plan for Georgia Pigtoe Mussel, Interrupted Rocksnail, and Rough Hornsnail	USFWS 2013
Conservation Status of Freshwater Mussels of the United States and Canada	Williams et al. 1993
Freshwater Mussels of Alabama and the Mobile Basin in Georgia, Mississippi, and Tennessee	Williams et al. 2008
Other Invertebrates	
the Oyster Fishery of the Gulf of Mexico, United States: a Regional Management Plan	Berrigan et al. 1991
Evidence for Decline in Eastern North American Bumblebees (Hymenoptera: Apidae), with Special Reference to *Bombus Affinis* Cresson	Colla and Packer 2008
Stone Crab Fishery Management Plan	GMFMC 1979
Shrimp Fishery Management Plan	GMFMC 1981
Coral and Coral Reefs Fishery Management Plan	GMFMC 1982
Spiny Lobster Fishery Management Plan	GMFMC and SAFMC 1982
the Tiger Beetle of Arkansas, Louisiana, and Mississippi	Graves and Pearson 1973
the Blue Crab Fishery of the Gulf of Mexico, United States: a Regional Management Plan	Guillory et al. 2001
Caddisflies of Alabama	Harris et al. 1991
Endangered Invertebrates: the Case for Greater Attention to Invertebrate Conservation	Hoffman Black et al. 2001
Catalogue of the Beetles of Alabama	Loding 1945
Western Monarch Thanksgiving Count Data from 1997-2014	Monroe et al. 2015
Recovery Plan for the American Burying Beetle	USFWS 1991
Determination of Endangered Status for the Hine's Emerald Dragonfly	USFWS 1995
Multiple Species	
2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation	USFWS and Census Bureau 2011
Alabama Inventory List: the Rare, Threatened and Endangered Plants, Animals, and Natural Communities of Alabama	NatureServe-ALNHP 2013
Alabama Wildlife	Mirarchi et al. 2004
Aquatic Fauna in Peril: the Southeastern Perspective	Benz and Collins 1997
Ecological Assessment and Terrestrial Vertebrate Surveys for Black Belt Prairies in Alabama	Schotz and Barbour 2009
Endangered and Threatened Species Recovery Program: Report to Congress	USFWS 1990
Endangered and Threatened Wildlife and Plants; Animal Notice of Review	USFWS 1989
Managing Wildlife on Private Lands in Alabama and the Southeast.	Yarrow and Yarrow 1999

Title	Reference
Red Hills Salamander Habitat Delineation, Breeding Bird Surveys, and Habitat Restoration Recommendations on Commercial Timberlands	Godwin 2008
Habitats	
Freshwater Ecoregions of North America: a Conservation Assessment	Abell et al. 2000
Restoration of Longleaf Pine Ecosystems	Brockway et al. 2005
Ecological and Behavioral Studies in Shelta Cave, Alabama, with Emphasis on Decapod Crustaceans	Cooper 1975
Description of Alabama Estuarine Area	Crance 1971
A History of Management of Biological Resources of Shelta Cave, Alabama, USA	Culver 1999
Southern Wonder: Alabama's Surprising Biodiversity	Duncan 2013
Managing the Forest and the Trees; a Private Landowner's Guide to Conservation Management of Longleaf Pine	Earley 2002
An Index of Cumulative Disturbance to River Fish Habitats of the Conterminous United States from Landscape Anthropogenic Activities	Esselman et al. 2011
the Gulf Coast Pitcher Plant Bogs	Folkerts 1982
Stewardship of Longleaf Pine forests: a Guide for Landowners	Franklin 2008
Alabama Mill Dam Inventory	Gangloff et al. 2009
Ecoregions of Alabama	Griffith et al. 2001
Economic Botany of Alabama	Harper 1928
forests of Alabama	Harper 1943
Forest Statistics for Alabama, 2000	Hartsell 2002
Alabama, 2012—Forest Inventory and Analysis Factsheet	Hartsell 2013
Application of the Index of Biotic Integrity for Assessing Biological Conditions of Wadeable Streams	Henderson 2009
Land Use Changes and Invasions	Hobbs 2000
ACT (Alabama-Coosa-Tallapoosa) Aquatic Gap and Water Quality Monitoring	Irwin et al. 2007
Adaptive Management and Monitoring for Restoration and Faunal Recolonization of Tallapoosa River Shoal Habitats	Irwin et al. 2011
Natural Terrestrial Cover Classification; Assumptions and Definitions	Jennings 1993
Range-Wide Conservation Plan for Longleaf Pine	Lopez et al. 2014
A Diverse and Endangered Aquatic Ecosystem of the Southeast United States	Lydeard and Mayden 1995
Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity	Master et al. 1998
the Contribution of Headwater Streams to Biodiversity in River Networks	Meyer et al. 2007
Wetlands	Mitsch and Gosselink 1993
Wildlife Values of Small, Isolated Wetlands in the Southeastern Coastal Plain	Moler and Franz 1987
Ecological Systems of the United States: a Working Classification of U.S. Terrestrial Systems	NatureServe 2003
International Ecological Classification Standard: Terrestrial Ecological Systems of the United States	NatureServe 2004
Calibration of the Index of Biotic Integrity for the Southern Plains Ichthyoregion in Alabama	O'Neil and Shepard 2009

Title	Reference
Ecoregions of the Conterminous United States	Omernik 1987
Discovering Alabama Wetlands	Phillips 2002
Ecological Assessment and Terrestrial Vertebrate Surveys for Black Belt Prairies in Alabama	Schotz and Barbour 2009
Restoration and Enhancement of the Longleaf Pine Ecosystem and Mixed Mesophytic Forest Floodplains on Applicable forever Wild Land Trust Lands. State Lands Division Report to DWFF.	Sharp 2009
Freshwater Biodiversity Conservation Assessment of the Southeastern United States	Smith et al. 2002
Impacts of Wind Energy Facilities on Wildlife and Wildlife Habitat	the Wildlife Society 2007
Priority Areas for Freshwater Conservation Action: a Biodiversity Assessment of Southeastern United States	TNC 2002
America's Wetlands: Our Vital Link Between Land and Water	U.S. Environmental Protection Agency 1995
Alabama and Mobile Bay Basin Integrated Assessment of Watershed Health	U.S. Environmental Protection Agency 2014
Revised Land and Resource Management Plan; National forests in Alabama	USDA and FS-SR 2004
Description of the Ecoregions of the United States	USDA Forest Service 1995
2000 RPA Assessment of Forest and Range Lands	USFS 2000
Mobile Basin Aquatic Ecosystem Recovery Plan	USFWS 2000
Encyclopedia of Caves	White and Culver 2012
Lost Worlds in Alabama Rocks: A Guide to the State's Ancient Life and Landscapes	Lacefield 2013
Plants	
Colorado Wildlife Action Plan: Proposed Rare Plant Addendum	Grunau et al. 2011
Assisting the Michigan Wildlife Action Plan: Tools and Information for Incorporating Plants	Penskar and Derosier 2012
Hidden in Plain Sight: the Role of Plants in State Wildlife Action Plans	Stein and Gravuer 2008
Integrating the Conservation of Plant Species of Concern in the New Jersey State Wildlife Action Plan	Walz 2013
Measuring and Monitoring Plant Populations	Elzinga et al. 1998
Basin Management Plans	
Black Warrior River Basin Management Plan	ADEM 2003
Cahaba River Basin Management Plan	ADEM 2003
Chattahoochee-Chipola River Basin Management Plan	ADEM 2005
Choctawhatchee-Pea-Yellow River Basins Management Plan	ADEM 2005
Coastal River Basin Management Plan	ADEM 2004
Conecuh-Sepulga-Blackwater Rivers Basin Management Plan	ADEM 2004
Middle Coosa Basin Management Plan	ADEM 2003
Tallapoosa Basin Management Plan	ADEM 2004
Tennessee River Basin Management Plan	ADEM 2003
Upper Coosa Basin Watershed Management Plan	ADEM 2004
Alabama-Tombigbee River Basins Management Plan	ADEM 2005

Title	Reference
Climate Change	
Voluntary Guidance for States to Incorporate Climate Change Into Swaps and Other Management Plans	AFWA 2009
Resilient Sites for Terrestrial Conservation in the Southeast Region	Anderson et al. 2014
Hurricanes and Global Warming—Potential Linkages and Consequences	Anthes et al. 2006
Amphibian and Reptile Climate Vulnerability Assessment	Barrett et al. 2012.
Emerging Infectious Diseases of Wildlife-- Threats to Biodiversity and Human Health	Daszak et al. 2000
Climate Change and Its Potential Effects 0n Alabama's Plant Life	Davenport 2007
Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions	Frumhoff et al. 2007.
Scanning the Conservation Horizon: a Guide to Climate Change Vulnerability Assessment	Glick et al. 2011
Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change	Intergovernmental Panel on Climate Change 2007
Global Climate Change Impacts in the United States	Karl et al. 2009
National Fish, Wildlife, and Plants Climate Adaptation Strategy	National Fish, Wildlife and Plants Climate Adaptation Partnership 2014
Climate Smart Conservation: Putting Adaptation Principles Into Practice	Stein et al. 2014
Planning, Monitoring, and Other	
Alabama's 2004 Integrated Water Quality Monitoring and Assessment Report	ADEM 2004
Alabama's 2014 Integrated Water Quality Monitoring and Assessment Report	ADEM 2014
Alabama's 2014 §303(D) List	ADEM2014
Assessment of the Bioenergy Provisions in the 2008 Farm Bill	AFWA 2012
Wind Power Siting Regulations and Wildlife Guidelines in the United States	AFWA and USFWS 2007
Alabama Statewide Transportation Plan	Alabama Department of Transportation 2008
Alabama's Forest Assessment and Resource Strategy	Alabama forestry Commission 2010
Alabama Inventory List: the Rare, Threatened and Endangered Plants & Animals of Alabama	Alabama Natural Heritage Program 2012
Combining Biotic Surveys, GIS Modeling, and Ecological Genetics to Prioritize Land Purchases for the Conservation of the Federally Threatened Red Hills Salamander (*Phaeognathus Hubrichti*)	Apodaca et al. 2010
Measuring the Effectiveness of State Wildlife Grants Final Report	Association of Fish and Wildlife Agencies 2011
Middle Coosa River, Upper Coosa River, Eightmile Creek, and Cotaco Creek Nonpoint Source Prioritization Project	Barbour 2004
Citizen Participation Handbook for Public Officials and Other Professionals Serving the Public (13th Ed.)	Bleike and Bleiker 2000
Alabama Forest Legacy Program; Assessment of Need	Boyce et al. 2002
Highway Statistics 1992	Federal Highway Administration 1992
National Vegetation Classification Standard	FGDC 1997
Four Years Into the Gulf Oil Disaster: Still Waiting for Restoration	Fikes et al. 2014
Monitoring Program for Biodiversity of Terrestrial Vertebrates on Conservation Lands Within the Cumberland Plateau Region of Alabama	Grand et al. 2008

Title	Reference
Planning for Biodiversity Conservation: Putting Conservation Science Into Practice	Groves et al. 2002
Application of the Index of Biotic Integrity for Assessing Biological Conditions of Wadeable Streams	Henderson 2009
Burning for Conservation Values: Should the Goal Be to Mimic a Natural Fire Regime?	Hermann et al. 2014
ACT (Alabama-Coosa-Tallapoosa) Aquatic Gap and Water Quality Monitoring	Irwin et al. 2007
Adaptive Management and Monitoring for Restoration and Faunal Recolonization of Tallapoosa River Shoal Habitats	Irwin et al. 2011
A Comprehensive Change Detection Method for Updating the National Land Cover Database to Circa 2011	Jin et al. 2013
Making Monitoring Count: Project Design for Active Adaptive Management	Larson et al. 2013
Protocol for Fish Data Collection to Develop a Tailwater Fish Index on the Coosa River, Alabama	Maceina and Hunter 2009
Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects	Margolius, R.a., and Salafsky, N. 1998.
Structured Decision Making as a Conceptual Framework to Identify Thresholds for Conservation and Management	Martin et al. 2009
Alabama Wildlife. Volume 4. Conservation and Management Recommendations for Imperiled Wildlife	Mirarchi et al. 2004
Guidance on forested Riparian Buffers	Natural Resources Conservation Service 2015
Summary Report on Vegetation Classification Development for USDA Forest Service	NatureServe 2004
Guidelines for Long-Term Monitoring Protocols	Oakley et al. 2003
Ecoregions of the Conterminous United States	Omernik 1987
Landscape-Scale Effects of Hydrological Alterations on Riverine Macrobiota in the New World: Tropical--Temperate Comparisons	Pringle 2000
Adaptive Management: a Tool for Conservation Practitioners	Salafsky et al. 2001
Improving the Practice of Conservation: a Conceptual Framework and Research Agenda for Conservation Science	Salafsky et al. 2002
Conventions for Defining, Naming, Measuring, Combining, and Mapping Threats in Conservation: An Initial Proposal for a Standard System	Salafsky et al. 2003
A Standard Lexicon for Biodiversity Conservation: Unified Classifications of Threats and Actions	Salafsky et al. 2008
Habitat Use by Terrestrial and Aquatic Species on State-Managed Lands in Alabama. Report to DWFF	Silvano et al. 2012
States of the Union: Ranking America's Biodiversity	Stein 2002
Prioritization Guide for Coastal Habitat Protection and Restoration in Mobile and Baldwin Counties, Alabama	the Nature Conservancy 2009
Resilient Sites for Terrestrial Conservation in the Southeast Region	the Nature Conservancy 2014
Mobile Basin Aquatic Ecosystem Recovery Plan	U.S. Fish and Wildlife Service 2000
Writing Refuge Management Goals and Objectives: a Handbook	U.S. Fish and Wildlife Service 2004
2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation	U.S. Fish and Wildlife Service 2011
Revised [Forest Service] Land and Resource Management Plan	U.S. Forest Service 2015

Appendix 1.2. Alabama's 2015 SWAP SGCN List

Originally presented in the taxa sections of Chapter 1, the SGCN list is provided here in its entirety without breaks.

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
MAMMALS						
SIRENIA						
Trichechidae						
Trichechus manatus	West Indian Manatee	LE	SP	G2	S1	P1
RODENTIA						
Sciuridae						
Geomys pinetis	Southeastern Pocket Gopher	--	SP	G5	S3	P2
Cricetidae						
Peromyscus polionotus ammobates	Alabama Beach Mouse	LE	SP	G5T1	S1	P1
Peromyscus polionotus trissylepsis	Perdido Key Beach Mouse	LE	SP	G5T1	S1	P1
Neotoma magister	Allegheny Woodrat	--	--	G3G4	S3	P2
Zapus hudsonius	Meadow Jumping Mouse	--	SP	G5	S1	P2
LAGOMORPHA						
Leporidae						
Sylvilagus obscurus	Appalachian Cottontail	--	GA	G4	S1	P2
Sylvilagus palustris	Marsh Rabbit	--	GA	G5	S3	P2
SORICOMORPHA						
Soricidae						
Sorex fumeus	Smoky Shrew	--	--	G5	SU	P2
Sorex hoyi	American Pygmy Shrew	--	SP	G5	S1	P2
CHIROPTERA						
Molossidae						
Tadarida brasiliensis	Brazilian Free-tailed Bat	--	--	G5	S3	P2
Vespertilionidae						
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	--	SP	G3G4	S2	P1
Lasiurus intermedius	Northern Yellow Bat	--	SP	G4G5	S1	P2
Myotis austroriparius	Southeastern Myotis	--	SP	G3G4	S2	P1
Myotis grisescens	Gray Myotis	LE	SP	G3G2	S2	P1
Myotis leibii	Eastern Small-footed Myotis	--	--	G1G3	SNA	P1
Myotis lucifugus	Little Brown Myotis	--	SP	G3	S3	P1
Myotis septentrionalis	Northern Long-eared Bat	LT	SP	G1G3	S2	P1
Myotis sodalis	Indiana Bat	LE	SP	G2	S2	P1
Perimyotis subflavus	Tri-colored Bat	--	--	G3	S3	P2
CARNIVORA						
Felidae						
Puma concolor	Cougar	LE	GANOS	G5	SX	EX
Canidae						
Canis rufus	Red Wolf	LE	GANOS	G1Q	SX	EX
Ursidae						
Ursus americanus	Black Bear	--	GANOS	G5	S2	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Mustelidae						
Mustela frenata	Long-tailed Weasel	--	SP	G5	S3	P2
Mephitidae						
Spilogale putorius	Eastern Spotted Skunk	--	SP	G5	S2S3	P2
ARTIODACTYLA						
Cervidae						
Cervus elaphus	Elk	--	--	G5	SX	EX
Bovidae						
Bison bison	American Bison	--	--	G4	SX	EX
BIRDS						
ANSERIFORMES						
Anatidae						
Anas fulvigula	Mottled Duck	--	SP	G4	S2N,S3B	P2
Anas rubripes	American Black Duck	--	GB	G5	S2B,S5N	P2
CICONIIFORMES						
Ciconiidae						
Mycteria americana	Wood Stork	LT	SP	G4	S2N	P2
PELECANIFORMES						
Ardeidae						
Egretta rufescens	Reddish Egret	--	SP	G4	S1B,S3N	P2
Ixobrychus exilis	Least Bittern	--	SP	G5	S2N,S4B	P2
ACCIPITIRIFORMES						
Accipitridae						
Aquila chrysaetos	Golden Eagle	BGEPA[8]	SP	G5	SNRN	P2
Elanoides forficatus	Swallow-tailed Kite	--	SP	G5	S2	P2
GRUIFORMES						
Rallidae						
Coturnicops noveboracensis	Yellow Rail	--	GB	G4	S2N	P2
Laterallus jamaicensis	Black Rail	--	GB	G3G4	S2N	P2
Rallus elegans	King Rail	--	GB	G4	S2S3B,S4N	P2
CHARADRIIFORMES						
Haematopodidae						
Haematopus palliatus	American Oystercatcher	--	SP	G5	S1	P1
Charadriidae						
Charadrius melodus	Piping Plover	LT	SP	G3	S1N	P1
Charadrius nivosus	Snowy Plover	--	SP	G3	S1B,S2N	P1
Charadrius wilsonia	Wilson's Plover	--	SP	G5	S1	P1
Scolopacidae						
Calidris canutus	Red Knot	PT	SP	G4	S3N	P2
Laridae						
Gelochelidon nilotica	Gull-billed Tern	--	SP	G5	S2B,S4N	P2
STRIGIFORMES						
Strigidae						
Asio flammeus	Short-eared Owl	--	SP	G5	S2N	P2

[8] Golden Eagle protected by the Bald and Golden Eagle Protection Act of 1940

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
FALCONIFORMES						
Falconidae						
Falco sparverius paulus	Southeastern American Kestrel	--	SP	G5	S3B,S5N	P2
PICIFORMES						
Picidae						
Campephilus principalis	Ivory-billed Woodpecker	LE	SP	G1	SX	EX
Picoides borealis	Red-cockaded Woodpecker	LE	SP	G3	S2	P1
PASSERIFORMES						
Laniidae						
Lanius ludovicianus	Loggerhead Shrike	--	SP	G4	S4	P2
Corvidae						
Corvus corax	Common Raven	--	SP	G5	SX	EX
Troglodytidae						
Thryomanes bewickii	Bewick's Wren	--	SP	G5	SHB,S1N	P1
Parulidae						
Setophaga cerulea	Cerulean Warbler	--	SP	G4	S1B	P1
Emberizidae						
Ammodramus henslowii	Henslow's Sparrow	--	SP	G4	S2N	P1
Ammodramus maritimus	Seaside Sparrow	--	SP	G4	S2	P2
Ammodramus nelsoni	Nelson's Sparrow	--	SP	G5	S3N	P2
Peucaea aestivalis	Bachman's Sparrow	--	SP	G3	S3	P2
Icteridae						
Euphagus carolinus	Rusty Blackbird	--	--	G4	S4N	P2
AMPHIBIANS						
CAUDATA						
Ambystomatidae						
Ambystoma bishopi	Reticulated Flatwoods Salamander	LE	SP	G2	S1	P1
Ambystoma texanum	Smallmouth Salamander	--	--	G5	S3	P2
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	--	--	G5	S3	P2
Amphiumidae						
Amphiuma pholeter	One-toed Amphiuma	--	SP	G3	S1	P2
Cryptobranchidae						
Cryptobranchus a. alleganiensis	Eastern Hellbender	--	SP	G3G4	S2	P1
Plethodontidae						
Aneides aeneus	Green Salamander	--	SP	G3G4	S3	P2
Desmognathus aeneus	Seepage Salamander	--	SP	G3G4	S2	P2
Desmognathus auriculatus	Southern Dusky Salamander	--	SP	G5	S2	P1
Gyrinophilus palleucus	Tennessee Cave Salamander	--	SP	G2G3	S2	P2
Phaeognathus hubrichti	Red Hills Salamander	LT	SP	G2	S2	P1
Plethodon serratus	Southern Red-backed Salamander	--	--	G5	S2S3	P2
Proteidae						
Necturus alabamensis	Black Warrior Waterdog	C	SP	G2	S2	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
ANURA						
Hylidae						
Hyla andersonii	Pine Barrens Treefrog	--	SP	G4	S2	P1
Pseudacris ocularis	Little Grass Frog	--	--	G5	S1	P2
Ranidae						
Lithobates areolatus	Crawfish Frog	--	--	G4	NR	P1
Lithobates capito	Gopher Frog	--	SP	G3	S2	P1
Lithobates heckscheri	River Frog	--	SP	G5	S1	P1
Lithobates sevosus	Mississippi Gopher Frog	LE	SP	G1	SH	P1
Lithobates sylvaticus	Wood Frog	--	SP	G5	S2	P2
REPTILES						
SQUAMATA suborder Lacertilia						
Anguidae						
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	--	--	G5	S5	P2
Ophisaurus mimicus	Mimic Glass Lizard	--	SP	G3	S1	P1
Scincidae						
Plestiodon anthracinus	Coal Skink	--	SP	G5	S3	P2
Plestiodon inexpectatus	Southeastern Five-lined Skink	--	SP	G5	S3	P2
SQUAMATA suborder Serpentes						
Colubridae						
Drymarchon couperi	Eastern Indigo Snake	LT	SP	G3	S1	P1
Farancia erytrogramma	Rainbow Snake	--	SP	G4	S3	P1
Heterodon simus	Southern Hognose Snake	--	SP	G2	SH	P1
Lampropeltis getula	Eastern Kingsnake	--	SP	G5T5	S4	P2
Lampropeltis nigra holbrooki	Eastern Speckled Kingsnake	--	SP	G5T5	S3	P2
Liodytes (Seminatrix) pygaea	North Florida Swampsnake	--	--	G5	S1	P2
Nerodia clarkii	Gulf Salt-marsh Snake	--	SP	G4T4	S2	P2
Pituophis melanoleucus lodingi	Black Pinesnake	C	SP	G4T2T3	S2	P1
Pituophis m. melanoleucus	Northern Pinesnake	--	SP	G4T4	S3	P2
Pituophis m. mugitus	Florida Pinesnake	--	SP	G4T3	S2	P2
Elapidae						
Micrurus fulvius	Eastern Coral Snake	--	SP	G5	S3	P1
Viperidae						
Crotalus adamanteus	Eastern Diamond-backed Rattlesnake	--	--	G4	S3	P2
TESTUDINES						
Cheloniidae						
Caretta caretta	Atlantic Loggerhead	LT	SP	G3	S1	P1
Chelonia mydas	Green Sea Turtle	LT	SP	G3	S1	P1
Eretmochelys imbricata	Atlantic Hawksbill	LE	SP	G3	SNR	P1
Lepidochelys kempii	Kemp's Ridley	LE	SP	G1	S1	P1
Dermochelidae						
Dermochelys coriacea	Leatherback Sea Turtle	LE	SP	G2	SNA	P1
Emydidae						
Graptemys barbouri	Barbour's Map Turtle	--	SP	G2	S2	P2
Graptemys ernsti	Escambia Map Turtle	--	SP	G2	S2	P2

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Malaclemys terrapin pileata	Mississippi Diamondback Terrapin	--	SP	G4T3Q	S2	P1
Pseudemys alabamensis	Alabama Red-bellied Turtle	LE	SP	G1	S1	P1
Kinosteridae						
Sternotherus carinatus	Razor-backed Musk Turtle	--	--	G5	S1	P2
Sternotherus depressus	Flattened Musk Turtle	LT	SP	G2	S2	P2
Testudinidae						
Gopherus polyphemus	Gopher Tortoise	LT, C6F[9]	SP	G3	S3	P2
FISHES						
ACIPENSERIFORMES						
Acipenseridae						
Acipenser fulvescens	Lake Sturgeon	--	SP	G3G4	SX	EXCAU
Acipenser oxyrinchus desotoi	Gulf Sturgeon	LT	SP	G3T2	S1	P2
Scaphirhynchus platorynchus	Shovelnose Sturgeon	--	SP	G4	SX	EX
Scaphirhynchus suttkusi	Alabama Sturgeon	LE	SP	G1	S1	P1
LEPISOSTEIFORMES						
Lepisosteidae						
Lepisosteus platostomus	Shortnose Gar	--	CNGF	G5	SX	EX
HIODONTIFORMES						
Hiodontidae						
Hiodon alosoides	Goldeye	--	--	G5	SX	EX
CLUPEIFORMES						
Clupeidae						
Alosa alabamae	Alabama Shad	--	SP	G2G3	S2	P1
CYPRINIFORMES						
Cyprinidae						
Cyprinella caerulea	Blue Shiner	LT	SP	G2	S1	P1
Cyprinella callitaenia	Bluestripe Shiner			G2G3	S1S2	P1
Erimonax monachus	Spotfin Chub	LT, XN	SP	G2	SX	EXCAU
Erimystax dissimilis	Streamline Chub	--	--	G4	S1	P2
Macrhybopsis hyostoma	Shoal Chub	--	--	G5	S3	P1
Notropis albizonatus	Palezone Shiner	LE	SP	G1	S1	P1
Notropis ariommus	Popeye Shiner	--	--	G3	SX	EX
Notropis buchanani	Ghost Shiner	--	--	G5	S2	P2
Notropis cahabae	Cahaba Shiner	LE	SP	G2	S2	P1
Notropis chalybaeus	Ironcolor Shiner	--	SP	G4	SH	P1
Notropis cummingsae	Dusky Shiner	--	--	G5	S2	P1
Notropis hypsilepis	Highscale Shiner	--	--	G3	S2	P2
Notropis melanostomus	Blackmouth Shiner	--	SP	G2	S1	P2
Phenacobius mirabilis	Suckermouth Minnow	--	--	G5	S1	P1
Phenacobius uranops	Stargazing Minnow	--	--	G4	S1	P2
Pteronotropis euryzonus	Broadstripe Shiner	--	--	G3	S2	P1
Pteronotropis welaka	Bluenose Shiner	--	--	G3G4	S2	P2

[9] *Gopherus polyphemus* is listed by USFWS as Threatened west of the Mobile and Tombigbee rivers in Alabama (Choctaw, Mobile, and Washington counties). Eastern population is candidate for listing.

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
SILURIFORMES						
Ictaluridae						
Noturus crypticus	Chucky Madtom	--	CNGF	G4	SX	EX
Noturus eleutherus	Mountain Madtom	--	CNGF	G4	S1	P1
Noturus flavus	Stonecat	--	CNGF	G4	S1	P2
Noturus miurus	Brindled Madtom	--	CNGF	G5	S1	P2
Noturus munitus	Frecklebelly Madtom		CNGF, SP	G3	S2	P1
AMBLYOPSIFORMES						
Amblyopsidae						
Speoplatyrhinus poulsoni	Alabama Cavefish	LE	SP	G1	S1	P1
CYPRINODONTIFORMES						
Fundulidae						
Lucania goodei	Bluefin Killifish	--	--	G5	S1	P2
SCORPAENIFORMES						
Cottidae						
Cottus paulus	Pygmy Sculpin	LT	SP	G1	S1	P1
PERCIFORMES						
Centrarchidae						
Acantharchus pomotis	Mud Sunfish	--	--	G4G5	SNR	P2
Micropterus cataractae	Shoal Bass	--	GF-HP	G3	S2	P1
Percidae						
Ammocrypta vivax	Scaly Sand Darter	--	--	G5	S1	P1
Etheostoma bellator	Warrior Darter	--	--	G2	S2	P2
Etheostoma sp. cf. bellator "A"	Sipsey Darter	--	--	G2	S2	P2
Etheostoma sp. cf. bellator "B"	Locust Fork Darter	--	--	GNR	S1	P2
Etheostoma boschungi	Slackwater Darter	LT	SP	G1	S1	P1
Etheostoma brevirostrum	Holiday Darter	--	SP	G2	S1	P1
Etheostoma camurum	Bluebreast Darter	--	--	G4	S1	P1
Etheostoma chermocki	Vermilion Darter	LE	SP	G1	S1	P1
Etheostoma cinereum	Ashy Darter	--	--	G2G3	SX	EX
Etheostoma ditrema	Coldwater Darter	--	SP	G2	S1	P2
Etheostoma lynceum	Brighteye Darter	--	SP	G5	S1	P1
Etheostoma neopterum	Lollypop Darter	--	SP	G3	S1	P1
Etheostoma nuchale	Watercress Darter	LE	SP	G1	S1	P1
Etheostoma phytophilum	Rush Darter	LE	SP	G1	S1	P1
Etheostoma trisella	Trispot Darter	--	SP	G1	S1	P2
Etheostoma tuscumbia	Tuscumbia Darter	--	SP	G2	S2	P2
Etheostoma wapiti	Boulder Darter	LE, XN	SP	G1	S1	P1
Etheostoma zonistium	Bandfin Darter	--	--	G4	G5	P2
Etheostoma sp. cf. zonistium	Blueface Darter	--	--	G1	S1	P2
Percina aurolineata	Goldline Darter	LT	SP	G2	S1	P2
Percina brevicauda	Coal Darter	--	--	G2	S2	P2
Percina burtoni	Blotchside Darter	--	SP	G2G3	S1	P1
Percina crypta	Halloween Darter	--	SP	G2	S1	P1
Percina evides	Gilt Darter	--	--	G4	S2	P2
Percina phoxocephala	Slenderhead Darter	--	SP	G5	S2	P1
Percina sipsi	Bankhead Darter	--	SP	G1	S1	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Percina tanasi	Snail Darter	LT	SP	G2G3	S1	P1
Sander sp. cf. vitreus	Southern Walleye	--	GF	G3	S3	P1
Elassomatidae						
Elassoma alabamae	Spring Pygmy Sunfish	LT	SP	G1	S1	P1
MUSSELS						
UNIONOIDA						
Margaritiferidae						
Cumberlandia monodonta	Spectaclecase	LE	SP	G3	S1	P1
Margaritifera marrianae	Alabama Pearlshell	LE	SP	G1	S1	P1
Unionoidea						
Actinonaias ligamentina	Mucket	--	PSM	G5	S2	P1
Actinonaias pectorosa	Pheasantshell	--	PSM	G3	SX	EX
Alasmidonta marginata	Elktoe	--	PSM	G4	S1	P1
Alasmidonta triangulata	Southern Elktoe	--	PSM	G1Q	S1	P1
Alasmidonta viridis	Slippershell Mussel	--	SP	G4G5	S1	P1
Anodontoides radiatus	Rayed Creekshell	--	PSM	G3	S3	P2
Cyprogenia stegaria	Fanshell	LE	SP	G1Q	S1	P1
Dromus dromas	Dromedary Pearlymussel	LE	SP	G1	S1	EX
Elliptio arca	Alabama Spike	--	PSM	G2G3Q	S2	P1
Elliptio arctata	Delicate Spike	--	PSM	G2G3Q	S2	P2
Elliptio chipolaensis	Chipola Slabshell	LT	SP	G1	S1	P1
Elliptio dilatata	Spike	--	PSM	G5	S1	P1
Elliptio fraterna	Brother Spike	--	PSM	G1	SX	EX
Elliptio nigella	Winged Spike	--	PSM	G1	SX	EX
Elliptio purpurella	Inflated Spike	--	PSM	G2	S1	P1
Elliptoideus sloatianus	Purple Bankclimber	LT	SP	G2	S1	P1
Epioblasma ahlstedti	Duck River Dartersnapper	LE	SP	G1	SH	EX
Epioblasma brevidens	Cumberlandian Combshell	LE	SP	G1	S1	P1
Epioblasma capsaeformis	Oyster Mussel	LE	SP	G1	SX	EXCAU
Epioblasma obliquata	Catspaw	LE	SP	G1	SX	EX
Epioblasma penita	Southern Combshell	LE	SP	G1	SX	EXCAU
Epioblasma triquetra	Snuffbox	LE	SP	G3	S1	P1
Fusconaia burkei	Tapered Pigtoe	LT	SP	G2G3	S2	P2
Fusconaia cor	Shiny Pigtoe	LE	SP	G1	S1	P1
Fusconaia cuneolus	Finerayed Pigtoe	LE	SP	G1	S1	P1
Fusconaia escambia	Narrow Pigtoe	LT	SP	G2	S2	P2
Fusconaia subrotunda	Longsolid	--	PSM	G3	S1	P1
Hamiota altilis	Finelined Pocketbook	LT	SP	G2G3	S2	P2
Hamiota australis	Southern Sandshell	LE	SP	G2G3	S2	P2
Hamiota perovalis	Orangenacre Mucket	LT	SP	G2	S2	P2
Hamiota subangulata	Shinyrayed Pocketbook	LE	SP	G2	S1	P1
Hemistena lata	Cracking Pearlymussel	LT	SP	G1	S1	P1
Lampsilis abrupta	Pink Mucket	LE	SP	G2	S1	P1
Lampsilis virescens	Alabama Lampmussel	LT	SP	G1	S1	(P1
Lasmigona etowaensis	Etowah Heelsplitter	--	PSM	G3	S2	P2
Lasmigona holstonia	Tennessee Heelsplitter	--	PSM	G3	S1	P2

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Lasmigona subviridis	Green Floater	--	PSM	G3	SX	EX
Lemiox rimosus	Birdwing Pearlymussel	LE	SP	G1	S1	EX
Leptodea leptodon	Scaleshell	LT	SP	G1G2	SX	EX
Ligumia recta	Black Sandshell	--	PSM	G4G5	S2	P2
Medionidus acutissimus	Alabama Moccasinshell	LT	SP	G2	S2	P1
Medionidus conradicus	Cumberland Moccasinshell	--	SP	G3G4	S1	P1
Medionidus parvulus	Coosa Moccasinshell	LT	SP	G1Q	SX	EXCAU
Medionidus penicillatus	Gulf Moccasinshell	LE	SP	G2	S1	P1
Obovaria choctawensis	Choctaw Bean	LE	SP	G2G3	S2	P2
Obovaria jacksoniana	Southern Hickorynut	--	PSM	G2	S2	P1
Obovaria olivaria	Hickorynut	--	PSM	G4	SX	EX
Obovaria retusa	Ring Pink	LE	SP	G1	SH	EX
Obovaria subrotunda	Round Hickorynut	--	PSM	G4	S2	P1
Obovaria unicolor	Alabama Hickorynut	--	PSM	G3	S2	P2
Pegias fabula	Littlewing Pearlymussel	LE	SP	G1	SX	EX
Plethobasus cicatricosus	White Wartyback	LE	SP	G1	S1	P1
Plethobasus cooperianus	Orangefoot Pimpleback	LE	SP	G1	SH	EX
Plethobasus cyphyus	Sheepnose	LE	SP	G3	S1	P1
Pleurobema athearni	Canoe Creek Clubshell	--	PSM	G1	S1	P1
Pleurobema beadleianum	Mississippi Pigtoe	--	PSM	G3	SNR	P1
Pleurobema clava	Clubshell	LE	SP	G1G2	SX	EX
Pleurobema cordatum	Ohio Pigtoe	--	PSM	G4	S2	P1
Pleurobema decisum	Southern Clubshell	LE	SP	G2	S2	P2
Pleurobema georgianum	Southern Pigtoe	LE	SP	G1	S1	P1
Pleurobema hanleyianum	Georgia Pigtoe	LE	SP	G1	SX	P1
Pleurobema hartmanianum	Cherokee Pigtoe	--	PSM	G1	SX	EX
Pleurobema oviforme	Tennessee Clubshell	--	PSM	G2G3	S1	P1
Pleurobema perovatum	Ovate Clubshell	LE	SP	G1	S1	P1
Pleurobema plenum	Rough Pigtoe	LE	SP	G1	S1	P1
Pleurobema pyriforme	Oval Pigtoe	LE	SP	G1	S1	P1
Pleurobema rubellum	Warrior Pigtoe	LE	SP	G1G2	S1	P1
Pleurobema rubrum	Pyramid Pigtoe	--	SP	G2G3	S1	P1
Pleurobema sintoxia	Round Pigtoe	--	SP	G4G5	S1	P1
Pleurobema stabile	Coosa Pigtoe	--	--	GH	SX	EX
Pleurobema strodeanum	Fuzzy Pigtoe	LT	SP	G2G3	S2	P2
Pleurobema taitianum	Heavy Pigtoe	LE	SP	G1	S1	P1
Pleuronaia barnesiana	Tennessee Pigtoe	--	PSM	G2G3	S1	P2
Pleuronaia dolabelloides	Slabside Pearlymussel	LE	SP	G2	S1	P1
Potamilus inflatus	Inflated Heelsplitter	LT	SP	G1G2Q	S1S2	P2
Ptychobranchus fasciolaris	Kidneyshell	--	PSM	G4G4	S2	P1
Ptychobranchus foremanianus	Rayed Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus greenii	Triangular Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus jonesi	Southern Kidneyshell	LE	SP	G1	S1	P1
Ptychobranchus subtentus	Fluted Kidneyshell	LE	SP	G2	SX	EX
Quadrula cylindrica	Rabbitsfoot	LT	SP	G3G4	S1	P1
Quadrula infucata	Sculptured Pigtoe	--	PSM	G3	S1	P2
Quadrula intermedia	Cumberland Monkeyface	LE	SP	G1	SX	EX
Quadrula kieneriana	Coosa Orb	--	PSM	G3Q	SX	EX

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Quadrula metanevra	Monkeyface	--	PSM	G4	S3	P2
Quadrula sparsa	Appalachian Monkeyface	LE	SP	G1	SX	EX
Reginaia rotulata	Round Ebonyshell	LE	SP	G1	S1	P1
Strophitus connasaugaensis	Alabama Creekmussel	--	PSM	G3	S3	P2
Strophitus undulatus	Creeper	--	PSM	G5	S1	P1
Toxolasma corvunculus	Southern Purple Lilliput	--	PSM	G1	S1	P1
Toxolasma cylindrellus	Pale Lilliput	LE	SP	G1	S1	P1
Utterbackia peggyae	Florida Floater	--	PSM	G3	S1	P1
Villosa fabalis	Rayed Bean	LE	SP	G2	SX	EX
Villosa nebulosa	Alabama Rainbow	--	PSM	G3	S3	P2
Villosa taeniata	Painted Creekshell	--	PSM	G4	S2	P2
Villosa trabalis	Cumberland Bean	LE	SP	G1	SX	EXCAU
Villosa umbrans	Coosa Creekshell	--	PSM	G2	S2	P2
Villosa villosa	Downy Rainbow	--	PSM	G3	S1	P1
FRESHWATER SNAILS						
CAENOGASTROPODA						
Cochliopidae						
Pseudotryonia grahamae	Salt Spring Hydrobe	--	--	G1	S1	P1
Hydrobiidae						
Fontigens nickliniana	Watercress Snail	--	--	G5	S4	P1
Marstonia angulobasis	Angled Marstonia	--	--	G1	S1	P2
Marstonia hershleri	Coosa Pyrg	--	--	G1	S1	P2
Marstonia pachyta	Armored Marstonia	LE	SP	G1	S1	P1
Marstonia scalariformis	Moss Pyrg	--	SP	G1	S1	P2
Stiobia nana	Sculpin Snail	--	--	G1	S1	P1
Lithoglyphidae						
Antrorbis breweri	Manitou Cavesnail	--	--	G1	S1	P1
Clappia cahabensis	Cahaba Pebblesnail	--	--	G1	S1	P2
Lepyrium showalteri	Flat Pebblesnail	LE	SP	G1	S1	P1
Pleuroceridae						
Athearnia anthonyi	Anthony's Riversnail	LT	SP	G1	S1	P1
Elimia ampla	Ample Elimia	--	--	G1	S1	P2
Elimia annettae	Lilyshoals Elimia	--	--	G1	S1	P2
Elimia bellacrenata	Princess Elimia	--	--	G1Q	S1	P1
Elimia boykiniana	Flaxen Elimia	--	--	G2Q	SNR	P2
Elimia broccata	Brooch Elimia	--	--	G1	S1	P1
Elimia cochliaris	Cockle Elimia	--	--	G1	S1	P1
Elimia crenatella	Lacy Elimia	LT	SP	G1	S1	P1
Elimia dickinsoni	Stately Elimia	--	--	G5	S3	P2
Elimia exusta	Fire Elimia	--	--	G2	S2	P2
Elimia lachryma	Teardrop Elimia	--	--	G1	S1	P1
Elimia melanoides	Black Mudalia	C	SP	G2	S2	P2
Elimia mihalcikae	Latticed Elimia	--	--	G1	S1	P1
Elimia nassula	Round-ribbed Elimia	--	--	G1Q	S1	P1
Elimia perstriata	Engraved Elimia	--	--	G1	S1	P1
Elimia teretria	Auger Elimia	--	--	G1	S1	P1

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Elimia vanuxemiana	Cobble Elimia	--	--	G1	S1	P1
Elimia varians	Puzzle Elimia	--	--	G1G2Q	S1S2	P2
Elimia variata	Squat Elimia	--	--	G2Q	S2	P2
Io fluvialis	Spiny Riversnail	--	--	G2	SX	EX
Leptoxis ampla	Round Rocksnail	LT	SP	G2	S2	P2
Leptoxis compacta	Oblong Rocksnail	--	--	G1	S1	P1
Leptoxis foremani	Interrupted Rocksnail	LE	SP	G1	SX	EXCAU
Leptoxis picta	Spotted Rocksnail	--	SP	G1	S1	P2
Leptoxis plicata	Plicate Rocksnail	LE	SP	G1	S1	P1
Leptoxis taeniata	Painted Rocksnail	LT	SP	G1	S1	P2
Leptoxis virgata	Smooth Mudalia	--	--	G2	SX	P2
Lithasia armigera	Armored Rocksnail	--	--	G3G4	S1	P2
Lithasia curta	Knobby Rocksnail	--	--	G1	SX	EX
Lithasia lima	Warty Rocksnail	--	--	G2Q	S1	P2
Lithasia salebrosa	Muddy Rocksnail	--	--	G2G3Q	S1	P2
Pleurocera alveare	Rugged Hornsnail	--	--	G3	S1	P2
Pleurocera corpulenta	Corpulent Hornsnail	--	--	G1	S1	P1
Pleurocera foremanii	Rough Hornsnail	LE	SP	G1	S1	P1
Pleurocera pyrenella	Skirted Hornsnail	--	--	G2	S2	P2
Pleurocera striatum	Striate Hornsnail	--	--	GNR	SNR	P2
Planorbidae						
Rhodacmea cahawbensis	Cahaba Ancylid	--	--	GNR	SNR	P1
Rhodacmea filosa	Wicker Ancylid	--	--	G1	S1	P1
Rhodacmea hinkleyi	Knobby Ancylid	--	--	G2G3	S2	EX
Viviparidae						
Campeloma decampi	Slender Campeloma	LE	SP	G1	S1	P1
Lioplax cyclostomaformis	Cylindrical Lioplax	LE	SP	G1	S1	P1
Tulotoma magnifica	Tulotoma	LT	SP	G2	S2	P2
CRAYFISHES						
DECAPODA						
Cambaridae						
Barbicambarus simmonsi	Tennessee Bottlebrush Crayfish	--	--	G1G2	SU	P1
Cambarellus diminutus	Least Crayfish	--	--	G3	S3	P1
Cambarellus lesliei	Angular Dwarf Crayfish	--	--	G3	S3	P1
Cambarellus shufeldtii	Cajun Dwarf Crayfish	--	--	G5	S2	P2
Cambarus cracens	Slenderclaw Crayfish	--	--	G1	S1	P1
Cambarus distans	Boxclaw Crayfish	--	--	G5	S1	P1
Cambarus englishi	Tallapoosa Crayfish	--	--	G3	S3	P2
Cambarus halli	Slackwater Crayfish	--	--	G3G4	S3	P2
Cambarus hamulatus	Prickly Cave Crayfish	--	--	G3	S2	P2
Cambarus howardi	Chattahoochee Crayfish	--	--	G3	S2	P2
Cambarus jonesi	Alabama Cave Crayfish	--	--	G2	S2	P2
Cambarus laconensis	Lacon Exit Cave Crayfish	--	--	G1	S1	P1
Cambarus longirostris	Longnose Crayfish	--	--	G5	S2	P2
Cambarus manningi	Greensaddle Crayfish	--	--	G4	S2	P2

ORDER Family *Species*	Common Name	Fed Prot	State Prot	Global Rank	State Rank	SGCN Rank
Cambarus parvoculus	Mountain Midget Crayfish	--	--	G5	S1	P2
Cambarus pecki	Phantom Cave Crayfish	--	--	G1G2	S1S2	P1
Cambarus pyronotus	Fireback Crayfish	--	--	G2	SNR	P1
Cambarus rusticiformis	Depression Crayfish	--	--	G5	S1	P2
Cambarus speleocoopi	Sweet Home Alabama Cave Crayfish	--	--	G1	S1	P2
Cambarus veitchorum	White Spring Cave Crayfish	--	--	G1	S1	P1
Fallicambarus burrisi	Burrowing Bog Crayfish	--	--	G3	S1	P1
Fallicambarus byersi	Lavender Burrowing Crayfish	--	--	G4	S2	P2
Fallicambarus danielae	Speckled Burrowing Crayfish	--	--	G2	S1	P2
Hobbseus prominens	Prominence Riverlet Crayfish	--	--	G4G5	S3	P2
Orconectes cooperi	Flint River Crayfish	--	--	G1	S1	P2
Orconectes durelli	Saddle Crayfish	--	--	G5	S1	P2
Orconectes lancifer	Shrimp Crayfish	--	--	G5	S1	P2
Orconectes sheltae	Shelta Cave Crayfish	--	--	G1	S1	P1
Procambarus capillatus	Capillaceous Crayfish	--	--	G3	S2	P2
Procambarus clemmeri	Cockscomb Crayfish	--	--	G5	S2	P2
Procambarus escambiensis	Escambia Crayfish	--	--	G2	S2	P1
Procambarus evermanni	Panhandle Crayfish	--	--	G4	S3	P2
Procambarus hagenianus hagenianus	Southeastern Prairie Crayfish	--	--	G4G5T4	S1	P2
Procambarus hayi	Straightedge Crayfish	--	--	G5	S1	P2
Procambarus hubbelli	Jackknife Crayfish	--	--	G4	S2	P2
Procambarus hybus	Smoothnose Crayfish	--	--	G5	S4	P2
Procambarus lagniappe	Lagniappe Crayfish	--	--	G2	S1	P2
Procambarus lecontei	Mobile Crayfish	--	--	G3G4	S1	P2
Procambarus lewisi	Spur Crayfish	--	--	G4	S3	P2
Procambarus marthae	Crisscross Crayfish	--	--	G3	S2	P2
Procambarus okaloosae	Okaloosa Crayfish	--	--	G4	S2	P2
Procambarus paeninsulanus	Peninsula Crayfish	--	--	G5	S2	P2
Procambarus planirostris	Flatnose Crayfish	--	--	G4	SNR	P2
Procambarus viaevirdis	Vernal Crayfish	--	--	G5	S1	P1
OTHER INVERTEBRATES						
Lepidoptera Nymphalidae						
Neonympha mitchellii	Mitchell's Satyr	LE	SP	G2	S1S2	P1
Coleoptera Silphidae						
Nicrophorus americanus	American Burying Beetle	LE	SP	G2G3	SH	EX
Odonata Corduliidae						
Somatochlora hineana	Hine's Emerald Dragonfly	LE	SP	G2G3	SH	P1
Decapoda Atyidae						
Palaemonias alabamae	Alabama Cave Shrimp	LE	SP	G2G3	S1	P1

Appendix 1.3. Changes in SGCN since the 2005 SWAP

While the majority of species included in the 2005 SWAP are retained in the 2015 version, 80 were added to the list (Table 1), 23 were removed from the list (Table 2), and 38 had changed priority ranks (Table 3).

Sorted alphabetically by species rather than taxonomically

Table 1. SGCN New to List (Not Addressed in 2005 SWAP)

Scientific Name	Common Name	SGCN Rank	Reason for Change
Mammals (2)			
Perimyotis subflavus	Tri-colored Bat	P2	White-nose syndrome
Sorex fumeus	Smoky Shrew	P2	Recently discovered in state
Birds (7)			
Anas fulvigula	Mottled Duck	P2	Decline in past decade
Aquila chrysaetos	Golden Eagle	P2	Decline in past decade
Rallus elegans	King Rail	P2	Decline in past decade
Calidris canutus	Red Knot	P2	Decline in past decade
Gelochelidon nilotica	Gull-billed Tern	P2	Decline in past decade
Lanius ludovicianus	Loggerhead Shrike	P2	Decline in past decade
Euphagus carolinus	Rusty Blackbird	P2	Decline in past decade
Amphibians (4)			
Ambystoma texanum	Smallmouth Salamander	P2	Rarity; lack of systematic survey; decreasing habitat
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander	P2	Rarity; lack of systematic survey; decreasing habitat
Plethodon serratus	Southern Red-backed Salamander	P2	Rarity; limited distribution; decreasing habitat
Lithobates sylvaticus	Wood Frog	P2	Rarity; limited distribution; decreasing habitat
Reptiles (2)			
Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	P2	Rarity; decreasing population
Nerodia clarkii	Gulf Salt-Marsh Snake	P2	Rarity; restricted distribution; habitat vulnerability
Fishes (5)			
Sander sp. cf. vitreus	Southern Walleye	P1	Not yet described; genetically distinct
Acantharchus pomotis	Mud Sunfish	P2	Discovered in AL in 2000, but not recognized until 2009
Cyprinella callitaenia	Bluestripe Shiner	P1	Decreasing population
Notropis hypsilepis	Highscale Shiner	P2	Decreasing population, habitat vulnerability
Etheostoma bellator	Warrior Darter	P2	Declining population, restricted distribution
Mussels (16)			
Epioblasma ahlstedti	Duck River Dartersnapper	EX	Described subsequent to previous SWAP
Pleurobema hartmanianum	Cherokee Pigtoe	EX	Not recognized in 2002 assessment
Pleurobema stabile	Coosa Pigtoe	EX	Not recognized in 2002 assessment

Scientific Name	Common Name	SGCN Rank	Reason for Change
Quadrula kieneriana	Coosa Orb	EX	Not recognized in 2002 assessment
Quadrula sparsa	Appalachian Monkeyface	EX	Not recognized in 2002 assessment
Elliptio nigella	Winged Spike	EX	Thought extinct; rediscovered in FL
Obovaria jacksoniana	Southern Hickorynut	P1	Rarity; decreasing population
Pleurobema athearni	Canoe Creek Clubshell	P1	Described subsequent to previous SWAP
Pleurobema beadleianum	Mississippi Pigtoe	P1	Discovered in AL portion of Escatawpa River subsequent to previous SWAP
Pleurobema cordatum	Ohio Pigtoe	P1	Very little evidence of recruitment observed since 2002
Pleurobema rubellum	Warrior Pigtoe	P1	Taxonomic change: species is listed as *P. furvum* under ESA and in state regulation
Utterbackia peggyae	Florida Floater	P1	Rarity; decreasing population
Lasmigona etowaensis	Etowah Heelsplitter	P2	Taxonomic revision; previously included with *L. holstonia*
Quadrula metanevra	Monkeyface	P3	Declining in some areas (TN River)
Villosa nebulosa	Alabama Rainbow	P2	Found to be less widespread and common than previously thought
Villosa taeniata	Painted Creekshell	P2	Found to be less widespread and common than previously thought
Freshwater Snails (18)			
Pseudotryonia grahamae	Salt Spring Hydrobe	P1	Not ranked in 2005
Fontigens nickliniana	Watercress Snail	P1	Not ranked in 2005
Marstonia angulobasis	Angled Marstonia	P2	Not ranked in 2005
Marstonia hershleri	Coosa Pyrg	P2	P3 in 2005
Stiobia nana	Sculpin Snail	P1	P3 in 2005
Antrorbis breweri	Manitou Cavesnail	P1	P3 in 2005
Clappia cahabensis	Cahaba Pebblesnail	P2	Not ranked in 2005
Rhodacmea cahawbensis	Cahaba Ancylid	P1	Not ranked in 2005
Rhodacmea filosa	Wicker Ancylid	P1	P3 in 2005
Rhodacmea hinkleyi	Knobby Ancylid	EX	P3 in 2005
Elimia boykiniana	Flaxen Elimia	P2	Not ranked in 2005
Elimia broccata	Brooch Elimia	P1	Not ranked in 2005
Elimia dickinsoni	Stately Elimia	P2	P3 in 2005
Elimia exusta	Fire Elimia	P2	Not ranked in 2005
Elimia mihalcikae	Latticed Elimia	P1	Not ranked in 2005
Elimia teretria	Auger Elimia	P1	Not ranked in 2005
Leptoxis compacta	Oblong Rocksnail	P1	Was considered “extinct” in 2005
Pleurocera striatum	Striate Hornsnail	P2	P3 in 2005
Crayfishes (26)			
Barbicambarus simmonsi	Tennessee Bottlebrush Crayfish	P1	Rarity; habitat vulnerability, poorly known
Cambarellus shufeldtii	Cajun Dwarf Crayfish	P2	Rarity; habitat vulnerability, poorly known
Cambarus distans	Boxclaw Crayfish	P1	Rarity; habitat vulnerability, poorly known
Cambarus laconensis	Lacon Exit Cave Crayfish	P1	Rarity; habitat vulnerability, poorly known
Cambarus longirostris	Longnose Crayfish	P2	Rarity; habitat vulnerability, poorly known

Scientific Name	Common Name	SGCN Rank	Reason for Change
Cambarus manningi	Greensaddle Crayfish	P2	Rarity; habitat vulnerability, poorly known
Cambarus parvoculus	Mountain Midget Crayfish	P2	Rarity; habitat vulnerability, poorly known
Cambarus pecki	Phantom Cave Crayfish	P1	Rarity; habitat vulnerability, poorly known
Cambarus pyronotus	Fireback Crayfish	P1	Recent discovery in state
Cambarus rusticiformis	Depression Crayfish	P2	Rarity; habitat vulnerability, poorly known
Cambarus speleocoopi	Sweet Home Alabama Cave Crayfish	P2	Rarity; habitat vulnerability, poorly known
Fallicambarus byersi	Lavender Burrowing Crayfish	P2	Rarity; habitat vulnerability, poorly known
Hobbseus prominens	Prominence Riverlet Crayfish	P2	Rarity; habitat vulnerability, poorly known
Orconectes durelli	Saddle Crayfish	P2	Rarity; habitat vulnerability, poorly known
Orconectes lancifer	Shrimp Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus clemmeri	Cockscomb Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus evermanni	Panhandle Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus hayi	Straightedge Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus hubbelli	Jackknife Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus hybus	Smoothnose Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus lecontei	Mobile Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus marthae	Crisscross Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus okaloosae	Okaloosa Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus paeninsulanus	Peninsula Crayfish	P2	Rarity; habitat vulnerability, poorly known
Procambarus planirostris	Flatnose Crayfish	P2	Recent discovery in state
Procambarus viaevirdis	Vernal Crayfish	P1	Rarity; habitat vulnerability, poorly known

Table 2. Former (2005) SGCN, Not Included in 2015

Scientific Name	Common Name	Reason
Birds (7)		
Circus cyaneus	Northern Harrier	Stabilized or increasing
Falco sparverius sparverius	American Kestrel[10]	Stabilized or increasing
Helmitheros vermivorum	Worm-eating Warbler	Stabilized or increasing
Hylocichla mustelina	Wood Thrush	Stabilized or increasing
Limnothlypis swainsonii	Swainson's Warbler	Stabilized or increasing
Oporornis formosus	Kentucky Warbler	Stabilized or increasing
Scolopax minor	American Woodcock	Stabilized or increasing
Reptiles (3)		
Lampropeltis calligaster calligaster	Prairie Kingsnake	Peripheral distribution
Macrochelys temminckii	Alligator Snapping Turtle	Surveys reveal presence in suitable habitat
Fishes (1)		
Etheostoma chuckwachatte	Lipstick Darter	Abundant with limited distribution.
Mussels (7)		
Elliptio mcmichaeli	Fluted Elephantear	Found to be more common than previously thought
Epioblasma florentina	Yellow Blossom	Presumed extinct. ("Extirpated" in 2005 SWAP)
Epioblasma metastriata	Upland Combshell	Presumed extinct. ("Extirpated" in 2005 SWAP)
Epioblasma othcaloogensis	Southern Acornshell	Presumed extinct. ("Extirpated" in 2005 SWAP)
Lasmigona costata	Flutedshell	Found to be more common than previously thought
Pleurobema curtum	Black Clubshell	Presumed extinct. ("Extirpated" in 2005 SWAP)
Pleurobema marshalli	Flat Pigtoe	Presumed extinct. ("Extirpated" in 2005 SWAP)
Crayfishes (5)		
Cambarus miltus	Rusty Grave Digger	Found to be more common than previously thought
Cambarus unestami	Blackbarred Crayfish	Found to be more common than previously thought
Orconectes chickasawae	Chickasaw Crayfish	Found to be more common than previously thought
Orconectes holti	Bimaculate Crayfish	Found to be more common than previously thought
Orconectes jonesi	Sucarnoochee River Crayfish	Found to be more common than previously thought

[10] Another subspecies, Southeastern American Kestrel (*Falco sparverius paulus*), is retained as P2.

Table 3. 2005 SGCN with Changed Priority Rank in 2015

Scientific Name	Common Name	2005 / 2015 SGCN Rank	Reason
Mammals (4)			
Myotis austroriparius	Southeastern Myotis	P2 / P1	White-nose syndrome
Myotis leibii	Eastern Small-Footed Myotis	P3 / P1	White-nose syndrome
Myotis lucifugus	Little Brown Myotis	P2 / P1	White-nose syndrome
Myotis septentrionalis	Northern Long-eared Bat	P2 / P1	White-nose syndrome
Birds (1)			
Haematopus palliatus	American Oystercatcher	P2 / P1	Decline in past decade
Amphibians (3)			
Hyla andersonii	Pine Barrens Treefrog	P2 / P1	Apparent declines
Necturus alabamensis	Black Warrior Waterdog	P2 / P1	Extreme rarity, no surveys
Phaeognathus hubrichti	Red Hills Salamander	P2 / P1	Fragmentation, inbreeding
Reptiles (3)			
Farancia erytrogramma erytrogramma	Rainbow Snake	P2 / P1	Extreme rarity; habitat vulnerability; decreasing population trend
Micrurus fulvius	Eastern Coral Snake	P2 / P1	Extreme rarity; habitat vulnerability; decreasing population
Ophisaurus mimicus	Mimic Glass Lizard	P2 / P1	Extreme rarity; habitat vulnerability; limited distribution
Fishes (10)			
Alosa alabamae	Alabama Shad	P2 / P1	Decreasing population
Erimonax monachus	Spotfin Chub	EX / EXCAU	Restoration across state line in TN has resulted in reproduction in AL
Etheostoma camurum	Bluebreast Darter	P2 / P1	Declining population
Etheostoma trisella	Trispot Darter	EX / P2	Rediscovered in AL in 2008
Macrhybopsis hyostoma	Shoal Chub	P2 / P1	Decreasing population
Micropterus cataractae	Shoal Bass	P2 / P1	One viable population left in AL
Notropis cummingsae	Dusky Shiner	P2 / P1	Decreasing population
Noturus munitus	Frecklebelly Madtom	P2 / P1	Declining population
Phenacobius mirabilis	Suckermouth Minnow	P2 / P1	Restricted distribution
Pteronotropis euryzonus	Broadstripe Shiner	P2 / P1	Decreasing population, habitat vulnerability
Mussels (9)			
Alasmidonta marginata	Elktoe	EX / P1	Recent report from Paint Rock River
Elliptio arctata	Delicate Spike	P1 / P2	Several populations discovered since 2002
Elliptio chipolaensis	Chipola Slabshell	EX / P1	Discovered in Chipola River headwaters since last SWAP
Epioblasma penita	Southern Combshell	P1 / EXCAU	Conservation actions underway
Fusconaia escambia	Narrow Pigtoe	P1 / P2	Found to be fairly common in a small area of Gantt Reservoir

Scientific Name	Common Name	2005 / 2015 SGCN Rank	Reason
Hamiota australis	Southern Sandshell	P1 / P2	Found to be more common than previously thought
Medionidus acutissimus	Alabama Moccasinshell	P2 / P1	Declining population
Quadrula infucata	Sculptured Pigtoe	P1 / P2	Found to be more common than previously thought
Villosa villosa	Downy Rainbow	P2 / P1	Declining population
Freshwater Snails (3)			
Leptoxis foremani	Interrupted Rocksnail	EXCAU / EX	
Marstonia scalariformis	Moss Pyrg	P1 / P2	Conservation action underway
Tulotoma magnifica	Tulotoma	P1 / P2	
Crayfishes (5)			
Cambarellus diminutus	Least Crayfish	P2 / P1	
Cambarellus lesliei	Angular Dwarf Crayfish	P2 / P1	
Cambarus cracens	Slenderclaw Crayfish	P2 / P1	
Fallicambarus burrisi	Burrowing Bog Crayfish	P2 / P1	
Procambarus escambiensis	Escambia Crayfish	P2 / P1	

Appendix 1.4. Imperiled Animals Not Presently Considered as SGCN

This alphabetically (not phylogenetically) sorted list is at present confined to G1 and G2 ranked taxa and may be expanded as data comes available.

Scientific Name	Common Name	Fed Prot	State Prot	Global Rank	State Rank
Agapetus alabamensis	A Caddisfly	--	--	G1	S1
Agapetus spinosus	A Caddisfly	--	--	G2	S1
Agarodes alabamensis	A Caddisfly	--	--	G1	S1
Agarodes stannardi	Stannard's Agarodes Caddisfly	--	--	G2G3	S2
Agarodes tuskaloosa	A Caddisfly	--	--	G1G3	S1S3
Alabamocreagris mortis	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Alabamocreagris pecki	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Amblyscirtes alternata	Dusky Roadside-skipper	--	--	G2G3	S2S3
Anguispira alabama	Alabama Tigersnail	--	--	G2	S2?
Aphrastochthonius pecki	A Cave Pseudoscorpion	--	--	G1	S1
Aphrastochthonius tenax	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Apochthonius russelli	A Cave Pseudoscorpion	--	--	G1	S1
Appaleptoneta barrowsi	A Cave Spider	--	--	G1	S1
Appaleptoneta credula	A Cave Spider	--	--	G1	S1
Appaleptoneta jonesi	A Cave Spider	--	--	G1	S1
Baetisca becki	A Mayfly	--	--	G2G3	S1
Batriasymmodes troglodytes	A Beetle	--	--	G1G2	S1
Batrisodes cavernosus	A Cave Beetle	--	--	G1	S1
Batrisodes jocuvestus	A Cave Beetle	--	--	G1	S1
Batrisodes jonesi	A Cave Beetle	--	--	G2G3	S2S3
Batrisodes profundus	A Cave Beetle	--	--	G1G2	S1S2
Batrisodes subterraneus	A Cave Beetle	--	--	G1	S1
Batrisodes tumoris	A Beetle	--	--	G1	S1
Batrisodes valentinei	A Cave Beetle	--	--	G2G4	S2
Beloneuria jamesae	Cheaha Beloneurian Stonefly	--	--	G1G2	S1S2
Bishopella jonesi	A Cave Harvestman	--	--	G1	S1
Cambarincola sheltensis	A Cave Worm	--	---	G1G2	S1S2
Catinella aprica	Diurnal Ambersnail	--	--	G2	S2?
Catinella pugilator	Weedpatch Ambersnail	--	--	G1G2	S1
Ceraclea alabamae	A Caddisfly	--	--	G1G3	S1
Cheumatopsyche bibbensis	A Caddisfly	--	--	G1	S1
Cheumatopsyche cahaba	A Caddisfly	--	--	G1	S1
Cheumatopsyche kinlockensis	A Caddisfly	--	--	G1G2	S1
Cicindela marginipennis	Cobblestone Tiger Beetle	--	--	G2	S1

Scientific Name	Common Name	Fed Prot	State Prot	Global Rank	State Rank
Cicurina wiltoni	A Cave Spider	--	--	G1	S1
Dactylocythere arcuata	A Cave Shrimp	--	--	G1G2	S1S2
Dicranopselaphus variegatus	Variegated False Water Penny Beetle	--	--	G1G3	S1S3
Discus clappi	Channelled Disc	--	--	G1	S1
Dryachloa dauca	Carrot Glass	--	--	G2	S1
Glyphyalinia pecki	Blind Glyph	--	--	G1G2	S1S2
Gomphus septima	Septima's Clubtail	--	--	G2	S1S2
Heterosternuta folkertsi	Folkerts' Hydroporus Diving Beetle	--	--	G1G3	S1S2
Homoeoneuria cahabensis	Cahaba Sand-filtering Mayfly	--	--	G2G3	S1S2
Hydropsyche alabama	A Caddisfly	--	--	G1	S1
Hydropsyche rotosa	A Caddisfly	--	--	G2G3	S1
Hydroptila cheaha	A Caddisfly	--	--	G1	S1
Hydroptila chelops	A Caddisfly	--	--	G1	S1
Hydroptila coweetensis	A Caddisfly	--	--	G1G2	S1
Hydroptila cretosa	A Caddisfly	--	--	G1G2	S1S2
Hydroptila decia	Knoxville Hydroptilan Micro Caddisfly	--	--	G2	S1
Hydroptila fuscina	A Caddisfly	--	--	G1	S1
Hydroptila lagoi	A Caddisfly	--	--	G1	S1
Hydroptila lennoxi	A Caddisfly	--	--	G2G4	S1
Hydroptila licina	A Caddisfly	--	--	G1G2	S1S2
Hydroptila metteei	A Caddisfly	--	--	G1G2	S1
Hydroptila micropotamis	A Caddisfly	--	--	G1G2	S1
Hydroptila molsonae	Molson's Microcaddisfly	--	--	G2G3	S2S3
Hydroptila oakmulgeensis	A Caddisfly	--	--	G1	S1
Hydroptila paralatosa	A Caddisfly	--	--	G2	S2
Hydroptila parastrepha	A Caddisfly	--	--	G2G3	S1
Hydroptila patriciae	A Caddisfly	--	--	G1	S1
Hydroptila scheiringi	A Caddisfly	--	--	G1G2	S1
Hydroptila setigera	A Caddisfly	--	--	G1	S1
Hydroptila wetumpka	A Caddisfly	--	--	G1	S1
Inflectarius approximans	Tight-gapped Shagreen	--	--	G2	S2?
Inflectarius smithi	Alabama Shagreen	--	--	G2	S2
Islandiana muma	A Cave Spider	--	--	G1G2	S1
Lepidostoma weaveri	A Caddisfly	--	--	G1	S1
Liocranoides archeri	Archer's Two-clawed Spider	--	--	G2	S2
Lissocreagris persephone	A Cave Pseudoscorpion	--	--	G1	S1
Lissocreagris pluto	A Cave Pseudoscorpion	--	--	G1	S1
Lissocreagris subatlantica	A Pseudoscorpion	--	--	G2G4	S1S2
Litocampa henroti	A Hexapod	--	--	G1G2	S1
Litocampa sp. 1	A Cave Dipluran (Salamander Cave)	--	--	G1	S1
Mesodon trossulus	Danby Globelet	--	--	G1	S1
Micrasema sp. 1	Undescribed Caddisfly	--	--	G2	S2

Scientific Name	Common Name	Fed Prot	State Prot	Global Rank	State Rank
Microcreagris eurydice	A Cave Pseudoscorpion	--	--	G1	S1
Microcreagris nickajackensis	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Neoleptoneta serena	A Cave Spider	--	--	G1G2	S1S2
Neonympha mitchellii	Mitchell's Satyr	LE	SP	G2	S1S2
Neophylax acutus	A Caddisfly	--	--	G2G3	S1
Neophylax atlanta	A Caddisfly	--	--	G2G4	S1
Neophylax securis	A Caddisfly	--	--	G1G2	S1S2
Neotrichia mobilensis	A Caddisfly	--	--	G1G2	S1S2
Neotrichia sepulga	A Caddisfly	--	--	G1	S1
Nesticus jonesi	Cave Spring Cave Spider	--	--	G1	S1
Nicrophorus americanus	American Burying Beetle	LE	SP	G2G3	SH
Nyctiophylax morsei	A Caddisfly	--	--	G2	S1
Ochrotrichia elongiralla	A Caddisfly	--	--	G1G2	S1
Ochrotrichia weoka	A Caddisfly	--	--	G1G2	S1S2
Onychiurus janus	A Cave Springtail	--	--	G2G3	S1
Onychiurus paro	A Cave Springtail	--	--	G1	S1
Oxyethira lumipollex	A Caddisfly	--	--	G2	S2
Palaemonias alabamae	Alabama Cave Shrimp	LE	SP	G2G3	S1
Palaemonias sp. 1	Tuscambia Cave Shrimp	--	--	G1	S1
Paravitrea bidens	Gray Supercoil	--	--	G1	S1
Paravitrea pilsbryana	Translucent Supercoil	--	--	G2	S2?
Paravitrea tiara	Crowned Supercoil	--	--	G1G2	S1?
Paravitrea toma	Sharp Supercoil	--	--	G1	S1
Paravitrea variabilis	Variable Supercoil	--	--	G2G3	S1?
Patera sargentiana	Grand Bladetooth	--	--	G2	S2
Philomycus sellatus	Alabama Mantleslug	--	--	G2G3	S1?
Phylocentropus harrisi	A Caddisfly	--	--	G1G2	S1S2
Polycentropus carlsoni	Carlson's Polycentropus Caddisfly	--	--	G2G3	S1
Polycentropus chelatus	A Caddisfly	--	--	G2G4	S1
Polycentropus floridensis	Florida Brown Checkered Summer Sedge Caddisfly	--	--	G2	S1
Protoptila cahabensis	Cahaba Saddle-case Caddisfly	--	--	G1	S1
Pseudanophthalmus alabamae	A Ground Beetle	--	--	G2	S2
Pseudanophthalmus assimilis	West Wills Valley Cave Beetle	--	--	G1G2	S1
Pseudanophthalmus distinguens	A Ground Beetle	--	--	G1G2	S1
Pseudanophthalmus lodingi	A Ground Beetle	--	--	G1G2	S1S2
Pseudanophthalmus meridionalis	A Cave Beetle	--	--	G2	S2
Pseudanophthalmus nickajackensis	Nickajack Cave Beetle	--	--	G1	S1
Pseudanophthalmus profundus	A Cave Beetle	--	--	G2	S2
Pseudanophthalmus sequoyah	Sequoyah Cave Beetle	--	--	G1	S1
Pseudanophthalmus steevesi	A Cave Beetle	--	--	G1G2	S1S2
Pseudosinella nata	A Cave Springtail	--	--	G1	S1
Pseudosinella pecki	A Cave Springtail	--	--	G2G3	S1

Scientific Name	Common Name	Fed Prot	State Prot	Global Rank	State Rank
Pseudotremia minos	A Cave Millipede	--	--	G1	S1
Pseudotremia nyx	A Cave Millipede	--	--	G1	S1
Ptomaphagus chromolithus	A Cave Beetle	--	--	G2G3	S2
Ptomaphagus episcopus	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus hazelae	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus julius	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus laticornis	A Cave Beetle	--	--	G1G2	S1
Ptomaphagus lodingi	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus solanum	A Cave Beetle	--	--	G1	S1
Ptomaphagus torodei	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus walteri	A Cave Beetle	--	--	G1G2	S1S2
Ptomaphagus whiteselli	A Cave Beetle	--	--	G2G3	S1
Rhyacophila alabama	A Caddisfly	--	--	G1	S1
Rhyacophila carolae	A Caddisfly	--	--	G1	S1
Rhyacophila teddyi	A Caddisfly	--	--	G2G3	S1
Schaefferia alabamensis	A Cave Springtail	--	--	G1G2	S1
Schaefferia christianseni	A Cave Springtail	--	--	G1	S1
Setodes epicampes	A Caddisfly	--	--	G2	S1
Somatochlora hineana	Hine's Emerald Dragonfly	LE	SP	G2G3	SH
Spanglerogyrus albiventris	Primitive Whirligig Beetle	--	--	G1G3	S1S2
Speleobama vana	A Cave Beetle	--	--	G1	S1
Speleochus croceus	A Cave Beetle	--	--	G1G2	S1S2
Speleochus stygicus	A Cave Beetle	--	--	G1G2	S1S2
Speleochus synstygicus	A Cave Beetle	--	--	G1	S1
Stactobiella cahaba	A Caddisfly	--	--	G1	S1
Stenelmis gammoni	Gammon's Stenelmis Riffle Beetle	--	--	G1G3	S1S2
Subterrochus eurous	A Cave Beetle	--	--	G2G3	S1
Subterrochus ferus	A Cave Beetle	--	--	G1G2	S1S2
Theliopsyche tallapoosa	A Caddisfly	--	--	G1	S1
Triaenodes florida	Floridian Triaenode Caddisfly	--	--	G2	S1
Triaenodes sp. 1	Undescribed Caddisfly	--	--	G1	S1
Triaenodes tridontus	Three-tooth Triaenodes Caddisfly	--	--	G1G3	S1
Tychobythinus jonesi	A Cave Beetle	--	--	G1G2	S1S2
Tyrannochthonius alabamensis	A Pseudoscorpion	--	--	G1	S1
Tyrannochthonius aladdinensis	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius aralu	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius archeri	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius attenuatus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius avernicolus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius barri	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius binoculatus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius chamberlini	A Cave Pseudoscorpion	--	--	G1	S1

Scientific Name	Common Name	Fed Prot	State Prot	Global Rank	State Rank
Tyrannochthonius charon	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius diabolus	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Tyrannochthonius erebicus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius felix	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius floridensis	A Pseudoscorpion	--	--	G1G2	S1S2
Tyrannochthonius gnomus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius halopotamus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius infernalis	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius jonesi	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius nergal	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius orpheus	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Tyrannochthonius osiris	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius parvus	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Tyrannochthonius pecki	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius pholeter	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius pluto	A Cave Pseudoscorpion	--	--	G1G2	S1S2
Tyrannochthonius satan	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius sheltae	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius skeletonis	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius stygius	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius tartarus	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius tenuis	A Cave Pseudoscorpion	--	--	G1	S1
Tyrannochthonius torodei	A Cave Pseudoscorpion	--	--	G1	S1

Appendix 1.5. Definitions of Ranks Used in Species Tables

SGCN ranks are defined in Chapter 1, pages 3 and 4. Additional classifications appearing in the column headers of the tables in Chapter 1 and Appendices 1.1, 1.3, and 1.5 are defined as follows:

Fed Prot = Federally Protected. A double dash (--) indicates no federal protection is in place.

- **LE** – Listed Endangered: In danger of extinction throughout all or a significant portion of the range.
- **LT** – Listed Threatened: Likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
- **PE** – Proposed Endangered: Proposed to be listed as endangered.
- **PT** – Proposed Threatened: Proposed to be listed as threatened.
- **C** – Candidate: Under consideration for official listing for which there is sufficient information to support listing. The USFWS encourages other agencies to give consideration to such taxa in environmental planning.

State Prot = State Protected. A double dash (--) indicates no state protection is in place.

- **SP** – State Protected: Species protected by Regulation 220-2-.92 (Nongame Species Regulation), 220-2-.98 (Invertebrate Species Regulation), 220-2-.26(4) (Protection of Sturgeon), 220-2-.94 (Prohibition of Taking or Possessing Paddlefish), or 220-2-.97 (Alligator Protection Regulation).
- **PSM** – Partial Status Mussels: All mussel species not listed as a protected species under the Invertebrate Species Regulation are partially protected by other regulations of the Alabama Game, Fish, and Fur Bearing Animals Regulations. Regulation 220-2-.104 prohibits the commercial harvest of all but the 11 mussel species for which commercial harvest is legal. Regulation 220-2-.52 establishes mussel sanctuaries and prohibits the take, capture, kill, or attempt to take, capture, or kill of any freshwater mussel from Wheeler Lake from Guntersville Dam downstream to the mouth of Shoal Creek and from the upstream end or head of Hobbs Island downstream to Whitesburg Bridge, Pickwick Lake from Wilson Dam downstream to the upper end or head of Seven Mile Island, Wilson Lake from Wheeler Dam downstream to the mouth of Town Creek on the south bank and the mouth of Bluewater Creek on the north bank, and the Cahaba River.
- **GA** – Game Animal (managed hunting regulations).
- **GANOS** – Game Animal - No Open Season: Species designated a game animal by Regulation 220-2-.07, but for which there is no open season.
- **GB** – Game Bird (managed hunting regulations).
- **GF** – Game Fish (managed fishing regulations).
- **GF-HP** – Game Fish – Harvest Prohibited: Species designated a game fish by Regulation 220-2-.34, but harvest of the species in the state is prohibited.
- **CNGF** – Commercial or Non-Game Fish (managed fishing regulations).

Global and State Ranks

Each species is assigned two ranks; one representing its range-wide or global status (G Rank), and one representing its status in the state (S Rank). Species with a rank of 1 are most critically imperiled; those with a rank of 5 are most secure.

Global Ranks

- **G1** Critically Imperiled – At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
- **G2** Imperiled – At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
- **G3** Vulnerable – At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
- **G4** Apparently Secure – Uncommon but not rare; some cause for long-term concern due to declines or other factors.
- **G5** Secure – Common; widespread and abundant.
- **G#T#** Infraspecific Taxon (trinomial) – The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks.

State Ranks

- **S1** Critically Imperiled - Critically imperiled in Alabama because of extreme rarity (5 or fewer occurrences of very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from Alabama.
- **S2** Imperiled - Imperiled in state because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from Alabama.
- **S3** Vulnerable - Rare or uncommon in Alabama (on the order of 21 to 100 occurrences).
- **S4** Apparently Secure - Apparently secure in Alabama, with many occurrences.
- **S5** Secure - Demonstrably secure in Alabama; common, widespread, and abundant in the state
- **SX** Presumed Extirpated – Species or community is believed to be extirpated from Alabama. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
- **SH** Historical (Possibly Extirpated) – Species or community occurred historically in Alabama, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species could become SH without such a 20-40 year delay if the only known occurrences were destroyed or if it had been extensively and unsuccessfully looked for.
- **SNR** Unranked – State conservation status not yet assessed.

Appendix 1.6. Alabama Plants of Conservation Concern

Without a demonstrable connection to SGCN, at-risk plants are not eligible for SWG funds, but a conservation and management strategy is nevertheless needed and could be funded through other sources. The following is a list of Alabama's plants in greatest need of conservation attention, according to rankings assigned by the Alabama Natural Heritage Program and Natureserve.

Conifers and relatives (n = 3)

Scientific name	Common name	G Rank	S Rank
Juniperus communis	Ground Juniper	G5	S1
Pinus serotina	Pond Pine	G5	S1
Pinus clausa	Sand Pine	G4	S2

Ferns and relatives (n = 38)

Scientific name	Common name	G Rank	S Rank
Asplenium abscissum	Cutleaf Speenwort	G3G4	S1
Asplenium monanthes	Single-sorus Spleenwort	G4	S1
Asplenium ruta-muraria	Wall Rue Spleenwort	G5	S1
Asplenium scolopendrium var. *americanum*	American Hart's-tongue Fern	G4T3	S1
Asplenium tutwilerae	Scott's Spleenwort	G1	S1
Asplenium x ebenoides	Scott's Spleenwort	GNA	S1
Astrolepis x integerrima	Hybrid Cloak Fern	GNA	S1
Botrychium jenmanii	Alabama Grapefern	G3G4	S1
Diphasiastrum tristachyum	Deep-root Clubmoss	G5	S1
Dryopteris celsa	Log Fern	G4	S1
Huperzia porophila	Rock Clubmoss	G4	S1
Hymenophyllum tayloriae	Gorge Filmy Fern	G2	S1
Isoetes appalachiana	Appalachian Quillwort	G4	S1
Isoetes flaccida	Southern Quillwort	G3	S1
Isoetes hyemalis	Winter Quillwort	G2G3	S1
Isoetes louisianensis	Louisiana Quillwort	G2G3	S1
Isoetes melanopoda	Blackfoot Quillwort	G5	S1
Lycopodium obscurum	Tree Clubmoss	G5	S1
Lygodium palmatum	Climbing Fern	G4	S1
Osmunda claytoniana	Interrupted Fern	G5	S1
Pilularia americana	American Pillwort	G5	S1
Psilotum nudum	Whiskfern	G5	S1
Thelypteris burksiorum	Alabama Streak-sorus Fern	G4T1	S1

Scientific name	Common name	G Rank	S Rank
Lycopodiella cernua	Nodding Clubmoss	G5	S1S2
Selaginella ludoviciana	Gulf Spike-moss	G3G4	S1S2
Asplenium bradleyi	Bradley's Spleenwort	G4	S2
Cystopteris tennesseensis	Tennessee Bladderfern	G5	S2
Equisetum arvense	Field Horsetail	G5	S2
Huperzia lucidula	Shining Clubmoss	G5	S2
Isoetes butleri	Butler's Quillwort	G4	S2
Isoetes virginica	Piedmont Quillwort	G3	S2
Selaginella arenicola ssp. riddellii	Riddell's Spikemoss	G4T4	S2
Thelypteris quadrangularis	Hairy Maiden Fern	G3G5	S2
Trichomanes petersii	Dwarf Filmy-fern	G4G5	S2
Asplenium trichomanes	Maidenhair Spleenwort	G5	S2S3
Ophioglossum engelmannii	Limestone Adder's-tongue	G5	S2S3
Selaginella rupestris	Ledge Spike-moss	G5	S2S3
Thelypteris ovata	Ovate Marsh Fern	G3G5	S3

Flowering Plants (n = 455)

Scientific name	Common name	G Rank	S Rank
Aconitum uncinatum	Blue Monkshood	G4	S1
Actaea rubifolia	Appalachian Bugbane	G3	SH
Agalinis aphylla	Leafless False-foxglove	G3G4	S2
Agalinis auriculata	Auriculate False-foxglove	G3	S1
Agalinis divaricata	Pineland False-foxglove	G3?	S1
Agalinis filicaulis	Thin-stemmed False-foxglove	G3G4	S2
Agalinis gattingeri	Gattinger's False-foxglove	G4	SH
Agalinis heterophylla	Prairie False-foxglove	G4G5	S2
Agalinis linifolia	Flax-leaf False-foxglove	G4?	S2
Agalinis oligophylla	Ridge-stem False-foxglove	G4	S1
Agalinis pseudaphylla	Shinners' False-foxglove	G1G2Q	S1
Agastache nepetoides	Yellow Giant Hyssop	G5	S1
Agrimonia incisa	Incised Groovebur	G3	S2
Allium speculae	Little River Canyon Onion	G2	S2
Allium tricoccum	Wild Leek	G5	S1
Amorpha nitens	Indigo Bush	G3?	S1?
Amphianthus pusillus	Granite Pool Sprite	G2	S1
Amphicarpum muehlenbergianum	Blue Maiden-cane	G4	S1
Amsonia rigida	Stiff Blue-star	G4	S1
Andropogon arctatus	Pine-woods Bluestem	G3	S1
Andropogon gyrans var. stenophyllus	Beardgrass	G5T4	S1
Andropogon virginicus var. glaucus	Beardgrass	G5T4T5	S2

Scientific name	Common name	G Rank	S Rank
Apios priceana	Price's Potato-bean	G2	S2
Aplectrum hyemale	Puttyroot	G5	S2
Arabis georgiana	Georgia Rockcress	G1	S1
Arabis patens	Spreading Rockcress	G3	S1
Aralia racemosa	American Spikenard	G4G5	S1
Aristida simpliciflora	Southern Three-awned Grass	G3G4	S1
Aristida spiciformis	Pine Barren Three-awned Grass	G4	S1
Armoracia lacustris	Lake Cress	G4?	S1
Arnoglossum diversifolium	Variable-leaved Indian-plantain	G2	S1
Arnoglossum sulcatum	Indian-plantain	G3	S2S3
Asclepias cinerea	Carolina Milkweed	G4?	S1
Asclepias exaltata	Poke Milkweed	G5	S1
Asclepias rubra	Red Milkweed	G4G5	S1
Asclepias viridula	Southern Milkweed	G2	S1
Astragalus canadensis	Canadian Milkvetch	G5	S1
Astragalus obcordatus	Florida Milkvetch	G3G4	S1
Astragalus tennesseensis	Tennessee Milkvetch	G3	S1S2
Astragalus villosus	Hoary Milkvetch	G4	S2
Aureolaria patula	Spreading False-foxglove	G3	S1
Balduina atropurpurea	Purple Balduina	G2	SH
Baptisia australis	Blue Wild Indigo	G5	S1
Baptisia australis var. aberrans	Tall Blue Wild Indigo	G5T2	S1
Baptisia megacarpa	Apalachicola Wild Indigo	G2	S2
Berberis canadensis	American Barberry	G3	SH
Bidens cernua	Nodding Beggar-ticks	G5	S1
Bigelowia nuttallii	Nuttall's Rayless Goldenrod	G3G4	S3
Blephilia subnuda	Smooth Blephilia	G1G2	S1S2
Bolboschoenus fluviatilis	River Bulrush	G5	S1
Boykinia aconitifolia	Brook Saxifrage	G4	S1
Brickellia cordifolia	Flyr's Brickell-bush	G2G3	S2
Bulbostylis warei	Ware's Hairsedge	G3G4	SH
Calamovilfa arcuata	Cumberland Sandgrass	G2G3	S1
Callirhoe alcaeoides	Clustered Poppy-mallow	G5?	S2
Callirhoe triangulata	Clustered Poppy-mallow	G3	S1
Calopogon barbatus	Bearded Grass-pink	G4?	S1
Calopogon multiflorus	Many-flowered Grass-pink	G2G3	S1
Calopogon oklahomensis	Oklahoma Grass-pink	G3	S1
Canna flaccida	Bandana-of-the-everglades	G4?	S1
Carex austrocaroliniana	Tarheel Sedge	G4	S2?
Carex baltzellii	Baltzell's Sedge	G3	S1
Carex barrattii	Barratt's Sedge	G4	S1?
Carex brysonii	Bryson's Sedge	G1	S1

Scientific name	Common name	G Rank	S Rank
Carex decomposita	Cypress-knee Sedge	G3G4	S1
Carex eburnea	Ebony Sedge	G5	S2
Carex exilis	Coast Sedge	G5	S1
Carex fissa var. aristata	Hammock Sedge	G4?T4?	S1
Carex godfreyi	Godfrey's Sedge	G3G4	S1
Carex impressinervia	Impressed-nerved Sedge	G2	S1
Carex purpurifera	Purple Sedge	G4?	S2
Carex socialis	Social Sedge	G4	S1?
Carex striata	Walter's Sedge	G4G5	S1
Castanea pumila var. ozarkensis	Ozark Chinquapin	G5T3	SH
Castilleja coccinea	Scarlet Indian Paintbrush	G5	S1
Castilleja kraliana	Cahaba Paintbrush	G2	S2
Celastrus scandens	Climbing Bittersweet	G5	S2
Chamaecrista deeringiana	Florida Senna	G2G4Q	S1
Chasmanthium nitidum	Shiny Spikegrass	G3G4	S1
Chelone lyonii	Pink Turtlehead	G4	S1
Chelone obliqua var. obliqua	Red Turtlehead	G4T3T4Q	S1
Chrysopsis godfreyi	Godfrey's Golden-aster	G2	S1
Chrysopsis gossypina ssp. cruiseana	Cruise's Golden-aster	G5T2	S1
Chrysosplenium americanum	American Golden-saxifrage	G5	SH
Cirsium lecontei	Le Conte's Thistle	G2G3	S1
Cirsium muticum	Swamp Thistle	G5	S1
Cirsium nuttallii	Nuttall's Thistle	G5	S1
Cladium mariscoides	Twig Rush	G5	S1
Claytonia caroliniana	Carolina Spring Beauty	G5	S1
Clematis morefieldii	Morefield's Leather-flower	G2	S2
Clematis socialis	Alabama Leather-flower	G1	S1
Clethra acuminata	Mountain Pepper-bush	G4	S1
Coelorachis tuberculosa	Florida Jointgrass	G3	S1
Collinsia verna	Spring Blue-eyed Mary	G5	S1
Comandra umbellata	Bastard Toad-flax	G5	S1
Corallorhiza wisteriana	Spring Coralroot	G5	S2
Coreopsis gladiata	Southeastern Tickseed	G4G5	S2
Coreopsis grandiflora var. inclinata	Tickseed	G5T2	S2
Coreopsis nudata	Georgia Tickseed	G3?	S1
Coreopsis pulchra	Woodland Tickseed	G2	S2
Cotinus obovatus	American Smoke-tree	G4	S2
Crataegus aemula	Rome Hawthorn	G2G3	S1
Crataegus ashei	Ash's Hawthorn	G1	S1
Crataegus triflora	Three-flowered Hawthorn	G2G3	S2
Croomia pauciflora	Croomia	G3	S2
Croton alabamensis var. alabamensis	Alabama Croton	G3T3	S3

Scientific name	Common name	G Rank	S Rank
Croton elliottii	Elliott's Croton	G2G3	S1
Cuscuta harperi	Harper's Dodder	G2G3	S2
Cyperus granitophilus	Granite-loving Flatsedge	G3G4Q	S2
Cypripedium candidum	Small White Lady's-slipper	G4	S1
Cypripedium kentuckiense	Southern Lady's-slipper	G3	S1
Dalea cahaba	Cahaba Prairie Clover	G2	S2
Dalea foliosa	Leafy Prairie Clover	G2G3	S1
Dalea gattingeri	Gattinger's Prairie Clover	G3G4	S3
Delphinium alabamicum	Alabama Larkspur	G2	S2
Delphinium carolinianum ssp. calciphilum	Prairie Larkspur	G5T2T4	S1
Desmodium ochroleucum	Creamflower Tick-trefoil	G1G2	S1S2
Diarrhena americana	American Beakgrain	G4G5	S2
Dicentra cucullaria	Dutchman's Breeches	G5	S2
Dicerandra linearifolia	Large-flowered Pennyroyal	G4G5	S2
Diervilla rivularis	Mountain Bush-honeysuckle	G3	S2
Dodecatheon frenchii	French's Shooting Star	G3	S1
Draba cuneifolia	Wedge-leaf Whitlow-grass	G5	S1
Drosera rotundifolia	Round-leaved Sundew	G5	S1
Dyschoriste oblongifolia	Oblong-leaved Dyschoriste	G4G5	S1
Echinacea pallida	Pale-purple Coneflower	G4	S2
Echinodorus parvulus	Dwarf Burhead	G3Q	S1
Eleocharis melanocarpa	Black-fruited Spike-rush	G4	S1
Eleocharis olivacea	Capitate Spikerush	G5	S1
Eleocharis robbinsii	Robbins' Spikerush	G4G5	S1
Eleocharis rostellata	Beaked Spikerush	G5	S1
Eleocharis wolfii	Wolf's Spikerush	G3G5	S1
Elodea canadensis	Broad Waterweed	G5	S1
Elymus churchii	Church's Wildrye	G2G3	S1
Enemion biternatum	False Rue-anemone	G5	S2
Epidendrum magnoliae	Green-fly Orchid	G4	S2
Epilobium coloratum	Purple-leaf Willow-herb	G5	S1
Erigeron strigosus var. dolomiticola	Cahaba Daisy Fleabane	G5T2?	S2?
Eriocaulon lineare	Narrow Pipewort	G4	S2
Eriocaulon texense	Texas Pipewort	G4	S2
Eriogonum longifolium var. harperi	Harper's Umbrella Plant	G4T2	S1
Erythronium albidum	White Trout Lily	G5	S1S2
Euphorbia discoidalis	Euphorbia	G3?Q	S2?
Euphorbia inundata	Florida Pine Spurge	G4G5	S1
Eurybia chapmanii	Chapman Aster	G2G3	SH
Eurybia eryngiifolia	Coyote-thistle Aster	G3G4	S2
Eurybia spectabilis	Showy Aster	G5	S2
Eurybia surculosa	Creeping Aster	G4G5	S1

Scientific name	Common name	G Rank	S Rank
Eustachys floridana	Two-spike Finger Grass	G2?	S1
Evolvulus sericeus var. sericeus	Creeping Morning-glory	G5T3T5	S1
Fimbristylis brevivaginata	Glade Fimbristylis	G2	S1
Fothergilla gardenii	Dwarf Witch-alder	G3G4	S1
Fothergilla major	Mountain Witch-alder	G3	S2
Frasera caroliniensis	Carolina Gentian	G5	S2
Galactia floridana	Florida Milk Pea	G3G4	SH
Galium lanceolatum	Torrey's Wild Licorice	G5	S1
Geum laciniatum	Rough Avens	G5	S1
Geum virginianum	Pale Avens	G5	S2
Gordonia lasianthus	Loblolly Bay	G5	S1
Habenaria quinqueseta var. quinqueseta	Michaux Orchid	G4G5T4?	S1
Hamamelis ovalis	Mississippi Witch Hazel	G1	S1
Hedeoma drummondii	Drummond's Pennyroyal	G5	S2
Helenium brevifolium	Little Leaf Sneezeweed	G4	S1
Helenium vernale	Spring Sneezeweed	G4?	S2
Helianthemum arenicola	Coastal-sand Frostweed	G3	S1
Helianthus eggertii	Eggert's Sunflower	G3	S1
Helianthus glaucophyllus	White-leaved Sunflower	G3G4	SH
Helianthus longifolius	Longleaf Sunflower	G3	S1S2
Helianthus porteri	Confederate Daisy	G4	S2
Helianthus smithii	Smith's Sunflower	G2Q	S2
Helianthus verticillatus	Whorled Sunflower	G1Q	S1
Heuchera longiflora	Long-flower Alumroot	G4	S1
Hexastylis shuttleworthii var. harperi	Harper's Wild Ginger	G4T3	S2
Hexastylis speciosa	Harper's Heartleaf	G2	S2
Hibiscus coccineus	Brilliant Hibiscus	G4?	S1
Hottonia inflata	Featherfoil	G4	S2
Hydrastis canadensis	Golden Seal	G3G4	S2
Hydrophyllum appendiculatum	Appendage Waterleaf	G5	S2?
Hymenocallis coronaria	Shoals Spider-lily	G2Q	S2
Hypericum dolabriforme	Straggling St. John's-wort	G4	SH
Hypericum harperi	Sharp-lobe St. John's-wort	G3G4	S1
Hypericum lloydii	Lloyd St. John's-wort	G4?	S1
Hypericum nitidum	Carolina St. John's-wort	G4	S2
Hypericum nudiflorum	Pretty St. John's-wort	G5	S2
Hypericum reductum	Atlantic St. John's-wort	G5	S2
Ilex amelanchier	Serviceberry Holly	G4	S2
Isotria verticillata	Large Whorled Pogonia	G5	S2
Iva microcephala	Small-headed Marsh-elder	G5	S1
Jamesianthus alabamensis	Jamesianthus	G3	S3
Jeffersonia diphylla	Twinleaf	G5	S2

Scientific name	Common name	G Rank	S Rank
Juglans cinerea	Butternut	G4	S1
Juncus georgianus	Georgia Rush	G4	S1
Juncus gymnocarpus	Naked-fruited Rush	G4	S2
Juncus interior	Inland Rush	G4	S1
Juncus interior var. interior	Inland Rush	G4T4Q	SH
Juncus nodatus	Stout Rush	G5	S1
Kalmia hirsuta	Hairy Laurel	G5	S2
Kosteletzkya smilacifolia	Southern Sea-shore Mallow	G1G3Q	S1?
Lachnocaulon digynum	Pineland Bogbutton	G3	S2
Lachnocaulon engleri	Engler's Bogbutton	G3	S1?
Lachnocaulon minus	Small's Bog-button	G3G4	S1?
Lathyrus venosus	Smooth Veiny Peavine	G5	S1
Leavenworthia alabamica	Alabama Glade-cress	G2	S2
Leavenworthia crassa	Fleshy-fruit Glade Cress	G2	S2
Leavenworthia exigua var. lutea	Pasture Glade-cress	G4T1	S1
Leavenworthia torulosa	Necklace Glade Cress	G4	SX
Leavenworthia uniflora	Michaux Leavenworthia	G4	S2
Leptopus phyllanthoides	Maidenbush	G4	S2S3
Lepuropetalon spathulatum	Southern Lepuropetalon	G4G5	S1
Lesquerella densipila	Duck River Bladderpod	G3	S1
Lesquerella lyrata	Lyrate Bladderpod	G1	S1
Liatris chapmanii	Chapman's Gay-feather	G5	S1
Liatris cylindracea	Slender Blazing-star	G5	S2
Liatris oligocephala	Cahaba Torch	G1	S1
Lilaeopsis carolinensis	Carolina Lilaeopsis	G3G5	S1
Lilium canadense	Canada Lily	G5	S2
Lilium iridollae	Panhandle Lily	G2	S1
Lilium michiganense	Michigan Lily	G5	S1
Lilium superbum	Turk's-cap Lily	G5	S2
Lindera melissifolia	Pondberry	G2G3	S1
Lindera subcoriacea	Bog Spicebush	G2G3	S1
Linum macrocarpum	Flax	G2	S1
Linum sulcatum var. harperi	Harper's Grooved-yellow Flax	G5T2	S1
Liparis liliifolia	Lily-leaved Twayblade	G5	S1
Liparis loeselii	Loesel's Twayblade	G5	S1?
Lobelia boykinii	Boykin's Lobelia	G2G3	S1S2
Ludwigia arcuata	Pond Seedbox	G4G5	S1
Ludwigia spathulata	Spathulate Seedbox	G2	S1S2
Luziola bahiensis	Brazilian Luziola	G4G5	S1
Lycium carolinianum	Christmas Berry	G4	S1S2
Lysimachia fraseri	Fraser's Loosestrife	G3	S1
Lysimachia graminea	Grass-leaf Loosestrife	G1Q	S1

Scientific name	Common name	G Rank	S Rank
Macranthera flammea	Flame Flower	G3	S2
Magnolia fraseri	Fraser's Magnolia	G5	S1
Marshallia mohrii	Mohr's Barbara's Buttons	G3	S3
Matelea alabamensis	Alabama Anglepod	G2	S1
Matelea baldwyniana	Baldwin's Milkvine	G3	S1
Melanthium latifolium	Broadleaf Bunchflower	G5	S1
Melanthium parviflorum	Small-flowered False Hellebore	G4?	S1S2
Melanthium woodii	Wood's False Hellebore	G5	S1
Melica nitens	Three-flower Melic Grass	G5	S1
Mikania cordifolia	Florida Keys Hempweed	G5	S1
Minuartia godfreyi	Godfrey's Sandwort	G1	SH
Mirabilis albida	Pale Umbrella-wort	G5	S2
Mitella diphylla	Miterwort	G5	S1
Mitreola angustifolia	Narrow-leaf Miterwort	G4G5	S1
Monarda clinopodia	Basil Bee-balm	G5	S2
Monotropsis odorata var. odorata	Sweet Pinesap	G3TNR	S1
Muhlenbergia sobolifera	Cliff Muhly	G5	S1
Myriophyllum laxum	Loose Water-milfoil	G3	S2
Najas gracillima	Thread-like Naiad	G5?	S1
Nemastylis geminiflora	Prairie Pleatleaf	G4	S1
Nestronia umbellula	Nestronia	G4	S2
Neviusia alabamensis	Alabama Snow-wreath	G2	S2
Nuphar lutea ssp. ulvacea	West Florida Cowlily	G5T2	S1
Oenothera heterophylla	Vari-leaf Evening-primrose	G4	SH
Onosmodium decipiens	Alabama Marbleseed	G2	S2
Onosmodium molle ssp. molle	Soft False Gromwell	G4G5T3	S2
Orbexilum lupinellum	Lupine Scurfpea	G3G4	S1?
Orbexilum simplex	Single-stemmed Scurf-pea	G4G5	SH
Orobanche uniflora	One-flowered Broomrape	G5	S2
Oxalis grandis	Giant Wood-sorrel	G4G5	S1
Pachysandra procumbens	Allegheny-spurge	G4G5	S2S3
Panicum lithophilum	Swallen's Panic-grass	G2G3Q	S1
Panicum nudicaule	Naked-stemmed Panic Grass	G3Q	S2
Parnassia asarifolia	Kidneyleaf Grass-of-parnassus	G4	S2
Parnassia grandifolia	Large-leaved Grass-of-parnassus	G3	S1
Paronychia herniarioides	Coastal-plain Nailwort	G2G4	S1
Paronychia rugelii	Rugel's Nailwort	G2?	S1
Paronychia virginica	Yellow Nail-wort	G4	S2
Pediomelum subacaule	Nashville Breadroot	G4	S2
Peltandra sagittifolia	Spoon-flower	G3G4	S2
Penstemon multiflorus	Many-flower Beardtongue	G4	S1
Penstemon smallii	Small's Beardtongue	G3	S1

Scientific name	Common name	G Rank	S Rank
Phacelia dubia var. georgiana	Outcrop Small-flower Phacelia	G5T3	S2
Phacelia strictiflora var. robbinsii	Prairie Scorpion-weed	G5T4	S1
Phemeranthus calcaricus	Limestone Fame-flower	G3	S2
Phemeranthus parviflorus	Small-flowered Flame-flower	G5	S1
Phlox pulchra	Wherry's Phlox	G2	S2
Phoebanthus tenuifolius	Pineland False Sunflower	G3	SH
Physalis carpenteri	Carpenter's Ground-cherry	G3	S1
Physostegia leptophylla	Slenderleaf False Dragonhead	G4?	SH
Pieris phillyreifolia	Climbing Fetter-bush	G3	S2
Pinguicula planifolia	Chapman's Butterwort	G3?	S1S2
Pinguicula pumila	Small Butterwort	G4	S1?
Pityopsis oligantha	Coastal-plain Golden-aster	G2G4	S1
Pityopsis pinifolia	Golden Aster	G4	S1
Plantago cordata	Heart-leaved Plantain	G4	S2
Platanthera blephariglottis var. conspicua	Large White Fringed Orchid	G4G5T3T4	S1S2
Platanthera integra	Yellow Fringeless Orchid	G3G4	S2
Platanthera integrilabia	White Fringeless Orchid	G2G3	S2
Platanthera lacera	Green-fringed Orchid	G5	S2
Platanthera nivea	Snowy Orchis	G5	S2
Platanthera peramoena	Purple Fringeless Orchid	G5	S1
Pleea tenuifolia	Rush False-asphodel	G4	S1S2
Polanisia tenuifolia	Slenderleaf Clammy-weed	G5	S1
Polygala balduinii	White Milkwort	G4	S1?
Polygala crenata	Crenate Milkwort	G4?	S1
Polygala hookeri	Hooker Milkwort	G3	S1S2
Polygala senega var. latifolia	Seneca Snakeroot	G4G5TNR	S1
Polygonella americana	Southern Jointweed	G5	S1
Polygonella macrophylla	Large-leaved Jointweed	G3	S1
Polymnia laevigata	Tennessee Leafcup	G3	S2S3
Prenanthes barbata	Barbed Rattlesnake-root	G3	S1S2
Prosartes maculata	Spotted Mandarin	G3G4	S1
Pteroglossaspis ecristata	Crestless Eulophia	G2G3	S1
Ptilimnium costatum	Eastern Bishop-weed	G4	S1
Ptilimnium nodosum	Harperella	G2	S1
Pycnanthemum curvipes	A Mountain-mint	G3	S1?
Pycnanthemum virginianum	Virginia Mountain Mint	G5	S1
Pyrularia pubera	Buffalo-nut	G5	S2
Quercus arkansana	Arkansas Oak	G3	S2
Quercus boyntonii	Boynton's Sand Post Oak	G1	S1
Quercus georgiana	Georgia Oak	G3	S2
Quercus macrocarpa	Bur Oak	G5	S2
Quercus minima	Dwarf Live Oak	G5	S2

Scientific name	Common name	G Rank	S Rank
Quercus oglethorpensis	Oglethorpe's Oak	G3	S1
Quercus similis	Bottomland-post Oak	G4	S1
Ranunculus flabellaris	Yellow Water-crowfoot	G5	S1
Rhamnus lanceolata	Lance-leaved Buckthorn	G5	S2
Rhexia aristosa	Awned Meadowbeauty	G3G4	S1
Rhexia parviflora	Small-flowered Meadowbeauty	G2	S1
Rhexia salicifolia	Panhandle Meadowbeauty	G2	S1
Rhododendron austrinum	Orange Azalea	G3	S2S3
Rhododendron cumberlandense	Cumberland Azalea	G4?	S2
Rhododendron minus	Carolina Rhododendron	G4	S2
Rhododendron prunifolium	Plumleaf Azalea	G3	S2S3
Rhynchospora capillacea	Horned Beakrush	G4	S1
Rhynchospora crinipes	Hairy-peduncled Beakrush	G2	S1
Rhynchospora fernaldii	Fernald's Beak Rush	G3G4	S1?
Rhynchospora harperi	Harper's Beakrush	G4?	S1
Rhynchospora macra	Southern White Beak Rush	G3	S1
Rhynchospora pleiantha	Brown Beakrush	G2G3	S1
Rhynchospora saxicola	Stone Mountain Beakrush	G3Q	S1
Rhynchospora stenophylla	Chapman Beakrush	G4	S2
Rhynchospora thornei	Thorne's Beakrush	G3	S1
Rhynchospora tracyi	Tracy's Beak Rush	G4	S1
Ribes curvatum	Granite Gooseberry	G4	S2
Ribes cynosbati	Prickly Gooseberry	G5	S1S2
Rubus allegheniensis	Allegheny Blackberry	G5	S1
Rudbeckia auriculata	Eared Coneflower	G2	S2
Rudbeckia heliopsidis	Sun-facing Coneflower	G2	S2
Rudbeckia mollis	Soft-hair Coneflower	G3G5	S1
Rudbeckia triloba var. pinnatiloba	Pinnate-lobed Black-eyed Susan	G5T3	S2S3
Ruellia noctiflora	Night-flowering Wild-petunia	G2	S1
Sabatia brevifolia	Short-leaved Pink	G3G4	S1
Sabatia capitata	Rose Gentian	G2	S2
Sabatia grandiflora	Large-flowered Pink	G3G4	S1?
Sabatia quadrangula	Four-angled Pink	G4G5	SH
Sageretia minutiflora	Tiny-leaved Buckthorn	G4	S1
Sagittaria isoetiformis	Slender Arrow-head	G4?	S2
Sagittaria secundifolia	Little River Arrow-head	G1	S1
Salix floridana	Florida Willow	G2	S1
Salix humilis	Tall Prairie Willow	G5	S2S3
Sarracenia leucophylla	Whitetop Pitcher-plant	G3	S3
Sarracenia oreophila	Green Pitcher Plant	G2	S2
Sarracenia rubra ssp. alabamensis	Alabama Canebrake Pitcher-plant	G4T1T2	S1S2
Sarracenia rubra ssp. wherryi	Wherry's Sweet Pitcher-plant	G4T3	S3

Scientific name	Common name	G Rank	S Rank
Schisandra glabra	Bay Starvine	G3	S2
Schizachyrium maritimum	Gulf Bluestem	G3G4Q	S1
Schizachyrium scoparium ssp. divergens	Eastern Little Bluestem	G5T5	SH
Schoenolirion croceum	Yellow Sunnybell	G4	S2
Schoenolirion wrightii	Texas Sunnybell	G3	S1
Schoenoplectus subterminalis	Water Bulrush	G4G5	S1
Schwalbea americana	Chaffseed	G2G3	S1
Scutellaria alabamensis	Alabama Skullcap	G2	S2
Scutellaria glabriuscula	Glabrous Skullcap	G2?	S1
Scutellaria saxatilis	Rock Skullcap	G3	S1
Sedum nevii	Nevius' Stonecrop	G3	S3
Sideroxylon reclinatum	Buckthorn	G4G5	S1?
Sideroxylon thornei	Swamp Buckthorn	G2	S1
Silene caroliniana ssp. wherryi	Wherry's Catchfly	G5T2T4Q	S2
Silene ovata	Ovate Catchfly	G3	S2
Silene regia	Royal Catchfly	G3	S2?
Silene rotundifolia	Roundleaf Catchfly	G4	S1S2
Silphium brachiatum	Cumberland Rosinweed	G2G3	S2
Silphium glutinosum	Sticky Rosinweed	G2	S2
Silphium mohrii	Mohr's Rosinweed	G3?Q	S1
Silphium perplexum	Old Cahaba Rosinweed	G1	S1
Silphium pinnatifidum	Prairie-dock	G3Q	S1
Sium floridanum	Florida Water-parsnip	G1Q	S1
Solanum carolinense var. hirsutum	Horse-nettle	G5T1	S1
Solidago arenicola	Southern Racemose Goldenrod	G2G3	S1
Spigelia gentianoides var. alabamensis	Gentian Pinkroot	G1T1	S1
Spigelia gentianoides var. gentianoides	Gentian Pinkroot	G1T1	S1
Spiranthes brevilabris	Texas Ladies'-tresses	G1G2T1	SH
Spiranthes floridana	Florida Ladies'-tresses	G1G2T1	SH
Spiranthes longilabris	Giant Spiral Ladies'-tresses	G3	S1
Spiranthes lucida	Shining Ladies'-tresses	G5	S1
Sporobolus curtissii	Pineland Dropseed	G3	S1
Sporobolus teretifolius	Wire-leaved Dropseed	G2	S1
Stachys eplingii	Epling's Hedgenettle	G5	S1
Stellaria corei	Chickweed	G4	S1
Stellaria fontinalis	Water Stitchwort	G3	S1
Stewartia malacodendron	Silky Camellia	G4	S2S3
Stewartia ovata	Mountain Camellia	G4	S2S3
Stillingia aquatica	Water Toothleaf	G4G5	S1
Stylisma aquatica	Water Southern Morning-glory	G4	S1
Stylisma pickeringii var. pickeringii	Pickering's Morning-glory	G4T3	S1
Stylophorum diphyllum	Celandine Poppy	G5	S1

Scientific name	Common name	G Rank	S Rank
Symphyotrichum drummondii var. texanum	Texas Aster	G5T3T4	S1?
Symphyotrichum georgianum	Georgia Aster	G3	S3
Symphyotrichum kralii	Pale-violet Aster	GNR	SH
Symphyotrichum oolentangiense var. oolentangiense	Sky Blue Aster	G5T5	S1
Symphyotrichum pratense	Barrens Silky Aster	G4?	S1
Synandra hispidula	Guyandotte Beauty	G4	S1
Talinum teretifolium	Quill Fame-flower	G4	S1
Tephrosia mohrii	Pineland Hoary-pea	G3	S1S2
Thalia dealbata	Powdery Thalia	G4	S1
Thalictrum debile	Southern Meadowrue	G2	S2
Thalictrum mirabile	Little Mountain Meadowrue	G4?Q	S2
Thelesperma filifolium	Stiff Greenthread	G4G5	S1
Thermopsis mollis	Soft-haired Thermopsis	G3G4	S1
Tradescantia ernestiana	Ernest's Spiderwort	G3G4Q	S1
Tridens carolinianus	Carolina Fluff Grass	G3G4	S1
Trillium flexipes	Nodding Trillium	G5	S2S3
Trillium grandiflorum	Large-flowered Trillium	G5	S1
Trillium lancifolium	Narrow-leaved Trillium	G3	S2S3
Trillium pusillum var. 1	Alabama Least Trillium	G3T2Q	S2
Trillium recurvatum	Prairie Trillium	G5	S2
Trillium reliquum	Relict Trillium	G3	S2
Trillium rugelii	Southern Nodding Trillium	G3	S2?
Trillium sessile	Toadshade	G4G5	S2
Trillium sulcatum	Southern Red Trillium	G4	S1
Trillium vaseyi	Vasey's Trillium	G4	S1?
Triosteum angustifolium	Yellowleaf Tinker's-weed	G5	S1
Utricularia floridana	Florida Bladderwort	G3G5	S1S2
Utricularia inflata	Swollen Bladderwort	G5	S1S2
Utricularia olivacea	Dwarf Bladderwort	G4	S1
Utricularia resupinata	Northeastern Bladderwort	G4	S1S2
Uvularia floridana	Florida Bellwort	G3	S1
Valeriana pauciflora	Valerian	G4	S1
Verbesina walteri	Carolina Crownbeard	G4	S1
Veronicastrum virginicum	Culver's Root	G4	S1
Viburnum bracteatum	Limerock Arrowwood	G1G2	S1
Viburnum obovatum	Small-leaf Viburnum	G5	S1
Viburnum rafinesquianum	Downy Arrowwood	G5	SNR
Viola canadensis	Canada Violet	G5	S2
Viola egglestonii	Eggleston's Violet	G4	S1
Vitis mustangensis	Mustang Grape	G4?	S1
Vitis rotundifolia var. munsoniana	Munson Grape	G5T4?	S1

Scientific name	Common name	G Rank	S Rank
Waldsteinia lobata	Piedmont Barren Strawberry	G2G3	S1
Warea sessilifolia	Sessile-leaved Warea	G2G4	S1
Xerophyllum asphodeloides	Turkeybeard	G4	S1
Xyris chapmanii	Chapman's Yellow-eyed Grass	G3	S1
Xyris drummondii	Drummond's Yellow-eyed Grass	G3	S3
Xyris isoetifolia	Quillwort Yellow-eyed Grass	G1	SH
Xyris longisepala	Kral's Yellow-eyed Grass	G2G3	S1
Xyris scabrifolia	Harper's Yellow-eyed Grass	G3	S1S2
Xyris serotina	Acid-swamp Yellow-eyed-grass	G3G4	S1
Xyris spathifolia	a Yellow-eyed Grass	G1	S1
Xyris tennesseensis	Tennessee Yellow-eyed Grass	G2	S1
Zanthoxylum americanum	Northern Prickley Ash	G5	S1
Zephyranthes atamasca var. treatiae	Easter Lily	G4G5T4	S1?
Zigadenus leimanthoides	Crow-poison	G4Q	S1

Appendix 3.1. Wildlife TRACs Action Drivers

Resource threats from Conservation Measures Partnership
Levels 1-3 labels used to indicate hierarchy in TRACS, not meant to be the same as CMP threat labels
Data entry recommended for all three levels

Level 1	Level 2	Level 3	Description/Examples/Notes
Resource Threats			Need to respond to threats to fish and wildlife species and their habitats
	Fish and wildlife habitat loss or degradation		Threats of development and degradation of fish and wildlife habitats from human settlements or other non-energy or non-agricultural land uses
		Residential development	Human cities, towns and settlements including non-housing development typically integrated with housing
		Non-energy commercial development and operations	Industrial and other non-energy commercial development and operations
		Transportation corridors	Non-energy transportation corridors and the vehicles that use them
		Tourism and recreation activities	Pressures from tourism and recreational activities (e.g., recreation areas, off-road vehicles, spelunking)
	Agriculture and aquaculture side effects		Threats from farming and ranching as a result of agricultural expansion and intensification, including silviculture, mariculture and aquaculture
		Silviculture, logging and wood harvesting	Growing and harvesting trees and other woody vegetation for timber, fiber or fuel
		Annual and perennial non-timber crops	Crops planted for food, fodder, fiber, fuel or other uses
		Livestock farming and ranching	Domestic terrestrial animals raised in one location on farmed or non-local resources (farming); also domestic or semi-domesticated animals allowed to roam in the wild and supported by natural habitats (ranching)
		Marine and freshwater aquaculture	Aquatic animals raised in one location on farmed or non-local resources; also hatchery fish allowed to roam in the wild

Level 1	Level 2	Level 3	Description/Examples/Notes
	Energy development and distribution		Threats from exploring for, developing, producing and distributing energy resources
		Oil drilling	Drilling and distribution of petroleum and other liquid hydrocarbons
		Natural gas extraction	Hydrofracturing and other natural gas extraction and distribution processes
		Mining and quarrying	Removal and distribution of minerals and rocks, limited to energy production
		Wind power	Generating and distributing power from the wind
		Solar power	Generating and distributing power from the sun
		Hydropower	Generating and distributing power from moving water
	Overharvesting of biological resources		Threats from overharvesting biological resources for commercial, recreation, subsistence, research or cultural purposes; including both deliberate and unintentional harvesting beyond sustainable levels
		Hunting and collecting terrestrial animals	Overharvesting terrestrial wild animals or animal products; includes accidental mortality/bycatch
		Gathering terrestrial plants	Overharvesting plants, fungi, and other non-timber/non-animal products
		Fishing and harvesting aquatic resources	Overharvesting aquatic wild animals or plants; includes accidental mortality/bycatch
	Invasive and other problematic species and genes		Threats from non-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance
		Invasive non-native/alien species	Harmful plants, animals, pathogens and other microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities

Level 1	Level 2	Level 3	Description/Examples/Notes
		Problematic native species	Harmful plants, animals, or pathogens and other microbes that are originally found within the ecosystem(s) in question, but have become out-of-balance or released directly or indirectly due to human activities
		Introduced genetic material	Human altered or transported organisms or genes
	Climate change and severe weather		Threats from long-term climatic changes or other severe weather/geological events that or potentially could eliminate a vulnerable species or habitat
		Habitat shifting and alteration	Major changes in habitat composition and location
		Droughts	Periods in which rainfall falls below the normal range of variation
		Temperature extremes	Periods in which temperatures exceed or go below the normal range of variation
		Storms and flooding	Extreme precipitation and/or wind events
		Catostrophic geological events	Threats from catastrophic geological events like volcanoes, earthquakes, tsunamis, avalanches or landslides
Resource Management Needs			Need for information on fish and wildlife resources for management decision-making
	Resource information collection needs		Need to collect information on fish and wildlife resources
		Need for initial baseline inventory	
		Need to update existing information	e.g., annual survey, periodic stock assessment
		Need to answer research question	
		Need to develop new technique	
	Management decision needs		Need to use fish and wildlife information for management
		Need to provide technical assistance	
		Need to conduct environmental reviews	

Level 1	Level 2	Level 3	Description/Examples/Notes
		Need for fish, wildlife and/or habitat planning	
Recreation Needs			Need to provide for the public use and benefit from fish and wildlife resources
	Training needs		Need to provide and/or enhance training and safety/ethics for outdoor recreation
		Need for more and/or improved training in outdoor recreational methods	
		Need to improve safety/ethics in outdoor recreation	
	Public access needs		Need to provide and/or enhance public access for recreational opportunities
		Need for more public access to areas or facilities for outdoor recreation	
		Need to maintain or improve quality of areas or facilities for outdoor recreation	
	Utilization needs		Need to manage the utlilization of outdoor recreational resources
		Need more information on how fish and wildlife resources are utilized	
		Need more information on how outdoor recreation areas and facilities are utilized	

Level 1	Level 2	Level 3	Description/Examples/Notes
		Need to provide information on locations of fish and wildlife resources and public access areas and facilities	
		Need to maintain or increase recruitment and/or retention of outdoor recreationalists	
		Need to maintain or increase supply of fish to support fishing	
Education/ Outreach Needs			Need to develop an informed citizenry on fish and wildlife issues
	Education needs		Need to increase knowledge or understanding and encourage practices in support of fish and wildlife conservation
		Need for improved knowledge of fish and wildlife and their habitats	
		Need to provide aquatic resources and wildlife education facilities	
		Need for improved knowledge of WSFR grant programs and their accomplishments	
	Outreach needs		Need to communicate information to encourage understanding of and involvement by, or enable various publics to make informed decisions
		Need to develop and/or maintain a broad base of	

Level 1	Level 2	Level 3	Description/Examples/Notes
		support for agency goals and objectives	
		Need to maintain and/or increase constituient base	
Administrative Needs			Need to provide the tools for a fish and wildlife agency to support its agency functions
	Infrastructure needs		Need to maintain or improve fish and wildlife agency infrastructure
		Need to maintain or improve fish and wildlife agency administrative facilities	
		Need to maintain or improve information management systems	
	Organizational/ program planning needs		Need to conduct fish and wildlife agency organizational and program planning
		Need for agency organizational planning to meet goals and objectives	
		Need for WSFR program/subprogram planning to meet goals and objectives	
	Coordination/administration needs		Need for fish and wildlife agency administrative support and program coordination
		Need for agency administrative support for effective operations	
		Need for coordination for effective program/project management	

Appendix 4.1. Wildlife TRACS Project Action Levels with Indicators

Project Level Catagories	Action Level 1 Category	Action Level 2 Strategy	Action Level 3 Activity	Level 2 and 3 Output Measures Units	Description/Examples/Notes
Administration and/or Conservation / Management and/or Recreation	Coordination and Administration	Coordination and Administration		Number	Coordination and administration necessary for effective agency operations and program/project management
			Agency administrative support	Number	Administration necessary for effective agency operations (e.g., acquisition of goods and services, human resources tasks)
			Program/project administrative support	Number	Administration necessary for effective program/project management (e.g., staff support and training, monitoring progress of grant proposal and reporting processes)
		Incentives	Incentives	Number	Development and delivery of economic incentives to private landowners to influence responsible stewardship of land/water and specific species
	Direct Management of Natural Resources				
		Create new habitat or natural processes		Acres	Creation of new habitat or natural processes for the benefit of fish and wildlife and recreational users
			Habitat conversion	Acres	Conversion of one type of habitat into another (e.g., creating bottomland forest from agricultural land, wetland creation) Note: Forest and wetland would be the appropriate broad habitat types to code for these two examples

			Public fishing lake construction	Acres	Construction of new public fishing lakes
			Waterfowl impoundment creation	Acres	Creation of shallow water impoundments for the primary benefit of waterfowl
		Dam and barrier removal		Structures	Removal of barriers to maintain aquatic species populations and restore ecological functions in streams (e.g., dam or dike removal, notching of dams)
			Culvert work	Structures	Replacement or repair of road culverts (e.g., installing larger culvert, eliminating perching)
			Dam notching	Structures	Removal of portions of dams for increased flow
			Dam removal	Structures	Removal of entire dams
			Road crossing removal	Structures	Removal of in-stream road crossings
			Obstruction removal	Structures	Removal of other obstructions (e.g., beaver dams)
		Fire management		Acres	Use of fire to benefit fish and wildlife and their habitats
			Firebreak	Acres	Creation or maintenance of a strip of cleared or plowed land used to stop the spread of a fire
			Fuel reduction	Acres	Application of treatments to reduce the risk of high-severity wildfires and to manage changes in the ecological functions of forests (e.g., mechanical thinning)
			Prescribed burning	Acres	Application of fire in a knowledgeable manner to forest fuels on a specific land under selected weather conditions to accomplish predetermined, well-defined management objectives (e.g., burning an established native grass community to reduce or eliminate invading brush or exotic species)

		Fish and wildlife habitat structures		Structures	Installation of structures to benefit fish and wildlife and their habitats
			Artificial reef development	Structures	Development of artificial reefs in freshwater or marine environments for aquatic species spawning, foraging and refugia
			Hibernacula	Structures	Creation or improvement of overwintering sites
			Nesting habitat improvements	Structures	Installation of nesting structures (e.g., wood duck boxes, osprey platforms)
			Wildlife escape structures	Structures	Installation of structures that allow wildlife to escape from man-made devices placed in the environment (e.g., ramps that allow sage grouse to escape from livestock watering troughs)
		Grazing/farm management		Acres	Improvements to agricultural practices to benefit fish and wildlife and their habitats
			Alley cropping/silvopasture	Acres	Methods of planting in which perennial, preferably leguminous trees or shrubs, are grown simultaneously with an arable crop
			Farming residue management	Acres	Use of vegetative crop material left on a field after harvesting, pruning or processing to benefit wildlife and soil quality
			Forage use management	Acres	Management of timing and duration of grazing to maintain adequate cover for range health and nesting success (e.g., establishment of rotational grazing system to improve grassland nesting bird habitat)
			Livestock heavy use area establishment	Acres	Provision of stable, non-eroding surfaces for areas intensively used by livestock to protect and improve water quality

			Livestock stream crossing	Acres	Installation of structures that allow livestock to cross a stream in a safe and environmentally sound manner (e.g., fords, culverts, bridges)
			Nutrient or runoff management system	Acres	Application of techniques to minimize nutrient runoff from agricultural operations
			Riparian fence installation	Acres	Installation of fences along riparian areas to keep out livestock
			Waste storage/treatment	Acres	Management of on-farm generated wastes in an environmentally responsible manner (e.g., liquid retention and storage ponds, anerobic waste treatment lagoons)
		Hazard or infrastructure removal		Acres	Removal of hazards or infrastructure to benefit fish and wildlife and their habitats
			Building removal	Acres	Removal of buildings to improve habitat for wildlife
			Degraded land reconstruction	Acres	Reconstruction of degraded land to benefit wildlife (e.g., abandoned mine area recovery, deleveling)
			Derelict gear (net/pot) removal	Acres	Removal of derelict fishing gear from waters to prevent continued capture of aquatic species (e.g., fishing nets, fish/crab pots)
			Pavement removal	Acres	Removal of pavement to improve habitat for wildlife (e.g., roads, airplane runways)
			Pier/dock removal	Acres	Removal of piers or docks to improve aquatic habitats
			Shoreline armoring removal	Acres	Removal of shoreline armoring to improve aquatic habitats (e.g., jetties, riprap)
			Solid waste removal	Acres	Removal of solid waste to improve habitat for wildlife (e.g., derelict vehicles, rubbish)
		Instream modification		Miles	Stream improvements to benefit fish and wildlife and their habitats

			Channel reconfiguration	Miles	Restoration of natural stream channel (e.g., returning meanders and sustainable profiles to straightened streams, sandbar improvement)
			Channel structure placement	Miles	Placement of structures within streams to restore natural characteristics (e.g., cross vanes, boulders)
			Nutrient improvement	Miles	Application of nutrients to improve water quality of fish and wildlife (e.g., liming of streams, carcass placement)
			Spawning by-pass channels	Miles	Construction of side channel fish spawning and rearing habitat
			Spawning gravel placement	Miles	Addition of gravel to streams to improve spawning areas
			Streambank stabilization	Miles	Stabilization of streambanks (e.g., bank armoring, bank bioengineering)
		Invasive species control		Acres	Control of invasive animal and plant species to maintain native species populations and restore ecological functions
			Animal - biological	Acres	Control of invasive animal species by biological means (e.g., introducing predators to control invasive animal species)
			Animal - chemical	Acres	Control of invasive animal species by chemical means (e.g., piscicide treatment of sea lamprey in inland waters)
			Animal - mechanical	Acres	Control of invasive animal species by mechanical means (e.g., constructing a barrier in a stream to prevent entry of invasive fish species)
			Plant - biological	Acres	Control of invasive plant species by biological means (e.g., using beetles to control purple loosestrife)

		Plant - chemical	Acres	Control of invasive plant species by chemical means (e.g., herbicide treatment of invasive plant species)
		Plant- mechanical	Acres	Control of invasive plant species by mechanical means (e.g., hand pulling of invasive plant species)
	Living shorelines		Acres	Physical manipulation in shoreline areas to maintain fish and wildlife habitats and/or restore ecological functions
		Beach renourishment	Acres	Placement of sand onto beaches and employing other techniques for their renourishment
		Erosion control structures	Acres	Installation of hard structures (e.g., seawall bulkhead) or living structures (e.g., greenwall systems) to control erosion
		Sand dune restoration	Acres	Application of techniques to restore sand dunes (e.g., fencing off sea-grass areas)
	Planting/seeding		Acres	Planting or seeding to maintain fish and wildlife habitats and/or restore ecological functions
		Coral	Acres	Application of techniques to reestablish coral reefs
		Field border/hedgerow	Acres	Maintenance or establishment of edge between two vegetation types
		Food plots	Acres	Planting crops specifically as food for wildlife
		Herbaceous vegetation	Acres	Planting/seeding of grasslands
		Mulching	Acres	Application of organic materials to enrichment and protect soil
		Plant propagation/nursery	Acres	Use of nurseries to raise plants for habitat improvement
		Submerged aquatic vegetation	Acres	Restoration of vegetation that lives at or below the water surface

		Trees/shrubs	Acres	Planting trees or shrubs
		Vegetation buffer	Acres	Maintenance or establishment of strips of land with permanent vegetation to intercept stormwater runoff and minimize soil erosion
		Woody debris	Acres	Placement of limbs, bush, trees and stumps to improve habitat
	Vegetation management		Acres	Physical manipulation of vegetation to maintain fish and wildlife habitats and/or restore ecological functions
		Chaining	Acres	Dragging heavy chains to remove unwanted vegetation
		Clearing and snagging	Acres	Use of varied techniques to clear vegetation (e.g., brush shearing to set back early successional plant communities)
		Dixie harrow/Lawson aerator	Acres	Removal of vegetation and treating soil by pulling devices behind a tractor (e.g., removing sagebrush for improved herbaceous cover for sage grouse)
		Forest stand improvement	Acres	Removal of trees to improve forest habitat for wildlife (e.g., forest management that promotes a particular serial stage)
		Mowing	Acres	Cutting down grass or grain to maintain habitat for wildlife
		Plowing/Discing	Acres	Plowing or other mechanical means of disturbing existing vegetation and exposing soil
	Water management		Number	Management of water to benefit fish and wildlife and their habitats
		Ditch plugs	Number	Installation of earthen plugs into drainage ditches to restore wetlands
		Diversion/headgate	Number	Installation or maintenance of structures to divert water

		Drainage	Number	Removal of tile drains or drainage ditches to restore wetland hydrology
		Public fishing lake enhancement	Number	Enhancements made to public fishing lakes (e.g., installation of aerators)
		Spring development	Number	Application of techniques to improve the flow, quantity and yield of water from a natural spring
		Tide gate	Number	Installation or maintenance of structures to increase the hydro-period and water depth of a wetland
		Waterfowl impoundment maintenance	Number	Maintenance of impoundments for waterfowl habitat (e.g., renovation of impoundment dikes)
		Water control structure	Number	Installation or maintenance of structures to simulate natural hydrological processes
		Watering facilities	Number	Installation or maintenance of structures to collect and store water for the benefit of wildlife (e.g., water holes, guzzlers, wells)
	Wildlife damage management		Interventions	Assessment and management of damage from nuisance native fish and wildlife. Includes control of predators by biological, chemical or mechanical means to maintain populations of species at risk and restore ecological functions (e.g., gull or cormorant control, nest exclusion devices, cave gating) Note: Limited eligibility for funding through WSFR grant programs
	Wildlife disease management		Interventions	Assessment and management of wildlife disease situations. Includes control or treatment of diseased animals to maintain populations of species at risk and restore ecological functions (e.g., chronic wasting disease, brucellosis, tuberculosis, plague management activities)

	Data Collection and Analysis	Database development and management		Databases	Information technology development and maintenance to support project objectives (e.g., statewide database development) Note: This is different from other Data Collection and Analysis activities in that it refers to the hardware, software, and supporting infrastructure that support multiple data collection efforts
			Database development	Databases	Information technology development to support project objectives (e.g., statewide database development) Note: This is different from other Data Collection and Analysis activities in that it refers to the hardware, software, and supporting infrastructure that support multiple data collection efforts
			Information systems operations and maintenance	Databases	Information technology maintenance to support project objectives (e.g., GIS analyses) Note: This is different from other Data Collection and Analysis activities in that it refers to the hardware, software, and supporting infrastructure that support multiple data collection efforts
		Research, survey or monitoring - fish and wildlife populations		Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on fish and wildlife populations Note: includes compilation, management, synthesis, analysis and reporting of spatial and non-spatial data Note: Code work on fish and wildlife diseases to Wildlife Disease Management within Direct Management of Natural Resources
			Abundance determination	Projects	Determination of relative abundance or estimation of size of fish and wildlife populations (e.g., adult population estimate, juvenile relative abundance)

		Age, size and sex structure	Projects	Determination of age, size or sex structure of fish and wildlife populations (e.g., age and growth, length frequency, sex ratio)
		Baseline inventory	Projects	Baseline survey and inventory to understand distribution of fish and wildlife populations
		Food habits	Projects	Studies on food habits of fish and wildlife species or their utilization as prey
		Genetics	Projects	Genetics studies of fish and wildlife populations (e.g., population connectivity, hybridization)
		Movement	Projects	Studies of fish and wildlife movements (e.g., tagging, telemetry)
		Population assessment	Projects	Assessments of biological information to determine status of fish and wildlife populations (e.g., population viability analysis, fisheries stock assessment)
		Reproduction	Projects	Studies of reproduction of fish and wildlife populations (e.g., fecundity, nesting success)
	Research, survey or monitoring - habitat		Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on fish and wildlife habitats Note: includes compilation, management, synthesis, analysis and reporting of spatial and non-spatial data
		Baseline inventory	Projects	Baseline survey and inventory to understand distribution of fish and wildlife

					habitat quality and quantity (e.g., wetland mapping)
			Monitoring	Projects	On-going monitoring of fish and wildlife habitat quality and quantity (e.g., annual early successional habitat survey, artificial reef condition)
		Research, survey or monitoring - utilization		Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on utilization of fish or wildlife resources and demographics of users Note: includes compilation, management, synthesis, analysis and reporting of data
			Facility usage/inventory	Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on number and usage of facilities (e.g., survey of boat pumpout usage; inventory of fish screen devices)
			Harvest	Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on utilization of fish or wildlife resources (e.g., lake creel surveys; deer harvest statistics)
			Human dimensions	Projects	Collection and analysis of data as part of research, survey or monitoring primarily focused on human dimensions (e.g., demographic surveys; resource economics analyses)
		Techniques development		Studies	Research and development of techniques important for the conservation and management of fish and wildlife
			Artificial propagation studies	Studies	Research on artificial propagation of fish and wildlife (e.g., nutrition studies, culture methods)
			Educational methods research	Studies	Research on educational instruction and evaluation methods

			Habitat restoration methods	Studies	Development or improvement of methods to restore habitats and natural processes (e.g., evaluations of water level fluctuations)
			Fish and wildlife research, survey and management techniques	Studies	Development or improvement of research techniques or management tools (e.g., tag retention studies, sampling device improvements, testing of animal control devices)
	Education				
		Educator/Instructor training		Instructors	Training of educators/instructors on aquatic resources, firearm safety, and archery-related activities
			Aquatic resource education (*)	Instructors	Training of new instructors and teachers in aquatic resource education who will teach others Note: This includes angler education volunteer instructors, teachers, nature center staff and camp counselors who attend ARE workshops, teachers who help the agency write curriculum, etc.
			Hunter education - firearms (*)	Instructors	Training of new and in-service volunteer instructors in hunter education who will teach others Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education
			Cumulative number of active instructors (*)	Instructors	Number of active hunter education volunteer instructors including those just trained within a given year Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education

		Student training		Students	Training of students on aquatic resource education, firearm safety, or archery-related activities Note: Could include Section 10 enhanced hunter education non-range related enhancements to the program (e.g., training supplies acquired, operations and maintenance, etc.)
			Aquatic resource education (*)	Students	Instruction of students on aquatic resources in an educational setting (contact hour of 0.5 or more) Note: This does not include people who have no personal educational interaction - reading an article, borrowing a video, walking by an exhibit booth, etc.; or people that the agency trained to help deliver the program
			Hunter education - firearms (*)	Students	Instruction of students on firearm safety in an educational setting leading to hunter education certification Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education Note: Could include participation in programs intended to recruit and retain hunters that are only eligible through Section 10 enhanced hunter education
			Hunter education - Archery in the Schools (*)	Students	Instruction of students on archery-related activities specifically through the Archery in the Schools program Note: Can only be funded with Section 10 enhanced hunter education Note: Usage started with TRACS launch at start of FY 2013.

			Hunter education - other archery (*)	Students	Instruction of students on archery hunting-related activities not through the Archery in the Schools program Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education Note: Pre-TRACS data could have included Archery in the Schools information.
			Wildlife education	Students	Instruction of students on wildlife species and their habitats in an educational setting Note: This activity has a limited eligibility for reimbursement through WSFR grant programs
	Facilities and Areas (Major Renovation)	Agency support facilities		Sites	Major renovation of facilities used by agency personnel in support of programs/projects (e.g., office buildings, garages, equipment sheds)
		Aquatic resource education centers		Sites	Major renovation of facilities for aquatic resource education
		Boating access facilities		Number	Major renovation of facilities providing access for anglers and others using motor boats
			Launch ramps (*)	Number	Boat ramp lanes at boat launch sites
			Docks/piers (*)	Number	Docks/piers at boat launch sites
			Parking areas (*)	Number	Parking areas at boat launch sites
			Parking spaces (*)	Number	Parking spaces at boat launch sites
			Access roadways (*)	Number	Roadways to access launch ramps
			Restrooms (*)	Number	Restrooms at boat launch sites
			Fish cleaning stations (*)	Number	Fish cleaning stations at boat launch sites
			Shelters (*)	Number	Shelters at boat launch sites
		Boat pump out and dump stations		Number	Major renovation of facilities for pumping sewage from boats Note: Typically funded through the Clean Vessel Act program

		Pump out stations (*)	Number	Pump out stations
		Dump stations (*)	Number	Dump stations
		Floating restrooms (*)	Number	Floating restrooms
		Pump out boats (*)	Number	Pump out boats
	Fish passage facilities		Number	Major renovation of facilities designed to allow fish to move past instream barriers (e.g., fish ladders; counting stations) Note: Not related to removal of dams and other barriers coded elsewhere
		Counting traps/stations	Number	Counting traps/stations
		Downstream bypass facilities	Number	Facilities designed specifically for downstream movement of fish
		Fish ladders	Number	Fish ladders
		Fish lifts	Number	Fish lifts
		Nature-like fishways	Number	Fishways whose designs are based on simulating natural stream characteristics and are constructed of natural materials
	Fish screening and related facilities		Sites	Major renovation of screening systems that prevent fish from passing into areas that do not support their survival (e.g., into irrigation diversion channels). Note: Primarily funded by FRIMA grant program in Region 1
	Hatcheries (recreational purposes)		Sites	Major renovation of facilities to propagate fish or wildlife species for restoration
	Hatcheries (restoration)		Sites	Major renovation of facilities to propagate fish or wildlife species for recreational purposes
	Hunter education - archery ranges		Sites	Major renovation of archery ranges for hunter education purposes

	Hunter education - classrooms		Sites	Major renovation of classrooms for hunter education purposes Note: Could be funded through Wildlife Restoration basic or enhanced hunter education
	Hunter education - firearm shooting ranges		Sites	Major renovation of firearm shooting ranges for hunter education purposes Note: Could be funded through Wildlife Restoration basic or enhanced hunter education
	Public fishing areas/access		Number	Major renovation of non-boating access public fishing areas Note: Activities primarily for restoration and management of species and habitats should be coded to Create, Restore or Enhance Habitat and Natural Processes
		Carry-down access	Number	Access points for carry-down boats
		Fishing piers	Number	Fishing piers
		Parking areas	Number	Parking areas for fishing
		Jetties	Number	Jetties for fishing
		Access roadways	Number	Roadways to access fishing areas
		Restrooms	Number	Restrooms at fishing areas
		Fish cleaning stations	Number	Fish cleaning stations at fishing areas
		Shelters	Number	Shelters at fishing areas
	Transient boat tie up - primary facilities		Number	Major renovation of primary facilities for tie-up of transient boats Note: Typically funded through Boating Infrastructure Grant program
		Docks/slips (*)	Number	Spaces for tie-up to docks
		Moorings (*)	Number	Moorings
		Gangways (*)	Number	Gangways
	Transient boat tie up - secondary facilities		Number	Major renovation of secondary facilities for tie-up of transient boats Note: Typically funded through Boating Infrastructure Grant program

			Restrooms (*)	Number	Restrooms
			Fuel stations (*)	Number	Fuel stations
			Laundry facilities (*)	Number	Laundry facilities
		Wildlife Management Areas		Number	Major renovation of facilities at Wildlife Management Areas
			Campgrounds	Number	Campgrounds
			Dikes/levees	Number	Dikes/levees
			Observation structures	Number	Wildlife blinds, towers, platforms, etc.
			Parking lots	Number	Parking lots
			Roads	Number	Roads
	Facilities and Areas (New Construction)	Agency support facilities		Sites	Construction of new facilities used by agency personnel in support of programs/projects (e.g., office buildings, garages, equipment sheds)
		Aquatic resource education centers		Sites	Construction of new facilities for aquatic resource education
		Boat pump out and dump stations		Number	Construction of new facilities for pumping sewage from boats Note: Typically funded through the Clean Vessel Act program
			Dump stations (*)	Number	Dump stations
			Floating restrooms (*)	Number	Floating restrooms
			Pump out boats (*)	Number	Pump out boats
			Pump out stations (*)	Number	Pump out stations
		Boating access facilities	Access roadways (*)	Number	Roadways to access fishing areas
			Docks/piers (*)	Number	Docks/piers at boat launch sites
			Fish cleaning stations (*)	Number	Fish cleaning stations at boat launch sites
			Launch ramps (*)	Number	Boat ramp lanes at boat launch sites

		Parking areas (*)	Number	Parking areas at boat launch sites
		Parking spaces (*)	Number	Parking spaces at boat launch sites
		Restrooms (*)	Number	Restrooms at boat launch sites
		Shelters (*)	Number	Shelters at boat launch sites
	Fish passage facilities		Number	Construction of new facilities designed to allow fish to move past instream barriers (e.g., fish ladders; counting stations) Note: Not related to removal of dams and other barriers coded elsewhere
		Counting traps/stations	Number	Counting traps/stations
		Downstream bypass facilities	Number	Facilities designed specifically for downstream movement of fish
		Fish ladders	Number	Fish ladders
		Fish lifts	Number	Fish lifts
		Nature-like fishways	Number	Fishways whose designs are based on simulating natural stream characteristics and are constructed of natural materials
	Fish screening and related facilities		Sites	Construction of new screening systems that prevent fish from passing into areas that do not support their survival (e.g., into irrigation diversion channels). Note: Primarily funded by FRIMA grant program in Region 1
	Hatcheries (recreational purposes)		Sites	Construction of new facilities to propagate fish or wildlife species for restoration or recreational purposes
	Hunter education - archery ranges		Sites	Construction of new archery ranges for hunter education purposes
	Hunter education - classrooms		Sites	Construction of new classrooms for hunter education purposes Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education Note: Pre-TRACS data could have

				included major renovation or operations and maintenance
	Hunter education - firearm shooting ranges		Sites	Construction of new firearm shooting ranges for hunter education purposes Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education Note: Pre-TRACS data could have included major renovation
	Public fishing areas/access		Number	Major renovation of non-boating access public fishing areas Note: Activities primarily for restoration and management of species and habitats should be coded to Create, Restore or Enhance Habitat and Natural Processes
		Access roadways	Number	Access points for carry-down boats
		Carry-down access	Number	Fishing piers
		Fish cleaning stations	Number	Parking areas for fishing
		Fishing piers	Number	Jetties for fishing
		Jetties	Number	Roadways to access fishing areas
		Parking areas	Number	Restrooms at fishing areas
		Restrooms	Number	Fish cleaning stations at fishing areas
		Shelters	Number	Shelters at fishing areas
	Transient boat tie up - primary facilities		Number	Major renovation of primary facilities for tie-up of transient boats Note: Typically funded through Boating Infrastructure Grant program
		Docks/slips (*)	Number	Spaces for tie-ups to docks
		Gangways (*)	Number	Gangways
		Moorings (*)	Number	Moorings

		Transient boat tie up - secondary facilities		Number	Major renovation of secondary facilities for tie-up of transient boats Note: Typically funded through Boating Infrastructure Grant program
			Fuel stations (*)	Number	Fuel Stations
			Laundry facilities (*)	Number	Laundry Facilities
			Restrooms (*)	Number	Restrooms
		Wildlife Management Areas		Number	Major renovation of facilities at Wildlife Management Areas
			Campgrounds	Number	Campgrounds
			Dikes/levees	Number	Dikes/Levees
			Observation structures	Number	Wildlife blinds, towers, platforms, etc.
			Parking lots	Number	Parking Lots
			Roads	Number	Roads
	Facilities and Areas (Operations and Mantenance)	Agency support facilities		Sites	Routine operations and maintenance of facilities used by agency personnel in support of programs/projects (e.g., office buildings, garages, equipment sheds)
		Aquatic resource education centers		Sites	Routine operations and maintenance of facilities for aquatic resource education
		Boat pump out and dump stations		Number	Routine operations and maintenance of facilities for pumping sewage from boats Note: Typically funded through the Clean Vessel Act program
			Dump stations	Number	Dump Stations
			Floating restrooms	Number	Floating Restrooms

		Gallons of sewage pumped	Number	Gallons of sewage pumped. Note: Likely to be a required data element in the future when CVA regulations are revised
		Pump out boats	Number	Pump out boats
		Pump out stations	Number	Pump out stations
	Boating access facilities		Number	Routine operations and maintenance of facilities providing access for anglers and others using motor boats
		Access roadways (*)	Number	Roadways to access launch ramps
		Docks/piers (*)	Number	Docks/piers at boat launch sites
		Fish cleaning stations (*)	Number	Fish cleaning stations at boat launch sites
		Launch ramps (*)	Number	Boat ramp lanes at boat launch sites
		Parking areas (*)	Number	Parking areas at boat launch sites
		Parking spaces (*)	Number	Parking spaces at boat launch sites
		Restrooms (*)	Number	Restrooms at boat launch sites
		Shelters (*)	Number	Shelters at boat launch sites
	Cooperatively managed areas for hunting		Acres	Lands not owned by the State fish and wildlife agency that are cooperatively managed for hunting purposes (e.g., US Forest Service lands, State parks, private lands)
		Government agency	Acres	Operations and maintenance activities on lands owned by other government agencies
		Private lands	Acres	Operations and maintenance activities on privately owned lands
	Fish passage facilities		Number	Routine operations and maintenance of facilities designed to allow fish to move past instream barriers (e.g., fish ladders; counting stations) Note: Not related to removal of dams and other barriers coded elsewhere

			Counting traps/stations	Number	Counting traps/stations
			Downstream bypass facilities	Number	Facilities designed specifically for downstream movement of fish
			Fish ladders	Number	Fish ladders
			Fish lifts	Number	Fish lifts
			Nature-like fishways	Number	Fishways whose designs are based on simulating natural stream characteristics and are constructed of natural materials
		Fish screening and related facilities		Sites	Routine operations and maintenance of screening systems that prevent fish from passing into areas that do not support their survival (e.g., into irrigation diversion channels). Note: Primarily funded by FRIMA grant program in Region 1
		Hatcheries (recreational purposes)		Sites	Routine operations and maintenance of facilities to propagate fish or wildlife species for recreational purposes
		Hatcheries (restoration)		Sites	Routine operations and maintenance of facilities to propagate fish or wildlife species for restoration purposes
		Hunter education - archery ranges		Sites	Routine operations and maintenance of archery ranges for hunter education purposes
		Hunter education - classrooms		Sites	Routine operations and maintenance of classrooms for hunter education purposes Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education
		Hunter education - firearm shooting ranges		Sites	Routine operations and maintenance of firearm shooting ranges for hunter education purposes Note: Could be funded through Wildlife Restoration basic or Section 10 enhanced hunter education

		Public fishing areas/access		Number	Routine operations and maintenance of non-boating access public fishing areas Note: Activities primarily for restoration and management of species and habitats should be coded to Create, Restore or Enhance Habitat and Natural Processes
			Access roadways	Number	Roadways to access fishing areas
			Carry-down access	Number	Access points for carry-down boats
			Fish cleaning stations	Number	Fish cleaning stations at fishing areas
			Fishing piers	Number	Fishing piers
			Jetties	Number	Jetties for fishing
			Parking areas	Number	Parking areas for fishing
			Restrooms	Number	Restrooms at fishing areas
			Shelters	Number	Shelters at fishing areas
		Wildlife Management Areas		Number	Routine operations and maintenance of Wildlife Management Areas Note: Activities primarily for restoration and management of species and habitats should be coded to Create, Restore or Enhance Habitat and Natural Processes
			Boundary designation	Number	
			Campgrounds	Number	Campgrounds
			Dikes/levees	Number	Dikes/Levees
			Observation structures	Number	Wildlife blinds, towers, platforms, etc.
			Parking lots	Number	Parking Lots
			Trails	Number	
			Trash Collection	Number	
			Roads	Number	Roads
				Acres	

	Land and Water Rights Acquisition and Protection (Potential High Level Purposes: Conservation/ Management, Recreation, Administration)	Land acquisition	Fee title	Acres	Acquisition of lands through fee title acquisition
			Non-fee title	Acres	Acquisition of lands through leases, permanent easements, cooperative agreements, contracts or other non-fee title arrangements
		Water rights acquisition	Fee title	Acres Feet	Purchase of water rights through fee title acquisition (e.g., purchase of water rights to maintain adequate flows for endangered stream fishes)
			Non-fee title	Acres Feet	Acquisition of water rights through leases, permanent easements, cooperative agreements, contracts or other non-fee title arrangements (e.g., purchase of water rights to maintain adequate flows for endangered stream fishes)
		Conservation area designation		Acres	Designation of a site or landscape as having unique and important value to fish and wildlife with or without legal protections (e.g., waterfowl breeding area, Marine Protected Area)
		Private lands agreements		Acres	Number of acres that are protected by agreement with private landowners, but which do not involve active habitat improvement Note: Used extensively within the Landowner Incentive Program

	Law Enforcement (Potential High Level Purposes: Conservation/ Management, Recreation)	Law enforcement		Cases	Enforcement of laws and regulations related to the protection of fish and wildlife
	Outreach				
		Partner/stakeholder engagement		Number	Engagement of partners to achieve shared objectives and broader coordination across overlapping areas
			Government agency	Number	Engagement of federal, state and local agencies and tribal entities to achieve shared objectives and broader coordination across overlapping areas (e.g., outreach with tribal governments for habitat restoration)
			Non-governmental organization	Number	Engagement of the NGO community to achieve shared objectives and broader coordination across overlapping areas (e.g., coordinate with an NGO on a fish and wildlife GIS analysis)
			Others	Number	Engagement of other partners to achieve shared objectives and broader coordination across overlapping areas (e.g., convene an advisory committee from academia to assist with management planning for a species)
		Recruitment and retention activities		Number	Participation in programs intended to recruit and retain anglers, boater, hunters or wildlife watchers

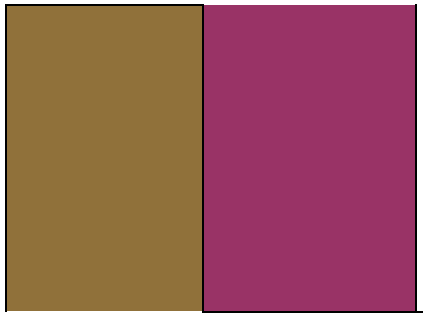
			For fishing and boating (SFR outreach and communications)	Number	Provision of information on fishing and boating opportunities to current and future anglers and boaters (e.g., creation and dissemination of maps of boat ramps, participation in angler recruitment and retention programs) Note: the cost of these activities counts toward the 15 percent SFR apportionment cap on ARE and outreach and communications
			For hunting and shooting	Number	Participation in programs intended to recruit and retain hunters and shooters. Note: Non-hunting related shooting activities are only eligible for Multi-State Grant Program or Section 10 enhanced hunter education funding
			For wildlife watching	Number	Participation in programs intended to recruit and retain wildlife watchers Note: this activity has limited eligibility for funding through WSFR grant programs
		WSFR program/ subprogram outreach		Number	Provision of educational information on WSFR grants and grant programs to a variety of audiences through a variety of means (e.g., participating in trade shows to share information WSFR funded work; building kiosks to display WSFR program information at supported areas and facilities)
			Displays, exhibits, kiosks	Number	Activities associated with producing displays, exhibits or kiosks
			Presentations, workshops, seminars, conferences	Number	How many presentations, workshops, seminars and conferences were conducted (not attended). Note: an outdoor writers conference, a speech to a hunting club, and media training for biologists count as a total of 3

			Outreach research	Number	Survey or research projects undertaken
			Brochures, Fliers	Number	The number of distinct brochures and flyers prepared, not the press run
			Public service announcements	Number	The number of original public service announcements prepared
			Stories, interviews, news releases	Number	The number of original stories produced, interviews given to the media and/or news releases prepared for the media
			Trade shows	Number	Participation in trade shows including setting up and maintaining booths
	Planning				
		Land use planning		Plans	Leading or participating in land use planning for rural, urban or agricultural lands (e.g., assist in developing county-wide zoning plans, participate in workgroup regarding low impact development siting)
		Organizational strategic and CMS planning		Plans	Development of agency strategic and operational plans and fish and wildlife comprehensive management systems Note: Does not include actions to implement plans
			Organizational strategic and operational planning	Plans	Development of agency strategic and operational plans Note: Does not include actions to implement plans
			CMS planning	Plans	Development of fish and wildlife comprehensive management systems Note: Does not include actions to implement comprehensive management systems

		Species and habitat management planning		Plans	Development of management plans for fish and wildlife species and habitats
			Species management planning	Plans	Development of management plans for fish and wildlife species (e.g., interjurisdictional fisheries management planning)
			Listed species recovery planning	Plans	Development of recovery plans for federal or state listed species
			Habitat management planning	Plans	Development of management plans for habitats and natural processes (e.g., management planning for longleaf pine habitat; Habitat Conservation Plan development)
			Habitat Conservation Plan (HCP) Development	Plans	
		State Wildlife Action planning		SWAPs	Conduct activities to develop and revise State Wildlife Action Plans (e.g., convene interagency work groups to revise portions of a SWAP, hold public hearings to help set priorities for SWAP conservation actions)
		WSFR program/ subprogram planning		Plans	Conduct planning activities for a specific WSFR program or subprogram (e.g., CVA planning, hunter education planning)
	Species Re-introduction and Stocking				
		Native species restoration		Animals	Re-introduction, rehabilitation and relocation of native animals or plants in their historic habitats

			Propagation and stocking	Animals	Re-introduction of propagated native animals or plants to their historic habitats (e.g., restore mussels to rivers within their historic range, head-starting rare turtles)
			Rehabilitation	Animals	Rehabilitation of injured fish and wildlife
			Translocation	Animals	Relocation of native species (including plants) to suitable habitats (e.g., translocate/breed in captivity black-footed ferrets to establish new populations in suitable habitat)
		Production and stocking for recreational purposes		Animals	Production and stocking of animals for recreational purposes
			Forage species	Animals	Production and stocking species that serve as forage for recreational species (e.g., rainbow smelt for salmonid species)
			Put-and-take	Animals	Production and stocking harvestable-size animals that are not expected to reproduce or grow significantly before they are harvested (e.g., catchable trout stocking for recreational purposes)
			Put-grow-and-take	Animals	Production and stocking sublegal-size animals for the purpose of maintaining populations with insufficient natural reproduction for sustainable harvest (e.g., walleye fry stocking for future sport fishing)

		Environmental review		Reviews	Review of agency and private sector policies, projects and plans (primarily related to development and adverse impacts to natural resources) to help ensure potential impacts to fish and wildlife are avoided, minimized and/or compensated/mitigated (e.g., review of municipal pier development, review of transmission corridor siting)
			Review of proposed projects	Reviews	Review of proposed development projects to help ensure that impacts to fish and wildlife are minimized and resource benefits are maximized
			Review of proposed policies and plans	Reviews	Review of non-conservation oriented policies and plans to help ensure that impacts to fish and wildlife are minimized and resource benefits are maximized (e.g., review of harbor dredging plan, review of state highway plans)
		Technical assistance		Assists	Provision of professional training and technical assistance to others on fish and wildlife assessment and management
			With individuals and groups involved in resource management decision making	Assists	Provision of professional training and technical assistance on fish and wildlife assessment and management to individuals and groups involved in resource management decision-making (e.g., provide agency-collected data to other governmental officials, train non-governmental organizations on new trapping methods, review of conservation-oriented policies and plans)

			With private landowners	Assists	Provision of technical assistance on fish and wildlife management practices to private landowners Note: Could Include development and delivery of economic incentives to private landowners to influence responsible stewardship of land/water and specific species

Appendix 5.1. Existing Plans and Programs for Monitoring SGCN and/or their Habitats

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Alabama - Mississippi Rapid Assessment Team (survey for potential aquatic invasives)	MBNEP	X	X	
Alabama Bat Working Group Winter Cave Surveys for White-Nose Syndrome	ADCNR Nongame Wildlife Program	X	X	
Alabama Black Bear Alliance	AWF, TNC	X		
Alabama Clean Water Partnership	CWP			X
Alabama Coastal Cleanup	ADCNR			X
Alabama CoastWatch (monitor water quality)	Alabama Coastal Foundation			X
Alabama Forest Legacy Program; Assessment of Need	Alabama Forest Resources Center			X
Alabama Inventory List: the Rare, Threatened and Endangered Plants, Animals, and Natural Communities of Alabama	NS-ALNHP	X	X	
Alabama's 2004 Integrated Water Quality Monitoring and Assessment Report	ADEM			X
Alabama-Tombigbee River Basins Management Plan	ADEM			X
Alabama Rivers and Streams Network	ADCNR, GSA, ADEM, ACWP, AFC, AWW			X
Atlas of Cerulean Warbler Populations	USFWS	X	X	
Breeding Bird Atlas Project	AOS	X	X	
Black Warrior River Basin Management Plan	ADEM			X
Cahaba River Basin Management Plan	Cahaba River Basin Clean Water Partnership			X
Chattahoochee-Chipola River Basin Management Plan	ADEM			X
Choctawhatchee-Pea-Yellow River Basins Management Plan	ADEM			X
Clean Marina Programs	Mississippi-Alabama Sea Grant Consortium			X
Comprehensive Watershed Management Plan for the Choctawhatchee, Pea, and Yellow Rivers	GSA	X	X	X
Conecuh-Sepulga-Blackwater Rivers Basin Management Plan 2004 draft	ADEM			X
Derelict Crab Trap Recovery Program	ADCNR			X
Ducks Unlimited's Conservation Plan: Meeting the Annual Life Cycle needs of North America's Waterfowl	Ducks Unlimited	X	X	
Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems	NatureServe			X
Expanding the Vision: 1998 Update, North American Waterfowl Management Plan	USFWS	X	X	
Geological Survey of Alabama	GSA	X	X	X

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Gray Bat Population Surveys	ADCNR Nongame Wildlife Program	X	X	
Fowl River Water Quality Monitoring	Alabama Coastal Foundation			X
Mid-Coosa River Basin Management Plan	ACWP			X
Middle Coosa River, Upper Coosa River, Eightmile Creek, and Cotaco Creek Nonpoint Source Prioritization Project	NS-ALNHP			X
North American Bat Conservation Partnership Strategic Plan	North American Bat Conservation Partnership	X	X	
North American Landbird Conservation Plan	Partners in Flight	X	X	
Plan for the Population Restoration and Conservation of Imperiled Freshwater Mollusks of the Mobile River Basin	Mobile River Basin Mollusk Restoration Committee	X	X	X
Plan for the Population Restoration and Conservation of Freshwater Mollusks of the Cumberlandian Region	Cumberlandian Region Mollusk Restoration Committee	X	X	X
Rare Bird Alert	Alabama Ornithological Society	X	X	
Recovery Plan: Alabama Beach Mouse	USFWS	X		
Recovery Plan: Alabama Red-bellied Turtle	USFWS	X		
Recovery Plan: American Burying Beetle	USFWS	X		
Recovery Plan: Anthony's Riversnail	USFWS	X		
Recovery Plan: Blue Shiner	USFWS	X		
Recovery Plan: Cahaba Shiner	USFWS	X		
Recovery Plan: Clubshell and Northern Riffleshell	USFWS	X		
Recovery Plan: Cracking Pearlymussel	USFWS	X		
Recovery Plan: Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot	USFWS	X	X	
Recovery Plan: Eastern Indigo Snake	USFWS	X		
Recovery plan: Endangered Fat Threeridge, Shinyrayed Pocketbook, Gulf Moccasinshell, Ochlockonee Moccasinshell, Oval Pigtoe; Threatened Chipola Slabshell, and Purple Bankclimber	USFWS	X	X	
Recovery Plan: Flattened Musk Turtle	USFWS	X		
Recovery Plan: Florida Manatee	USFWS	X		
Recovery Plan: Florida Panther	USFWS	X		
Recovery Plan: Gopher Tortoise	USFWS	X		
Recovery Plan: Gray Bat	USFWS	X		
Recovery Plan: Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico	NMFS and USFWS	X		
Recovery Plan: Indiana Bat (Revised)	USFWS	X		
Recovery Plan: Inflated Heelsplitter	USFWS	X		
Recovery Plan: Kemp's Ridley Sea Turtle	USFWS and NMFS	X		

Monitoring Program or Action	Implementation Lead	Level of Monitoring		
		Species	Guild	Habitat
Recovery Plan: Leatherback Turtles in the U.S. Caribbean, Atlantic and Gulf of Mexico	NMFS and USFWS	X		
Recovery Plan: Little-wing Pearlymussel	USFWS	X		
Recovery Plan: Mississippi Sandhill Crane	USFWS	X		
Recovery Plan: Mobile Basin Aquatic Ecosystem	USFWS			X
Recovery Plan: Palezone Shiner	USFWS	X		
Recovery Plan: Piping Plover, Atlantic Coast Population (Revised)	USFWS	X		
Recovery Plan: Red Hills Salamander	USFWS	X		
Recovery Plan: Red Wolf	USFWS	X		
Recovery Plan: Red-cockaded Woodpecker	USFWS	X		
Recovery Plan: U.S. Breeding Population of the Wood Stork (Revised)	USFWS	X		
Recovery Plan: U.S. Population of Atlantic Green Turtle	NMFS and USFWS	X		
Recovery Plan: U.S. Population of Loggerhead Turtle	NMFS and USFWS	X		
Recovery Plan: Watercress Darter	USFWS	X		
Recovery/Management plan: Gulf Sturgeon	USFWS and NMFS	X		
Review of the Progress on the North American Bird Conservation Initiative	North American Commission for Environmental Cooperation	X	X	
Revised Land and Resource Management Plan; National Forests in Alabama 2004	USFS			X
Tallapoosa Basin Management Plan	ADEM			X
Tennessee River Basin Management Plan	ACWP 2003			X
Waterbird Conservation for the Americas: The North America Waterbird Conservation Plan 2002	PIF	X	X	
Wolf Bay Watershed Project (develop management plan)	Alabama Coastal Foundation			X
Southeast U.S. Waterbird Conservation Plan	USFWS	X		
Priority Information Needs for Rails and Snipe: A funding strategy	USFWS	X		

Appendix 6.1. Coordination with Partners and Stakeholders: Meetings and Contacts

Organization Represented	Contacts and Attendees
ADCNR Marine Resources	Kevin Anson
ADCNR State Lands Division	Eric Soehren, Jo Lewis, Courtney Norman, and Ashley Peters
ADCNR State Parks Division	Forrest Bailey
ADCNR WFF	Chuck Sykes, Jim Schrenkel, Casey Norris
ADCNR WFF Fisheries	Nick Nichols, Stan Cook, Jeff Garner, Steve Rider, and Taconya Goar
ADCNR WFF Nongame	Mark Sasser, Nicholas Sharp, Carrie Threadgill, and Roger Clay
ADCNR WFF Wildlife	Ray Metzler, Drew Nix, Jim Schrenkel, Casey Norris, and Keith Gauldin
ADCNR Alabama Aquatic Biodiversity Center	Paul Johnson
Alabama Cooperative Wildlife Unit	Amy Silvano and Barry Grand
Alabama Dept. of Environmental Management	Cal C. Johnson, Brien Diggs, Fred Leslie, Lacey Genard, Lisa Huff, Ruthie Perez, and S. Kumar
Alabama Forestry Commission	Dan Jackson, Hank McKinley, Jim Jeter, Otis French, Jason Dockery, and Ryan Prince
Alabama Geological Survey	Pat O'Neil and Stuart McGregor
Auburn University	Craig Guyer, Jim Godwin, and Michael Barbour
Poarch Creek Tribe	David Elliott, Billy Smith, and James Agerton
Tennessee Valley Authority	Evan Crews and Raymond Moore
The Nature Conservancy	Mary Kate Brown, Judy Haner, and Keith Tassin
U.S. Forest Service	Allison Cochran, Art Henderson, Dagmar Thurmond, John Moran, Ryan Shurette, Steve Lohr, and Travis McDonald
USFWS Daphne Field Office	Andy Ford, Bill Lynn, Dianne Ingram, Drew Rollman, Eric Spadgenske, Jeff Gleason, Matt Laschet, Jeff Powell, and Patric Harper
USFWS Wheeler NWR	Dwight Cooley and Rob Hurt
USFWS/East Gulf Coastal Plain Joint Venture	Rob Holbrook