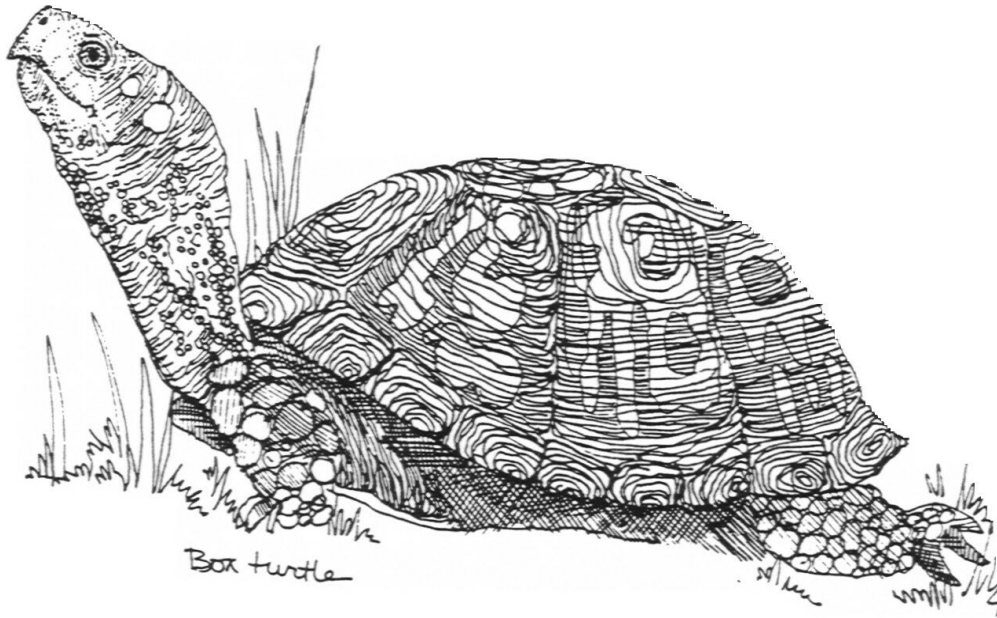


GA Project Wild Teacher Resource Guide:

Introduction to Georgia's Natural History



Georgia Department of Natural Resources
Wildlife Resources Division
Second Edition

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INTRODUCTION

This guide is a supplement to the *Project Wild K-12 Activity Guide* (PW) and includes Georgia's natural history information. The PW curriculum primarily deals with environmental issues from across the United States.

This guide seeks to provide a basic introduction to key habitats and wildlife for each physiographic region within Georgia, provide references for further study, field trip sites, and PW activities that can be adjusted to add local information and flavor.

Hopefully this guide helps to generate a greater knowledge and appreciation of Georgia's diverse and increasingly threatened habitats. It is only a deep concern and commitment to these wild places that will ensure their existence for future generations to enjoy.

GEORGIA OVERVIEW

Georgia is the largest state east of the Mississippi River, with a land area of 37 million acres, and is home to over 10 million people. This number is expected to increase by 37% over the next 25 years.

The state of Georgia is also home to a remarkably diverse collection of plants and animals. The term "biodiversity" may inspire images of Australian coral reefs and Brazilian rain forests, but for certain taxa, the southeastern United States ranks high in the world, and certainly within the United States for sheer number of species. Georgia is home to 975 vertebrates (ranks 2nd in the nation), of which 63 are found only in Georgia (endemic species). Georgia provides habitats for 62 endangered species. Georgia ranks among the highest of all states for amphibian (80 species), freshwater fishes (265), and crayfish (70) diversity, and is in the top 10 for reptile (84) and vascular plant diversity (3,600 native plant species).

Many excellent field guides are available that provide detailed information on the identification and life history of plants and

animals. This guide seeks to introduce some of the important plants and animals, not to replace existing guides.

CHANGING HABITATS

Walking through a cove forest in the mountains, floating down the Altamaha River by canoe, or wandering the Spanish-moss draped hammock forests on Sapelo Island, one may get a sense of permanence and stability. This sense is largely an illusion as every habitat experience subtle and sometimes more obvious changes through time. These changes result from internal and external processes.

Internal processes such as plant growth, death, and replacement (called natural succession), are constantly at work, subtly changing every habitat, whether a rock outcrop or a mature forest. Habitats often progress towards a theoretical "climax" stage, where the species composition remains relatively stable over long periods of time. If one walks into a forest and the under-story saplings are the same species as the dominant canopy trees, one is witnessing a forest in its climax stage.

External disturbances such as hurricanes, droughts, lightning strikes and fires can interfere with plant succession, setting back the successional clock. In some habitats, external disturbances occur with enough frequency that the climax stage is never reached. For example, the long-leaf pine forests of the coastal plain are fire-maintained ecosystems, which are rapidly replaced by hardwoods if fire is suppressed.

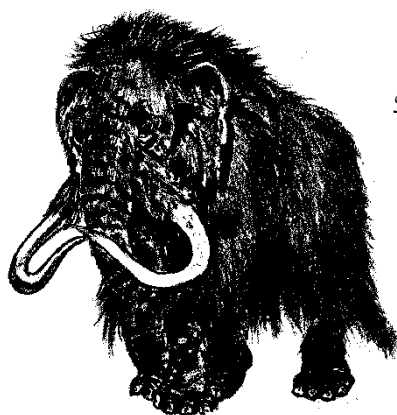
On a much broader time scale, Georgia's habitats are also changing due to hemispheric and global climate changes. The most obvious example is the oscillating climate associated with the Ice Ages over the last 2 million years.

PREHISTORIC GEORGIA

Georgia's landscape at the peak of the last major ice age (20,000 years ago) would be unrecognizable to a modern observer. Ice ages have occurred about every 100,000 years for the last 2 million years in the northern hemisphere. A combination of three distinct cycles in the earth's rotation and orbit seem to cause these predictable climatic fluctuations. Whatever the cause, ice ages dramatically changed the face of North America, beyond the actual extent of ice, which reached only as far south as New York State.

During the ice ages a northern forest of **Jack Pine** (*Pinus sylvestris*), **Red Pine** (*Pinus resinosa*) and **Spruce** (*Picea* sp.) found refuge in the southern Appalachians, pushed from its' northern range by vast sheets of ice, that in places reached 2 miles thick. Between 14,000 and 11,000 years ago as the climate moderated, the landscape changed, becoming closer in appearance to modern Georgia.

A closer look however would reveal remarkably different fauna. **Mastodons** (*Mammot* sp.) grazed in pine grasslands and spruce forests along the Atlantic coasts, with 400-pound **Shasta Giant Ground-sloths** (*Nothrotheriops shastensis*), and **Giant Beaver** (*Castoroides ohioensis*) the size of Black Bear. Predators such as the **Dire Wolf** (*Canis dirus*), **American Lions** (*Panthera leo*), **American Cheetahs** (*Miracinonyx* sp.), and **Saber-toothed Cats**



Mastodon

(*Smilodon fatalis*) prowled the landscape as well. In a relatively short period of time between 12,000 to 9,000 years ago, 35 to 40 species of large mammals went extinct. The cause of this extinction is still debated today. However, the arrival of Paleo-Indian hunters, approximately 12,000 years ago, probably played a major role in their extinction.

Parallel tales can be told of early human arrival on other continents, such as South America and Australia, where large mammal extinctions followed close on the heels of human hunters.

RECENT HABITAT LOSS

Recent challenges to wildlife are easier to see and understand than prehistoric climate change and Paleo-Indian hunting. Rapidly expanding human populations exert increasing pressure on wildlife habitat throughout the state. This growing pressure raises concern for the survival of plants and animals that are dependent on the varied natural landscapes of the Southeast.

Habitat provides vital benefits for wildlife including space, food, water, and shelter. Changes in natural habitats may render them unsuitable for wildlife. For example, impounding rivers to make lakes alters natural water flow, temperature, and sediment levels and habitat for many freshwater species. Wetland draining in the past destroyed about 50% of North America's wetlands (about 23% of Georgia's), and threatened the habitat of about 70% of endangered species. The rate of loss has decreased in recent years thanks to conservation efforts. Water pollution in the form of sediment and chemical pollutants also threaten native species.

One of Georgia's most damaged habitats is the bottomland hardwood forest.

Seventy-seven percent of bottomland hardwood forests have been cleared over the last 2 centuries, leading to the recent extinction of three of five bird species that depend exclusively on this habitat. North America's largest woodpecker (**Ivory-billed** – *Campephilus principalis*), North America's only native parrot (**Carolina Parakeet** – *Conuropsis carolinensis*), and the **Bachman's Warbler** (*Vermivora bachmanii*) have all become extinct. The brilliant **Prothonotary Warbler** (*Prothonotaria citrea*) and skulking **Swainson's Warbler** (*Lymnotherlypis swainsonii*) remain, although both are species of concern due to habitat loss.



Ivory-billed Woodpecker

PW Activities:

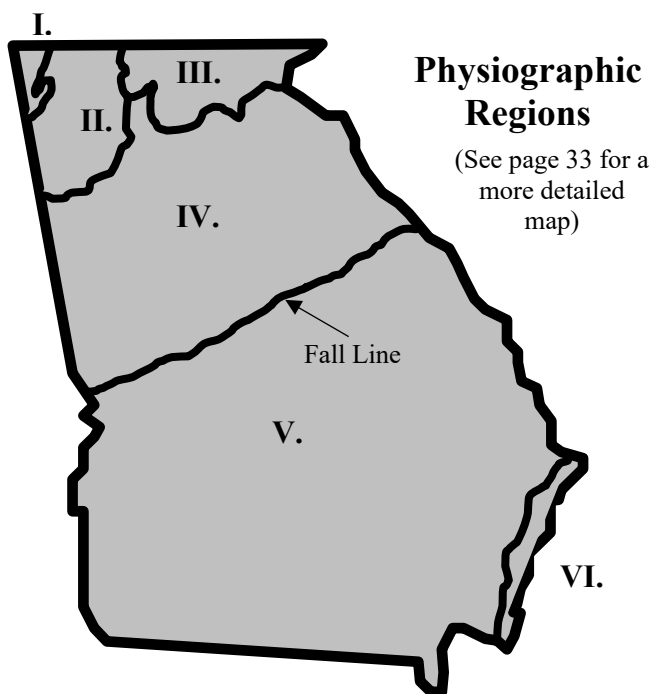
Oh Deer! Tracks, What's that Habitat?
Habitat Circles

GEORGIA'S PHYSIOGRAPHIC REGIONS

From the southern terminus of the Appalachian Mountains to the barrier islands, Georgia includes a wide range of habitats and landscapes. This diversity supports the vast array of plants and animals that make the state unique. This guide divides Georgia into six ecoregions,

including three mountain regions, the piedmont, coastal plain, and maritime. Each ecoregion is defined by its underlying geology, plants, soil types and topography. These physical factors in conjunction with climate (long term weather patterns) and local disturbances (storms, fires and floods), determine the types of habitats that develop in each region. The central role of soils, climate and natural disturbance will be revisited again and again, as these three factors determine what plants and animals become established in any given habitat.

This guide starts in the mountains and moves to the coast, as if one were hiking from the mountains of northwest Georgia to the sea. This cross-section of Georgia would be wedge shaped, with the high tumbled rocks of the mountains gradually softening to the rolling piedmont, and then dropping to the essentially flat coastal plain and ocean (see page 5).



Physiographic Regions

(See page 33 for a more detailed map)

I. Cumberland Plateau
II. Ridge and Valley
III. Blue Ridge

IV. Piedmont
V. Coastal Plain
VI. Maritime

MOUNTAINS

Physical Landscape

The mountains of North Georgia only cover 9% of the state's area, yet they contain a significant portion of animal and plant diversity. Georgia's mountains are ancient, formed from rocks between 200 million and one billion years old. The Rocky Mountains, Andes, and Himalayas are mere children in comparison. Geologic evidence suggests that the entire Appalachian chain has emerged and eroded several times, a slow but dramatic story of repeated continental collisions and mountain building, followed by gradual erosion. Geologists estimate that between 5 and 10 miles of vertical rock have been eroded from the Appalachians and washed into the sea. Some of this material now forms the piedmont, coastal plain and maritime regions.

Forests probably covered Georgia's mountains for the last 2 million years. Trees provided organic material for soil production and root systems to stabilize that soil. Montane forests offer many examples of plants stabilizing and gradually altering their environment.

Variations in elevation, slope and aspect create changing temperature and moisture patterns that produce many distinct microclimates in mountainous regions. These microclimates dramatically increase habitat diversity, allowing for specialized plants and animals to become established in local areas.

Typically, rainfall increases in mountainous areas as air masses cool and release moisture as they rise and pass over mountains. For this reason, one can see clouds that seem perched on mountaintops, while the valleys are sunny.

As elevation increases the average temperature decreases. For every 6,000 feet of elevation gained, the climate changes as if one moved 1,000 miles north. A state like Georgia gains a broader diversity of plants and animals because of the mountains, which house species that would otherwise live far to the north.

Georgia's mountains can be divided into 3 distinct regions based on geologic history. These regions are the Cumberland Plateau of northwest Georgia, the Ridge and Valley ecoregion of north-central Georgia and the Blue Ridge ecoregion of northeast Georgia.

Mountain Sites to Visit:

Rome-Floyd E.C.O. Center

Rome (706) 622-6432

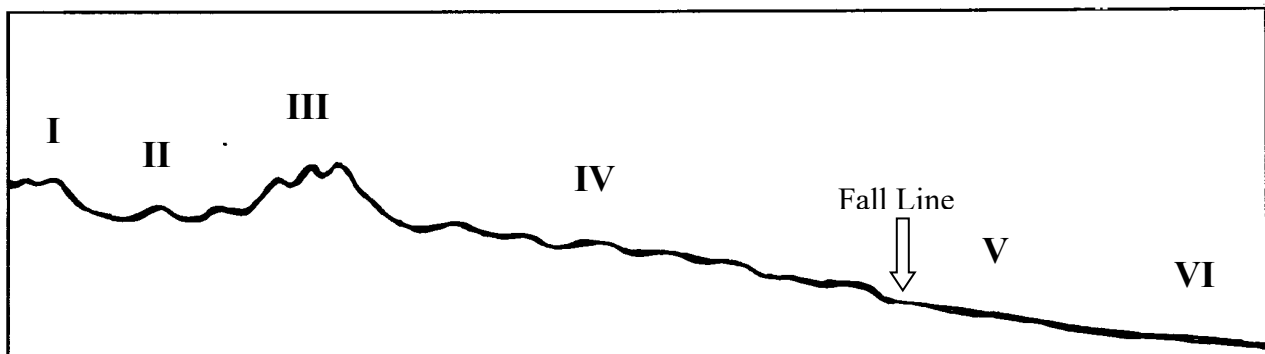
Smithgall-Woods Conservation Area,

Helen (706) 878-3087

Elachee Nature Center, Gainesville

(770)-535-1976

Cross-section of Georgia



CUMBERLAND PLATEAU ECOREGION

Caves, Crevices and Canyons

Physical Landscape

The Cumberland Plateau is Georgia's smallest ecoregion, encompassing only about 865 square miles or 1% of the state's area. Located in the northwest corner of the state, this region comprises a high elevation plateau that extends into both Tennessee and Alabama and ranges from 880 to 2,200 feet in elevation.

Sand Mountain and Lookout Mountain form most of the Cumberland Plateau region in Georgia. They differ from the mountains of the Ridge and Valley by their flat tops. Both the Cumberland Plateau and the Ridge and Valley ecoregions are primarily sedimentary rock (formed by marine sediments compressing over millennia) such as shale (formed from silt) and sandstone (formed from sand).

The underlying rock of the Cumberland Plateau is limestone formed from the shells of marine organisms deposited in a prehistoric sea between 300 to 425 million years ago. Limestone is a soft and porous rock notorious for cave formations. Caves form when limestone is dissolved by weak acids produced when rainwater combines with carbon dioxide. This process of chemical erosion created some of the deepest caves east of the Mississippi, including Ellison's Cave, which has drops of up to 600 vertical feet. Several rivers have eroded deep canyons into the high plateau, forming impressive landforms such as Cloudland Canyon and Johnson's Crook.

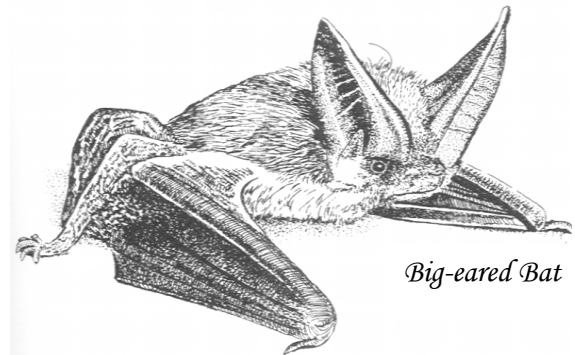
Habitat highlight: Caves

More than 500 caves are known in Georgia. They are mostly found in the Cumberland Plateau, Ridge and Valley and Coastal Plain ecoregions. A recent cave survey documented 173 invertebrate species from 47 Georgia caves, ranging from worms, to mollusks, molds and beetles.

Many vertebrates also make caves their homes, permanently or temporarily. Trogllobites are animals that only live underground, while troglloxenes are species that spend time in caves but must come to the surface for food.



Living underground in caves generates some unique adaptations among many cave dwelling creatures. Trogllobites are often blind and have lost skin pigmentation, so they appear white. They often find their way around with extensive antennae.



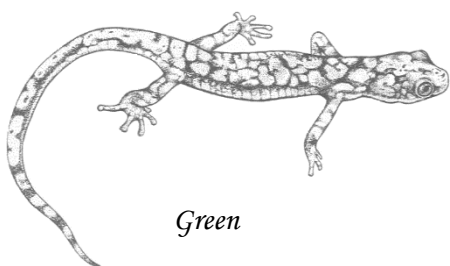
There are several species of fish, salamanders and crayfish that live only in caves. Troglloxenes include bats, rats, and cave crickets (perhaps the most common cave species). One of the most common bats that roost in Georgia's caves is the Tri-colored bat formerly known as the Eastern Pipistrelle (*Perimyotis subflavus*). Like all

Georgia bats, they are insectivores. They depend on echolocation to find their food at night, as well as navigating dark caves. Disturbing bats during hibernation, or during the breeding season, can lead to high rates of mortality for both adults and young.

Although cave wildlife is fascinating, geological formations are often the spectacular aspect of cave exploration. Minerals deposited on the roof, walls, and floors of caves form speleothems, such as stalactites and stalagmites, which create the moonscape appearance of many caves.

Key Plants and Animals

Many animals are restricted to the Cumberland Plateau region in Georgia. Most of them are amphibians that live in and among the canyons, cliffs and caves. The **Zigzag Salamander** (*Plethodon dorsalis*) is one such creature. They live in the mountain forests and are found near springs and cave openings. The **Tennessee Cave Salamander** (*Gyrinophilus pallescens*) resembles many other cave dwelling organisms with reduced eyes and pigmentation. The **Green Salamander** (*Aneides aeneus*), one of the climbing salamanders, is well adapted for its life on the cliffs and caves, where it can compress itself into narrow crevices to avoid predators and inclement weather.



The **Common Map Turtle** (*Graptemys geographica*) resides only in the Cumberland Plateau. These beautifully patterned turtles tend to live in rivers and lakes, feeding primarily on snails and crayfish. Female map turtles grow much

larger than males. Pollution and river channelization have led to decreased map turtle populations. Populations have decreased, in some states, due to collection for the pet trade.

Bats often use caves as roosting sites. Two endangered bats are found in northwest Georgia, the **Gray Bat** (*Myotis grisescens*) and **Indiana Bat** (*Myotis sodalis*). These species have been found in a small handful of caves in the Cumberland Plateau.

Historic records suggest that **Golden Eagles** (*Aquila chrysaetos*) once nested in the Cumberland Plateau. The Georgia DNR Wildlife Conservation Section is part of a regional project exploring migration routes and habitat use of golden eagles in the eastern U.S.

Other Key Species:

Northern Spring Salamander (*Gyrinophilus porphyriticus*)

Northern 2-lined Salamander (*Eurycea bislineata*),

Cave Salamander (*Eurycea lucifuga*),

Cumberland Pond Slider (*Trachemys scripta*)

Southern Cavefish (*Typhlichthys subterraneus*)

Sites to Visit:

Cloudland Canyon State Park (Case Cave),
Rising Fawn (706) 657-4050

Ellison's Cave, Walker County

Lookout Mountain, Lookout Mountain,
(800)825-8366

Sand Mountain, Dade County

Pigeon Mountain, Lafayette (includes
one of the deepest caves in the
world at 1,062 feet deep)

Crockford-Pigeon Mountain WMA
(706) 295-6041

RIDGE AND VALLEY ECOREGION

The Folded Hills

Physical Landscape

The Ridge and Valley ecoregion is adjacent to the Cumberland Plateau in northwestern Georgia and occupies about 2,800 square miles, or 5% of the state's surface area. The underlying rock is symmetrically folded, producing long parallel valleys and ridges that are oriented in a northeast-southwest direction. The ridges typically reach 1,000 to 1,600 feet in elevation, while the valleys range from 600 to 800 feet.

The Chickamauga Valley and the Great Valley are separated by the Armuchee Ridges. These three features form the majority of Georgia's Ridge and Valley ecoregion. The Great Valley (Coosa River Valley) seems to act like a corridor running diagonally from northwest Georgia and southwest through Alabama.

The Coosa River Basin, which drains the central valley, is one of Georgia's most diverse rivers. It has been called the snail capital of the world, as 32 gastropods make it their home. A total of 37 snails and mussels have been lost since the early 20th century. Researchers say that this loss is considered the largest single extinction event in U.S. history. Of the mussels and snails remaining in the Upper Coosa River Basin, seven are listed as federally threatened or endangered.

Habitat Highlight: Etowah River

Georgia's rivers are the most diverse temperate freshwater ecosystems in the world. Between native fish, mussels, snails and crayfish, these rivers are unparalleled for their species diversity. Freshwater turtle diversity in Georgia and Alabama is among the highest in the world.

The Etowah River offers a good example of a highly diverse Georgia river. The Etowah watershed is in central north Georgia and drains into Lake Allatoona in

Cherokee County. The headwaters of the Etowah are in the Blue Ridge ecoregion, but it flows through the Ridge and Valley.

Though small in comparison to many other river basins in Georgia, the Etowah river system is one of the most diverse in the world and one of the most imperiled. Historically, 91 species of fish were found in the Etowah. Since the late 1800's however, 15 species have disappeared from the watershed. Still, with 76 native fish species, the Etowah remains one of the most biologically diverse river systems in the world. Etowah River is home to more than three times the native fish species than the entire Colorado River system, and more than twice that of the Columbia River System.

Other Key Species:

Cherokee Darter (*Etheostoma scotti*)

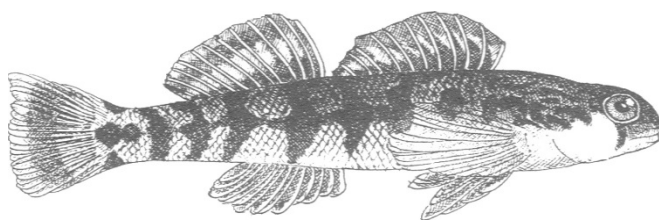
Etowah Darter (*Etheostoma etowahae*)

Upland combshell (*Epioblasma*
metastrata)

Southern Clubshell (*Pleurobema*
decisum) (freshwater mussels)

Large-flowered Skullcap (*Scutellaria* sp.)

Tennessee yellow-eyed grass (*Xyris* sp.)



Cherokee Darter

PW Aquatic Activities:

Fashion a Fish, Riparian Retreat, Blue Ribbon Niche

Key Plants and Animals

Biologically the Ridge and Valley ecoregion is more like southwest Georgia than it is to the rest of north Georgia. The Coosa River Valley allows species, more typical of the Coastal Plain, to expand their ranges into North Georgia. Several coastal plain species reach up from the Coosa Valley into North Georgia; some continuously and others with disjunct populations. **Pine Woods Tree Frog** (*Hyla femoralis*), **Gopher Frog** (*Rana areolata*), **Southern Hognose Snake** (*Heterodon simus*), as well as **Chicken Turtle** (*Deirochelys reticularia*), **Squirrel Tree Frog** (*Hyla squirella*) and **Oak Toad** (*Bufo quercicus*) extend north of the coastal plain to the Coosa River Valley.

Species Highlight: Burrowing crayfish

Georgia is home to 70 species of crayfishes. Of these 70 approximately 25 are classified as burrowing crayfishes. Instead of living in open waters such as streams and lakes, these species construct complex burrows in which they spend most of their lives. They are still considered aquatic animals as they require water for survival. They accomplish this by digging down until they reach groundwater. These burrowing species typically are found in low swampy areas or along stream margins where the water table is close to the surface. Small earthen “chimneys” are often the only evidence of their presence. These chimneys are formed as they push small balls of earth out of their burrows, which can be more than 10 feet deep. They can occasionally be seen foraging around the mouth of their burrow or moving over land on warm, damp nights, possibly looking for mates. The **Conasauga Blue Burrower** (*Cambarus cymatilis*) is a burrowing crayfish known only from the Conasauga River system in northwestern Georgia. This species was first found in burrows in the rose garden of a family in Chatsworth, Georgia. It has since been found in only four additional locations.

The Conasauga Blue Burrower lives in complex systems of tunnels that it excavates and maintains throughout its life. Because crayfish are aquatic organisms, at least one of these tunnels must go below the water table. This animal is a beautiful blue color with creamy white edges on its claws and legs. It is an endangered species in Georgia due to its small range size.

Sites to Visit:

New Echota Historic Site, Calhoun

(706) 624-1321

Chickamauga and Chattanooga Nat.

Military Park, Fort Oglethorpe

(706) 866-9241

Johns Mountain WMA, Calhoun

(706) 295-6041

BLUE RIDGE ECOREGION

A Crumpled Landscape

Physical Landscape

The Blue Ridge ecoregion includes much of north central and all northeastern Georgia, forming some of the most dramatic terrain in the state. It occupies about 1,850 square miles, or less than 5% of Georgia's area. The Blue Ridge is composed of highly metamorphosed and deformed rocks, including some of the oldest rocks in the state. The rocks range from 400 million to over one billion years old. The topography is rugged with many steep mountains ranging in elevation from 1,600 to over 4,700 feet. Brasstown Bald is Georgia's highest point at 4,784 feet above sea level. An observation building at the summit offers spectacular views of the surrounding mountains, and a museum provides excellent natural and cultural history of the area. The Blue Ridge ecoregion forms the backbone of the Appalachian Mountains from North Georgia to New York, forming the "eastern continental divide," which separates watersheds draining into the Atlantic Ocean from those draining into the Gulf of Mexico.

Habitat Highlight: Cove Forest

Some of Georgia's most splendid remnants of uncut forest reside in isolated mountain coves that proved inaccessible to earlier generations of loggers. Despite the mountain surroundings, the coves are still home to some truly massive trees to support a wonderful plant and animal diversity. A spring day is well spent in the cool understory of a Cove Forest, surrounded by wildflowers and being serenaded by the songs of thrushes and warblers.

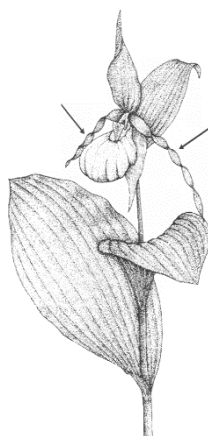
Mountain Cove Forests in Georgia typically are located above 3,000 feet on the cooler north slopes of mountains in the Blue Ridge. Though Cove Forests cover a tiny percent of the state, they are home to a

highly diverse assemblage of plants and animals. This diversity is supported by 70 inches of precipitation annually and a temperate climate.

Georgia's cove forests are home to several plant species in every level of the forest. The dominant canopy trees are often **Basswood** (*Tilia heterophylla*), **Sugar Maple** (*Acer saccharum*), **American Beech** (*Fagus american*) and **Buckeye** (*Aesculus* sp.). At higher elevations, more northerly trees are found, such as **Yellow Birch** (*Betula lutea*). In lower elevation coves, southern species appear, such as **Umbrella**, **Bigleaf** and **Fraser's Magnolia** (*Magnolia* sp.). These trees provide thick leaf litter, each fall, that contributes to the rich soils of the forest floor.

Despite the varied canopy trees, the most striking plant diversity is found in the herbaceous layer of the forest, which also provides the wonderful spring display of wildflowers. Species typical of the Cove Forest include **False Lily-of-the-Valley** (*Maianthemum canadense*), **Spring Beauty** (*Claytonia caroliniana*), **Trout Lily** (*Erythronium americanum*), **Squirrel Corn** (*Dicentra canadensis*) and **Dutchman's Britches** (*Dicentra cucullaria*). Many **Trillium** species are also present.

Many wildflowers bloom from March until May. This early spring window, between cold weather and the period when canopy trees leaf out, provides enough time for the herbaceous plants to rapidly grow, flower and produce seeds. By the time late spring arrives, many of the wildflowers will have already died.



*Yellow Lady
Slipper*

An economically important species, the **Wild Ginseng** (*Panax quinquefolius*), is the basis of a multi-million-dollar annual harvest throughout the Appalachian Mountains. The sustainability of the Wild Ginseng harvest is in question, and ginseng poaching has become a problem in protected areas such as the Great Smoky National Park. Wild Ginseng is a perennial herb that can live up to 60 years, developing a large forked taproot with many medicinal uses. Concerns over the harvest of Wild Ginseng are based in part upon its slow growth, low reproductive rate and long-life span.

The Southern Appalachians are home to 27 species of salamanders, more than anywhere else in the world. Georgia's cove forests provide habitat for many of these species. Rich under-story vegetation and rotting fallen logs provide excellent habitat for salamanders.

Natural disturbances of the cove forests are generally rare and localized, and usually consist of high winds or insect outbreaks. Though the cool humid climate led these forests to be nicknamed "asbestos forests", fires occasionally occur during droughts.

Recently, human disturbances have altered the cove forest ecosystems. Logging, both selective and clear-cutting, has removed most of the largest trees. Accidentally introduced diseases have also taken their toll. The **American Chestnut** (*Castanea dentata*) has been lost to Chestnut Blight. **Florida Dogwoods** (*Cornus florida*) and **Eastern Hemlock** (*Tsuga canadensis*) trees are currently suffering from introduced diseases.

Georgia's cove forests are home to the largest land mammal, the **Black Bear** (*Ursus americanus*). Black bears in Georgia are primarily found in the mountains and the Okefenokee Swamp. They are omnivores consuming a wide range of plants, animals and even garbage. Black bears can reach almost 500 pounds but are typically much smaller. They rarely harass people although

in areas where people feed them, they can become dangerous.

PW Activities:

*What Bear Goes Where, Limiting Factors:
How Many Bears, Raindrops and Ranges*

Key Animals: Mountain Warblers

The cooler climate of the mountains generates habitat typical of land far to the north. Because of this pattern, the Southern Appalachians form the southern range limit of many species of plants and animals, including several breeding bird species.

The diverse habitats throughout the Georgia Mountains provide nesting sites for many colorful breeding birds, but **Wood Warblers** (*Parulidae*) are among the most spectacular. Though there are several species that are year-round residents, most of Georgia's warblers are long distance migrants, leaving for the tropics each fall and returning in spring. Several of the most spectacular warblers' nest in the mountains of north Georgia, including some rare species, such as **Cerulean Warbler** (*Dendroica cerulea*) and **Golden-winged Warbler** (*Vermivora chrysoptera*). Both birds are species of concern due to recent severe declines in their populations. These two species raise an interesting management dilemma because they require quite different habitat. The Golden-winged Warbler is an early-successional species, requiring recently disturbed habitat in the mountains. Historically, blowdowns and recently burned areas provided nesting habitat for this bird. Today, regenerating clear-cuts can provide habitat for the golden-winged warbler. The cerulean warbler; however, generally nests in old forests, typically selecting large super-canopy trees for nest locations.

These two species are linked by declining numbers, but they require different habitat, illustrating the complexity and often conflicting demands of wildlife management.

PW Activities:

Changing the Land, Bird Song Survey, Migration Barriers



Habitat highlight: Trout Streams

The cold, clear water of the mountain streams offers superb habitat for cold-water fish, such as **Brook Trout** (*Salvelinus fontinalis*) and the introduced **Rainbow Trout** (*Oncorhynchus mykiss*). These fish depend on the cold water because they need high levels of oxygen that only cold water provides. The rocks along the streambed are often crawling with aquatic invertebrates that provide the food for the growing trout. These invertebrates typically press themselves flat to the rocks to keep from being swept downstream and breath with gills until they immerse from the water as adults. The North Georgia cold mountain streams are extremely diverse and provide an important source of recreation for all fishermen and women.

Sites to Visit:

*Fort Mountain State Park, Chatsworth,
(706) 422-1932*

*Sosebee Cove, Rte. 108 NE of Vogel State
Park*

Brasstown Bald, (706) 896-2556

*Vogel State Park, Blairsville,
(706) 745-2628*

*Tallulah Gorge State Park, Clayton
(706) 754-7981*

*Smith-Gall Woods Conservation Area,
Helen (706)-878-3087*



Brook Trout

PIEDMONT ECOREGION

The Foothills

Physical Landscape

Piedmont literally means foothills. The Piedmont forms a gentle “S” curve from New York State to Montgomery, Alabama, bordered to the west by the Appalachian Mountains and to the east by the flat Coastal Plain. Crystalline rocks (mostly granite) underlay the Piedmont. The low-relief landscape found in the Piedmont is a result of millions of years of erosion gradually transforming mountains into a gentle rolling landscape that is not yet flat like the Coastal Plain.

The Piedmont covers about 29% of the state of Georgia (17,253 square miles) and is typically associated with rough hilly terrain in the north and gentle rolling hills further south. The Piedmont extends south from the mountains of north Georgia to the fall line and ranges from 500 to 1,500 feet in elevation. The fall line marks the boundary between the crystalline rocks of the northern part of the state and the mostly unconsolidated sediments of the coastal plain. It is thought to be the furthest inland extent of the prehistoric coastline. The fall line is often associated with waterfalls and rapids formed as rivers tumble from the Piedmont to the Coastal Plain.

Early settlers would have found much of the Piedmont covered with broad-leaf hardwood trees dominated by the now rare **American Chestnut** (*Castanea dentata*). Today much of the Piedmont is covered with pine forests, a result of silvicultural rather than natural processes.

Habitat Highlight: Flint River Basin

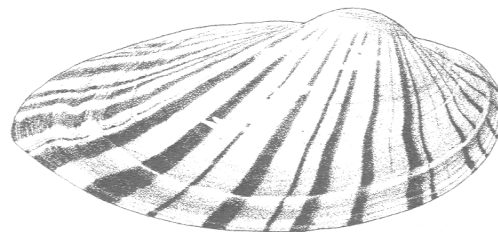
The Flint River is considered the most scenic river in the Georgia Piedmont and Coastal Plain. The uppermost headwaters originate under Hartsfield Jackson International Airport. From such inauspicious beginnings the Flint rapidly forms a dramatically carved channel through

the red hills region of the Georgia Piedmont and is one of only 40 rivers in the United



States that stretches for over 200 miles virtually unimpeded (without dams).

Like the Etowah River in north Georgia, the Flint River exhibits remarkable biotic diversity, exhibiting an abundance of freshwater mussel species. The Flint originally was home to 29 mussel species, though recent surveys suggest that only 22 remain. Though certainly not the most charismatic and high-profile species, freshwater mussels have an interesting natural history.



Shinyrayed Pocketbook

Freshwater mussels filter water through elaborate gill structures to collect oxygen and food. An intriguing aspect of Georgia freshwater mussels is their parasitic dependence upon fish for reproduction. Mussel larvae must attach to the gills of specific fish in order to survive. After several weeks, they drop off, and continue their development independently. In order to attract the required fish host within range,

the adult mussels produce elaborate “lures” which look remarkably like the host fish. Once a suitable host approaches, the mussel expels the larvae (glochidia) into the water. This form of reproduction aids in mobility of an otherwise immobile species.

Sedimentation, dams, pollution and channelization threaten many species of Unionoid mussels today.

PW Aquatic Activities:

*Watershed, To Dam or not to Dam, Silt:
A Dirty Word, Dam Design*



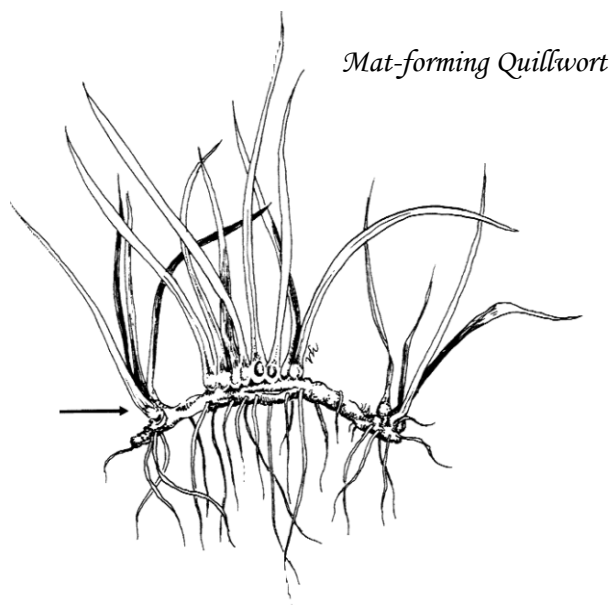
Habitat Highlight: Rock Outcrops

A particularly harsh habitat type found mostly on the Piedmont is the rock outcrop. Georgia boasts many rock outcrops including the largest in the world, Stone Mountain. Rock outcrops can be either Manadnocks, which rise above the surrounding Piedmont like Stone Mountain, Arabia Mountain and Panola Mountain, or they can be simple “flat-rock” or “pavement rock” outcrops, like Heggies Rock. Most outcrops are composed of granite, an igneous rock that crystallized from slow cooling magma underground (intrusive igneous rock). The molten domes of magma that cooled to form outcrops were generated from the heat and friction at the edges of colliding continental plates about 500 million years ago. The softer rock surrounding these granite domes gradually

eroded away, leaving the granite exposed at ground level. In some cases, such as Arabia Mountain, the granite changed into gneiss (a metamorphic rock) due to high heat and pressure long before the surrounding rock eroded and exposed it.

Rainwater falling on rock outcrops fill pools of standing water. These pools are called solution pits and provide habitat for rare plants and animals. If rainfall is consistent these wet depressions support dish gardens, a unique rock outcrop community that exhibits distinctive rings of progressively drier habitat further from the wet center. Standing water in the center of a dish garden may contain **Fairy Shrimp** (*Branchinella* sp) and **Mat-forming Quillwort** (*Isoetes tegetiformans*), species that only occur on rock outcrop pools. Both species can survive desiccation as the outcrop pools often dry up in summer.

Because of their harsh exposed environment, rock outcrops offer a good place to observe primary succession and early soil development. The first organisms that can survive on the bare rock surface are lichens and mosses. These organisms dissolve rock with weak acids. After many years, through chemical and physical



decomposition, a thin soil layer is formed.

Soil allows other tolerant plants to establish, such as **Diamorpha** (*Diamorpha smallii*) and **Sedum** (*Sedum pusillum*), both succulent plants (fleshy leaves that hold moisture) well designed to withstand long periods of dry weather. As the soil continues to thicken, **Broomsedge** (*Angropogon* sp.), **Sandworts** (*Caryophyllacea* sp.) and **Orange grass** (*Ctenium aromaticum*) can colonize the rock. **Confederate Daisy** (*Viguiera porteri*), an endangered and endemic species, is quick to follow. Eventually small shrubs and trees will completely cover the rock outcrop. This progression from rock to forest can often be seen on a single rock outcrop transect starting on bare rock and walking towards the encroaching forest at the outcrop's edge.

Rock outcrop plants are vulnerable to disturbance of vehicle and extensive foot traffic. Many of the rock outcrops in Georgia are or have been actively quarried for granite, making Georgia one of the top producers of granite in the United States.

Outcrop Sites to Visit:

Davidson-Arabia Mountain Heritage Area, Lithonia (770) 484-3060
Heggie's Rock, Columbia County (404) 873-6946
Panola Mountain State Park, Lithonia (770) 389-7801
Stone Mountain Park, Stone Mountain (770) 498-5690

Key Species: Birds of Prey

Georgia is home to 23 birds of prey species. These range in size from the massive **Bald Eagle** (*Haliaeetus leucocephalus*) to the diminutive **Eastern Screech-Owl** (*Otus asio*). Birds of prey share a suite of impressive adaptations

allowing them to catch and kill live prey. Talons, or sharp curved claws, are the principal weapons of the bird of prey, although a formidable hooked beak is put to good use. Birds of prey are known for their eyesight, which approaches the limits of vision possible with the vertebrate eye.

The diurnal birds of prey (those that hunt by day), include the hawks, eagles, falcons, harriers and osprey. The only nocturnal birds of prey are the owls. In Georgia there are three breeding species of owl and several others that winter sporadically throughout the state. Owls' eyes see only in black and white but are extremely sensitive to low light conditions, allowing them to fly through the woods chasing prey in the middle of the night. Owls' hearing is acute, allowing them to pinpoint the location of their prey before they can even see it. Owls are well known for their ability to fly almost completely silent, allowing them to sneak up on their prey without being detected.

PW Activities:

Owl Pellets, Birds of Prey, Quick Frozen Critters

Piedmont Sites to Visit:

Charlie Elliott Wildlife Center, Mansfield (770) 784-3059
Hard Labor Creek State Park, Rutledge (706) 557-3001
McDuffie Environmental Education Center, Dearing (706) 969-4373
Newman Wetland Center, Jonesboro (770) 603-5606
Piedmont National Wildlife Refuge, Juliette (478) 986-5441
Ocmulgee Indian Mounds National Monument, Macon (478) 752-8257 x222

COASTAL PLAIN ECOREGION

Ancient Sea Floor

Physical Landscape

The Coastal Plain of Georgia stretches from the fall line to the Atlantic Ocean, covering 35,650 square miles (60% of the state). The Coastal Plain was once a sea floor and is composed mainly of unconsolidated sediments with little hard rock at the surface. Coastal Plain sediments originated in the Piedmont and even in the mountains beyond and have been deposited over thousands of years. Near the fall line the Coastal Plain can be highly dissected with river valleys ranging from 50 to 250 feet below ridge tops. It becomes nearly flat as one gets closer to the coast. The soils of the Coastal Plain tend to be sandy, a result of prehistoric oceans advancing and retreating across them. Prehistoric wave action dissolved and reduced soils to the sturdiest of substrates, quartzite or sand.

The Coastal Plain typically has a moderate climate with hot humid summers and mild winters. There is an average of 51 inches of rain, which comes from both convective thunderstorms in spring and summer and occasional hurricanes in fall.

Habitat Highlight: Longleaf Pine-Wiregrass Community

The Longleaf Pine-Wiregrass community is unique to the Coastal Plain and among the most endangered habitats in the United States. The extent of **Longleaf Pine** (*Pinus palustris*) forests just 200 years ago were unimaginably large. It is estimated that over 90 million acres of longleaf pine forests stretched from Texas throughout the Gulf Coast states, peninsular Florida, Georgia and up the east coast to Virginia. Currently, only several thousand acres of good quality old-growth longleaf pine remain scattered throughout the southeast. The remaining stands of longleaf pine are mostly found on private quail hunting plantations and military land. longleaf pine

forest was without a doubt the dominant woodland of the Southeastern coastal plain before European settlement.



Longleaf pine trees tend to grow widely spaced, creating an open park-like forest. Sometimes these forests appeared more like grasslands with scattered pine trees than true forests. At first glance, a Longleaf Pine-Wiregrass ecosystem appears to be composed of only two or three species, but the herbaceous understory forms one of the most diverse plant communities north of the tropics. In some areas over 40 plant species per square meter is not uncommon. Hundreds of species of grasses, legumes and other herbaceous plants grow beneath the pines. Many of these plant species are only found in the longleaf pine forest. Another defining feature of the longleaf pine forest, and one that played an important role in its

decline, is the forest's dependence upon fire. In fact, fire is a crucial factor in maintaining many plant communities and is essential to the survival of the Longleaf Pine –Wiregrass community. Without fire, hardwoods grow up through the Longleaf Pine, competing for light, nutrients and space. Fire suppression throughout much of the last century contributed to the decline of longleaf pine forests.

PW Activity:

Fire Ecologies, Smoky Bear Said What?

Historically fires, started by lightning strikes, swept through the understory every three to five years burning back shrubs and hardwoods. Mature longleaf pine were protected from fire by thick heat-resistant bark. Native Americans also burned the understory to manage for game, and early European settlers burned to maintain good forage for cattle in forest understory.

Blow downs are the chief natural cause for mortality among mature longleaf pine trees. Older trees rise above the canopy, exposing them to direct wind. Without windstorms, it seems that the longleaf pine trees show very little signs of aging and can live for many hundreds of years.

Key Plants: Longleaf Pine

The namesake of the longleaf pine forest is a tree with a fascinating natural and cultural history. Its dependence on fire and unique growth strategy set it apart from most other trees. Its cultural history is as interesting as its natural history. Much of the United States was built with longleaf pine. It is estimated that 200 billion board feet of lumber were cleared from these southeastern forests over the last 200 years.

Every stage of the longleaf pine's life depends on fire. The seeds require bare mineral soil to germinate. These soils are typically found after a fire has burned off the leaf litter. The germinated seed grows into

the grass stage, which looks like a low growing bunch grass. Closer observation will show that the leaves are pine needles. The longleaf pine can remain in the grass stage for many years, awaiting a fire to clear the way for its growth. The dense clusters of needles protect the growth cells from this fire. After a fire burns through, clearing brush away from the pine seedling, the tree enters the rocket stage. This involves a rapid period of growth during which the tree is vulnerable to fire. Once freed from the understory, the tree can continue to grow and eventually become a canopy tree. As it grows, it develops thick bark that protects it from subsequent fires.

Longleaf Pine Sites to Visit:

Fort Stewart, Hinesville (912) 767-8241
Tall Timbers, Thomasville (850)893-4153

Key Animals: Birds



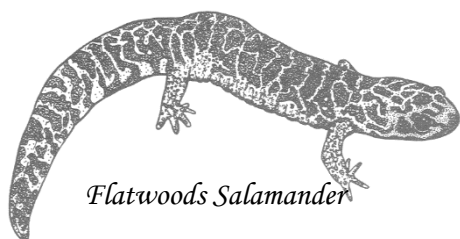
Red-cockaded

The **Red-cockaded Woodpecker** (*Picoides borealis*) and the **Bachman's Sparrow** (*Aimophila aestivalis*) are two birds that are dependant upon the Longleaf Pine ecosystem. The red-cockaded woodpecker (RCW) is listed as an endangered species largely due to its

exclusive dependence on a diminished habitat. As habitat specialists, RCW's require large old pines suffering from red-heart rot, a disease that softens the wood enough for them to drill nest holes. RCW's are the only North American woodpecker to nest in living trees. This means that

building a nest hole is a difficult task that can take years to complete. This fact leads to high site fidelity in areas with cavities already excavated and has led managers to create artificial cavities for RCW's.

Predators, such as rat snakes and other woodpeckers, can significantly decrease nest success. In order to discourage predators RCW's often drill many small holes around their nest hole to release sap making it difficult for snakes to get into the nest.



Flatwoods Salamander

Other Key Species:

Sherman's Fox Squirrel (*Sciurus niger shermani*) The largest North American squirrel

Gopher Tortoise (*Gopherus polphemus*)
Threatened species

Eastern Indigo Snake (*Drymarchon corais*)
Threatened Species

Flatwoods Salamanders (*Ambystoma cingulatum*) Threatened Species

Habitat Highlight: Carolina Bays

A unique wetland feature of the Southeastern Coastal Plain is the Carolina Bay. Carolina Bays are oval, or teardrop shaped wetlands oriented along a Northwest-Southeast axis and are found from Maryland south to Georgia. Some support permanent lakes while others experience more irregular water levels. Carolina Bays range from 6 to 30 feet deep and from several acres to 6,000 acres in size. Due to varying water levels, the vegetation differs dramatically from one bay to another. Some are characterized by cypress forests, others marsh and some shrub bogs. Georgia

is home to more than 1,000 Carolina Bays, covering 250,000 acres.

The unique distribution, shape and orientation of Carolina Bays have generated some interesting speculation about their origins. Some hypothesized that meteor showers caused craters, which then filled with water. This dramatic origin is supported by the similar alignment of the bays, but no meteoric fragments have been found. A more probable hypothesis suggests that gale-force winds during the last glacial period scooped these depressions out of the sandy soil. Sandy ridges occurring on the eastern side of many Carolina Bays support this hypothesis. Whatever their origin, Carolina Bays along with cypress and gum trees are important inland wetlands that provide habitat for a wide range of plants and animals.

Underlying the Carolina Bays is a clay layer that keeps the water from draining through the otherwise porous soil of the Coastal Plain. Carolina Bays tend to be isolated from other bodies of water, so their only access to water is rainfall. Water loss comes from evaporation and plant transpiration.



Carolina Bays tend to have some peat development, which is a layer of partially decomposed plant matter. Peat forms when plant production exceeds the rate of decomposition. Decomposition rates are slow in wetlands due to the lack of oxygen

in the soil. Several Georgia Bays have peat deposits over 14 feet deep, the product of about 9,000 years of plant decomposition.

Peat saturated soils tend to become highly acidic (pH 4.5) creating a stressful environment for plants, leading to a limited plant community. Plants that can thrive in these oxygen poor acidic soils are called hydrophilic or “water loving”. **Pond Cypress** (*Taxodium acendus*) dominate in bays that are flooded for extended periods, while more irregularly flooded habitats maintain **Blackgum** (*Nyssa sylvatica*), **Red Maple** (*Acer rubrum*) and **Pond Pine** (*Pinus serotina*) as well. **Pickerel Weed** (*Pontedara cordata*) and **Water Lily** (*Nymphoea stellata*) dominate open water habitat.

Though it may seem counterintuitive, fire plays an important role in the maintenance of Carolina Bays. During dry periods, peat becomes flammable, and lightning strikes can ignite fires that burn off woody vegetation and layers of peat. Historically, bays probably burned about every 25 years, keeping them from growing over with vegetation. This is a great example of how a disturbance regime can play an important role in habitat maintenance.

Human impacts on Carolina Bays have been dramatic. Many have been drained and cut for farming and timber. Peat mining and fire suppression have both led to the declining quality of Carolina Bays.

Carolina Bays offer an excellent place to learn about the importance of wetlands in

the Georgia landscape. Unfortunately, wetlands are often viewed as inhospitable wastelands, dominated by things that bite, sting and otherwise impede human “progress”. This attitude led to a loss of more than 50% of wetlands in the U.S. and threatened many of the unique wetlands in Georgia. Conservation efforts have helped decrease the rate of wetland loss.

The benefits of wetlands are hard to overestimate. They provide critical habitat for many plant and animal species that could not survive in other habitats. They are also critical for water management as they absorb and store vast quantities of storm water, helping reduce floods and recharge aquifers. Not only do wetlands store water like sponges, they also filter and clean water absorbing toxins and other pollutants.

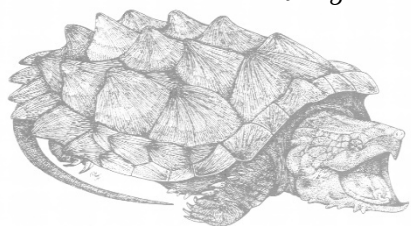
PW Aquatic Activity:

Wetland metaphors. Marsh Activity, Pond Succession

Key Animals: Altamaha Spinymussel

The **Altamaha Spinymussel** (*Elliptio spinosa*) is found only in the Altamaha River drainage of Georgia. This animal reaches a length of about four inches, a height of nearly three inches and is dark greenish to black in color. What makes this species so interesting is the three to five, long spines that develop on each of its valves (shells). The spines begin growing when the mussel is a juvenile and can reach an inch or more in length. However, they often break off as the mussel gets older and many adult individuals show little evidence that a spine was ever there. It has been suggested that the spines help to anchor the mussel in the sandy habitats of the Altamaha River drainage. There are two or three additional “spinymussels” in North America but none as large and handsome as the Altamaha Spinymussel.

Alligator Snapping Turtle



Key Animals: American Alligator

The **American Alligator** (*Alligator mississippiensis*) is the largest reptile in Georgia. Today it is rare for one to exceed 14 feet in length, but alligators have reached over 19 feet. Alligators have lived mostly unchanged for 180 million years, coexisting with and surviving the extinction of the dinosaurs. Until human settlement in the Southeast they remained the unchallenged rulers of swamps and bayous from Texas to North Carolina.

Due to excessive hunting and wetland draining, American alligators were placed on the Endangered Species list in the 1970's. In the last 30 years American alligators have made a remarkable comeback, and there are currently an estimated 2 million alligators in the southeastern United States.

Alligators serve many important roles in the swamps of Georgia. They keep rodents and other grazing species under control. Alligators also create wallows, which stay wet even if the surrounding swamp dries out. These wallows or "gator holes" provide watery refuges for aquatic plants and animals that would otherwise dry up and die during times of drought.



American Alligator

PW Activity:

Back from the Brink

Key Plants: Pond Cypress

The **Pond Cypress** (*Taxodium acendus*) is the dominant tree in still water wetlands. Whereas the **Bald Cypress** (*Taxodium distichum*) prefers moving water wetlands. Both are impressive trees that can reach 150 feet tall and live over 900 years. They are deciduous conifers, shedding their needles in late November and re-growing them in March. Cypress require varying water levels at different stages of their life history. Cypress seeds need bare wet soil to germinate, while the adults dominate in flooded areas where other trees cannot survive. The most distinctive features of both Cypress species are the splaying buttresses at their base and the cypress knees projecting above the ground surface. The buttresses provide structural support in the muddy soils. It is thought that the knees may aid in gas exchange allowing oxygen to reach the roots despite saturated soils.

Both species of Cypress are valuable timber species, and many of the state's most impressive stands have been cut. The wood is of value due to its resistance to rot and insect infestation.

Key Plants: Pitcher Plants

Throughout the Coastal Plain, wherever there are bogs, wet savannas, low areas in pine flatwoods and other wetland habitats, a variety of **Pitcher Plants** (*Sarracenia* sp.) may be found. Pitcher plants are a fascinating group of plants adapted to the low nutrient soils of wetlands. In order to meet their nutrient requirements, Pitcher plants are carnivorous, feeding off a wide variety of insects. Georgia has 7 species of pitcher plants, some of which can be found in the Piedmont and Mountains, but most are restricted to the Coastal Plain. All pitcher plants are protected due to concern over their declining populations. The **Green Pitcher Plant** (*Sarracenia oreophila*) is federally listed as an endangered species.



Sites to Visit:

Big Hammock Natural Area, Glennville
(229) 426-5267

Radium Springs, Albany
(229) 317-4760

Grand Bay Wetland Center, Valdosta
(229) 333-0052

Providence Canyon Conservation Park,
Lumpkin, (229) 838-6202

Oxbow Meadows Environmental Learning Center
Columbus (706) 687-4090

Okefenokee Swamp, Fargo
(912) 637-5274

Magnolia Spring State Park, Millen
(478) 982-1600

Pitcher plants have tube-shaped leaves (known as “the pitcher”) that form a trap when partially filled with water. Insects are lured into the pitcher with sweet nectar. A waxy layer on the inside of the pitcher, coupled with many downward pointing hairs, makes it difficult for insects to escape. Once they fall into the water, they drown and are digested by enzymes the plants produce.

Building a pitcher plant bog is a fairly easy way to encourage children to observe these carnivorous plants. (See Web Resources page 30).

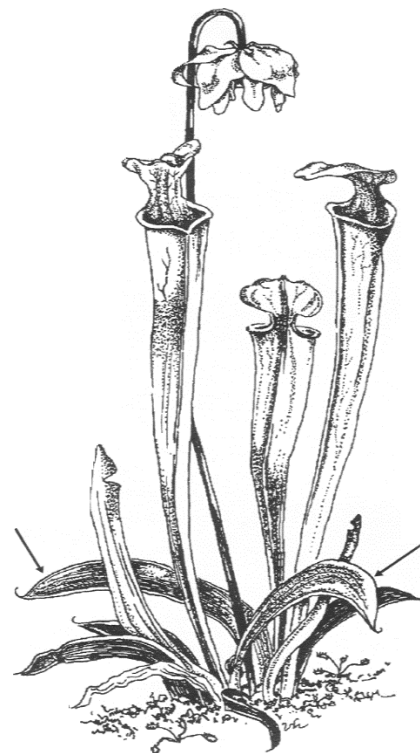
Other Key Species:

Alligator Snapping Turtle

(Macrolemys temminckii) – Our largest freshwater turtle, the Alligator Snapping Turtle is a species of concern in Georgia. It can reach 300 lbs in weight.

Sandhill Crane (*Grus canadensis*)

Grazing disturbance helps maintain open prairie in Carolina Bays and the Okefenokee.



Green Pitcher Plant

MARITIME ECOREGION

Habitat Highlight: Barrier Islands

The crown jewels of the Georgia coast are the undeveloped barrier islands. Due to a fascinating history of land ownership and farsighted conservation laws (The Marsh Protection Act) Georgia has the least disturbed coast on the eastern seaboard.

Georgia's coastline is roughly 110 miles long, stretching from the Savannah River in the north to the St. Mary's River in the south. The soils are typically sandy and habitat disturbances include wind, waves and tides. The Georgia coast enjoys a subtropical climate with long hot summers and mild winters during which temperatures rarely fall below freezing. The coast receives 30 to 50 inches of rain annually. Thunderstorms generate most of the summer rainfall as the Bermuda High Pressure system dominates the region keeping low-pressure storms away.

There are eight clusters of barrier islands off the coast of Georgia, four of which are accessible by car (Tybee, Sea, Jekyll, and St. Simons Islands). The remaining islands are more difficult to reach, but are worth the effort, because they are less developed than the accessible islands. These island clusters protect the mainland and salt marshes from the constant onslaught of wind and waves.

Barrier islands are, by their very nature, in a state of constant change, reshaped by the ongoing action of wind, currents and tides. Depending on the relative strengths of these three forces, barrier islands will assume radically different shapes. Even a cursory glance at a map illustrates the difference between the barrier islands of Georgia and those of the Carolinas. Georgia's islands are generally tear dropped in shape in sharp contrast to the narrow linear islands forming North Carolina's Outer Banks.

Due to the location of Georgia in the heart of the South Atlantic Bight, a large

indentation in the southeastern coastline stretching from Cape Hatteras in the north to Cape Canaveral in the south, and the continental shelf 70 miles offshore.

Georgia's coastline is well protected from major storms, waves and currents. This protection, coupled with a high tide range (7 to 9 feet), makes the daily tidal fluctuations the most important shaping force on the islands. Tidal currents generally run perpendicular to the coastline, forming wide, short islands from the sands and silts of the coastal sediments. These wide, short islands are called mesotidal islands. In sharp contrast, the North Carolina coast is exposed to the brunt of many Atlantic storms and has a much smaller tidal range than Georgia. This situation generates a strong longshore current running parallel to the coast that creates long narrow islands that are called microtidal islands.

The tear dropped islands of the Georgia coast are more stable than the islands of North Carolina and have developed more extensive maritime forests. The islands have been in roughly the same position for



the last 4,000 to 5,000 years.

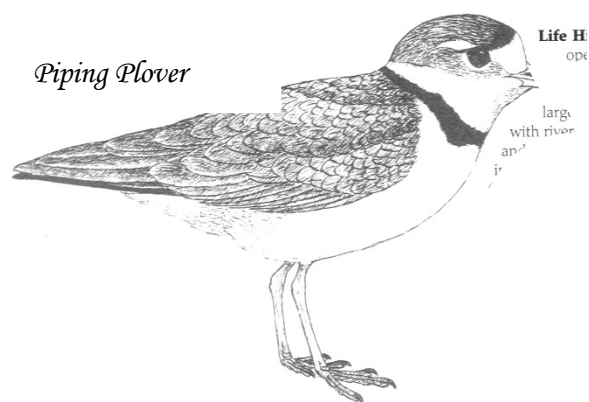
The actual formation of Georgia's Barrier Islands requires a gently sloping continental shelf and a rising sea level. These two parameters were met in Georgia over the last 20,000 years, as sea levels rose

from melting glacial ice at the end of the last glacial period. Rising sea levels surrounded and isolated existing dunes, forming islands. Sediments carried downstream settled in behind these islands to form the rich salt marshes of the tidal zone.

The typical form of Georgia's barrier islands includes a wide beach facing the open ocean, with slightly elevated dunes above the high-tide line. Behind and protected by these dunes is the maritime forest of the interior. Vast expanses of salt marsh stretch between the islands and mainland with scattered hammock forests protruding from the otherwise unbroken waves of saltmarsh cord grasses.

Habitat Highlight: Beaches

Constant wave action prohibits the establishment of plants along active beaches, and a quick glance might suggest a lifeless boundary between sand and water. Closer observation reveals a complex reality. Shorebirds continuously probing into the sand provide evidence of an invisible host of invertebrates beneath the uniform sands.



Dark cylinders reminiscent of chocolate ice cream “sprinkles” surround the opening of **Ghost Shrimp** (*Callinassa* sp.) holes in the low tide zone. **Ghost Crab** (*Ocypode ceratophthalmus*) tracks and holes are also evident to the careful observer. These are white crabs up to 3 inches wide that scavenge along the upper beaches at night. The high-tide line of seaweed and driftwood is often hopping with **Sand Fleas** (*Orchestia agilis*) and provides cover for the elusive

Piping Plover (*Charadrius melodus*, an endangered species). Further evidence of life includes washed up coral fragments, shells, **Sand Dollars** (*Dendraster excentricus*) and seaweed.

Glancing over the Atlantic Ocean itself often yields diving terns and pelicans, rafts of ducks and flocks of shorebirds. In winter **Northern Gannet** (*Morus bassanus*) may be seen diving from up to 50 feet above the surface. Dolphins are also commonly seen at points along the Georgia Coast.

PW Aquatic Activity: *Kelp Help*

Habitat Highlight: Dunes

As one walks inland from the beach towards the maritime forest, one will pass through distinct vegetative zones as the effects of direct wave action, salt-spray and wind diminish. The first plants met are the hardiest most salt tolerant species such as **Sea Oats** (*Uniola paniculata*), **Prickly-pear Cactus** (*Opuntia* sp.) and **Beach Morning Glory** (*Ipomea stolonifera*). These plants can survive the harsh sandy landscape. They play an important role in stabilizing the dunes with their extensive but shallow root systems. Plant cover and diversity generally increase as one moves inland from the fore dunes, across the dune meadow to the more stable back dunes. **Wax Myrtle** (*Myrica ceriferus*) shrubs will often form dense thickets on the back dunes, both stabilizing the soil and providing habitat and food for wildlife such as wintering **Yellow-rumped Warblers** (*Dendroica coronata*).

During storm surges, waves may break through and obliterate the protective dunes carrying saltwater inland. These washover events can form saltpans that are highly resistant to plant establishment. Few environments exhibit such an obvious struggle between plants and natural disturbances as the dunes, where plants

constantly work to stabilize and winds and water to destabilize.

Habitat Highlight: Maritime Forest

Crossing into the back dunes and beyond, one enters the realm of the maritime forest. The maritime forests of the southern coast are as unique and enchanting as any other forest in the United States. The intricately gnarled **Live Oak** (*Quercus virginiana*) cloaked in **Spanish Moss** (*Tillandsia usneoides*) and **Resurrection Fern** (*Polypodium polypodioidies*) and surrounded by **Saw Palmetto** (*Serenoa repens*) seems to be an anachronistic remnant of a slower and quieter past. The spreading canopy of **Live Oak**, **Southern Pine** (*Pinus* sp), **Southern Magnolia** (*Magnolia grandifolia*) and **Cabbage Palm** (*Sabal palmetto*) temper the harsh forces of wind and water that assault the dunes and beaches. Temperatures and winds moderate under the tree canopy, which increases moisture levels and allows a dense understory of herbs and shrubs to develop.

Spanish moss and resurrection fern are both epiphytes, plants that live on other plants entirely independent of the soil. Typically, epiphytes require humid environments where they can absorb moisture directly from the atmosphere, so they are more common in the humid tropics than temperate regions. In the understory dense clusters of saw palmetto provide excellent hiding places for **Eastern Diamondback Rattlesnakes** (*Crotalus adamanteus*), Georgia's most dangerous

snake, which hunts rabbits and other mammals across the Coastal Plain and islands.



Habitat Highlight: Salt Marshes

A combination of heat, biting insects and the odor of decomposing vegetation can make salt marshes a challenging habitat to enjoy in the summer. During the cooler times of the year however; salt marshes are great places to visit, affording good views of many birds and other wildlife.

Georgia contains one third of the salt marshes along the entire eastern seaboard. Vast expanses of marsh grasses live between the mainland and the protective barrier islands all along the Georgia coast. The lack of plant diversity belies the incredible biological importance of coastal salt marshes. Marshes are some of the most productive systems on earth, producing vast

Bald Eagle



Key Species:

Live Oak (*Quercus virginiana*)

Georgia's State tree, the live oak is a magnificent tree that is often characterized by a broad spreading canopy. Live oaks are evergreen broadleaf trees with a small waxy leaf that protects them from salt spray and desiccation.

amounts of biomass annually. They provide important habitat for a wide range of fish, shellfish and bivalves, many of which form important staples of the human diet.

Many species of birds such as **Great Blue Herons** (*Ardea herodias*), **Bald Eagles** (*Haliaeetus leucocephalus*), **Clapper Rails** (*Rallus longirostris*) and various ducks and sparrows use these coastal marshes seasonally. **Raccoons** (*Procyon lotor*) regularly hunt the edges of salt marshes leaving their characteristic handprint tracks as evidence of their nocturnal forays.



Salt marshes form behind barrier islands where they are protected from the relentless wind and waves of the ocean. They also form along estuaries where rivers enter the ocean. Salinity of these marshes decreases as one moves farther inland. This salinity gradient offers a wide range of habitats for plants and animals.

Salt marshes exhibit some of the harshest environmental conditions of any Georgia ecosystem. As the tides ebb and flow, temperature, salinity and water levels drastically change. Plants and animals must be able to survive these environmental fluctuations if they are to last in the salt marsh. The star of the salt marsh is **Cord grass** (*Spartina alterniflora*), which is well adapted to surviving the rigors of life in the inter-tidal zone.

Key Species:

Cord Grass (*Spartina alterniflora*).

Few species can handle the environmental hardships of tidal life. Temperature, salinity and water levels change drastically twice a day, and there is a complete lack of oxygen in the muddy soil. *Spartina* is ideally adapted to this life and is essentially the only plant that can survive in the low marsh. *Spartina* absorbs oxygen through folds in its leaves, channeling it to the roots. Excess salt is secreted through pores along the leaves. Sliding a blade of grass through one's fingers, one will wipe off a fine salty residue that the plant has emitted through its pores. *Spartina* plays a critical role in trapping and stabilizing sediment in the marsh. Without the grass, mud would rapidly erode.

Periwinkles (*Littorina* sp.) are salt-water snails that crawl up and down the *Spartina*, grazing on algae that grow on the leaves.

Tidal creeks and streams meander through the marsh draining and flooding the salt marshes twice each lunar day. Though tides create a harsh environment, they also provide the sustaining nutrients and carry wastes from the entire system. Along these channels **Oysters** (*Crassostrea virginica*), **Ribbed Mussels** (*Geukensia demissa*) and **Blue Crab** (*Callinectes sapidus*) can be found.

PW Aquatic Activity:

Marsh Munchers, Dragonfly Pond

Habitat Highlight: Live Bottom Reefs

Probably the least known habitat in Georgia, and certainly the hardest to visit, is the live bottom reef ecosystem off the Georgia Coast. The largest example is Gray's Reef National Marine Sanctuary located 17 miles offshore from Sapelo Island.

The vast majority (> 95%) of the Georgia Bight seafloor is composed of loose sediments that provide very little habitat for marine species.

Ridges of sedimentary rock exposed on the sea floor form Gray's Reef. Though these ridges only rise about 6 feet off the sea floor, they form a critical substrate for soft corals and sponges to grow, attracting large numbers of marine fish, mammals and even reptiles. Burrowing marine worms dig through the soft rock, creating even more habitat. Due to the location of Gray's Reef both tropical and temperate species are found. Temperate fish such as **Sheepshead** (*Archosargus probatocephalus*) share space with tropical reef fish, such as **Angel Fish** (*Centropyge* sp.) and **Butterfly Fish** (*Chaetodon* sp.).

Several endangered species can be found at Gray's Reef. During the calving season, **Atlantic Right Whales** (*Eubalaena glacialis*) have their young within the sanctuary and endangered **Loggerhead Sea Turtles** (*Caretta caretta*) feed on the sponges, whelks and crabs found on the reefs. Gray's Reef is so critical for marine wildlife that it was designated a National Marine Sanctuary in 1981.

Attempts have been made to increase the amount of reef habitat off the Georgia coast. Divers have long known that shipwrecks are often great places to observe marine animals and plants, as the physical structure of the wreck provides habitat. This knowledge has led to the intentional sinking of ships, subway cars and artificial cement reef structures to provide habitat for fish and

other species. Marine plants and animals rapidly colonize these artificial reefs.

PW Aquatic Activity:

Fishy Who's Who, Fishable Waters

Key Animals: Manatee

Manatees (*Trichechus manatus*) are an intriguing, large, endangered marine mammals found off the Georgia coast between March and November. It is one of only 4 **Sirenians** (order Sirenia) in the world, a group of aquatic mammals that are closely related to elephants. Generally, it is found in shallow coastal waters and tidal rivers. Manatees eat *Spartina* (cord grass) as well as other emergent vegetation. Manatee primarily stay in Florida though they do swim north to Georgia in spring and summer. They bask near the surface, leading to frequent boat collisions and associated mortality.



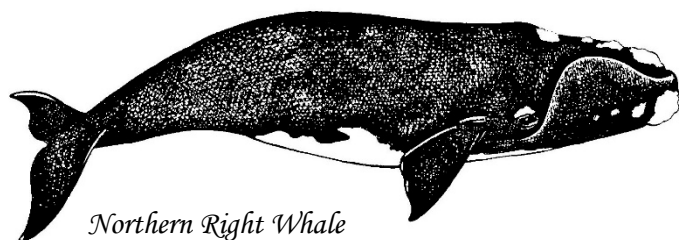
West Indian Manatee

PW Aquatic Activity:

Mermaids and Manatees

Key Animals: Northern Atlantic Right Whale

The **Northern Atlantic Right Whale** (*Eubalaena glacialis*) is Georgia's state marine mammal and is the most endangered whale in the world. Estimates put their population at around 350 individuals. The right whale is a baleen whale, meaning that it feeds by filtering vast amount of water through hundreds of baleen bristles hanging from its top jaw. Right whales generally feed on tiny zooplankton called calanoid copepods off the coast of Cape Cod and Nova Scotia, and do not feed during their southward visit to Georgia and Florida where they calf and feed.



Northern Right Whale

The right whale received its name from whalers because of the ease and profitability of hunting them. Right whales are large and produce huge amounts of blubber. They are also slow and float once they are killed. This combination made them easy prey for early hunters, and their numbers rapidly declined until they were first protected in 1935.

Today the most serious threats to the right whale are entanglement in fishing nets and collisions with ships. A communications network has been established to alert commercial vessels of the presence of right whales so that collisions can be averted.

PW Aquatic Activity:

Whale of a Tail, A Whale of an Issue

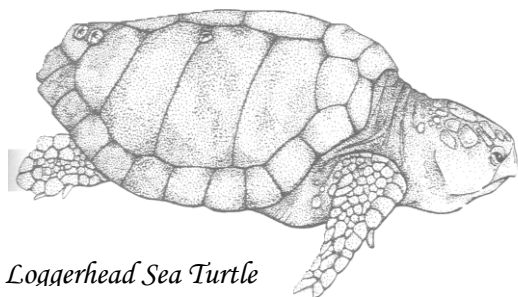
Key Animals: Loggerhead Sea Turtle

The **Loggerhead Sea Turtle** (*Caretta caretta*) is the most common of 5 sea turtle species that use the coast of Georgia and is the only one that regularly lays eggs on the beaches. The other species include the **Leatherback** (*Dermochelys coriacea*), **Kemp's Ridley** (*Lepidochelys kempii*), **Green** (*Chelonia mydas*), and **Hawksbill Sea Turtles** (*Eretmochelys imbricata*).

Sea turtles have navigated the world's oceans and beaches for more than 200 million years. Despite this remarkable longevity (surviving major catastrophes such as those triggering the dinosaur extinctions), most of the world's sea turtles are currently endangered or threatened.

Loggerhead sea turtle can reach 400 lbs. in weight and nests from North Carolina to Texas. Georgia averages 2,000 nests annually between May and August. Female sea turtles usually return to the same beaches every time they nest (every 2 to 3 years after they reach 15 to 30 years old), these are often the same beaches where they hatched.

Once young loggerheads make it to the ocean, they enter the North Atlantic Gyre, a massive current that carries them clockwise around the entire north Atlantic. During the first 12 years of their lives, they stay in this current feeding at the surface and hiding from predators in floating mats of seaweed. When they leave the gyre, they become bottom feeders, eating mollusks, crabs and



Loggerhead Sea Turtle

other invertebrates that they pluck from the sea floor.

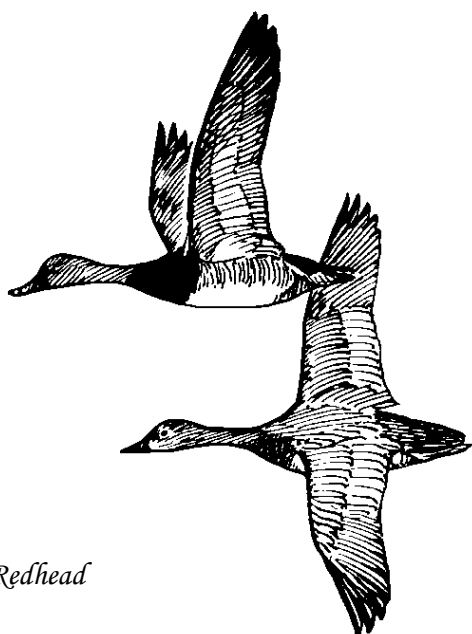
Sea turtles face many challenges animals, including humans, predate turtle eggs. Newly hatched young turtles must make it to the ocean, running a gauntlet of predators. Once at sea, new predators await, and many are caught in fishing nets or suffocated from ingesting floating garbage. This array of threats leads to a high mortality rate, especially early in life. Biologists estimate that only about one in 1,000 eggs survive to adulthood.

PW Aquatic Activities:

Sea Turtles International, Plastic Voyages, Turtle Hurdles, Here Today: Gone Tomorrow

Key Animals: Waterfowl

Though Georgia is not on a large migratory flyway for waterfowl, a wide variety of ducks do winter in Georgia's lakes, marshes and islands. Wintering ducks offer a great opportunity for wildlife watching, and many sites along the coast and inland are suitable for field trips. Only four species of ducks' nest in Georgia. They are: **Wood Duck** (*Aix sponsa*), **Mottled Duck** (*Anas fulvigula*), **Mallard** (*Anas*



Redhead

platyrhyncos) and **Hooded Merganser** (*Lophodytes cucullatus*). During the winter many more species can be found. Sea ducks and mergansers, winter off the coast of Georgia, and can be viewed from beaches. These include various species of **Scoter** (*Melanitta* sp.) and **Red-breasted Mergansers** (*Mergus serrator*). Diving ducks, or bay ducks, can also be seen along the coast, but tend towards large inland lakes, such as lake Seminole, where they stay in deep water, diving for fish. Bay ducks include **Scaup** (*Aythya* sp.), **Bufflehead** (*Bucephala albeola*) and **Canvasback** (*Aythya valisineria*). The dabbling ducks are most commonly seen, as they tend to stay in water shallow enough to "tip-up" and reach the bottom. Dabblers include **Northern Shovelers** (*Anas clypeata*), Mallard and **Blue-winged Teal** (*Anas discors*). Stiff-tailed ducks are the last group and only one species makes it to Georgia: The **Ruddy Duck** (*Oxyura jamaicensis*).

PW Activity:

Migration Headache, No Water Off a Duck's Back

Coastal Sites to Visit: (By Car)

Colonial Coast Birding Trail

Map on page 34

Tybee Island 4-H Camp

(912) 786-5534

Skidaway Island State Park - Savannah

(912) 598-2300

Oatland Island Education Center

(912) 395-1212

Jekyll Island 4-H Center

(912) 635-4115

Harris Neck National Wildlife Refuge

(912) 832-4608

(By Boat)

Cumberland Island (912) 882-4336

Sapelo Island National Estuarine

Research Reserve (912) 485-2300

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Web Resources:

Atlanta Audubon Society
www.atlantaaudubon.org

Carolina Bays
<http://archive-srel.uga.edu/outreach/factsheet/carolinabays.html>

Cornell Lab of Ornithology web site. This offers many excellent citizen science projects that schools can get involved with, such as Project Feeder Watch. <http://birds.cornell.edu/>

Freshwater Mussels information and pictures
<https://www.fws.gov/southeast/wildlife/mussels>

Georgia Dept. of Natural Resources
www.georgiawildlife.com

Georgia Museum of Natural History
<https://gmnh.franklin.uga.edu>

Georgia Ornithological Society
www.gos.org

Clearinghouse for Environmental Education in Georgia. www.eeingorgia.org

Journey North offers a migration program that schools can become involved in.
<http://www.learner.org/jnorth/>

Pitcher plant bog instructions
http://www.pitcherplant.com/bog_making.html

Real bird population data for most North American species.
https://www.usgs.gov/centers/pwrc/science/north-american-breeding-bird-survey?qt-science_center_objects=0#qt-science_center_objects

State Park website:
<http://gastateparks.org>

Species Fact Sheets Weblinks

Raptors
https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/raptors_2001.pdf

Ruffed Grouse
https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/ruffed_grouse_2001.pdf

Wood Duck
https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/wood_duck_2002.pdf

Black Bear
<https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/Bear%20Fact%20Sheet%200718.pdf>

Coyote
https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/2017_coyote.pdf

Alligator
https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/2016_alligator.pdf

Snake
<https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/SnakesOfGeorgiaOCS09.pdf>

Red-cockaded Woodpecker
https://georgiabiodiversity.org/natels/profile.html?es_id=18726&fus_tab_id=181xt2L6XVhGaGZhwGpN5mLK06bcL2Vz3E__rZcWG&group=bird

Spadefoot Toad
<https://srelherp.uga.edu/anurans/scahol.htm>

Stream Insects and Crustaceans
https://adoptastream.georgia.gov/sites/adoptastream.georgia.gov/files/related_files/document/Macro_Key.pdf

General info on a variety of species
<https://georgiabiodiversity.org/>

APPENDICES

Appendix A:

The top ten exotic invasive plants in Georgia:

Chinese privet (*Ligustrum sinense*)
Nepalese browntop (*Microstegium vimineum*)
Chinaberry (*Melia azedarach*)
Autumn Olive (*Lespedeza lespedeza*)
Japanese climbing fern (*Lygodium japonicum*)
Kudzu (*Pueraria Montana*)
Autumn olive or silverberry (*Elaeagnus umbellata*),
Chinese tallowtree (*Triadica sebifera*)
Mimosa (*Albizia julibrissin*).
Chinese wisteria (*Wisteria sinensis*),

Appendix B: Georgia State Symbols

Reptile – Gopher Tortoise
Amphibian – Green Tree Frog
Marine Mammal – Atlantic Right Whale
Mammal – White-tailed Deer
Bird – Brown Thrasher
Game Bird – Bobwhite Quail
Tree – Live Oak
Flower – Cherokee Rose
Fish – Largemouth Bass
Game Fish – Brook Trout
Saltwater Fish – Red Drum
Butterfly – Tiger Swallowtail
Gem – Quartz
Insect – Honeybee
Seashell – Knobbed Whelk
Wildflower – Azalea
Mineral - Staurolite
State Fossil – Shark tooth
State Vegetable – Vidalia Onion
State Fruit – Peach
State Crop – Peanuts

Appendix C:

Citizen Science Activities for
School Groups:

Georgia Adopt-a-Stream

Monitoring program for stream invertebrates and water quality.

(404) 651-8512

<https://adoptastream.georgia.gov>

Project Feeder Watch

Winter-long bird count. Starts 2nd Saturday of November. Longest running citizen science project (since 1976). Receive a research kit. Data forms, posters, basic birding information.

<https://feederwatch.org>

Great Backyard Bird Count

Collect data in mid-February to help track population trends for common wintering species. Web site has helpful bird identification and bird feeding tips. For more information visit:

gbbc.birdcount.org

The Birdhouse Network

Build bird boxes for cavity nesting species. Bluebirds, Chickadees, nuthatches, tree swallows, titmice, wrens etc...

Students can monitor nests throughout breeding season, collect data, send to Cornell Lab of Ornithology.

For more information:

<https://nestwatch.org>

Project Pigeon Watch:

Count pigeons and record the color of courting pigeons.

<https://scistarter.org/project-pigeon-watch>

Appendix D: Curriculum Aids

Audubon Adventures – curriculum for all grade levels. Provides activities and materials to educators interested in exposing students to hands-on interactive learning about birds, habitats and conservation.

www.atlantaaudubon.org/learning-about-birds-curriculum.html

Georgia Youth Science and Technology Centers: 13 regional centers to help science teachers

<https://gystc.org>

Project Wet –

Water education resources for teachers.

K-12

(404) 651-8556

<https://projectwet.georgia.gov>

Project Learning Tree

K-12 Forest education

(478) 751-3534

<https://www.plt.org/network/georgia>

Environmental Education in Georgia Web Site.

Wealth of information and lesson plans.

www.eeingorgia.org

Appendix E: Develop Schoolyard wildlife habitat

There are organizations that help schools develop wildlife habitats in schoolyards for education and conservation.

U.S. Fish and Wildlife Service

<https://www.fws.gov/cno/pdf/HabitatGuideColor.pdf>

National Wildlife Federation

<http://www.nwf.org/schoolyardhabitats/>

For funding ideas visit:

<https://georgiaorganics.org/schools/fundraisingandgrants>

Special Thanks

Timothy S. Keyes for development of the first edition.

Tammy D. Hyder for editing and updating the second edition.

Chris Skelton for the Crayfish and Altamaha Spiny mussel accounts.

Linda May, Ken Riddleberger Walter Lane, and Alice Keyes for advice and editing the first edition.

Kim Morris-Zarneke, Bruce Thomas and Alycia McDonald for proofreading the second edition.

Eric VandeGenachte for accessing photographs.

Kitty Esco for accessing artwork.

Artists

J.B. Burch, Michael Frick, David Lanier, Richard Parks, Chris Skelton, Jennifer Smith, Mrs. Barlow, Vicky Holifield

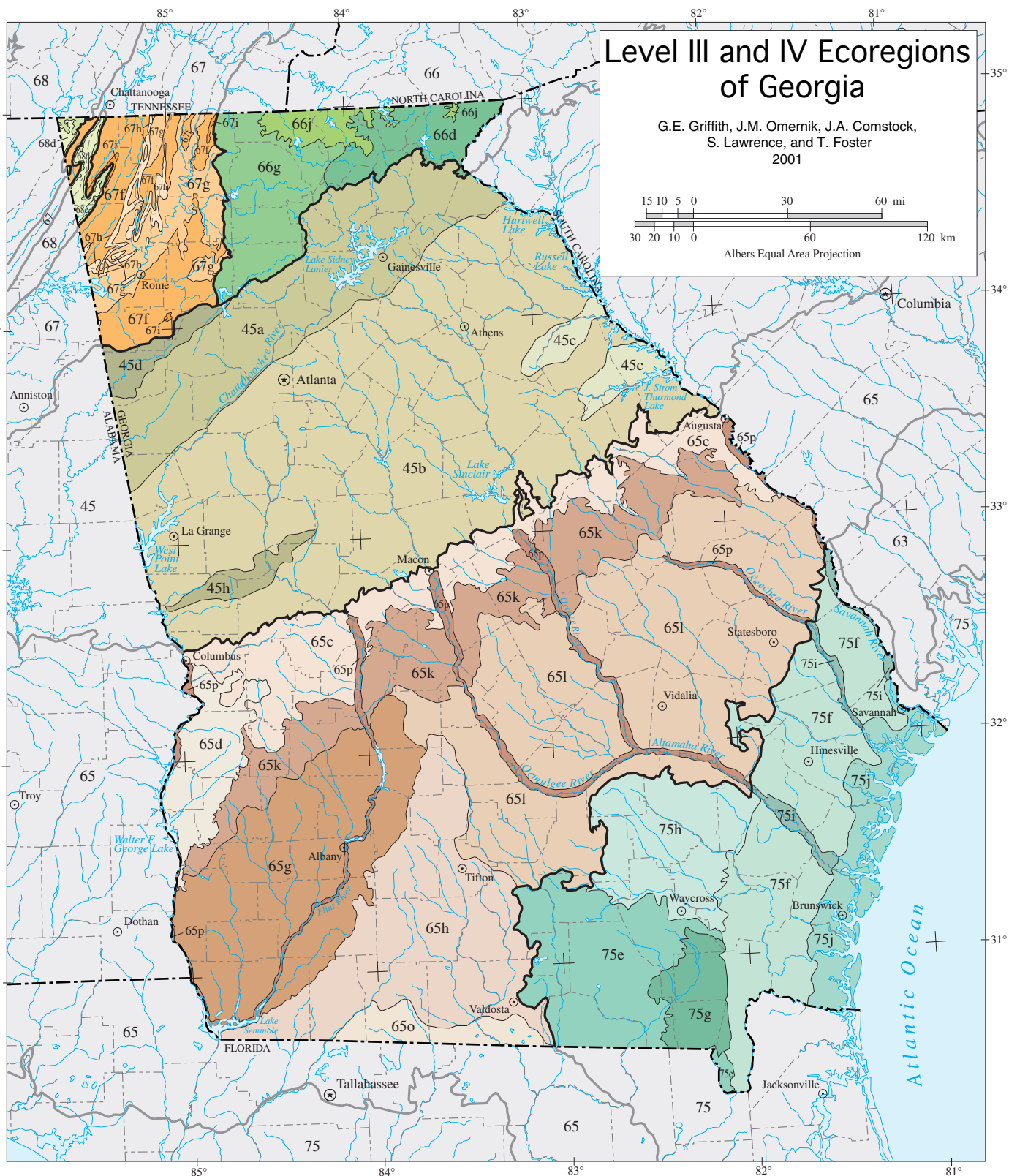
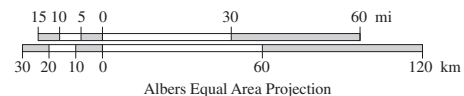
Photo Credits

Jim Allison: Carolina Bay, Marsh Hammock, Tallulah Gorge

Jon Ambrose: Longleaf Pine, Cloudland Canyon

Level III and IV Ecoregions of Georgia

G.E. Griffith, J.M. Omernik, J.A. Comstock,
S. Lawrence, and T. Foster
2001



45 Piedmont

- 45a Southern Inner Piedmont
- 45b Southern Outer Piedmont
- 45c Carolina Slate Belt
- 45d Talladega Upland
- 45h Pine Mountain Ridges

65 Southeastern Plains

- 65c Sand Hills
- 65d Southern Hilly Gulf Coastal Plain
- 65g Dougherty Plain
- 65h Tifton Upland
- 65k Coastal Plain Red Uplands
- 65l Atlantic Southern Loam Plains
- 65o Tallahassee Hills/Valdosta Limesink
- 65p Southeastern Floodplains and Low Terraces

66 Blue Ridge

- 66d Southern Crystalline Ridges & Mountains
- 66g Southern Metasedimentary Mountains
- 66j Broad Basins

67 Ridge and Valley

- 67f Southern Limestone/Dolomite Valleys and Low Rolling Hills
- 67g Southern Shale Valleys
- 67h Southern Sandstone Ridges
- 67i Southern Dissected Ridges and Knobs

68 Southwestern Appalachians

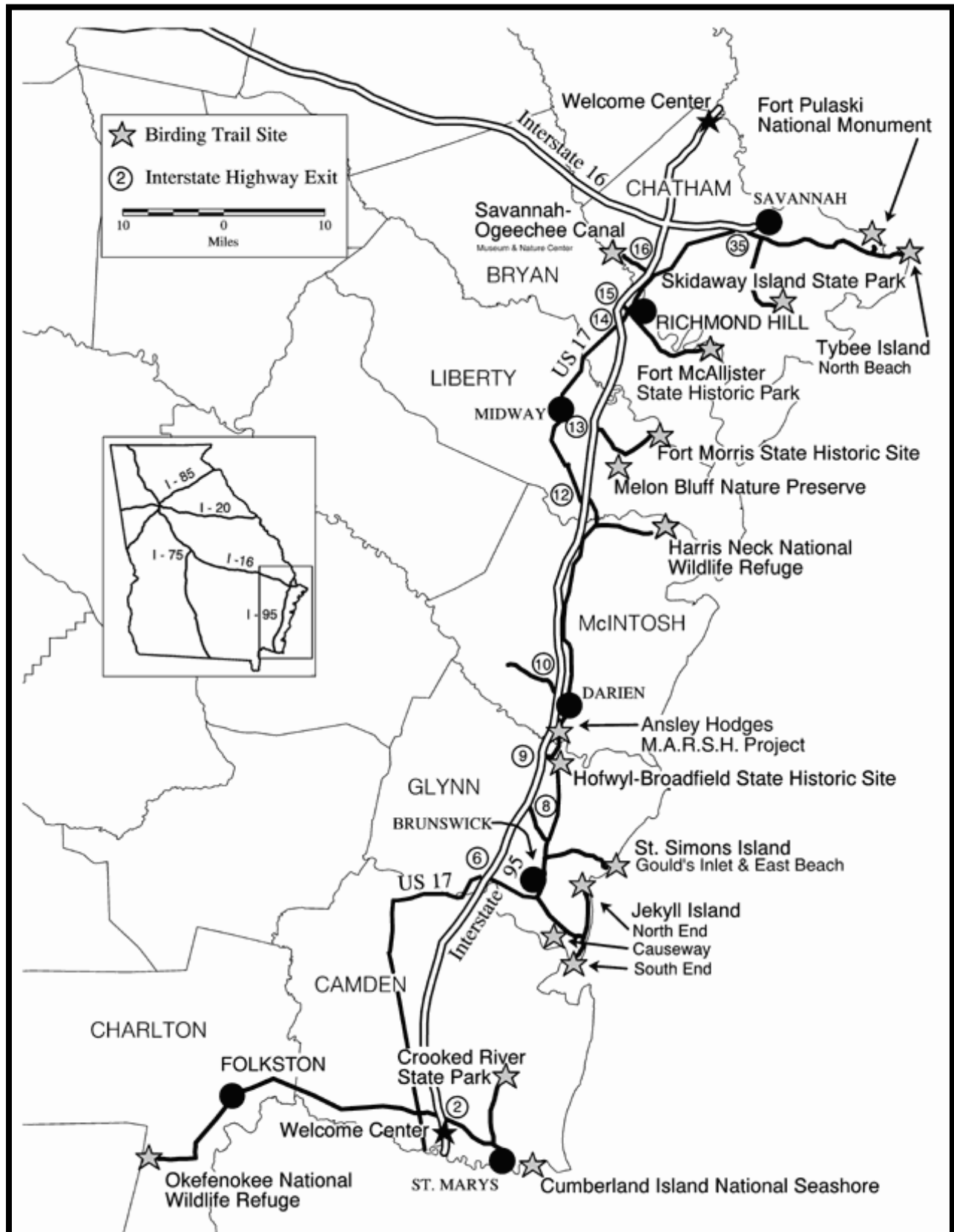
- 68c Plateau Escarpment
- 68d Southern Table Plateaus

75 Southern Coastal Plain

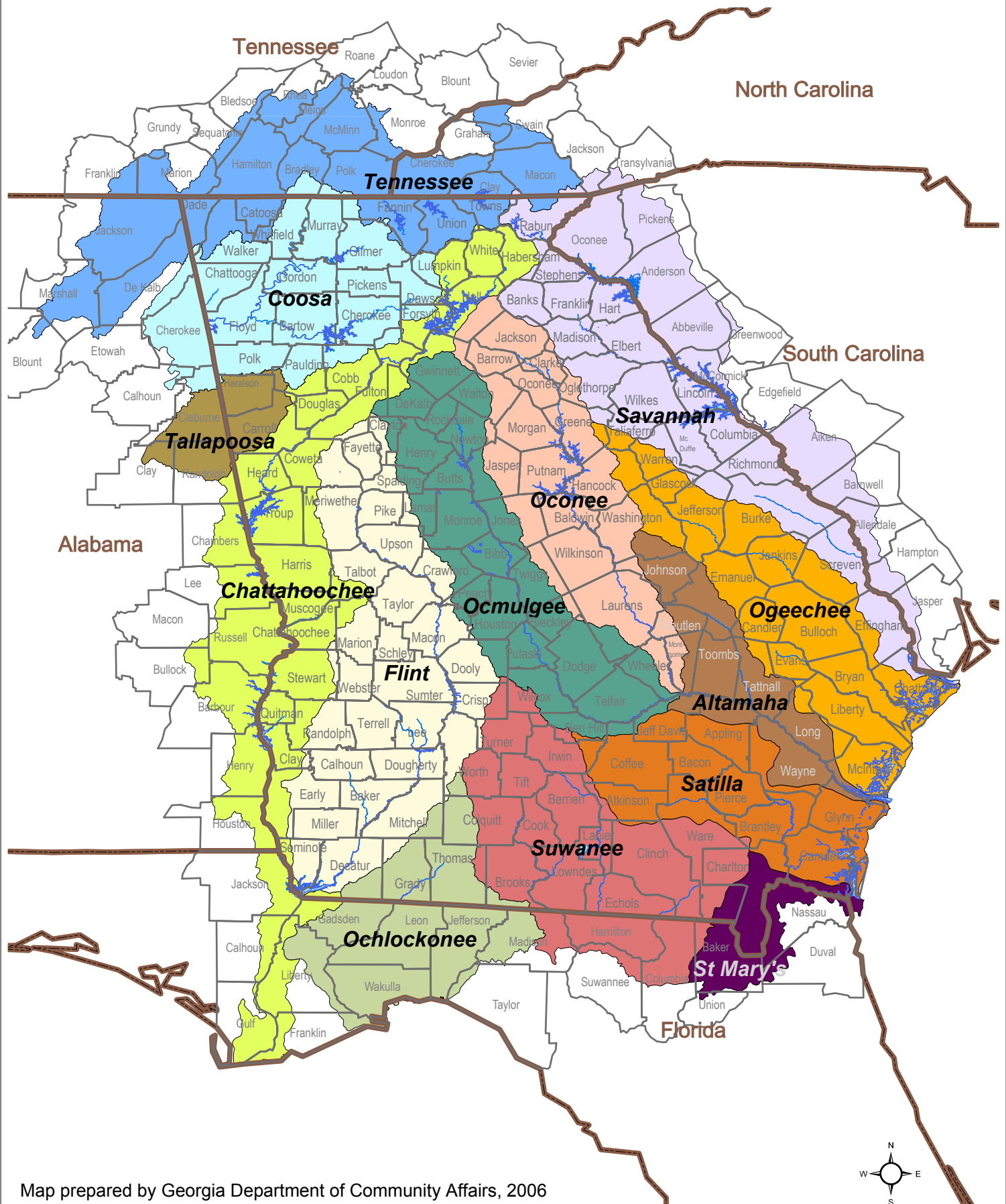
- 75e Okefenokee Plains
- 75f Sea Island Flatwoods
- 75g Okefenokee Swamp
- 75h Bacon Terraces
- 75i Floodplains and Low Terraces
- 75j Sea Islands/Coastal Marsh

- Level III ecoregion
- Level IV ecoregion
- State boundary
- County boundary

Colonial Coast Birding Trail



Georgia's 14 River Basins



Georgia's Protected Animals

Mammals

Rafinesque's Big-eared Bat (rare)
North Atlantic Right Whale (endangered)
Southeastern Pocket Gopher (threatened)
Humpback Whale (endangered)
Indiana Bat (endangered)
Round-tailed Muskrat (threatened)
Florida Panther (endangered)
Appalachian Cottontail (rare)
West Indian Manatee (endangered)

Birds

Bachman's sparrow (rare)
Henslow's Sparrow (rare)
Red Knot (rare)
Ivory-billed Woodpecker (endangered)
Piping Plover (threatened)
Wilson's Plover (threatened)
Common Raven (rare)
Cerulean Warbler (rare)
Kirtland's Warbler (endangered)
Swallow-tailed Kite (rare)
Peregrine Falcon (rare)
Southeastern Kestrel (rare)
American Oystercatcher (rare)
Bald Eagle (threatened)
Wood Stork (endangered)
Red-cockaded Woodpecker (endangered)
Black Skimmer (rare)
Least Tern (rare)
Gull-billed Tern (threatened)
Golden-winged Warbler (endangered)

Reptiles

Loggerhead Sea Turtle (endangered)
Green Sea Turtle (threatened)
Spotted Turtle (unusual)
Leatherback Sea Turtle (endangered)
Eastern Indigo Snake (threatened)
Hawksbill Sea Turtle (endangered)
Bog Turtle (endangered)
Gopher Tortoise (threatened)
Barbour's Map Turtle (threatened)
Common Map Turtle (rare)
Alabama Map Turtle (rare)

Southern Hognose Snake (threatened)
Kemp's Ridley Sea Turtle (endangered)
Alligator Snapping Turtle (threatened)
Diamondback Terrapin (unusual)
Mimic Glass Lizard (rare)

Amphibians

Flatwood Salamander (threatened)
One-toed Amphiumid (rare)
Green Salamander (rare)
Hellbender (threatened)
Tennessee Cave Salamander (threatened)
Georgia Blind Salamander (threatened)
Striped Newt (threatened)
Pigeon Mountain Salamander (rare)
Gopher Frog (rare)

Fishes

Shortnose Sturgeon (endangered)
Alabama Shad (threatened)
Spotted Bullhead (rare)
Blue Shiner (endangered)
Bluestripe Shiner (rare)
Altamaha Shiner (endangered)
Bluebarred Pygmy Sunfish (endangered)
Blackbanded Sunfish (endangered)
Blotched Chub (endangered)
Holiday Darter (endangered)
Greenfin Darter (threatened)
Lipstick Darter (endangered)
Coldwater Darter (endangered)
Black Darter (rare)
Etowah Darter (endangered)
Goldstripe Darter (rare)
Rock Darter (rare)
Cherokee Darter (threatened)
Tallapoosa Darter (rare)
Trispot Darter (endangered)
Wounded Darter (endangered)
Stippled Studfish (endangered)
Northern Studfish (rare)
Flame Chub (endangered)
Lined Chub (rare)
Ohio Lamprey (rare)
Bluefin Killifish (rare)
Coosa Chub (endangered)
Suwannee Bass (rare)

Fishes (continued)

River Redhorse (rare)
Robust Redhorse (endangered)
Sicklefin Redhorse (endangered)
Popeye Shiner (endangered)
Burrhead Shiner (threatened)
Highscale Shiner (rare)
Silver Shiner (endangered)
Sandbar Shiner (rare)
Mountain Madtom (endangered)
Frecklebelly Madtom (endangered)
Amber Darter (endangered)
Tangerine Darter (endangered)
Goldline Darter (endangered)
Conasauga Logperch (endangered)
Freckled Darter (endangered)
Dusky Darter (rare)
River Darter (endangered)
Halloween Darter (threatened)
Muscadine Darter (rare)
Upland Bridled Darter (endangered)
Olive Darter (endangered)
Snail Darter (endangered)
Fatlips Minnow (endangered)
Stargazing Minnow (threatened)
Tennessee Dace (endangered)
Broadstripe Shiner (rare)
Bluenose Shiner (threatened)
Southern Cavefish (endangered)

Invertebrates

Altamaha Arcmussel (threatened)
Southern Elktoe (endangered)
Fat Threeridge (endangered)
Apalachicola Floater (rare)
Rayed Creekshell (threatened)
Coosawattee Crayfish (endangered)
Dougherty Plain Cave Crayfish (threatened)
Conasauga Blue Burrower (endangered)
Dougherty Burrowing Crayfish (endangered)
Tallapoosa Crayfish (rare)
Chickamauga Crayfish (threatened)
Etowah Crayfish (threatened)
Little Tennessee Crayfish (endangered)
Piedmont Blue Burrower (endangered)
Chattahoochee Crayfish (threatened)
Hiwassee Headwaters Crayfish (endangered)
Chattooga River Crayfish (threatened)

Beautiful Crayfish (endangered)
Lean Crayfish (threatened)
Oconee Burrowing Crayfish (threatened)
Blackbarred Crayfish (threatened)
Say's Spiketail (threatened)
Broad River Burrowing Crayfish (threatened)
Alabama Spike (endangered)
Delicate Spike (endangered)
Inflated Spike (threatened)
Altamaha Spiny mussel (endangered)
Purple Bankclimber (threatened)
Upland Combshell (endangered)
Southern Acornshell (endangered)
Atlantic Pigtoe (endangered)
Cherokee Clubtail (threatened)
Fine-lined Pocketbook (threatened)
Shinyrayed Pocketbook (endangered)
Interrupted Rocksnail (endangered)
Alabama Moccasinshell (threatened)
Coosa Moccasinshell (endangered)
Gulf Moccasinshell (endangered)
Ochlockonee Moccasinshell (endangered)
Edmund's Snaketail (endangered)
Southern Clubshell (endangered)
Southern Pigtoe (endangered)
Georgia Pigtoe (endangered)
Oval Pigtoe (endangered)
Muckalee Crayfish (threatened)
Grainy Crayfish (rare)
Sly Crayfish (rare)
Triangular Kidneyshell (endangered)
Alabama Creekmussel (endangered)
Southern Creekmussel (endangered)
Savannah Lilliput (threatened)