TEACHER GUIDE TO GEORGIA SANDHILLS

GEORGIA
DEPARTMENT OF NATURAL RESOURCES
WILDLIFE RESOURCES DIVISION

T.E.R.N.
The Environmental Resources Network
Friends of Georgia's Wildlife Conservation Section

Walmart Foundation

GEORGIA
Project WILD

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FOREWORD

Imagine a desert-like habitat surprisingly full of rare plants and a variety of wildlife. Longleaf pines dominate the sparse canopy, while scrub oaks and native shrubs form a patchy understory. A ruby-throated hummingbird buzzes by to sip nectar from the tubular-shaped blooms of scarlet wild basil, while a gopher tortoise slowly moves through clumps of wiregrass, sandhill milkweed and gopher apple towards its burrow.

If you live in South Georgia, this beautiful scene could be in your backyard. However, if you're from North or Central Georgia and encounter this landscape while traveling south, you may feel as though you've entered another world. The clay soils of the Piedmont transition abruptly to sandy loam as you enter the Coastal Plain ecoregion. This part of Georgia was covered by the ocean millions of years ago, and sandy deposits from that period were later left exposed as the sea receded. These deposits have been reworked by wind and water, resulting in a variety of different sandhill environments. Despite their somewhat desolate appearance, sandhills are biologically diverse, home to many rare species of wild animals and plants.

The "Teacher Guide to Georgia Sandhills" was developed to highlight this important landscape, its features and inhabitants. Georgia DNR interpretive staff and biologists as well as formal and non-formal educators contributed their passion, expertise and hundreds of hours of work to creating this curriculum guide. We hope you will find these activities and related resources both interesting and useful in the classroom. Through education, we can increase awareness and instill appreciation for Georgia's wildlife and habitats to ensure their conservation for future generations.

Thank you for helping to keep Georgia wild!

Jon Ambrose, Chief of Wildlife Conservation Section

Georgia Department of Natural Resources, Wildlife Resources Division

"In the end, we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught." ~ Baba Dioum, 1968

HOW TO USE THIS GUIDE

The Teacher Guide to Georgia Sandhills is an instructional resource for third- and fourth-grade teachers to introduce students to a unique ecosystem in southern Georgia. These hands-on activities encourage decision making and hone problem-solving skills related to this special habitat and its inhabitants.

ORGANIZATION OF EACH ACTIVITY

Each activity includes instructional objectives, Georgia Standards of Excellence correlations for third-and fourth-grade Science, a brief description of the instructional method used, list of materials, background information, step-by-step procedures, extensions or additions to the activity and several assessment options. Several activities also include variations or alternate procedures. In the lower left corner of each activity's first page, educators will find a summary box that includes the suggested grade level(s), subject areas, duration, group size and setting required (indoors or outdoors). Activities may be adjusted by educators for use with broader grade levels, as appropriate. This reference box also includes key terms used in the activity. These terms are printed in italics throughout each activity and are defined in the Glossary.

APPENDICES

The appendices include an Ecoregions of Georgia Map, a detailed map of Georgia Sandhills, coloring pages and a list of agencies and organizations for helpful contacts and references.

GLOSSARY

The vocabulary words in the glossary include the terms that are italicized throughout this guide.

SUPPORTING ACADEMIC CONCEPTS REQUIRED IN THE CLASSROOM

The activities in this guide were created using a Project WILD format. They are intended for use in both classroom and non-formal settings. The instructional materials are designed to support the Georgia Standards of Excellence for third- and fourth-grade science but can be adapted to meet the learning requirements for other academic disciplines as well. The activities may be integrated into existing courses of study or used all together as a one unit. In addition, each individual activity is designed to stand alone, although some lessons compliment others when used consecutively (i.e. "Burrow Buddies" as a follow-up to "Tortoise Troubles" to emphasize the importance of a keystone species, and "Sandhills Bird Detective" as a follow-up to "Sandhills Retreat" to introduce students to the unique habitat needs of various bird species of the Sandhills).

ORGANIZATION OF MATERIALS

This curriculum guide is organized into three sections: (1) Sandhill Ecosystem Overview, (2) Wildlife of the Sandhills and (3) Plants of the Sandhills. The activities within each section are arranged by complexity so that the student gains a basic conceptual understanding of the topic before advancing to the next activity. However, activities may be used in any order. Following the three sections are fact sheets and recommended internet resources for other wildlife and plant species facts.

SECTION ONE: SANDHILL ECOSYSTEM OVERVIEW

Section One is an introduction to the sandhill ecosystem and explains the important role that fire plays in this habitat. This section includes a Georgia Sandhills Fact Sheet and the activity "Sandhills Retreat," as well as a Sandhills Fire Ecology Fact Sheet and the activity "Fire in the Sandhills."

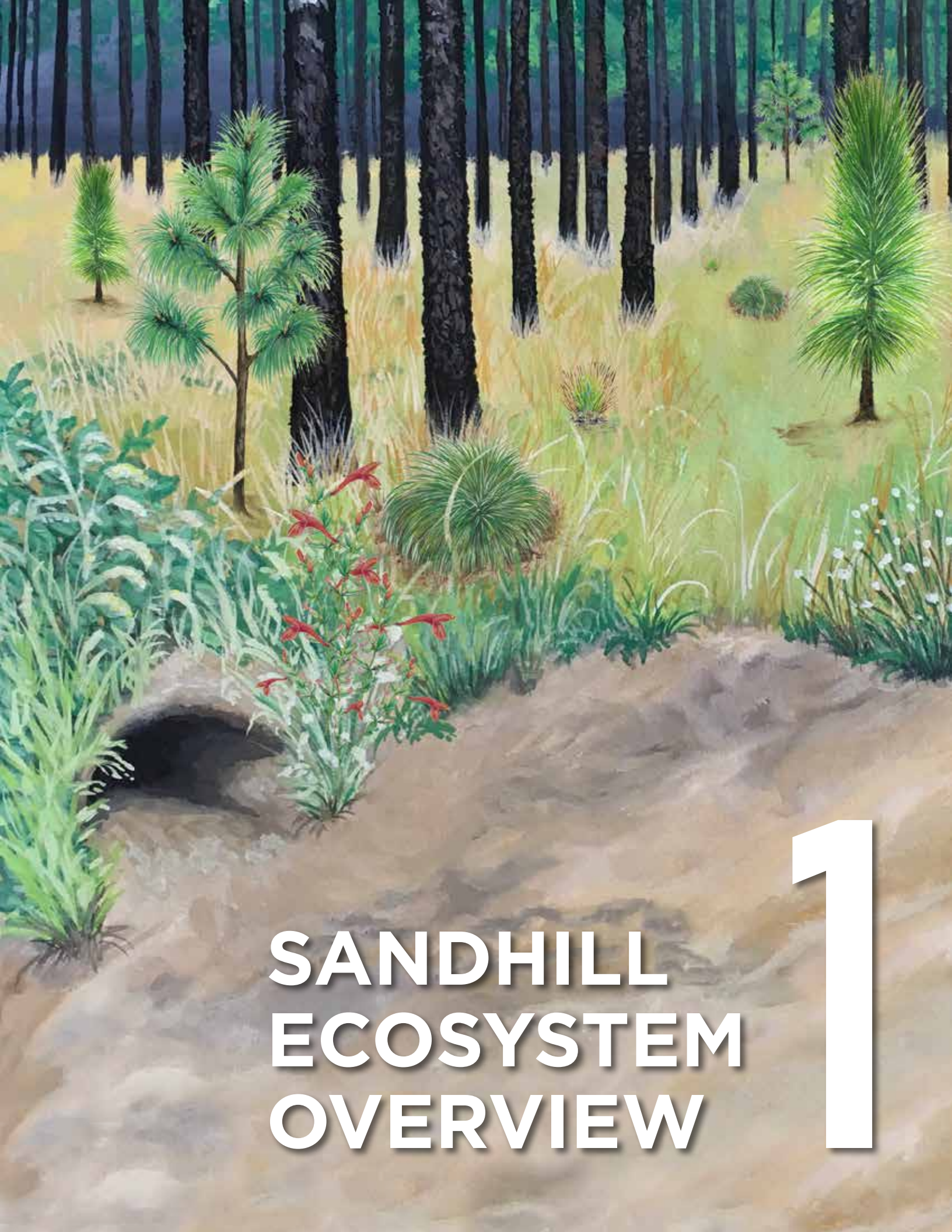
SECTION TWO: WILDLIFE OF THE SANDHILLS

Section Two consists of four activities demonstrating the importance of the gopher tortoise as a keystone species, as well as the roles that other wildlife play in the Sandhills. This section includes the activities "Tortoise Troubles," "Burrow Buddies," "Interview a Sandhill Herp" and "Sandhills Bird Detective." The fact sheets that supplement these activities are found on pages 57-100 of this guide.

SECTION THREE: PLANTS OF THE SANDHILLS

Section Three consists of a Coastal Plain Pitcher plant Bog Fact Sheet and the activity "Plant Adaptation Artistry." Additional fact sheets that supplement this activity are found on the pages following Section Three.

NOTE: At the time of printing, all website addresses referenced in this guide were up-to-date. However, due to the dynamic nature of the internet, some websites may no longer function. In that case, please conduct an internet search for the species.



1 SANDHILL ECOSYSTEM OVERVIEW

GEORGIA SANDHILLS FACT SHEET

Aerial view of a sandhill habitat. *Mincy Moffett, GA DNR*

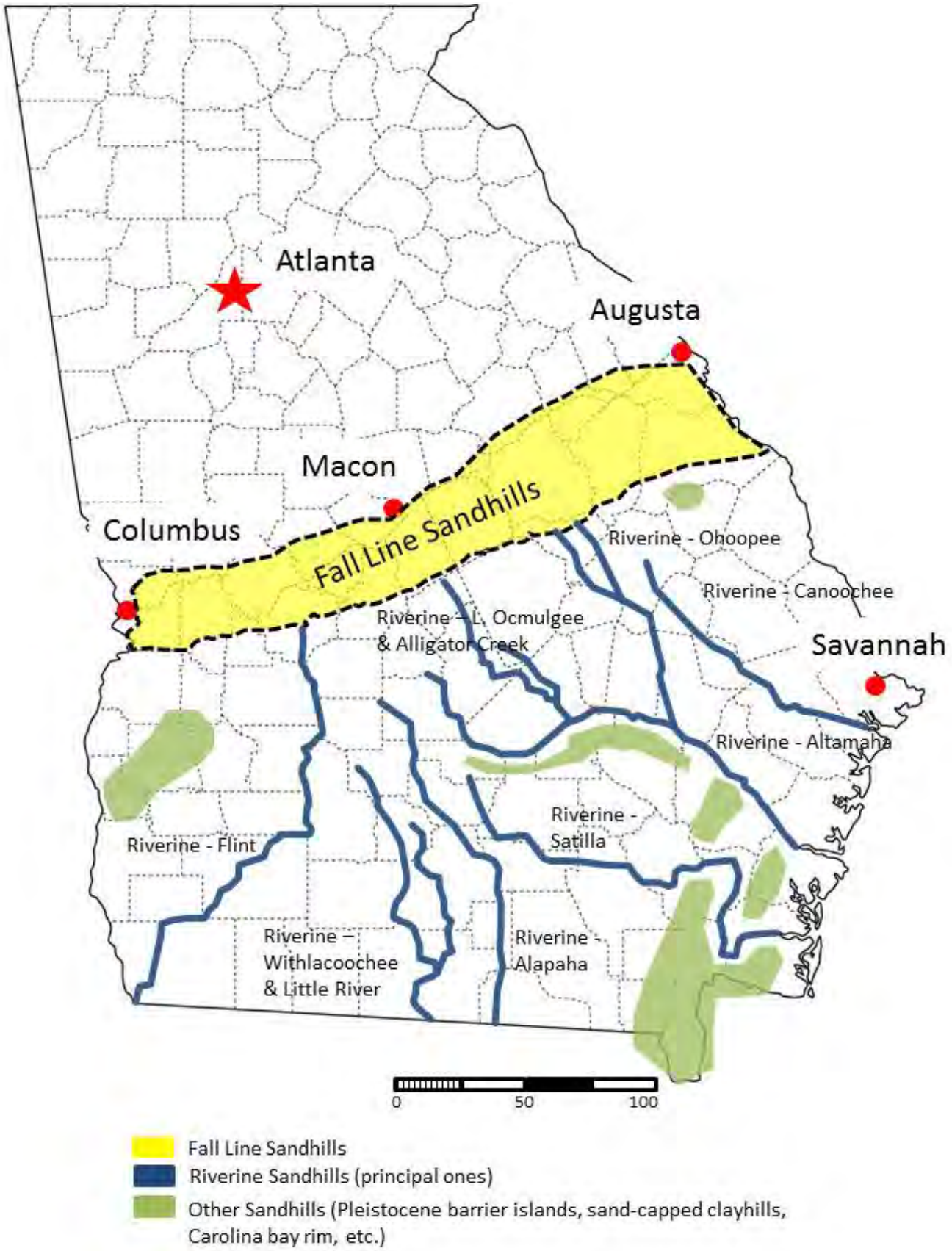
DESCRIPTION: Sandhills are upland, land-locked dune habitats with sandy soil and sloping terrain. They are found in the southeastern U.S., most notably in Georgia, Alabama, Florida, and North and South Carolina. In Georgia, they are located just below the transition zone between the Piedmont and Coastal Plain (Fall Line sandhills), along the northern and eastern banks of rivers of Coastal Plain streams (riverine sandhills), on top of clay hills in southwest Georgia and along ancient ocean terraces near the coast. The sand has a high percentage of quartz and, on some dunes, is starkly white.

Sandhills look a lot like sand dunes at the beach, but with trees and other vegetation. They have a striking appearance with islands of exposed sand and sparse vegetation interspersed with tall pines and an open understory. Longleaf pine, turkey oak and wiregrass are the most common vegetation on these dunes. Wildflowers, woody evergreen shrubs and lichens are also part of this ecosystem. The open canopy and grassy herb-filled undergrowth make these woodlands a perfect habitat for many important and rare species of plants and animals. They are a special part of Georgia's natural heritage.

FORMATION: There are several types of sandhills in Georgia. The two most common are the Fall Line sandhills and riverine sandhills. Fall Line sandhills date from the late Cretaceous Period (around 65 million years before the present) when they were a part of the ancient Atlantic Ocean coastline. Riverine sandhills, which are smaller and less continuous than Fall Line sandhills, formed when exposed sand from river bottoms was deposited by Aeolian (wind) processes on the banks of rivers and streams during the Pleistocene (2.6 million to 11,000 years before the present, with deposition peaking around 30,000 years ago). Other less common types of sandhills include sand-capped clayhills, Pleistocene barrier island sandhills and other sandy terraces found throughout the Coastal Plain.

SOIL: Soil from sandhills may contain up to 95 percent quartz sand. It has few nutrients and doesn't hold water well.

HABITAT: Because of the harsh conditions, plants and animals require behavioral or physical adaptations to thrive in this environment. Adaptations allow certain species to endure the quickly drying sandy soils, summertime soil temperatures in excess of 120° F and frequent fires, which are characteristic of a healthy sandhill habitat. Some sandhills also contain isolated wetlands. These bodies of water are not connected to a stream, are filled mainly by rainfall and dry periodically. These temporary ponds or bogs are safe havens for many rare invertebrates and amphibians since predatory fish can't survive there. Semi-aquatic species like the striped newt and gopher frogs need water for breeding and larval growth, as well as adjacent high-quality sandhill habitat and gopher tortoise burrows to retreat to when the wetlands dry up.



Range map of sandhill types.
Mincy Moffett, GA DNR

WILDLIFE: Sandhills support many of the rare and endangered wildlife of Georgia. They are the prime habitat of Georgia's state reptile, the gopher tortoise, and the endangered eastern indigo snake. Other important species that depend on healthy sandhill habitats include the gopher frog, red-cockaded woodpecker and Bachman's sparrow, among others. Many of the animals found in sandhills survive by living in tortoise burrows. More than 360 animals have been documented using gopher tortoise burrows for shelter from heat, cold, fires and predators, designating the tortoise as a keystone species for the sandhills.

Gopher tortoise near burrow. *Jessica McGuire, GA DNR*

FIRE: Fire plays a vital role in the health and maintenance of sandhill ecosystems. The habitat is pyric, or fire dependent. Frequent fire promotes herbaceous growth, especially grasses, minimizes competition from woody species, and stimulates flowering and seed germination of many sandhill plants. Frequent low-intensity fires also clear out the underbrush, allowing seeds from species such as the longleaf pine to find space in the mineral soil. Each life stage of the longleaf pine, from the grass stage to maturity, allows the plant to thrive with frequent fires. In turn, the open structure of a longleaf pine forest, including the production of flammable cones and needles, helps promote the very pyric system that the pine needs and to which it is adapted. In areas where fire is suppressed, hardwood species and woody shrubs become established, altering the ecosystem and eventually driving out the native plants and animals.

THREATS: Sandhill habitats have declined significantly in recent history. Once covering nearly two million acres in Georgia, just 200,000 acres of intact sandhills exist today. Of these, only about 50,000 acres are protected on conservation lands. This 90% decline in quality habitat puts tremendous pressure on rare and endangered plants and animals. Ongoing threats to sandhills include conversion to agriculture and silviculture, incompatible recreation, conversion to housing and industrial development (including solar farms) and fire suppression. More than 50 sandhill species need our help to survive.

SELECTED REFERENCES:

New Georgia Encyclopedia. "Sandhills." https://www.georgiaencyclopedia.org/articles/geography-environment/sandhills

SANDHILL RETREAT

Adapted from Aquatic WILD's "Riparian Retreat" and "Blue-Ribbon Niche" activities, as well as "Hints for Using Simulated Field Trips."

OBJECTIVES

Students will (1) identify basic characteristics of *sandhill habitats*, (2) identify different species of plants and animals that live in sandhill habitats, (3) describe the ecological *niche* (role) of some species in sandhill habitats and (4) evaluate potential positive and negative effects of changes in sandhill habitats.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Awareness of the importance of sandhill habitats and the plants and animals that inhabit them is created through the use of a simulated field trip and artistic representations.

GRADE LEVEL: 3rd Grade - 4th Grade

SUBJECT AREAS: Science, Environmental Education

DURATION: Two 50- to 60-minute sessions (Steps 1-5 on first day. Step 5 continued on 2nd day with Steps 6 & 7 as well as discussions, variations and extensions.)

GROUP SIZE: 15-30 students

SETTING: Outdoors and indoors

KEY TERMS: carnivore, consumer, ecosystem, habitat, herbivore, niche, predator, prey, producer, sandhills

MATERIALS

GA DNR fact sheets (included in this guide and at https://georgiawildlife.com/species), sandhill habitat references (i.e., www.longleafalliance.org), a variety of art materials such as drawing paper, construction paper, crayons, watercolors, poster paints, brushes, clay, glue, wire, string, etc.

BACKGROUND

Refer to "Georgia Sandhills" Fact Sheet in Section One Overview.

PROCEDURE

1. Ask students if they have ever visited a sandhill habitat. What did the area look like? Were trees and plants growing there? What animals were present? Was it hot or cool? Was it dry or moist? Have students talk about and share their descriptions of any sandhill habitat they may have visited, lived in or at least seen pictures of.

2. Next, tell the students that the sandhill habitats they described are important natural areas for wildlife and people. To learn more about these habitats, the students will be going on a simulated field trip. Ask the students to get into a comfortable and relaxed position, close their eyes and try to picture the things that the teacher will be describing. When reading aloud the following narrative, speak in a slow and steady manner, pausing between statements to allow time for the students to create rich mental images.

Note: Research has shown that with their eyes closed, people activate parts of their brain that are not often stimulated. Studies show that skill in picturing things in our minds enhances our ability to enrich reading and increases skill and imagination in writing.

SANDHILL RETREAT: A SIMULATED FIELD TRIP

It is the month of May … a beautiful, early morning in south Georgia. You are going to explore a unique habitat … one that is endangered … the sandhill ecosystem. You begin your walk through the sandhills in an open forest filled with tall, majestic longleaf pines … These trees are spaced apart so that the golden rays of sunlight stream though their branches, creating patches of light that dance on the sandy soil beneath … A cool breeze blows gently through the shiny green, pine needles … You are amazed by the length of these needles … They're the longest you have ever seen, all in bundles of three, 10-18 inches long.

The spring green wiregrass tickles your calves as you continue hiking. You notice small, young pines that resemble mop heads blending in with the low clumps of grass …Then you see a few taller pines that look like fuzzy bottle brushes growing toward the sky like rockets, some whose taproots are 6 feet deep to safely anchor them into the ground … Large, beautiful pine cones, 6-10 inches long, lie scattered on the ground from the previous year's shed … Suddenly a large fox squirrel, gray and black with a black mask, white nose and white ears, scampers into view as he forages through the cones, looking for seeds. Filled with life, the nutritious longleaf pine seeds are food for many wild animals and birds.

As you continue walking under the magnificent pines, you see dainty ferns that look like lace … they're mixed in with the grasses, wildflowers and low-growing shrubs … Butterflies and bumblebees flash a rainbow of colors as they carelessly fly about, pollinating wildflowers that spread as far as you can see … colorful blooms of purples, pinks, yellows and oranges … While gazing upward, captivated by all of the surrounding beauty, you carelessly trip and fall over the entrance of a gopher tortoise burrow! Now that your face is close to the sandy ground, you notice tracks leading in and out of the burrow, which tells you that it is active and a tortoise lives there now…You are surprised to see a variety of other types of wildlife tracks scattered throughout the sand surrounding the opening … this leads you to believe that many types of animals use this burrow as a safe haven.

As you stand up and brush the sand off your body, the faint smell of smoke alerts your senses. At first, you're afraid, for you immediately think there may be a forest fire nearby. As you quickly scan the habitat, you don't see fire … but you notice black scars on the trunks of the tall, mature longleaf pines, some reaching into the air 100 feet or more … You realize that the smoky smell is coming from these blackened pine tree trunks … their centers protected by thick bark ... unharmed by a recent fire started by lightning during a thunderstorm. You look around, concerned for the younger trees. Did they burn up? You are relieved to see that they too survived. Surrounded by protective layers of needles, their growing buds stayed safe from the fire … As you move along, you notice that most of the dead grasses, leaves and shed pine needles that once carpeted the ground have burned … Igniting slowly, they were the fuel source that gently carried the fire across the land. The fire has, in fact, cleaned up the forest … removing sun-blocking, dense vegetation and exposing mineral-rich soil that allows young seeds not eaten by wildlife to take root. As the spring rains come, seedlings begin to sprout and life begins again. This sandhill habitat depends on fire to stimulate seed germination and flowering.

As you hike further into the woods, you spook a white-tailed deer ... It runs away … its tail flipping up and down as it leaps, flashing the white color on the underside … You wonder what happens to the wildlife during a fire … You come to the conclusion that most animals can run or fly away. Maybe some of the tracks that you saw outside the gopher tortoise burrow earlier were from a few animals taking shelter from the fire.

A tap-tap-tapping sound breaks your thoughts … You search high into the treetops and spy movement … a small bird, about 8 inches long, is moving up and down the longleaf pine trunk, looking for insects in the bark to feed to its young … Its back is barred with black and

white horizontal stripes resembling a zebra … It sports a black cap and neck with a large patch of white on its cheek. Since spring is breeding season, this male bird has a small red streak on each side of its black cap behind his eye, called a cockade. You have just seen your first red-cockaded woodpecker, an endangered species in Georgia! As you continue to watch, it flies up to a small hole in a pine tree about 25 feet high … Just underneath the hole, you notice a dried white resin that looks like candle wax dripping down the trunk … You realize that this hole in the tree is the woodpecker's nesting cavity … The sticky, oozing resin protects the nest from predators such as rat snakes. You also notice younger woodpeckers in the area, who are called helpers … they appear to be hunting for insects and assisting the feeding of the nestlings. These young males and females are black and white but have no red on their bodies.

Off in the distance, you hear many different birds singing their hearts out … warblers, sparrows, wrens … and the "killy-killy-killy" call of the southeastern kestrel, the smallest falcon in North America ... it eats grasshoppers, small birds and mice … You also hear the "bob-bob-white" call of the Northern bobwhite, a quail that is Georgia's state game bird. A female bobwhite quickly scurries from grass clump to grass clump, seeking refuge for her 10 tiny chicks … They run behind her as they all search for seeds and insects to eat.

As you stand still for a moment to soak in the sights, smells and sounds of the sandhills, your eyes catch a gopher tortoise slowly heading back to its burrow after a morning of grazing on tender, green vegetation … Full from eating the new growth put out by grasses and other plants after the fire, the tortoise settles in a sandy patch, called the apron, which is just outside of its burrow … Here he will bask in the sun, where he can escape danger quickly if needed … A large eastern diamondback rattlesnake slithers quickly past the tortoise and into the burrow to escape the oncoming heat of the day. The surprise of seeing this venomous snake inspires you to move along quickly! Once you reach a safe distance, you wonder how the gopher tortoise feels about sharing his burrow with a rattlesnake. Then you remember learning that rattlesnakes don't bother the tortoise … they are just neighbors in the burrow! You also imagine what it would be like to see a long, shiny bluish-black indigo snake, another burrow user, eating a rattlesnake. You have heard how they eat other snakes and are immune to the venom, just like the kingsnake. Indigo snakes thrash their prey about instead of constricting … what a sight that would be to see!

As you start to wind down your journey, you feel your feet sinking a little … you look down and see the soil is a soggy mix of sand and moss. This bog joins the longleaf pine sandhills to a nearby swamp … The moist ground sparkles in the sunlight … You notice really strange-looking carnivorous plants with odd names – sundews, butterworts, pitcher plants and bladderworts … Each sundew is a clump of small, dark red, spoon-shaped leaves … each leaf is covered with tiny stalks, glistening with sticky dewdrops … The butterworts nearby have small sticky leaves that hug the soggy soil, arranged in a star-shaped pattern … each plant has one or two flower stems rising above the leaves that support delicate blue flowers at the top. You watch in awe as these tiny plants trick insect prey by luring them closer with their honey-like droplets … Once the insects are trapped on the sticky substance, the leaves slowly roll up, surrounding their prey.

Scattered about the wildflower meadow are beautiful pitcher plants … whitetop, purple and hooded … The leaves of these plants are tall and tubular with an umbrella-like hood that bends over to cover the opening at the top ... Colorful patterns and sticky nectar glands on the edge of the opening attract insects to come and take a closer look. Once inside, some insects slide down the slippery walls of the tube and get trapped in digestive juices at the bottom … The pitcher plant eats its insect victims to get nutrients that it can't get from the soil or water.

A little further along, you find yourself standing in shallow water looking at bladderworts. Their bright yellow flowers rise above the water on thin stalks … At the base of the plant, in the water, are inflatable bubbles called bladders, each with a trap door on one end. When the bladder is empty, the door is closed … but when an insect touches the small hairs on the plant, the door swings open, sucking in water with the insect and trapping its prey! Wow … you are really glad you are not a bug living in a sandhill bog … These carnivores can be pretty sneaky!

As you slosh out of the water and back to dry land to end your trip, you think of all the unique plants and animals you saw … Sandhills are such interesting places to visit! You can't wait to get back to school to research and learn more about this amazing habitat and the species that live here.

3. Once the narrative has been read aloud, ask the students to continue to sit quietly with their eyes closed and mentally review the images that they saw in their minds for 1-2 minutes before opening their eyes. Have them pay particular attention to their favorite images. Tell them they will be asked to describe this setting as they saw it.

4. Ask several of the students to describe their favorite images. Next, allow them to read about other animals and plants that inhabit the sandhills by using the provided GA DNR fact sheets or other resources.

5. After students have had time to read and explore other species, have them select the art materials of their choice. Students can use drawings, paintings, collage or clay sculpture to create or mold his or her favorite images with the materials provided. Once they are finished, ask students to share their creations and display them for all to enjoy.

6. Ask the students to identify some characteristics of the sandhill habitat. What kinds of trees and plants live there? What kinds of animals? What role (niche) did each species play in the sandhill habitat? Were any producers or consumers? Predators or prey? Herbivores or carnivores?

7. Ask the students to list, describe and discuss some of the many reasons that sandhill habitats are important. How could changes to this habitat affect the plants and animals?

VARIATIONS

As a class, create a sandhill habitat in the form of a diorama using art materials.

EXTENSIONS

1. Visit a sandhill habitat with your class. Look for things that were encountered in the simulated field trip visualization. List things that were found there that were not pictured in your mind.

   Note: Here are several parks and natural areas in Georgia that feature sandhills. Do an internet search for more information, and check with area staff before visiting to learn of any reservations required, restrictions, area closures or hunting seasons.

   Big Hammock Wildlife Management Area (Glennville), Broxton Rocks Preserve (Broxton), Charles Harrold Preserve (Metter), Chattahoochee Fall Line Wildlife Management Area (Geneva), Dodge County Public Fishing Area (Eastman), Fall Line Sandhills Wildlife Management Area (Butler), Flat Tub Wildlife Management Area (Broxton), General Coffee State Park (Nicholls), George L. Smith State Park (Twin City), Gordonia-Alatamaha State Park (Reidsville), Griffin Ridge Wildlife Management Area (Ludowici), Little Ocmulgee State Park (Helena), Mary Kahrs Warnell Forest Education Center (Guyton), McDuffie Environmental Education Center (Dearing), Moody Forest Natural Area (Baxley), Ohoopee Dunes Wildlife Management Area (Swainsboro), Okefenokee National Wildlife Refuge (Folkston), Orianne Indigo Snake Preserve (McRae), Reed Bingham State Park (Adel), Seminole State Park (Donalsonville) and Townsend Wildlife Management Area (Ludowici).

2. Develop a list of ways that would make it possible for people to visit a sandhill habitat without damaging it.

3. Is a different word used in your region to describe those kinds of areas? If not sandhills, what are they called?

ASSESSMENT

1. What is a sandhill habitat?

2. Identify four animals found in a sandhill habitat. What is their niche?

3. Identify four plants/trees found in a sandhill habitat. What is their niche?

4. Why are sandhill habitats important to wildlife? Why are they important to humans?

SANDHILLS FIRE ECOLOGY FACT SHEET

The sandhill ecosystem in the southeastern United States is a very unique community of plants and animals. These habitats can be found throughout the Coastal Plain, which in ancient times actually was part of the ocean floor. As you might expect, the soil in these areas is mostly white sand, similar to what you might find on a present-day beach like Panama City, Florida. Sand does not hold water very well; when it rains, the water is quickly absorbed from the surface and drains deep into the earth. Therefore, sandhills are usually pretty dry places. Sand also doesn't retain nutrients as well as other soil types. As rain water drains deeper and deeper into the ground, it dissolves nutrients and takes them with it. Eventually, these nutrients sink so deep that the roots of many plants can't reach them. This combination of dry conditions and poor nutrient content in the soil means that plants have had to evolve special characteristics in order to survive in this environment. It may sound strange at first, but fire is the key additional ingredient upon which many of these plants and the animals rely to survive in these harsh conditions.

When fire moves through a forest, it does a lot of things. The most obvious effect is that it burns almost everything lying or growing on or near the ground--dead leaves, limbs and trees as well as grasses, shrubs and other low-growing plants. All of this material required nutrients to grow, nutrients that have been absorbed from the soil and locked into plant life. Since the sandhills are an area that is already limited in the amount of nutrients available in the soil, it is important that as many of these nutrients as possible eventually return to the soil so other plants can use them to grow. Fire is the process that allows this soil enrichment to happen. When those fuels on or near the ground are burned to ash and charcoal, the nutrients left behind are easily absorbed back into the soil and available for use by the plants that are still growing and the new plants that will sprout after a fire.

Fire also kills shrubs and many shorter trees. These plants are not usually burned to ash by a fire, but since they are now dead, they become fuel for future fires to keep the cycle of regular fire going. That isn't the only reason why the death of these plants is important though. Shrubs

Fire technician Bryn Pipes working on a sandhill site.
Shan Cammack, GA DNR

and small trees can grow densely if they are not controlled in some way. If this crowding is allowed to happen, the leaves of these plants eventually produce so much shade that very little sunlight is able to reach the forest ground. That means that plants like grasses and legumes can't receive enough sunlight to grow. These types of plants are very important food sources for many animals, including the most important animal in the sandhills: the gopher tortoise. The gopher tortoise is especially important because it creates a habitat for many other animals. Gopher tortoises dig their homes, called burrows, in the ground. These tortoises prefer sandy soils; it is easier for them to dig because the soil is loose and easier to move than a clay-based soil type, which is much more compact. The tortoise's burrow provides shelter for many animals,

including two protected species: the eastern indigo snake and the gopher frog. Even foxes have been known to use tortoise burrows for dens! If too many shrubs and small trees are growing in an area, their root systems make it very difficult for tortoises to dig their burrows – so fire helps prevent this problem. If sandhills become too overgrown, gopher tortoises and all of the other animals that depend on their burrows disappear.

By now we understand that both plants and animals in the sandhills depend on fire to maintain a healthy ecosystem. But there is one more interesting thing to know about the relationship between fire and the sandhills: The plants that grow here actually have evolved to encourage fire. Let us consider the longleaf pine, which is the dominant natural tree species in this ecosystem. Longleaf are so named because they have the longest needles of any pine tree in North America (between 8 and 18 inches). They also have thicker bark and a specialized growing pattern that allows them to tolerate regular fire. The longer needles, once shed, help to create a more continuous ground cover of fuel for fire. (Pine needles in general are flammable, but longleaf needles are especially receptive fuel). The thicker bark helps to protect the vulnerable cambium on the inside of the tree from heat generated by fire. Even younger trees, which are shorter and therefore more at risk of damage from even fairly mild fires, are protected from fire by the tightly-bunched needle bundles at the ends of the main trunk and limbs, called terminal buds. Longleaf are not just *pyrophytic* (fire-resistant) but also *pyrophillic* (fire-loving)! Other plants common to the sandhills love fire too. Turkey oaks are specially adapted to fire, as they quickly resprout. Wiregrass forms dense, highly flammable clumps, which help to carry fire from one longleaf pine to the next. Almost all the plants in the sandhills are adapted to fire and need it to maintain a healthy, diverse ecosystem. All it takes for a fire to occur in a sandhill community is for a single lightning strike to create a spark or flame in one of the many receptive fuels, and the fire slowly but steadily spreads from there. Afterward, the entire community of plants and animals responds by a burst of regrowth, continuing their life cycles.

So if all it takes is one lightning strike to start a natural fire in the sandhills, then why do we need people to perform prescribed burns? The answer is because people live here. The Coastal Plain of the Southeast may not be as densely populated as many parts of the world, but people still live here and have put a lot of work into building things they want to protect. Wildfires are not acceptable to many people simply because they are wild and unpredictable. Prescribed fires allow us to control where and how intensely a fire burns so we can protect both people and property. Another important reason we need prescribed fire is because it allows us to control the amount of fuel available to burn. Without regular fire management, the amount of fuel in forests would continue to increase over time. The more fuel that builds up over time, the more intense and destructive a wildfire will be once one eventually starts. It is a lot safer for everyone if we burn a forested area every two to five years under controlled conditions than it is to contain and put out a wildfire that is burning in a forest that has not seen fire in 25 or 50 years. Managing forests with fire is not only good for environments like sandhills, which need it to thrive, but it's also good for the people who live in and around these forests.

PRESCRIBED FIRE Q & A

Interview questions by 4th-grader Claire Elise Fritsch.
Answers by Fire Coordinator Shan Cammack and Fire Technician Bryn Pipes of GA DNR.

Why does the forest need fire?

The forest needs fire because it creates suitable habitats for some plants and animals to grow and live. Fire also reduces the amount of fuel on the ground in a forest; too much fuel on the ground can lead to an unnaturally large fire—like some of the wildfires we see in the West—that can completely destroy a forest. Lastly, fire is the most effective way to return nutrients to the soil. The ash that is left behind after a fire is rich in nutrients that plants need to grow healthily. A prescribed fire for a forest is like when we eat fruits and vegetables and exercise; it's good for us!

What is prescribed fire?

Prescribed fire is a safe way to apply a natural process to ensure ecosystem health and reduce the risk of wildfire. It is a way to recreate a process that used to happen naturally in many forests. Before humans began cutting down large areas of forest for farming, industry, roads and homes, lightning regularly started fires that would slowly burn thousands of acres at a time. As a result, many plants and animals evolved over time to depend on habitats that were created by regular natural wildfires. Since humans have changed the landscape, these regular natural fires either don't happen or need to be put out to protect people's safety and property. Prescribed fire is the best way we can balance a forest's need for fire and people's safety.

What needs prescribed fire?

In the Coastal Plain, there are many plants, animals and habitats that need fire. Some habitats include longleaf pine ecosystems (like forests, savannas and flatwoods), sandhills, Carolina bays and bogs. Some rare and endangered animals that need fire include gopher tortoises, indigo snakes and red-cockaded woodpeckers. Gopher tortoises need very open forest floors so they can move around easily, find food and dig their burrows into the ground; if the forest floor is too crowded with lots of smaller trees and bushes, their roots make it very difficult for gopher tortoises to dig their homes. Indigo snakes also need open forest floors to find food, and they use tortoise burrows for shelter and warmth in the colder winter months. Red-cockaded woodpeckers need lots of old, healthy longleaf pine trees to create their unique nests in the trunks of living longleaf; since this particular tree has evolved to depend on fire, they cannot grow into old, healthy trees without regular fire. Even more common animals like white-tailed deer, wild turkey and songbirds benefit from fire.

Prescribed fire technicians protecting a sign.
Shan Cammack, GA DNR

What do you need to start a fire?

Mostly, we use a drip torch, which is an old-fashioned tool that looks like a metal can with a handle that has a long spout coming out of the top. There is also a wick at the end of the spout that stays lit when you are using the torch. The liquid inside is a mix of diesel and gasoline, and when this liquid is poured out of the spout over the wick, it drips small flames onto the ground. It is very safe for trained fire professionals to use.

What do you wear?

We wear a uniform that we call personal protection equipment, or PPE for short. This uniform includes a helmet, eye protection, leather gloves, tall leather boots, and special pants and long-sleeved shirts made out of a fire-resistant (not fire-proof) fabric. We also carry a backpack in which we have a head lamp in case we need to work in the dark, a compass to help us find our way in the forest, a radio so we can communicate with the other people we are working with and a fire shelter to protect us in case of emergency. It is also very important to carry drinking water, sports drinks and snacks to keep us hydrated and fed while we work. It often takes many hours to safely perform a prescribed burn, so we have to take everything we might need for an entire day into the woods.

What do you do before you start a fire?

First, we pick the area we want to burn. Then, we write a burn plan which describes what kind of goals we have, like reducing fuels, improving access and preparing seed beds. The burn plan lists the weather that we need to create fire behavior that will achieve those goals. Next, we choose and prepare the firebreaks we will use to keep the fire where we want it to be. Finally, we watch the weather and make sure we will have enough people and equipment to complete the burn safely.

What equipment do you use?

We have lots of equipment that we can use. If the fire is near people's homes or other structures that need to be protected, we use fire trucks with large water tanks to put out fire if it gets too close. ATVs (or four-wheelers) and UTVs (they're like off-road golf carts) are also important. They allow us to quickly patrol firebreaks to monitor fire behavior and make sure the fire is staying where we want it to. These vehicles often have water tanks on them. Every person who works on a fire carries a hand tool like a shovel, rake, or hoe that is useful for all sorts of small tasks that are required. We can also fill special backpacks with water and carry them deep into the forest if we need to put out a fire that cannot be reached by a fire truck or ATV.

How hot is the fire?

It depends on the purpose of the prescribed fire. Usually, we want the fire to be fairly "cool," so we keep flames between 2-4 feet high. This kind of fire is like the natural fires that used to occur more regularly from lightning strikes. It protects the taller trees from being killed by too much heat, but it burns fuels lying on the ground and kills the lower growing shrubs that can cause the forest understory to become too crowded. Sometimes we want a fire to be hotter though, especially if there aren't mature trees to protect. For example, if an area has been clear-cut, we would want to create the hottest fire possible to consume all of the logging debris so the area could be replanted and a new, healthy forest could begin to grow.

Pat McChesney setting a prescribed fire with a drip torch.
Shan Cammack, GA DNR

How do you control a fire?

To control a fire, we need to have firebreaks to help us keep a fire contained to a specific area. Firebreaks that we commonly use are roads, trails, lakes, rivers, streams and even bare rock or sand. Sometimes we have to create a new firebreak by plowing or mowing a break with bulldozers and tractors. We prefer to use firebreaks that already exist because that has less of an impact on the land, but sometimes we don't have a choice.

The other way we control fire is by understanding how it works. There are three things fire needs to burn: heat, fuel and oxygen. We call these three things the Fire Triangle. If you take away any one of these three things,

a fire will go out. On the other hand, if you increase either one of these things, a fire will get bigger and hotter. If you have ever been around a campfire, you have seen the Fire Triangle in action. If you put more

Fire Triangle. *National Wildlife Coordinating Group*

wood on the fire, you are adding more fuel and the flames get bigger. If a gust of wind blows, that adds more oxygen to the fire and the coals glow brighter and get hotter. And if you pour water onto a fire, that decreases the heat of the fire and the flames get smaller or go out.

What kind of training do you have?

We get trained in how to control fire in a wildland firefighting class. We learn how to understand the weather, how to use the equipment, how to put out the fire if it escapes, and how to be safe around the fire. It is very important that everyone working on a prescribed fire has this training.

Is the smoke dangerous?

The neat thing about prescribed fires is that usually there is not a lot of smoke because there is not a lot of fuel. But if a wildfire starts in an area that hasn't been burned in a long time, there is a lot more fuel that can burn. That creates more smoke that is thicker, dangerous and unhealthy. So one of the reasons prescribed fire is so important is because it helps reduce the fuel in forests. That means that if a wildfire does start or moves into an area that has been burned regularly, there is less smoke and the fire is much less likely to be destructive and dangerous to animals and humans.

Where does the smoke go?

The smoke goes where the wind takes it. That is one of the reasons why it is important to write a burn plan before you start a prescribed fire. It gives us a chance to carefully think about any smoke-sensitive locations like schools, hospitals or busy roads that may be in the area. Once we know where those smoke-sensitive areas are, we can then identify which wind direction would be best to carry the smoke away from those areas. For example, if there was a hospital south of where you are planning to burn, you would want to burn on a day when the wind is blowing from the south. That would carry the smoke to the north, the opposite direction from the hospital.

FIRE IN THE SANDHILLS!

Adapted from Project WILD's "Time Lapse" and "Smokey Bear Said What?"

OBJECTIVES

Students will (1) describe successional changes in the sandhill *habitat* without fire, (2) describe some of the changes fire can make in the *sandhills* and (3) identify the positive role of fire in the sandhill habitat.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Students brainstorm the positive role of fire in the sandhill habitat, research the effect on sandhill plant and animal species and create murals showing changes caused by sandhill fires.

MATERIALS

Computer lab internet access, media center research materials, provided list of sandhill plants and animals to research, provided GA DNR animal and plant fact sheets, provided Sandhills Fire Ecology fact sheet, provided diagram of "Succession in the Sandhills," drawing markers or crayons, paper for mural display.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, environmental education

DURATION: Two or three 50-minute sessions

GROUP SIZE: Up to 30 students

SETTING: Classroom or outdoors

KEY TERMS: annuals, habitat, keystone species, perennials, prescribed fire, pyrogenic, sandhills, succession

BACKGROUND

In nature, the only thing constant is change. Habitats are always changing, sometimes subtly and sometimes dramatically. For example, if an open field is left alone, it gradually will turn into a forest. However, a disturbance such as a forest fire could change a thick grove of trees into an open field fairly quickly. Without further disturbance (such as another fire, mowing or plowing), that area once again will turn into a forest naturally over time.

The natural sequence of plant and animal species that come in to occupy an open area over a period of time is called ecological *succession*. Without disturbance, grasslands turn into shrubby habitats and then into forests. Plants with seeds that travel through the air (like grasses and weeds) are more likely to land on bare soil and start growing first. Therefore, those plants are referred to as early successional species. Trees with winged seeds that require lots of sunlight to grow (like pines) will be one of the first trees on site. On the other hand, trees with heavy seeds or nuts that can tolerate shade (such as oaks) typically come in an area after some time has passed, or later in the successional sequence. For early successional plants (and the wildlife that use them) to survive and not be overtaken by oaks and other hardwood trees, regular disturbance like fire is needed.

At one time, all fires were suppressed and fought. Today, however, many fires are allowed to burn as part of a natural cycle within a forest ecosystem. Research has shown that the lack of periodic fire in many wild areas increases risks to society and the environment. In remote areas, some agencies now monitor lightning-ignited fires and allow them to burn as long as they stay within acceptable limits of fire behavior and location. However, blazing wildfires near populated areas are still fought aggressively.

Students may wonder – If some fires are helpful, why does Smokey Bear say, "Only you can prevent forest fires"? This message is aimed at humans causing accidental fires through carelessness in camping situations. Accidental and arson fires often are started near developed areas and occur during times of severe drought or high winds, and they can be terribly destructive.

On the other hand, after much planning and only under certain conditions, qualified resource managers may set *prescribed fires* in some areas. The purpose is to restore a natural cycle that helps maintain healthy ecosystems by sending rich nutrients back into the soil and promoting new growth. These low-intensity fires also reduce the amount of combustible matter or "fuel load" in the forest, thereby preventing future wildfires that can kill everything and scorch the soil. For more details, see the Sandhills Fire Ecology Fact Sheet.

Fire plays a major role in maintaining sandhill ecosystems. These habitats are *pyrogenic* (fire dependent) and require frequent, low-intensity fires about every two to five years. These burns minimize competition and stimulate the flowering and germination of many sandhill plants. Many plants have adapted to survive in fire-dependent habitat. Examples include the longleaf pine, wiregrass and sandhill rosemary. The positive effects and benefits of fire in the sandhills include:

- maintaining and enhancing this fire-dependent habitat
- providing habitat for wildlife that depend primarily on this fire-driven ecosystem
- increasing soil productivity by releasing and recycling nutrients in leaf litter and undergrowth
- preparing soil for germination of some seeds
- activating heat-dependent seed varieties
- providing a greater variety of food and shelter sources for some species of wildlife, such as the gopher tortoise, a *keystone species*
- opening up habitat, generating new growth and a diversity and abundance of food plants

The purpose of this activity is to illustrate to students the positive effects that fire has in maintaining a healthy environment for plant and wildlife species in the sandhill habitat.

PROCEDURE

1. Display a class copy of the "Succession in the Sandhills" diagram in the classroom.

2. Discuss with the class the definition of succession while referencing the diagram. Ask students what species of plants and animals they think might live in the various stages of succession in the sandhills. Where do they think the greatest variety of species would be found? How have the sizes and types of plants changed throughout time? Discuss the difference between *annuals* and *perennials*.

3. Lead a discussion with the students about forest fires. The student's reactions may be negative at first. Point out that while the effects of fire may be detrimental to some wildlife species, the fire may benefit other species. Explain that some habitats, such as the sandhills, are fire dependent.

4. Have students brainstorm possible positive and negative effects of forest fires in the sandhills and keep a list for future reference.

5. Divide the class into groups of five. Have each group research more about the various species living in the sandhills, choosing one plant and one animal from the following list: Bachman's sparrow, eastern diamondback rattlesnake, eastern indigo snake, gopher frog, gopher tortoise, gopher tortoise tick, little gopher scarab beetle, longleaf pine, northern bobwhite, Pickering's morning glory, red-cockaded woodpecker, sandhill golden-aster, sandhill milkweed, sandhill rosemary, Sherman's fox squirrel, southeastern American kestrel, southern hognose snake, striped newt, turkey oak, wiregrass. Using access to the internet, media center research materials and provided GA DNR species fact sheets, have students learn about their chosen species and determine how fire might benefit each species and if their species has special "fire survival skills."

6. After students complete their research, have the groups share their findings with the class. Groups should explain the importance of fire to their species and if they have any special "fire survival skills." Refer back to the brainstormed list of positive and negative effects and see if the students still agree with the original list. Discuss why or why not.

7. Create two murals showing a sandhill habitat before and after a controlled burn. Have students draw or cut out pictures of plant and animal species that would live in this habitat. Have students place them on the mural where they think their species might live the most successful life and explain to the class why. Have students discuss why they think fire made a difference.

Manassas bog before a prescribed burn.
Lisa Kruse, GA DNR.

Manassas bog two months after a prescribed burn.
Lisa Kruse, GA DNR.

EXTENSIONS

1. Contact a wildlife biologist or prescribed-fire specialist to come and speak to the class about the different ways that prescribed fire can benefit wildlife, possibly sharing photos.

2. Take a field trip to a habitat that has gone through a prescribed burn.

3. Create an enlarged replica of a winged pine seed (see Pine Seed Helicopters at the end of this activity). Test its flight through the air from various heights. Discuss how the pine's seed shape lends itself to be an early successional species. *Hint: Seeds that can travel well are more likely than heavier seeds (such as acorns) to quickly land on bare soil and start growing.*

ASSESSMENT

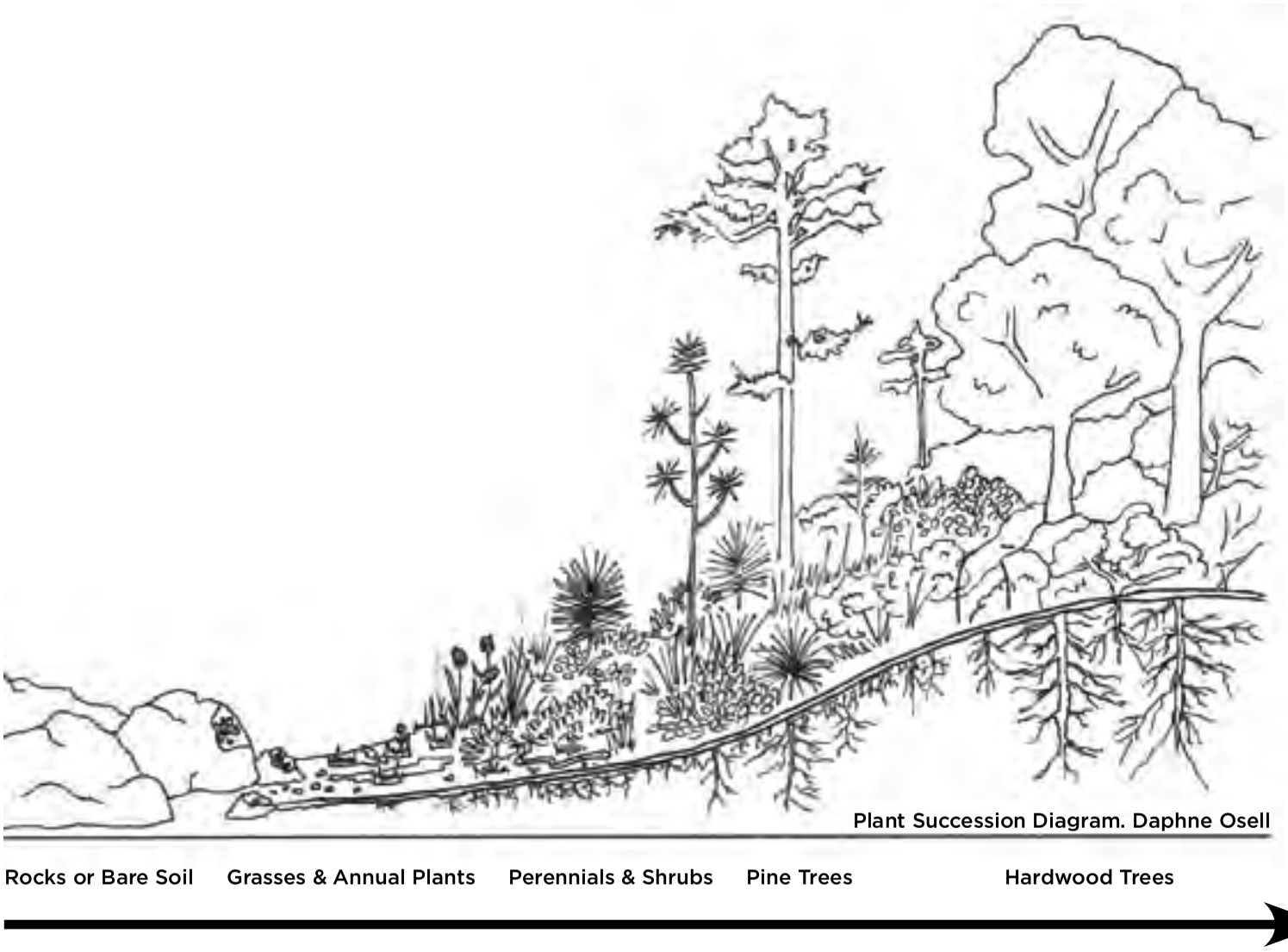
1. Explain the importance of fire to the sandhill habitat.

2. Name 5 species of plants or wildlife that benefit from fire in the sandhill habitat.

3. Explain how succession is limited by fire in the sandhill habitat.

SUCCESSION IN THE SANDHILLS

COPY ME



Plant Succession Diagram. Daphne Osell

CHANGES IN VEGETATION OVER TIME, WITHOUT DISTURBANCE (FIRE, MOWING, TIMBER HARVEST, ETC.)

COPY ME

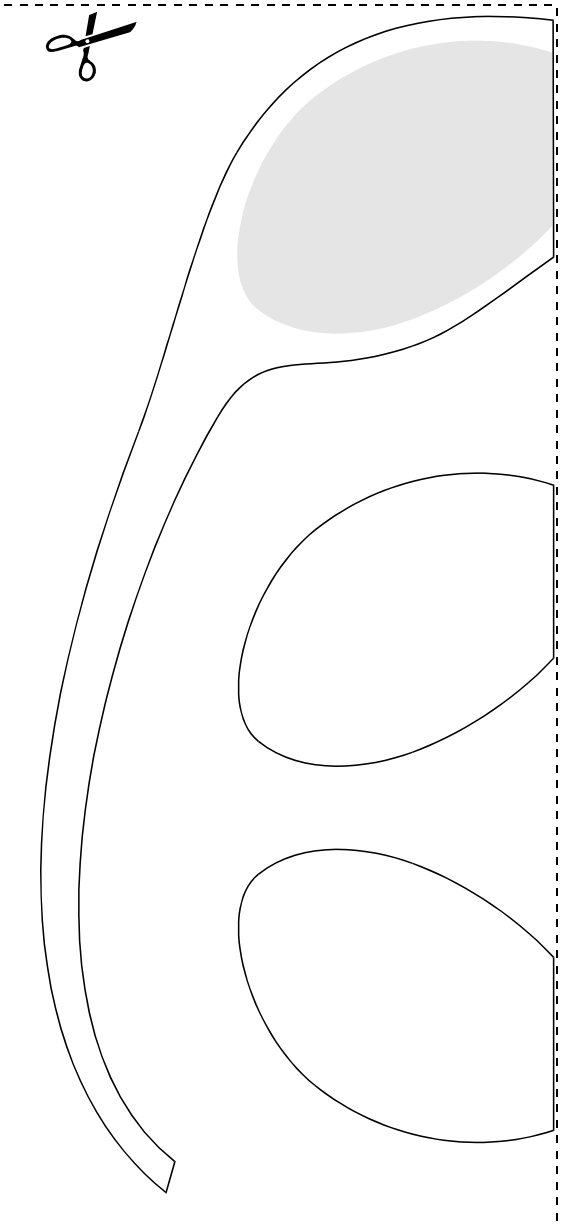
PINE SEED HELICOPTERS

Adapted from "Maple Seed Helicopters" activity; permission to use granted to GA DNR from Bird Flight: www.ornithopter.org/birdflight.

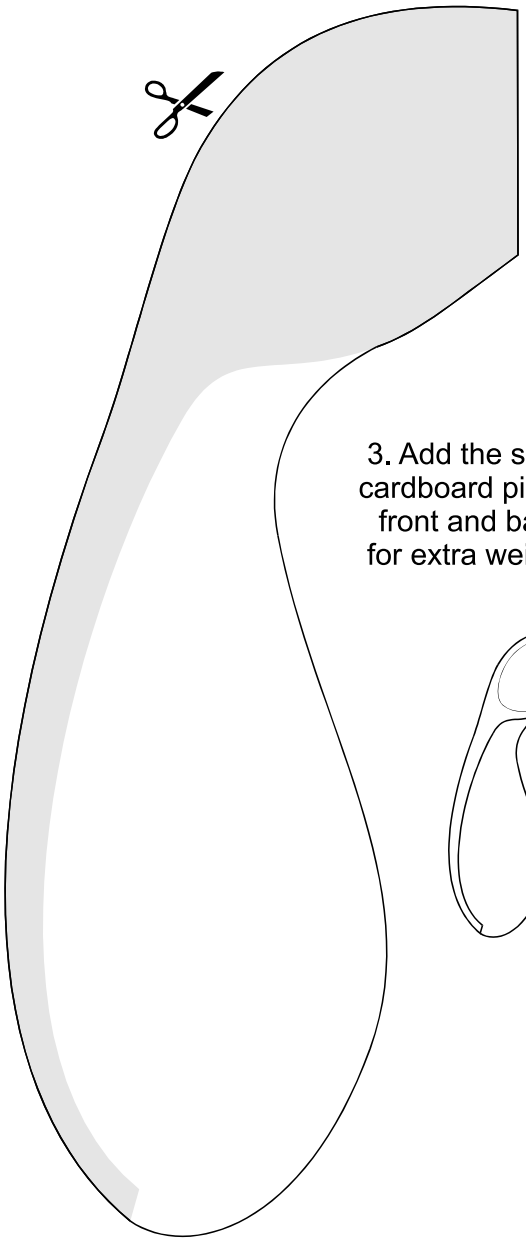
FIRE IN THE SANDHILLS – EXTENSION #3:

Maple Seed Helicopters

1. Cut on the dotted line. Glue the pattern onto cardboard, and then cut out the three pieces.



2. Glue the long cardboard piece onto the shaded area below. Then cut along the solid outline.



3. Add the small cardboard pieces front and back for extra weight.

Fox Squirrel

Red-cockaded Woodpecker

Northern Bobwhite

Eastern Indigo Snake

Gopher Tortoise

WILDLIFE OF THE SANDHILLS 2

TORTOISE TROUBLES

Adapted from Project WILD's "Quick Frozen Critters," Aquatic WILD's "Hooks & Ladders" and Flying WILD's "Hidden Hazards" activities.

OBJECTIVES

Students will (1) experience and then describe some of the threats or *limiting factors* (i.e., predators, impacts from cars, fire, development, disease, gassing of burrows) affecting gopher tortoises as they go about their daily activities and (2) explain how many of these limiting factors are hazards caused by humans.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Students simulate a day in the life of a gopher tortoise by navigating an obstacle course portraying threats or limiting factors faced by this *foraging* keystone species.

MATERIALS

Playing area (50 feet by 50 feet in a gymnasium or grassy field), gopher tortoise fact sheet, 2 jump ropes (cotton ropes work best because they are sturdy when being twirled), 12 boundary cones for marking various zones, 5 hula hoops (1 Home Burrow and 4 Safe Burrows), a hat or vest to designate the predator, food tokens (poker chips, counters, or laminated colored-paper pieces, etc.) of equal amounts of three different colors with the total equaling 3 times the number of participants (i.e., for 20 students: 20 red + 20 blue + 20 green = 60 food tokens), a pencil and the Research Biologist Tally Sheet for the student investigator. For extensions: 1- to 2-foot piece of hose, 1 brick and stickers to place on a few random food tokens representing disease.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, environmental education

DURATION: One or two 45-60 minute sessions

GROUP SIZE: 15-30 students

SETTING: Outdoors or gymnasium

KEY TERMS: forage, habitat, herbivores, keystone species, limiting factors, predator, prey, silviculture, urban sprawl, URTD

BACKGROUND

Gopher tortoises are a characteristic species of the longleaf pine and sandhill communities. With their specially adapted shovel-like front feet, these tortoises dig burrows that can extend up to 40 feet long and 10 feet deep. The burrows average 15 feet in length and maintain a constant temperature and humidity throughout the year, serving as homes that are well-insulated from the heat and cold. These burrows also provide protection from predators and fire.

Gopher tortoises may have multiple burrows that they use in their home range over time, sometimes traveling several miles to take up residence in an existing burrow or dig a new burrow. This reptile is considered a *keystone species* of the sandhill region, meaning that its presence is key to the health and support of other animals in the community. Because of the burrows they dig, more than 360 different species can use either active or abandoned gopher tortoise burrows for shelter and protection. The gopher cricket, gopher moth and the gopher scarab beetle are examples of animals that rarely are found anywhere but in gopher tortoise burrows. Other animals that depend on these burrows include federally threatened eastern indigo snakes, eastern diamondback rattlesnakes, mice, rabbits, armadillos, skunks, foxes, burrowing owls, spiders, ticks and beetles.

Gopher tortoises are *herbivores*, using their eyesight and

sense of smell to seek out many different plants for food. When tortoises forage, they graze on a basic diet of low-growing broad-leaved grasses and wiregrasses, similar to cows that graze in pastures. Tortoises cover their home range (about 1-4 acres) seeking out a variety of plants that provide the nutrients required for survival – plants such as sea grapes, legumes, poison ivy, stinging nettle, gopher apple and blackberries. They are known to eat 300-400 different species of plants, and they benefit plant communities by dispersing seeds throughout their habitats through defecation.

Gopher tortoises are long-lived reptiles with a lifespan of 60 years or more, but they face many challenges for survival. Threats or limiting factors include the loss of their native longleaf pine-wiregrass *habitats* through agricultural and *silvicultural* development, as well as *urban sprawl* that fragments home ranges when roads, buildings and parking lots are built. Road mortality is one of the main causes of adult tortoise deaths. Other factors include *predators* such as dogs and coyotes and nest predators such as raccoons, foxes, skunks, armadillos and fire ants.

Although fire would seem to be a threat, natural and prescribed fires can be beneficial to tortoises by opening up the tree canopy to allow sunlight to reach the forest floor, encouraging the growth of grasses and other low-growing plants for food. Tortoises retreat to their burrows for protection during these fires. By clearing out large debris on the forest floor, fires also make it easier for tortoises to travel through their habitat.

In the past, tortoise populations were affected by humans consuming them for food, a practice which is now illegal. Today, another threat to gopher tortoises is the introduction of gasoline into their burrows (gassing), a technique used by some rattlesnake hunters to force the snakes out for capture. This exposure to gas often is fatal to all burrow inhabitants, and doing so is illegal. Another serious concern is an upper respiratory tract disease (*URTD*). This illness is highly contagious and is transmitted by close contact between tortoises. Clinical signs of URTD include clear or white nasal discharge, watery eyes and swollen eyelids. Tortoises can be "silent carriers," meaning they have the disease but do not exhibit obvious signs. Also, URTD may be introduced into established colonies when tortoises are relocated.

PROCEDURE

The goal of this activity is for each student (as a gopher tortoise) to complete one full cycle of the playing field (foraging in its home range) by successfully obtaining three different colored food tokens while surviving obstacles representing threats or limiting factors.

1. Set up playing area as shown in Figure 1. A 50 foot by 50 foot area allows for plenty of space. Allow 20-30 minutes prep time based on familiarity with activity. Using three different color food tokens will facilitate honesty and will represent a variety of required plant nutrients. Scatter one set of the same color food tokens in each the three foraging areas, making sure there are enough tokens to cover the number of participants. (Example: 15 participants representing gopher tortoises = 45 tokens of three equal amounts of three different colors.)

2. The teacher should begin by discussing the gopher tortoise background information with students. The term *limiting factors* should be defined, and the students should consider how the activity's obstacles represent the threats that gopher tortoises face in their daily lives.

3. Designate roles for students (roles may be switched in multiple rounds) and explain the playing field, describing the route tortoises must take to complete the activity. A demonstrative walk-through of the activity will help students to understand their roles.

ROLES:
1 predator representing a dog or coyote
1 Good Samaritan, who helps tortoises get across the road
1 student investigator representing a Research Biologist (keeps data records)
4 jump rope holders (2 for road crossing and 2 for fence)
# of remaining students are foraging gopher tortoises

4. To begin the activity, the student investigator (Research Biologist) records the number of gopher tortoises that start the course on the Research Biologist Tally Sheet. Tortoises line up at Home Burrow, one at a time. As a tortoise moves out of the burrow and into Foraging Area #1, another tortoise can occupy the burrow (hula hoop).

5. Tortoises must pick up one food token in Foraging Area #1 and then advance to the Road Crossing Zone (swinging jump rope representing cars). To survive, tortoises must run through the swinging rope without stopping the rope movement (tortoises are allowed to run under the arms of the rope twirlers if they choose to). If the rope movement is stopped, the tortoise dies and goes out of the playing area to the Graveyard and stays there until the round is over. If a tortoise is hit by the rope but does not stop the rope movement, then he has a nonfatal wound and must HOP through the rest of the course. The Good Samaritan stays in the Road Crossing Zone and may help up to three tortoises safely cross the road by walking them around the rope one at a time to the Safe Zone (the other side of the road). After all tortoises have passed through the Road Crossing, the Good Samaritan helps tally the fatally wounded tortoises in the Graveyard with the Research Biologist.

6. After reaching the Safe Zone, tortoises must next attempt to get past the predator to reach Foraging Area #2. The two hula hoops in the Predator Zone represent Safe Burrows that one tortoise at a time may use to avoid being tagged by the predator. If the predator tags a tortoise trying to get through to Foraging Area #2, then the predator has two choices: he may either WALK his *prey* (the tagged tortoise) back to the Home Burrow starting area, where the tagged tortoise may begin his journey again (representing harassment only), or he may WALK his prey to the Graveyard (representing that the tortoise was fatally wounded). Remind the predator that he MUST ESCORT his prey to the destination of EITHER the Graveyard or Home Burrow with each tortoise tagged. Then the predator may return to the Predator Zone.

7. Once tortoises reach Foraging Area #2, they must pick up one token of the second color before advancing.

8. The next zone that tortoises must survive is the Fire Zone. Once again, the two hula hoops represent Safe Burrows that only one tortoise at a time may use. Each tortoise must enter a burrow and PRETEND TO DIG for 10 strokes before advancing to the Developed Area. This digging motion represents the tortoise scrambling down the burrow for safety. If a tortoise is caught by the teacher not digging, then they are sent to the Graveyard, indicating that they did not escape the fire and died.

9. No food is available in the Developed Area because it has been logged and scraped clean of all vegetation by bulldozers in order to build a store. A barbed wire fence (jump rope #2) at the edge of the zone leads to the way back home. Tortoises must crawl under the jump rope held at student waist height without touching it to make it to Foraging Area #3. If a tortoise touches the rope, he is wounded and must HOP the rest of way through the course.

10. In the last foraging area, surviving tortoises must pick up a token of the third color. To enter the Home Burrow safely, students must show the teacher three different color tokens, and then they report their status to the Research Biologist.

11. Tortoises report to the student investigator (Research Biologist) for data recording:

    # surviving with food tokens
    # killed by car / # helped by Good Samaritan
    # attacked by predator (wounded or killed)
    # burned in fire
    # wounded at barbed wire fence

12. As time permits, repeat the activity for 2-3 rounds, allowing students to change roles.

13. Discuss with students the recorded results. How did the limiting factors affect the tortoise population? How might these threats affect other species that are dependent upon gopher tortoises and their burrows? How do multiple burrows in the home range affect survival? How many of these limiting factors are caused by humans? What can be done to help gopher tortoises survive?

14. For a more in-depth study, have students repeat the activity using the following variations, and discuss the impacts that these threats or limiting factors have on the gopher tortoise population.

VARIATIONS

Conduct activity the same as before but with the following options:

1. Teacher randomly places a short piece of hose in one of the Safe Burrows (hula hoop) while a tortoise is occupying it, representing the illegal practice of gassing burrows. This tortoise dies and goes to the Graveyard.

2. Teacher randomly places a brick in one of the Safe Burrows (hula hoop) while a tortoise is occupying it, representing land being cleared by heavy equipment that causes the burrow to collapse and smother the gopher tortoise. This tortoise dies and goes to the Graveyard.

3. Teacher secretly marks 3 food tokens in Foraging Area #3 with stickers designating URTD (upper respiratory tract disease). These tokens are turned so that the stickers are unseen, facing the ground. Tortoises finishing the round with one or more of the URTD marked tokens represent either "silent carriers" or tortoises that exhibit symptoms of this highly contagious disease and are capable of infecting other tortoises through close contact.

EXTENSIONS

1. Have students research which state and federal laws protect the gopher tortoise.

2. Have students research what must be done before land occupied by gopher tortoises can be developed.

3. Have students research URTD (upper respiratory tract disease) in gopher tortoises.

ASSESSMENT

1. Identify and describe some of the limiting factors that affect gopher tortoises as they go about their daily foraging activities, and indicate which threats are caused by humans.

2. Identify and describe some of the limiting factors that might also affect other species that are dependent upon the gopher tortoise and its burrows.

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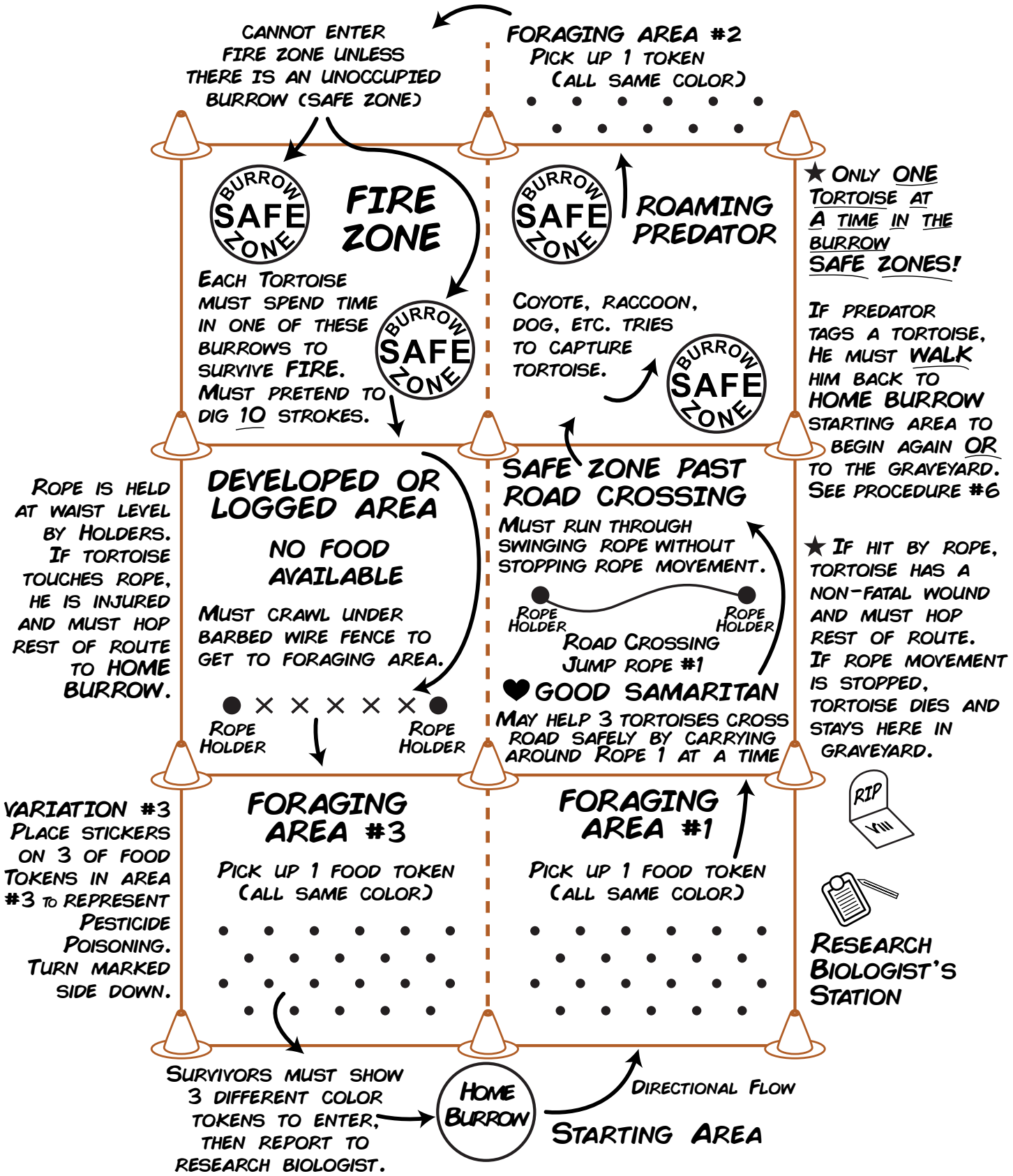
FIGURE 1: TORTOISE TROUBLES PLAYING FIELD DIAGRAM



Tortoise Troubles playing field diagram. *Kim Kilgore*

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RESEARCH BIOLOGIST TALLY SHEET

for use in "Tortoise Troubles"

Gopher Tortoise Numbers	Round #1	Round #2	Round #3	Round #4
# starting from Home Burrow				
# surviving with three food tokens				
# fatally wounded by cars				
# helped across road by Good Samaritan				
# wounded by predator				
# killed by predator				
# burned in fire				
# wounded at barbed wire fence				

VARIATIONS

# killed by burrow being gassed				
# killed by heavy equipment				

BURROW BUDDIES

Adapted from Project WILD's "Everybody Needs a Home" and "My Kingdom for a Shelter."

*Suggestion: Do this activity as a follow-up to "Tortoise Troubles."

OBJECTIVES

Students will (1) explain that humans and animals share a basic need to have a home or shelter, (2) identify the role of the gopher tortoise as a keystone species in the sandhill habitat and (3) identify different organisms that use gopher tortoise burrows for a home or shelter.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1

4TH GRADE: S4L1

METHOD

Students will draw a floor plan of their house, compare it to a cross-section drawing of a gopher tortoise burrow and compare the inhabitants and needs of each home.

MATERIALS

Gopher Tortoise Fact Sheet, drawing paper, poster paper, colored pencils or crayons, glue, scissors, provided "Burrow Buddies" fact cards about common gopher tortoise inhabitants, provided diagram of gopher tortoise burrow with no animals, provided sketches of burrow animals and magazines with animal photos for cutting out. Extensions will require internet access and other media center resources.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, Environmental Education

DURATION: Two 45- to 60-minute sessions

GROUP SIZE: 15-30 students

SETTING: Indoors

KEY TERMS: commensal, habitat, herbivores, invertebrates, keeled, keystone species, obligate, sandhills, vertebrates, wildlife

BACKGROUND

Humans and animals have many of the same basic needs. Every animal needs a home, but a home is not just a house where people live. For *wildlife,* a home is usually outdoors. The scientific term for an animal's home is *habitat*. An animal's habitat includes food, water, shelter or cover and space. These habitat components must be available in a suitable arrangement for the animal to survive.

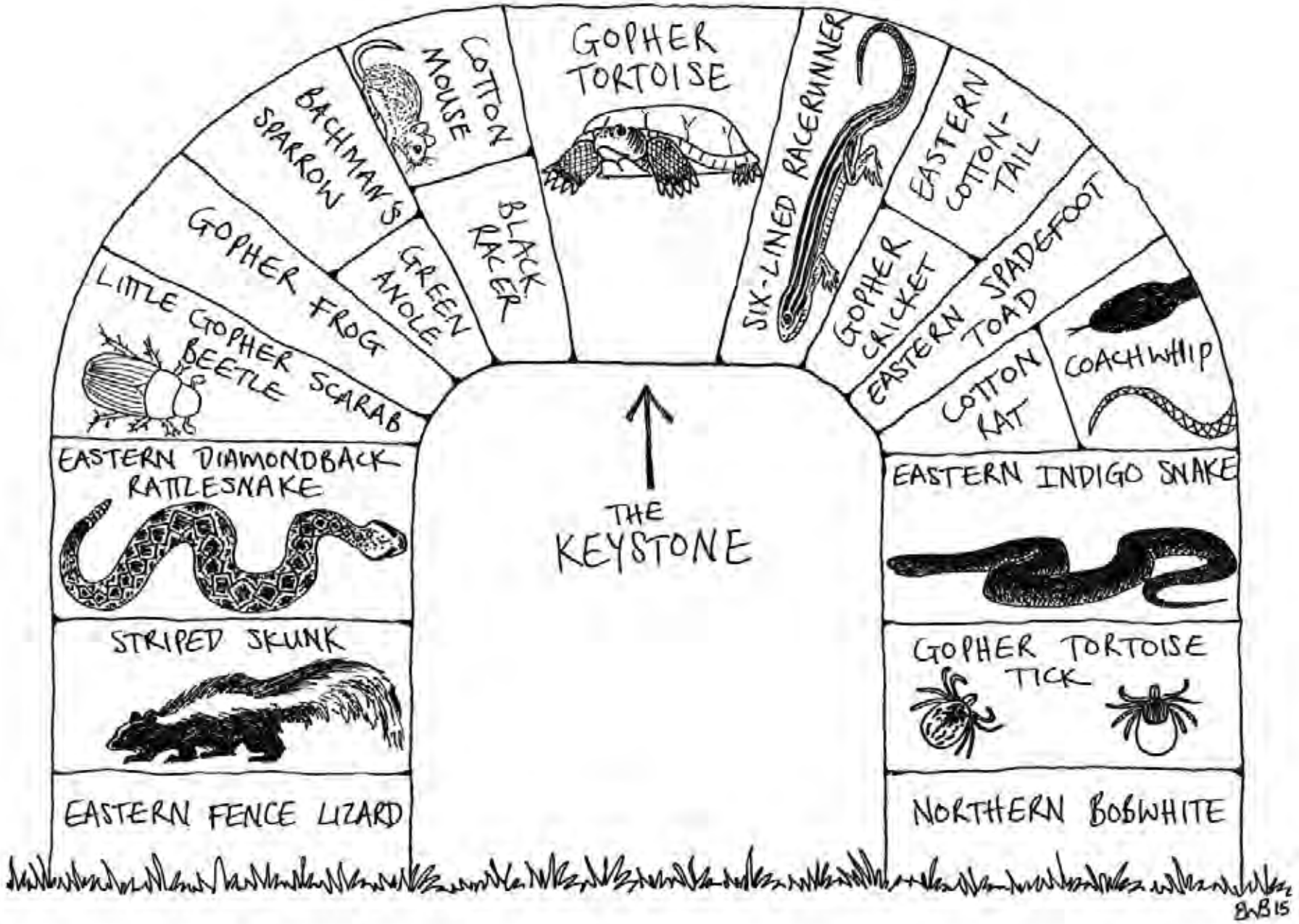
A house may be considered shelter for people. People build houses, apartments, trailers and other kinds of shelters in which to live. An animal's shelter might be underground, in a bush, in a hollow tree or under some rocks. Animals need a place to find food and water. They also need enough space in which to live and find the resources they need. Home for an animal is like a neighborhood with everything in it that is needed for survival.

One animal that creates its own home is the gopher tortoise. Gopher tortoises are a characteristic species of the longleaf pine and *sandhill* communities. With their specially adapted shovel-like front feet, they dig burrows that average 15 feet in length but can reach 40 feet long and up to 10 feet deep. These burrows stay at a constant temperature and humidity throughout the year, providing insulation from the heat and cold. Gopher tortoises depend on these burrows for their homes, temporary shelter, protection from predators and as a way to escape fire, so they may use several burrows over time. Tortoises may travel several miles to take up new residence in an existing burrow or to dig a new one. The burrows used by a tortoise, its breeding territory and its feeding grounds make up its home range.

The gopher tortoise is considered a *keystone species* of the

sandhill region, meaning that its presence is key to the health and support of other species in the community. The term "keystone" comes from Roman architecture and designates the most important piece in an arch, the wedge-shaped stone or brick at the top that distributes the weight and holds the structure together.

Over 360 different species use either active or abandoned burrows for shelter, protection and sometimes food. Many kinds of *invertebrates* (worms, crustaceans, insects and spiders) and several *vertebrates* (amphibians, reptiles, birds and mammals) live in tortoise burrows. Some of these animals rarely are found anywhere except for in gopher tortoise burrows and are called *obligates.* Examples include the gopher tick, gopher cricket, gopher moth and the gopher scarab beetle. Other animals that could live elsewhere but benefit by sharing these burrows are called *commensals* and include eastern indigo snakes, eastern diamondback rattlesnakes, gopher frogs, mice, rabbits, armadillos, skunks, foxes, burrowing owls, spiders and a variety of insects. Since gopher tortoises are *herbivores* and their diets consist of a wide variety of low-growing, broad-leaved grasses, wiregrasses and a large diversity of other plants, they do not pose a predatory threat to any of their burrow inhabitants.



Gopher Tortoise as the Keystone Species in the Sandhills. *Berkeley Boone*

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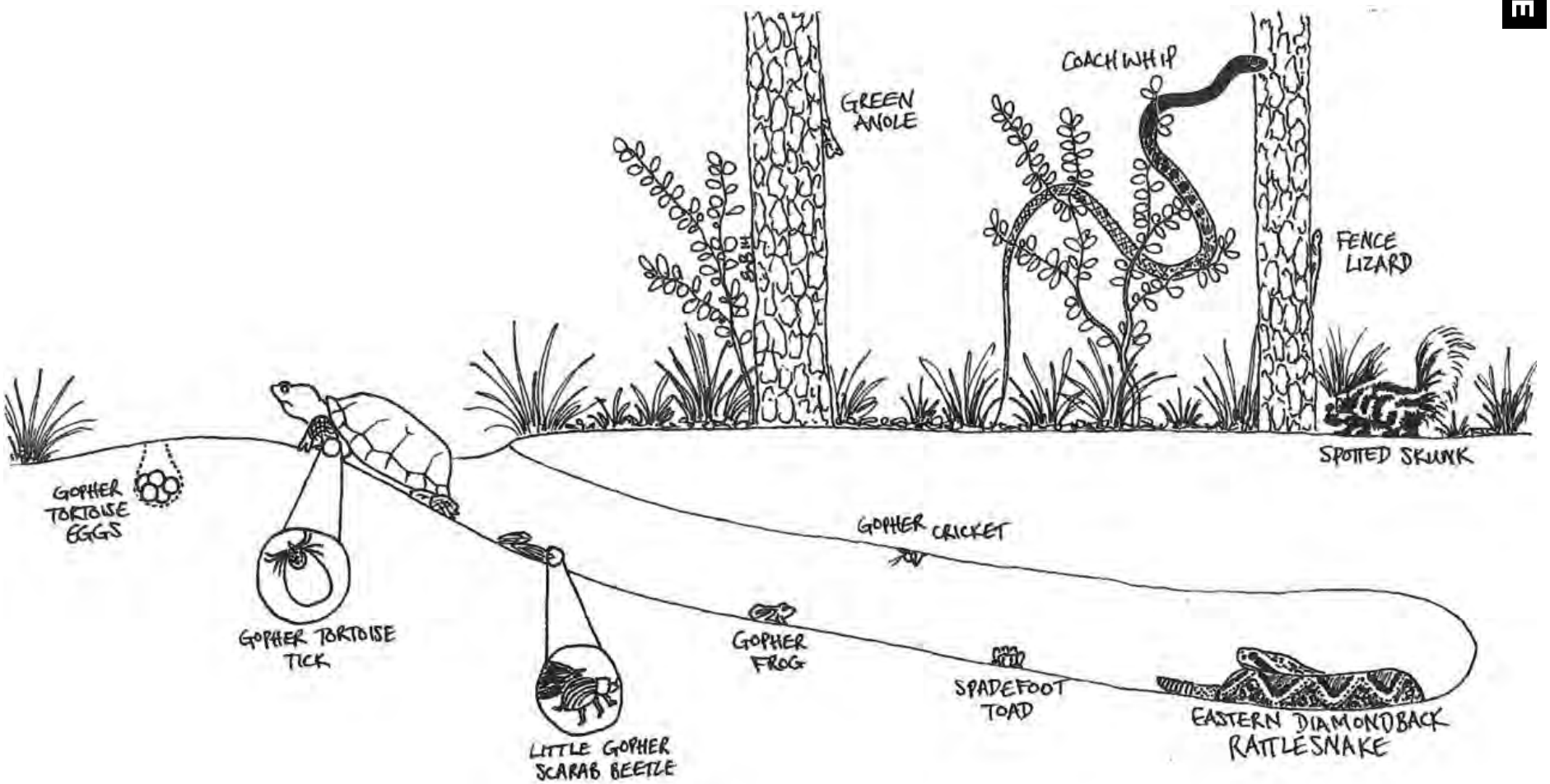

Gopher Tortoise Burrow with Inhabitants. *Berkeley Boone*

PROCEDURE

1. The teacher should lead a discussion on the background information with students, emphasizing the basic needs of humans and animals. Explain the term *keystone species* and the role of the gopher tortoise in sandhill habitats.

2. Have the students draw a floor plan of where they live or where someone they know lives. The floor plan should include things that the student needs in their home to survive such as a place to cook and keep food, a place for everyone to sleep, and a source of water. Students also should include any pets that are a part of their family that live indoors.

3. Once the drawings are finished, ask students to share their work with the class and point out the things included in their drawings that they need to live. Ask students if someone else makes it possible for them to live in this home, such as a parent or grandparent. (This person can later be compared to the gopher tortoise as the "keystone" of the family.)

   Ask students to save these drawings for further discussion.

4. Divide the class into groups of four or five students. Give each member of the group a Burrow Buddies fact card from different classifications (i.e., mammal, bird, reptile, amphibian, insect or arachnid). Each card describes one of the common gopher tortoise burrow inhabitants. Ask students to read the information on their Burrow Buddies fact card, and then have them discuss what they learned about their "burrow buddy" with their group.

5. After groups have completed step 4, distribute the cross-section diagrams of a gopher tortoise burrow (with and without inhabitants). Have each student in the group place their animal somewhere in the burrow by drawing their animal or by cutting out and gluing the provided sketch of their animal into the burrow. Allow groups to draw a larger version of the burrow on poster paper to allow more room for animal placement as well as a more visible diagram for class discussion.

6. Next, have students present their group's "burrow buddies" to the class and share what they learned about the different species living in the burrows they created. Students should highlight any interesting or important information about these species (i.e., the eastern indigo snake is federally threatened).

7. Have students collectively display their home drawings on the wall on one side of the classroom. Explain that everyone needs a home, and all of the homes together form a neighborhood. Neighborhoods and the resources they provide form a community.

8. Have students collectively display their gopher tortoise burrow cross-section diagrams or drawings on the other side of the classroom. Lead a discussion on the following questions:

   - Every gopher tortoise burrow is a home or shelter for the gopher tortoise. As a "keystone species," what else does the gopher tortoise provide for some of the other species of animals in its sandhill habitat? Who is the "keystone" in the student's family?
   - Is the gopher tortoise community similar to a human community? How or how not?
   - What might happen to this community of animals if the gopher tortoise population declined?

EXTENSIONS

1. Have students do more in-depth research on the "Burrow Buddies" of their choice through internet access in a computer lab or other media center resources.

2. Have students research "obligate" and "commensal" species.

3. Have students research what state and federal laws protect the gopher tortoise.

ASSESSMENT

1. Identify three reasons why humans and animals need homes or shelter.

2. Explain why the gopher tortoise is called a "keystone species."

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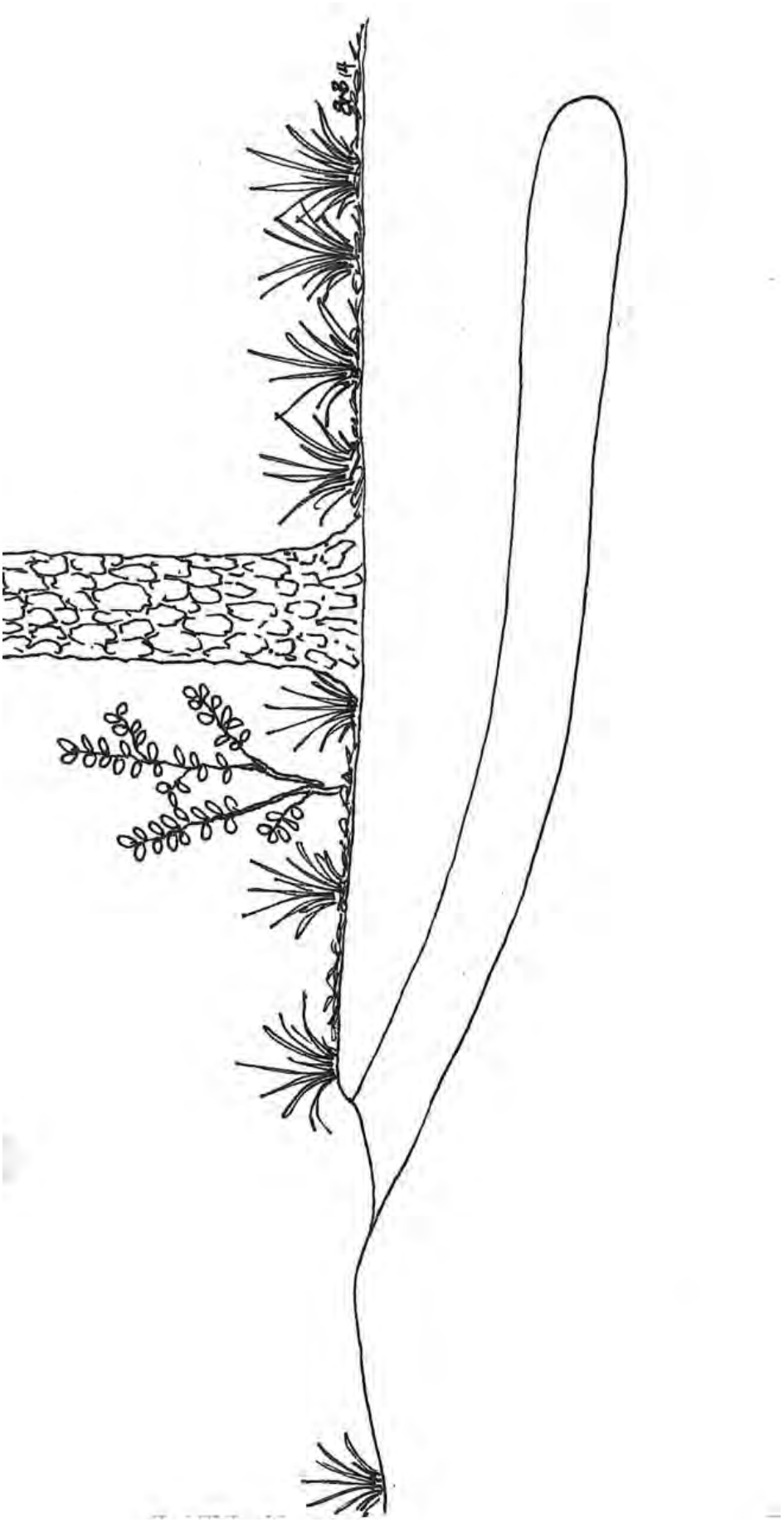

Gopher Tortoise Burrow Cross-Section. *Berkeley Boone*

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BURROW BUDDIES FACT CARDS

GOPHER TORTOISE TICK *Amblyomma tuberculatum*

INVERTEBRATE / CLASSIFICATION: ARACHNID

- Largest tick species in North America.
- Mostly feeds on the blood of the tortoise.
- Commonly found in gopher tortoise habitats with shrub cover, in the sand of burrows and on gopher tortoises.

GOPHER CRICKET *Ceuthiphilus walkeri*

INVERTEBRATE / CLASSIFICATION: INSECT

- Large, brown, wingless hump-backed cricket.
- May be food for other species living in burrows, such as gopher frogs.
- Often found in gopher tortoise burrows.

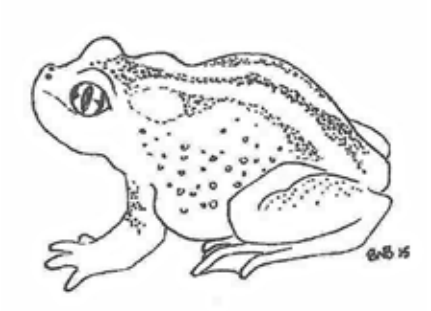
LITTLE GOPHER SCARAB BEETLE *Alloblackburneus troglodytes*

INVERTEBRATE / CLASSIFICATION: INSECT

- Yellowish-brown beetle with an elongated body about 3.5 mm long.
- Removes dung from the gopher tortoise burrow, which it uses as food.
- Uses specialized mouth parts to suck out moisture and nutrients from the dung.
- Helps control parasites and pest flies in burrows by removing dung.
- Only found in gopher tortoise burrows.

EASTERN SPADEFOOT TOAD *Scaphiopus holbrookii*

VERTEBRATE / CLASSIFICATION: AMPHIBIAN



- Smooth, moist toad with several very small bumps.
- Adults are 1.5-2.5 inches long with short, stocky legs.
- Body color can be olive, brown, gray or black, but all have yellow markings shaped like reverse parentheses that extend the length of their body.
- Has elliptical pupils, like those of a cat.
- On the inside of each hind foot is a hardened, dark spade used for digging, which gives this toad its name.
- Call is an explosive, low-pitched grunt.
- Spends most of the year in underground burrow that it creates by digging backwards with its "spades," often coming above ground only during heavy rains or to forage.
- Also lives in gopher tortoise burrows in Georgia.

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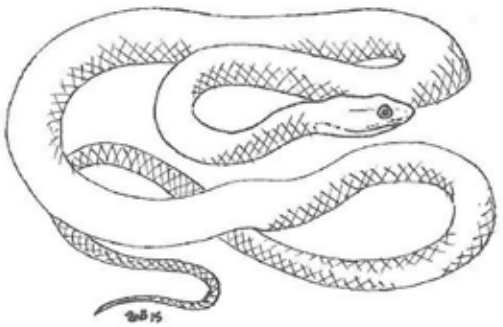
GOPHER FROG *Lithobates capito*

VERTEBRATE / CLASSIFICATION: AMPHIBIAN

- Stout-bodied frog with a large head and mouth and stubby legs.
- Adults are 3-3.5 inches long.
- Body color ranges from light tan to gray with black or brown irregular blotches on the back, sides and legs.
- Call is a long, deep, snoring sound.
- Often found in gopher tortoise burrows, which provide shelter, safety, humidity and sometimes food.

BLACK RACER *Coluber constrictor*

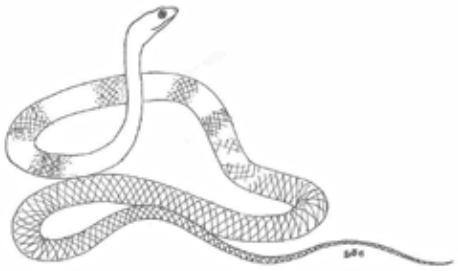
VERTEBRATE / CLASSIFICATION: REPTILE



- Nonvenomous, slender, streamlined snake.
- Solid black except for a white chin.
- Has large eyes compared to most other snakes.
- Often searches for prey with its head held high.
- Seeks shelter beneath leaves, ground litter, under logs, in stumps and in animal burrows.
- Also uses gopher tortoise burrows in Georgia as a safe shelter.

COACHWHIP *Coluber flagellum*

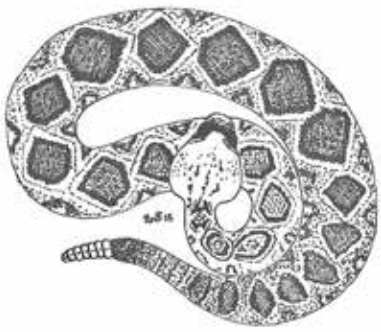
VERTEBRATE / CLASSIFICATION: REPTILE



- Nonvenomous snake that does not constrict its prey, but rather grabs and swallows it live.
- The only snake in the Southeast that is solid black anteriorly (head end) and completely tan on the posterior (tail end) portion of its body.
- Long, slender body ranging from 4-8 feet with large head and large eyes.
- Sometimes called a whipsnake.
- Gets its name from the appearance of its tail, which has patterned scales resembling a long braided whip.
- Goes under logs and vegetation or underground in animal burrows during cold weather and at night.
- Found in gopher tortoise burrows in Georgia.

EASTERN DIAMONDBACK RATTLESNAKE *Crotalus adamanteus*

VERTEBRATE / CLASSIFICATION: REPTILE



- Venomous, heavy-bodied snake with large, diamond-shaped markings outlined with white on a brown, gray or yellowish body.
- Has two light stripes on either side of the head and large rattles on its tail.
- Eats mammals such as rats and rabbits.
- Takes refuge in gopher tortoise and armadillo burrows, stump holes and other underground cavities.

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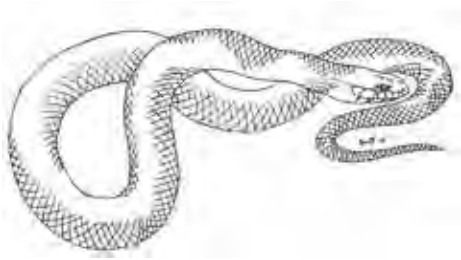
EASTERN INDIGO SNAKE *Drymarchon couperi*

VERTEBRATE / CLASSIFICATION: REPTILE



- Nonvenomous, solid black snake that may look shiny dark blue in the sunlight.
- Some indigo snakes have a reddish brown chin.
- Longest native snake in the United States, reaching up to 8.5 feet long.
- Uses its powerful jaws to overpower its prey.
- Eats rodents, small mammals, birds, lizards, frogs and even rattlesnakes.
- Is immune to the bite of venomous snakes.
- Listed as threatened under the U.S. Endangered Species Act.
- Uses gopher tortoise burrows for shelter.

PINE SNAKE *Pituophis melanoleucus*

VERTEBRATE / CLASSIFICATION: REPTILE

- Nonvenomous snake that is lightly colored (white, pale yellow, or light gray) with dark blotches and a white belly.
- Has large scales covering its pointed nose, which it uses for burrowing.
- Spends a lot of time underground in burrows that it digs or in other animal burrows.
- Powerful constrictor that eats mammals such as rabbits, squirrels, southeastern pocket gophers, rats and mice.
- Uses gopher tortoise burrows in Georgia as a safe shelter.

EASTERN FENCE LIZARD *Sceloporus undulatus*

VERTEBRATE / CLASSIFICATION: REPTILE

- Medium-sized, spiny lizard with gray or brown patterns on its back and blue (males only) on its chin and belly.
- Its scales are heavily *keeled* (have a ridge down the center), giving them a rough appearance and feel.
- The dark and light pattern on its back provides camouflage in its pine forest habitat.
- Survives forest fires by climbing to the tops of trees or burrowing into soft soil.
- Uses gopher tortoise burrows for shelter in Georgia.

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GREEN ANOLE *Anolis carolinensis*

VERTEBRATE / CLASSIFICATION: REPTILE

- Medium-sized lizard about 7 inches long with a long snout.
- Can change colors from bright lime green to dark brown or gray while the underside stays white.
- Does not change color to blend in with its environment but rather to regulate its body temperature. To absorb heat from the sun when it's cold, this lizard turns dark gray or brown. To reflect the sun's heat when too warm, it changes to a light green color.
- Activity level also affects this lizard's color – green when active and brown or gray when resting.
- To attract females during the breeding season, males do pushups and flash a bright pinkish-red dewlap beneath their chin.
- Uses gopher tortoise burrows for shelter in Georgia.

SIX-LINED RACERUNNER *Aspidoscelis sexlineatus*

VERTEBRATE / CLASSIFICATION: REPTILE

- Medium-sized lizard with a streamlined body.
- Dark gray to black with six yellow stripes running from its eye to the tail.
- Belly is white in females and blue in males.
- Also called sand streak, sand runner and field streak.
- Lives in dry sandhill habitats among longleaf pines and turkey oaks, as well as in sand dunes along the coast of Georgia.
- If chased, will dart under vegetation, logs or rocks, or into an underground burrow.
- Uses gopher tortoise burrows as a safe shelter in Georgia.

BACHMAN'S SPARROW *Aimophila aestivalis*

VERTEBRATE / CLASSIFICATION: BIRD

- Shy and secretive sparrow.
- Has gray and rusty-brown streaks marking its back, a gray rump, dark brown upper tail and a whitish underbelly.
- Body is 5-6 inches long with a 7-inch wingspan.
- Lives in open, grassy pine forests and in brushy, overgrown fields.
- Used to be called the pine-woods sparrow because of its preferred habitat – pine woodlands that are kept open by natural fires.
- Fires open the forest so that the grasses that produce seeds (which these sparrows need for food) can grow. Grasses in the habitat attract insects too, which is another source of food.
- Nests on the ground and uses grass parts, weed stems and small roots lined with animal hair and fine grass to make its nest.
- Is a rare species in Georgia because of the loss of its preferred habitat – pine woodlands.
- Sometimes seeks shelter in gopher tortoise burrows in Georgia.

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NORTHERN BOBWHITE *Colinus virginianus*

VERTEBRATE / CLASSIFICATION: BIRD

- Georgia's state game bird.
- Gets its name from its call that sounds like "Bob Bob White."
- Short, stocky, mostly brown quail with a short gray tail.
- Male has white eye stripes and chin. Female has buff brown eye stripes and chin.
- Secretive ground-dwelling bird.
- Will stop and "freeze" when threatened, relying on its camouflaged feathers blending in with leaves and grasses to avoid being spotted by a predator.
- Sometimes uses a gopher tortoise burrow on cold nights for shelter or as a refuge from predators and forest fires.

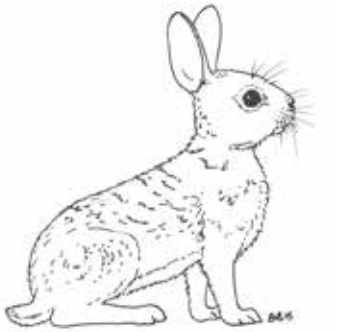
COTTON MOUSE *Peromyscus gossypinus*

VERTEBRATE / CLASSIFICATION: MAMMAL

- Small-sized rodent.
- Large ears and eyes, a dark brown body and white feet and belly.
- 7-8 inches long.
- Lives in the woodlands of the Southeastern United States.
- Gets its name from frequently using cotton while constructing its nests.
- Omnivorous, eating seeds and insects.
- Preyed upon by owls, snakes, weasels and bobcats.
- Uses gopher tortoise burrows, most likely because of the comfortable temperatures and shelter it finds there.

EASTERN COTTONTAIL *Sylvilagus floridianus*

VERTEBRATE / CLASSIFICATION: MAMMAL



- Grayish brown rabbit.
- Has a short cottony-white tail, whitish feet and long ears.
- Usually hops but can leap 10-15 feet.
- May use gopher tortoise burrows for shelter in bad weather or to escape fire and predators.

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HISPID COTTON RAT *Sigmodon hispidus*

VERTEBRATE / CLASSIFICATION: MAMMAL

- Stocky, medium-sized rodent.
- Has coarse yellowish-brown fur, stiff black guard hairs and a grayish-white to buff-colored belly.
- 7-13 inches long.
- Females build nests on the ground or in a burrow, either one they dug or an abandoned mole or pocket gopher burrow.
- Nest is made of woven grasses and lined with cotton.
- May be a nuisance to cotton farmers since it takes cotton to make nests.
- In the Southeast, prefers grassy areas under fire-maintained pines (including loblolly, shortleaf, slash and longleaf pines).
- Uses gopher tortoise burrows for shelter in the Southern Coastal Plain sandhills where longleaf pine, bluejack oak and sand post oak grow.

STRIPED SKUNK *Mephitis mephitis*

VERTEBRATE / CLASSIFICATION: MAMMAL

- About the size of a domestic cat – 21-28 inches long and 3-11 pounds.
- Also called a polecat.
- Black fur and white stripes from its head down its back. Striping pattern varies from broad stripes to narrow stripes (sometimes in pairs) and short stripes.
- When threatened, will face its potential predator, raise its tail and stomp its front feet as a warning before spraying.
- Stinky scent comes from glands on its rump.
- Sometimes digs its own den but also will use the abandoned burrow of another animal (including a gopher tortoise) and make it bigger.

SPOTTED SKUNK *Spilogale putorius*

VERTEBRATE / CLASSIFICATION: MAMMAL

- Smaller than the more common striped skunk – 17-23 inches long and 1-3 pounds.
- Dark black fur with four to 16 broken white stripes, which give the appearance of being spotted.
- Face has a triangle-shaped white nose patch.
- Tail is white-tipped and bushy.
- Has well-developed scent glands on its rump.
- When threatened, it does a handstand as a warning before it sprays the potential predator.
- Dens in natural cavities and in the burrows of other mammals and gopher tortoises.
- Uses burrows for shelter and to find food such as insects, small mammals, reptiles and eggs.

INTERVIEW A SANDHILL HERP

Adapted from Project WILD's "Interview a Spider."

OBJECTIVES

Students will generalize that *sandhill* herps (*reptiles* and *amphibians*) range in size and occur in a variety of forms, colors and *adaptations*.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Students use interviewing, researching and writing techniques to gather information about the natural history of a sandhill herp species.

MATERIALS

Writing and research materials, provided list of sandhill herps and provided GA DNR animal fact sheets.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, environmental education

DURATION: Two or three 50-minute sessions

GROUP SIZE: Up to 28 students (in groups of 2)

SETTING: Classroom or outdoors

KEY TERMS: adaptations, amphibian, anthropomorphism, carnivore, consumer, ecosystem, food chain, habitat, herbivore, herp, insectivore, omnivore, predator, prey, reptile, sandhills, vertebrate

BACKGROUND

A diverse number of *herp* species live in sandhill *habitats*, although many reptiles and amphibians in this *ecosystem* often go unseen.

NOTE: Students may have a tendency to project human characteristics to animals, especially because the "interview" format puts the "animals" in a human situation. Assist the students in avoiding *anthropomorphism*. Emphasize that they should try to see the world from the animal's perspective.

PROCEDURE

RECOMMENDATION: To begin this activity, invite a local newspaper or news reporter to talk with the students. Ask him or her to describe what a reporter does and to talk about interviewing and writing techniques used in journalism.

1. Have students form groups of two for this activity. Distribute to the students the provided list of herp species found in the sandhill habitat. Each group should interview a different herp. Students will choose their herp to interview from the following species list: eastern spadefoot toad, gopher frog, striped newt, eastern fence lizard, green anole, six-lined racerunner, black racer, coachwhip, eastern diamondback rattlesnake, eastern indigo snake, eastern kingsnake, pine snake, southern hognose snake, gopher tortoise.

2. Instruct students to design a research, interview and reporting format for their use as reporters. For example, try these methods:

RESEARCH

Each group of two students could:

- decide what sandhill herp to interview
- develop a list of questions to ask, and
- use reference materials and fact sheets to find

appropriate responses to the questions.

Each group could find out how the herp is classified (reptile or amphibian), where it lives, what type of habitat it is found in, what it eats, etc.

INTERVIEW

During the interview, one student asks questions while the other student assumes the role of the herp and responds to the interviewer's questions. Instruct the students to then switch roles. Remind them to convey the perspective of the interviewed herp without projecting human attributes.

REPORTING

Next, organize the information gathered through the process of researching and interviewing the herp. Using this information, have the students write a newspaper article or give an oral presentation in the form of a newscast to the class about the herp.

3. Conclude this activity by discussing the diversity of wildlife living in the sandhills. Ask each student to define herps -- verbally or in writing—in a way that shows his or her understanding of the term. Have students explain how these animals are adapted to survive in sandhill habitats and how they might affect each other (i.e., the *food chain*, *predator/prey* relationships, etc.). What effect might humans have on the sandhill habitats of these animals?

EXTENSIONS

With the newspaper articles complete,

- publish a wildlife newspaper for everyone to read and have a copy, or
- read the articles aloud for everyone in the class to hear, and then post them to the school's webpage, or
- share information with the whole school by presenting a newscast on one herp each day during the school's morning show.

ASSESSMENT

Choose three animals that were interviewed. Which of the following words can be used to describe each herp? -- *vertebrate*, cold-blooded, predator, prey, *herbivore*, *carnivore*, *consumer*, *insectivore*, *omnivore*, amphibian, reptile, colorful, dull, striped, spotted, camouflaged, runner, crawler, hopper, slider, large, small? What other words might describe each of these herps? What external features allow these herps to survive better than those that do not have these features? Have students identify ways to protect the sandhill habitat for the future of these herps.

SANDHILLS BIRD DETECTIVE

Adapted from Flying Wild's "Home Is Where the Forest Is" and "Habitat Match."

*Suggestion: Do this activity as a follow-up to "Sandhill Retreat."

OBJECTIVES

Students will (1) define the concepts of habitat and carrying capacity, (2) evaluate whether a site is a suitable habitat for a specific bird, (3) describe the importance of sandhill habitat to various bird species, (4) recognize some of the factors that influence or change bird populations in the *sandhills* and (5) recommend on-site actions to benefit birds.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Students analyze clues to identify various bird species that can be found in sandhill habitats. Students will then use these clues and additional research to discover the specific habitat requirements of their assigned bird, adaptations that allow their species to thrive in a healthy sandhill *ecosystem* and which species can live in other habitats as well.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, environmental education

DURATION: Two or three 50-minute sessions

GROUP SIZE: Up to 30 students

SETTING: Classroom

KEY TERMS: adaptations, carrying capacity, ecosystem, endangered, field guide, field marks, habitat, sandhills

MATERIALS

Provided bird fact cards and solutions with photo identification, GA DNR species fact sheets (some provided in this guide and others online at https://georgiawildlife.com/species), bird field guides, computer lab internet access or media center for additional research materials

BACKGROUND

Habitat is the place where a wild animal lives, or its outdoor home. Everything the animal needs to survive, including food, water, shelter/cover and space, is found in its habitat – all in the proper arrangement. If any of these important components changes or disappears and the animals can no longer find what they need to survive in their habitat, they may die. Habitat loss is the main cause for a decrease in the populations of birds and other wildlife.

Carrying capacity is the number of animals of a particular species that can survive in a habitat at any given time. This number changes as the availability of food, water, shelter and space changes. A habitat may support more of one species than another. For some species, the carrying capacity rises and falls constantly throughout the seasons. Changes in a habitat may decrease the carrying capacity for certain species of birds but could increase the carrying capacity for other species and even humans. As people decide how to use the land, they must carefully consider the best ways to provide what humans need while protecting and restoring the natural environment.

Birds live in many different kinds of habitats. Although all birds need food, water, shelter and space, the amount of and access to these habitat components is different for each species.

Adaptations are special characteristics that help a species to survive in its environment. Various adaptations enable

birds to live in many different habitats, from deserts and mountains to oceans and lakes. Each species has certain habitat requirements that are specific to its needs.

The purpose of this activity is for students to learn how to identify some of the bird species that live in sandhill habitats. First the students will analyze clues on bird fact cards. Then they will do further research to discover the specific habitat requirements needed for their survival. Finally, students will determine if the sandhills are a good home for these birds and if they can survive in other habitats as well.

PROCEDURE

1. Discuss with students what a forest ecosystem provides for birds, including the four components of habitat: food, water, shelter and space. Discuss and define carrying capacity. Have students brainstorm factors that can affect bird populations (i.e., predators, disease, reproduction, drought, storms, etc.).

2. Discuss with students that birds can live in a wide variety of habitats ranging from mountains to deserts to grasslands to oceans. To survive in different environments, animals have special features, or adaptations, that help them to obtain food, protect themselves, build homes and survive. Students will be focusing on the sandhill habitat and the bird species that live there.

3. Have students pair up with a partner. Each pair will receive a different bird fact card (supplied) and will try to identify the bird using the clues. Display the names of the possible bird answers with supplied photos (cut out separately from the fact cards) on a table where students can come and choose their matched solution from the selection. Allow students to use teacher supplied bird *field guides*, GA DNR bird fact sheets (some provided in this guide and others at https://georgiawildlife.com/species) and other internet sites (such as The Cornell Lab of Ornithology – www.birds.cornell.edu) for researching if they cannot identify their bird from the clues alone. Suggested field guides are "Birds of Georgia" by Parrish, Beaton & Kennedy; "Peterson Field Guides - The Young Birder's Guide to Birds of North America" by Bill Thompson III; "The New Stokes Field Guide to Birds, Eastern Region" by Donald and Lillian Stokes; and "Birds of Georgia Field Guide" by Stan Tekiela.

4. After students have identified their bird, allow them time to research more information about their species. Groups should be prepared to share the following with the class:

   - Name and photo of the bird species (photos can be found in field guides, on fact sheets or printed from a website).
   - Description of the bird using *field marks* (i.e., size, color, feet, beak, unique characteristics).
   - What the bird eats.
   - Habitat requirements (describe where and why).
   - What adaptations help them to live in the sandhills?
   - Are they dependent on sandhill habitats? Why?
   - Can they live in other habitats? Where and why?

5. Have students brainstorm some of the factors that may affect bird populations in the sandhills and how the carrying capacity would change (fire, weather, predators, etc.). Ask students what could be done to ensure the health of the sandhills and the birds that live there.

EXTENSIONS

1. Contact a wildlife biologist or environmental educator to come and speak to the class about the *endangered* red-cockaded woodpecker.

2. Have a prescribed fire specialist come and speak to the class about the different ways that prescribed fire can benefit birds and wildlife, especially in the sandhills.

ASSESSMENT

1. Name the four components of habitat necessary for wildlife to survive.

2. Explain why bird species are dependent on certain habitats.

3. Explain why the red-cockaded woodpecker has a better chance of survival in the longleaf sandhill habitat than in another pine forest habitat.

COPY ME

SANDHILLS BIRD DETECTIVE FACT CARDS

BIRD FACT CARDS and SOLUTIONS WITH PHOTOS

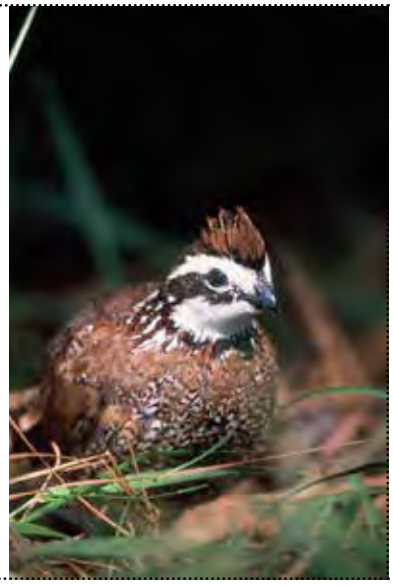
RED-COCKADED WOODPECKER

I am about 8-9 inches long with black and white feathers and white cheek patches. My back is black and white horizontally striped, and the males of my species have a tiny red line of feathers on the side of our faces called a cockade. My long beak helps me to loosen bark on pines while I hunt for insects to eat, and it also helps me to excavate a cavity to live in and raise my young. I prefer to live in mature southern pine forests, especially longleaf. Unfortunately, I am an endangered species because of the destruction of my favorite habitat, the longleaf pine forest in Georgia's Coastal Plain.

red-cockaded woodpecker: *Cornell Lab of Ornithology*

NORTHERN BOBWHITE

I am a small round bird, about 9½ inches long, with brown, buff and black feathers. Males of my species have a black and white face while females have a tawny-buff face. I like to run across the ground from one shrubby patch to another, and I depend on my camouflage to help me blend in with the grasses. I travel with my friends in groups called coveys that explode into the sky when spooked up off the ground or flushed. I like to live in open pine forests, overgrown fields and grasslands. I like to eat seeds, leaves and sometimes insects and spiders. I loudly whistle "bob-white" when staying in touch with my girlfriends. I am Georgia's state game bird.

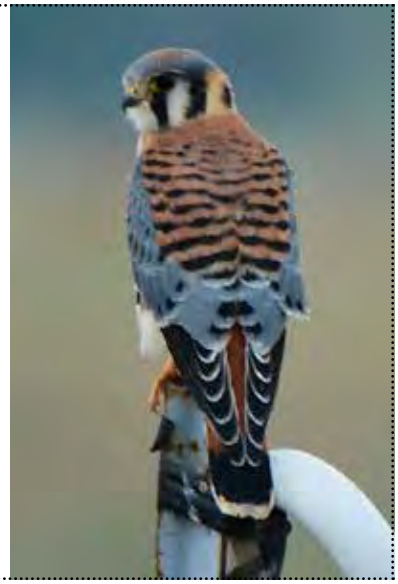


northern bobwhite: *Phillip Jordan*

COPY ME

SOUTHEASTERN AMERICAN KESTREL

I am the smallest falcon in the United States at about 9-10 inches long. I have a reddish-brown back with dark bars, a reddish-brown tail and a blue-gray cap. The males of my species have blue-gray wings, while the females are slightly larger and have brownish wings. We both have distinctive black marks below our eyes that look like a mustache. My favorite food is grasshoppers, but I will eat small birds and rodents. I have a high-pitched call of "klee-klee-klee" or "killy-killy-killy." I prefer to live in the longleaf pine sandhill habitat with short ground vegetation and sparse trees, where I can easily see and capture my prey. I nest in large, dead trees in abandoned woodpecker cavities. My species' population is decreasing because of loss of habitat.



Southeastern American kestrel: *Giff Beaton*

WILD TURKEY

I am a very large, plump ground-feeding bird about 48 inches long. I have a bare head and neck with blue and red wattles. I am dark brown overall with a bronze-green shininess to my feathers. I have long legs, a wide rounded tail and a long, slim neck. I like to travel in flocks and search the ground for nuts, berries and insects to eat. Like other males of my species, I like to strut around and show off my long beard, leg spurs and colorful tail for the ladies while I call out "gobble, gobble, gobble"! I like to live in mature forests, especially ones with nut trees such as oaks, next to edges and fields.

wild turkey: *USFWS*

BACHMAN'S SPARROW

I am a rarely seen sparrow about 6 inches long with a long rounded tail. I have reddish-brown and gray feathers running down my back. I have a reddish-brown cap on the top of my head and a thin reddish-brown stripe running from the back of my eye to the back of my neck. I am sometimes confused with a field sparrow, but I do not have a white eye ring. I am very shy and secretive, and I like to run on the ground through thick cover. I live in mature open pinewoods with a dense cover of grasses, especially wiregrass and broomsedge where I can search for seeds and insects to eat. I really like the same habitat where you can find red-cockaded woodpeckers because of the grassy groundcover found there.

Bachman's sparrow: *Tim Keyes, GA DNR*

COPY ME

BROWN THRASHER

I am about 11½ inches long, and the feathers on my back are rusty brown while my belly is white with brown streaks. I have a bright yellow eye and a long bill that curves down. I sing many different songs, usually repeating each song two times in a row before switching to another melody. When I hunt for food, I use my bill to thrash leaves and sticks out of the way, hoping to uncover an insect or earthworm. I like to live in scrubby fields, woodland edges, brushy old fields and hedgerows. I usually build my nest low in a tree or thorny shrub. I am Georgia's State Songbird!

brown thrasher: *Todd Schneider, GA DNR*

AMERICAN CROW

I am a large, black, thick-necked bird about 15-20 inches long. I am a very social bird, sometimes even a drama queen! I am very smart and sometimes mischievous. I will chase larger birds, especially hawks and owls! I like to eat a large variety of foods, including grains, seeds, nuts, fruits, berries and many small animals like earthworms and mice. I am also a scavenger and will even raid garbage cans for something to eat. I am very common and can be seen in fields, open woodlands, forests, lawns, parking lots and even garbage dumps.

American crow: *Todd Schneider, GA DNR*

MOURNING DOVE

I am a plump-bodied, fawn-colored bird about 12 inches long with a long, pointed tail that is edged in white. My call is a sad-sounding cooing. Unlike other birds, I can sip water by sucking it up through my bill. I can live almost anywhere except in thickly wooded habitat. I prefer to live in open country with scattered trees and along woodland edges. I come to birdfeeders and search lawns, roadsides and agricultural fields for seeds. I build a very flimsy nest out of twigs, pine needles and grass stems.

mourning dove: *Linda May, GA DNR*

COPY ME

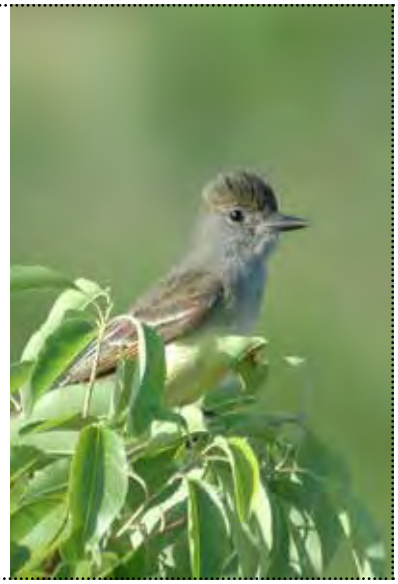
EASTERN BLUEBIRD

I am a small, royal blue bird with a rusty-red throat and breast about 6-8 inches long. I have a rounded head, plump body and a short straight bill. I like to perch on wires, posts and low branches in open country, scanning the ground for insects to eat. I also like to eat wild fruit and berries. I prefer to live in open meadows surrounded by trees that offer cavities for nesting, such as old woodpecker holes in dead pines or oak trees. Just the sight of me can make you happy!

eastern bluebird: *Linda May, GA DNR*

GREAT CRESTED FLYCATCHER

I have a crested head, gray face and throat, a bright lemon-yellow belly and a reddish tail. My body is 6½ to 8 inches long. I like to hunt high in the tree canopy, searching for flying insects to eat. I sit and wait on branches and then swoop down on my prey. I also like to eat berries and fruits. I prefer to live in open woodlands, along the edges between habitats. I nest in natural cavities in dead trees and abandoned woodpecker holes.



great crested flycatcher: *Todd Schneider, GA DNR*

RED-TAILED HAWK

I am the most common hawk you will see in North America, measuring up to 22 inches tall with a wingspan up to 52 inches wide. My back is a rich brown color while my belly is creamy with brown streaks. As an adult, I have a rusty red tail, but during my first year of life it is brown and banded. I like to soar above open fields, slowly making wide circles. You may also see me perched on a tall tree out in a field, a fence post or a telephone pole. I have keen eyesight that helps me hunt for my meals, which is usually a mammal such as a rabbit, rat or mouse. I might also eat a snake or small bird. I can live in many types of open habitats, including fields, pastures, grasslands, roadsides and open woodlands.

red-tailed hawk: *Todd Schneider, GA DNR*

COPY ME

BROWN-HEADED NUTHATCH

I am a small bird about 4 inches long with a bluish–gray back, wings and rump and a whitish neck and belly. I have a brown crown (top of my head) with a white spot on the back. I like to climb headfirst down pine tree trunks while searching for insects and seeds to eat. Sometimes I will use a piece of bark as a tool to pry up other bark to look for food! I might even carry my tool from tree to tree. I prefer to live in pine forests, especially in open mature forests with periodic fires. I nest in cavities in trees. My call sounds like squeezing a toy rubber duck.

brown-headed nuthatch: *Todd Schneider, GA DNR*

FIELD SPARROW

I am a small brownish bird about 4½ - 6 inches long with a rusty cap, a white eye ring and a pink bill. I am a type of sparrow whose song is similar to the rhythm of a dropped ping-pong ball bouncing! It sounds like "too-too-too-too-tootootoottititititititititi." I like to live in old fields and open habitats, such as abandoned agricultural fields and pastures, fencerows, forest edges and openings in wooded areas. I hunt from low perches near tall grass and brush that provide protective cover while I search for food. I mainly like to eat grass seeds in winter and then a blend of seeds and insects as the weather warms.

field sparrow: *Giff Beaton*

LOGGERHEAD SHRIKE

I am a songbird with a killer instinct! I am only 8-9 inches long but have the hunting habits of a raptor. I am a black, gray and white thick-bodied bird with a black mask. I am easy to see as I hunt from posts and other open perches, preying on insects, lizards, birds and rodents. I do not have talons but I like to skewer my prey on thorns or barbed wire, making them easy to eat! My bill is thick with a small hook, much like a falcon's. I like to live in open country with short vegetation and low trees or shrubs, especially those with thorns. My nickname is the "Butcherbird."

loggerhead shrike: *Todd Schneider, GA DNR*

COPY ME

EASTERN KINGBIRD

I am a dark gray bird about 7½-9 inches long with a black head and tail and a white underbelly. My tail is accented by bright white tips. I will harass crows, red-tailed hawks, great blue herons and anybody else that flies through my territory! I can also be quite aggressive when defending my nest. I like to perch atop trees, fences and utility lines in open country, watching for flying insects that I can snatch out of the air. I will also eat fruit and berries, especially in the summer and fall. My name comes from the crown of yellow, orange and red feathers on my head, which is usually hidden unless I am agitated. I like to live in fields with scattered shrubs and trees, as well as along the edges of forests and wetlands.

eastern kingbird: *Linda May, GA DNR*

GREAT BLUE HERON

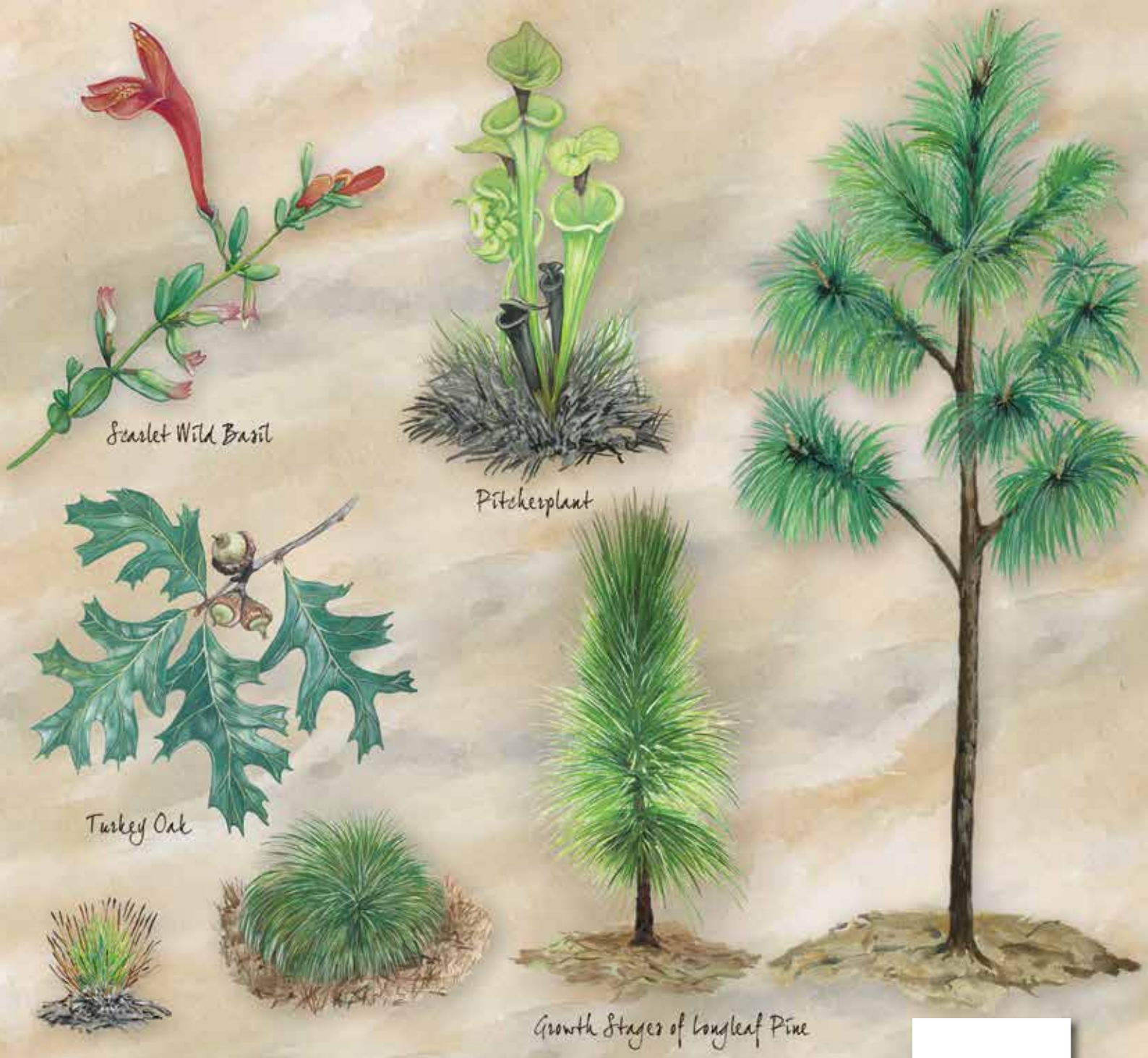
I am a tall wading bird with long legs, a long curving neck and a long, thick, yellowish bill. My height is 4-4½ feet, and I have a wingspan that can be up to 6½ feet. I am a beautiful blue-gray color with a wide black stripe over my eyes. I have specialized feathers on my head and chest that make me look shaggy. I like to stand motionless or move slowly in belly-deep water as I stalk my dinner, quickly striking fish and other prey with my spear-like bill. I am graceful in flight, tucking my neck into an S shape and trailing my long legs out behind. I like to live in both freshwater and saltwater habitats. I also like to hunt in grasslands and agricultural fields, where I stalk frogs and small mammals.

great blue heron: *Tim Keyes, GA DNR*

RUBY-THROATED HUMMINGBIRD

I am a tiny bird measuring 3 -3½ inches long with a wingspan up to 4 inches. I have a long, slender bill, and I zip through the air in search of red and orange flowers, which provide a source of nectar for my survival. I glitter like an emerald-green jewel in the full sun, flashing my red throat if I am a male and a white throat if female. I can beat my wings 53 times a second! I like to live in open woodlands, forest edges, meadows, grasslands, parks, gardens and backyards.

ruby-throated hummingbird: *Todd Schneider, GA DNR*



3 PLANTS OF THE SANDHILLS

COASTAL PLAIN PITCHERPLANT BOG FACT SHEET

Coastal Plain pitcher plant bog. *Jordan Wallace, GA DNR*

As one of Georgia's most diverse habitats, pitcherplant bogs occur next to dry sandhill habitats throughout the Coastal Plain. In order for these bogs to thrive, they must have the right hydrology (water conditions), fire and an open tree canopy.

HYDROLOGY: Coastal Plain bog habitats are considered wetlands, although the water does not form a distinct pond or stream channel. Instead, water seeps just under the surface of the sandy soil. In these wetlands, water flow is slow and near constant, with rare flooding or drying out.

Bog plants growing in moist sandy soil. *Linda May, GA DNR*

Prescribed fire in bog. *Linda May, GA DNR*

FIRE: Throughout history, fire from lightning strikes swept through these habitats every one to three years. Today, many of these naturally set fires are extinguished, which can harm bog plants that need fire in order to produce flowers and fruit. Frequent fire keeps grassy vegetation from growing too tall and woody vegetation from overtaking the habitat. Fire cleans out old, decaying organic matter (dead leaves, thatch and mulch) to provide open soil for herbaceous plants to germinate and grow. In the absence of natural fires, prescribed fire creates an ideal environment for bog plants to grow and thrive.

OPEN TREE CANOPY: Coastal Plain bogs thrive with an open tree canopy, allowing lots of sunlight to reach the herbaceous (nonwoody) plants. They don't grow in the shade as well as they do in the sun. If trees started growing in the bog (perhaps because of lack of fire to keep them out), they would compete with pitcherplants and other bog plants for sunlight and water, making the bog disappear over time.

Pitcher plant bog with open tree canopy. *Jim Allison*

COASTAL PLAIN PLANT BOG DIVERSITY

Herbaceous pitcherplant bogs thrive in wet, open, sunny areas in the Coastal Plain. This type of habitat has a higher number of plant species than many other places in Georgia and is one of the most diverse habitats in the Southeast. Abundant wildflowers spread throughout the wetlands during the growing season. Many of Georgia's rarest plants grow in herbaceous bogs, including many orchids and carnivorous plants. Bogs occur where the soil is often acidic and low in nutrients. While the lack of nutrients creates challenges for some plants to grow, carnivorous plants have adapted unique mechanisms for obtaining their nutrients from insects.

Some carnivorous bog plants, such as pitcherplants, have modified leaves that catch insects. The erect, tubular pitcher-shaped leaves have slick inner walls with stiff hairs that point down to trap insects for digestion. The yellow trumpets pitcherplant uses sweet-smelling nectar at the lip of the pitcher to attract insects. This species has hoods covering the pitchers to keep rainwater from diluting the digestive enzymes inside the tubular leaf.


Yellow trumpets pitcher plant, ***Sarracenia flava***.
Lisa Kruse, GA DNR

Another species, the hooded pitcherplant, also contains aromatic nectar and modified leaves to trap insects. This species has white patches on the back of its hood. The sweet-smelling nectar and light colors attract insects to fly closer, only to be trapped and digested inside the pitcher.


Hooded pitcher plants, ***Sarracenia minor***.
Christa Frangiamore Hayes

The sweet pitcherplant is a threatened species in Georgia. It can be found in herbaceous bogs as well as Atlantic white cedar swamps in southwestern Georgia.


Sweet pitcher plant, ***Sarracenia rubra***.
Lisa Kruse, GA DNR

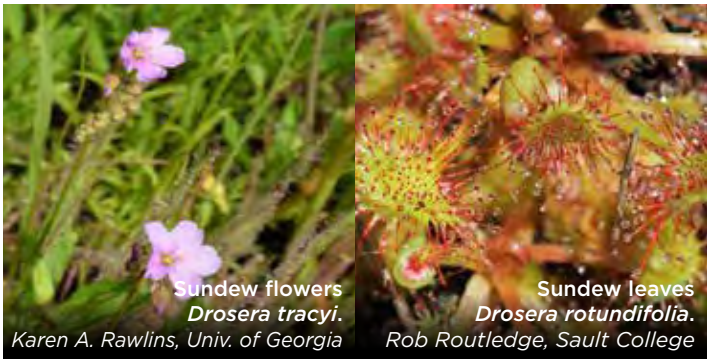
The purple pitcherplant is considered endangered in Georgia. Unlike other pitcherplants, its pitchers are open to the rain. This species doesn't make its own digestive juices to break down the insects trapped inside. Instead, microorganisms in the rainwater digest the insects for them. The plants take in nutrients from the waste produced by the microorganisms.


Purple pitcher plant, ***Sarracenia purpurea***.
Brad Wilson

Coastal Plain bogs are home to many carnivorous plants other than pitcher plants. The clearwater butterwort is a Georgia threatened bog species that has developed a unique insect-trapping tactic. This perennial herb has sticky leaves that look wet, which attracts insects in search of water. Once trapped by the plant's "flypaper" strategy, the leaves roll inward to cover and trap the small insect. The sticky glands contain digestive enzymes that break down nutrients for absorption through microscopic pores in the leaves.

Clearwater butterwort, ***Pinguicula primuliflora.***
Barry Rice, 2009

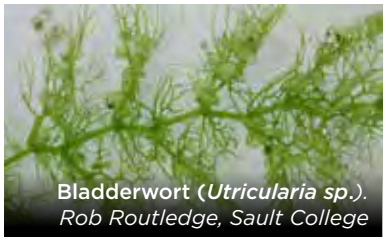
Sundews use tactics similar to butterworts for capturing nutritious insects. The sundew's tentacle-like leaves are covered with sweet, sticky glands that look like dew glistening in the sunlight. Attracted to the aroma and droplets that look like water, insects land on the leaves and get stuck. The leaves then curl inward (like fern fronds) to capture and digest the insect.



Sundew flowers
Drosera tracyi.
Karen A. Rawlins, Univ. of Georgia

Sundew leaves
Drosera rotundifolia.
Rob Routledge, Sault College

Unlike pitcher plants, butterworts and sundews, bladderworts get nutrients from bogs in a very different way. They use balloon-shaped traps throughout their root system to capture protozoa, nematodes and even mosquito larvae for food. When these bladders sense movement in the water, they suck up their prey. The bladders remain closed when full and can only be triggered again once its prey has been digested.



Bladderwort (***Utricularia sp.***).
Rob Routledge, Sault College

Coastal Plain pitcher plant bogs are fragile ecosystems that support many different species. Plants that thrive in this unique environment are threatened by hydrology changes and fire suppression. Lack of prescribed fire, off-road vehicles, land development and mismanaged timber can cause a pitcher plant bog to slowly die and disappear. The invasion of exotic plants and poaching (stealing) of rare bog plants are also big threats.

Pitcher plant bogs can be conserved, even next to developed areas, by leaving a buffer of land around them. That way, the water can flow properly, and prescribed fire crews can access the bog. If done carefully, timber can be harvested next to the bog. Landowners near the bog can refrain from using herbicides and fertilizers that could upset bog plant diversity.

Coastal Plain pitcher plant bog.
Jordan Wallace, GA DNR

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Georgia Department of Natural Resources Wildlife Resources Division, "Sarracenia rubra Fact Sheet." https://georgiawildlife.com/species#plants

Georgia Department of Natural Resources Wildlife Resources Division, "Sarracenia purpurea Fact Sheet." https://georgiawildlife.com/species#plants

SANDHILL PLANTS ADAPTATION ARTISTRY

Adapted from Project WILD & Flying WILD's "Adaptation Artistry."

OBJECTIVES

Students will (1) investigate the diversity of plants found in the *sandhills* (2) identify and describe the advantages of plant *adaptations* unique to various sandhill plants (3) evaluate the importance of adaptations to these plants and (4) identify the importance of the sandhill habitats to the survival of these plants.

GEORGIA STANDARDS OF EXCELLENCE

3RD GRADE: S3L1, S3L2

4TH GRADE: S4L1

METHOD

Students design and create models of plants and trees and then present their creations to the class, highlighting the various adaptations that are unique to their sandhill species.

MATERIALS

Access to the internet, resource materials found in media center, pictures of plants/trees found in Georgia (provided by teacher and in Coastal Plain Pitcher plant Bog Fact Sheet), drawing, painting, clay sculpture or paper mache materials, construction paper, drawing paper, crayons, markers, colored pencils, glue, pipe cleaners and miscellaneous items that students may choose to use.

GRADE LEVEL: 3rd grade - 4th grade

SUBJECT AREAS: Science, environmental education

DURATION: Two or three 50-minute sessions

GROUP SIZE: Up to 25 students (in groups of 5)

SETTING: Classroom

KEY TERMS: adaptation, carnivore, environment, food chain, habitat, insectivore, predator, prey, sandhills.

BACKGROUND

Each species of plant has its own special characteristics or *adaptations* that help it survive in its *environment*. Plants develop these adaptations by gradually changing over long periods of time in ways that help them tolerate the temperature, moisture level, soil nutrients or being eaten by wildlife. Some examples of adaptations of sandhill trees, shrubs and other plants are provided in the chart included in this activity.

The purpose of this activity is for students to realize that there are reasons why plants and trees look the way they do and that their physical characteristics or adaptations give them an advantage in their environment. This activity focuses specifically on plant adaptations in the sandhill habitat.

PROCEDURE

1. Discuss with the students the various adaptations plants may have that help them survive. Show pictures of plants from different habitats in Georgia. Discuss some of the kinds of species living in the sandhills and their unique adaptations as provided in this guide's Coastal Plain Pitcher plant Bog Fact Sheet and the Sandhill Plant Adaptation Chart in this lesson. Show students provided diagram of "Anatomy of a Pitcher plant" as an example of pitcher plant adaptations. Have students discuss the advantages of these adaptations in the sandhills. Compare and contrast the pictures of plants from other habitats in Georgia with those living in the sandhills.
2. Have students form groups of four. Explain that

the students in groups will work together to create an artistic version of a sandhill plant of their choice from the provided list. Their creation must show at least one of their plant's adaptations – a physical characteristic that helps it survive in this habitat. All groups will present their plant model to the class and should provide:

- The name of their plant.
- Where the plant lives in the sandhills.
- Food sources.
- Examples of the adaptations (may be more than one) that their plants have that enable them to survive in the sandhills.

Assign each group a different species from the following list: big-fruited buckthorn, bracken fern, butterfly weed, catbells, clearwater butterwort, gopher apple, hooded pitcher plant, longleaf pine, Pickering's morning glory, pink sundew, prickly pear cactus, purple pitcher plant, sandhill golden-aster, sandhill rosemary, sandhill milk-vetch, scarlet wild basil, turkey oak, wiregrass.

3. Have students research their plant species online (using suggested websites in Table of Contents) or using reference books (i.e. field guides such as "A Field Guide to the Wildflowers of the Sandhills Region" by Bruce A. Sorrie). Fact sheets for several rare plant species may be found on the GA DNR Wildlife Resources Division website (https://georgiawildlife.com/species). Using this information, groups should investigate their plant and view photos of their chosen species.

4. Have the students brainstorm a list of their plant's adaptations that enable it to survive in its habitat. Using the characteristics on their list, have the students create a model of their chosen plant by drawing, sculpting, making it out of construction paper, three-dimension or by another artistic technique.

5. Have the groups write down the name of their plant, where it lives in the sandhills (flatwoods, bog, pond, etc.), food sources (sunshine, insects, soil nutrients, etc.) and the adaptations that the group brainstormed together. Have students explain the benefits of these adaptations and how they help their plant to survive in the sandhills.

6. Ask students how plants that are *insectivores* or *carnivores* might fit into the *food chain*. Would these plants be considered *predators* and their food *prey*?

7. Ask students how changes in the sandhill habitat might affect these plants. What effect does fire have on them? What would happen if other plants or trees grew taller and shaded them out?

EXTENSIONS

Visit the Atlanta Botanical Gardens website (https://atlantabg.org/classes-education/educator-resources/classroom-activities/wetlands-pitcher-plants/) to learn more information about wetlands and pitcher plants.

ASSESSMENT

Name several adaptations of the plants found in Georgia sandhills. Explain how important these adaptations are to each plant's ability to survive in its environment.

SANDHILL PLANT ADAPTATION CHART

LEAF SHAPE

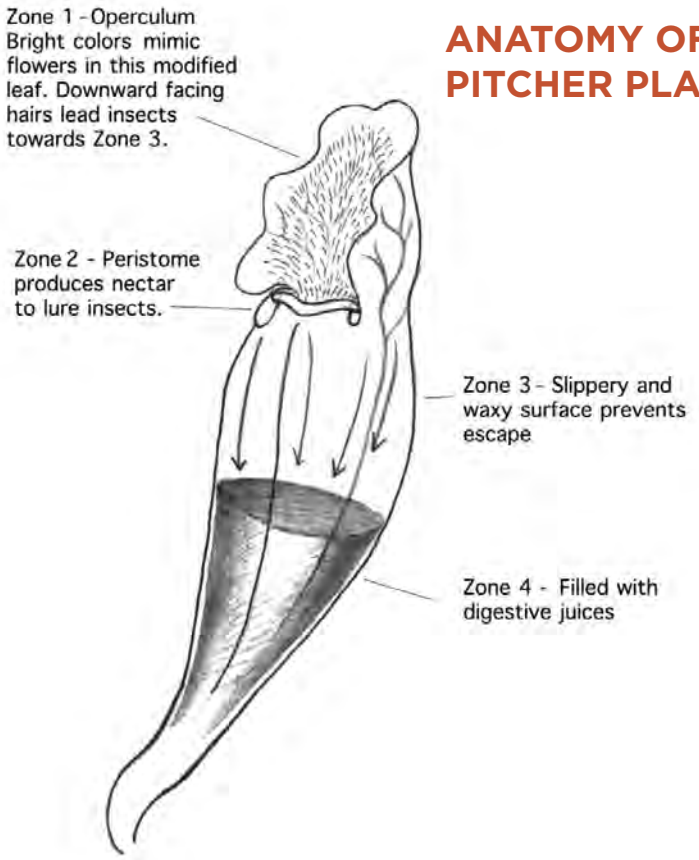
Adaptation	Plant	Advantage
Needles	Pines, Sandhill Rosemary	Reduces evaporation
Tubular	Pitcher plants	Traps insects

ROOTS

Adaptation	Plant	Advantage
Long tap roots	Longleaf Pine	Anchors tree
Release chemicals into soil	Sandhill rosemary	Reduces competition

SEEDS

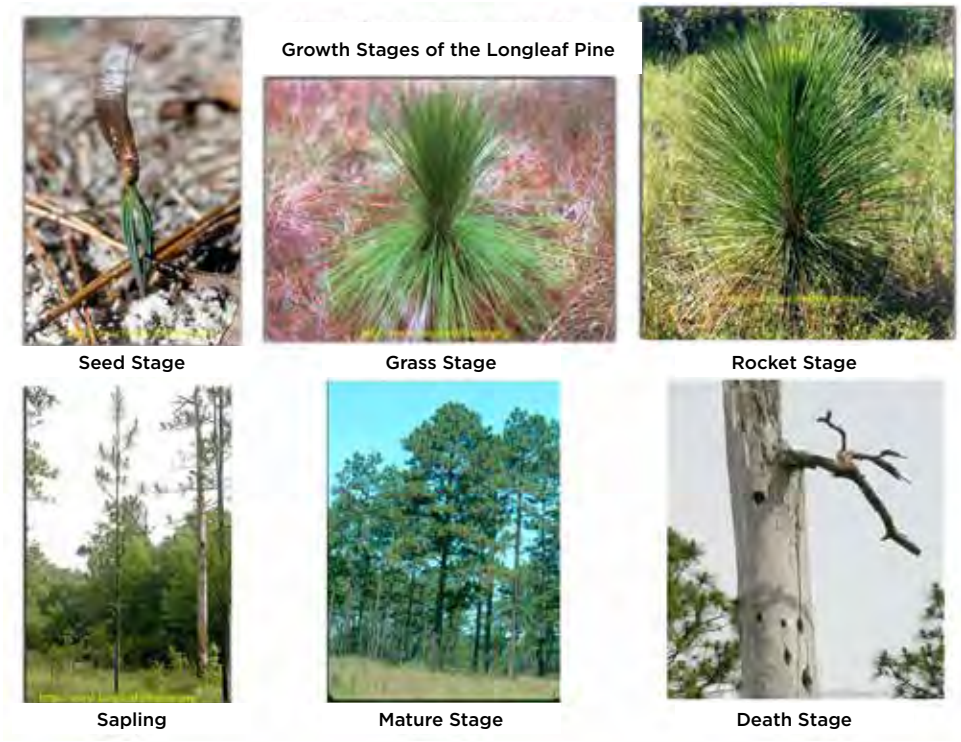
Adaptation	Plant	Advantage
Winged seeds	Longleaf Pine	Flies through air
Round seeds	Turkey Oak	Bounces or rolls



Anatomy of a Pitcher plant. *Daphne Osell.*

EXAMPLES OF SANDHILL PLANTS

Plants of the Sandhills. *Linda May, GA DNR*



Growth stages of the Longleaf Pine. *The Longleaf Alliance, http://www.longleafalliance.org. 7/2013*

WILDLIFE FACT SHEETS

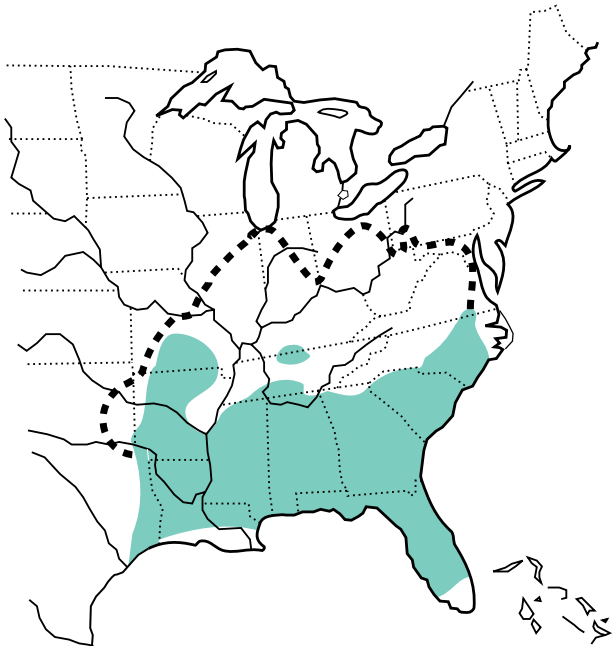
4

BACHMAN'S SPARROW

Scientific Name: *Peucaea aestivalis*

Other Names: pine woods sparrow, piney woods sparrow

RANGE: The Bachman's sparrow is a rare species that occurs throughout portions of the southeastern United States. In Georgia, it is more commonly found in the Coastal Plain, particularly in pine savanna habitats.



Bachman's sparrow range map. *Birds of North America. Cornell Lab of Ornithology*

Bachman's Sparrow. *Tim Keyes, GA DNR*

GEORGIA STATE LEGAL STATUS: Rare

FEDERAL LEGAL STATUS: Protected under the Migratory Bird Treaty Act (1918). This law protects most species of migratory birds from killing, harm, harassment and prohibits possession without proper permits.

DESCRIPTION: The Bachman's sparrow is about 6 inches (15.2 centimeters) in length with a relatively long tail. Adult birds have alternating reddish-brown and gray stripes running down the back from the base of the neck to the top of the rump. A reddish-brown cap covers the top of the head, and a thin reddish-brown stripe runs from the back of the eye to the nape of the neck. The cheek, throat and upper breast are buff to grayish. The lower breast and abdomen are lighter buff to whitish. Wing and tail feathers are reddish-brown, and legs are yellow to brownish-gray in color. The bill is grayish to dull grayish-brown.

HABITAT: This sparrow lives in mature open pinewoods, regenerating clear-cuts (both pine and hardwoods), utility rights-of-way and old pastures with a dense ground cover of grasses and forbs, or palmetto scrub. These habitats need to be burned frequently, particularly during the growing season, to remain suitable for this species.

DIET: The Bachman's sparrow eats beetles, weevils, grasshoppers, moths and butterflies and their caterpillars, crickets, millipedes, snails and spiders, as well as seeds of grasses, sedges and forbs that are gathered from the ground.

LIFE HISTORY: This sparrow is secretive and shy most of the year. Due to its habit of stealthily running on the ground through dense cover, it is usually difficult

to see. Territorial singing by males starts as early as February in the Coastal Plain and often continues through the summer. Males will sing from the ground, low shrubs and the lower branches of pine trees. Their very distinctive and beautiful song is a series of lazy whistles and trills. Nesting usually starts in April and can last through August. The female constructs the nest from grasses, forbs and rootlets at the base of a grass clump, small shrub or pine seedling. She then lays two to five eggs, which are incubated for 12-14 days before they hatch. Fledging (leaving the nest) occurs nine to 10 days later. The female does all of the incubating and brooding (caring for young after hatching); however, both parents feed the young. Within three weeks to a month after fledging, the young disperse from the nest (birth) area. This species will usually have two, and possibly three, broods per year.

FUN FACTS:

*The Bachman's sparrow was named after John Bachman, a Lutheran minister, naturalist and friend of John James Audubon, who lived in Charleston, South Carolina.

*Bachman was a gifted naturalist and was the leading mammologist (one who studies mammals) of his time.

*This bird is often called the piney woods sparrow because of its preference for open pine woods and savanna habitats.

THREATS: Fire suppression and lack of prescribed burning, conversion of pine savanna habitat to densely planted pine or agriculture and the use of herbicides that reduce or eliminate grass and forb ground cover all threaten the existence of the Bachman's sparrow.

SURVEY METHODS: The best survey method for this species is listening for singing males as they advertise their territories. Biologists may stop at certain points along a road to listen and record the number of Bachman's sparrows they see or hear. Territorial singing is most consistent during the first three hours after sunrise on sunny days from March through June. Recordings of Bachman's sparrow songs and calls may be used to see if a bird in the area responds.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Generally, Bachman's sparrows are found in older pine stands (60 or more years) with widely spaced trees; however, maintaining a lower density of trees within younger stands can provide suitable conditions for grass and forb growth, improving the habitat for this sparrow. Regular burning is needed in pine woods habitats, and often in fields, to control shrub and sapling growth that would keep herbaceous (nonwoody plant) ground cover from growing. A burning cycle of two to three years in pine woods habitat will usually create the best habitat for Bachman's sparrows. Clear-cuts that are not too densely replanted also can provide suitable habitat for several years.

SELECTED REFERENCES:

Burleigh, T. D. 1958. Georgia Birds. University of Oklahoma Press, Norman. 746pp.

Dunning, J. B. Jr. 1993. Bachman's Sparrow (*Aimophila aestivalis*). In A. Poole, P. Stettenheim, and F. Gill, eds., The Birds of North America, no. 38. Academy of Natural Sciences, Philadelphia, Pa.; American Ornithologists' Union, Washington, D.C.

Dunning, J. B., and B. D. Watts. 1990. Regional differences in habitat occupancy by Bachman's sparrow. Auk 107: 463-472.

Dunning, John B. 2006. Bachman's Sparrow (*Peucaea aestivalis*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/bacspa/introduction

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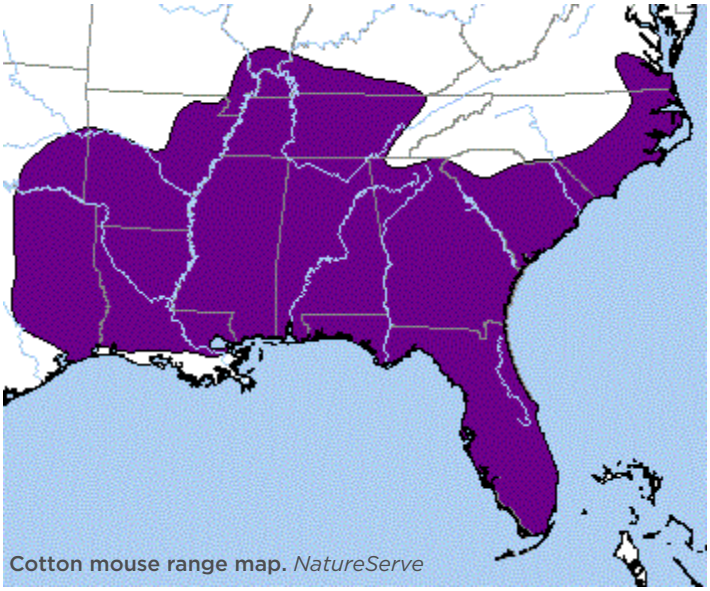
Plentovich, S., J. Tucker, N. R. Holler, and G. Hill. 1998. Enhancing Bachman's Sparrow habitat via management of Red-cockaded Woodpeckers. Journal of Wildlife Management 62:347-354.

Schneider, T. M. and T. S. Keyes. 2010. Species profile for Bachman's Sparrow (*Aimophila aestivalis*). Georgia Department of Natural Resources. https://georgiawildlife.com

COTTON MOUSE

Scientific Name: *Peromyscus gossypinus*
Other Names: *cotton deermouse*

RANGE: The cotton mouse is fairly common within suitable habitat throughout the Southeastern U.S. but isn't found as frequently along the northern edge of its range. In Georgia, this rodent is more common in the Coastal Plain.



Cotton mouse range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: None (not protected).

FEDERAL LEGAL STATUS: A subspecies of cotton mouse, the Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*) is listed as endangered. This type is slightly larger and more reddish in color when compared to other cotton mice, although some biologists think it's not different enough to be called a subspecies. The only remaining population of the Key Largo cotton mouse lives in a tiny area in southern Florida.

DESCRIPTION: This dark-colored mouse is relatively large, with a slightly darker, indistinct stripe down its back. Its underparts are light-colored, and it has white feet. The hind foot is large, at about an inch long. The tail makes up less than half of the animal's total length of about 7½ inches. Like other rodents in this genus, the eyes and ears are relatively large.

Cotton mouse. *Erika Taketa*

HABITAT: Cotton mice are found mainly in swamps and bottomland forests that are sometimes flooded. They also live in a variety of other open and brushy habitats, including rocky areas, old field edges, flatwoods palmetto thickets, sandhill scrub and beach dunes. This rodent frequently nests under logs, under the bark of dead trees, in tunnels or in the burrows of gopher tortoises and pocket gophers.

DIET: The cotton mouse eats seeds, fruits, insects and other invertebrates.

LIFE HISTORY: This mouse is a good climber and swimmer and is mostly active at night. Females begin reproducing at 70 days of age and give birth to several litters during all seasons of their short lifespans. Most cotton mice don't live longer than a year because they are eaten by other animals. Predators include owls, foxes, bobcats and snakes. Cotton mice build nests of plant fibers, often above ground.

FUN FACTS:

*The cotton mouse apparently got its name by its habit of sometimes using cotton in its nests.

*Cotton mice frequently take up residence in buildings, where they can be pests.

THREATS: Feral cats are unnatural predators to cotton mice, causing their numbers to decline. Also, beachfront development takes away some of their habitat, making survival there difficult.

SURVEY METHODS: Box traps and snap traps typically are used to find cotton mice.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Smaller populations of cotton mice on islands should be conserved.

SELECTED REFERENCES:

Animal Diversity Web: https://animaldiversity.org/accounts/Peromyscus_gossypinus/

U.S. Fish and Wildlife Service: https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=A086

U.S. Fish and Wildlife Service: https://www.fws.gov/verobeach/MSRPPDFs/KeyLargoCottonmouse.pdf

University of Georgia Museum of Natural History: http://fishesofgeorgia.uga.edu/gawildlife/index.php?page=speciespages/species_page&key=pgossypinus

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Whitaker, J.O., Jr., and W.J. Hamilton Jr. 1998. Mammals of the Southeastern United States. Cornell University Press. 583 pp.

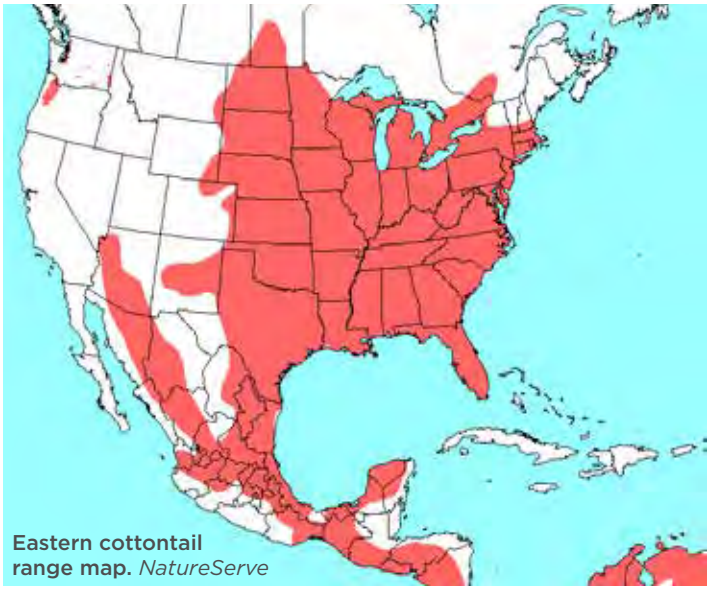
Wolfe, J.L., and A.V. Linzey. 1977. *Peromyscus gossypinus*. Mammalian Species No. 70, pp. 1-5. American Society of Mammalogists.

Cotton mouse painting. *Wendy Smith from Kays and Wilson's Mammals of North America, © Princeton University Press (2002)*

EASTERN COTTONTAIL

Scientific Name: *Sylvilagus floridanus*
Other Names: Florida cottontail

RANGE: The eastern cottontail has the widest distribution of any rabbit species, ranging from southern Canada into northern South America. In the United States, it is common within suitable habitat east of the Rocky Mountains. In Georgia, it is the most common rabbit and is found throughout the state.



Eastern cottontail range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: None (not protected)

The eastern cottontail is an important game species in the state. Hunting season typically runs from mid-November to February.

FEDERAL LEGAL STATUS: None (not protected)

DESCRIPTION: This rabbit has dense brown to gray fur with a white underside and feet. The name comes from its small white or "cotton" tail. Adults typically weigh between 2 and 4 pounds and are between 14-17 inches (35.5-43.2 centimeters) long. Like most rabbits, eastern cottontails have long ears, short front legs and large hind feet.

Eastern cottontail. *Linda May, GA DNR*

HABITAT: Eastern cottontails use a variety of habitats but prefer areas that have a mix of brushy and weedy vegetation. The brushy areas provide cover from predators and weather, and the weedy vegetation is a source of food. This type of habitat is created by frequent disturbance (such as mowing or fire) and is often referred to as early successional habitat.

DIET: The eastern cottontail is an herbivore (plant eater) and feeds on a wide variety of vegetation.

LIFE HISTORY: Cottontails are crepuscular, meaning they are most active during early morning or late evening. Eastern cottontails breed between February and September. They can have up to seven litters a year with four to seven young per litter. The young are nursed at dawn and dusk, begin eating grass at 8 days old, and are weaned after 14 days. Most rabbits have a lifespan of a little more than a year due to predation. Cottontails have many predators, including hawks, owls, coyotes, foxes and bobcats.

FUN FACTS:

*Male rabbits are called bucks, female rabbits are called does and baby rabbits are called kittens or kits.

*Eastern cottontails don't dig a burrow like other rabbit species. For nesting and cover they create a shallow depression under a shrub or clump of grass often called a form.

*Though cottontails prefer to hide from predators, they can run up to 18 mph.

*Cottontails usually hop, but they can leap 10-15 feet!

THREATS: Loss of habitat is the main threat to eastern cottontail populations. Also, feral cats and dogs are unnatural predators to cottontails. In some areas, collisions with cars can be a major cause of mortality.

SURVEY METHODS: Box traps and hunter surveys often are used to measure cottontail populations.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Cottontail rabbits are an important game animal in Georgia. Early successional habitat should be maintained to increase numbers. In residential and agricultural areas, rabbits also can be a pest species. In problem areas, reducing brushy cover and trapping can reduce population numbers.

SELECTED REFERENCES:

Animal Diversity Web: https://animaldiversity.org/accounts/Sylvilagus_floridanus/

University of Georgia Museum of Natural History: http://fishesofgeorgia.uga.edu/gawildlife/index.php?page=speciespages/species_page&key=sfloridanus

Webster, W. D., J. F. Parnell, and W. C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press. 255 pp.

Whitaker, J. O., Jr., and W .J. Hamilton Jr. 1998. Mammals of the Southeastern United States. Cornell University Press. 583 pp.

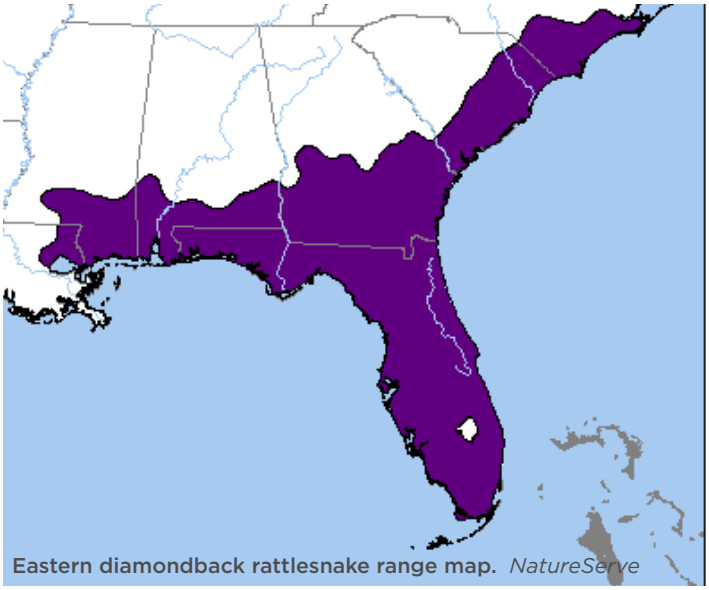
Chapman, J. A., J. G. Hockman, M. M. Ojeda C. 1980. *Sylviagus floridanus*. Mammalian Species No. 136, pp.1-4. American Society of Mammalogists.

Eastern cottontail painting by Ron Klinger. *Kays and Wilson's Mammals of North America, © Princeton University Press (2002)*

EASTERN DIAMONDBACK RATTLESNAKE

Scientific Name: *Crotalus adamanteus*
Other Names: diamondback rattler

RANGE: The eastern diamondback rattlesnake is restricted to the Coastal Plain region of the Southeast, ranging from eastern North Carolina south and westward to eastern Louisiana, including all of Florida. Georgia populations are found throughout the southern half of the state, including the barrier islands.



Eastern diamondback rattlesnake range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: None

FEDERAL LEGAL STATUS: None, although U.S. Fish and Wildlife Service has been petitioned to list the species as "threatened."

DESCRIPTION: Venomous. The eastern diamondback rattlesnake is the largest venomous snake in the United States and the largest rattlesnake in the world. Adults can reach or exceed 7 feet (2 m) in total length and are heavily bodied. Characteristic of all rattlesnakes, found at the end of the tail is a rattle made of interlocking segments of hard layers of skin cells that have lost their moisture (keratinized). The eastern diamondback has a long row of yellow or cream-colored diamonds, each with a dark brown center, down the middle of the back and fading toward the tail. The large head has two diagonal yellow or cream-colored lines bordering a dark brown or black band on the side that hide the dark eyes. The belly is cream-colored and has no distinct pattern. Scales on the back and sides are keeled (upturned), giving the snake a coarse rather than smooth appearance.

Eastern diamondback rattlesnake. *Berkeley Boone*

HABITAT: Eastern diamondback rattlesnakes live in a variety of upland habitat types including sandhills, flatwoods, scrub, maritime hammocks, fallow fields (not planted) and the secondary dunes and inter-dune meadows of barrier islands. Underground retreats such as gopher tortoise burrows, stumpholes and uprooted tree mounds are important components in these habitats.

DIET: Eastern diamondback rattlesnakes eat rodents, including various species of rats, mice and squirrels. Rabbits are the primary prey of large adult diamondbacks. Birds are occasionally taken when the opportunity arises.

LIFE HISTORY: Courtship and mating take place in late summer and early fall, with fertilized females waiting

until the following year to give live birth to 8-29 young, also in late summer and early fall. Eastern diamondbacks seek underground refuges, especially those of the gopher tortoise, during the colder months of November-March, but they will emerge and bask near the retreats' entrances during warm spells. From April-October these snakes remain on the surface, where they hunt prey by sit-and-wait ambush tactics. Predators include red-tailed hawks, eastern indigo snakes, eastern kingsnakes, feral hogs and bobcats.

FUN FACTS:

*A new rattle segment is added every time a rattlesnake sheds its skin, which can be one to three times each year. Therefore, you cannot tell the age by the number of rattle segments.

* Eastern diamondbacks readily take to water to travel, and some have even been seen in the surf along the coast.

* Eastern diamondbacks and other vipers in Georgia have pits on the side of their head that can detect infrared heat waves given off by the warm-blooded prey they hunt.

MANAGEMENT RECOMMENDATIONS:

THREATS: As with all snakes, especially venomous species, humans are a significant threat because many ignorantly follow the belief that "the only good snake is a dead snake." Eastern diamondback rattlesnakes are also captured and killed for the skin trade and for "rattlesnake roundups." Habitat loss and alteration is the most significant threat to the species. Regular wildfires or prescribed fire are important to keep the habitat open and usable by eastern diamondbacks. Without fire, their habitats become too overgrown with hardwoods. The decline of the gopher tortoise also affects the well-being of this species, which depends on the tortoise burrows for cover.

SURVEY METHODS: Visual encounter surveys focusing on areas with lots of gopher tortoise burrows are the best way to locate this species. Surveys should be conducted on relatively warm (greater than 55°F) days during the winter when eastern diamondbacks are often sunning near the burrow entrances or are visible with a flashlight just inside the burrow.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Habitats with eastern diamondback rattlesnakes should be burned every two to three years, ideally during the growing season (warmer months). Conservation and management efforts to benefit gopher tortoises also will benefit eastern diamondbacks. Efforts to educate the general public on the value of snakes and their deserved place in the ecosystem will go a long way to reduce thoughtless persecution by humans.

SELECTED REFERENCES:

Savannah River Ecology Laboratory: http://srelherp.uga.edu/snakes/croada.htm

Means, D. B. 2008. Eastern Diamondback Rattlesnake *Crotalus adamanteus*. Pp. 430-432 in Jensen, J. B., C. D. Camp, J. W. Gibbons, and M. J. Elliott (eds.). Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, GA. 575 pp.

Gopher Tortoise Council Species Fact Sheet: http://www.gophertortoisecouncil.org/edu/pdf/Eastern_Diamondback.pdf

EASTERN FENCE LIZARD

Scientific Name: *Sceloporus undulatus*
Other Names: fence lizard

RANGE: Eastern fence lizards are found throughout the southeastern United States.

Eastern fence lizard range map. *Black dots represent counties in Georgia with known occurrences. Amphibians and Reptiles of Georgia, UGA Press (2008)*

GEORGIA STATE LEGAL STATUS: Common

FEDERAL LEGAL STATUS: None

DESCRIPTION: Fence lizards are medium-sized lizards ranging from 4-7.5 inches (10-19 centimeters) long and have rough keeled scales that appear to be spiny. These lizards are usually all gray in color, however, they can be black or brown as well. The males feature a bright blue underside during the breeding season, which begins in spring. Male lizards are territorial and will defend their territory by doing pushups and head bobbing, eventually fighting if needed.

HABITAT: Eastern fence lizards are found in many different habitats throughout the Southeast. These lizards are terrestrial and usually occur in sunny habitats, such as open forests and field edges. They can be seen basking during the day on structures such as logs, fence posts and rock piles.

Eastern fence lizard. *Linda May, GA DNR*

DIET: The Eastern fence lizard's diet consists largely of ants, grasshoppers, beetles, termites, spiders and other invertebrates. This lizard is a "sit-and-wait" predator, meaning that it sits motionless until its prey comes close enough to strike.

LIFE HISTORY: Courtship occurs in the spring when eastern fence lizards are about 2 years old. In late spring or early summer, females bury an average of nine eggs in soft substrate, such as loose soil or rotten logs. Hatchlings begin to emerge in approximately 10 weeks.

FUN FACTS:

*Eastern fence lizards readily take up residence around human-occupied buildings, providing free pest control!

*Lizards in some areas seem to have evolved longer legs and a twitch to combat the imported fire ant.

THREATS:

Although fence lizards are common, pesticides and flooding can decrease their populations.

SURVEY METHODS:

Keep an eye out for eastern fence lizards around buildings as well as on rocks and tree trunks.

CONVSERVATION AND MANAGEMENT RECOMMENDATIONS:

This lizard is common throughout the state and can be found around human structures. It prefers sunny areas with plenty of basking structures and hiding spots such as stumps and logs.

SELECTED REFERENCES:

IUCN Red List: http://www.iucnredlist.org/details/64156/0

Jensen, J. B., C. D. Camp, W. Gibbons, and M. J. Elliott. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, GA. 600 pp.

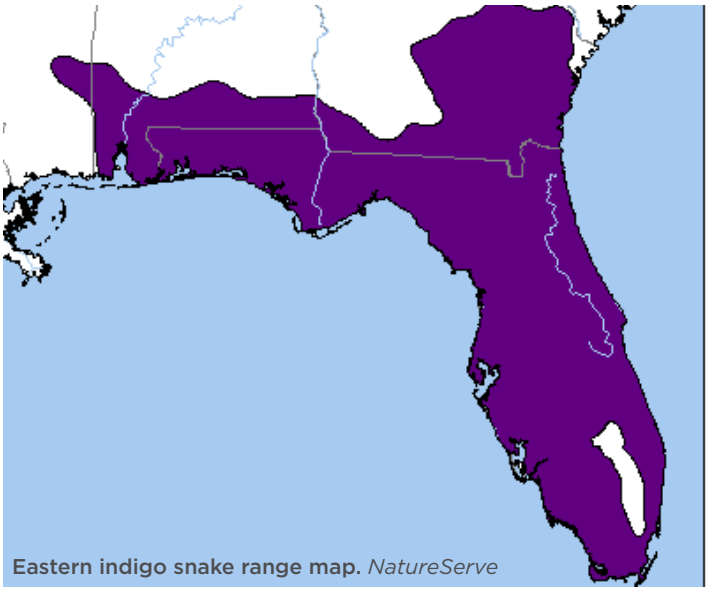
National Wildlife Federation: http://www.nwf.org/Educational-Resources/Wildlife-Guide/Reptiles/Eastern-Fence-Lizard

Savannah River Ecology Laboratory: http://srelherp.uga.edu/lizards/sceund.htm

EASTERN INDIGO SNAKE

Scientific Name: *Drymarchon couperi*
Other Names: blue gopher snake

RANGE: Historically, the eastern indigo snake ranged from southeastern Georgia south and west to southeastern Mississippi. Currently, populations are known from only Georgia and Florida. Georgia populations are highly fragmented and primarily occur in the southeastern portion of the state. Eastern indigo snakes are not found on the barrier islands of Georgia.



Eastern indigo snake range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: Threatened

FEDERAL LEGAL STATUS: Threatened

DESCRIPTION: Nonvenomous. The eastern indigo snake reaches a total length of just over 8½ feet (2.6 meters), making it the longest native snake in North America. The head of this stout snake is only slightly distinct from the neck. Coloration is iridescent blue-black throughout, except on the chin, throat and cheeks, which are usually reddish or occasionally cream-colored. It has no pattern on its body. The scales are large, shiny and mostly smooth, although several middorsal (middle of the back) scale rows of mature males are partially keeled.

HABITAT: Though present in a wide variety of habitat types in peninsular Florida, indigo snakes in Georgia mostly live in longleaf pine habitats, such as sandhills and turkey oak scrub. Stump holes and gopher tortoise burrows provide winter retreats. Within the Altamaha Grit areas of Georgia, cracks in sandstone outcroppings are used by indigos for shelter. During the warmer months, indigo snakes often are found close to water in sandhill habitats, in floodplains or by the edges of cypress ponds.

Eastern indigo snake. *Dirk J. Stevenson*

DIET: Indigo snakes eat a wide variety of prey, including birds, small mammals, fish, frogs, small turtles, lizards and snakes (including venomous snakes). Since indigo snakes are not venomous and they're not constrictors, they simply grab their prey with their powerful jaws and eat it alive.

LIFE HISTORY: Indigo snakes live in a variety of habitats during the year. In the warmer months, they often stay along the edge of wetlands, where they can find plenty of frogs and other snakes to eat. They use large areas of more than 2,000 acres during this time

of year. Once the weather starts to cool down, indigos move upland to sand ridges for the winter. Their breeding season is from November until April, and each female typically lays five to 10 eggs during May or June, often placing the eggs in the moist sand of gopher tortoise burrows. Males fiercely defend their territory by fighting with other males and sometimes eating them.

FUN FACTS:

*The nonvenomous eastern indigo snake is immune to the venom of native pit vipers (rattlesnakes, copperheads and cottonmouths).

*When they feel threatened, indigo snakes will flare their neck to look frightening. However, they flatten it vertically, rather than horizontally like cobras do.

THREATS: Indigo snakes use gopher tortoise burrows for shelter more than any other animals that use burrows. Therefore, a decrease in gopher tortoise populations means fewer indigo snakes too. Agriculture and tree farming in Georgia's Coastal Plain take away natural habitats, forcing these snakes into smaller, isolated plots of suitable habitat. Because they need to roam a lot to find food and mates, they often cross roads and get hit by cars. They are killed illegally by humans too – many people just kill any snake they see. Many years ago, indigos were taken from the wild to be used as pets, but that was before they were protected under the Endangered Species Act. Despite being illegal, some people still pour gasoline down gopher tortoise burrows (called "gassing") to drive out eastern diamondback rattlesnakes. Doing this could kill all of the animals that live in the burrow, including the indigo snake.

SURVEY METHODS: Keep an eye out for indigo snakes when you walk around sandhills that have lots of gopher tortoise burrows. It's easiest to find them in late fall through early spring when they most commonly use tortoise burrows and when temperatures are above 50°F (10°C). Biologists look for snakes just inside the burrows or basking on the sandy soil nearby. Sometimes they put cameras attached to long, flexible poles down burrows to see what's inside. Also, if they find a shed snake skin, they can identify the species and know that the snake lives nearby.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Large areas where indigos live should be protected from roads, farming and other development. Prescribed burning will help keep the habitat suitable for gopher tortoises and indigo snakes. Any efforts to protect or enhance gopher tortoise populations will benefit indigo snakes too. Stronger enforcement of the laws to prevent the gassing of tortoise burrows will help save indigos. Helping people to overcome their fears and false beliefs about nonvenomous snakes is perhaps the most important thing we can do to conserve indigo snakes in the long run.

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EASTERN KINGSNAKE

Scientific Name: *Lampropeltis getula*

Other Names: common kingsnake, chain kingsnake

RANGE: Throughout Georgia

Eastern kingsnake range map. *Black dots represent counties in Georgia with known occurrences. Amphibians and Reptiles of Georgia, UGA Press (2008)*

GEORGIA STATE LEGAL STATUS: Common

FEDERAL LEGAL STATUS: None

DESCRIPTION: The eastern kingsnake is one of Georgia's larger snakes, reaching lengths of 35-37 inches (90-100 centimeters). The smooth dorsal (back) scales are solid black to dark brown with light bands of yellow or white, creating a chain-like pattern. The underside of the snake is usually shiny black or mottled with dark and light scales. Patterns and color may vary throughout their range, and some snakes may be nearly all black.

HABITAT: Kingsnakes are found in a variety of habitats, including hardwood forests, pine forests, sandhills, swamps, hammocks and even farmlands. Found throughout the Southeast, kingsnakes have one of the largest ranges of North American snake species. They prefer habitats in which they can burrow, areas that are generally close to the water on stream edges and swamps.

DIET: Kingsnakes are constrictors and eat other snakes, including venomous species such as rattlesnakes, copperheads and cottonmouths. They also will eat a variety of rodents, amphibians, lizards and birds. Kingsnakes are even known to raid a nest for eggs.

Eastern kingsnake. *Todd Pierson*

LIFE HISTORY: Kingsnakes spend most of their time underground, emerging to the surface to hunt and mate in late spring and early summer (March through June). Six to nine weeks after mating, the female will lay her eggs in moist substrate such as rotting logs. Eggs hatch eight to nine weeks later, depending on the climate.

FUN FACTS:

*Kingsnakes eat other snakes, even venomous snakes! Amazingly, they are immune to venom!

*Kingsnakes vibrate their tails when threatened.

THREATS: Kingsnakes are becoming scarce in Georgia because of habitat loss and illegal collection as pets. They are killed illegally by humans too.

SURVEY METHODS: Keep an eye out for kingsnakes as they emerge from underground to hunt and mate in late spring and early summer.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Habitat protection and helping people to overcome their fears and false beliefs may help conserve eastern kingsnakes.

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Savannah River Ecology Laboratory: http://srelherp.uga.edu/snakes/lamget.htm

Jensen, J. B., C. D. Camp, W. Gibbons, and M. J. Elliott. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, GA. 600 pp.

EASTERN SPADEFOOT TOAD

Scientific Name: *Scaphiopus holbrookii*
Other Names: None

RANGE: Throughout Georgia

Eastern spadefoot toad range map. *Black dots represent counties in Georgia with known occurrences. Amphibians and Reptiles of Georgia, UGA Press (2008)*

GEORGIA STATE LEGAL STATUS: Common

FEDERAL LEGAL STATUS: None

DESCRIPTION: The eastern spadefoot is a short-legged, stout toad that is typically 1.5-2.5 inches (3.8-6.3 centimeters) long. The toad's color is often close in color to the substrate in which it lives. These toads have dark, shovel-like protrusions on their hind feet, hence the name. These shovels, or spades, help the toads dig their burrows. This species has bright yellow eyes with vertical pupils (often compared to cat eyes) instead of horizontal, as in other native toads. They generally have yellow lines forming an hourglass shape, which run from the rear corner of the eye and down their back and are brighter on male toads. Spadefoots have smooth skin with tiny warts, unlike other toads, which have more pronounced warts and parotoid glands.

HABITAT: Spadefoots burrow for shelter and prefer dry, loose, well-drained soil, which explains why they live in the southern half of the state, where the soil is sandy. These toads can remain buried in the soil for long periods of time, which might contribute to their success in pastures and suburban habitats.

Eastern spadefoot toad. *Berkeley Boone*

DIET: Spadefoot tadpoles are aggressive feeders and will eat plankton and anything they can catch. As their mouthparts develop, they rely on the film that develops on vegetation in the water. Adult toads feed at night and eat a variety of invertebrates, including crickets, flies, earthworms, centipedes, millipedes, spiders and ants.

LIFE HISTORY: Spadefoot toads are known as explosive breeders, with breeding events triggered by heavy rainfall (2 inches or more). Unlike other toads that have a mating season, spadefoot breeding can happen any time of the year. The male's call is a low-pitched "errrrh" repeated in short intervals. Females can lay strings of 2,500 or more eggs underwater, attached to vegetation in wetlands, ephemeral (temporary) pools, roadside ditches and puddles. Development is fast; the eggs hatch in four to seven days and tadpoles can undergo metamorphosis in as few as 28 days. Thousands of individuals may congregate in schools. These toads reach sexual maturity in two to three years and can live for a decade or more. Their skin secretions deter predators; however, raccoons, birds and snakes (especially hognose snakes) will take advantage of their migrations.

FUN FACTS:

*During times of drought, spadefoots release a fluid that hardens the soil around them, protecting them from drying out until the rain returns.

*Handle them with care, as some people have allergic reactions to their skin secretions.

*Some people think spadefoot toads smell like peanut butter.

*The spadefoot toad is considered threatened or endangered in northern states such as Connecticut and Massachusetts.

THREATS: This species is vulnerable to habitat loss and wetland destruction.

SURVEY METHODS: Spadefoot toad populations appear to be strong in Georgia. However, their secretive nature makes them difficult to monitor.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS SECTION: Protection of wetland habitats helps conserve this species.

SELECTED REFERENCES:

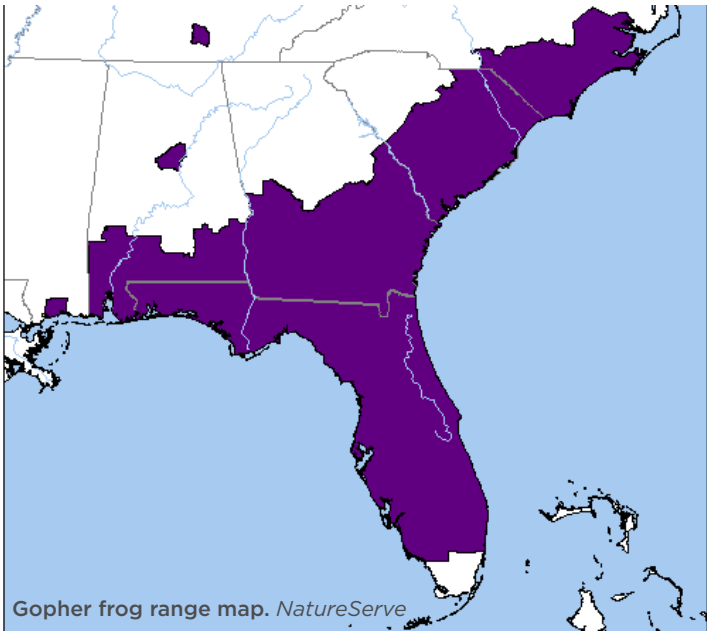
Savannah River Ecology Laboratory: http://srelherp.uga.edu/anurans/scahol.htm

Jensen, J. B., C. D. Camp, W. Gibbons, and M. J. Elliott. 2008. Amphibians and Reptiles of Georgia. University of Georgia Press, Athens, GA. 600 pp.

GOPHER FROG

Scientific Name: *Lithobates capito (formerly Rana capito)*
Other Names: none

RANGE: The gopher frog is restricted to the Coastal Plain of the southeastern U.S. In Georgia, this frog is found in scattered sites south of the Fall Line (the boundary between the Piedmont and the Coastal Plain). Their populations are patchy across their range due to the loss of natural longleaf pine habitats.



Gopher frog range map. *NatureServe*

Gopher frog. *Dirk J. Stevenson*

GEORGIA STATE LEGAL STATUS: Rare

FEDERAL LEGAL STATUS: None, although the Center for Biological Diversity requested that the U.S. Fish and Wildlife Service list the species as "threatened."

DESCRIPTION: The gopher frog is a stout, medium-sized frog, with adults ranging from 2½-4 inches (6.5-10 centimeters) long. Its body color may vary – brown, gray or creamy white with several reddish brown or dark brown spots. Warts are obvious on the back. Two raised ridge lines, often tinged with a yellow or brassy color, run down the sides of the back. The belly is white or cream-colored with dark mottling in most Georgia populations. The underside of the hind limbs is often yellow. Males make their snore-like call by blowing air into vocal sacs, which look like bubbles blowing up on each side of his head. Tadpoles can reach 3.5 inches (9 centimeters) long and are olive green. Dark spots, which may be faded, are scattered over the top of its body and tail.

HABITAT: In Georgia, the gopher frog only lives in longleaf pine ecosystems, including dry sandhills and flatwoods. Except when breeding, it stays mostly on land and lives in animal burrows or stump holes. In sandhill habitats, they often use the burrows of gopher tortoises and old field mice for shelter. In soggy flatwoods habitats (where there are no tortoise burrows), gopher frogs will find shelter in crayfish burrows. The gopher frog breeds in remote, temporary wetlands (i.e., cypress ponds, limesink ponds, Carolina bays) with no fish predators, as well as big holes in the ground that fill with water at construction sites. When longleaf pine forests are burned naturally or by prescribed fire, the gopher frog will want to live there. The perfect habitat for this amphibian is a large area of connected sandhills or flatwoods that include several wetlands.

DIET: Gopher frog tadpoles only eat algae and plants. Adult gopher frogs eat invertebrates (animals without a backbone, like insects), as well as other frogs and toads.

LIFE HISTORY: Gopher frogs typically migrate to breeding ponds in the fall, winter and early spring when there are heavy rains. Summer breeding, especially during the passage of tropical storms, also has been documented. Males typically remain at breeding ponds for longer periods of time than females. Adult male frogs call from shallow water along the shoreline, while floating on the surface of the water in deep areas or while submerged. The call is of very low frequency and sounds like a snore or low growl. Because of its low frequency, the call can carry a considerable distance. Females attach large egg masses (up to the size of a grapefruit) to vegetation near the water's surface. These egg masses may contain 2,000 or more individual eggs. The average length of time until hatching is approximately a week. Metamorphosis (developmental period) of the gopher frog may take from 87-215 days to reach the adult stage, depending on water temperature.

FUN FACTS:

*When they feel threatened, gopher frogs will curl up and put their front feet over their eyes.

*One gopher frog researcher successfully "fished" for gopher frogs by tying a young mouse to a string and sending it down gopher tortoise burrows. The frog would seize the mouse by its mouth and could then be pulled out.

THREATS: Now isolated, small gopher frog populations are threatened by extreme weather events such as lengthy drought, which is made worse by climate change. Populations on private land often are not appropriately managed. Generally, gopher frog populations are threatened by fire suppression or a lack of burning at the proper time of year (such as during the growing season). Declining gopher tortoise populations probably have negatively affected this frog. Any impacts to breeding pond habitat quality (perhaps from lack of fire, ruts from firebreaks or off-road vehicles, ditching or poor water quality) may also have a harmful effect on this amphibian.

SURVEY METHODS: Surveys are best conducted during the breeding season, which usually lasts from October through March, with peaks in October-November and February-March. Listening for the distinctive call of males at potential breeding sites after sunset is perhaps the easiest way to detect gopher frogs. Those experienced in identification of egg masses can search for them during the same period but during the day. Similarly, those experienced at identification of tadpoles can seine or dip net for them, ideally from March-May. Adults occasionally are encountered on rainy fall and winter nights by slowly driving roads that cross between their upland habitat and breeding wetlands.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Protection of wetland habitats helps preserve this species. Prescribed fire would enhance both upland and wetland breeding sites used by this species, and the fire frequency and timing should mimic as closely as possible what would be natural in these habitats. Stocking fish into breeding wetlands must be avoided since they may eat gopher frog tadpoles or adults. Any efforts that protect the gopher tortoise and its habitats also would benefit the upland needs of gopher frogs. Captive rearing and release efforts at suitable, protected sites may help the recovery of this species.

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U.S. Fish and Wildlife Service: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=9073

GOPHER TORTOISE

Scientific Name: *Gopherus polyphemus*
Other Names: gopher, gopher turtle

RANGE: Gopher tortoises live in the Coastal Plain from the southernmost point of South Carolina south and westward to extreme eastern Louisiana. In Georgia, these reptiles are found throughout the southern half of the state below the Fall Line. They are not found in the Okefenokee Swamp and most barrier islands.

Gopher tortoise range map. *Gopher Tortoise Council*

Documented specimens collected on St. Simons and Cumberland islands likely were introduced rather than naturally occurring. In 1994, a large number of tortoises were salvaged from an industrial park development site in Bulloch County and relocated to St. Catherines Island, where they have reproduced and are thriving. Tortoises observed or collected from the Piedmont and mountains of Georgia are undoubtedly released or escaped animals that were originally collected elsewhere, illegally.

GEORGIA STATE LEGAL STATUS: Threatened. Gopher tortoise populations are found on many public lands in the Coastal Plain. Sites with large populations include Fort Stewart, Fort Benning, General Coffee State Park, Seminole State Park, George L. Smith

Gopher tortoise. *Kim Kilgore, GA DNR*

State Park, Reed Bingham State Park, Silver Lake Wildlife Management Area and River Creek Wildlife Management Area. Other large, protected populations are found on several of The Nature Conservancy preserves, as well as at Joseph W. Jones Ecological Research Center at Ichauway.

FEDERAL LEGAL STATUS: Candidate for listing in Georgia and eastern part of range; threatened west of the Tombigbee and Mobile rivers in Alabama, Mississippi and Louisiana.

DESCRIPTION: The official state reptile of Georgia, the gopher tortoise is a relatively large terrestrial turtle, with a maximum carapace (top of shell) length of 15 inches (38 centimeters), though it averages 9-11 inches (23-28 centimeters). Its oblong carapace is unkeeled and domed, somewhat flattened and brown or gray in color. The weight of an adult tortoise averages 12-14 pounds. In juveniles and young adults, distinctive growth annuli (rings) are evident on the carapace, which usually become obscured later in life. The yellowish plastron (bottom of shell) is hinge-less and has throat plates called gular scutes extending below the throat that are especially long on males. Males also have slightly concave plastrons. The scaly skin of adults is typically dark gray.

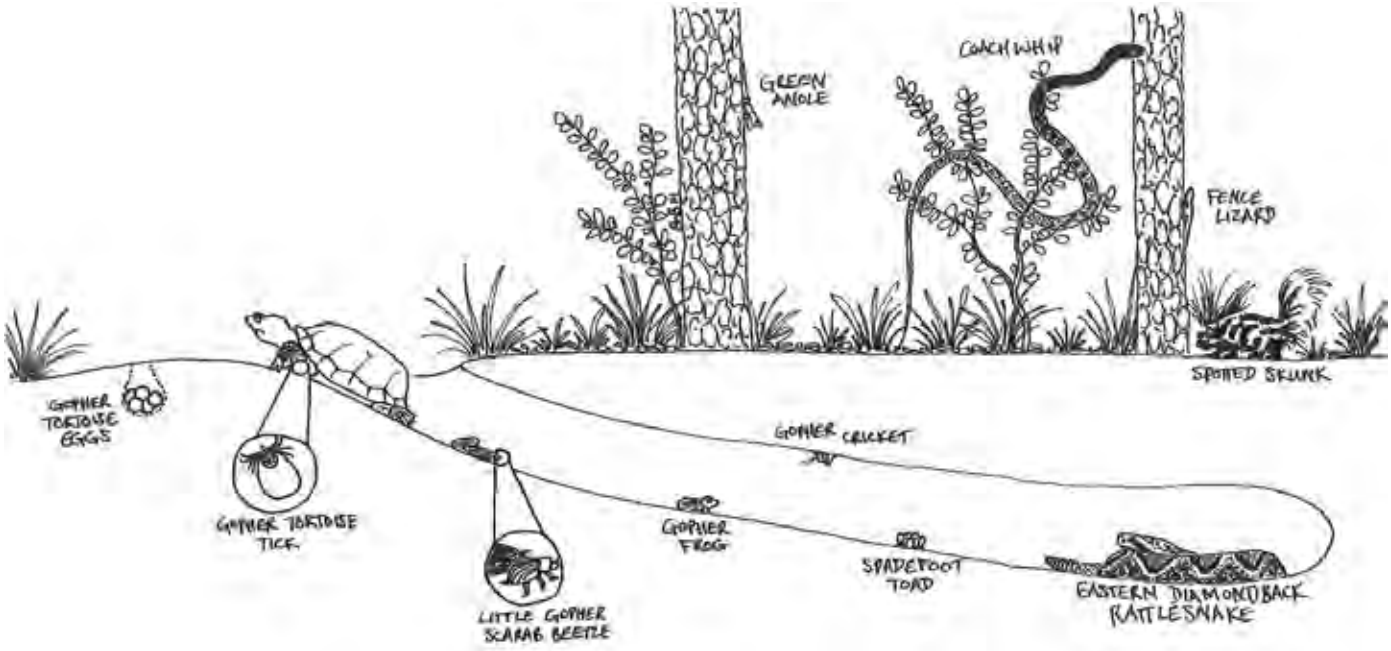
Hatchlings have yellowish skin and yellow-centered scutes (scales), both of which darken with age. The head is wide and rounded. The most characteristic features of the gopher tortoise are its flattened, shovel-like forelimbs and stumpy, elephantine hind limbs.

HABITAT: Gopher tortoises need well-drained, sandy soil for burrowing and plentiful sunlight for basking as well as to provide growth of the abundant herbaceous vegetation needed for food. They are a characteristic species of the rapidly disappearing longleaf pine and wiregrass community, which includes sandhills, pine flatwoods and turkey oak scrub. Historically, this community was represented by an open-canopied forest that allowed abundant sunlight penetration and conditions favorable for a rich growth of grasses and forbs. Unfortunately, very little of this naturally occurring habitat still exists; therefore, many tortoises have been forced into artificial habitats, such as roadsides, old fields and graveyards, that retain the basic requirements.

DIET: Gopher tortoises are herbivores and find their food by using their sight and sense of smell. Their diets include a wide variety of low-growing, broad-leaved grasses, wiregrasses and a large diversity of other plants that provide nutrients for survival, such as legumes, asters, cacti and the fruits of a variety of species. They eat all parts of low-growing plants (leaves, stems, flowers, etc.). They get most of their water from their diet, although they may drink from or soak in temporary shallow ponds. Tortoises depend on bacteria and roundworms in their intestines to aid in the digestion of tough plant materials.

LIFE HISTORY: The life of a gopher tortoise revolves around the tunnel-like burrow that it excavates using its shovel-like front feet. The burrow serves as a home and remains at a fairly constant temperature and humidity year-round. This consistency provides shelter during periods of extreme winter and summer temperatures, drought and fire – not only for the tortoise but for more than 360 invertebrate and vertebrate animal species. Gopher tortoises also benefit the plant life by returning leached nutrients to the surface and creating bare, competition-free areas of soil. They also disperse seeds through fruit consumption and defecation throughout their habitat. For these reasons, the gopher tortoise is considered a "keystone species" of the longleaf pine community, meaning its existence is critical to the existence of many other species. In Georgia, animals that rely on gopher tortoise burrows include the eastern indigo snake, eastern diamondback rattlesnake, pine snake, gopher frog, gopher cricket and scarab beetles. Other species often found using these burrows are northern bobwhites, striped skunks, eastern cottontails, coachwhips and southern toads.

Gopher tortoise burrows can reach 20-40 feet (6-12 meters) long and 10 feet (3 meters) deep. Each burrow has a single opening and is excavated wide enough to allow room for the tortoise to turn around at any point.



Gopher tortoise burrow cross-section. *Berkeley Boone*

It also usually has an enlarged end chamber. Burrows are fairly easy to spot because of the characteristic mound of loose sand at the burrow entrance called the "apron." A single tortoise may dig more than one burrow each season, and occupancy of a burrow by more than one tortoise may occur, at least temporarily. They may travel several miles to take up a different residence in an existing burrow or to dig a new one. The burrows used by a tortoise, its breeding territory and its feeding area make up the tortoise's home range.

Gopher tortoise burrow. *Berkeley Boone*

Gopher tortoises typically court and mate from March through September. Nesting reaches a peak in early June but may last until mid-July. Females, which may not attain sexual maturity until they are 19-20 years old, produce only one clutch each year and usually dig their nest in or near the burrow apron. They lay an average of six white, spherical eggs (resembling ping-pong balls), which develop in the sand, are warmed by the sun and usually hatch following an incubation period of 97-106 days. Hatchling tortoises may take refuge in an adult burrow but eventually make or find their own burrows. Nests and hatchlings are preyed upon by raccoons, fire ants, hogs, armadillos, foxes, skunks, snakes and domestic cats and dogs, though raccoons are apparently the chief predators at most sites. Hatchlings are well camouflaged with yellow- and brown-splotched scales that help conceal them in dry leaves and grasses. At about 4 years old, they begin to darken. They remain juveniles for about six to 10 years. Between 10-20 years, they are considered subadults until they become sexually mature and their shells harden. Gopher tortoises may live 60 years or more.

FUN FACTS:

*The generic name of the gopher tortoise, *Gopherus*, is derived from the word "gopher" that was used to describe the burrowing habits of this species. The species name *polyphemus* is from Greek mythology and means "lives in a cave."

*The gopher tortoise is the only native tortoise species in North America found east of the Mississippi River.

*During the Great Depression, gopher tortoises were known as "Hoover chickens" because they were a reliable source of food for people who could not afford chicken when there was little else to eat. (A campaign circular for Herbert Hoover, elected president shortly before the Depression, had promised "a chicken in every pot.")

*The sex of a tortoise is determined by nest temperature. Female hatchlings develop if temperatures are higher than 85˚F (30˚C), and males develop if below 85˚F (30˚C).

THREATS: The loss and alteration of the longleaf pine-wiregrass community through agricultural and silvicultural activities, urban sprawl and fire suppression have eliminated many populations of gopher tortoises and isolated most others. Estimates show that the average female gopher tortoise in Georgia only produces about 5.8 hatchlings every 10 years, assuming she lays eggs each year. This naturally low rate of reproduction is diminished further by isolation, unnaturally high populations of certain predators, less than ideal habitat conditions and other factors. Tortoises forced into roadside habitats because of a lack of suitable surrounding land are more vulnerable to vehicle impacts and collection by humans. In the past, tortoise populations in many areas were decimated heavily by human exploitation for food, a practice now illegal but which may continue in some areas. The introduction of gasoline into the burrows of gopher tortoises ("gassing") is an illegal technique used by some rattlesnake hunters to force the snakes to the surface. This practice is typically fatal to all burrow inhabitants. Furthermore, Upper Respiratory Tract Disease (URTD) is a highly contagious illness found in many gopher tortoise populations that can be fatal.

SURVEY METHODS: Gopher tortoises are best located through pedestrian searches for their distinctive burrows. Burrow openings are half-moon shaped, and an apron of excavated sand fans out in front of the opening. Active burrows (those most likely to have a resident tortoise) have aprons mostly devoid of plants and debris, do not have spider webs within, may show tracks or slides from the tortoise and may have scat in and around them.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: The protection of remaining natural longleaf pine forests will not only benefit the gopher tortoise but a large number of rare animals and plants as well. Periodic controlled burns should be conducted to reduce hardwood vegetation and promote the growth of grasses and forbs. Predators may need to be controlled in areas of high human activity, such as state parks.

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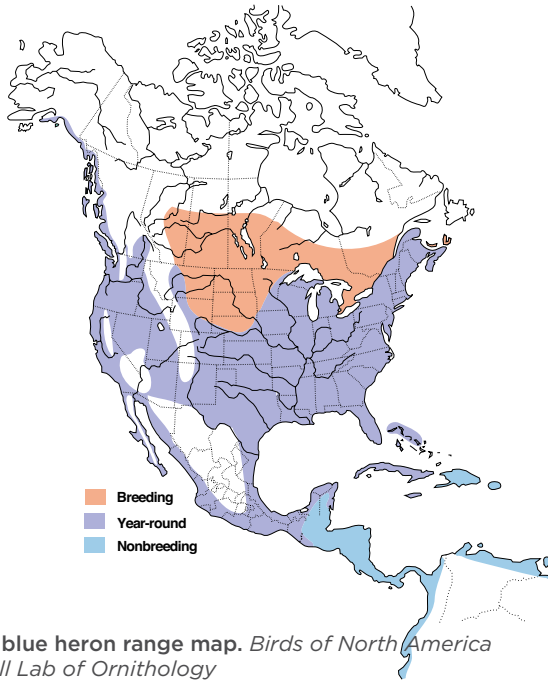
GREAT BLUE HERON

Scientific Name: *Ardea herodias*

Other Names: blue crane, Florida heron, big cranky

RANGE: The great blue heron is a relatively common species that nests in much of southern Canada and is resident throughout much of the continental United States, southern coastal Alaska and coastal British Columbia, portions of the Caribbean, much of coastal and southern Mexico and northern Central America. Wintering birds also can be found in much of Central America, some Caribbean islands and portions of the northern coastal areas of South America.



Great blue heron range map. *Birds of North America Cornell Lab of Ornithology*

Great blue heron. *Todd Schneider GA DNR*

GEORGIA STATE LEGAL STATUS: None.

FEDERAL LEGAL STATUS: Protected under the Migratory Bird Treaty Act (1918). This law protects most species of migratory birds from killing, harm, harassment and prohibits possession without proper permits.

DESCRIPTION: This heron is 38-54 inches (96.5-137 centimeters) in length with a very long neck and legs and a long pointed knife-like bill. The body and wings are bluish-gray in color with some brown on the flanks near the base of the wings and on the feathers near the top of the legs. A vertical black stripe can be seen on the flanks near the base of the wings as well. The neck is gray. The face, throat and forehead are white with a black patch above the eye that extends in black plumes that stick out from the back of the head. This bird often can be seen flying with its neck folded in an "S"-shape.

HABITAT: This species lives in or near wetlands and open water. It feeds in ponds, lakes, sloughs, wet ditches and the slower moving portions of rivers and streams, as well as occasionally in the ocean surf in coastal areas. Next to these areas, it nests in trees, shrubs or on the ground and will occasionally nest on artificial structures such as large power poles or communications towers.

DIET: The great blue heron mostly eats fish but also will eat frogs, salamanders, small turtles, snakes, crayfish, crabs, shrimp, other invertebrates, small mammals and birds.

LIFE HISTORY: This bird feeds solitarily (alone) while wading or remaining motionless in shallow water or occasionally from along the edge of the water or a low perch. Most often it thrusts its bill under the surface of the water with a lightning-quick motion, grabbing the fish or other food item before it can escape. Great

blue herons may nest as single pairs, but most often they nest in colonies with other great blue herons and other wading bird species. Colonies vary in size from a few to several hundred nests. In Georgia, these colonies are most often in trees or shrubs within a wetland or on an island within a lake, pond or river. Nesting can start as early as January in Georgia, but most nesting occurs from March through May. Courtship includes a number of displays and vocalizations, sometimes as the male and female take turns incubating the eggs. The nest is built out of sticks that are collected by the male from trees, the ground or the nests of other great blue herons or wading birds. These sticks are passed off to the female who constructs the nest. Once the nest is complete, she lays two to four eggs, which are incubated for 25-30 days before they hatch. Young herons will leave the nest 65-90 days after hatching.

FUN FACTS:

*The great blue heron is one of the most widespread and adaptable wading birds in North America.

*A subspecies of this bird in south Florida, the great white heron, has entirely white plumage.

THREATS: Some of the threats that the great blue heron faces are the draining and filling of isolated wetlands where this species nests and feeds, chemical contaminants in certain areas and human disturbance of nesting colonies.

SURVEY METHODS: Today, great blue heron surveys are conducted through colony nest counts from helicopters with observers, video or still photography. In the future, unmanned aerial vehicles (drones) with video and still cameras could be used effectively in many locations, and probably with significantly less disturbance to nesting birds than helicopters.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Changes to interpretation of some federal wetlands protection laws has led to decreased protection for many isolated wetlands that are used by this species, as well as many other species. These changes allow many wetlands to be legally filled or drained, thereby eliminating important habitats for these birds. Despite this concern, the broad distribution and adaptability of this heron likely will help keep its populations stable well into the future. Efforts should be made to change wetland laws so they offer more protections, and efforts should continue to reduce human disturbance of nesting colonies.

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HISPID COTTON RAT

Scientific Name: *Sigmodon hispidus*
Other Names: cotton rat

RANGE: The hispid cotton rat is very common throughout the southeastern United States in grassy fields and roadsides.

Hispid cotton rat range map.
Smithsonian National Museum of Natural History

GEORGIA STATE LEGAL STATUS: None (not protected)

FEDERAL LEGAL STATUS: None (not protected)

DESCRIPTION: This medium-sized rat has coarse grayish-brown fur; each hair has a black tip, giving the animal a grizzled appearance. The total length is about 12 inches for males, with females being slightly smaller. The sparsely haired tail makes up only about one-third of the animal's total length.

HABITAT: Cotton rats are the most prevalent rodent of Southern fields and roadsides, found in just about any grassy, weedy area. They construct runways through the vegetation for quickly moving about.

DIET: Cotton rats eat mostly seeds and succulent plant parts, including fruits. They occasionally consume insects and bird eggs.

LIFE HISTORY: These animals are active day and night. They have many young – females begin reproducing at less than 2 months of age and produce litters of five to eight young every few weeks throughout most of the year. The young are well-developed at birth and able to take care of themselves within a week**.** Rarely does a cotton rat live to be even 1 year old because so many things like to eat them, including hawks, owls, foxes, coyotes, bobcats, snakes and other predators.

Hispid cotton rat. J.N. Stuart, Creative Commons 2.0

FUN FACT:

*The term "hispid" refers to the coarse hairs found in the coat of this animal.

THREATS: Cotton rat populations are thriving wherever habitat is available; no management is needed.

SURVEY METHODS: Snap traps and box traps can be used to capture cotton rats. Also, their runways are sometimes obvious.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Bobwhite quail populations seem to do best when cotton rats are abundant. Probably the rats serve as alternative food sources for predators, decreasing predation pressure on the quail.

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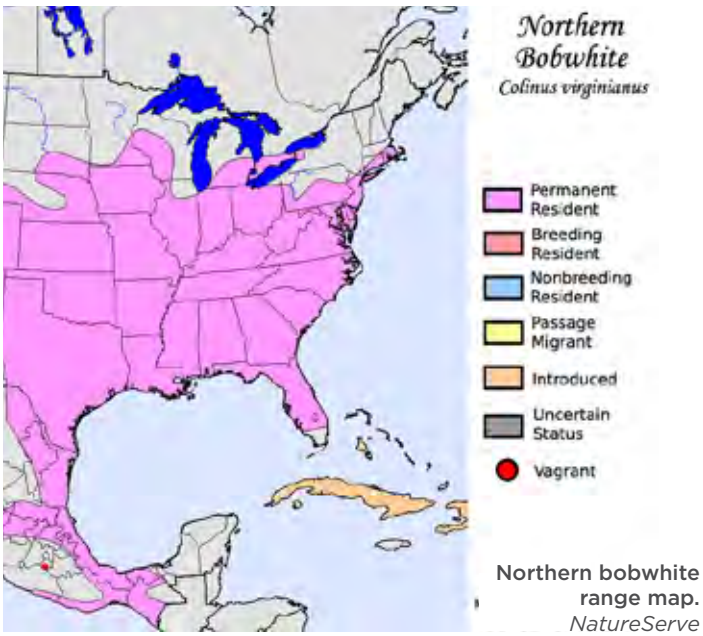
NORTHERN BOBWHITE

Scientific Name: *Colinus virginianus*
Other Names: bobwhite quail

RANGE: The northern bobwhite quail occurs within suitable habitat throughout all or parts of 38 states. In Georgia, they can be found from the mountains to the coast, but the highest populations are in Southwest Georgia.



Northern bobwhite range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: None

FEDERAL LEGAL STATUS: None

From 1966 to present, bobwhites have experienced a widespread, sharp decline with numbers dropping almost 3 percent per year, resulting in a total loss of over 80 percent across its range. The 2014 State of the Birds Report listed the northern bobwhite as a common bird in steep decline.

DESCRIPTION: The northern bobwhite is Georgia's state game bird (legally hunted for sport or food). Bobwhites are relatively small, ground dwelling, gallinaceous (chicken-like) birds. They have round bodies, small heads, curved wings and short tails. Adults stand 6 to 7 inches (15-17.7 centimeters) in height and typically weigh about 6 ounces. Both males and females have beautifully detailed feathers of brown, buff, rufous and black. The male can be most easily identified by a prominent white stripe above the eye, whereas hens (females) have cream- or buff-colored head stripes. During the breeding season, both males and females make a loud whistled "bob-white" call that sweeps upward in pitch.

Northern bobwhite female and male. *US Fish and Wildlife Service*

HABITAT: Bobwhites are classified as a grassland-forb-shrub habitat dependent species. They live in early successional habitats (areas that recently started to regrow after a fire, farming, logging or other disturbance). Bobwhites need large expanses of clumped native grasses mixed with annual weeds, legumes, briars and other woody thickets that are dense above but open underneath. The average annual home range size is around 40 acres, but depending on habitat quality, home ranges can vary from 10 to more than 200 acres.

DIET: The bobwhite's diet varies by season. Bobwhites forage as a group, scratching and pecking through leaf litter or foraging on low plants. During fall and winter they eat many legume seeds, ragweed seeds, pine seeds and acorns. In spring, they eat more leafy green parts of plants. In summer, their diet includes grass seeds, some fruits and arthropods – such as bugs, flies, bees, wasps, beetles and spiders. Chicks mostly eat insects until

they are 6-8 weeks old since they need protein to grow quickly.

LIFE HISTORY: Bobwhite nesting season extends from March through October, with the peak occurring from May through August. Bobwhites nest on the ground using the previous year's dead vegetation, with both hens and cocks (males) collecting material for nest construction. Males often incubate the nest along with the female. The average clutch size is 12 eggs with an incubation period of 23 days. Chicks are precocial, meaning they leave the nest with the adult shortly after hatching. Bobwhites can produce two or three broods during the nesting season. During the early fall, bobwhite adults and broods form into social groupings called coveys with an average covey size of 12 birds. Coveys roost (or spend the night) on the ground in a circle with their heads pointed outward, which allows them to conserve heat and more easily escape nocturnal predators. Quail will remain in coveys until the spring, at which time they begin to pair up for breeding. While many bobwhites (up to 80 percent) die during the course of a year, high reproductive rates make up for this loss. Poor habitat quality, harsh weather, predators and other factors contribute to bobwhite deaths.

FUN FACTS:

*The northern bobwhite was designated as Georgia's State Game Bird in 1970.

*Because of its history as a game bird, the northern bobwhite is one of the most intensively studied bird species in the world.

* The bobwhite genus is represented by more than 700 known fossils, dug up in sites ranging from Florida to Arizona to the Yucatan Peninsula of Mexico. Some of these fossils are at least 2.5 million years old.

*The oldest northern bobwhite on record was 6 years, 5 months old.

THREATS: More intense agriculture and forestry along with increased urban development are the main causes for bobwhite quail decline. It is important to note that hunting has not led to fewer bobwhites. In fact, without the support of hunters for its conservation, bobwhite populations would have experienced far greater declines.

SURVEY METHODS: Fall covey counts and spring breeding bird counts involve listening for their distinctive calls at designated locations.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Efforts are underway to improve habitat for bobwhites through Georgia's Bobwhite Quail Initiative. Several federal programs also promote habitat and population restoration practices, including prescribed burning, thinning pine stands, restoring longleaf pine and providing fallow (uncultivated) borders on agricultural fields.

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Bobwhite Quail Initiative Management Notes: https://georgiawildlife.com/bobwhite-quail

PINE SNAKE

Scientific Name: *Pituophis melanoleucus*

Other Names: chicken snake, gopher snake, bull snake

RANGE: Pine snakes are found primarily on the Coastal Plain and Piedmont Ridge, with a few sightings in the upper Piedmont and Ridge and Valley provinces.

Pine snake range map. *Black dots represent counties in Georgia with known occurrences. Amphibians and Reptiles of Georgia, UGA Press (2008)*

GEORGIA STATE LEGAL STATUS: Threatened

FEDERAL LEGAL STATUS: None

DESCRIPTION: The pine snake is a large, heavy-bodied snake with a small head, averaging 48-66 inches (122-168 centimeters) long but reaching up to 89 inches (226 centimeters) long. This species is beautifully patterned and variable in color. Typically, the base color ranges from yellow to white with markings that vary from black to orange. Patterned saddles cover the midbody to the tip of the tail. These saddles form bands on the sides that continue to the underside of the snake. Head markings are highly variable with many snakes having a dark band across the forehead to under the eyes. The snout is somewhat pointed with an enlarged rostral (nose) scale for burrowing. Other scales along the body are strongly keeled.

HABITAT: Pine snakes are found throughout the Coastal Plain of south Georgia. They prefer deep, well-drained, sandy soils, which allow them to dig hibernacula (places to overwinter) and summer dens. Pine snakes are most commonly found living in longleaf pine savannas, often near gopher tortoises and pocket gophers. Since they are rare in other parts of the state, biologists are not sure of their habits there – but they believe they live in hardwoods and mixed oak-pine forests, as well as dry mountain ridges.

Pine snake outside gopher tortoise burrow. *Berkeley Boone*

DIET: Extremely powerful constrictors, pine snakes eat small mammals such as rabbits, squirrels, mice and rats. They sometimes eat ground-nesting birds and their eggs. Due to their fossorial (burrowing) nature, pine snakes may also eat pocket gophers.

LIFE HISTORY: Pine snakes are burrowers and spend most of their time underground, under logs, rocks, pine stumps and other debris. They also find shelter in the burrows of gopher tortoises and small mammals. In April and May, they might come above ground to find a mate and hunt. Females lay an average of four to 12 eggs in June through August. Large eggs are laid underground in sandy areas with plentiful sunlight. Hatchlings are over 12 inches long and emerge in September and October.

FUN FACTS:

*The pine snake is one of Georgia's longest snakes and can reach over 7 feet long.

*Several female pine snakes may lay eggs in one nest chamber, which is called communal nesting.

*The pine snake is known for its "hissing" but will also vibrate its tail, inflate its body and strike when threatened.

THREATS: Habitat loss and illegal killing are threats to the pine snake.

SURVEY METHODS: Since pine snakes spend a lot of time underground, they are hard to find. Biologists check gopher tortoise burrows and other ground dwellings. Surgically implanted radio transmitters also are used to track pine snakes in the wild.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: This species benefits from regular prescribed fires and habitat protection.

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RED-COCKADED WOODPECKER

Scientific Name: *Picoides borealis*
Other Names: RCW

RANGE: Few isolated populations in the southeastern United States

Red-cockaded Woodpecker range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: Endangered
FEDERAL LEGAL STATUS: Endangered

DESCRIPTION: The red-cockaded woodpecker (RCW) is a small black-and-white bird (7-8 inches) named for the tiny, red patch behind the eye of adult males. Closely resembling the more common downy and hairy woodpeckers, it can be distinguished by its large white cheek patch and lack of a white patch in the middle of its back. The red-cockaded woodpecker has a black cap and a black mustache, which extends down the neck.

HABITAT: The RCW needs large tracts of open, mature, Southern pine forests – preferably longleaf, but they also will use loblolly or slash pine. This species is the only woodpecker that creates a cavity in a living pine tree. Old living pines often are selected because they have red heart fungus, which softens the heartwood (core of the tree) and makes excavation easier. Even so, it may take several years for the woodpecker to complete the cavity. The extensive pecking is worth it though, because the live tree responds by exuding resin around the cavity.

Male red-cockaded woodpecker at longleaf pine nest cavity. *Cornell Lab of Ornithology*

The sticky resin protects nestlings from tree-climbing predators like rat snakes. Today, the largest populations of RCWs are found in the sandhills of Fort Benning, Fort Stewart and in the Red Hills region.

DIET: RCWs eat beetles, ants, spiders and other insects found in the tree bark. These birds will occasionally eat fruits and seeds.

LIFE HISTORY: The RCW is a cooperative breeder that lives in breeding groups. The group typically consists of the breeding pair and one to three of their adult male offspring, known as "helpers." As their name implies, the helpers assist with incubation, brooding and feeding the hatchlings in the spring. Each bird has its own cavity, but the breeding male uses the best one. Eggs are laid in his cavity, and he takes care of them at night. Female offspring usually leave to find other

breeding territories and rarely stay with their parents. Entire families forage together as a group, moving together from tree to tree after the young fledge.

FUN FACTS:

*The RCW is known as a "keystone species" due to the number of other animals that use their tree cavities.

*Biologists install artificial nest box inserts in live longleaf pine trees to create nesting spaces, thereby decreasing the amount of time for cavity excavation and allowing the population to grow quicker.

THREATS: Loss of habitat, namely mature longleaf pine forests, is the main threat to this species. Extreme weather, like hurricanes, can destroy cavity trees.

SURVEY METHODS: Biologists look and listen for RCWs in suitable habitats. Recordings may be used to see if a bird in the area responds.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Habitat management practices such as tree thinning and prescribed burning are key to the success of this endangered bird. Cooperation between multiple landowners can provide the RCW with the habitat connectivity that is required. Translocation of juvenile RCWs is another technique biologists use to boost and expand populations.

SELECTED REFERENCES:

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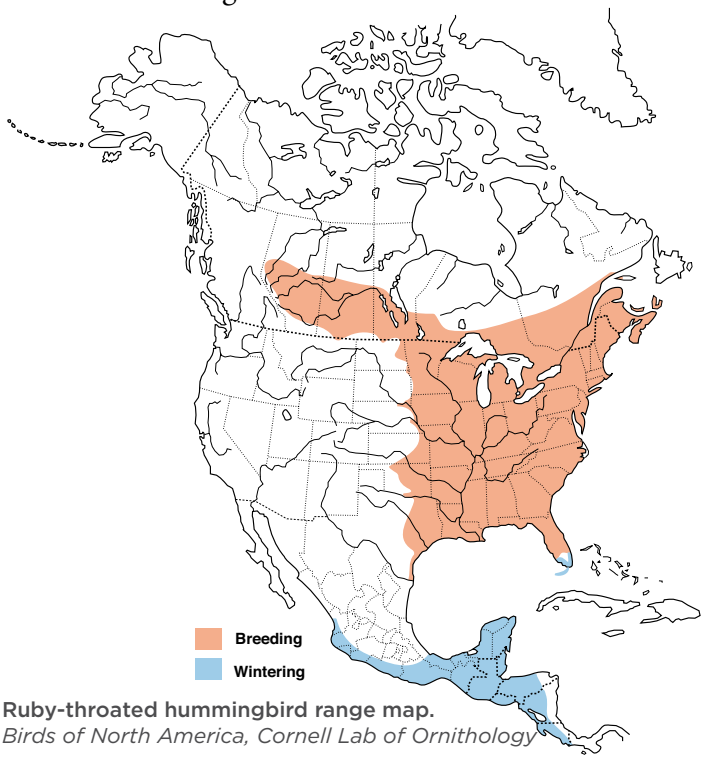
Cornell Lab of Ornithology: http://www.allaboutbirds.org/guide/Red-cockaded_Woodpecker/id

U.S. Fish and Wildlife Service: http://www.fws.gov/rcwrecovery/rcw.html

RUBY-THROATED HUMMINGBIRD

Scientific Name: *Archilochus colubris*
Other Names: none

RANGE: The ruby-throated hummingbird is a common species that nests throughout much of the eastern U.S. and southern Canada. In Georgia, it is found throughout the state, although it is less common in the Blue Ridge Mountains. This species spends winter in southern Mexico and Central America, with smaller numbers wintering in southern Florida.



Ruby-throated hummingbird range map.
Birds of North America, Cornell Lab of Ornithology

GEORGIA STATE LEGAL STATUS: None

FEDERAL LEGAL STATUS: Protected under the Migratory Bird Treaty Act (1918). This law protects most species of migratory birds from killing, harm, harassment and prohibits possession without proper permits.

DESCRIPTION: The ruby-throated hummingbird is about 3-3.5 inches (7.6-8.9 centimeters) in length with a long narrow bill that is 0.6-0.8 inches long. Adult birds normally weigh from 3-4 grams (range 2-6 grams). Both sexes have iridescent green feathers on the top of their head, back, upper wings and the upper portion of the tail. Females have a light gray throat, breast, stomach and abdomen, while males are similarly colored on the underside, except for the flanks, which are iridescent green. Males also have a throat patch called a gorget that may look black to vivid, iridescent red, depending on the direction and intensity of the light illuminating it. Juvenile ruby-throated hummingbirds look similar to females, except they are duller in overall appearance.

Male ruby-throated hummingbird. *Todd Schneider, GA DNR*

HABITAT: Ruby-throated hummingbirds are found in hardwood forests and mixed hardwood-pine forests, particularly near clearings, edges and openings and also gardens and orchards. Nests are placed on smaller horizontal to downturned branches of hardwoods and sometimes pines.

DIET: Hummingbirds feed on nectar from flowers such as trumpet creeper, bergamot, red buckeye, jewelweed, morning glories and honeysuckle, as well as from sugar water feeders. They also eat invertebrates, including mosquitoes, gnats, fruit flies, aphids, small bees, caterpillars, spiders and insect eggs.

LIFE HISTORY: Male ruby-throated hummingbirds start arriving in Georgia from wintering areas in late March, with females arriving about three weeks later.

Once a male has established a territory, he will court one or more females and defend the territory against other males. The female alone will build the nest, incubate the eggs and raise the young. Nests are made of plant down that is held together with spider webs and decorated on the outside with lichens that provide excellent camouflage. Usually two eggs are laid (range one to three) and incubated for 12-14 days before they hatch. Fledging (leaving the nest) occurs 18-22 days later. Young are able to feed by themselves within four to seven days of fledging. This species usually will have two broods per year.

FUN FACTS:

*The wings of the ruby-throated hummingbird can flap at over 50 beats per second.

*Many individuals fly over the Gulf of Mexico during migration, a distance in excess of 500 miles.

*The ruby-throated hummingbird's heart rate can reach 1,200 beats per minute when it is flying.

THREATS: Deforestation and some changes in forest structure affect ruby-throated hummingbirds. Extreme weather, especially during migration, may kill hummingbirds. Predators include larger birds, praying mantids, orb weaver spiders and domesticated cats.

SURVEY METHODS: This species is difficult to monitor. The federal Breeding Bird Survey (BBS) tracks ruby-throated hummingbird breeding populations, although the data is limited in its effectiveness. Banding stations can provide additional information on pathways and timing of migration, as well as other information.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Feeders have been blamed for hummingbird deaths caused by window strikes, as well as house cats that can more easily prey on hummingbirds at feeders. Fortunately, this mortality is minimal and easily preventable with proper feeder placement. The Breeding Bird Survey. has shown an increasing population trend for this species across much of its breeding range during the last four decades, and it appears populations in most areas are secure. Unfortunately, the long-term effects of habitat loss and degradation in breeding and wintering areas are still unknown.

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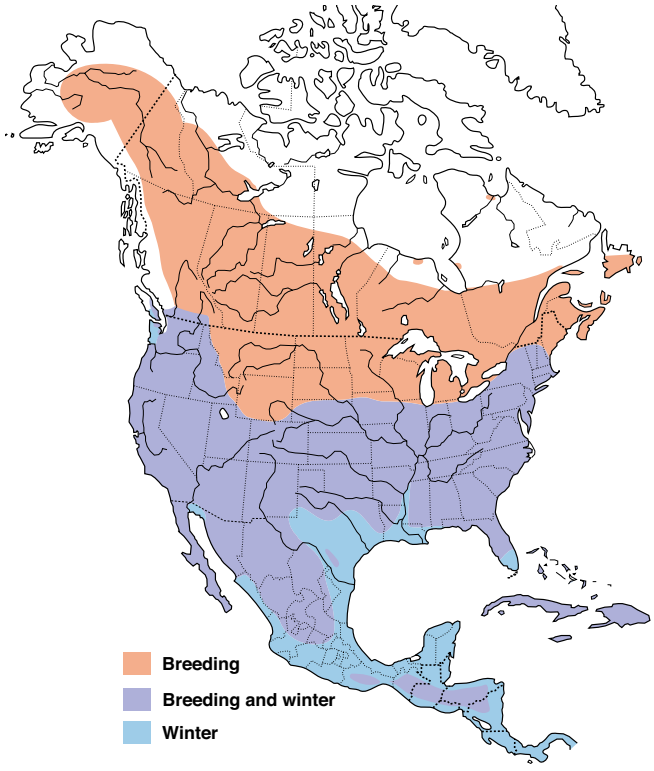
SOUTHEASTERN AMERICAN KESTREL

Scientific Name: *Falco sparverius paulus*
Other Names: sparrow hawk

RANGE: The American kestrel breeds or is resident throughout much of the U.S., portions of Alaska, much of southern Canada and parts of Mexico. Resident populations also occur in portions of Central America, the Caribbean and northern South America. In Georgia, the northern subspecies (*Falco sparverius sparverius*) breeds in small numbers above the Fall Line and the Southeastern American kestrel (*Falco sparverius paulus*) breeds in the Coastal Plain. The largest population of the Southeastern American kestrel is found along a power line corridor from Pierce County west to Dougherty County, with a second significant population nesting along a similar power line corridor in Houston, Peach, Crawford, Taylor, and Talbot Counties.



American kestrel range map. *Birds of North America, Cornell Lab of Ornithology*

American kestrel. *Giff Beaton*

GEORGIA STATE LEGAL STATUS: Rare

FEDERAL LEGAL STATUS: Protected under the Migratory Bird Treaty Act (1918). This law protects most species of migratory birds from killing, harm, harassment and prohibits possession without proper permits.

DESCRIPTION: The American kestrel is about 9 inches (22.8 centimeters) long. Both sexes have a reddish-brown back with dark horizontal bars, a reddish-brown tail, a blue-gray cap with reddish-brown center, a white face with a dark vertical stripe under the eye and a dark vertical stripe on the side of the head behind the eye. The female has reddish-brown upper wings with darker reddish-brown barring while the male has blue-gray upper wings. Her breast is white with wide reddish-brown vertical streaking or spotting. The male's breast is buff colored with some larger dark spots, particularly on the flanks. The vent area on both sexes is white. Kestrels wag their tails when perched and will regularly hover to search for prey on the ground.

HABITAT: The kestrel is found in large open habitats, including grasslands, pastures, sandhills and open pine forests, as well as in urban and suburban areas. It nests

and roosts in old woodpecker holes, other cavities in trees and in nest boxes, buildings and other human-made structures. The Southeastern kestrel historically inhabited open longleaf pine and similar forests, as well as other open habitats throughout much of the Coastal Plain.

DIET: The kestrel's diet consists of invertebrates, including grasshoppers, cicadas, beetles, dragonflies, butterflies, moths, other insects, spiders and scorpions. Vertebrate prey includes small mammals, especially mice and voles, small birds, snakes, lizards and frogs.

LIFE HISTORY: The breeding season in Georgia begins in late March or April when the male escorts the female to potential nest sites within his territory. She chooses a nest cavity and lays four or five eggs. Both sexes incubate the eggs, although the female does most of the work. Eggs hatch in 26-32 days, and only the female broods (cares for) the young in the nest. Fledging (young flying from the nest) usually occurs 28-31 days after hatching, and young become independent of their parents within about two weeks. Thousands of kestrels that breed farther north move into Georgia in winter. These migrants can be seen perched on power poles and wires along roadsides next to open habitats, such as farm fields and pastures. Most wintering kestrels leave the state by early May.

FUN FACTS:

*Kestrels often hover in place 20-50 feet above the ground to spot prey such as mice and rats.

*This species used to be called the sparrow hawk, not because it occasionally eats sparrows, but because of its small size.

*The American kestrel is the smallest falcon species in North America.

THREATS: The biggest threats to kestrel populations in the state are loss and alteration of open habitats, loss of cavity trees and heavy pesticide use in feeding areas. Direct loss of habitat to urban and suburban development is a concern; however, changes in forestry and farming practices (such as dense replanting of pine trees and "clean" farming practices) likely affect a much greater amount of habitat. The canopy of densely planted stands closes quickly and eliminates the herbaceous (nonwoody plant) ground cover used by the kestrel's prey. Cleaner farming practices leave little or no vegetation along field borders, reducing foraging habitat. Shorter timber harvest rotations reduce the number of cavity trees available for nesting. Increased pesticide use can cause direct poisoning of birds as well as decreased prey numbers, particularly insects, leading to reduced survival rates for kestrels as well as less reproductive success.

SURVEY METHODS: Biologists conduct roadside and power line corridor surveys to document nesting activity from mid-May through July. Helicopters can be used along power line corridors that are not easily accessible from the ground. Nest boxes may be monitored on utility rights-of-way, state wildlife management areas, military bases, federal refuges and private conservation lands.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Kestrel populations have declined substantially over the last several decades throughout much of the species' range. Populations of the Southeastern subspecies appear to have declined even more strongly, and there is concern that this subspecies could be lost from Georgia and other portions of its range. Natural grassland habitats that provide nest sites are the major limiting factor for the kestrel throughout its range. The installation of well-designed nest boxes has increased populations in some areas, including Fort Gordon and several other areas in the Coastal Plain. Fortunately, the kestrel uses a variety of human-made habitats (i.e., roadsides and agricultural sites) and has found some human-made structures suitable as nest sites. Providing nest sites in the existing habitats and further conservation of grassland habitats throughout the state will help to ensure the survival of this species in Georgia.

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SOUTHERN HOGNOSE SNAKE

Scientific Name: *Heterodon simus*

Other Names: puff adder, spreading adder

RANGE: Southern hognose snakes are mostly found in the Coastal Plain from southeastern North Carolina south and westward to the Pearl River in southern Mississippi, including much of peninsular Florida. A portion of Alabama's Ridge and Valley region likely is home to southern hognose snakes too. This species is widely distributed in the Coastal Plain of Georgia but tends to occur in small, separate populations that are sometimes miles apart from each other. Only one southern hognose snake is on record in Georgia's Piedmont, and it was found near Lake Jackson.

Southern hognose snake range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: Threatened

FEDERAL LEGAL STATUS: The southern hognose snake is not on the Endangered Species List. However, the Center for Biological Diversity requested that the U.S. Fish and Wildlife Service list this species as "threatened."

DESCRIPTION: This non-venomous snake is short and thick with an upturned snout. The longest this species gets is 24 inches (61 centimeters). Females get larger and have shorter tails than males. The scales are keeled (lifted up on one side). Background color is light brown, tan, yellowish or gray, but never black like its relative the eastern hognose snake can be. Dark brown, squarish blotches go down the center of the snake's back, alternating with similar but smaller blotches on the sides. The color between the blotches on the back usually is light reddish-brown, forming a broken stripe down its back. On each side of the neck is a large, long brown blotch. Lighter brown bands partially wrap around the top side of the tail. A diagonal, dark brown stripe stretches from the top of the head, past each eye and to the corner of the jaw. The snake's underside is often whitish with gray or brown speckles. The color and pattern are similar among young and older southern hognose snakes. Upon hatching, this snake is 5-7 inches (13-18 centimeters) long.

Southern hognsose snake. *John B. Jensen*

HABITAT: Southern hognose snakes live in places with dry sandy soil. The vegetation in their habitats includes fire-adapted trees like longleaf pine and turkey oak, as well as wiregrass. They also may be found in old fields.

DIET: As adults, this species eats toads almost exclusively, including eastern spadefoots, southern toads, Fowler's toads and oak toads. Young southern hognose snakes also eat six-lined racerunner lizards.

LIFE HISTORY: Very little is known about this harmless and secretive snake, mainly because it lives under ground and is hard to find. Southern hognose snakes burrow to create shelter and to unearth toads, their main prey. They may come to the surface during the day but are hard to find during the middle of summer. They mate in the spring and lay nests of six to 14 eggs in late spring or summer. However, biologists haven't found nests in the wild. In captivity, snakes incubate the eggs for 56-70 days, and the eggs hatch between mid-September and mid-October. When bothered, southern hognose snakes will hiss, blow and flare their neck and head like a cobra, but they will not bite. They also may roll over and fake death, but they don't do that as often as their close relative, the eastern hognose snake.

FUN FACTS:

*Southern hognose snakes have especially long teeth in the back of their mouth that are specifically designed to puncture and deflate toads that puff up (when the toad tries to become too big to swallow).

*Although they are called "hognose" snakes, their nose is actually more shovel-shaped and is used for digging in soft sand.

THREATS: Southern hognose snakes are getting harder to find in many parts of their range. None have been found in Alabama in over 30 years, and the last observation in Mississippi was in 1981. Therefore, they may no longer live there. This species is disappearing in other states too, but it can still be found in some parts of Georgia, peninsular Florida and the Carolinas. Biologists aren't sure why their numbers are going down, but one cause may be the destruction of longleaf pine-wiregrass and upland Coastal Plain habitats. Other threats include non-native predators (especially fire ants), getting hit by cars while trying to cross roads and harassment by humans.

SURVEY METHODS: This snake is rarely found when people try to find it. Most southern hognose snakes are found while crossing roads, or they're found lying dead on roads.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Biologists and naturalists who work in this snake's habitats should learn how to identify and properly document this species. When they find a southern hognose snake, they should take a photo and record the exact date and exact location. Research into this species' habitat requirements, life history and vulnerabilities, as well as effective survey techniques, is desperately needed.

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U.S. Fish and Wildlife Service: https://www.fws.gov/southeast/wildlife/reptiles/southern-hognose-snake/

STRIPED NEWT

Scientific Name: *Notophthalmus perstriatus*
Other Names: none

RANGE: Striped newts have a fairly small range that extends from the Georgia side of the Savannah River into northern and peninsular Florida. In Georgia, striped newts live in the lower and middle Coastal Plain, as well as at one site in the Upper Coastal Plain.

Striped newt range map. *Black dots represent counties in Georgia with known occurrences. Amphibians and Reptiles of Georgia, UGA Press (2008)*

GEORGIA STATE LEGAL STATUS: Threatened

FEDERAL LEGAL STATUS: Candidate (it's being considered for the Endangered Species List).

DESCRIPTION: Adult striped newts are typically 2½-4 inches (6-10 centimeters) long and mostly live in the water (aquatic) but may at times live on land (terrestrial). This species is olive or greenish-brown and has a red stripe down each side of its back that extends onto the tail. It usually has a row of red spots on the lower sides of its body too. Small black spots are scattered on its yellow belly. Younger terrestrial newts are called "efts" – they have a pair of red stripes like the adults but rougher skin, a more rounded tail and their overall color is dull orange or reddish-brown. Larvae that have just hatched in the water have bushy external gills, a

Striped newt. *Dirk J. Stevenson*

dark mottled pattern on the tail and sides and a cream or silvery belly with black spots. Before the bold red stripes appear in older larvae, efts and adults, striped newts have a series of pale dashes on the sides of their back.

HABITAT: Striped newts live in and around the wetlands within longleaf pine-wiregrass communities, especially near sandhills and well-drained pine flatwoods. They breed in cypress ponds, sinkhole ponds (lime sinks) and even large holes in the ground from construction or mining. The ponds they use often have lots of grasses, sedges and aquatic flowers growing in them.

DIET: Striped newts eat a variety of invertebrates such as insects and crustaceans, as well as frog eggs.

LIFE HISTORY: Striped newts breed in late winter and early spring when temporary ponds are filled with rainwater. After hatching in the water, larvae develop over two or three months and then their body changes so they can live on land. Terrestrial newts are called efts, and they stay in this stage for one to three years. Once the efts are old enough to breed, they go back to ponds during winter rains. There they will stay as aquatic adults until drought forces them back to land. If the normally dry season is rainy and the pond doesn't dry up, the newts will stay in the water, skip the terrestrial eft stage, and become aquatic adults with bushy gills. After

breeding, these aquatic adults will transform and become terrestrial again.

FUN FACTS:

*Newts are a type of salamander, just like a sparrow is a type of bird and a toad is a type of frog.

*Newts can be poisonous to eat for many animals, but otherwise they are harmless.

THREATS: The striped newt is threatened by the loss of both upland and wetland habitats. Many of the longleaf pine forests where this salamander once lived were converted to agricultural or tree farms. Striped newts can't live in fields that are plowed frequently or planted with other pine trees. In areas where natural fires aren't allowed to burn or where prescribed fire isn't used, the open longleaf pine forests that striped newts prefer turn into dense stands of pines and hardwood trees. Also, the wetlands that newts use are drained sometimes, so they can no longer live or breed there. Currently, only seven striped newt populations are known in Georgia. Only the Ichauway Plantation and Fort Stewart sites are thought to support large, healthy populations. The other five sites are less stable – they may only have one breeding pond, may lack natural or prescribed fire and/or be located on private land, making their future uncertain.

SURVEY METHODS: The best way to find striped newts in their aquatic stages is by using a dip net or minnow trap in one of their breeding ponds, especially where a lot of aquatic grasses and plants are growing. Terrestrial adults may sometimes be found by slowly driving roads that cross between their upland habitat and breeding wetlands.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: More research is needed to better understand everything this unusual salamander needs to survive. Habitats around breeding sites should be protected from heavy logging and other disturbances. Prescribed fire is needed to keep the forest from becoming too dense and should be allowed to burn into wetland habitats. Also, drainage of wetlands should be avoided.

SELECTED REFERENCES:

Georgia Department of Natural Resources Wildlife Resources Division. "Striped Newt Species Fact Sheet." https://georgiawildlife.com/species#amphibians

Savannah River Ecology Laboratory: http://srelherp.uga.edu/salamanders/notper.htm

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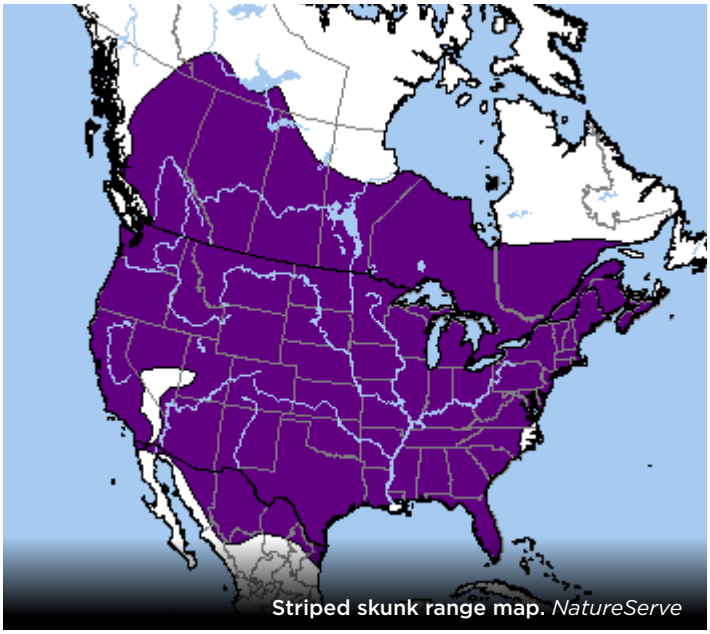
U.S. Fish and Wildlife Service: https://www.fws.gov/northflorida/Striped_Newt/Striped-Newt_Info.htm

STRIPED SKUNK

Scientific Name: *Mephitis mephitis*
Other Names: skunk, polecat

RANGE: The striped skunk is common throughout its range, which covers almost all of the United States (except for a small portion of the desert Southwest), as well as southern Canada and northern Mexico.



Striped skunk range map. *NatureServe*

GEORGIA STATE LEGAL STATUS: None (not protected). However, skunks are considered furbearers (meaning they can be harvested for their fur) and trapping regulations apply.

FEDERAL LEGAL STATUS: None.

DESCRIPTION: The striped skunk is about the size of a house cat, measuring 21-28 inches (53-71 centimeters) in total length and weighing from 3-11 pounds. As one of the most recognizable mammals anywhere, striped skunks are known for their black fur and characteristic white stripes on their head and down their back. Striping patterns may vary considerably, including a broad stripe, narrow stripe, pair of stripes or a short stripe. Coloration may vary as some striped skunks will have very little white while others are almost completely white.

Striped skunks. *Tom Friedel, Wikimedia Commons*

HABITAT: Striped skunks are the most common skunks in both Georgia and throughout North America. They live in a wide variety of habitats, including forests, agricultural and urban/suburban areas, but they prefer brushy areas next to grassy fields and forests (commonly referred to as edge habitat). Although they may occasionally dig their own dens, striped skunks will seek out shelter in crevices, abandoned burrows of other animals, hollow logs or even underneath buildings or homes. During the winter, they may den in groups of up to seven females with a single male.

DIET: Striped skunks are opportunistic feeders, meaning they will eat a variety of foods based on what is available. A large portion of their diet includes insects and other invertebrates, but they also will eat small animals, eggs and plant matter.

LIFE HISTORY: Striped skunks mostly are solitary and nocturnal animals. They are best known for emitting an overpowering musk from their anal glands when threatened. Most mammals avoid preying on skunks due to this musk, but large birds of prey, such as great-horned owls, have a poor sense of smell and are significant predators. Females generally have one litter a year, but males will breed with several females, with peak

breeding occurring between February-March. Gestation usually lasts 64 days. Litters of two to 10 young (with an average of five) are born in May-June and remain with the mother for six months to a year.

FUN FACTS:

*Striped skunk babies are called kits or kittens.

*When threatened, the striped skunk generally faces its potential predator, arches its back, stomps and chatters its teeth before resorting to spraying musk.

*Striped skunks can spray their musk up to 15 feet, and the smell can be detected over a mile away.

THREATS: Severe weather, car strikes along roads, predation and disease (including rabies) can cause striped skunk deaths.

SURVEY METHODS: In addition to visual surveys and following tracks and odor, striped skunks can be lured into live traps with sardines or other smelly bait. Before setting a live trap, cover it with canvas to reduce the chance of getting sprayed when you check it later.

CONSERVATION AND MANAGEMENT RECOMMENDATIONS: Although they are beneficial to humans by controlling insect and rodent populations, striped skunks commonly are considered a nuisance species. They sometimes cause damage in poultry operations and gardens or yards. Skunks are one of the major terrestrial (land) mammal carriers of rabies, and wild skunks should not be handled.

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Burt, W. H. and R. P. Grossenheider. Petersen Field Guides: A Field Guide to the Mammals on North America North of Mexico. 1952. Houghton Mifflin Co. 289 pp.

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Webster, W. D., J. F. Parnell, and W. C. Biggs. 1985. Mammals of the Carolinas, Virginia, and Maryland. University of North Carolina Press. 255 pp.

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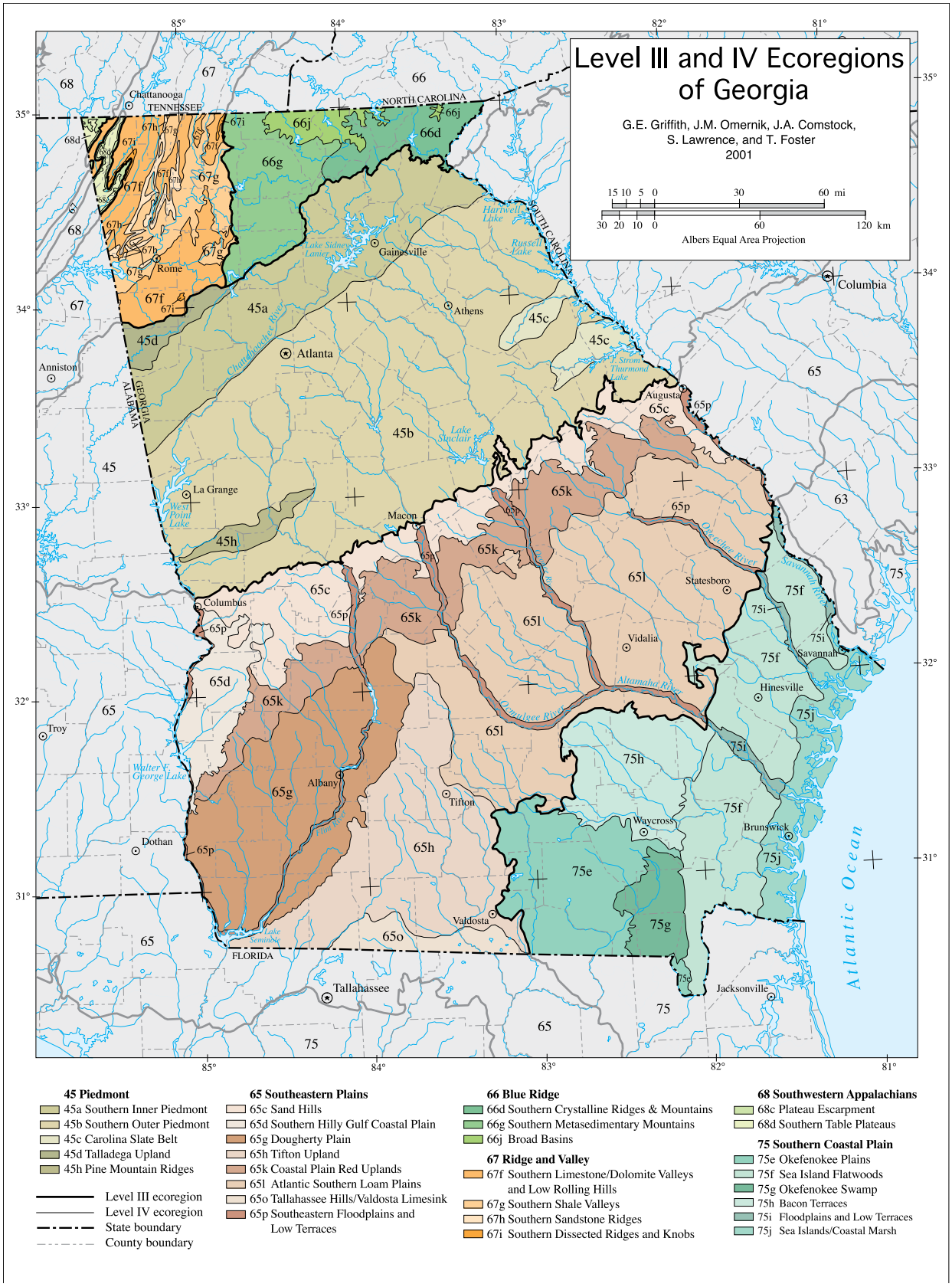
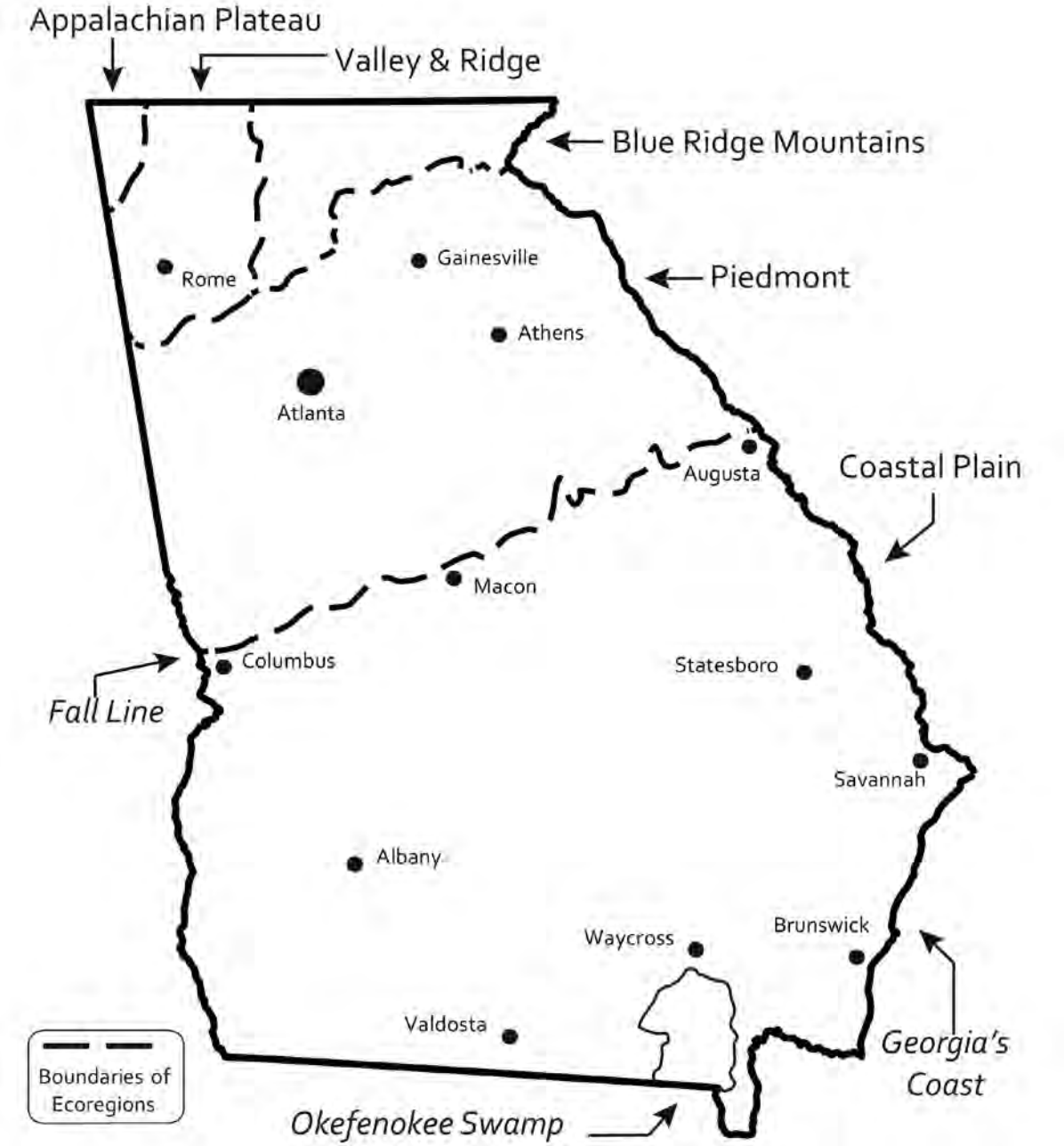
APPENDICES

A. ECOREGIONS OF GEORGIA MAPS

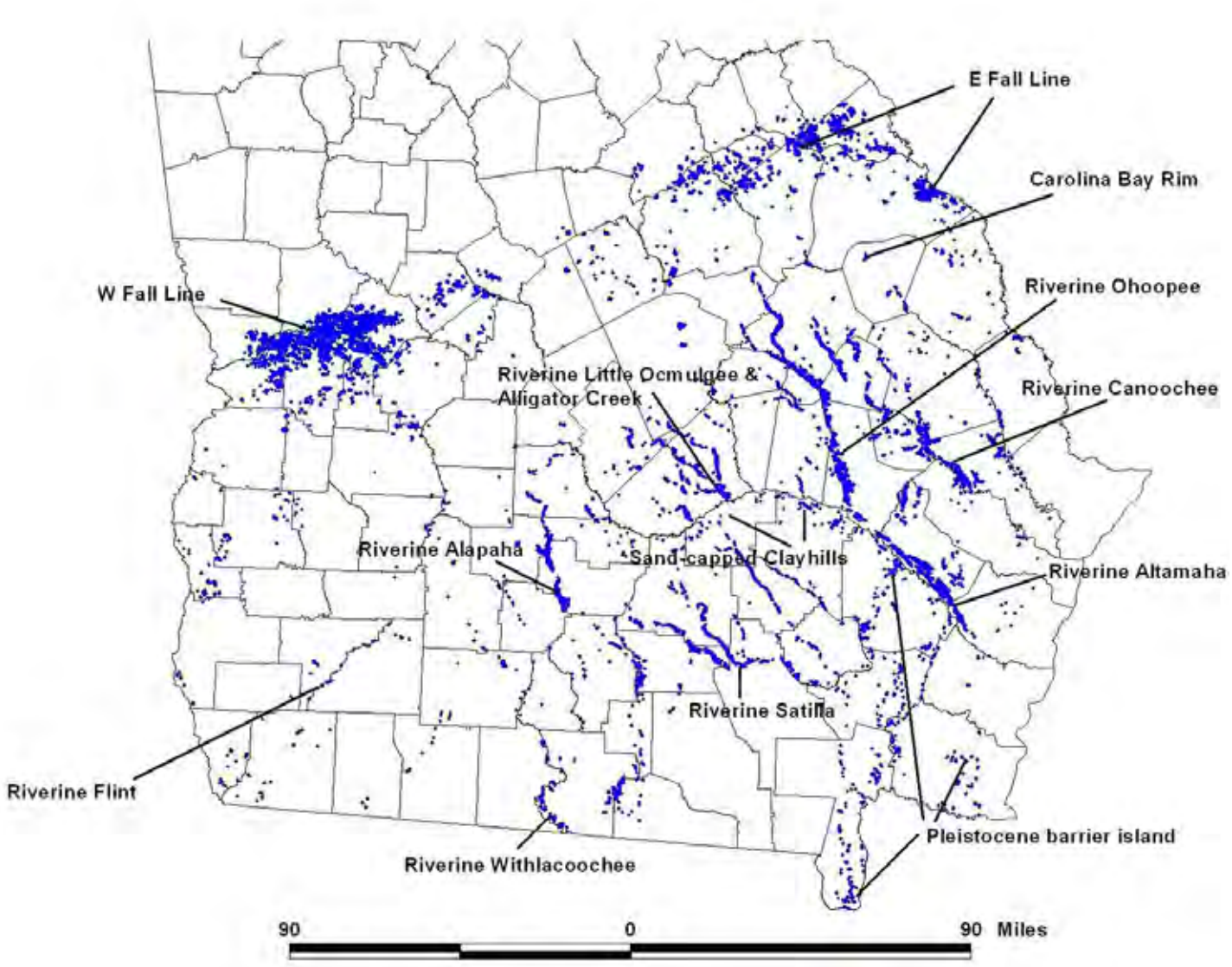


Ecoregions of Georgia Map. *Environmental Protection Agency*



The different habitat zones in our state are called ECOREGIONS. Georgia is made up of five ecoregions, each with its own unique climate, soils, plants and animals. In which ecoregion do you live?

B. DETAILED MAP OF GEORGIA SANDHILLS



Detailed Map of Georgia Sandhills. *Matt Elliott, GA DNR.*

C. RECOMMENDED WEB LINKS

WILDLIFE SPECIES FACTS:

American Crow: https://www.allaboutbirds.org/guide/American_Crow/id

Black Racer: http://www.srelherp.uga.edu/snakes/colcon.htm

Brown-headed Nuthatch: https://www.allaboutbirds.org/guide/Brown-headed_Nuthatch/id

Coachwhip: http://www.srelherp.uga.edu/snakes/masfla.htm

Eastern Cottontail: https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/2005_rabbit.pdf

Fox Squirrel: https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/2005_squirrel.pdf

Gopher Tortoise Tick: https://bugguide.net/node/view/638872

Great Crested Flycatcher: https://www.allaboutbirds.org/guide/Great_Crested_Flycatcher

Green Anole: http://www.srelherp.uga.edu/lizards/anocar.htm

Little Gopher Tortoise Scarab Beetle: https://myfwc.com/wildlifehabitats/wildlife/gopher-tortoise/commensals/invertebrates/

Loggerhead Shrike: https://www.allaboutbirds.org/guide/Loggerhead_Shrike/id

Mourning Dove: https://georgiawildlife.com/sites/default/files/wrd/pdf/fact-sheets/mourning_dove_2004.pdf

Six-lined Racerunner: http://www.srelherp.uga.edu/lizards/cnesex.htm

Spotted Skunk: https://animaldiversity.org/accounts/Spilogale_putorius/

Wild Turkey: https://georgiawildlife.com/turkey-info

White-tailed Deer: https://georgiawildlife.com/deer-info

PLANTS:

Coastal Plain Pitcherplant Bogs Fact Sheet (included in Section 3 Plants of the Sandhills)

PLANT SPECIES FACTS:

Big-fruited Buckthorn: https://georgiawildlife.com/species#plants

Bracken Fern: https://extension.uga.edu/publications/detail.html?number=B987-2#title9

Butterfly Weed: https://gnps.org/plants/butterfly-weed-asclepias-tuberosa/

Gopher Apple: https://www.regionalconservation.org/beta/nfyn/plantdetail.asp?tx=Licamich

Hooded Pitcherplant (change to one word): https://georgiawildlife.com/species#plants

Pickering's Morning Glory: https://georgiawildlife.com/species#plants

Pink Sundew: https://www.wildflower.org/plants/result.php?id_plant=DRCA2

Prickly Pear Cactus: https://www.wildflower.org/plants/result.php?id_plant=ophu

Purple Pitcherplant (change to one word): https://georgiawildlife.com/species#plants

Sandhill Golden-aster: https://georgiawildlife.com/species#plants

Sandhill Milkvetch: https://georgiawildlife.com/species#plants

Sandhill Milkweed: https://www.wildflower.org/plants/result.php?id_plant=ASHU3

Sandhill Rosemary: https://georgiawildlife.com/species#plants

Scarlet Wild Basil: https://www.wildflower.org/plants/result.php?id_plant=CLCO10

Turkey Oak: https://www.wildflower.org/plants/result.php?id_plant=QULA2

Wiregrass: http://www.sfrc.ufl.edu/extension/4h/plants/Wiregrass/index.html

NOTE: At the time of printing, all website addresses referenced in this guide were up-to-date. However, due to the dynamic nature of the internet, some websites may no longer function. In that case, please conduct an internet search for the species.

D. COLORING PAGES

BACHMAN'S SPARROW
CONTROLLED BURN
EASTERN DIAMONDBACK RATTLESNAKE AND POCKET GOPHER
EASTERN INDIGO SNAKE
GOPHER FROG AND GOPHER CRICKET
GOPHER TORTOISE
GOPHER TORTOISE AND EASTERN INDIGO SNAKE
LONGLEAF PINE HABITAT
RED-COCKADED WOODPECKER
SOUTHERN HOGNOSE SNAKE

COPY ME

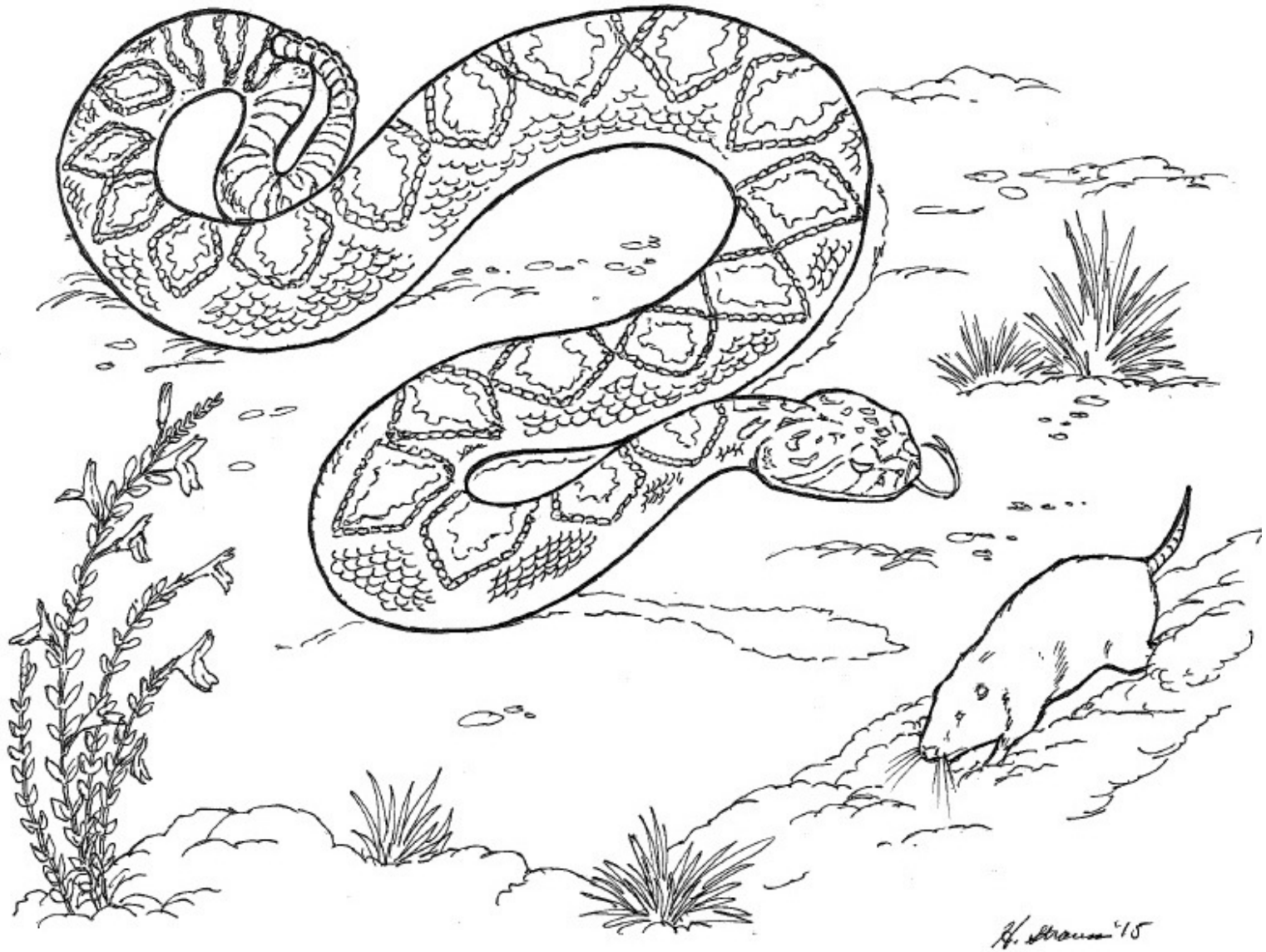
BACHMAN'S SPARROW

A rare species in Georgia, the Bachman's sparrow is found in mature pine forests of the Coastal Plain. Secretive and shy, this songbird is difficult to see due to its habit of running on the ground through dense, grassy ground cover. It prefers wiregrass and broomsedge habitats where it searches for seeds and insects to eat. Females construct their nests at the base of grass clumps, small shrubs or pine seedlings. Loss of suitable habitat has led to a decline in its numbers. Look up this bird in a field guide of birds to appreciate its camouflaged feathers.

CONTROLLED BURN

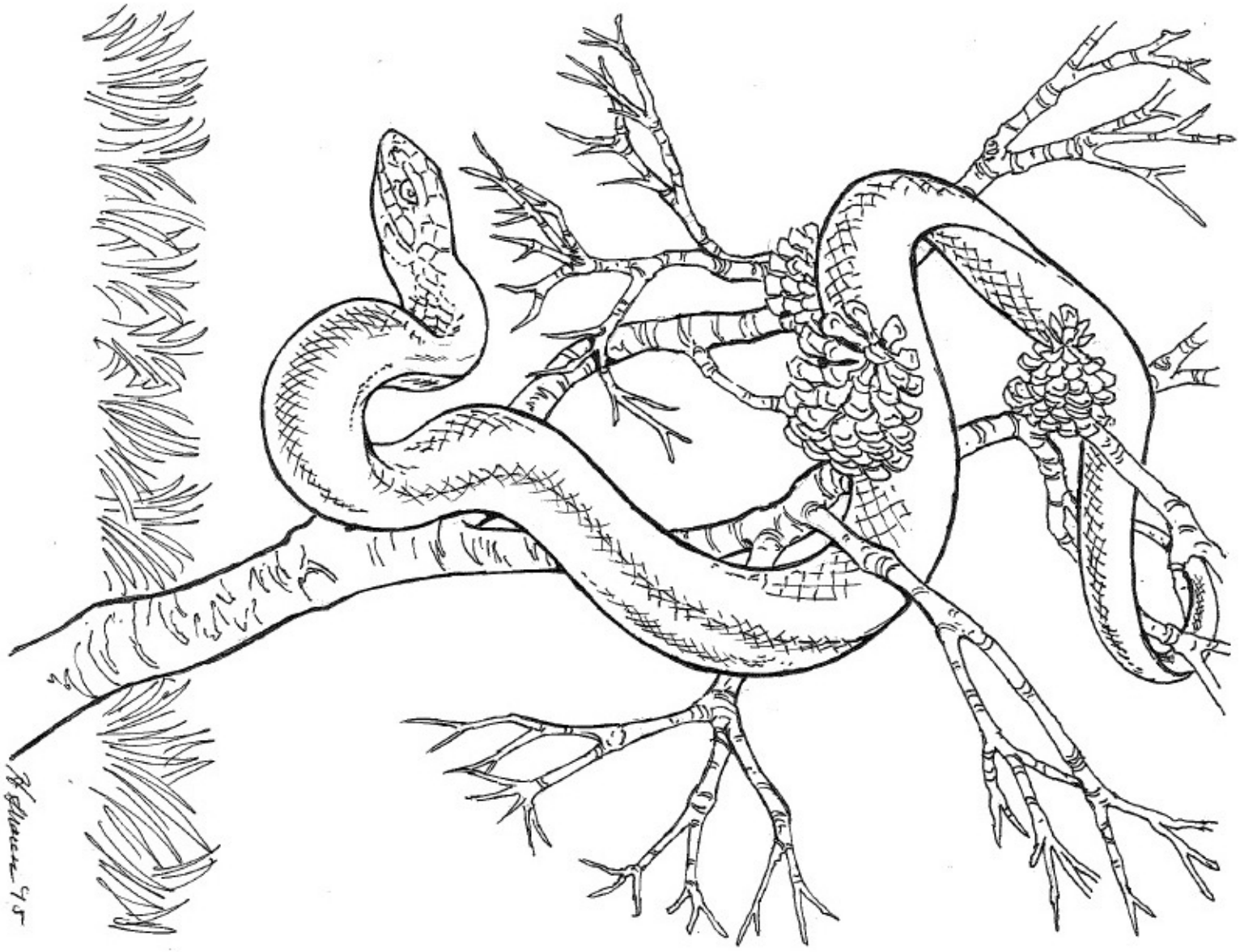
A trained fire professional uses a drip torch to start a prescribed fire. These fires create suitable habitats for plants and animals to grow and live, reduce excess fuel that can lead to wildfires and return nutrients to the soil. Sandhills depend on fire to maintain a healthy ecosystem.

COPY ME



EASTERN DIAMONDBACK RATTLESNAKE AND POCKET GOPHER

Eastern diamondback rattlesnakes are found in the Lower Coastal Plain and inhabit dry sandy areas such as the pinewoods and wiregrass flatwoods of the sandhills. These venomous, heavy-bodied snakes are the largest of all rattlesnakes and have broad heads with two light stripes on either side. Large, brown diamond-shaped markings on their backs are outlined with white on a brown, tan or yellowish body. Every time the snake sheds its skin, a new rattle segment is added to its tail. Diamondbacks take refuge in gopher tortoise burrows and eat mammals such as rats, mice and pocket gophers.



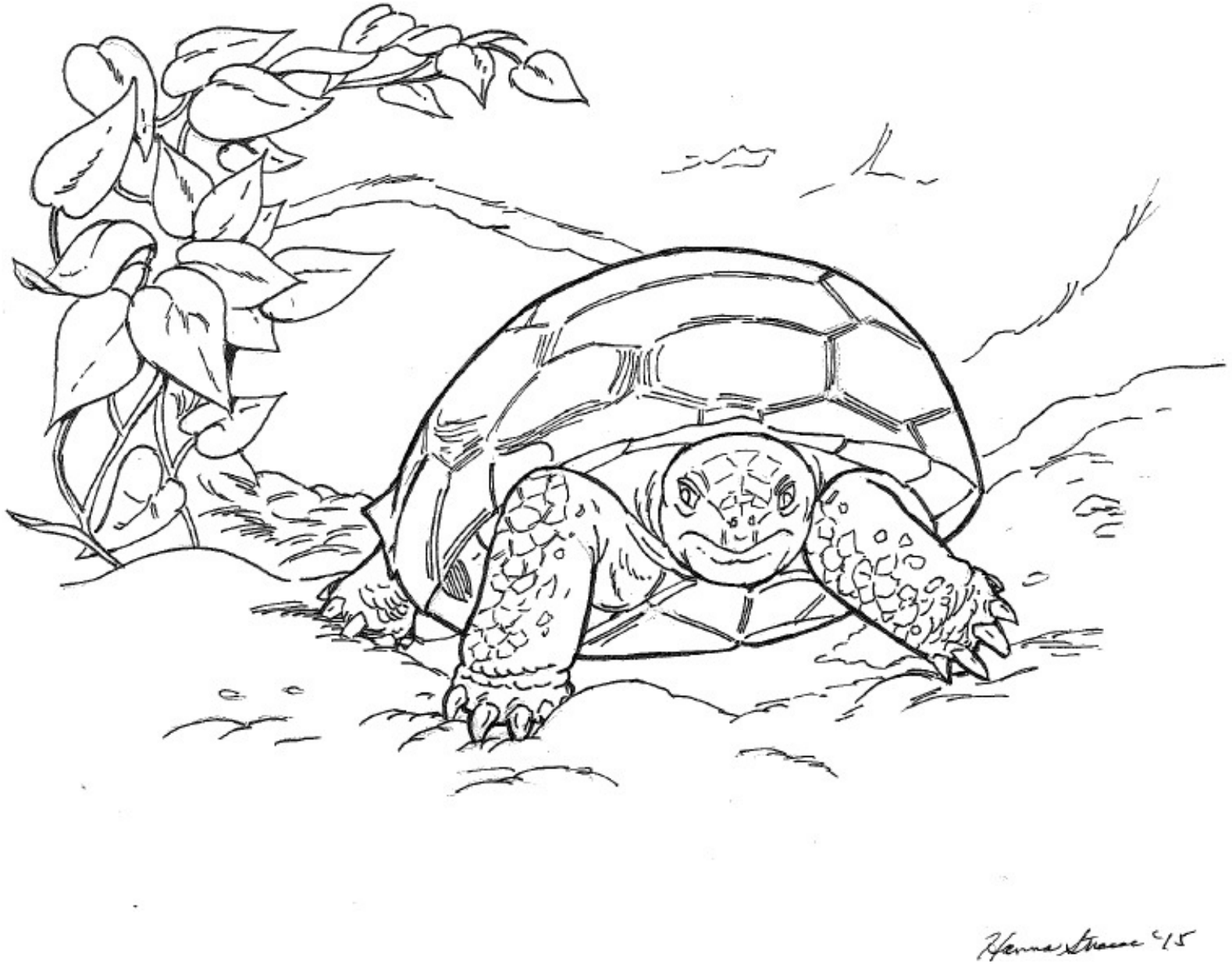
EASTERN INDIGO SNAKE

The federally threatened, nonvenomous eastern indigo snake is the longest native snake in North America, reaching lengths of 8½ feet. Its color is iridescent blue-black except for the chin, throat and cheeks, which are usually reddish or occasionally cream-colored with no pattern on its body. Indigo snakes in Georgia mostly live in longleaf pine habitats, such as sandhills and turkey oak scrub. The eastern indigo snake is immune to the venom of native pit vipers (rattlesnakes, copperheads and cottonmouths).

COPY ME

GOPHER FROG AND GOPHER CRICKET

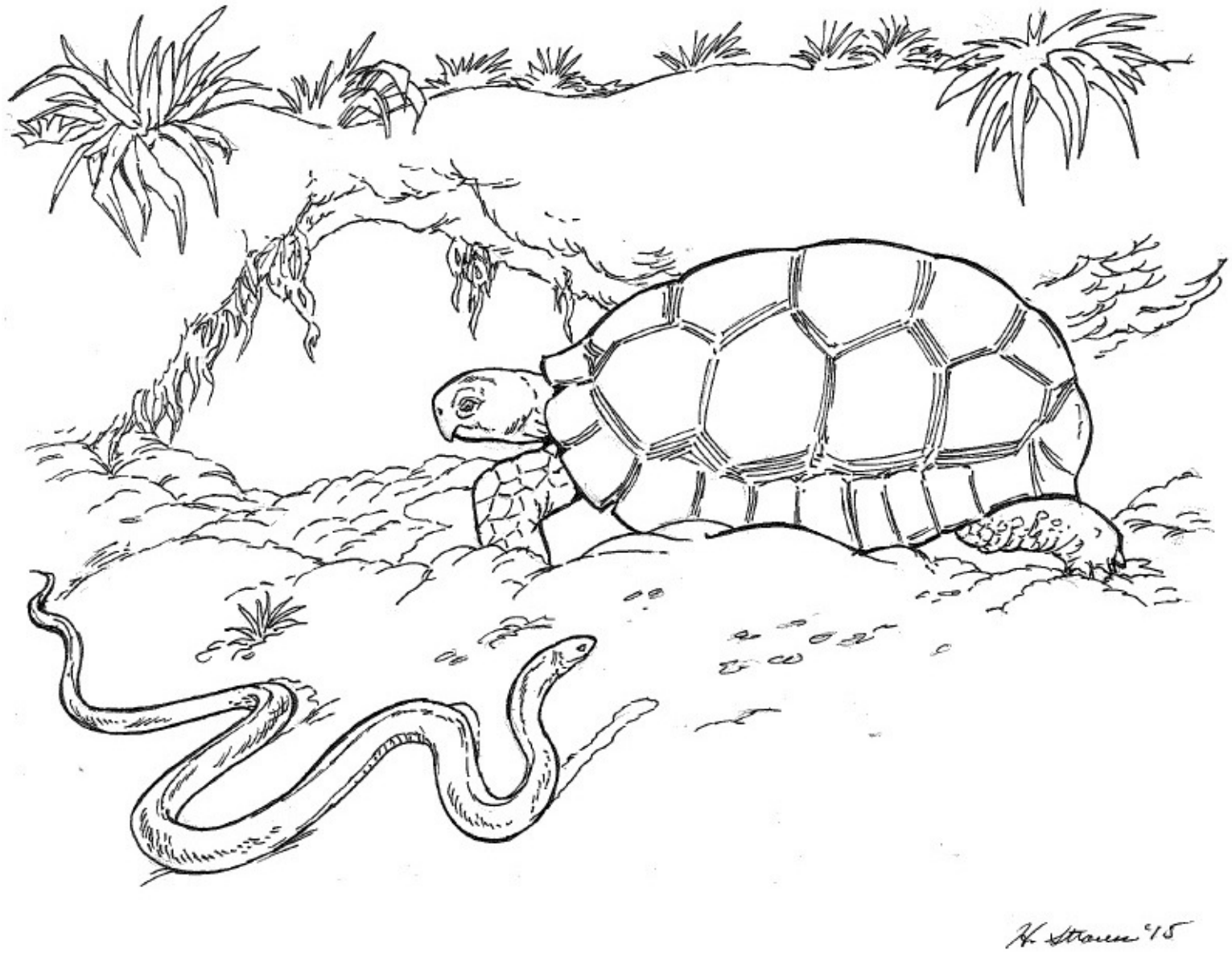
The gopher frog is a stout-bodied frog with a large head and mouth and stubby legs. Its color ranges from light tan to gray with black or brown blotches on the back, sides and legs. Its call is a deep snoring sound! This amphibian is often found in gopher tortoise burrows, which provide shelter, safety and sometimes food, such as this brown, wingless gopher cricket.



GOPHER TORTOISE

Georgia's state reptile, the gopher tortoise, is a keystone species that lives in the sandhills. Weighing 12-14 pounds, adult tortoises can reach a length of 15 inches and are brown or gray in color. This land turtle creates its own underground home by digging a tunnel-like burrow with its shovel-like front feet. Over 360 species of vertebrates and invertebrates also use gopher tortoise burrows for shelter.

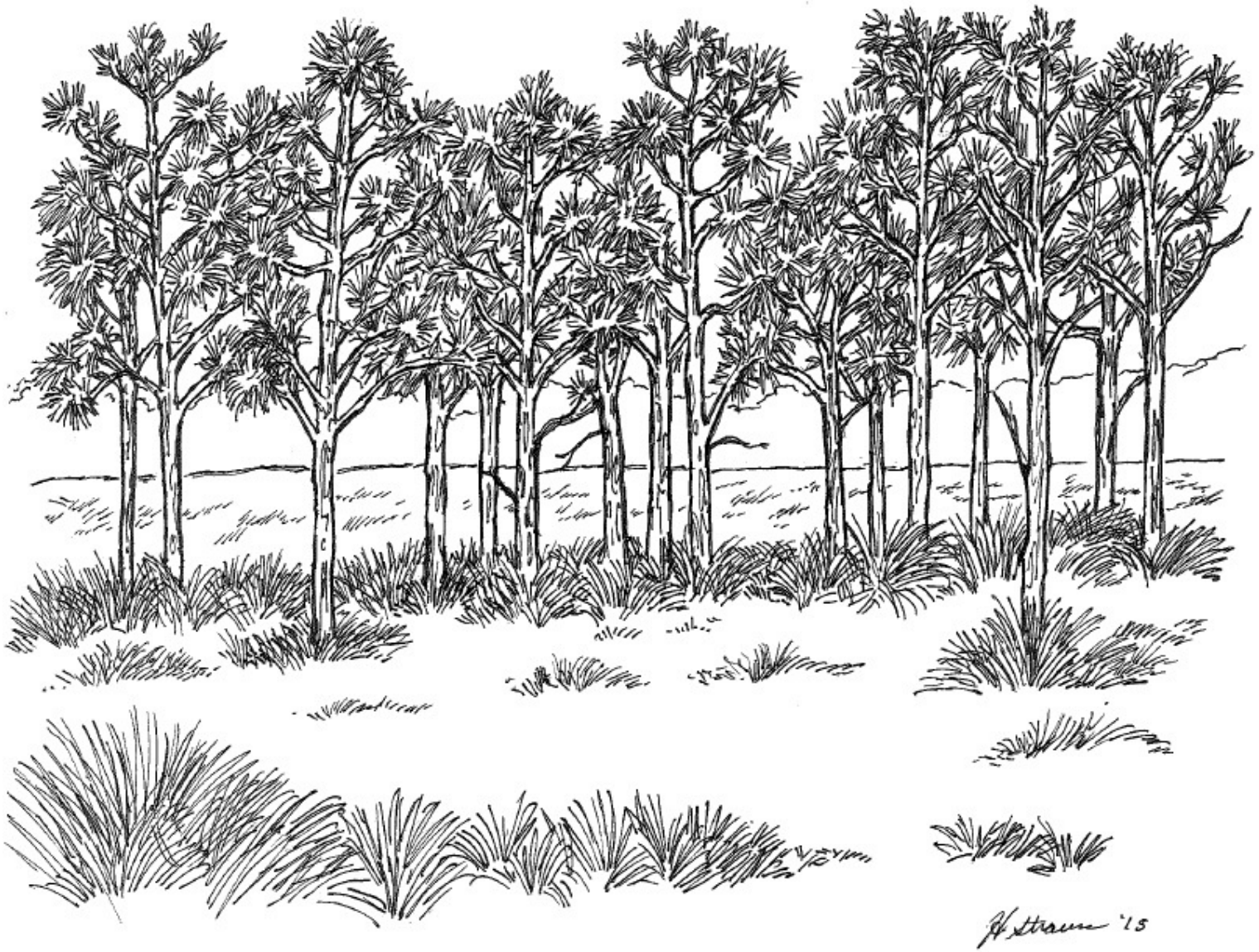
COPY ME



GOPHER TORTOISE AND EASTERN INDIGO SNAKE

The gopher tortoise is considered a keystone species of the longleaf pine habitats, such as sandhills and turkey oak scrub, meaning its existence is critical to the existence of many other species. In Georgia, many animals, including the threatened eastern indigo snake, rely on gopher tortoise burrows. Indigo snakes use gopher tortoise burrows for shelter more than any other animals that use burrows. Therefore, a decrease in gopher tortoise populations means fewer indigo snakes too.

COPY ME



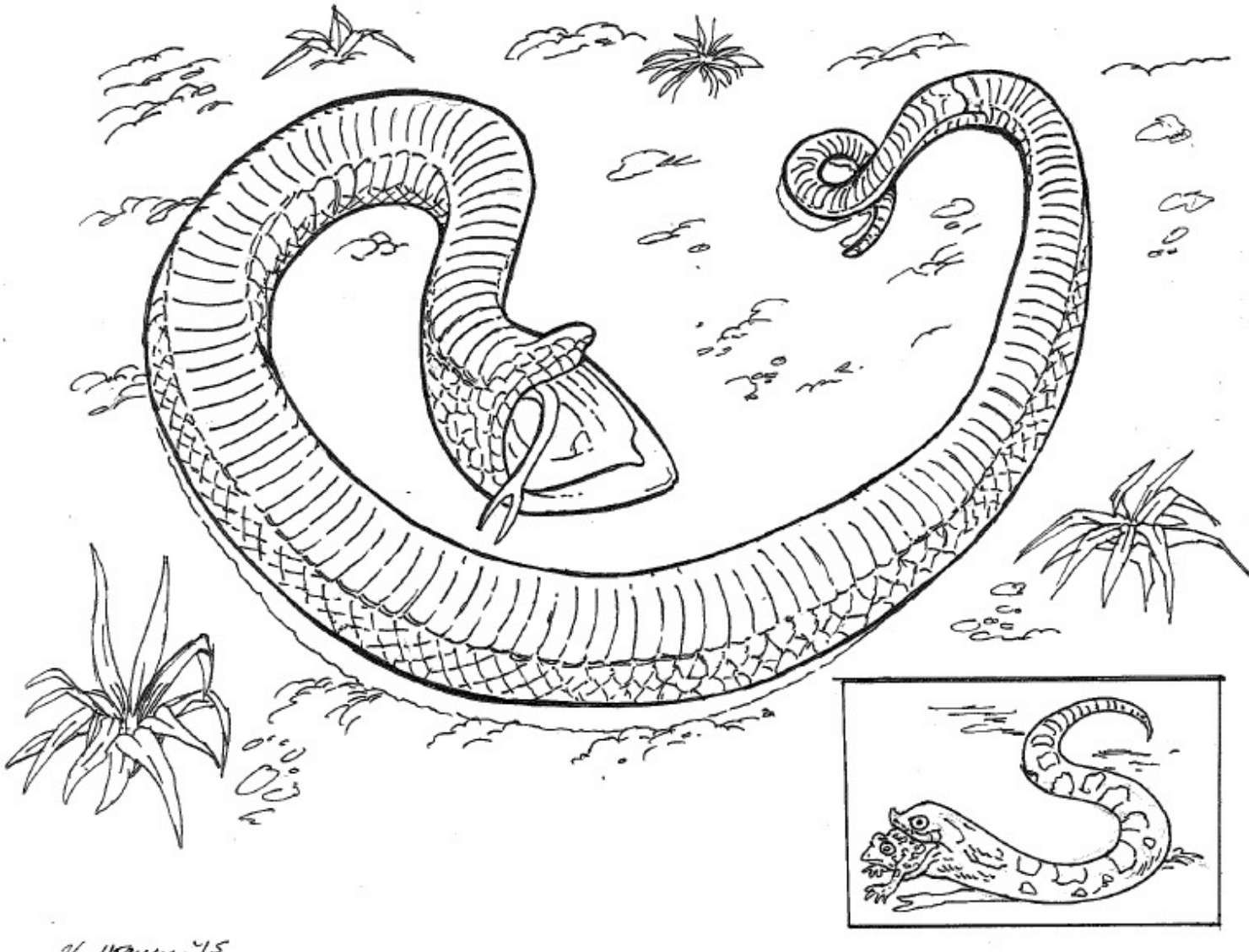
LONGLEAF PINE HABITAT

Longleaf pines are found across a variety of habitats, including sandhills. This tall, long-lived pine tree is well-adapted to fire and depends on regular burns to keep competing hardwood trees at bay. Many species of wildlife depend on open longleaf pine forests for their homes. Add drawings of your favorite native species that live in longleaf pine habitats!

COPY ME

RED-COCKADED WOODPECKER

The preferred habitats of the endangered red-cockaded woodpecker are fire-maintained longleaf pine forests of the Coastal Plain. The feathers on its back are black and white horizontally striped, and the face has a white cheek patch. The males have a tiny line of red feathers on the side of the face called a cockade. Long beaks help the birds loosen bark on pines while hunting for insects to eat and also help them excavate a cavity to live in and raise their young.



SOUTHERN HOGNOSE SNAKE

The nonvenomous southern hognose snake is found mostly in the Coastal Plain. Short and thick with an upturned snout, its background color is light brown, tan, yellowish or gray. Dark brown, squarish blotches go down the center of the snake's back. When threatened, it may roll over and fake death. This toad-eating snake has especially long teeth in the back of its mouth that are designed to puncture and deflate toads when they puff up. A species of concern, biologists aren't sure why their numbers are going down, but one cause may be the destruction of longleaf pine-wiregrass and upland Coastal Plain habitats.

E. STATE AGENCIES & ORGANIZATIONS

ENVIRONMENTAL EDUCATION ALLIANCE OF GEORGIA
P. O. Box 768081
Roswell, GA 30076
www.eealliance.org

GEORGIA DEPARTMENT OF NATURAL RESOURCES (GA DNR)
2 Martin Luther King Jr. Drive SE
Suite 1252 – East Tower
Atlanta, GA 30334
(404) 656-3500
www.gadnr.org

GA DNR ENVIRONMENTAL PROTECTION DIVISION
Outreach Unit – Adopt-A-Stream, Project WET, Rivers Alive, etc.
2 Martin Luther King Jr. Drive
Atlanta, GA 30334
(404) 651-8515
http://epd.georgia.gov/outreach

GA DNR HISTORIC PRESERVATION DIVISION
Jewett Center for Historic Preservation
2610 GA Highway 155 SW
Stockbridge, GA 30281
(770) 389-7844
http://georgiashpo.org

GA DNR STATE PARKS
2600 Highway 155 SW
Stockbridge, GA 30281
(770) 389-7286
www.gastateparks.org

GA DNR WILDLIFE RESOURCES DIVISION
2067 US Highway 278 SE
Social Circle, GA 30025
(706) 557-3333
www.georgiawildlife.com

GA DNR-WRD EDUCATION CENTERS:
https://georgiawildlife.com/alleducationcenters

ARROWHEAD ENVIRONMENTAL EDUCATION CENTER
2592 Floyd Springs Road
Armuchee, GA 30105
(706) 295-6073

CHARLIE ELLIOTT WILDLIFE CENTER & Project WILD
543 Elliott Trail
Mansfield, GA 30055
(770) 784-3059
https://georgiawildlife.com/projectwild

GO FISH EDUCATION CENTER
1255 Perry Parkway
Perry, GA 31069
(478) 988-6715

GRAND BAY WETLAND EDUCATION CENTER
4661 Knights Academy Road
Valdosta, GA 31605
(229) 333-0052

MCDUFFIE ENVIRONMENTAL EDUCATION CENTER
4695 Fish Hatchery Road
Dearing, GA 30808
(706) 339-5457

SAPELO ISLAND NATIONAL ESTUARINE RESEARCH RESERVE
1766 Landing Road
Darien, GA 31305
(912) 485-2300

SMITHGALL WOODS REGIONAL EDUCATION CENTER
61 Tsalaki Trail
Helen, GA 30545
(706) 878-3087

GA FORESTRY ASSOCIATION
Project Learning Tree
551 North Frontage Road
Forsyth, GA 31029
(478) 992-8110
http://gfagrow.org/programs/georgia-project-learning-tree

GA FORESTRY COMMISSION
5645 Riggins Mill Road
Dry Branch, GA 31020
(478) 751-3500
www.gfc.state.ga.us

GA JUNIOR RANGER PROGRAM
https://gastateparks.org/
EducationalResources#JuniorRanger

GEORGIA MUSEUM OF NATURAL HISTORY
Natural History Building
University of Georgia
Athens, GA 30602-1882
(706) 542-1663
http://naturalhistory.uga.edu

GEORGIA WILDLIFE FEDERATION
11600 Hazelbrand Road
Covington, GA 30014
(770) 787-7887
www.gwf.org

NATURE CONSERVANCY OF GEORGIA
100 Peachtree St. NE #2250
Atlanta, GA 30303
(404) 873-6946
www.nature.org/Georgia

SAVANNAH RIVER ECOLOGY LABORATORY
P.O. Drawer E
Aiken, SC 29802
(803) 725-2472
www.srel.uga.edu

USDA NATURAL RESOURCES CONSERVATION SERVICE (NRCS)
355 E. Hancock Ave.
Mail Stop 200
Athens, GA 30601
(706) 546-2272
www.nrcs.usda.gov

F. REFERENCES & RESOURCES

FIELD GUIDES, FACT SHEETS & LITERATURE

A FIELD GUIDE TO WILDFLOWERS OF THE SANDHILLS REGION: NORTH CAROLINA, SOUTH CAROLINA, GEORGIA

Bruce A. Sorrie
Copyright 2011
ISBN 978-0-8078-7186-7

AT HOME WITH THE GOPHER TORTOISE: THE STORY OF A KEYSTONE SPECIES

Madeleine Dunphy
Copyright 2010
ISBN 978-0-9777539-6-3

CORNELL LAB OF ORNITHOLOGY

Bird Facts
www.birds.cornell.edu/
www.allaboutbirds.org

ECOLOGY OF A CRACKER CHILDHOOD

Janisse Ray
Copyright 1999
ISBN: 978-1571312471

EXPLORING GEORGIA'S WILDLIFE COLORING BOOK

Animal, Plant, & Ecoregion Facts
www.georgiawildlife.com/ColoringBook

EEinGEORGIA

Animal & Plant Facts and Stats
www.eeingeorgia.org

GEORGIA MUSEUM OF NATURAL HISTORY

Natural History Building
University of Georgia
Athens, GA 30602-1882
(706) 542-1663
Wildlife Web Fact Sheets
https://gmnh.franklin.uga.edu

GEORGIA NATIVE PLANT SOCIETY

P.O. Box 422085
Atlanta, GA 30342-2085
770-343-6000
www.gnps.org

GOPHER TORTOISE COUNCIL

Gopher Tortoise Facts
www.gophertortoisecouncil.org

LONGLEAF ALLIANCE

Longleaf Pine Facts
www.longleafalliance.org

NATIONAL GEOGRAPHIC FIELD GUIDE TO THE BIRDS OF NORTH AMERICA

Jon Dunn and Jonathan Alderfer
Copyright 2011
ISBN 978-1426208287

NEW GEORGIA ENCYCLOPEDIA: SANDHILLS

https://www.georgiaencyclopedia.org/articles/geography-environment/sandhills

ORIANNE SOCIETY

Herp Facts
www.oriannesociety.org

PINE ECOSYSTEM CONSERVATION HANDBOOK FOR THE GOPHER TORTOISE IN GEORGIA: A GUIDE FOR FAMILY FOREST OWNERS

Publication of the American Forest Foundation
www.forestfoundation.org

PROJECT WILD TEACHER RESOURCE GUIDE

Introduction to Georgia's Natural History
https://georgiawildlife.com/sites/default/files/wrd/pdf/project-wild/ProjectWildTeacherResourcePacket30062011.pdf

SAVANNAH RIVER ECOLOGY LABORATORY

P.O. Drawer E
Aiken, SC 29802
(803) 725-2472
Herpetology Fact Sheets
www.srelherp.uga.edu

THE FIRE FOREST: LONGLEAF PINE-WIREGRASS ECOSYSTEM

Ga Wildlife Natural Georgia.
Series Volume 8, Number 2
Georgia Wildlife Federation

THE GOPHER TORTOISE: A LIFE HISTORY

Patricia Sawyer Ashton and Ray E. Ashton Jr.
Copyright 2004
ISBN 1-56164-301-7

GLOSSARY

ADAPTATION: special feature developed over time that helps animals obtain food, protect themselves against enemies and cope with diverse weather conditions

AMPHIBIAN: an animal that typically lives in an aquatic environment, breathing by gills when young, and primarily in a terrestrial habitat, breathing by lungs and through moist glandular skin as an adult (i.e., frog)

ANNUAL: a plant that completes its life cycle from seedling to mature seed-bearing plant during a single growing season

ANTHROPOMORPHISM: the attribution of human characteristics to nonhumans, especially animals

AQUATIC: growing, living in or frequenting water

BIOLOGIST: a person who studies living organisms and their relationship to one another

BOG: a wetland formed where low oxygen levels and soil temperature cause incomplete decomposition, limited drainage and an accumulation of fibrous peat

BURROWING: to dig a hole or tunnel to use for shelter

CANOPY: the cover formed by the leafy upper branches of the trees in a forest

CARAPACE: the hard bony shell on the dorsal (back) side of a turtle or tortoise, consisting of the animal's ribcage fused with the spine

CARNIVORE: a meat eater

CARRYING CAPACITY: the maximum number of individuals or inhabitants that a given environment can support without detrimental effects

COASTAL PLAIN: the region of Georgia that stretches from the Fall Line south to the Atlantic Ocean covering 35,650 square miles (60 percent of the state); the longleaf pine-wiregrass community is unique to the Coastal Plain

COMMENSAL: a species that benefits from the association with another species in which the commensal obtains food, shelter or other benefits without harming or benefiting the other

COMMUNITY: a group of plants and animals living and interacting with one another in a specific region under relatively similar environmental conditions

CONSERVATION: the use of natural resources in a way that ensures the continuing availability to future generations; the wise use or protection of natural resources

CONSUMER: an organism in a food chain that gets energy by eating other organisms

COVEY: a small flock or group, often a family group, of birds such as quail

CREPUSCULAR: active at dawn and dusk

DECIDUOUS: trees that shed or lose foliage at the end of the growing season

DECOMPOSER: an organism that converts dead organic material into inorganic materials

DIURNAL: active during the day; the opposite of nocturnal

ECOLOGY: the study of the relation of organisms or groups of organisms to their environment; the science of the interrelations between living organisms and their environment.

ECOREGION: a relatively large unit of land or water containing a geographically distinct assemblage of species, natural communities and environmental conditions

ECOSYSTEM: the combination of all living and nonliving things that interact and exchange materials and energy

EDGE EFFECT: the tendency of wildlife to use the areas where two habitat types come together, forming an edge

ENDANGERED: a species that is in imminent danger of disappearing forever

ENVIRONMENT: the conditions surrounding an organism that influence its existence, such as conditions in the climate, soil, terrain and living components

EXTINCTION: the complete annihilation of a species due to various factors

FALL LINE: a geological boundary about 20 miles wide running northeast across Georgia from Columbus to Augusta that separates the Piedmont to the north and the Coastal Plain to the south; a gently sloping region that rapidly loses elevation from the north to the south, thereby creating a series of waterfalls or rapids

FAUNA: the animals of a particular region, habitat or geological period

FIELD GUIDE: an illustrated book that helps the reader to identify birds, animals, trees or other natural occurrences

FIELD MARKS: visible characteristics of a bird, such as the color of its eye ring or legs

FLORA: the plants of a particular region, habitat or geological period

FOOD CHAIN: the transfer of food energy from one organism to another as each consumes a lower member and, in turn, is preyed upon by a higher member

FOOD WEB: an interlocking pattern of food chains

FORAGE: vegetation eaten by herbivorous animals

GAME ANIMAL: legal designation for animals that may be managed and hunted only under regulation

GRASSLAND: a vegetative community where grasses are the most conspicuous members

HABITAT: the place where an animal makes its home and finds all it needs for survival; components include food, water, shelter or cover and space

HERBACEOUS: plants that have no woody stem above the ground

HERBIVORE: a plant eater

HERP: short for "herptile" or "herpetofauna," referring to both reptiles and amphibians

HOME RANGE: the area where an animal travels in the scope of normal activities

HYDROLOGY: a science dealing with the properties, distribution and circulation of water on and below Earth's surface and in the atmosphere

INSECTIVORE: an insect eater

INVASIVE SPECIES: a plant or animal species that has the ability to significantly displace desirable species; often used when referring to non-native or exotic species that take over an area

INVERTEBRATE: an animal that lacks a backbone or spinal column, including insects, spiders, worms, mollusks and jellyfish.

KEELED: upturned or unattached on one edge

KEYSTONE SPECIES: a species that has a big influence on the environment and one that many other species depend on; like the keystone that supports an entire architectural arch, this species supports an entire ecological community

LIMITING FACTOR: something that reduces the population of a living organism, either natural occurrences (weather, predators, disease) or human actions, such as habitat destruction and pesticide use

NEST: shelter prepared by birds or other species for their eggs and/or young

NICHE: the function or position of an organism or a population within an ecological community

NOCTURNAL: active by night; the opposite of diurnal

NONGAME: all wildlife species that are not commonly hunted, killed or consumed by humans, such as songbirds and salamanders

OBLIGATES: an animal or plant that lives in or on another (the host) from which it obtains nourishment; the host does not benefit from the association and is often harmed by it

OMNIVORE: an animal that eats both plants and animals

ORGANISM: a living thing; one or more cells that work together to carry on the various processes of life

PARASITE: an organism that lives by deriving benefit from another organism, usually doing harm to the organism from which it derives benefit

PERENNIAL: a plant that lives for several years and usually produces seeds each year

PIEDMONT: ecoregion covering about one-third of Georgia (18,100 square miles); typically associated with rough hilly terrain in the north and gentle rolling hills further south, extending south from the mountains of north Georgia to the Fall Line and ranging from 500-1,500 feet in elevation

PLASTRON: the nearly flat part of the shell structure of a turtle or tortoise found on the belly or ventral surface of the body

POACH: to take game, fish or rare plants illegally

PREDATOR: an animal that kills and eats other animals

PRESCRIBED FIRE: the planned application of fire to natural fuels (leaf litter, downed tree limbs, grasses, etc.) with the intent to improve habitats and reduce the risk of wildfire; also called a controlled burn

PREY: animals that are killed and eaten by other animals

PRODUCER: a green plant that gets its energy from the sun through photosynthesis; the first level in a food chain

PYRIC: resulting from or associated with burning

PYROGENIC: fire dependent

PYROPHILLIC: fire loving

PYROPHITIC: fire resistant

RAPTOR: bird that is predatory (ie., eagle, hawk, owl) and eats other animals

REPTILE: a cold-blooded vertebrate having dry scaly skin and young produced in amniotic eggs; belongs to a class that includes snakes, crocodiles, turtles and tortoises

RODENT: mammal with large incisors adapted for gnawing or nibbling (ie., rat, mouse)

SANDHILLS: sand dune habitats along Georgia's seashores and Fall Line (marking current and ancient coastlines, respectively), as well as near Coastal Plain rivers and streams due to strong westerly winds that deposited exposed river bottom sand on the eastern banks (called riverine sandhills); a unique habitat that is home to several rare plant and animal species

SCAT: fecal material

SCAVENGER: an organism that habitually feeds on refuse or carrion

SCRUB: low, woody vegetation composed principally of shrubs

SCUTES: plates made of keratin that cover and protect a turtle/tortoise shell from scrapes or bruises

SHELTER: cover for nesting activity or bedding and protection from weather

SILVICULTURE: branch of forestry dealing with the development and care of forests

SPECIES: a population of individuals that are more or less alike and that are able to breed and produce fertile offspring under natural conditions

STATE WILDLIFE AGENCY: the state government administration that has the legal responsibility for the conservation and management of wildlife; also provides opportunities for outdoor recreation and sets regulations for hunting, fishing and trapping (i.e., Georgia Department of Natural Resources – Wildlife Resources Division)

SUCCESSION: the orderly, gradual and continuous replacement of one plant community by another over time in the absence of disturbance (such as fire, mowing, plowing, etc.)

TERRESTRIAL: living or growing on land

THREATENED: in wildlife terms, a species present in its range but in danger because of a decline in numbers

URTD: upper respiratory tract disease

UNDERSTORY: the layer of plants growing under another higher layer of plants (e.g., grass, weeds and brush under taller forest trees)

URBAN SPRAWL: the spreading of human populations away from the central urban areas into undeveloped land near a city

VERTEBRATE: an animal with a backbone or spinal column, including mammals, birds, reptiles, amphibians and fish

WETLAND: any land area that tends to be regularly wet or a lowland area that is saturated with moisture, such as a marsh or a swamp

WILDLIFE: animals that are not tamed or domesticated

WILDLIFE MANAGEMENT: the application of scientific knowledge and technical skills to protect, preserve, conserve, limit, enhance or extend the value of wildlife and its habitat

WOODLAND: land having a cover of trees and shrubs

ALPHABETICAL LISTING OF ACTIVITIES

NOTES

TEACHER GUIDE TO GEORGIA SANDHILLS

GEORGIA DEPARTMENT OF NATURAL RESOURCES
WILDLIFE RESOURCES DIVISION

T.E.R.N. The Environmental Resources Network
Friends of Georgia's Wildlife Conservation Section

Walmart Foundation

GEORGIA Project WILD

www.georgiawildlife.com/SandhillsTeacherGuide