



The University of Georgia

Savannah River Ecology Laboratory
Outreach Program

Eco-Meet 2012

Study Packet

This packet contains 7 factsheets about Carolina Bays and a small sample of the biodiversity associated with them.

1. Carolina Bays – 2 pages
2. Biodiversity – 2 pages
3. Pond Salamanders – 1 page
4. Marbled Salamander – 1 page
5. Giant Salamanders – 1 page
6. Eastern Cottonmouth – 2 pages
7. American Alligator – 2 pages



Carolina Bays

Fact Sheet

DEFINITION

Carolina bays are isolated wetlands in natural shallow depressions that are largely fed by rain and shallow groundwater. These bays have an elliptical shape and generally a northwest to southeast orientation. They are found primarily in Georgia and the Carolinas, but range from Florida to Delaware. As many as 300 Carolina bays exist on the Savannah River Site.

HABITAT DESCRIPTION

Carolina bays vary in size from less than an acre to many acres. Water levels are normally lowest in autumn and highest in early spring. Some Carolina bays are wet all year, while others fill with water, then dry up, depending on the season. The amount of time a typical bay holds water can vary greatly from year to year depending upon rainfall. For example, during a 13-year period, Rainbow Bay on the Savannah River Site held water only five days one year and about 280 days another year.

CAROLINA BAY WILDLIFE

Although many Carolina bays are temporary ponds that hold water only part of the year, these wetlands host a variety of wildlife, providing valuable habitat for such animals as frogs, salamanders, turtles, snakes and alligators. Many birds, such as herons, egrets and migratory waterfowl, live in Carolina bays. Also mammals, such as deer, raccoons, skunks and opossums get food and water from Carolina bays. In addition, microscopic organisms called zooplankton live in Carolina bays. Salamanders and frogs are among the most abundant wildlife found in Carolina bays. As amphibians, these animals spend part of their lives in the

water; as adults, they depend on Carolina bays as breeding sites where they lay their eggs.

PLANT LIFE IN BAYS

Average water depth and soil type have a large influence on the types of plants found in and around Carolina bays. Many bays contain trees such as black gum, sweet gum, magnolia, bald cypress and maple, and shrubs such as sumac, button bush, gallberry and red bay. Also common in Carolina bays are water lilies, sedges and various grasses. On the SRS, 60 percent of the rare and threatened plant species are found in Carolina bays.

WETLAND FUNCTIONS

Although different types of wetlands vary, some of the most important and most common functions of wetlands are:

1. Flood control and water availability.
2. Water quality — they purify water by processing nutrients, suspended materials and other pollutants.
3. Erosion control.
4. Wildlife habitat.
5. Recreation.

DID YOU KNOW?

- Researchers believe Carolina bays are 30,000 to 100,000 years old or older, yet scientists are not certain of their origins.
- One theory of the origin of Carolina bays suggests that a meteor hit Earth thousands of years ago, breaking into pieces that made dents as they skipped across the planet's surface. One legend even has it that Carolina bays are dinosaur footprints (not true).
- Some people consider Carolina bays to be annoying wet spots. Farmers commonly plowed through them and builders filled and paved over them until federal wetlands regulations began protecting them in the mid-1970s. Still, Carolina bays and other wetlands continue to be lost to agriculture and commercial development.
- More than 97 percent of the Carolina bays once found in South Carolina have been destroyed or severely altered. More protected Carolina bays are found on the SRS than in the remainder of South Carolina.
- The United States has lost more than half of its original wetland areas. More than 400,000 acres are lost annually.

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BAY RESEARCH

Water levels vary greatly from one Carolina bay to the next and from one year to the next even at a single bay. Given the variations, ecologists at the Savannah River Ecology Laboratory are studying how amphibians, plants and zooplankton (near-microscopic organisms totally dependent on water to survive) adapt to such extreme change. Scientists are developing a computer-based model that could predict the effects of climatic change — particularly global warming — on the zooplankton and other animals and plants of Carolina bays.

WETLANDS PROTECTION

The Environmental Protection Agency offers a toll-free hotline that is responsive to public interest, questions and requests for information about the values and functions of wetlands and options for their protection. The hotline operates from 9 a.m. to 5:30 p.m., Eastern

Standard Time, on weekdays. The phone number is 1-800-832-7828.



The University of Georgia

This fact card is a publication of the University of Georgia's Savannah River Ecology Laboratory. The Laboratory is operated by the University of Georgia under a cooperative agreement with the U.S. Department of Energy to conduct ecological research on the Savannah River Site, a nuclear materials processing facility on the Georgia/South Carolina border near Aiken, S.C.



What is Biodiversity?

Biodiversity may be defined simply as “the variety of life,” but it is much more than just the number of different kinds of organisms that occur in an area. Across all levels of biological organization, biodiversity includes:

- **genetic diversity**—the variation in heritable characteristics of each species,
- **species richness**—the number of different plant and animal species found in a particular place,
- **ecosystem diversity**—the variety of habitats or ecosystems across the landscape, and
- **landscape diversity**—the arrangement of ecosystems over a large land area.

Biodiversity also encompasses *processes*, such as biogeochemical cycles, biotic and abiotic responses to disturbances, and interactions among living organisms.

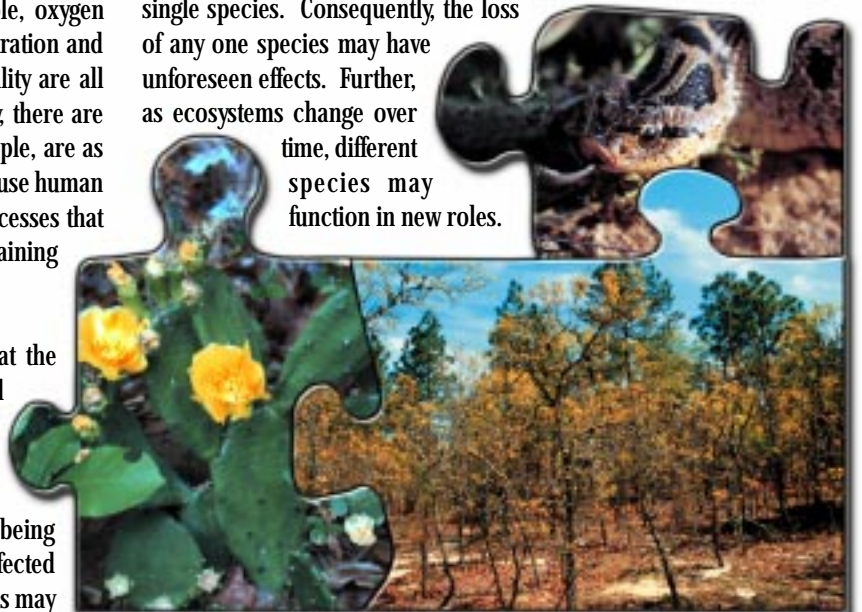
Biodiversity provides the basis for a functioning planet, buffering change and conferring resilience over all levels of biological organization. The many direct and indirect benefits of biodiversity include all the resources and processes required for human existence. For example, oxygen production, pollination of plants, global climate control, filtration and storage of water by wetlands, and soil production and fertility are all benefits of the biological diversity of the Earth. Additionally, there are intrinsic or aesthetic values to biodiversity that, to many people, are as valuable as the more tangible benefits illustrated above. Because human technology will never be able to duplicate the myriad of processes that occur every day in nature, our future depends upon maintaining the biodiversity of our planet.

Scientists and others have become increasingly alarmed at the accelerating losses of biodiversity at all levels of biological organization. Increases in human population coupled with continued conversion of lands for agriculture and development have resulted in increasing losses of genetic diversity and species richness worldwide. Landscapes are being altered and fragmented and ecological processes are being affected at a growing rate. Although the highest rate of biodiversity loss may

currently be in tropical regions, a 1996 assessment by The Nature Conservancy estimated that one-third of U.S. species are at risk for extinction. In the U.S. the conversion of lands for agriculture and development has led to dramatic losses of grasslands, wetlands, and old-growth forests. For example, less than 1% of the original 500 million acres of grasslands that once comprised North America’s Great Plains remain undisturbed by human activities; it is estimated that half the wetlands of the lower 48 states have been converted for agriculture or other uses since Colonial times; nearly all old-growth forest has been eliminated from the eastern U.S.



The consequences of biodiversity losses are difficult to measure accurately, but continuing losses ultimately compromise ecosystem integrity—loss of biodiversity results in species, ecosystems, and landscapes becoming less resilient. Although recent scientific studies have shown that relatively few species serve as *keystones*, or critically important “drivers” of ecosystem dynamics in any particular ecosystem, it is impossible to know with certainty the absolute importance of any single species. Consequently, the loss of any one species may have unforeseen effects. Further, as ecosystems change over time, different species may function in new roles.



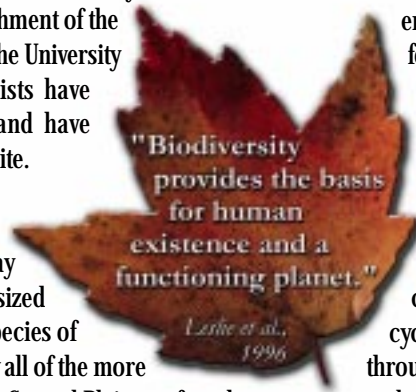
Biodiversity of the Savannah River Site

Biodiversity in the southeastern United States results from many factors, including the moderate climate and long growing season, topography that ranges from dry ridges to wet bottomlands, a history of moderate disturbances, including fire and windstorms, and the conjunction of the Piedmont, Sandhills, and Coastal Plain physiographic provinces. The biological diversity of the 310-square mile Savannah River Site (SRS) is unique within the Southeast. Only about 10% of the total land area of the SRS is developed or used for industrial purposes by the Department of Energy (DOE). The remainder of the Site is managed for timber, forest products, and wildlife by the U.S. Forest Service or is relatively undisturbed, providing baseline Set-Aside or "control" areas and sites for long-term ecological research. These Set-Asides include representative habitats of the SE U.S. and thus are important in enhancing the biodiversity of the SRS. Upon establishment of the SRS in 1951, the Atomic Energy Commission recognized the need to inventory the natural resources of the Site. Initial biological inventories were conducted by researchers from The University of Georgia and the University of South Carolina. These early surveys led to the establishment of the Savannah River Ecology Laboratory (SREL) by The University of Georgia. For over 45 years, SREL scientists have conducted ecological research on the SRS and have continued to document the biodiversity of the Site.

Studies by SREL scientists and others have documented that the biodiversity of the SRS may be greater than that of any other comparably sized area of the Upper Coastal Plain. Seventy-nine species of freshwater fish live in SRS wetlands and virtually all of the more than 50 species of mammals native to the Upper Coastal Plain are found on the Site. Additionally, Upper Three Runs Creek, a blackwater stream that flows through the SRS, has the highest reported biodiversity of aquatic macroinvertebrates of any stream in the western hemisphere. The SRS also is home to 42 species of amphibians and 59 species of reptiles, more than have been recorded from any other publicly owned land area in the United States, including the Everglades and Great Smoky Mountain national parks. Federally threatened American alligators thrive on the SRS and other herpetofaunal species of state or federal concern are also found here, including the Carolina gopher frog, tiger salamander, southern hognose snake, and



the pine snake. Site reservoirs, originally constructed to cool hot water effluent from nuclear reactors, now host thousands of waterfowl migrating between southern wintering areas and summer nesting grounds. Winter surveys have documented that more of some species of diving ducks use SRS wetlands than all other inland freshwater habitats in South Carolina. The SRS also provides nesting habitat for the federally endangered red-cockaded woodpecker and foraging habitat for the endangered wood stork, which nests in colonies close to the Site. The genetic diversity of both of these species has been well studied by SREL scientists.



The SRS hosts a diversity of plant communities—from dry upland sandhills, through moderately moist hardwood slopes, to bottomland hardwoods and cypress-tupelo swamps—which maintain natural nutrient cycles and control the movement of nutrients and water through watersheds. More than 1,500 species or varieties of vascular plants have been documented to occur on the SRS, including the federally endangered smooth purple coneflower and 34 plant species of conservation concern in South Carolina. This represents very high species richness for an area of this size. In addition, habitats that are increasingly rare in the southeastern U.S. remain on the SRS, including pockets of sandhills-scrub oak and hundreds of Carolina bays and other temporary depressional wetlands. Long-term ecological studies in these areas have confirmed their importance to maintenance of the biodiversity of this region of the U.S.

Thus, although past management of the SRS focused on national security needs, it also resulted in the maintenance and enhancement of the biological diversity of this vast tract of land. Maintaining the biodiversity of the SRS will require continued commitment and an acknowledgment by stakeholders that conserving biological diversity is an important Site mission. The SRS is faced with increasing threats from outside its borders, including development within the Upper Three Runs Creek watershed, continued agricultural and silvicultural conversion of natural habitats, and increasing industrial impacts to the Savannah River. Federal lands such as the SRS offer unique opportunities to help maintain regional biodiversity in the face of such impacts. If the Savannah River Site is to continue as a center of high biological diversity in the Southeast, sound ecological stewardship must be a top priority.



MOLE SALAMANDER



SPOTTED SALAMANDER



TIGER SALAMANDER

POND SALAMANDERS



Many kinds (species) of amphibians require wetlands in which to lay eggs so their young (larvae) can grow and develop. In the Aiken, SC area, there are four closely related species of salamanders whose individuals spend most of their lives in forests, but migrate to small wetlands to lay eggs. These species are the marbled salamander, the mole salamander, the tiger salamander, and the spotted salamander.

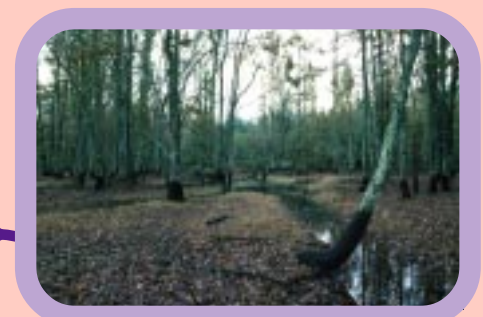
All four of these species have long life spans for such tiny animals. Some spotted salamanders may live more than 20 years! Studies at the Savannah River Ecology Lab have shown that some individuals of all of these species can live up to ten years in the wild. Most of a salamander's life is spent on land, usually underground in shaded, moist, wooded habitats. When adults are ready to breed, they migrate on rainy nights to seasonal wetlands. These wetlands, because they dry occasionally, usually do not have fish. This is very important from a salamander's point of view, because a fish can eat all its babies!



This information is provided as a public service by the Savannah River Ecology Laboratory Outreach office and the Student Partners in Amphibian and Reptile Conservation program (SPARC).



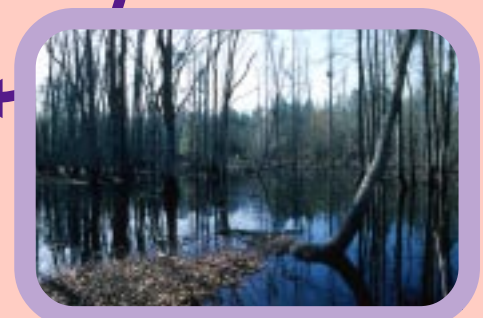
SUMMER



FALL



SPRING



WINTER

(Photos by David Scott)

Marbled Salamander

Ambystoma opacum

These beautiful salamanders are common residents of Carolina bays, river floodplains and other wetlands in the Southeast. Marbled salamanders have striking patterns of white, silver, or gray bands on a dark ground color. Individuals are rarely more than five inches long from head to tail tip. They feed on small invertebrates including earthworms, a variety of insects, and even centipedes. According to researcher David Scott from the Savannah River Ecology Lab (SREL), marbled salamanders have been known to live as long as ten years in the wild. He has found that marbled salamanders on the Savannah River Site lay an average of 80 to 120 eggs under logs or in clumps of vegetation in wetland areas that are likely to flood in late autumn. When the fall and winter rains fill these wetlands and flood the salamander nests, the eggs hatch and the larvae begin to grow and develop. After 3-6 months the larvae metamorphose into solid gray salamanders. As they mature they develop the bold silver pattern on their bodies. Males have a lighter-colored pattern than females. Adult marbled salamanders live in the woods around the wetland and return to the water to breed and lay eggs.

Marbled salamanders, like many other amphibians, require **wetlands** to use as breeding sites and nearby forests to live in the rest of their lives. SREL researchers have collected and released as many as twelve thousand salamanders emerging from a single wetland in a 24-hr period. Some small wetlands (and surrounding forests) may be home to more than 100,000 salamanders! Many of our wetlands in the East have been destroyed or heavily altered to the point where amphibians cannot survive in them. By studying amphibians and the wetlands they live in, we will better understand the role that salamanders and other amphibians play in the ecology of our area.



Female
salamander
with eggs



Salamander
larva

*This information is provided by
Savannah River Ecology Laboratory Outreach
and SPARC.*

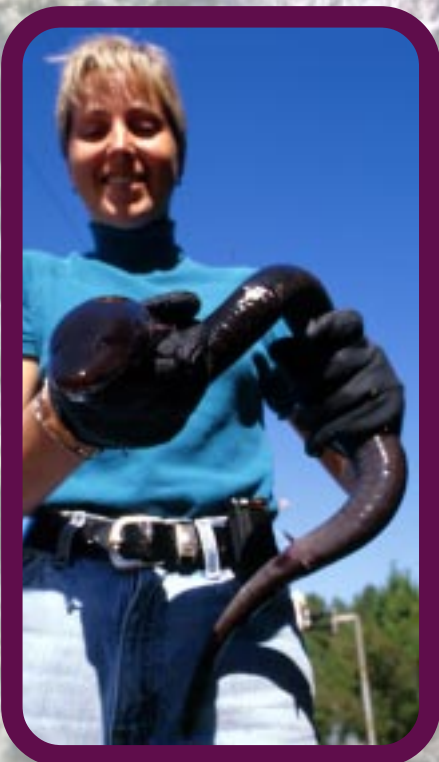


“Giant” Salamanders

Sirens and Amphiumas



When we think of salamanders, we usually think of small creatures that scurry away when we turn over rotten logs or other debris. Most people in the Southeast don't realize that southeastern wetlands are home to two groups of huge aquatic salamanders, sirens and amphiumas. Two species, the greater siren and the two-toed amphiuma, may grow to massive sizes – the largest individuals reaching more than three feet in length. These amphibians spend most of their time hiding in weed-choked wetlands, slow-moving streams, and Carolina bays. People rarely encounter these two species, although fishermen occasionally catch enormous black salamanders and assume that they are American eels (a species of fish). Amphiumas, or “congo eels” as they are often called, can be common in many southeastern wetlands. Two-toed amphiumas occur on the Coastal Plain across much of the Southeast. These animals have miniscule front and back legs with two toes on each foot. They feed on crayfish, aquatic invertebrates and other small animals that share their habitat. When wetlands dry up in extremely dry weather, these salamanders can be found deep underground in moist mud, where they remain until the wetland refills. Because sirens are similar in appearance and often occupy the same habitats as amphiumas, greater sirens are sometimes mistaken for two-toed amphiumas. Two key differences are that sirens only have front legs, and they also have feathery external gills. In general, sirens are a bit shorter than amphiumas and have a stockier body. Like amphiumas, sirens also feed on crayfish and other small animals. When wetland habitats dry, sirens go underground, and they have the ability to form a cocoon around their bodies to hold in moisture. This adaptation allows them to stay dormant in dry weather until the rains refill the wetlands. Sirens and amphiumas belong to the extensive “hidden biodiversity “ of the Southeast. It is hard to believe that two such large animals are so infrequently seen. Although these two species are fairly common, very little is known about their natural history. More research is needed to determine what role they play in the ecosystem.



*This information is provided by
Savannah River Ecology Laboratory Outreach and SPARC.*

*Photos by David Scott. Written by Tony Mills.
Layout and Design by Lindy Nowak.*

The Eastern Cottonmouth

(*Agkistrodon piscivorus*)

Myth and legend have magnified the fury of this native pit viper. Few Southerners are without tales of the snake also known as the water moccasin.

The cottonmouth is a semi aquatic freshwater snake, closely related to the terrestrial copperhead (*A. contortrix*).

Identification

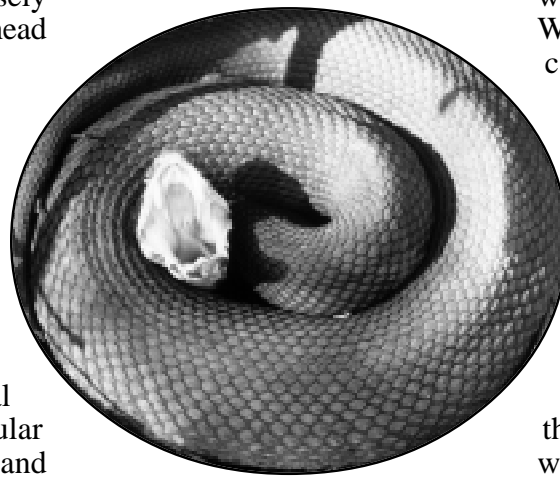
Cottonmouths are often difficult for the lay person to identify because the snakes exhibit so many variations in color and pattern. They are generally dull-colored with broad, thick heads. The dorsal pattern may appear in irregular diamonds or irregular bands and the color varies from dark brownish-green to copper to almost black. The background color varies from tan to olive. It is not uncommon to find solid-colored, unpatterned cotton-mouths. Age also makes a difference in coloration; the juveniles may be a vivid copper and old cottonmouths may be a gray-black.

Features

Cottonmouths have an opening located about half-way between the nostril and the eye, which is typical of pit vipers. This "pit" helps the snake detect warm-blooded prey. Cottonmouths have elongated, triangular-shaped heads with broad, thick snouts. The eyes are located on the side of the head and the pupil is vertically elliptical, rather than round as are those of

nonpoisonous water snakes.

The ridges above the eyes protrude outward and nearly shield the eyes from above, which prevent an observer above the snake from seeing its eyes.



The Eastern Cottonmouth

The fangs of a cottonmouth are truly a wonder. They are located in the upper jaw and are twice the length of the teeth and separate from them. The fangs are hollow tubes through which venom can be injected into prey. These weapons fold against the roof of the mouth when closed. Cottonmouths actually shed their fangs periodically, so they always have new ones developing.

Full-grown cottonmouths can approach six feet in length but many are smaller, usually three-to-four feet. The snake characteristically holds its head at an angle of 45 degrees and can detect movement for a distance of at least fifty feet.

Habitat

Often found basking in the sun, the cottonmouth may also be found under boards or in the bark of rotting trees or stumps near the water, especially in cold weather. While it has been thought that the cold keeps the cottonmouth inactive, researchers at the University of Georgia's Savannah River Ecology Laboratory have observed very active specimens all year long.

Defense

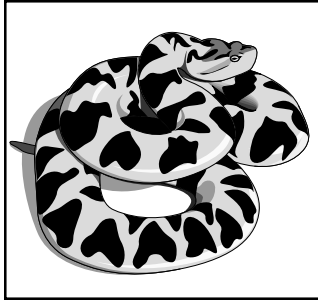
A cottonmouth that feels threatened will coil and open its whitish mouth, exposing its fangs in a threatening display, but usually will not strike unless provoked. Another defensive move of the species is to flick their tails about to indicate their displeasure. Some will also squirt musk from glands located on either side of the snake's tail.

Diet

Cottonmouths eat fish, amphibians, birds, rodents and other snakes and use their powerful venom to kill their prey. The cottonmouth is not a picky eater and will eat carrion without hesitation. Moccasins are also cannibalistic.

Most cottonmouths feed whenever prey is available. Cottonmouths shed their skins in accordance with how much they eat, usually several times a year.

Avoiding Snakebite



Reproduction

Reproduction occurs mainly, but not exclusively, in the spring. In many areas, cottonmouths do not breed every year, but only every two or three years, depending on food availability. Litters vary in size and typically juveniles display more aggressive behavior than older snakes.

Enemies

The cottonmouth is not invincible and has enemies all around including such predators as owls, hawks, eagles snapping turtles and alligators. They are also prone to parasites and diseases, as well as other problems such as infections and ulcers.

Man, too, is an enemy. Ignorance makes many people kill any snake, even if it is attempting to flee. In a complex ecosystem, all creatures play important roles.

According to research performed at SREL, cottonmouths did not bite when gently nudged by a booted foot but occasionally did bite when stepped upon and frequently bit when picked up. But even when the snake does bite, it does not always inject venom. The venom that is so deadly to the water moccasin's prey is usually reserved for the hunt and not always released during defensive strikes against larger predators, such as man. This preserves the snake's ability to hunt and kill prey.

The cottonmouth looks, smells and sounds dangerous. Usually that is enough to avoid confrontation and the pit viper will slither away, given the chance. Many bites occur when the defensive pose is presumed to be a precursor to biting and the person so threatened attempts to either kill or approach the snake. In a pitched battle, the snake's survival instinct will enable it to move quickly and it will not hesitate to bite.

If you see a cottonmouth, admire it from a distance. Do not attempt to pick it up. Do not prod it or otherwise annoy it. Do not attempt to kill it.

If you should be bitten, do not attempt first aid yourself. The best thing to do is to get to an emergency room quickly. Often people do more harm trying to treat a bite at the scene. See our fact sheet on snake bite for more information.

This information is provided as a public service by the Environmental Outreach and Education Division of The University of Georgia's Savannah River Ecology Laboratory located on the Savannah River Site near Aiken, S.C.



AMERICAN ALLIGATOR FACT SHEET

American alligators inhabit the southeastern United States. Once a federally listed endangered species, American alligators have recovered in many areas. The species is still federally listed as threatened because it looks like the American crocodile, which is endangered.

HABITAT

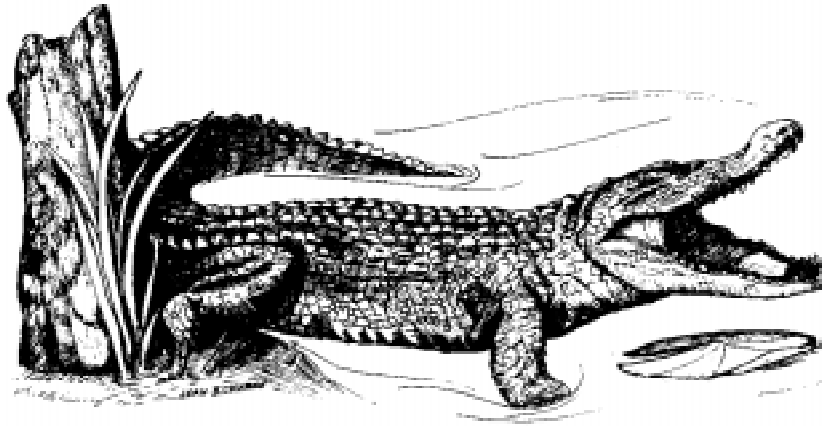
Although they are primarily freshwater animals, alligators will venture into brackish salt water. Alligators live in swampy areas, rivers, streams, lakes and ponds. On the Savannah River Site, alligators inhabit the Savannah River, its swamp and tributaries, and Par Pond and other reservoirs on the site.

BREEDING

Alligators are active year around, but they are most active in the warmer months in Georgia and South Carolina. With the start of their breeding season in May, males “bellow” to females and other males in the area. By June, pairs have mated, and females begin building mound nests out of marsh reeds or other vegetation.

Sometime during late June or early July, females lay be-

tween 20 and 60 eggs. The hard-shelled, white eggs are about 3 inches long and resemble goose eggs. The mother defends the nest against predators throughout the incubation period, about 65 days. When the eggs are ready to hatch, the mother alligator digs into the nest mound, opens any eggs that have not hatched and carries the young down to the water. Females sometimes aggressively defend their young for more than a year.



FEEDING

Alligators are opportunistic feeders; adults eat fish, turtles, wading birds, snakes, frogs and small mammals they find near the shoreline of their habitat. Young alligators feed on small fish and aquatic insects, but in turn, they can be food for raccoons, crabs, various types of wading birds and even fish.

Mother alligators that are killed or removed from the area cannot defend their nests or young, and the hatchlings often are doomed. If the young escape

predation and can find enough food, they may grow between 3 and 8 inches in length yearly. When they reach lengths of about 6 feet, they are considered adults.

RESEARCH

Scientists at the Savannah River Ecology Laboratory have studied American alligators on the Savannah River Site for more than 25 years. They have recorded population sizes,

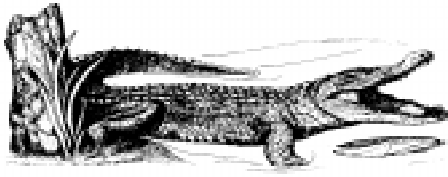
distribution and trends; animal sizes, sexes, activity periods, growth rates and reproductive efforts; diet, nutrition and energetics; responses to thermal effluent from

cooling reservoirs; uptake of radionuclides; genetic patterns and the conservation of the species.

DID YOU KNOW?

- The largest recorded American alligator was 19 feet in length.
- Alligators and their relatives are the last of the living reptiles that were closely related to dinosaurs.
- Alligators and crocodiles are related. But alligators have rounded snouts; most crocodile species have longer, pointed

HOW YOU CAN SAFELY OBSERVE ALLIGATORS



snouts. Also, crocodiles occur only in tropical and subtropical areas (only south Florida in the United States). Alligators, on the other hand, live in somewhat colder climates.

☐ Alligators have a strong homing instinct and sometimes will protect their “territory” from other alligators.

RANGE

On the Atlantic Coast, they occur from Florida to coastal North Carolina. Alligators are also found in the Upper Coastal Plain, which includes the Central Savannah River Area of Georgia and South Carolina. In South Carolina, alligators have been recorded to reach lengths of more than 13 feet.

1. DON'T FEED THE ALLIGATORS.

This is a most important rule! Providing food for these wild animals not only makes them bolder and encourages them to seek out people, it also alters their natural diet in an unhealthy way.

2. KEEP YOUR DISTANCE.

Although they may look slow and awkward, these animals are extremely powerful and can move with a startling burst of speed on land over short distances. A safe distance from an adult alligator is about 60 feet.

3. NEVER DISTURB NESTS OR SMALL ALLIGATORS.

Some female alligators protect their young and may become aggressive if provoked. A baby alligator should never be captured, even if the mother is not visible. She may be watching you and decide to take action to protect her baby.

4. KEEP YOUR PETS AND CHILDREN AWAY FROM ALLIGATORS.

Large alligators do not recognize the difference between domestic pets and wild food sources. When they are hungry, alligators act on their hunting instinct and might attempt to feed on your house pet if given the opportunity.

5. DON'T SWIM IN AREAS THAT ARE KNOWN ALLIGATOR HABITATS.

Always be careful around water. Splashing can attract alligators that think a prey animal is injured. They may act on instinct and attack.

Or, a protective female may believe her young or eggs are threatened and take defensive action. Be cautious when fishing in waters with alligators, as some will not hesitate to grab a hooked fish or eat the fish on a stringer.

ADVICE TO REMEMBER

“Alligators are fascinating creatures and should by all means be enjoyed as part of the natural beauty of our region. But please remember that they are wild animals and should be respected as such. Once they become too familiar with people, they lose their fear of humans, necessitating their removal from the area for the safety of everyone concerned. A few precautions on our part can help both humans and alligators co-exist safely.”

--Dr. J. Whitfield Gibbons
SREL senior ecologist

