Arkansas Animals: A Story of Change

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The land called Arkansas has changed greatly over time as it has been subjected to geologic forces and climate fluctuations. For these reasons the animals that have inhabited the state have also changed over time. Most recently, humans have directly and indirectly affected the existence of certain animals in Arkansas. In this lesson students will review the species of animals that have become extinct since the last ice age. They will also learn about the actions of early Europeans that caused the loss of some animal species in Arkansas and about the successful reintroduction of three species. Students will examine the human activities that threaten animals today and research a specific animal in Arkansas that is affected by our ever-increasing number of roads. Finally, students will learn about efforts to reduce roadkill on U.S. highways and ways that they can help Arkansas' animal populations.

Grades: 5-8

Arkansas Curriculum Frameworks:
Arkansas History 1.1.9, 1.1.12, 1.1.14, 2.1.4, 2.1.5, 2.1.7, and 4.1.13
Science LS.2.9, LS.2.12, ES.1.2, ES.2.2, ES.2.5, and ES.3.8

Key Terms:

topography	crinoids	endemic	endangered
extirpated	extinct	vertebrate	invertebrate

Key Terms Defined:
topography: The surface features of a place or region.

crinoids: Sea animals characterized by a cup-shaped body, feathery radiating arms, and either a stalk- or claw-like structure with which they are able to attach to a surface.

endemic: Native to or confined to a certain region.

endangered: Threatened with extinction.

extirpated: Totally destroyed or eliminated from a specific area.

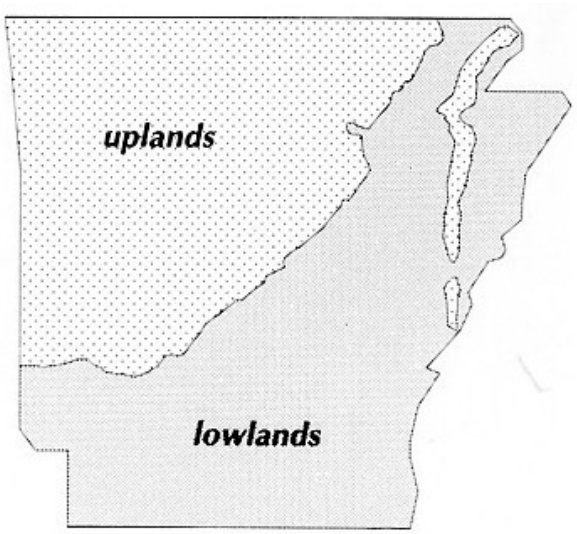
extinct: No longer living or existing anywhere.

vertebrate: Having a backbone or spinal column.

invertebrate: Lacking a backbone or spinal column.

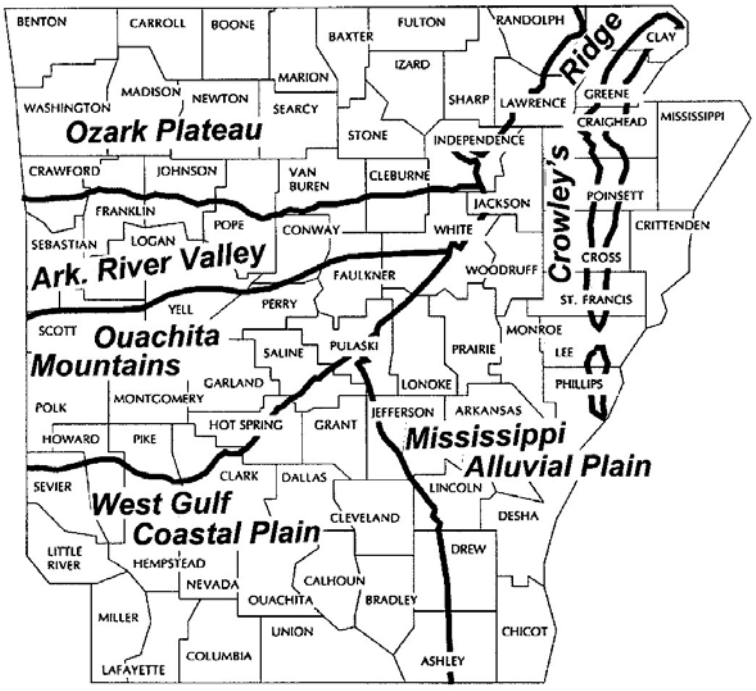
Materials:
- A copy of Arkansas Roads in 1835 Compared to Today for each student (included below)
- A copy of The Ecological Effects of Roads on Animals for each student (included below)

Background Information:



From Foti, Thomas and Gerald T. Hanson. *Arkansas and the Land.* Fayetteville: University of Arkansas Press, 1992, p. 31.

Arkansas can be subdivided into two distinct regions, the uplands and the lowlands. The most obvious difference between these two regions is elevation, but there are other differences including topography and type of vegetation. After examining the geology, climate, soil, plants, and animals of the uplands and lowlands, scientists have identified six distinct "natural divisions" in Arkansas. They are the Ozark Plateau, the Arkansas River Valley, the Ouachita Mountains, the West Gulf Coastal Plain, the Mississippi Alluvial Plain (Delta), and Crowley's Ridge. The six natural divisions are outlined on the map below:



Adapted from Foti, Thomas and Gerald T. Hanson. Arkansas and the Land. *Fayetteville: University of Arkansas Press, 1992, p. 36.*

The land we call Arkansas has undergone many changes over geologic time. Its climate has changed drastically, ranging from a warm, moist, tropical climate that supported dinosaurs during the Mesozoic Era, to the most recent ice age toward the end of the Cenozoic Era, known as the Pleistocene Epoch. Over time many animals have existed and then disappeared. If those animals had a hard shell or a bony skeleton, fossil records tell the fascinating story of their existence. Arkansas's oldest fossils are found in the uplands—the Ozark Plateau, the Arkansas River Valley, and the Ouachita Mountains. Our oldest rocks are also found in the uplands, some dating back 435 million years or more.

Because the land that formed the Ozark Plateau was once a shallow inland sea, the rocks there are studded with the fossils of marine animals, especially crinoids. In contrast, the land that formed the Ouachita Mountains was in a deep-sea basin, so the fossils there are not as abundant as in the Ozarks. Fossils of marine animals are also found in the Arkansas River Valley. Some of the most interesting animal fossils are found in the West Gulf Coastal Plain; there fossil seekers can see dinosaur tracks, as well as fossils of sharks, turtles, crocodiles, and a variety of fish. The western part of the West Gulf Coastal Plain yields many bivalves, worm tubes, and other interesting fossilized creatures. The Mississippi Alluvial Plain is the best place to look for fossils of Pleistocene animals. (For more information about the geologic history of Arkansas, fossils, and fossil hunting, visit the Arkansas Geological Commission's website—see "Suggested Websites" below.)

The most recent drastic climate change began about 2½ million years ago during the Pleistocene Epoch, the planet's most recent ice age. Glaciers covered much of the North American continent, and although they did not reach Arkansas, they did extend as far south as the Missouri River. As the climate began to warm the glaciers melted, releasing billions of gallons of water that flowed through Arkansas on its way to the sea. It was during this time that much of the erosion of the Ozark Plateau and Ouachita Mountains occurred. The great rivers that flowed during the ice age also regularly flooded the Mississippi Alluvial Plain, depositing vast amounts of sediment on the Delta in eastern Arkansas.

The Pleistocene Epoch ended about 20,000 years ago, after humans appeared on the North American continent. At the same time most of the large mammals that lived in North America became extinct. Why? Scientists are not certain, but they are looking at two possible reasons: (1) drastic changes in the environment due to climate change, and (2) human hunting. It may be that a combination of the two contributed to the demise of creatures like the woolly mammoth, mastodon, saber-toothed tiger, short-faced skunk, and giant beaver. If human activity contributed to their extinction, this marks the first time that humans were responsible for the extinction of animals!

To examine changes in animal populations over time, we must understand the four terms that apply to the status of living things. These are the "Four E's:" endemic, endangered, extirpated, and extinct. An animal that is endemic to a part of Arkansas is native to or confined to that region. Endemic animals may be protected by law simply because their numbers are low, and their low numbers may be due to the small size of their habitat. Human activity can threaten endemic species, and attempts are often made to protect them. An animal that is endangered has been identified by the U.S. Fish and Wildlife Service as being in peril of extinction. Animals that have been extirpated in Arkansas have been completely wiped out in the state, and animals that are extinct are no longer living anywhere on earth.

Because of the variety in topography and habitat types found in the state, Arkansas has a diverse population of animal species. We have about 680 vertebrate species (e.g., fish, amphibians, reptiles, birds, and mammals) and thousands of invertebrate species (e.g.,

insects, worms, and mollusks). Unfortunately, Arkansas has lost 21 species that lived in the state at one time. Among these are the following eight vertebrates, extirpated due to unregulated hunting and loss of habitat because of human activity:

Buffalo	Ivory-billed Woodpecker[+]
Gray Wolf	Carolina Parakeet (extinct)
Red Wolf	Passenger Pigeon (extinct)
Elk	Ruffed Grouse

In addition to the above animals, the American alligator was nearly extirpated in Arkansas by heavy poaching and the destruction of wetlands. Over-hunting also seriously depleted the white-tailed deer and black bear populations at one time. As noted above, the Carolina parakeet and passenger pigeon are now extinct, despite their huge numbers before European settlers came to North America. G. W. Featherstonhaugh traversed Arkansas in 1835 and observed immense flocks of passenger pigeons, now no longer in existence anywhere on earth:

> "A new and very interesting spectacle now presented itself, in the incredible quantities of wild pigeons that were abroad; flocks of them many miles long came across the country, one flight succeeding to another, obscuring the daylight, and in their swift motion creating a wind, and producing a rushing and startling sound…. These flights of wild pigeons constitute one of the most remarkable phenomena of the western country. I remember once, when amongst the Indians, seeing the woods loaded from top to bottom with their nests for a great number of miles."

Why were these animals lost? The answer is difficult, but an examination of the attitudes of Native Americans and the early European settlers may shed some light on the problem. Henry Rowe Schoolcraft traveled Arkansas in 1818 and 1819 and had this to say about the differences between the Osage Indians and the white settlers who hunted in the Ozarks:

> "The Indian considers the forest his own, and is careful in using and preserving everything which it affords. He never kills more meat than he has occasion for. The white hunter destroys all before him, and cannot resist the opportunity of killing game, although he neither wants the meat, nor can carry the skins. I was particularly struck with an instance of this wanton practice, which lately occurred on White River. A hunter returning from the woods heavy with flesh and skins of five bears, unexpectedly arrived in the midst of a drove of buffalo, and wantonly shot down three, having not other object than the sport of killing them. This is one of the causes of the enmity existing between the white and the red hunters of Missouri."

The Native Americans lived a subsistence lifestyle, hunting, fishing, and gathering food from the land in which they lived. Many of the tribes also practiced agriculture, particularly in the Mississippi Alluvial Plain, and supplemented their diet of wild plants and animals with cultivated plants such as corn. This lifestyle supported a limited population of humans, so the impact of the Native American on the land was minimal. European settlers, on the other

[+] Attempts in 2001 and 2002 to find ivory-billed woodpeckers in Louisiana have been unsuccessful.

hand, saw a land of bountiful resources. No doubt these individuals treated the plants and animals as limitless. But alas, they were not, and the record of extirpation and extinction in Arkansas provides evidence for the mistakes made by these early Arkansans.

The animals that are now extinct cannot be brought back into existence. What about those that have been extirpated in the state? The good news is that the Arkansas Game and Fish Commission has successfully reintroduced several threatened or extirpated animals, including the elk and the ruffed grouse. The reintroduction of the black bear, however, is the most remarkable repopulation effort in Arkansas.

Arkansas was once called "The Bear State" because of its large populations of black bears. Over-hunting and loss of habitat, accompanied by the loss of food, reduced the population of native black bears to just a few in the area known as the White River National Wildlife Refuge, in the lowlands of eastern Arkansas. In the mid-1960s the Arkansas Game and Fish Commission decided to reintroduce black bears to the uplands of Arkansas. They brought black bears from Minnesota to the Ozarks and Ouachita Mountains and released them. By the year 2000, there were over 3,000 black bears in Arkansas, and the project has been called the most successful reintroduction of a large mammal in the world!

Reintroduction can be successful, but only if sufficient habitat is available for the animals. Human attitudes toward the animals are also important. For example, attempts to reintroduce the gray wolf in the West met with opposition by farmers who feared the predators would harm their livestock.

Activities:

1. Present the "background information" above. Keep in mind that many students think of animals as mammals because they are mammals themselves, and because the largest land-dwelling animals are mammals. Remind them that the term "animal" includes many more creatures than the furry ones!

2. Students might see endangerment, extirpation, and extinction as problems that have little to do with them. After discussing these issues with the class, list on the board the following state and federal agencies that are associated with the protection of animal species or the regulation of hunting. Remind students that they can make a difference by contacting these agencies and becoming informed about issues related to animals.

Arkansas:

Arkansas Game and Fish Commission (AGFC)—This agency determines hunting regulations and is also involved in the protection of non-game species, including endangered species.

Arkansas Natural Heritage Commission (ANHC)—This agency is charged with the protection of lands that best represent the habitats found before European settlement. By setting aside natural areas, the ANHC protects the habitats of rare, threatened, and endangered species in Arkansas.

United States:

U.S. Fish and Wildlife Service, Department of the Interior—This federal agency determines the status of threatened land and freshwater animals and makes decisions about land use and other violations based on the Endangered Species Act.

National Marine Fisheries Service, Department of Commerce—This federal agency administers the Endangered Species Act for marine animals.

3. As a class, brainstorm ways in which people continue to threaten animal species. Some suggestions for discussion are:
* Population growth that leads to loss of habitat.
* Human disturbance of sensitive ecosystems, such as caves in the Ozarks.
* Pollution from industry.
* Poor sewage treatment.
* Unwarranted killing of animals because of fear—for example, snakes.

Students will probably not think of one particularly serious threat to animals today—roads. Think of the number of dead animals that you see on the road each day! Climate change and geologic processes certainly posed challenges for animals that existed in Arkansas over time, but most of those changes occurred slowly over thousands of years. Roads have been in existence less than 200 years; animals are not adapted to their presence, so many of them are particularly vulnerable to the hazards posed by roadways. An excellent source of information about roads and the animals killed on them is a book entitled Flattened Fauna *(see "Sources" below).*

4. Explain that while Arkansas is not a densely populated state, animals will most likely encounter a road at some point in their lives. Give each student a copy of Arkansas Roads in 1835 Compared to Today (included below) and discuss the stark contrast between these two maps. Remind students that the maps do not show the contrast between the vehicles that were traveling these roads, which is also an important factor. An animal is much more likely to be run over by a car going 60 or 70 miles per hour than a stagecoach or horse and buggy!

5. Give each student a copy of The Ecological Effects of Roads on Animals (included below) and allow them enough time to read it.

6. Divide the class into groups of three. Have each group research an animal commonly killed on the roads in Arkansas. Some possibilities are spotted salamanders, three-toed box turtles, northern copperhead snakes, turkey vultures, red-tailed hawks, Virginia opossum, nine-banded armadillos, gray squirrels, striped skunks, white-tailed deer, eastern cottontail rabbits, raccoons, and woodchucks. Students should determine why each of these animals is at high risk for being killed on roads.

A great source of information about the behavior of these animals is Flattened Fauna *(see "Sources" below).*

7. Students can either present their findings to the class or write reports on their animal.

The former allows students to share information with each other and might work better as a group exercise.

8. Discuss in class the following question: "If animals' defensive behavior is a primary reason they are hit on roadways, why don't they change their behavior?"

This is a big question for students. We talk of "adaptations" in science as behaviors, structures, or physiological mechanisms that suit an animal for its environment. But students still think of "adapting" as "changing to fit the environment." Humans can do that, after all.

We wear coats when the weather is cold and pipe in water from far-away rivers if our community doesn't have enough. To understand this issue students need to grasp the fact that most animals do not have the capacity to significantly change their behavior "in order to survive." They are at the mercy of humans.

9. Ask students if they can think of any solutions to the problem of roadkill. Tell them in some places highway construction has been modified to provide a means of passage for animals. In each case citizens have pressured their local and state governments to make the changes necessary for the animals' protection.

For specific measures that work to protect animals, your class should look at the Federal Highway Administration's excellent website about their program "Critter Crossings: Linking Habitats and Reducing Roadkill" (see "Suggested Websites" below).

10. Brainstorm other ways that citizens might become involved in the protection of animal species. Encourage students to make lists of things they can do to help animals and share them with other students in their school. Some simple ideas include:
* Encourage adults to leave dead trees on their property as long as the tree isn't close to a structure. Dead trees provide habitat for many animals, including woodpeckers, flying squirrels, raccoons, and others.
* Plant native vegetation when possible to provide food and cover for native animals.
* Keep your cat indoors! Cats kill millions of animals each year. They aren't being "mean;" cats are natural predators, and they are simply doing what they are designed to do.
* Design a schoolyard habitat for your school. (Contact Project WILD, Arkansas Game and Fish Commission for details (see "Suggested Websites" below).

Sources:

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[*] To access links, copy and paste into your browser.

Schoolcraft, Henry R. *Journal of a Tour into the Interior of Missouri and Arkansaw*. London: Printed for Sir R. Phillips and Co., 1821. (Republished as *Schoolcraft in the Ozarks*, Van Buren: Press-Argus, 1955.)

Smith, Kenneth L. et al., Bill Shepherd, ed. *Arkansas's Natural Heritage*. Little Rock: August House, 1984.

Suggested Websites:
Arkansas Geological Commission: *http://www.state.ar.us/agc.*

The Federal Highway Administration's "Critter Crossings: Linking Habitats and Reducing Roadkill:" *http://www.fhwa.dot.gov/environment/wildlifecrossings/main.htm.*

A *Los Angeles Times* article on California roads and wildlife:
http://www.mountainlion.org/BreakingNews/toll.htm.

Project WILD, Arkansas Game and Fish Commission:
http://www.agfc.state.ar.us/education/project_wild.html.

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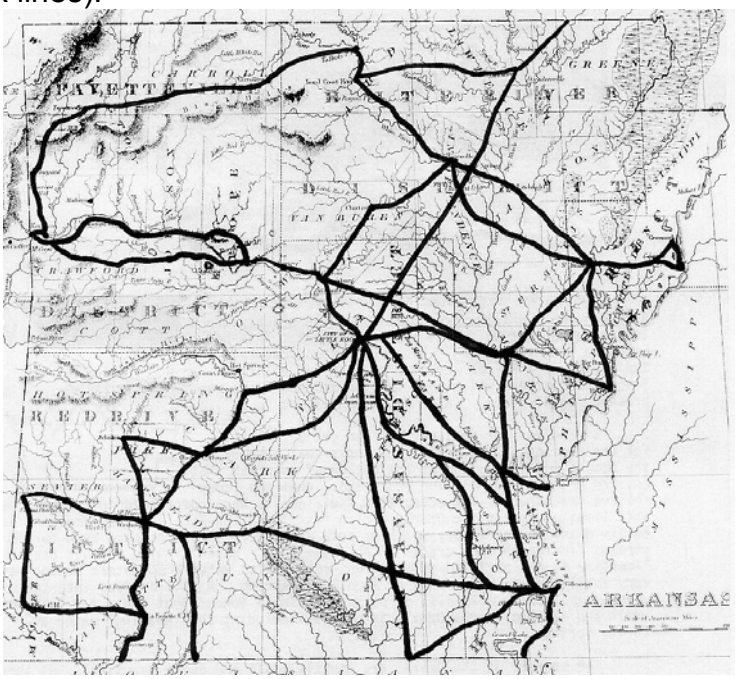
Arkansas History lesson plans are available online at the Butler Center for Arkansas Studies website:
http://www.cals.lib.ar.us/butlercenter/lesson_plans.

Arkansas Roads in 1835 Compared to Today

Roads in 1835 (black lines):



Roads Today (all lines):

Adapted from Foti, Thomas L. The Natural Divisions of Arkansas: A Classroom Guide*, 1978, pp. 46 and 49.*

The Ecological Effect of Roads on Animals

There is more than one reason that roads cause problems for animals, but one is most obvious: animals are killed on roads. The Humane Society of the United States and Urban Wildlife Research estimate that one million animals are killed each day on highways in the United States!

Consider these numbers. When Interstate 75 was opened in northern Michigan, the number of deer killed on Michigan highways increased by 500%. Since 1981, 65% of the known deaths of the Florida panther occurred on roads. The Florida panther is an endangered subspecies that is perilously close to extinction.

Anyone who drives a few miles of paved roads every day knows that many animals die on the nation's highways. Those who have hit an animal know that not all die on impact; many more crawl away and die in the ditches or nearby fields and forests.

Why are animals on the road in the first place? Some animals avoid roads, but many more are attracted to them. Reptiles may seek the warmth of asphalt on a cool summer evening. Rodents are lured to highway right-of-ways by the seed-producing grasses planted there, and hawks and owls follow their prey. Grazing animals such as deer come to highway right-of-ways to feed on the grasses and lick salt spread during the winter.

Other animals are merely crossing the roads on the way to someplace else, which brings us to the second reason that roads cause problems for animals. Look back at the present-day Arkansas map with all of its roads. That map provides a graphic representation of what scientists call "habitat fragmentation." This means just what it says: the habitat of animals is cut into small pieces by roads. If animals cross roads to find food, water, and a mate, they may be hit and killed. If they avoid roads, their populations are squeezed into small spaces that may not be large enough to support them.

Roads cause other problems for animals as well. The nation's biggest and fastest highways are the interstates, and they take up a lot of space. That space was once habitat for animals. Also, erosion increases along roadsides, because rainfall is concentrated on the hard surface of the roads and runs off in sheets. Roads bring their own pollutants into an area too, such as gasoline, oil, and anti-freeze (which tastes sweet to some animals but is poisonous).

Despite these problems, more and more roads are built in the United States each year.