Outreach
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

Nine-banded Armadillo *(Dasypus novemcinctus)*

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Armadillos are present throughout much of Georgia and are considered an urban pest by many people. Armadillos are common in central and southern Georgia and can easily be found in most of Georgia's 159 counties. They may be absent from the mountain counties but are found northward along the Interstate 75 corridor. They have poorly developed teeth and limited mobility. In fact, armadillos have small, peg-like teeth that are useful for grinding their food but of little value for capturing prey. No other mammal in Georgia has bony skin plates or a "shell", which makes the armadillo easy to identify. Just like a turtle, the shell is called a carapace.

Only one species of armadillo is found in Georgia and the southeastern U.S. However, 20 recognized species are found throughout Central and South America. These include the giant armadillo, which can weigh up to 130 pounds, and the pink fairy armadillo, which weighs less than 4 ounces.

Taxonomy

Order Cingulata – Armadillos

Family Dasypodidae – Armadillo

Nine-banded Armadillo – *Dasypus novemcinctus*

The genus name *Dasypus* is thought to be derived from a Greek word for hare or rabbit. The armadillo is so named because the Aztec word for armadillo meant turtle-rabbit. The species name *novemcinctus* refers to the nine movable bands on the middle portion of their shell or carapace. Their common name, armadillo, is derived from a Spanish word meaning "little armored one."

Figure 1. Nine-banded Armadillo. Photo by author, 2014.

Status

Armadillos are considered both an exotic species and a pest. However, Georgia law prohibits keeping armadillos in captivity. Because they are not protected in Georgia, they can be hunted or trapped throughout the year. There are no specific threats to their survival. Armadillos have few natural predators. Many are killed while trying to cross roads or highways or when feeding along roadsides.

Description

The nine-banded armadillo is about the size of an opossum or large house cat. They are 24 to 32 inches long, of which 9 ½ to 14 ½ inches is tail. The larger adult males weigh between 12 and 17 pounds, whereas the smaller females weigh between 8 and 13 pounds. They are brown to yellow-brown in color. Armadillos have a few sparse hairs on their belly. Long claws make them proficient diggers. They have four toes on each front foot and five on each back foot. The toes are spread so that a walking track looks somewhat like an opossum or raccoon. The ears are about an inch and a half long, and the snout is pig-like.

Distribution

About two million years ago, a relative of the armadillo that was as large as a rhinoceros, lived in South America. Smaller cousins lived as far north as Canada. All of these forms disappeared in the ice ages long before humans inhabited North America. At the start of the 20th century, the nine-banded armadillo was present in Texas. By the 1930's they were in Louisiana, and by 1954 they had crossed the Mississippi River heading east. In the 1950's they were introduced into Florida and began heading north. Today, some maps (Georgia Wildlife Web; http://museum.nhm.uga.edu/gawildlife/gaww.html) show them to be restricted to South Georgia, but, in fact, they are present as far north as Athens and Rome, Georgia. They occur throughout the South from Texas, Oklahoma, and Kansas through Missouri, eastern Tennessee and into South Carolina. They are currently absent from North Carolina but are likely to continue to move northward along the coast and into the Piedmont. Because they do not tolerate cold temperatures (below about 36° F), several studies suggest that further northward migration into the Appalachian Mountains will be limited. Rocky soils may also limit their establishment in the mountainous areas of Georgia. They may become established in valleys and stream corridors. Weather, especially cold winters, may be the most effective barrier to northern range expansion.

Form and Function

The armadillo's appearance is unique among Georgia's mammals. The shell (carapace) is made up of scutes, or bony plates, attached to a tough epidermal skin layer. Since each scute overlaps slightly with the one before it, the entire shell appears to move like a telescope or accordion. The ears, underbelly, and parts of the head and limbs are not covered by the shell. The head is relatively small. The skull is tubular; the lower jaw is long and slender. There are 7 or 8 teeth in each jawbone or 14-16 teeth in the lower jaw and the same number in the upper jaw. The teeth are small pegs with a single root.

Armadillos can have 7 – 10 bands on the shell, even though their name indicates nine. Males are about 25% heavier than females on average. Though males lack a scrotum and external testes, the sexes are easy to distinguish by the presence of four teats in females. Both sexes have anal glands, which protrude when the animal is excited. The anal glands produce a strong odor, but unlike a skunk, they do not spray.

Ecology

Armadillos dig their own burrows or use the burrow of another armadillo, tortoises, or natural holes. They do not hibernate, but neither can they tolerate high (above about 85^0-90^0 F) or low temperatures (below 40^0 F). During the winter months, they often are active during the warmer part he day. During the hot summer, activity shifts to the cooler night hours. In some armadillo species, individuals share a communal burrow in cold weather. This has not been documented in the nine-banded armadillo. While they can remain in their burrows for several days, they do not store food or accumulate large stores of body fat. So they must eventually emerge to forage. In bad weather, they

can freeze to death or starve if they are unable to locate food. Armadillo body temperature is about 2^0 F lower that most mammals. Heat loss across the carapace is responsible to their sensitivity to temperature extremes. The armadillo carapace loses heat at twice the rate of similar sized mammals.

Armadillos rely on a good sense of smell to locate food but have poor eyesight. The sense of hearing seems average, although people often assume it to be poor because they can be easy to approach. They eat insects, the surrounding soil, and plant litter while foraging, so their droppings consist of undigested insect parts, soil, and litter fragments. Droppings are about the size and shape of marbles.

Figure 2. Nine-banded armadillo foraging at night. UGA Forestry Images.

Reproduction - Armadillos reach sexual maturity at about one year of age. They breed between June and August. They have delayed implantation (a step in development when the fetus attaches to the wall of the uterus), which can last for up to four months. Implantation occurs around November, and gestation lasts about four months. Generally, the female produces only one litter per year. A single fertilized egg gives rise to four separate embryos. Thus, each litter consists of four identical quadruplets. Litters of 2, 3, and even 5 young have been reported. Fully formed young are born with their eyes open in March or April. They weigh 3-4 ounces at birth and can walk within a few hours, but remain in the nest or burrow for 2-3 weeks. Then, the young follow their mother while foraging. The young leave the nest at 20-22 days (around the first or second week of June in South Georgia), drink water at 21-25 days, eat solid food at 35-42 days, eat insects at 71-74 days, and are weaned at 90-140 days. The armor plates on the young are soft and flexible at birth - not hardening to the typical adult form until July in South Georgia. The male plays no role in raising or caring for the young.

Feeding - Armadillos are largely insectivores but may consume fruit when available. Their skull, jaw, and teeth are adapted to a specialized diet. Their tongue is sticky with rear facing hooks, which give the tongue a rough texture. The armadillo's diet consists mainly of invertebrates including insects (beetles, wasps, moth larvae) and also ants, millipedes, centipedes, snails, leeches, and earthworms. The exact composition varies by season, availability, and geographic locations. Studies show that they also consume fruit, seeds, and other vegetable matter. They have been reported to consume newborn rabbits and at least one American Robin. It is unknown if they merely found these animals dead or not. Other items consumed by armadillos include small amounts of plant material, salamanders, toads, frogs, lizards, skinks, small snakes, and eggs of ground nesting birds or turtles.

Feeding activity, such as digging, is often considered a nuisance, although consumption of ants, including fire ants, and white grubs may be beneficial in other ways. Small invertebrates are swallowed whole, while large items are chewed. They will hold and tear apart larger food items with their claws and feet. In one study in Alabama, nearly every fire ant mound on the study site showed evidence of disturbance by armadillos. They seem undeterred by the bite of the fire ant. Armadillos have been observed tearing the bark from fallen trees, presumably to feed on the insects (beetles and termites) in

the decaying wood. They move slowly while feeding and locate food items by smell. The diet shifts to fruits in the summer and fall as these items are often abundant in southern U.S. forests.

University of Georgia researchers studying armadillos on Cumberland Island found that although their diets varied seasonally, 99% of their diet consisted of beetle larvae and ant and wasp eggs, pupae, and adults. White grubs and wireworms were the most frequently consumed larvae throughout the year. Armadillos were also found to consume earthworms, crabs, crayfish, butterfly and moth larvae, fruits, and vertebrates. In addition, 60 out of 171 armadillos (35%) in the sample ate fruit. Grapes, saw palmetto, greenbrier, and Carolina laurel cherry were most common in the diet. Armadillos also occasionally consumed spadefoot toad, five-lined skink, green anole, eastern fence lizard, rough green snake, and various snake and lizard eggs. Using remote cameras to study nest predation, several studies have shown that armadillos consume quail eggs. Other observers report that sea turtle eggs are eaten. A more recent study (2004) conducted in Baker County, Georgia at the Joseph H. Jones Ecological Research Center found beetles and wasps, ants, and bees in 98% and 92% of stomachs, respectively (Table 1). Together, these two insect groups made up 67% of the stomach contents by volume (Table 2).

Behavior - Armadillos spend most of their active time outside the burrow feeding. They move slowly – traveling between 0.15 and 0.65 miles per hour – often in an erratic, wandering pattern. Often grunting like a pig and with their snout to the ground, they forage by smell and possibly sound. They often use their sticky tongue to probe holes searching for food, but they are also powerful diggers. Foraging pits are up to 5 inches deep and are often found in moist soil. Periodically they will stop foraging, stand upright on their hind legs balancing with their tail, and sniff the air. They also take low hanging fruits from this posture.

Armadillos mark their territory with secretions from the anal gland. Individuals recognize others through scent marking. When alarmed they can run quickly. They have a habit of leaping vertically like a bucking horse before running away in a surprising burst of speed. The anal gland's strong odor and the sudden leaping motion may momentarily startle a predator, possibly allowing the armadillo to escape. Contrary to popular folklore, the nine-banded armadillo cannot curl into a ball to protect itself.

Armadillos are good climbers and readily climb fences, although they are not known to climb trees. They often use fallen and leaning logs and trees to escape rising water along streams and rivers. Armadillos can cross water by either swimming in a typical dog-paddle motion or walking on the bottom while holding their breath. Buoyancy is increased by ingesting air into the stomach and intestines. Armadillos can cross small water bodies by holding their breath and walking underwater for short distances. One armadillo swam across a river 140 yards wide. Having a specific gravity of 1.06 helps, since it makes them heavier than water. Armadillos are known to take mud baths on hot days, perhaps to remove parasites or to coat themselves in cooling mud.

They make a variety of low grunting sounds when feeding or to call young to mother. Other sounds are described as "wheezy grunt," "pig-like sound," "buzzing noise," and a "weak purring" made by very young armadillos while attempting to nurse. They are capable of learning simple tasks in a laboratory, such as recognizing patterns in a Y-maze. They are primarily solitary animals except during brief periods for mating and mother-young groups.

Habitat - Armadillos prefer habitat near streams but avoid excessively wet or dry extremes. Soil type is important, due to their burrowing. They prefer sandy or clay soils. Armadillos can be found in pine

forests, hardwood woodlands, grass prairies, salt marsh, and coastal dunes. Human created habitats such as pasture, cemeteries, parks, golf courses, plant nurseries, and croplands also provide suitable habitat. They also forage along roadsides. Some studies have reported that armadillos prefer hardwood stands along streams. Recent work in South Georgia using radiotelemetry found that armadillos did not prefer or select hardwood areas along streams over other habitats. Overall, armadillos did not exhibit much evidence of habitat selections but did seem to avoid mature pine forests and recent pine regeneration areas. Armadillos seemed to avoid recently burned, mature pine stands but resumed use as vegetation developed following fire. Overall, armadillos in the South Georgia study did not exhibit evidence of habitat selection. They used all available habitats at various times.

While foraging, armadillo always seem to know where they are and, if alarmed, often take a direct route to the safety of a nearby burrow or tangle of roots and briars. They usually dig their own burrows. Burrow entrances will be 8 to 10 inches across and range from 2 to 24 feet long, averaging 3 to 4 feet. The burrow entrance is often concealed among clumps of vegetation, fallen logs, or under buildings. Each armadillo may have 5 to 10 burrows. Other animals will use armadillo burrows, including rabbits, opossums, mink, cotton rats, striped skunks, burrowing owls, and the eastern indigo snake. Occasionally, armadillos will cohabitate with other animals. Armadillos do not always dig a burrow; some will build nests out of dry grass. These nests resemble small haystacks and are often used in areas of wet soil. On Cumberland Island, UGA researchers found that 75% of all dens were under saw palmetto plants.

An individual's home range varies from 1.5 to 22.5 acres. The home range size is smaller for the armadillo than for similar sized animals. Researchers at UGA found that armadillos on Cumberland Island had a home range of 13 acres in summer and only 4 acres in winter. Armadillos spent 65% of their time in burrows in winter compared to only 29% in summer.

Enemies - Armadillos have no specific predators, but coyote, dogs, black bear, bobcat, cougar, fox, and raccoon will opportunistically catch and kill armadillos in places where these predators occur. Hawks, owls, and wild pigs may prey on armadillo young. One study noted a decline in armadillo numbers as wild pig populations increased. Humans and highways are a significant source of mortality in many areas. However, one study in Florida found no juveniles in a road-killed sample.

Populations - The sex ratio by litter is 1 male litter (= 4 identical quadruplets) per 0.78 female litters in Florida. Armadillos probably live 6 to 7 years in the wild. Population density is about 1 animal per 4 acres, but could range as high as 2 animals per acre.

Disease

Armadillos may carry diseases transmissible to humans, but reports are rare. Armadillos can acquire leprosy and are used in medical research to study this disease. Armadillos are used in medical research to study leprosy in humans. Relatively few cases are known in which a human contracted leprosy from wild armadillos. Most cases are from Texas and Louisiana, and the transmission occurred by consuming raw or undercooked armadillo meat. There are few reported positive leprosy cases in Georgia, Alabama, or Florida. One wild armadillo in Texas was reported to have rabies, but no known transmission to humans has occurred. Armadillos on Cumberland Island, Georgia had between 0 and 3

species of parasitic worms per individual. The average was 14 worms per individual armadillo, but the impact of these parasites on the health of the animal is unknown.

Armadillos are not known to carry the rabies virus. Their normal body temperature is 92-95^0 F. The lower body temperature may not allow the rabies virus to survive in armadillo. However, this hypothesis needs more research before we fully understand the relationship between the rabies virus and the armadillo.

Economic Value

One study in Texas conducted from 1975-1979 put the total amount of damage at $20,000 for a limited area but did not specify the type of damage. In Georgia, 78% of county agents reported receiving requests for information regarding armadillo and that armadillo complaints accounted for nearly 11% of all animal complaints they received each year. However, no dollar value was attached to the damage complaints. Furthermore, the monetary value of damage done to vehicles is not known. Damage occurs to lawns and landscapes due to digging for insects and other food items. Shallow holes 1 to 3 inches deep and 3 to 5 inches wide usually shaped like an inverted cone are the most common landowner complaints. Armadillos can uproot flowers and other plantings through their foraging. Damage is generally local and of a nuisance variety more than a large scale economic loss.

Legal Aspects

Armadillos are not protected in Georgia. There are no season or harvest restrictions. Check local (city and county) ordinances regarding discharging firearms. Shooting may be illegal in some jurisdictions.

Management

Management to Reduce - Armadillos can be locally controlled by trapping. Wire cage live traps measuring at least 10 x 12 x 32 inches are recommended. Use of wings, constructed of 1 x 6 inch lumber in various lengths and placed in a V-arrangement in front of the trap can help to “funnel” the armadillo into the trap (Figure 3). Setting traps along natural barriers like logs or the side of a building increases capture success. Placing the trap in front of a burrow entrance is better than random placement in the environment. No bait, lure, or attractant has been shown to be effective at increasing capture success, although there are numerous reports on internet websites of baits used with varying success. Controlled research studies have not identified any consistently effective bait.

Figure 3. Wooden box trap set for an armadillo. Note the position of the “wings” extending in either direction and used to funnel the animal into the trap. Photo by the author, 2016.

One study in Mississippi suggested that wooden box traps that have previously held an armadillo are 8 times more attractive than new traps. There is speculation that the scent of an armadillo acts as an attractant and increases trap effectiveness. Another research study in Florida concluded that traps baited with worms or crickets did not lure armadillo from any distance. There is evidence that armadillo may respond to sound and vibration produced by live bait (crickets or worms), but the range is extremely limited – about 12 inches or less.

When trapping armadillos, the animals should be euthanized with a gunshot. Trapping should be left to professional nuisance wildlife control experts. Armadillos should never be relocated to another property. Research shows that survival is very low, and, for those that survive, they may be able to return to their original capture site. Ninety-two percent (11 armadillos out of 12) readily dispersed from their release site, thus, simply transferring the problem and not solving the problem. Furthermore, mortality may be higher for translocated individuals as they disperse from their release site – perhaps in an attempt to return to their known home range.

No repellents are registered for use with armadillo. Unproven claims of ammonia soaked rags stuffed into armadillo burrows can be found on the internet. No scientific evidence exists to support this technique. Similarly, the use of naphthalene (i. e., moth balls) is suggested for repelling armadillos. This is both unproven and illegal. Naphthalene is a registered general use pesticide labeled for indoor use to repel clothes moths. It is not register for use with armadillos, and it is not registered for outside use as a broadcast repellent. Do not scatter moth balls as an armadillo repellent.

No toxicants (poisons) are registered for use. Pesticide use to reduce insect populations (for example, grub control) in landscape settings may be effective. No fumigants are registered for use to control armadillo.

Shooting is an effective control technique. Use a .22 caliber rifle in a safe and legal manner. Check city and county ordinances before discharging weapons. Always practice safe gun handling procedures.

Management to Enhance - Management activities are usually directed at control and elimination rather than enhancement.

General Human Use - Some humans consume armadillo flesh. The meat should be handled and cooked according to normal sanitary standards.

Native American Use – None. Armadillos are widely used (and considered a delicacy) by many cultures in Central and South America.

Colonists View – None.

Further Reading

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Table 1. Frequency of occurrence (%) for foods within the stomachs of 48 armadillos collected from southwest Georgia between April – July 2004[1].

Food	Frequency of Occurrence (%)
COLEOPTERA (Beetles)	98
HYMENOPTERA (Ants, Bees, Wasps)	92
DIPLOPODA (Millipedes)	73
LEPIDOPTERA (Butterflies, Moths)	46
ARANEIDA (Orb-weaver spiders)	42
CHILOPODA (Centipedes)	42
ISOPTERA (Termites)	33
HAPLOTAXIDA (Earthworms)	29
HOMOPTERA (Sucking Insects)	29
DIPTERA (Flies)	23
ORTHOPTERA (Grasshoppers, Locusts, Crickets)	21
UNKNOWN	21
REPTILIAN EGG	15
DERMAPTERA (Earwigs)	13
GASTROPODA (Snails and Slugs)	10
ANURA (Frogs and Toads)	8
ACARINA (Ticks and Mites)	6
SQUAMATA (Snakes)	6
Diospyros spp. (Persimmon)	6
RODENTIA (Rodents)	4
HEMIPTERA (True bugs)	2
ODONATA (Dragonflies, Damselflies)	2
SCORPIONIDA (Scorpion)	2
AVIAN EGG	2
DECAPODA (Crustacean – crayfish)	2

[1]Data from Senior Thesis by Kelly Overduijn, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602 USA.

Table 2. Total percent volume of identified foods within the stomachs of 48 armadillos collected from southwest Georgia between April – July 2004[1].

Food	Total Volume (mL)	Total Percentage of Volume (Identified Material)
COLEOPTERA (Beetles)	390.35	43.65
HYMENOPTERA (Ants, Bees, Wasps)	208.21	23.28
HAPLOTAXIDA (Earthworms)	69.20	7.74
UNKNOWN	55.80	6.24
DIPLOPODA (Millipedes)	36.55	4.09
ISOPTERA (Termites)	30.40	3.40
HOMOPTERA (Sucking Insects)	15.10	1.69
Diospyros spp. (Persimmon)	12.50	1.40
ANURA (Frogs, Toads)	11.80	1.32
LEPIDOPTERA (Butterflies, Moths)	11.35	1.27
ARANEIDA (Orb-weaver spiders)	10.30	1.15
CHILOPODA (Centipedes)	8.70	0.97
ORTHOPTERA (Grasshoppers, Locusts, Crickets)	8.30	0.93
GASTROPODA (Snails, Slugs)	7.30	0.82
DIPTERA (Flies)	5.90	0.66
RODENTIA (Rodents)	4.30	0.48
DERMAPTERA (Earwigs)	3.95	0.44
SQUAMATA (Snakes)	1.50	0.17
REPTILIAN EGG	1.05	0.12
AVIAN EGG	0.70	0.08
DECAPODA (Crustacean – crayfish)	0.40	0.04
ACARINA (Ticks, Mites)	0.20	0.02
HEMIPTERA (True bugs)	0.20	0.02
SCORPIONIDA (Scorpions)	0.20	0.02
ODONATA (Dragonflies, Damselflies)	0.10	0.01

[1]Data from Senior Thesis by Kelly Overduijn, Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA 30602 USA.

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