



Waco Mammoth National Monument Self-guided Tour Reading Companion



City of Waco
Parks and Recreation Department
Waco Mammoth National Monument

Waco Mammoth National Monument

This park and museum are operated by City of Waco Parks and Recreation Department in partnership with the National Park Service. Baylor University's Mayborn Museum Complex is the park repository of collections, and the Waco Mammoth Foundation is the private non-profit corporation that raises funds for development.

This guide will explain our attractions as you walk through the site.

Things to know before you leave the Welcome Center:

- You will walk down a 300-yard (274-meter), fully-paved path from the Welcome Center to the Dig Shelter.
- If you cannot make this walk, please ask for help in the Welcome Center.
- Restrooms are located in the Welcome Center.



You will see this symbol in the directions.



When you leave the Welcome Center, turn right.

Follow the path that starts by the water fountain.



Stop at the light post near the picnic area

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All of the fossils you will see today are from the Pleistocene Epoch, often called the Ice Age. The Ice Age started 2.5 million years ago and ended just 10,000 years ago.



Photo by Dava Butler, 2014. Used with permission.

Texas was warm during the Ice Age, reaching 90°F (32°C) during the summer. It wasn't wooded like it is today. Instead, Central Texas was savanna—open grassland.

Trees like this large live oak would only be found near the banks of rivers.

This map shows what Waco looked like before the Lake Waco dam was built.

Two rivers meet in Waco, the Bosque and the Brazos. This site is between the two rivers. It also had a seasonal creek or tributary during the Ice Age. Summers were hot in Ice Age Texas, so this place between the rivers may have been a nice watering hole with shade trees.



U.S. Army map of Waco, 1857. Site location added by Dava Butler. War of the Rebellion Collection, Baylor University Digital Collection. Used with permission.

Judging by how many fossils we have at the Waco Mammoth Site today, this area must have been very popular!



Proceed down the paved trail.

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Your next stop is the entrance bridge. Walk down the paved trail, pass the amphitheater, and keep going past the gate to the Dig Shelter



As you walk along the paved trail, imagine Ice Age megafauna roaming Waco:

Mammoths,
Giant Sloths,
Sabercats,
Camels,
Bison,
and so much more!

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Many animals lived in Central Texas during the Ice Age.

Most of the animals that live in Central Texas today lived here during the Ice Age. Rabbits, coyotes, deer, and other familiar animals have lived in Texas since the Ice Age. Larger animals, called megafauna, lived alongside them.



Illustration by Karen Carr. Used with permission

Herds of grazers, or grass-eating animals, migrated to these grasslands, including horses, Western camels, llamas, mammoths, bison, and whitetail deer.

Trees grew near rivers, and this is where browsers, or leaf-eating animals, lived. These included animals such as giant beavers and ground sloths. This Shasta ground sloth was about the size of a brown bear. The largest ground sloth, Megatherium, was 20 feet (6 m) long!



Illustration by Carl Buell. Used with permission



Illustration by Carl Buell. Used with permission

Predators followed these prey animals. One of the most famous is the Smilodon, or saber-tooth cat. This cat weighed 600 lb (272 kg) and had 6-inch (15 cm), blade-like fangs. Other predators lived in Texas, such as dire wolves and short-faced bears, as well as predators that still live here, such as coyotes, foxes, and bobcats.

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The largest of the animals that lived here during the Ice Age were the **Columbian mammoths**.

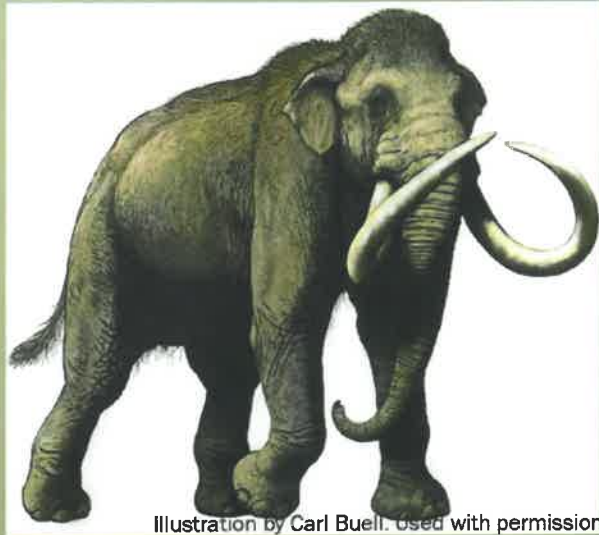


Illustration by Carl Buell. Used with permission

Columbian mammoths were much larger than their woolly mammoth “cousins.” A male woolly mammoth was about 10 ft (3 m) tall. A male Columbian mammoth was 14 ft (4.3 m) tall! These giants ate 300-700 lb (130-300 kg) of grass and drank 50-75 gallons (190-280 l) of water every day.

Mammoths are not ancestors of modern elephants; they are their relatives. However, scientists think mammoths behaved much like elephants. Evidence suggests female mammoths stayed together in a group, called a nursery herd. Each nursery herd had a matriarch, the oldest female of the group. This “grandmother” had the most experience migrating for food and defending against predators, so she led and protected the herd.

In contrast, male mammoths probably lived alone or in small groups called bachelor herds, which had 3-5 males. Males were chased out of their nursery herd around age 12 or 13, because they became more aggressive as they matured. Females would interact with males only during mating season.



After you cross the bridge, stop.

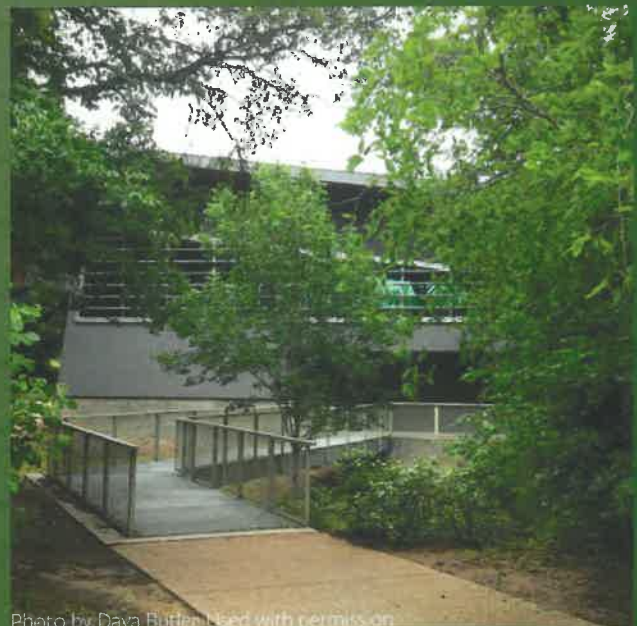


Photo by Dava Butler. Used with permission

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This bridge crosses over the southern half of our excavation site.

The confluence of the Bosque and Brazos rivers in Waco, called Steinbeck Bend, is well-known for its fossils. Paleontologists at the University of Texas collected fossils here in the 1930's, and Wacoans continued to hunt for them.



The southern half of the excavation site today
Photo by Dava Butler, 2014.
Used with permission.

In 1978, two young men named Paul Barron and Eddie Bufkin came to explore a creek that ran here, hoping to find some of these fossils, or possibly some arrowheads. They found a very large bone near the embankment you see by the bridge.



The southern half of the site, before bones were removed.
Photo by Nick Cirincione, 1990. Used with permission.

They didn't know what the bone was, so they took it to the Strecker Museum at Baylor University. There, David Lintz identified the fossil as a mammoth leg bone. Lintz came to this spot to see where it was found, and he saw the area was full of fossils. Excavation began in the summer of 1978,

continuing until 1980. Digging resumed under the direction of Calvin Smith in 1984, lasting until 2001.

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Waco Mammoth National Monument records the first and only discovery of a nursery herd of Columbian mammoths.



Ralph Vinson and volunteers
survey the nursery herd.
Photo by Nick Cirincione, 1998
Used with permission

Researchers have uncovered 23 mammoths here so far! Our mammoths are in two groups—an upper group of 4, and a group of 19 buried deeper. The lower group is all adult females and young calves, a nursery herd.

Waco Mammoth's herd is the only known nursery herd of Columbian mammoths in the world. Since its discovery in 1978, herds of woolly mammoths have been found in Russia and Serbia. Past research suggests the nursery herd died in a flash flood or mudslide, becoming trapped in thick, clay mud. This area may have been a popular watering hole during the Ice Age because it sits between two rivers. If these rivers flooded, this area may have become a trap. Scientists have found evidence of multiple flash floods and mudslides at this site, trapping several groups of animals over time.

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Waco Mammoth National Monument's fossils include great potential for more discoveries. Researchers continue to explore, appreciate, and ponder the mysteries of our mammoth herd.

Some mysteries about our herd still exist. Some researchers think the adults were in a circle around the calves, a defensive position modern elephants use. Others say the Waco mammoths were washed in with the flood water, settling at the edges of a round embankment. Another mystery is that one of the females had a calf in her tusks. This may be evidence of her attempt to rescue the calf, as a mother elephant would do. It may also be that the two bodies were pushed into each other during the event.



The adult female with a calf in her tusks.
Photo by Nick Cirincione, 1990.
Used with permission.



The southern half of the site, before bones were removed.
Photo by Nick Cirincione, 1990. Used with permission.

Faculty and students at Baylor University continue to study this site and may someday get a better idea of what happened.

This site was under a tent for many years, and it had a few problems. One was flooding. Every rainstorm caused fossils to wash out. While most of these fossils were found,

information about them was lost. Another problem was theft. For these reasons, most of the fossils were wrapped in plaster and removed in 1990. These fossils are in storage at Baylor University.

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*You are about to enter the Dig Shelter, but **STOP** first and read our rules:*

The **Dig Shelter** is a state of the art building that protects the northern half of the excavation site by keeping a steady temperature and humidity year-round.

Help us protect the fossils!

- Leave food and drinks outside.
- Throw away gum, candy, and tobacco.
- Leave wet umbrellas and raincoats outside.
- Secure your hats and sunglasses.

Most of the time, fossils are removed from the ground and put in storage to protect them. Very few are protected in situ like the ones here. By protecting the fossils in the ground where they were found, scientists can continue to learn from them.

Shelter walls extend deep underground to exclude water.

The ceiling has a hidden attic space to help maintain steady temperature.

The walkway is suspended from the ceiling to prevent soil disturbance.

The HVAC systems maintain steady temperature and humidity year-round.

The windows prevent UV light from directly touching fossils while allowing ambient light.

The Dig Shelter that protects the Waco mammoths is equipped with state-of-the-art features. These features will help protect the fossils for generations to come.



Your first stop in the building is the mural to the right of the doors

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The life-sized mural of an adult male Columbian mammoth is a great place for photos! Photography is allowed in the Dig Shelter.



Mural painted by Lee Jamison

His body was measured from "Mammoth Q" in the bone bed behind you.



Photo by Jean Fioca.
Used with permission

A. Asian elephants are the Columbian mammoth's closest living relative. This female would stand up to Mammoth Q's chin.



Illustration by Carl Buell.
Used with permission.

B. The woolly mammoth, also closely related to the Columbian mammoth, was just slightly larger than an Asian elephant.



Photo by Dava Butler.
Used with permission.

C. African elephants are taller than woolly mammoths were. This female would be almost at Mammoth Q's cheekbone.

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Illustration by Karen Carr.
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Scientists do not know yet how much hair the Columbian mammoth had, nor do they know what color they were.

Several frozen woolly mammoth bodies with intact hair have been found in Siberia. Woolly mammoths ranged in color from blonde to brown to red. Red seems to have been the most common color for woolly mammoths, so it is possible the same was true for Columbian mammoths. As for the amount of hair, scientists think Columbian mammoths had less hair than woolly mammoths, especially in warm areas like Texas. This mural shows Mammoth Q with a winter coat he is shedding



Illustration by Karen Carr.
Used with permission

Mammoths probably used their tusks in the same way modern elephants do

Male and female Columbian mammoths both had tusks. A female's tusks would average 3-5 ft (0.9-1.5 m) in length, while a male's tusks would average 12-14 ft (3.6-4.2 m). The longest Columbian mammoth tusk on record was 16 ft (4.8 m) long and was found in Post, Texas, near Lubbock. Tusks were used to defend against predators, move obstacles, and uproot trees to find groundwater. Males also probably used their tusks to compete with other males for the attention of females.



Illustration by Karen Carr.
Used with permission

Scientists also do not know how large the ears were on a Columbian mammoth

Elephants use their ears to control their body temperature. African elephants, which live in hot climates, have very large ears. By holding their ears out, elephants can cool the blood flowing through their ears. In contrast, frozen woolly mammoth carcasses reveal they had tiny ears, not much larger than a human's ear. This prevented frostbite and the loss of body heat. Columbian mammoths lived in a moderate climate, so they may have had medium-sized ears, like an Asian elephant.

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Turn around and view the bone bed.



Take a look around—this is an in-situ excavation site, which means the fossils have not been moved from where they were found. Standing by the mural of Mammoth Q, you are at the original ground level.

Soil has layers. Each layer, called a stratum, was left behind by a flood or mudslide. Layers build up over time, so the deeper a scientist digs, the older the fossils he or she finds. Of the many layers scientists uncovered here, three of them have produced fossils so far.

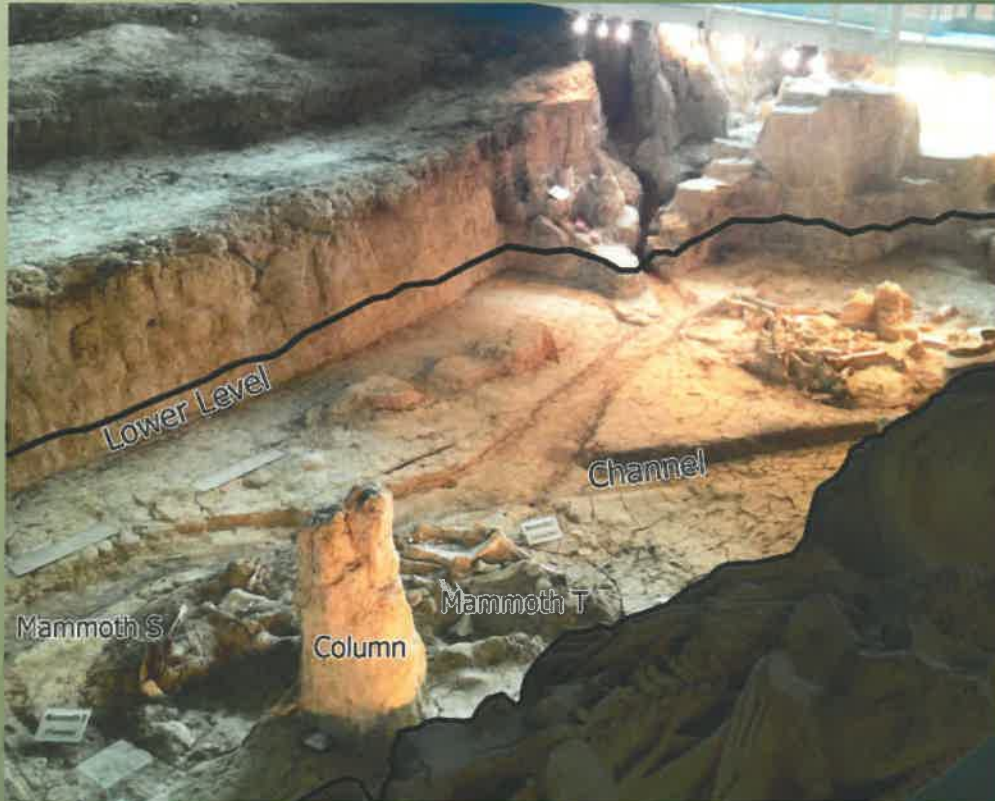
1. The lowest level has produced the Waco Mammoth National Monument's famous nursery herd, 19 mammoths so far. It also produced some other animals, which you'll see as you walk further into the building. According to test results from Baylor University, Southern Methodist University, and the University of Chicago, this event happened about 65,000 years ago.

2. The middle level has produced some mysterious fossils, very different from the other two levels, as you will soon see. This level has not been dated yet.

3. The upper level has produced 4 mammoths so far, including the Waco Mammoth National Monument's only adult male. Test results from Baylor University and the University of Chicago show this event occurred about 50,000 years ago.

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The lower layer of the fossil bed has many interesting details.



Mammoth S was a young adult female. Only her jaws and teeth were found.

Mammoth T was an older calf. Because T had not yet reached puberty, scientists cannot tell if it was male or female. Mammoths S and T are part of the nursery herd.

The **channel** was dug by Baylor University staff because of the flooding problems the site had during excavation, when the site was covered by a tent. Water would flow over bones and carry them downstream. The channel prevented some of this damage from happening by directing water away from the bones.

The **column** is undisturbed soil that has been left in place. This shows a scientist which level he or she is excavating. It also can be used for future testing, because the soil is not contaminated. This column is called a “pedestal” or “witness column.”

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Take a closer look at “Mammoth Q”, an adult male mammoth.



Mammoth Q diagram by Dava Butler, 2014. Used with permission.

- Q shows signs of sudden death. He is flat on his stomach, head raised, which suggests he was knocked down by force. There are no chew marks on the bones, and they were not pulled apart by scavengers. This means he was buried soon after death, if not immediately.
- One of his ribs has a large lump where it had broken and was healing. Broken ribs are the most common injury seen in male mammoths, mastodons, and modern elephants. In modern elephants, males jab each other in the side with tusks, breaking ribs. This probably is the cause of broken ribs in mammoths and mastodons, as well. Q survived an attack, and his rib had been healing for about a year.
- One of Q's teeth is visible inside his jaw. Mammoths were born with 4 teeth, which were replaced 5 times in their life for a total of 6 sets of teeth. Scientists can tell how old a mammoth was when it died by looking at the teeth. Q is on set 5, so he was about 45-years-old.
- Q's tusks are 11 ft (3.3 m) long and are made of ivory. They fell out of place when the skull collapsed over time under the weight of the soil.

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Three of four mammoths in the upper layer are seen here.

Upper level diagram by Dava Butler, 2014 Used with permission.



Mammoth R before partial removal.
Photo by Nick Cirincione, 1993.
Used with permission.

Mammoth R was a young calf. R was found across one of Q's tusks. Earlier researchers thought this was evidence of Q trying to rescue R. More recent research says this was unlikely. Modern male elephants do not stay with herds or protect the young. Part of Mammoth R has been removed so Q's tusk could be examined.

Mammoth V was an adult mammoth, but only two front leg bones and a rib (currently in storage) have been found. To identify gender, scientists need the tusks or pelvis. To calculate age, teeth are needed. So far, none of these have been found for Mammoth V.

Mammoth W is the fourth mammoth in the upper level. Go further along the walkway to see her next.

She is on the right side

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Mammoth W is in the same level as Mammoths Q, R, and V.

(The fossils in the outsets are discussed on the next page.)



Mammoth W diagram by Dava Butler, 2014 Used with permission

- Early studies did not find any DNA in these fossils, so it is still unknown whether R is W's calf.
- All four of W's teeth are visible. She was on her fourth set of molars, so she was about 25-years-old, a prime age for female elephants to breed. Q was about 45, also in his prime. There is no evidence to prove or disprove W and Q were a mating pair, but their age difference would be normal for a mating pair of modern elephants.

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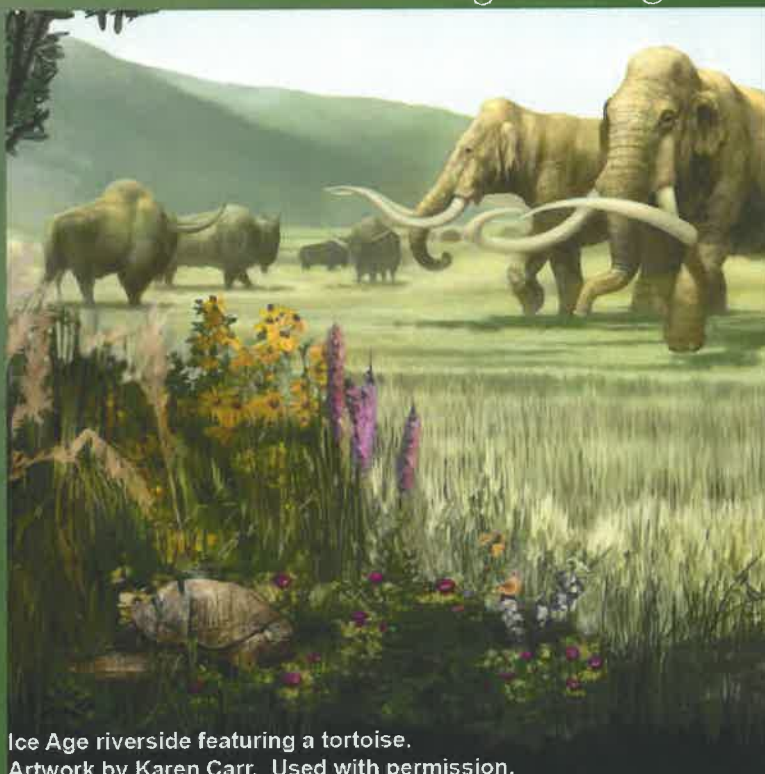
Let's take a closer look at the outsets: Mammoth W's tusk and a tortoise shell fragment.




Mammoth W before the tusk was removed.
Photo by Nick Cirincione, 1996. Used with permission.

One of W's tusks was removed to be examined. Tusks grow in rings, and these rings indicate the health of an elephant or mammoth. The more a mammoth ate, the thicker the rings would grow.

A small fossil sits against the wall behind W. This is a piece of a giant tortoise shell. This tortoise was related to the modern gopher tortoise, but it weighed up to 750 lbs (340 kg). Many species of tortoises lived at river banks, just like today. Fossils of red eared slider turtles also were found at this site. They have lived in Texas a long time!



Ice Age riverside featuring a tortoise.
Artwork by Karen Carr. Used with permission.

 **Turn around! On the other side of the walkway, you will see a camel.**

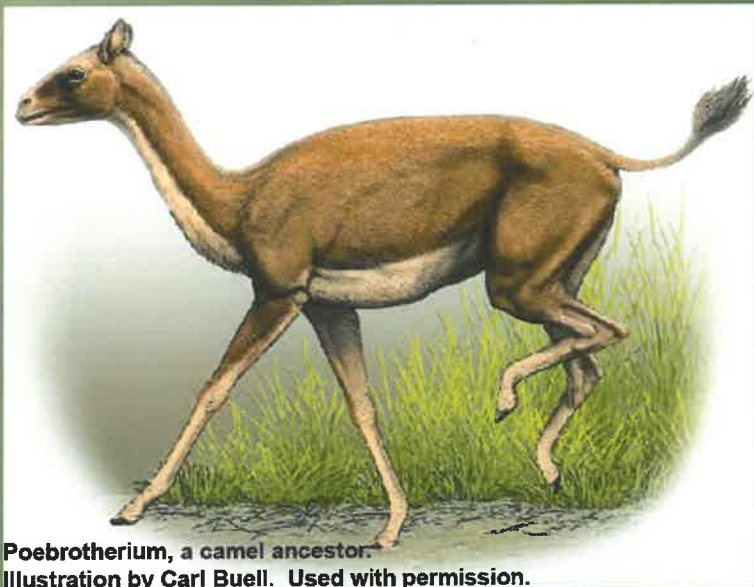
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Surprised? Camels evolved in North America, and like horses, they went extinct here at the end of the Ice Age.

Camelops hesternus, or a Western camel is in the lowest level with the herd of mammoths. Her head and jaw were found under the platform where you are standing. They were wrapped in plaster and moved out to protect them from damage. When the Dig Shelter was built, they were brought back and placed where they are easier to see.



Photo by Dava Butler, 2014. Used with permission.



Poebrotherium, a camel ancestor.
Illustration by Carl Buell. Used with permission.

The earliest camel ancestors were small—about the size of house cats—and they originated in North America. All modern camels, llamas, alpacas, guanacos, and vicuñas are descended from these tiny animals.

Western camels, like the one at Waco Mammoth, probably looked more like llamas than modern-day Dromedary camels. Western camels stood about 7 ft (2 m) tall at the shoulder, a bit taller than Dromedaries.

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Here's more information about prehistoric camels of Waco:



A close-up view of the lower level.

Photo by Dava Butler, 2014. Used with permission.

Fossils of Western camels are sometimes found with Columbian mammoth fossils. Our paleontologist has studied camel teeth to discover that these camels were eating trees and shrubs, whereas mammoths preferred tall grass. We know the two animals lived together here but ate different vegetation, so we can paint a better picture of what Waco looked like 65,000 years ago.



Mural painted by Lee Jamison

In the mural on the front wall of the Dig Shelter, the nursery herd and the camel are shown together with the flash flood waters approaching.

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No need to move far! Just look to the right of the camel, you can see the middle strata or level of our excavation.



Middle level diagram by Dava Butler, 2014. Used with permission.

The event that created the middle strata of our excavation site happened in between the other two events. So, the lowest/oldest layer trapped the nursery herd, then the middle layer trapped an unidentified animal and a saber tooth, and

the top/more recent layer trapped Q. The middle layer has not yet been tested to find exactly how old it is.

Only a small part of the middle level has been explored. So far, it has produced five ribs from an animal that has not yet been identified, as well as a tooth from a saber-tooth cat. This cat may have been a cub between 5- and 10-months-old.



Cat tooth with knife for scale
photographer unknown, 1998
Used with permission

The tooth was removed for security. Fossils of very young animals are rare, because babies have softer bones and teeth than adults. These softer bones and teeth are less likely to fossilize.

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Here's more information about the prehistoric cats of Waco:

This fossil tooth came from a saber-tooth cub, but some mystery remains. Two types of saber-tooth cats lived in Texas during the Ice Age.



Photo by Dave Miller, 2012
Used with permission



Smilodon.
Illustration by Carl Buell. Used with permission

The most famous sabertooth cat is *Smilodon*, a lion-sized cat that ambushed its prey from hidden areas. This cat relied on heavy muscles to drag down prey and long fangs to subdue them.

The other common prehistoric cat in Texas is *Homotherium*, sometimes called the scimitar cat. This cat had shorter fangs, but it also had features like a cheetah—long legs, non-retractable claws, and a wide nose. It probably chased its prey instead of ambushing it.



Homotherium.
Illustration by Carl Buell. Used with permission

If Waco's sabertooth had come from an adult cat, scientists could identify it based on size and shape. For a baby tooth, the root is needed for identification. Unfortunately, this tooth is missing the root. The identity of this cub will not be known unless more bones are found in future exploration.

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Waco Mammoth National Monument was designated as a unit of the national park system on July 10, 2015.

Then



Mammoth Q during excavation.
Photo by Nick Cirincione, 1993. Used with permission

Now



Mammoth Q protected by the dig shelter.
Photo by Dava Butler, 2014. Used with permission

Achieving a National Monument designation is no small feat. Waco Mammoth is a park run on partnerships and public support. When fossils were found here in 1978, citizens of Waco united with Baylor University to explore and preserve this amazing discovery. Building on that visionary support and perseverance of central Texas communities, Waco Mammoth National Monument is the embodiment of successful advocacy and collaboration to preserve and share America's heritage.

Thank you for visiting.
Feel free to chat with our friendly Rangers.
We love sharing our history with you!



After you exit the building, cross the foot bridge and turn left to return to the Welcome Center.

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