Welcome to the Waco Mammoth Site!

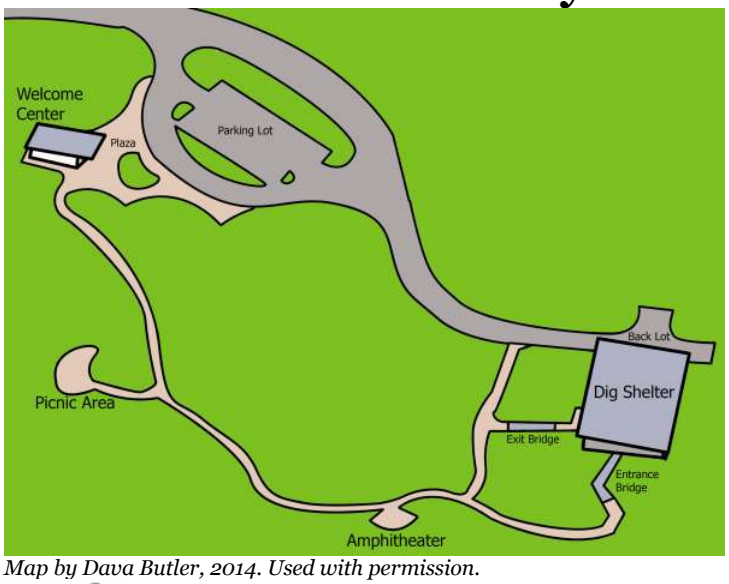
This park and museum are operated by the Parks and Recreation Department of the City of Waco. Baylor University has partnered with the City of Waco to conduct research at the site, and the private non-profit Waco Mammoth Foundation raises funds for development.

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 next to directions.



Map by Dava Butler, 2014. Used with permission.

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.

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.

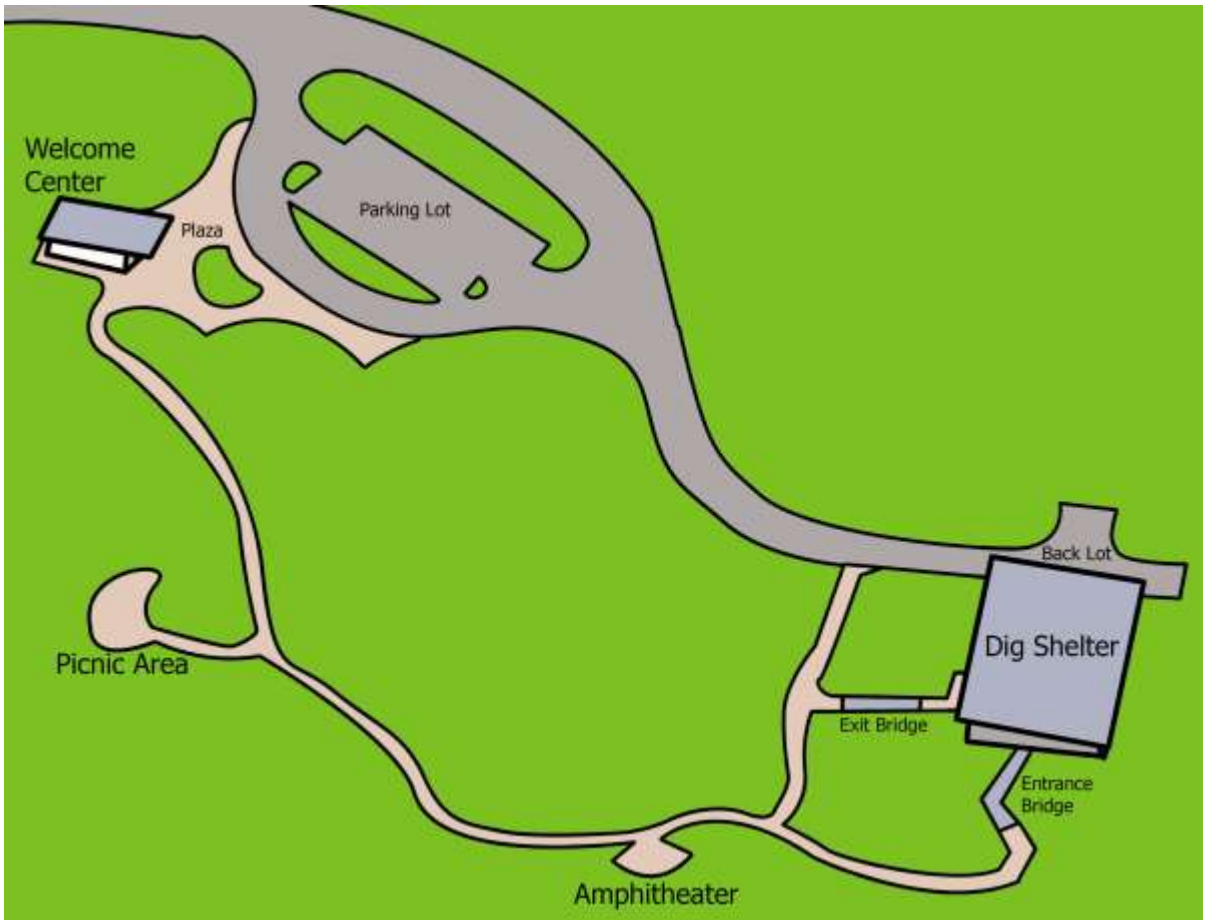
This map shows what Waco looked like before the Lake Waco dam was built.

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.

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.

Summers were hot in Ice Age Texas, so this place between the rivers would have been a nice watering hole with shade trees.

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



Your next stop is a foot bridge. Walk down the trail, pass the amphitheater and keep walking straight until you come to the foot bridge.

Read about Ice Age wildlife on the way there.

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.

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

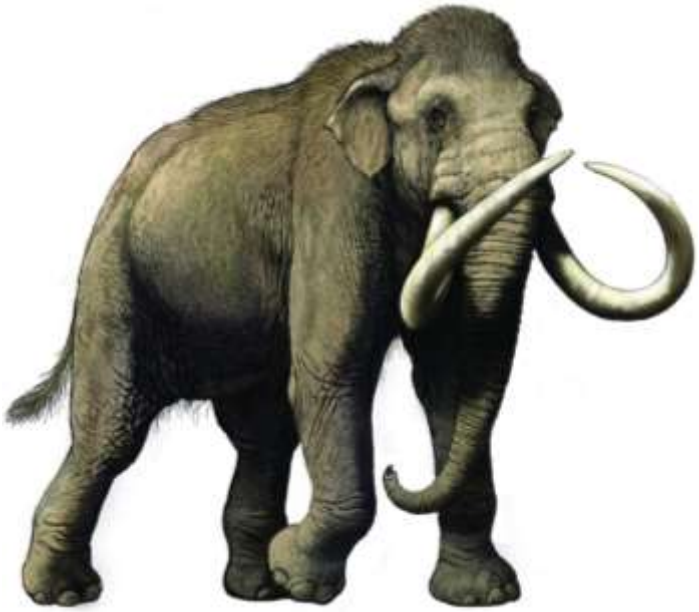


Illustration by Carl Buell.
Used with permission.

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.

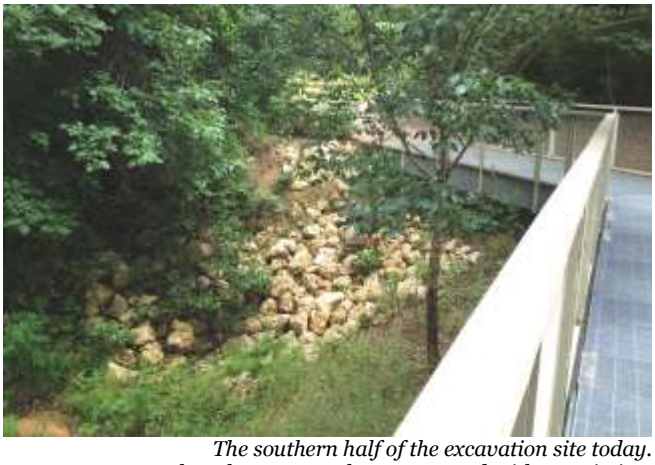
For example, evidence suggests female mammoths stayed together in a group, called a nursery herd. Each nursery herd had a matriarch, the oldest female of the group. This "grandmother" had the most experience migrating for food and defending against predators, so she led and protected the herd.

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.

Photo by Dava Butler.
Used with permission.

After you cross the bridge, stop.

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



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

This area of 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 here.

In 1978, two young men named Paul Barron and Eddie Bufkin came to explore the creek that runs 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 it 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.

Ralph Vinson and volunteers survey the nursery herd.
Photo by Nick Cirincione, 1990. 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 was all adult females and young calves, a nursery herd.

The Waco Mammoth Site 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.

Current research suggests the nursery herd died in a flash flood or mudslide, becoming trapped in thick, clay mud. This area was a popular watering hole during the Ice Age, but it sits between two rivers. When these rivers flooded, this area became a trap. Scientists have found evidence of multiple flash floods and mudslides at this site, trapping several groups of animals over time.

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.

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

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.

Fossils being prepared for removal.
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.

PLEASE READ BEFORE YOU ENTER THE DIG SHELTER

This building protects the northern half of the excavation site by keeping a steady <u>temperature</u> and <u>humidity</u> year-round.

<u>Help us protect the fossils!</u>

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

☺ Photography is allowed. ☺

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

Mural painted by Lee Jamison.

This is a life-size mural of Mammoth Q, an adult male.


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.

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.

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.

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.

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.

Strata diagram by Dava Butler, 2014.
Used with permission.

If you look at the soil, you may notice it has layers. Each layer, called a stratum, was left behind by a flood or mudslide. The layers build up over time, so the deeper a scientist digs, the older the fossils he or she finds.

Out of the many layers scientists uncovered here, three of them have produced fossils so far.

1. The lowest level has produced the Waco Mammoth Site'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 Site's only adult male. Test results from Baylor University and the University of Chicago show this event occurred about 50,000 years ago.

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

The lower level 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.”

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

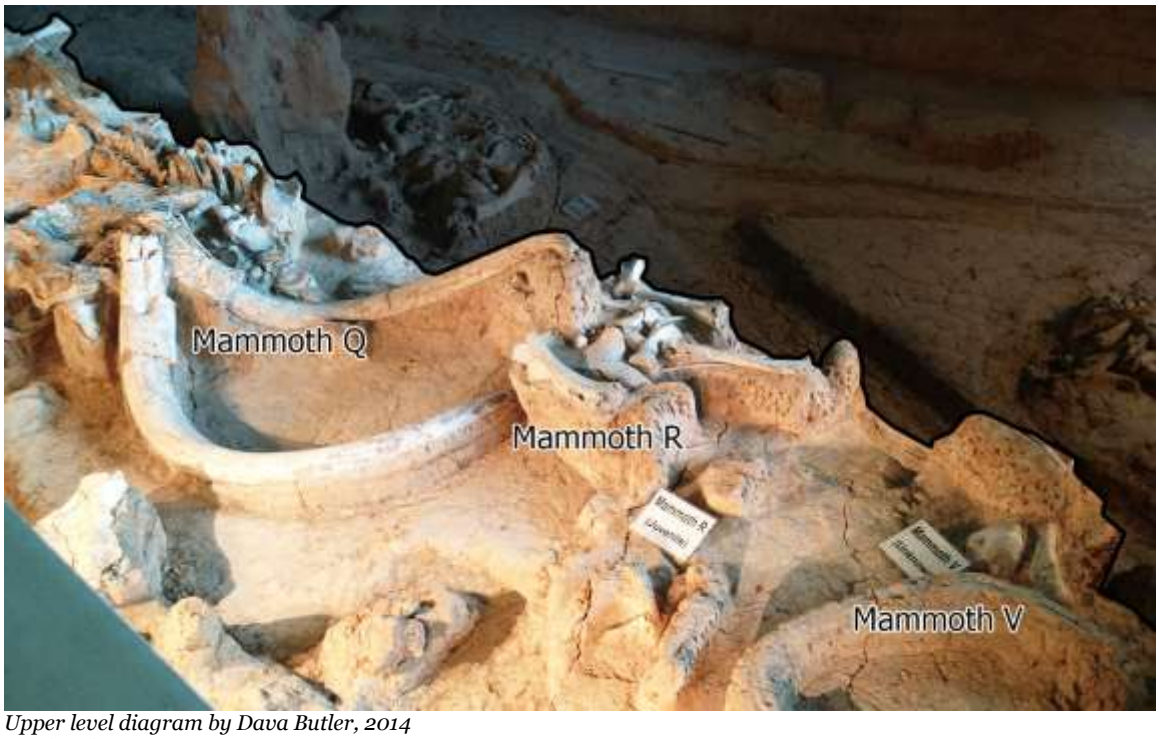
This is Mammoth Q, an adult male.

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.



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

The upper level has produced 4 mammoths so far. You can see 3 of them on this side of the walkway.

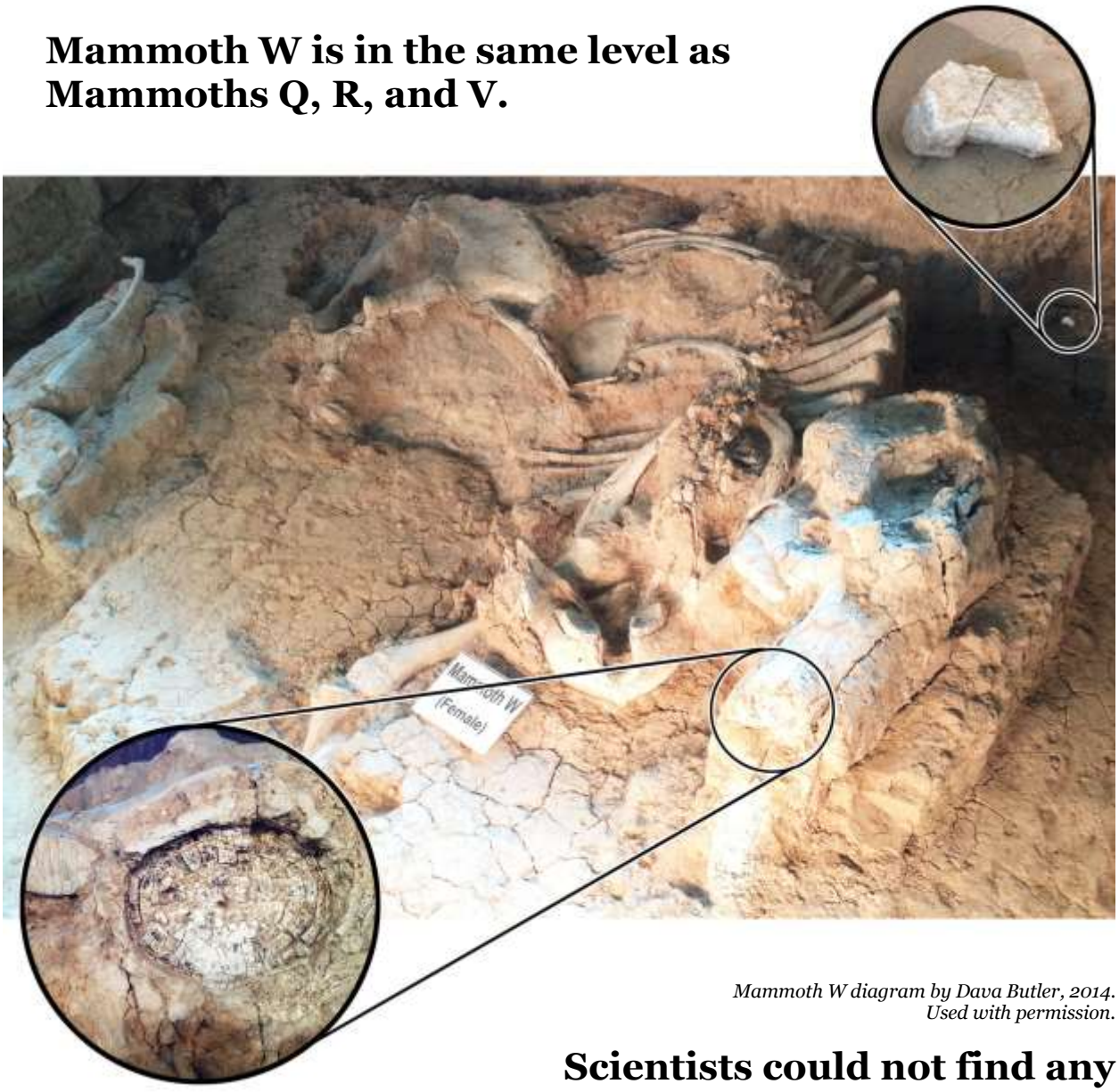

Mammoth R before partial removal.
Photo by Nick Cirincione, 1993. Used with permission.

Mammoth R was a young calf. R was found across one of Q's tusks. During the early years of excavation, some researchers thought this was evidence of Q trying to rescue R. More recent research says this is 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 is 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.

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



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

Scientists could not find any DNA left in these fossils. It is not known whether R is W's calf.

All four of W's teeth are visible. She was on her fourth set, 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.

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 painting by Karen Carr. Used with permission.

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

This is a *Camelops hesternus*, or a Western camel. She is in the lowest level with the herd of mammoths.

Photo by Dava Butler, 2014. Used with permission.

The 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, but placed out where they are easier to see.

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

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

The Western camel looked more like a llama than a modern camel, except it was about 7 ft (2 m) tall at the shoulder.

A close-up view of the lower level.
Photo by Dava Butler, 2014. Used with permission.

Fossils of Western camels often are found with Columbian mammoth fossils, which is why scientists think they traveled together. Predators like saber-tooth cats probably avoided herds of mammoths because of mammoths' size and strength. Following mammoths may have ensured a camel's safety. In exchange, mammoths may have benefitted from a camel's superior eyesight.

Mural painted by Lee Jamison.

In the mural, the nursery herd and the camel are shown together with the flash flood waters approaching.

To the right of the camel, you can see the middle level.

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

Cat tooth, photographer unknown, 1998. Used with permission.

The event that created the middle level happened after the lowest level's event, which killed the nursery herd, and before the upper level's event, which killed Mammoths Q and W. This level 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 was a cub between 5- and 10-months-old.

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.

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 Dava Butler, 2012.
Used with permission.

Smilodon.
Illustration by Carl Buell. Used with permission.

The most famous is the 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 cat is the 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 the tooth 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.

The Waco Mammoth Site is a community effort.

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.

When fossils were found here in 1978, citizens of Waco united with faculty and staff at Baylor University to explore and preserve this amazing discovery.

95.6%
of the funds for this park and museum came from
private donations.

Future donations will be used for:

- A **laboratory** to preserve and study fossils
- A **museum** to display fossils
- A **classroom** to teach students
- **Park expansion**
- …and much more!

Ralph Vinson surveys his work.
Photo by Nick Cirincione, 1993. Used with permission.

We have many exhibits near the exit of the museum. These exhibits change periodically. Feel free to touch open displays. Your admission is good for the day—stay as long as you want.

If you have any questions, our tour guides will be happy to answer them for you.

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

Thank you for your visit.
Come back soon!

WACO MAMMOTH SITE

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