

LIFE IN ANCIENT OHIO

LATE PLEISTOCENE · 20,000 YEARS AGO

In the golden hour of an early summer evening during the Late Pleistocene...

*...large mammals surround a small glacial pond. A family of giant beavers (key, next two pages, number **9**; fig. 1) gather and feed on cattail (**19**) roots while ignoring the harassing attacks of male red-winged blackbirds (**2**) defending their nesting territories. A female mastodon (**10**; fig. 2), mindful of her vulnerable calf, warily eyes the approach of a male giant short-faced bear (**7**). A white-tailed deer doe (**14**), also alert to the movements of the bear, stands still.*

*Farther from the pond, a giant ground sloth (**12**; fig. 3) browses leaves and branches of a young birch tree (**17**) at the edge of a forest dominated by conifers (**20–23**). Flying overhead, a red-tailed hawk (**5**) clutches a captured northern bog lemming (**13**). Beyond the forest edge, a bull ancient bison (**8**) watches for rivals as ancient bison cows graze with a calf nearby. On the windswept grasslands beyond, a lone male woolly mammoth (**11**) roams amidst scrub pines (**22**) charred by wildfires.*

*On the far side of a braided stream carrying cold meltwater from the glacier, young muskox bulls (**15**) forage for grasses, sedges, and mountain avens (**18**) atop a ridge of glacial rock debris. In the distance, but still far from the ice front, nonbreeding Canada geese (**4**) fly in a V-shaped formation, migrating to a safe location to settle and molt their flight feathers.*

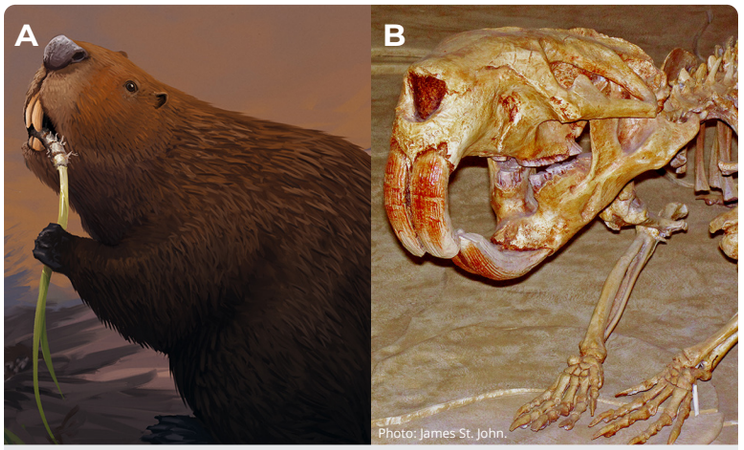


Figure 1. (A) Living reconstruction of *Castoroides ohioensis* (**9**). Giant beavers were nearly comparable in size to a small adult American black bear. (B) Mounted skeleton of the extinct giant beaver *C. ohioensis* on public display at the Sternberg Museum of Natural History in Hays, Kansas.

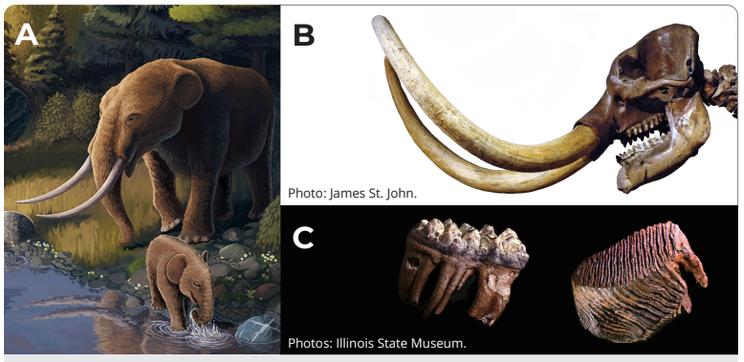


Figure 2. (A) Living reconstruction of an adult female mastodon, *Mammut americanum,* and calf (**10**). (B) Fossil skull and tusks of the Johnstown mastodon, an adult male specimen at the Cleveland Museum of Natural History. (C) Comparison of a molar from a mastodon (left) with that of a mammoth (right).

The imagined scene described above is based upon actual fossils from sediments deposited throughout Ohio during the Late Pleistocene. The depictions of animals that are now extinct are informed both by fossils and by living relatives of the fossil animals and the roles these relatives play in modern ecosystems. Although some aspects of the image are necessarily speculative, an attempt has been made to depict the animals and plants in a realistic manner consistent with our current knowledge of these life forms and their environment.

Major events in the history of life during the Pleistocene Epoch

During the Pleistocene Epoch, popularly known as the Ice Age (~2.6 million years ago [mya]–11,700 years ago), Earth's continents were approximately in their current global positions. The presence of large land masses near the polar regions permitted the formation of large continental ice sheets, like those that still exist in Greenland and Antarctica.

The Pleistocene was a time of frequent and severe climate fluctuations at middle and higher latitudes, with long glacial periods alternating with shorter interglacials (warmer intervals between glacial periods). The timing of glacial versus interglacial periods has been correlated with cyclical variations in the shape of Earth's orbit, as well as the tilt and orientation of Earth's axis of rotation relative to the plane in which Earth orbits the Sun. These orbital cycles (called Milankovitch cycles) affect the distribution of solar energy across Earth's surface, especially at higher latitudes, where ice sheets originate. In response to changes in climate from glacial to interglacial periods, plants and animals adapted by altering their geographic ranges—such as by relocating northward or southward.

Prior to the Pleistocene, the Isthmus of Panama formed from an arc of volcanic islands, connecting the continents of North and South America. By the early Pleistocene, the resulting land bridge allowed terrestrial species to travel between the two continents. Some mammals living in North America today, including species of armadillo, opossum, and porcupine, as well as extinct species, such as giant ground sloths (**12**), invaded from South America as part of this interchange. The formation of the isthmus also closed



Artwork by Kyle Hartshorn of Cincinnati, Ohio

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(Based on fossils of the glaciated portions of northern, western, and central Ohio)

ANIMALS

Arthropods

Insects

1. Ephemeropteran (unspecified mayfly)

Chordates

Birds

2. *Agelaius phoeniceus* (red-winged blackbird, male)
3. *Agelaius phoeniceus* (red-winged blackbird, female)
4. *Branta* cf. *B. canadensis* (Canada goose)
5. *Buteo jamaicensis* (red-tailed hawk)
6. *Corvus corax* (common raven)

Mammals

7. †*Arctodus simus* (giant short-faced bear)
8. †*Bison antiquus* (ancient bison; labeled 2x)
9. †*Castoroides ohioensis* (giant beaver; labeled 2x)
10. †*Mammut americanum* (American mastodon; labeled 2x)
11. †*Mammuthus primigenius* (woolly mammoth)
12. †*Megalonyx jeffersonii* (Jefferson's ground sloth)
13. *Mictomys (Synaptomys) borealis* (northern bog lemming)
14. *Odocoileus virginianus* (white-tailed deer)
15. *Ovibos moschatus* (muskox)
16. *Sciurus carolinensis* (eastern gray squirrel)

PLANTS

Angiosperms (flowering plants)

17. *Betula* sp. (birch)
18. *Dryas* sp. (avens)
19. *Typha* sp. (cattail)

Pinophytes (cone-bearing gymnosperms; conifers)

20. *Abies* sp. (fir)
21. *Picea* sp. (spruce)
22. *Pinus banksiana* (Jack pine or scrub pine)
23. *Pinus* sp. (pine)

Key to Abbreviations

cf.	Latin, *conferre* (species not determined but compare with this species)
sp.	species (of organisms: indeterminate species of the genus)
†	dagger symbol; indicates extinct species

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a connection between the Atlantic and Pacific Oceans and isolated warm-water marine species on either side. The loss of this marine connection may have altered ocean circulation and the distribution of heat from lower to higher latitudes, which could be related to the onset of this ice age.

Land bridges, which connected land masses previously separated by shallow waters, were also created by falling global sea levels. During glacial periods, vast volumes of water were frozen in massive ice sheets on land, and sea levels were as much as 120 meters [m; ~390 feet (ft)] lower than today. The Bering land bridge, which spanned the strait separating modern-day Siberia and Alaska, existed intermittently during the Pleistocene and allowed for the exchange of terrestrial species between Asia and the Americas. Modern humans (*Homo sapiens*) likely utilized this land bridge to enter the Americas about 20,000 years ago, or thereafter, when glaciers reached their greatest advance (Last Glacial Maximum).

The Ohio region during the Late Pleistocene

The Late Pleistocene (~129,000–11,700 years ago) spans the last interglacial and glacial periods to the beginning of the current (Holocene) interglacial period. The Ohio region, being near the southerly extent of ice sheets during glacial periods, was ice-free for much of this time. As early as 35,000 years ago, the Laurentide Ice Sheet began to advance into the region. By 26,000–24,000 years ago, it reached its greatest extent of southern advance, almost to the present-day Ohio River in the southwest corner of the state, and it covered much of western, central, and northern Ohio. Near present-day Lake Erie, ice thickness is estimated to have been nearly one mile (1.6 kilometers) but was likely less thick near its southern margin.

From seeds and pollen in glacial lake deposits and preserved fossil wood, including tree stumps preserved in

place, paleontologists can reconstruct the composition of forests during glacial and interglacial periods. During glacial periods, forests resembled those existing today in more northerly latitudes, with a dominance of coniferous evergreen trees, such as firs (**20**), spruces (**21**), and pines (**23**). By ~20,000 years ago, glacial ice was receding, and Ohio was ice-free by ~14,000 years ago. Deciduous broadleaf trees, characteristic of the present interglacial period, again became dominant.

Pleistocene deposits in Ohio

Unlike Ohio's older bedrock deposits, which are mainly composed of firm rock, the state's Pleistocene-age deposits consist of unconsolidated sediments. In the glaciated portion of the state, these consist primarily of glacial till, which is sediment eroded and transported by glaciers and deposited directly by ice. Deposits of till are unstratified (unlayered) and contain a mix of sediment sizes, from fine clay and silt to large boulders. Till may be distributed as a blanket of sediment, or concentrated in landforms such as terminal moraines, which mark the point of maximum advance of a glacier.

Rocks that are transported by glaciers from where they naturally outcrop and are redeposited elsewhere are called *glacial erratics.* In Ohio, rocks most easily recognized as glacial erratics are rounded boulders—especially of igneous and metamorphic rocks, which do not occur in the state's surface bedrock. Some of these erratics have been matched with source areas in Michigan and Canada.

Pleistocene-age deposits include sediments deposited within glacial lakes. *Proglacial lakes* formed when ice sheets dammed the natural flow of a river and caused it to back up, creating a lake along the ice margin. Other deposits, called *outwash deposits*, were made by glacial meltwater along natural drainages. These can extend into parts of southeastern Ohio that were not directly covered by ice.

Life during the Late Pleistocene in Ohio

The majority of species living during the Late Pleistocene in Ohio are still living today. Some animals, such as the northern bog lemming (**13**) and the muskox (**15**), and some plants, such as the Jack pine (**22**), now occupy more northerly ranges outside of Ohio. Numerous isolated fossil finds from around Ohio and more complete fossil faunas from rare exceptional sites, such as the Sheridan Cave site in Wyandot County, allow paleontologists to reconstruct life during the Late Pleistocene.

Most North American animal species with a large body size (called *megafauna*) became extinct near the end of the Pleistocene. Examples from the Ohio region include giant short-faced bears (**7**), giant beavers (**9**; fig. 1), giant ground sloths (**12**; fig. 3), and stag moose, among others. In general, larger animals are more vulnerable to extinction because they require extensive habitat areas and have slow rates of reproduction. The most widely accepted of the proposed causes of extinction of North America's large mammals include overkill by hunter-gatherers, human-caused modifications to the environment, such as removal of critical, keystone species or introduction of fire, rapid climate change, or a combination of these.

In the second annual report of the Ohio Geological Survey, J. W. Foster (1838) illustrated partial remains of an extinct giant beaver species, discovered near Nashport in Muskingum County, and named it *Castoroides ohioensis* (**9**; fig. 1). The remains included an incisor tooth that suggested a beaver of unusual size. Subsequent finds of more complete skeletons indicated a body length of ~6–7 ft (~2 m), making *C. ohioensis* one of the largest rodents known to have lived in North America.

Large, elephant-like mammals, such as the American mastodon (**10**; fig. 2) and the woolly mammoth (**11**), are the most frequently reported Ice Age fossils in Ohio. This recognition bias is likely because their remains are large and easily distinguished from remains of animals currently living in the state. Mammoths, which were more closely related to modern elephants, had teeth with flat grinding surfaces suitable for chewing grasses and sedges (fig. 2C). Mastodons browsed on needles and twigs of spruce trees (**21**) and woody shrubs and had molars with tall, nipple-shaped cusps (fig. 2C) that inspired their common name, which means "breast-tooth."

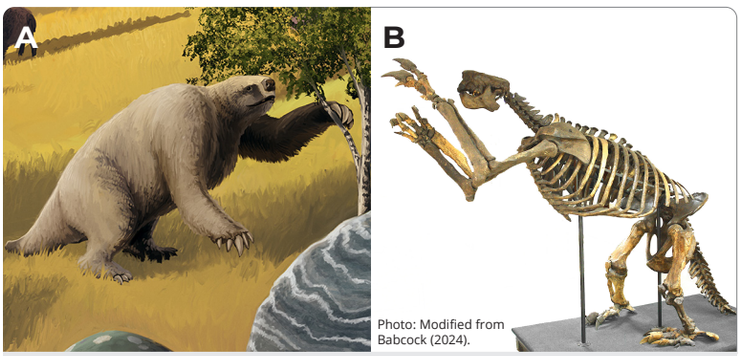


Figure 3. (A) Living reconstruction of the extinct giant ground sloth *Megalonyx jeffersonii* (**12**). The species name honors Thomas Jefferson, who erected the genus *Megalonyx* in 1799. (B) Skeleton (~7 ft tall as mounted) of *M. jeffersonii* recovered in 1890 from a farm in Holmes County, Ohio, on display in the Orton Geological Museum at the Ohio State University.

An Ohio natural resource

Events of the Pleistocene Epoch transformed the natural landscape in Ohio and contributed to the state's natural resources, including its most valuable resource: water. Ice Age glaciers shaped the basins of the Great Lakes and supplied their initial water. Unconsolidated glacial deposits comprise some of the state's most import aquifers. Glacial lakebed sediments and till deposits formed soils that are among the most fertile in Ohio for agriculture. Pleistocene-age deposits of sand-and-gravel outwash are mined for construction aggregate and other uses.

Besides the economic legacy of the Pleistocene, glacial processes acted on existing bedrock to shape many of Ohio's scenic broad valleys and deep gorges. Additionally, fossils of extinct large mammals capture the imaginations of Ohioans. Even less impressive fossils, such as snail shells, seeds, spores, and pollen, provide important data for reconstructing the climate of this region during glacial and interglacial periods.

For more information, references, and details about where to view Ohio's Pleistocene-age deposits, visit:

ohiodnr.gov/LIAO