ICE AGE MAMMALS OF YUKON

An x-ray image of a complete arctic ground squirrel mummy found preserved in its burrow. This mummy is 47,000 years old!

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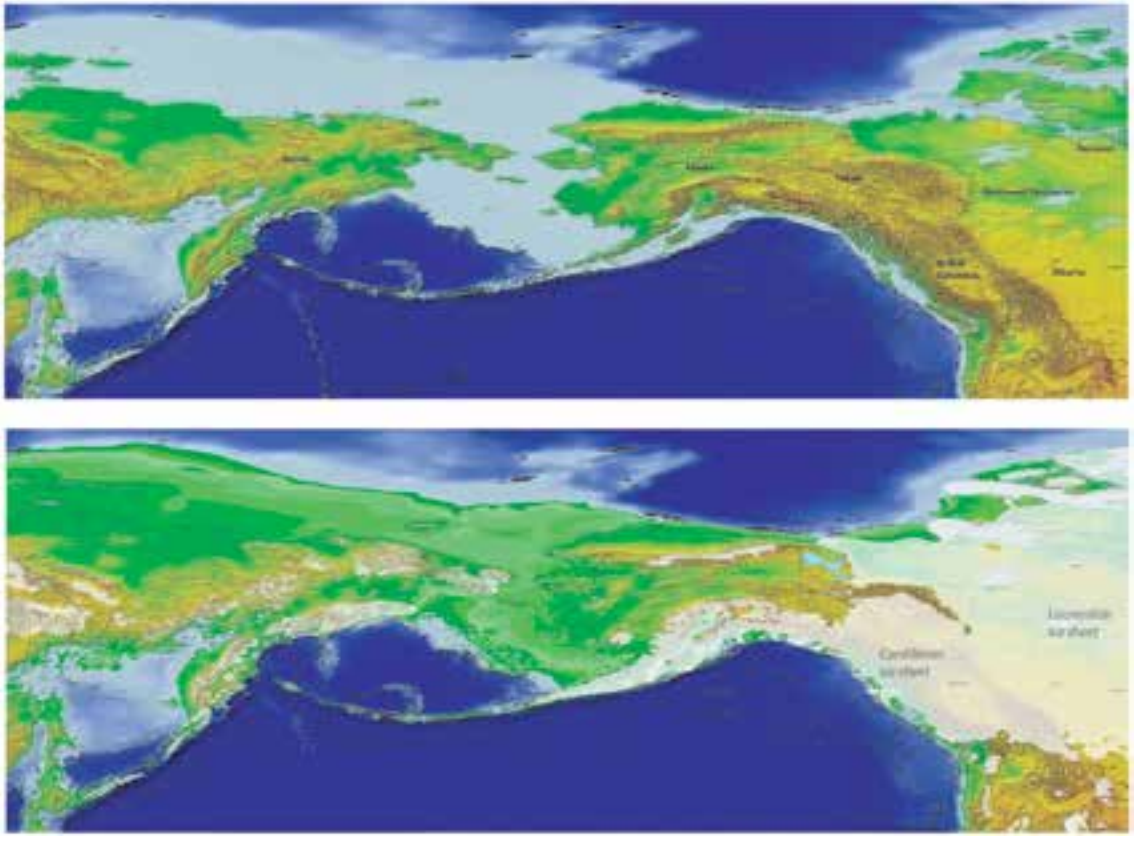
YUKON BERINGIA INTERPRETIVE CENTRE

Yukon Tourism and Culture

MAP OF BERINGIA



Beringia today (top) with submerged land bridge and Beringia 18,000 years ago (bottom) with exposed land bridge. Map courtesy Yukon Geological Society.

A Yukon horse jaw uncovered by placer miners on Quartz Creek near Dawson City.

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THE ICE AGE

In the far northwest corner of Canada lies a fascinating place that is treasured by the world for its stunning beauty and vast, unspoiled wilderness—a place called Yukon. Many come to Yukon to view the iconic wildlife of the boreal forest, from grizzly bears, wolves and lynx, to caribou and moose. But Yukon has not always looked this way. The picture of life in the North has changed immensely over thousands of years. These changes are well documented in the stories of the First Nations people who have traversed the land for generations. Change is also revealed by ancient fossils and bones of animals that roamed Yukon long ago. Probably the best understood period of Yukon's ancient history is the Ice Age. Before we explore this vanished version of Yukon, it is important to take a moment to set the stage and explain a bit about the Ice Age.

If we consider the past thousands or millions of years, the Earth's climate is far from stable. During the last 2.5 million years alone, there were many times when the Earth's temperature dropped well below what we think of as normal. Imagine Earth as much as five degrees colder than it is today! But there were also times between these cold periods when climate was as warm as today. Together these repeated cycles of cold "glacial" times and warm "interglacial" times are what we have come to call the **Ice Age**, or the **Pleistocene** epoch. This ice age climate has shaped the plants, animals, and landscapes that are familiar to us today.

Did You Know?

Climate has always been in a state of fluctuation. The **Ice Age** or **Pleistocene** wasn't always cold, but nearly 80 per cent of the Ice Age was dominated by glacial times when temperatures were colder than present day. For the remaining 20% of the Ice Age, temperatures were similar to today.

We are presently living in an interglacial warm period known as the Holocene which started 11,000 years ago.

Yukon's Ice Age Story

For most of the Ice Age, Canada was covered by ice several kilometers thick. Glaciers in the Arctic advanced and retreated with the cooling and warming of the Earth's climate. But a small corner of northwest Canada, in Yukon, escaped these glaciers and remained home to a vast array of both strange and familiar ancient beasts. Even with Yukon cut off from the rest of North America by these glaciers, it was not completely isolated. During these cold times, when glaciers blocked the way south, Yukon and neighbouring Alaska were connected to Asia by an exposed "land bridge" across the Bering Strait. This ice-free land, stretching from Yukon to Siberia, is known as Beringia.

When the Earth completed its transition from the last glacial to the present warm period approximately 11,000 years ago, the massive glaciers covering North America melted. The Bering land bridge was again flooded by the sea, and Yukon's strange ancient beasts vanished, but not entirely.

Now, throughout Yukon's short, intense summer months, fossil bones, teeth and skeletons are released from the frozen ground, from Herschel Island to the goldfields of the Klondike. This frozen ground, or **permafrost**, provides a window into life during the Ice Age. New fossils continually reveal incredible stories of ancient mammals that once called Yukon home. In fact, Yukon is Canada's most important source of ice age mammal fossils. Other areas of Canada, such as Alberta's badlands, are famous for their much older dinosaur bones. Yukoners can take great pride in the fact that their home produces the most abundant and most significant ice age mammal fossils in Canada.

Digging Deeper:

Permafrost is ground that remains frozen throughout the year. Permafrost is one of the most important and unique aspect of the fossil record of Beringia. Because some ancient animals were nearly instantly frozen when they died, permafrost provides the ideal situation for preserving bones, and sometimes soft tissues such as hair, skin and muscles. Nearly complete frozen carcasses of Ice Age mammals have been found in Beringia.

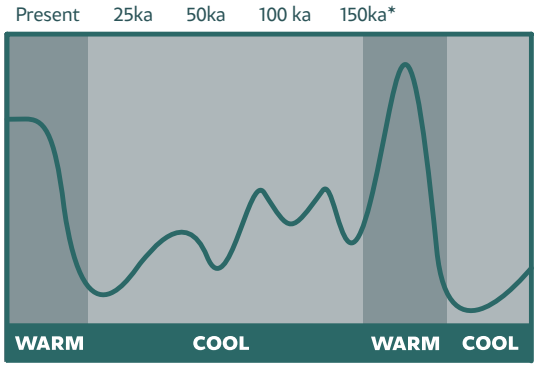


*Figure: Glacial and Interglacial Cycles for the last 150ka**

**150ka = 150,000 years ago*

Archaeologist Jana Morehouse shows off a recently discovered 3 metre long mammoth tusk.

When you see these icons and coloured tabs, it means there is more information available on our website.

Follow along to learn more about these Ice Age mammals! If you want to delve deeper into any of these topics, be sure to check out the additional information on our website **www.beringia.com,** check us out on Facebook at **facebook.com/yukonberingia**, or send us a note on twitter **@yukonberingia.**

WOOLLY MAMMOTH

Mammuthus primigenius

For many people, the woolly mammoth is the prime example of an ice age mammal. These large, furry elephants were perfectly adapted to living on the **Mammoth Steppe** of ice age Yukon. About the size of an African elephant, a woolly mammoth stood a little over three metres tall at the shoulder and consumed more than 200 kilograms of grass each day. The discoveries of complete frozen woolly mammoth carcasses have revealed detailed glimpses into the life and appearance of these iconic animals. Some preserved physical characteristics can even be linked back to specific adaptions to life in the cold—for example their thick fur, small ears and short tail were all adaptations to minimize heat loss.

Woolly mammoths, like many giant animals of the Ice Age, went extinct as the climate warmed at the end of the last glacial period. Fossils from North America and Asia indicate woolly mammoths disappeared from the mainland around 12,000 years ago. Remarkably, they managed to survive on small Arctic islands off northern Siberia until around 4,000 years ago.

Did you know?

Today, Yukon is mostly boreal forest, but during glacial periods of the Ice Age the region that remained free of ice making it an ideal habitat for woolly mammoths. This cold, treeless grassland plain takes its name from the mammoth—it is known as the **Mammoth Steppe.**

Yukon's Woolly Mammoth History

The long, curved tusks of woolly mammoths are probably the most immediately recognized ice age fossil from Yukon. A single tusk from an adult male tusk can stretch over 3.5 m long and weigh more than 100 kg. These tusks may have been used for display, defense, or possibly to sweep away snow to get at grass in the winter. Tusks preserve a wealth of information about a mammoth's life because they are a lot like trees, with layer upon layer of growth rings forming over time. By studying these growth rings, scientists can learn about a mammoth's health through its entire lifespan, the climate a mammoth lived in, and where it migrated to and from.

Did you know?

Scientists have found evidence that like modern elephants, mammoths sometimes used their tusks as a "nose-rack" for resting their trunk.

They only used the right or left tusk depending on whether they were right- or left- "handed".

Paleontologist Tyler Kuhn poses with a mammoth tusk found at a placer mine in Dawson City, Yukon.

Status: Extinct **In Yukon:** 300,000 – 12,000 years ago

George Teichmann's Beringia Winter Scene, 1996.

Mammoth teeth, or molars, are common fossils in Yukon. These mammoth molars are very distinctive, with vertical hard enamel plates that formed a flat grinding surface for breaking down tough grasses. Analysis of mammoth baby molars from Old Crow revealed that young mammoths may have nursed on their mother's milk for much longer than today's African elephants – nursing almost exclusively until about three years of age. This prolonged nursing may have been an adaptation to help survive the long dark winters, when food was scarce. Or, maybe young mammoths preferred to stay close to their mothers, so as to avoid falling prey to a hungry Beringian lion or other predator?

The first mammoths crossed Beringia into North America around 1 million years ago. DNA extracted from fossil bones reveals that the woolly mammoth evolved in Yukon and Alaska around 300,000 years ago from those ancestors. They eventually spread back across Beringia and into Europe. Woolly mammoths also had a close cousin, the larger bodied Columbian mammoth (*Mammuthus columbianus*), which lived further south in North America. Recent genetic evidence is suggesting that woolly and Columbian mammoths interbred in regions where they overlapped.

Recent Discoveries

Thanks in part to the amazing preservation of permafrost, the North's natural deep freezer, geneticists have come tantalizingly close to resurrecting the woolly mammoth! We now know the complete sequence of mammoth DNA—their genome—including the DNA sequence for mammoth hair colour and blood proteins. But so far a living, breathing woolly mammoth is still only possible in science fiction.

AMERICAN MASTODON

Mammut americanum

Mammoth or mastodon? Many people use these two names interchangeably to describe big furry ice age elephants. However, while both are distantly related to elephants, these two animals are distinctly different beasts. The ancestors of American mastodon split away from the mammoths sometime around 25 million years ago. Their ancestors eventually crossed Beringia, eastward from Asia, around 15 million years ago. As its name suggests, the American mastodon evolved in North America, some 3.5 million years ago. Even though it never made the return journey back into Asia, the American mastodon had an incredibly wide geographic range during the Ice Age—stretching from Arctic Alaska to the tropics of Honduras!

A few key features can help distinguish a mastodon from a mammoth. Both superficially looked like furry elephants, but mastodons were slightly shorter and had a stockier build. Mastodon tusks are shorter and straighter than those of their mammoth cousins. Probably the most significant difference is the shape and function of their molars. Mammoth molars had a nearly flat surface, used for grinding and sheering grass. American **mastodon molars** were distinguished by low, rounded cusps covered in hard enamel that formed a pair of rows. These teeth were great for snapping and chewing branches of shrubs and small trees. In essence, a mammoth was a grazer, while a mastodon was a browser. Think cattle (mammoth) versus moose (mastodon).

Did you know?

Mastodon molars look surprisingly similar to some human molars, albeit giant versions. Some early collections of American mastodon molars that were sent to scientists in France in the 18th century were described as the teeth of giant people!

Yukon's Mastodon History

Unlike Yukon's abundant record of mammoths, mastodon fossils are rarely found in Yukon. Approximately 95 per cent of the ancient "elephant" fossils in Yukon are from mammoths. A few isolated mastodon molars have been recovered from the Klondike placer mines and along the Old Crow River, and a single foot bone was found all the way up in Herschel Island. Because mastodon fossils are so rare in Yukon, it was a great surprise when Mr. Earl Bennett donated a partial mastodon skeleton to the Yukon Palaeontology Program! The skeleton included several limb bones, shoulder blades, vertebra, and jaws with molars. It was discovered by a crew working on Bonanza Creek in the early 1970s. It is the most complete example of an American mastodon ever found in Yukon.

George Teichmann's Mastodon, 1997.

Status: Extinct **In Yukon:** Unknown – 75,000 years ago

Digging Deeper

Radiocarbon dating is a technique used by scientists to work out how many years have passed since an animal's death. This works by measuring the amount of radioactive carbon remaining in a fossil. Since radioactive carbon (carbon-14) breaks down at a known rate starting once the animal dies, the amount remaining is used to determine how long ago the animal died.

Do you know what is the oldest age carbon dating can determine?

Not sure where to find the answer? Try looking on www.beringia.com.

Recent Discoveries

Radiocarbon dates and other information gleaned from mastodon fossils found in Alaska and Yukon indicate they died out in the North around 75,000 years ago. This is a stark contrast to American mastodon from more southern parts of the continent, where they thrived until around 12,000 years ago. It seems that mastodons only ventured northward during the relatively warm parts of the ice age—like the last interglacial period, around 125,000 years ago. This was a time when climates warmed up and trees and wetlands returned to Yukon. Mastodons did well in the interglacial forests because they were browsers. American mastodons were probably not able to cope with the return of the cold, dry, Mammoth Steppe of the glacial periods in Yukon.

Once gone from the North, mastodons thrived south of the great continental glaciers. Their fossils are very common near the Great Lakes and the Atlantic Coast south to Florida. Although people did hunt mastodons, there is still some debate as to whether it was over-hunting that finally finished them off.

One remarkable find at the 14,500 year old Manis site in Washington State has evidence of a mastodon being killed by a spear point made out of mastodon bone. This is amongst the earliest evidence of human hunters in the New World.

Yukon Palaeontologist Grant Zazula holds a mastodon ulna from the Bennett mastodon.

STEPPE BISON

Bison priscus

Not all of the iconic Ice Age animals went extinct at the end of the last glacial period. One example is the steppe bison. Steppe bison survived until quite recently, and gave rise to the two types of living bison we see today, the plains bison and wood bison. Although they had similar body size compared to their present-day cousins, the ice age steppe bison had much larger horns. The ancestors of steppe bison, called *Bison bonasus*, evolved in the grasslands of Europe and Asia during the early part of the Ice Age, over one million years ago.

Did you know?

One of the true icons of the early pioneering days in North America was the "buffalo". However, those animals are not actually buffalo—which is a type of animal only found in Africa—but rather, they are a relative of steppe bison known as plains bison.

Although bison are an iconic North American mammal, they were absent from this continent for much of the Ice Age. For over a million years, the North American landscape was dominated by mammoths and ancient horses. This picture changed around 160,000 years ago when steppe bison first crossed Beringia and soon became the most abundant, large herbivore in North America. From Beringia, they spread as far south as Mexico. A broken piece of fossil foot bone (metacarpal) found in a high bluff along the Porcupine River near Old Crow in 2006 is the most ancient bison fossil found in North America.

The Most Abundant Ice Age Yukon Fossils

In some parts of Yukon, the permafrost is nearly a graveyard of ancient bones of steppe bison. Over 80 per cent of the fossil mammal bones from the Klondike gold mines are from steppe bison. Part of why scientists know so much about steppe bison is because, like the woolly mammoth, mummified carcasses have been found. One of the most famous ice age carcasses is that of 36,000 year old "Blue Babe" that was discovered at a gold mine near Fairbanks, Alaska in 1979. Blue Babe had a spectacular blue color because its preserved skin was covered by the mineral vivianite. Thick tufts of preserved reddish brown fur indicate these bison were well insulated for the cold ice age climates.

Palaeontologist Richard Harington holds up a nearly complete steppe bison skull found near Dawson City, Yukon.

Status: Extant **In Yukon:** 160,000 – 200 years ago

Rows upon rows of bison skulls from the Canadian Museum of Nature.

Recent Discoveries

The study of ancient DNA preserved in steppe bison bones has revealed a fascinating historical tale. After the arrival of steppe bison in North America, their populations experienced several booms and busts. During one period of decline, around 30,000 years ago, the advance of glaciers across most of Canada created a barrier that separated the northern populations from those that lived in the southern part of North America. The split of these two populations—north and south—had dramatic consequences for bison evolution. Near the end of the Pleistocene, around 13,000 years ago, bison populations in Alaska and Yukon were dwindling, yet groups to the south of the glaciers were expanding and ultimately evolved into their modern forms. A bison bone found near Annie Ned Creek, between Whitehorse and Haines Junction, indicates that the northern population in Yukon survived until only about 400 years ago.

Unlike many ice age animals, bison are still with us today. Photo: Shutterstock.

Did you know?

The bison you can see in Yukon today are not direct descendants of the steppe bison which lived here during the Ice Age. Bison were reintroduced to Southern Yukon in the 1970s and thrive on the grasslands around Kluane and Aishihik Lakes.

AMERICAN SCIMITAR CAT

Homotherium serum

Perhaps the most popular icon of the Ice Age is the sabre tooth cat (*Smilodon fatalis*). But this iconic predator is only known from more southerly parts of North America, ranging no further north than southern Alberta. The more widely distributed American scimitar cat is perhaps a more fitting iconic predator of the ice age world. The scimitar cat is often confused with its sabre-toothed relative, but the two can be most easily distinguished by the size and shape of their oversized canine teeth. The scimitar cat has smaller, serrated "dirk-shaped" upper canines while its sabre-toothed relative has much larger "sabre-shaped" upper canines. Both would have been formidable hunters, but to date only scimitar cat remains have ever been found in Yukon.

Scimitar and sabre tooth cats are part of a unique and now extinct branch of the feline family tree, a fact only recently confirmed using DNA extracted from a Yukon fossil. Since these cats have no living relatives, palaeontologists have been struggling to unravel the mysteries of how they lived, how they used their oversized canine teeth, and why there are no scimitar or sabre-toothed cats alive today.

A scimitar cat canine from the Canadian Museum of Nature.

American scimitar cats had long slender limbs, a long powerful neck, a short stocky body with a sloping back, and a relatively short tail. They seem well adapted to short bursts of speed and for delivering a precise fatal bite with their fierce upper canine teeth. However, with its specialized, precision hunting style focused on medium-sized prey (for example horse, bison and caribou), the scimitar cat appears to have been unable to compete when prey populations changed and new, less specialized predators arrived.

Scimitar Cats in Yukon

The scimitar cat was the second largest feline species to live in Yukon during the Ice Age—weighing in around 200 kilograms. Their meagre fossil record indicates they were relatively rare, and their populations peaked just before 20,000 years ago.

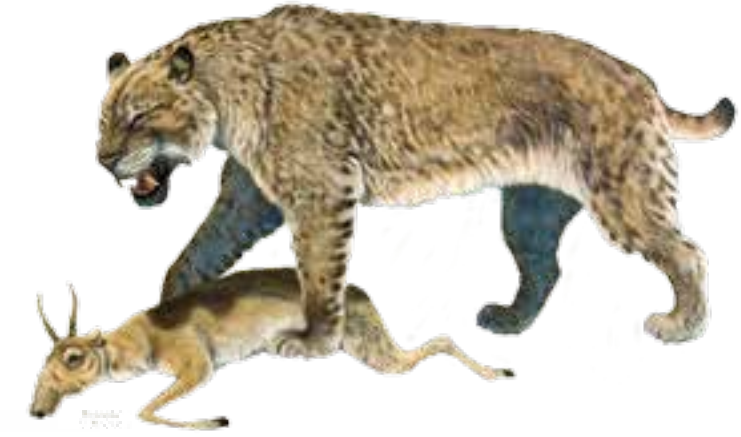
The first scimitar cat fossil ever discovered in Yukon was found in 1968. This bone, a fragment of a lower jaw, was recovered by researchers working along the Old Crow River in northern Yukon. Since this discovery, scimitar cat bones have also been found in the Klondike goldfields area and in Alaska.

Did You Know?

Scientists can tell a lot about an animal from its bones, but it's not just the shape and size of bones that tell the story. The **chemical composition,** or more accurately the chemical, or isotopic, composition, of bones can tell us where an animal lived and what they ate.

Status: Extinct **In Yukon:** 80,000 – 20,000 years ago

This jaw fossil was the first scimitar cat fossil ever found in the Yukon.



George Teichmann's Scimitar Cat with Saiga Antelope Kill, 1999.

Using the **chemical composition** of and radiocarbon dates for scimitar cat and other predator bones from Fairbanks, Alaska, researchers have been able to explore the predator-prey relationships of ice age Beringia. For example, the scimitar cat fossils from Fairbanks were all about 35,000 years old —from a time when there were few Beringian lions or short-faced bears. These scimitar cats preyed upon horses and bison, the most abundant prey animals of that time. But when horse and bison numbers started to decline, and lions and short-faced bears became more abundant, the scimitar cat was outcompeted and disappeared.

Recent Discoveries

Many researchers have attempted to answer the age-old question of why these cats have oversized canine teeth. Recent studies have looked at the relationship between the size of these impressive upper canines and overall body size to reveal information about their evolution. One striking conclusion suggests that the oversized sabre tooth cat canines may not have even been adaptations for hunting. Rather, these formidable canines are more related to impressing a female—something biologists call **sexual selection**. This contrasts with those of scimitar cats and modern felines where canines evolved as specialized hunting weapons.

Did you know?

Sexual selection, or evolutionary change that results from traits used to impress a mate, is responsible for many spectacular displays in the animal world, from peacocks' tail feathers, to moose antlers, and even the elaborate colouration of some fish. Now we can add sabre tooth cat teeth to the list of sexy apparel (or assets?) of the natural world!

ANIMALS OF THE INTERGLACIAL PERIODS

The Ice Age included brief and periodic returns to warm conditions much like today. We call these warm periods Interglacials. The establishment of these warm periods was part of the regular back and forth fluctuations in climate experienced over the last 2.5 million years.

During these interglacial periods, the Mammoth Steppe was replaced by forests and wetlands expanded, glaciers retreated and land across the Arctic and Subarctic was available for mammals once again. But, the mammal communities of the Ice Age interglacials were completely different from those we are familiar with today.

Instead of moose, animals like giant ground sloths, American mastodons and giant beavers made the northern forests their home. These strange beasts from the south only migrated northward to Alaska and Yukon during warm interglacial periods. They were not built for life in the North during the typical cold times of the Ice Age. When cold glacial climates returned to the North, these animals of the interglacial periods retreated to their southern homes.

A Jefferson's ground sloth skeleton from the Yukon Beringia Centre.

Collection of giant camel bones from the Old Crow river, in the collection from the Canadian Museum of Nature.

JEFFERSON'S GROUND SLOTH

Megalonyx jeffersonii

The Jefferson's ground sloth might be the strangest beast to ever inhabit Yukon. These unusual animals are distant relatives of the tree sloth that still live in Central and Southern America today. The sloth family originated in South America and migrated northward across the Isthmus of Panama some five million years ago. Several species of ground sloth lived in North and South America during the Ice Age, but only the one named after former U.S. President Thomas Jefferson made it all the way to Yukon and Alaska.

A full grown Jefferson's ground sloth was about the size of an ox, at up to three metres long. Although the appearance of these giant ground sloths might seem menacing, they were herbivores. They may have used their long, sharp claws in defense, but these claws were probably better suited to grasping for food in tall tree branches. Their long, blunt, peg-like teeth were used to strip leaves from shrubs and tree branches. Jefferson's ground sloth, like its tree-dwelling relatives, was probably a slow, awkward mover on land, with its feet rotated over so it was walking on its ankles and baby toes.

Jefferson's ground sloth fossils are commonly found in the western United States, the Great Lakes and Florida. Jefferson's ground sloths probably used caves for protection from the elements and hungry predators. One of their distant relatives, the Shasta's ground sloth (*Nothrotheriops shastensis*), is famous for the incredibly thick layers of fossilized dung they left preserved in caves of the American southwest. Another spectacular find from a cave in Tennessee contained an individual Shasta's ground sloth's bones that were still attached by ligaments and cartilage. There was even a mummified fingernail on the sloth's finger!

There is still considerable scientific debate on what caused the extinction of these ground sloths around 11,000 years ago. Only a single site discovered in North America has yielded Jefferson's ground sloth bones that appear to have been butchered by humans, so it is unlikely their demise was caused by overhunting.

Did you know?

When palaeontologists in Yukon discover a large, strange looking fossil that does not fit with the more typical ice age mammals, their first guess is that it is a bone from an ancient ground sloth.

Yukon's Ground Sloths

In Yukon, Jefferson's ground sloth fossils are rare and only known from sites along the Old Crow River. Other northern specimens have been found near Fairbanks, Alaska and near Yellowknife, Northwest Territories. The Old Crow specimens are significantly smaller than fossils of this species found further south. Their smaller size may be an adaptation to the colder temperatures faced by Jefferson's ground sloths in the North. Based on their diet of leafy and woody material, scientists believe Jefferson's ground sloths only lived in the North during the warm interglacial. Their habitat preferences suggest they were gone from Yukon by about 75,000 years ago, when cold glacial climates eliminated the trees and allowed the cold, dry Mammoth Steppe to spread. Like mastodons and giant beavers, Jefferson's gound sloths only ventured north to Yukon when brief periods of warm climates appeared during the Ice Age.

Status: Extinct **In Yukon:** Unknown – 75,000 years ago

The finger bone of a Jefferson ground sloth found in the Old Crow area.

Digging deeper

Ground sloth remains have never been found in Siberia or the rest of Asia and Europe. Do you know what might have prevented them from expanding west beyond Alaska?

Hint: Compare the maps of Beringia on page 3. Do you see any big differences between the warm periods (like today) and the cold period (20,000 years ago)?

George Teichmann's Ground Sloth, 1999.

GIANT BEAVER

Castoroides ohioensis

Rodents the size of bears! The giant beaver was a true ice age giant. Stretching up to two metres long and weighing up to 100 kilograms, the giant beaver is the largest rodent of all time. The giant beaver is known from fossil sites all across North America, but is most common along the Atlantic coast and just south of the Great Lakes. In northern Yukon, fossil incisors the size of bananas and molar teeth of giant beaver are well known from the banks and bluffs along the Old Crow and Porcupine Rivers. Tales of the giant beaver figure prominently in the Vuntut Gwich'in of Old Crow's traditional stories of times long ago.

Contrary to popular belief, giant beavers are not just huge ancestors of today's modern beaver (*Castor canadensis*). The fossil record suggests that the last time the giant beaver and the modern beaver species shared a common ancestor was about 24 million years ago. Even so, the shapes of their bones look a lot like those of a modern beaver, only much larger. The giant beaver's hind feet were also comparatively gigantic, enabling them to efficiently paddle around ponds and lakes. The drawback was that their shortened hind limbs would have made walking on land difficult. The size and shape of their tail vertebrae suggest that the giant beaver's tail was relatively narrow, unlike the wide flat paddle of the modern beaver.

In North America, the youngest radiocarbon dated giant beaver fossil is about 12,000 years old. Like many of the ice age mammals, it is uncertain why they went extinct. There is no evidence that people hunted giant beavers. Maybe giant beavers could not adapt to the changing habitats associated with periods of rapid climate fluctuations at the end of the Ice Age. Perhaps they were outcompeted by other semi-aquatic rodents, like modern beavers or muskrats.

Did you know?

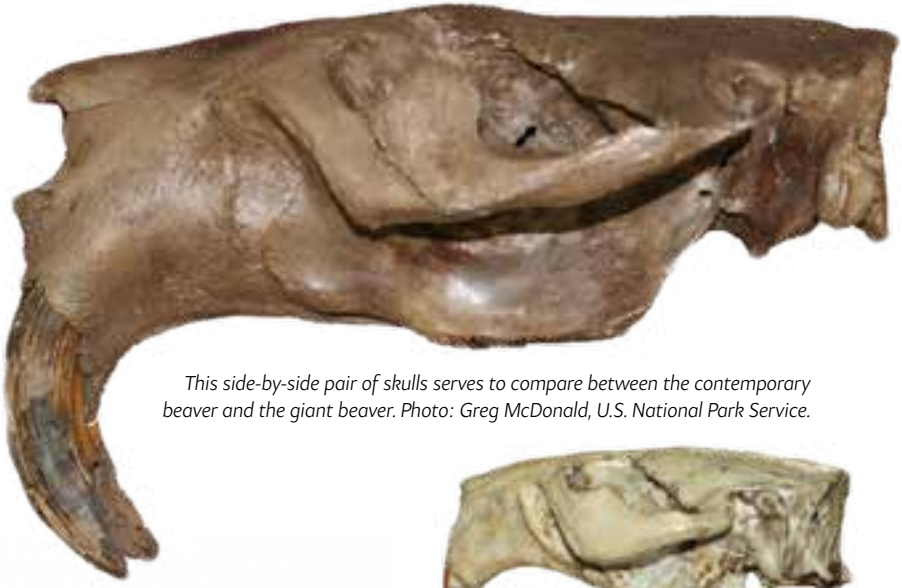
The oldest evidence in the world of beavers cutting down trees dates back to about five million years and comes from the "Beaver Pond site" on the now treeless Ellesmere Island! This was during the Pliocene epoch—a warmer, wetter interval before the Ice Age.

A History of Beaver Dams

In contrast to today's beaver, which is well known for cutting down trees with its teeth, there is no direct evidence that the giant beaver was a wood cutter and dam builder. However, some scientists believe the giant beaver evolved from an ancient beaver called *Dipoides*, which is known to have been a wood cutter. Comparison with fossils of both *Dipoides* and the modern beaver suggest that the giant beaver was semi-aquatic and may have been a dam-builder with a tendency to cut wood.

On the other hand, chemical analysis of giant beaver teeth suggests they may not have had much taste for wood—preferring to eat herbaceous aquatic plants, similar to today's muskrat. It is tempting to immediately consider the giant beaver, with its massive incisors, akin to an ice age lumberjack felling trees at will in the interglacial forests, but our scientific knowledge is still unclear. If the giant beaver was a semi-aquatic wood cutter, they probably only lived in Yukon during warm interglacial periods of the Ice Age when forests returned to the North.

Status: Extinct **In Yukon:** Unknown – 75,000 years ago



This side-by-side pair of skulls serves to compare between the contemporary beaver and the giant beaver. Photo: Greg McDonald, U.S. National Park Service.

George Teichmann's Giant Beaver, 1997.

YUKON'S CAMELS

Camelops hesternus **Western Camel**

Paracamenlus **Giant Camel**

It comes as a shock to many people when they learn that Northern Canada was once home to camels. Fossils from two very different types of ancient camels have been found in Yukon. The most ancient of these, called the Yukon giant camel, was a "true" camel and an ancestor of the living domestic camel found in the deserts of central Asia and Africa. The other camel was the western camel, which existed more recently and was closely related to the South American "camels"—alpacas, llamas and their relatives.

Did you know?

Camels underwent most of their evolution in North America. The present Holocene period is the first time in camels' millions of years of history that there are no wild camels in North America!

Yukon's Giant Camel History

Fossils of large-bodied giant camels have been found by scientists in the Old Crow area for over a century, but their identity remained elusive until quite recently. These camels were much larger than their modern counterparts—the dromedary (one-humped) and Bactrian (two-humped) camels. They had long massive limbs and long spines on the thoracic vertebra, creating a large hump.

Analysis of ancient proteins preserved in a camel bone discovered in 2011 on northern Ellesmere Island indicated the bone belonged to a close relative of living domestic camels of Asia. The protein signature was also nearly identical to the Yukon giant camel bones from Old Crow. In other words, this was a 3.5 million-year-old ancestor of today's living camels. This suggests that true camels evolved in the Arctic and spread across the Bering land bridge to Asia before the Ice Age, possibly as early as five million years ago. These early camel ancestors ranged from the Canadian High Arctic across Beringia into Europe. The fossils from Old Crow are members of this group that lived during the early stages of the Ice Age around 1 million years ago.

This is the toe bone of the giant camel.

Status: Extinct **In Yukon:** Unknown – 75,000 years ago

Status: Extinct **In Yukon:** 5 million – 1 million years ago

Did you know?

Many of the classic camel adaptations to desert life were originally adaptations to Arctic conditions and snowy ground.

Yukon's Other Camel

The more recent western camel was relatively common across western North America, as far south as central Mexico during the last 150,000 years of the Ice Age. Western camels were restricted to North America and never made the journey across Beringia to Asia. Reconstructions based on their overall skeleton indicate western camels probably looked like a large dromedary camel, with much longer limbs and a longer, narrower head. However, they were more closely aligned with the "camels" of South America, including the llama, alpaca, vicuna and guanaco.

Western camel fossils in Yukon are quite rare, but have been found along the Old Crow River, the White River and gold mines at Hunker Creek and Sixtymile in the Klondike. A small fragment of a western camel toe bone found on the White River in southwest Yukon was recovered just beneath a **volcanic ash** bed that dates to 90,000 years ago. This is the most ancient western camel fossil from Beringia. Recent radiocarbon dating of other western camel fossils revealed they disappeared from the North long before they went extinct in the southern part of their range. It seems western camels migrated northward to Yukon during the relatively warm times of the last warm interglacial period, around 125,000 years ago, and subsequently disappeared when colder glacial conditions returned around 75,000 years ago. The shape of their jaws and teeth suggest they were a mixed feeder, preferring a variety of leaves, shrubs, grasses and other flowering plants.

George Teichmann's Western Camel, 1997.

Digging deeper

Volcanic ashes, or tephras, are a powerful tool for Yukon palaeontologists. They allow scientists to determine the age of ancient soil and sediment, and can be used further back in time than radiocarbon dating. Yukon has an extensive tephra record, but do you know where the volcanoes that left their traces across prehistoric Yukon are located?

FLAT-HEADED PECCARY

Platygonus compressus

Peccaries have a long history of evolution in North and South America and are distantly related to the true pigs of Europe and Asia. Members of the peccary family have upward pointing canine teeth, while the tusks of true pigs point downwards. The flat-headed peccary was about the size of a European wild boar (*Sus scrofa*)—about 75 cm in height at the shoulder. Ice age peccary skulls suggest a small brain with a strong sense of smell and sight. Their oversized noses and nasal cavity may have provided filtration of the dry, dusty air blowing across the ice age landscape.

The ice age flat-headed peccary is best known from sites across the United States and as far south as Mexico. Peccaries are usually found as groups or even small herds, possibly up to 12 individuals. Groups of fossilized skeletons representing whole herds of flat-headed peccaries have been found in Texas, Missouri and Kentucky. At Bat Cave in Missouri, fossils from at least 98 individuals were recovered together, suggesting repeated use of the cave by herds over many years. A site at Hickman, Kentucky revealed a herd of flat-headed peccaries that were killed in a dust storm. The position of the fossilized skeletons indicates their backs were turned to the wind, but the dust eventually got the better of them and they all suffocated.

Did you know?

Peccaries actually have an important place in the history of palaeontology. One of the first fossils ever discovered in North America was a peccary skull found in a Kentucky cave in 1804 or 1805. The skull sat in a museum collection until it was described and named in 1853.

Peccary skull. Photo: collection of the Indiana State Museum and Historical Site.

Status: Extinct

In Yukon: Unknown

Flat headed peccaries went extinct near the end of the Ice Age around 11,000 years ago, along with many of the other large ice age mammals. There is no evidence that ice age people hunted them to extinction. Perhaps they could not cope with the rapid climate changes and their populations never recovered.

Yukon's Ice Age pigs

Only a single fossil peccary bone has ever been identified in Yukon. The bone was a broken part of a lower front limb (the radius) and was discovered along the Old Crow River in 1977. This discovery extended the known distribution of these animals north by over 3,000 km! Prior to that they were only known to have existed in the mid-continental United States. Palaeontologists never imagined peccaries could have lived above the Arctic Circle during the Ice Age!

Scientists really do not know when flat-headed peccaries lived in Yukon. The single fossil from Old Crow is quite small and has never been radiocarbon dated. It is likely they only ventured north to arctic latitudes during the warm interglacial period around 125,000 years ago. Climatic conditions at this time seem to have been right for the northward migration of many ice age mammals centred in the south, like American mastodons and Jefferson's ground sloth. The rarity of peccary fossils in Yukon suggests that few individuals made it as far north as Yukon, and those that did, didn't survive here for very long.

George Teichmann's Flatheaded Peccary, 2000.

Yukon's only peccary bone was found north of Old Crow.

ELK

Cervus elaphus

Elk (or wapiti) are members of the deer family and have their roots in the Ice Age of Eurasia. Their characteristic antlers, with the doubled lower tine, first appear in the fossil record of Europe around 400,000 years ago. Elk were well adapted to survive the waxing and waning of warm and cold periods. Their fossils are more abundant and widespread during warmer periods of the Ice Age when forests and shrubs were more common than grasslands. Even so, in some areas, elk fossils have been found from the peak cold periods of the Ice Age when trees were generally absent.

Elk are generalist herbivores that prefer open forests where they are able to forage on a mix of grasses and leafy shrubs. Their ability to survive in a wide range of habitats was probably key to their survival past the end of the Ice Age. It seems that snow depth and exposure to harsh weather might be limiting factors that control their distribution today. There is a strong correlation between high average annual snow cover (greater than 40-50 cm) and the absence of elk.

Yukon's Ice Age Elk

The North American elk barely makes the cut as an ice age mammal of Yukon. They only appeared in North America as the Ice Age was coming to a close. Elk fossils are not very common at most ice age fossil sites in Yukon. However, those that have been radiocarbon dated are remarkably consistent in age. Most elk fossils in Alaska and Yukon date between 15,000 and 12,000 years ago. This was a time of rapid environmental change, with the Mammoth Steppe grasslands quickly being replaced by shrub birch and willow. Climates were becoming warmer and wetter. While this change in climate was great for elk it caused hardship for most of Yukon's ice age mammals—mammoth and horse populations crashed to extinction at this time. Elk survived the wave of extinctions, going on to inhabit most of North America. Elk bones are quite common in the early prehistoric camp sites of Alaska and Yukon. In fact, it is possible that ice age people had a taste for elk meat and groups of hunters followed them across the Bering land bridge and into the Americas.

Digging deeper

Another powerful tool in a Yukon palaeontologist's kit is ancient genetic material, or **ancient DNA**. Thanks to Yukon's permanently frozen ground, or permafrost, the genetic code of long dead animals and plants is amazingly well preserved. By recovering this ancient genetic information scientists are able to reveal incredible details about the lives of these long extinct animals—like how many elk were alive 30,000 years ago, or how and when they migrated into North America.

Recent Discoveries

The study of **ancient DNA** from elk fossils provides great insight into the ice age history of elk and their connection to early humans in Beringia. Radiocarbon dates and DNA indicate that elk were consistently present in northeast Siberia over the last 50,000 years. Why then did they only migrate across Beringia into North America at the end of the Ice Age? It seems that environmental conditions on the Bering land bridge prevented them from completing their migration eastwards to Alaska and Yukon. Once they made it to Yukon, elk quickly moved south as the glaciers receded. Although elk were locally extirpated in Siberia around

Status: Extant **In Yukon:** 15,000 – 4,000 years ago

Elk remain relatively unchanged and are one of only a few remaining large mammals in North America.

500 years ago, they are still common across North America, mostly in the west.

In Yukon, the story is a bit different. Radiocarbon dates indicate that elk lived in Alaska and Yukon until as recently as 4,000 years ago. What happened to them after that remains to be discovered? The elk that roam the forests of southern Yukon today were reintroduced here in the 1950s.

Elk antlers and bones only appear in the fossil record around 15,000 years ago.

CARIBOU

Rangifer tarandus

Caribou, or reindeer, are probably the most iconic Yukon animal today. Their history runs deep in the North—they evolved in Beringia as much as two million years ago. Caribou are a member of the diverse New World deer group, and out of all the deer species they are the best adapted to the cold arctic climate. You may find it surprising to learn that scientists believe this iconic northern species has ancestry stretching back into South America, with their early ancestors moving north across the Isthmus of Panama about five million years ago.

Today, caribou can be found throughout the Circumpolar North, from Scandinavia to Greenland. In North America, these highly adaptable animals can be broadly divided into the ecotypes that live above the arctic treeline (barren-ground caribou) and those that live within the boreal forests (woodland caribou).

Today caribou remain one of the most abundant large mammals in the North.

With a few exceptions, this division into barren-ground and woodland caribou is intimately linked to the fluctuating glacial and interglacial climates of the Ice Age. Around 300,000 years ago, during a relatively warm interglacial period, caribou expanded throughout the northern half of North America. When temperatures began to cool and glaciers once again started to grow across Canada, the expansive caribou range was split in two, with isolated caribou populations living north of the continental ice sheets in Beringia and others in a thin margin of suitable habitat along the southern edge of the continental glaciers. Remarkably these two types of caribou appear to have remained isolated through the remainder of the Ice Age.

Did you know?

While most woodland caribou are descendants of caribou that survived south of the North American ice sheet during the Ice Age, the woodland caribou of Yukon—the northern mountain caribou—are actually descendants of caribou that survived the cold harsh glacial periods in Beringia, north of the ice sheets. Northern mountain caribou are in fact more closely related to the barren-ground caribou than they are to other woodland caribou.

Yukon's Long History of Caribou

The world's oldest known caribou remains were found in the Fort Selkirk region of central Yukon, dating back to 1.6 million years ago. Of the many ice age caribou bones, teeth and antlers recovered in Yukon, there are three particularly important specimens. Each of these three fossils—a lower leg bone and a fragment of an antler recovered from the Old Crow Basin, and another antler fragment from the Dawson City region—show clear evidence of human use. The two bones from Old Crow were initially thought to be 25,000

Status: Extant **In Yukon:** 1.6 million years ago – present

George Teichmann's Caribou, 2000.

- 27,000 years old, and at the time represented some of the earliest evidence of humans in North America. Those bones sparked the "Great Bone Rush" of the 1960s in the Old Crow region. Unfortunately more recent work has shown that these bones are in fact much younger, dating to only about 1,000 years ago. Regardless of their age, one thing is clear from these culturally-modified remains—in Yukon, humans have been hunting and using caribou for as long as humans have been in the region. Today, caribou are one of the most significant wildlife species for northern First Nations.

Recent Discoveries

Scientists have used DNA from fossil and recent bones to investigate how North American caribou have responded to the most recent climate cycles. Surprisingly, it appears that the North American caribou populations were relatively low during the peak cold periods. Their population began to expand at the end of the Pleistocene and continued to as the climate warmed up to the present. This increase in population is mirrored by studies showing an increase of suitable habitat for caribou as the North American ice sheets retreated. In a way, this suggests caribou are best suited for living in the North during the warmer interglacial periods. Even so, studies of living caribou are suggesting that current climate change and the continued warming of the Arctic are starting to have strong negative impacts on modern caribou populations.

WALRUS

Odobenus rosmarus

Some might be surprised to learn that the bones of ancient walruses can be found alongside those of woolly mammoths and steppe bison. Every spring and summer, the waves of the Beaufort Sea wash a curious mix of fossils onto the beaches that surround Herschel Island off the north coast of Yukon. These beaches are some of the most significant fossil localities in Yukon, and are the only place in Yukon where remains of ice age marine mammals can be found.

Walruses are closely tied to Arctic sea ice. Moving pack ice provides a surface for molting, pupping and resting between foraging trips to the shallow sea floor. Walruses are not very good divers compared to other large marine mammals, but have been observed diving to about 80 metres deep to feed. Walruses generally prefer molluscs such as clams, but they will also eat other invertebrates, fish and sometimes seals! Their only known predators are orcas, polar bears and people. In historic times, overhunting had significant negative impacts on both Pacific and Atlantic populations and led to the extirpation of one population that was historically found in the Canadian Maritimes.

During glacial periods of the Ice Age, when continental glaciers covered much of Canada, the Bering land bridge became exposed and sea ice covered the entire Arctic Ocean throughout the year. These changes had a dramatic impact on walrus populations, pushing them far down the coast of southern United States. Ice age walrus fossils have been found as far south as California and South Carolina, well beyond their present day range. The initial division into what would become the Pacific and Atlantic subspecies likely occurred during a one of these glacial periods, possibly more than 150,000 years ago.

Did you know?

Distinctive patterns preserved in ancient sea floor sediments exposed along the coast of Washington state show evidence of ice age walruses excavating the mud with their tusks to retrieve clams and other shell fish.

Yukon's Walrus Story

The study of walrus fossils from Herschel Island has only recently begun. When walrus bones were first collected near the historic settlement of Pauline Cove on Herschel Island, they were assumed to be those from modern animals that had recently died. However, walruses are rarely seen in the waters surrounding the island today. Yukon territorial park rangers last documented a living walrus in Pauline Cove around 1990. Over the last couple of decades, only a dozen or so walrus fossils have been found on Herschel Island.

When the first radiocarbon dates were obtained from walrus fossils, scientists were surprised to learn that these bones represented animals that were living during the Ice Age, more than 50,000 years ago! Interestingly, since the Arctic was locked in sea ice for most of the Ice Age, these walruses must have been living in the Beaufort Sea when climates were warm, like present day, and the Arctic was ice-free in the summer. The last time sea ice conditions resembled present day, and there was no Bering land bridge, was around 125,000 years ago.

Status: Extant **In Yukon:** Unknown – present

Curious to see how the Herschel Island walrus fossils were related to the living Pacific and Atlantic populations, scientists carefully analyzed the ancient DNA preserved in these bones. The results suggest that the Herschel Island fossil walruses may have been part of the ancient population that included the ancestors of all walruses living today. Further genetic studies from other ancient and modern walruses across their entire range suggest that walrus populations split into two unique populations during glacial times. As the climate warmed, walrus populations likely became smaller and retreated northward to the Arctic sea ice limits.

Walruses may not be the typical Yukon mammal, but they do have a long history in the Yukon. Photo: Shutterstock.

A walrus tusk. Photo: Shutterstock.

ANIMALS OF THE GLACIAL PERIODS

Most of the animals in Beringia during the cold glacial times were grazers—well-adapted for foraging on grass and forbs of the Mammoth Steppe.

The grazers of the glacial periods are dominated by Beringia's "Big Three", mammoths, bison and horse. The Big Three ranged from England to the Mackenzie Valley during the glacial periods when lower sea levels connected much of the northern hemisphere.

The animals of the glacial periods were hardy beasts, able to sustain herds in incredibly cold and dry conditions. The northern world today pales in comparison to the amazingly diverse communities of the glacial Mammoth Steppe.

George Teichmann's Short-faced Bear and Hunters, 2001.

A row of horse toe bones from the Canadian Museum of Nature.

ICE AGE HORSE

Equus ferus

Horses were one of the most abundant mammals that roamed the cold, treeless steppe of ice age Yukon. But unlike the steppe bison, which was a relative newcomer to North America, horses and their ancestors have been on this continent for a long time. In fact, horses, like the wild ones that we now know best from Africa and Eurasia, originally appeared and evolved in North America.

Did you know?

The extinction of horses 12,000 years ago, marks the first time in the last ~55 million years of history that North America has been horseless! The domesticated horses that we have in North America today are descendants of horses brought from Europe with pioneering settlers.

Palaeontologists have long been studying the evolution of horses, in part because they have a remarkably complete series of species. The earliest known ancestral horse was a four-toed, dog-sized horse that lived in North America around 30 to 55 million years ago. The modern horse form, which includes domestic and wild horses, zebras and wild asses, evolved around five million years ago in North America, and spread out to the other continents near the start of the Ice Age.

Horses were abundant across North America, Eurasia and Europe during the Ice Age. In fact, palaeontologists throughout the 20th and 21st centuries have defined over 50 different species of ice age horse based on the size and shape of their skeletons. In Yukon, most ice age horses were particularly small in size—standing only about 12 hands or 1.2 m high at the shoulders—suggesting they may be a unique species known as *Equus lambei*, the Yukon horse. However, recent DNA analyses suggests that all of these various species of ice age horse likely represented simply regional populations of a single wide-ranging, horse species. The ice age horses in Beringia were remarkably similar in appearance and are genetically related to the last truly wild horse, the endangered Przewalskii's horse of the Mongolian steppes. The ice age horses of Eurasia gave rise to the domestic horse, *Equus caballus*.

The skull of a Yukon horse from Yukon Government fossil collection.

Status: Extant **In Yukon:** Unknown – 14,000 years ago

A Yukon horse leg showing preserved hair, hide and muscle tissue.

Yukon's Ice Age Horse Story

One of the most significant ice age horse finds in Yukon was discovered in the muck along Last Chance Creek by gold miners Lee Olynyk and Ron Toews. While working their mine with a backhoe they uncovered a partial frozen carcass of a Yukon horse. The carcass consisted of large piece of hide, stretching from the snout to tail with hair and mane still attached a partial forelimb with muscle, tendons and bones, and a portion of the horse's internal organs, all preserved by the frozen ground. This remarkable find is the largest mummified remains ever discovered in Yukon. This spectacular specimen can be seen on display at the Yukon Beringia Interpretive Centre.

Yukon's Other Ice Age Horses

While the typical small bodied horse was certainly the most abundant horse roaming Yukon during the end of the Ice Age, it was not the only horse species to call Yukon home. During the latter part of the Ice Age, Yukon was home to a unique North American species—the North American "stilt-legged" horse. Stilt-leg horse leg bones are much thinner, suggesting they were much more lightly built than the typical ice age horses of the Yukon. Not that much is known about the rare stilt-leg horse. DNA recovered from bones found in Alaska and Yukon

George Teichmann's Woolly Mammoth and Yukon Horse, 1999.

has confirmed that stilt-legged horses are part of a group which evolved in and never expanded beyond North America. Radiocarbon dates reveal that the stilt-legged horse was gone from Yukon by about 35,000 years ago.

Some fossils of a much larger bodied horse have been found in Yukon. These beasts were as large as a draft horse of today. Scientists still don't know how these are related to the smaller common ice age horses of Beringia.

Did You Know?

In 2013 scientists extracted and analyzed the complete genetic sequence from a 700,000 year old ice age horse fossil that was discovered at a gold mine on Thistle Creek, Yukon. This is the oldest ancient DNA ever recovered in the world!

ARCTIC GROUND SQUIRREL

Spermophilus parryii

Of all the ice age animals still alive today, the Arctic ground squirrel has arguably taught us the most about the ice age world. Ground squirrels first appear about 10 million years ago in North America, but quickly expanded north and west into Eurasia. The oldest Arctic ground squirrel remains have been found in Alaska and date back 1.8 to 2.5 million years. Today, these medium sized rodents can be found beyond the treeline or in treeless clearings across the Circumpolar North, from Siberia to the Canadian Eastern Arctic. They are commonly seen along roadsides throughout much of the Southern Yukon—including a unique population of jet-black Arctic ground squirrels that live along the Alaska Highway south of Whitehorse, Yukon.

Arctic ground squirrels are well adapted for their Arctic world, particularly the cold glacial times when the Mammoth Steppe extended across Beringia. They can live in large colonies of as many as 50 individuals where they maintain extensive tunnel networks. Arctic ground squirrels survive the long winter months by hibernating for seven or eight months in dens, or hibernaculae, about 100 cm below ground surface. During hibernation, Arctic ground squirrels perform one of the most impressive feats of any living mammal—they allow their body temperature to drop below freezing to -2.9°C, warming up periodically through bouts of shivering. To survive once they emerge from their dens in late April or early May they make use of cached seeds and grasses from the previous fall. Conveniently, for scientists studying the ice age world, these adaptations for hibernation and seed caching have preserved an unprecedented record of the plant communities present during the Ice Age.

Digging deeper

Arctic ground squirrels can be thought of as the best botanists of the ice age world. Thanks to their need to hibernate and the seeds they cache underground we have a remarkably well-preserved collection of ice age plants.

Do you know what other types of plant remains palaeontologists, and more specifically palynologists, use to reconstruct the plant communities of the past?

A portion of George Teichmann's Arctic Ground Squirrel and Lemming, 2001.

Status: Extant **In Yukon:** 2.5 million years ago – present

Yukon's Ice Age Arctic Ground Squirrels

Ice age Arctic ground squirrel remains are common finds in the thick mud, or "muck", of the Klondike goldfields of Dawson City. Their prehistoric burrows and nests, also called middens, can be found criss-crossing the permafrost bluffs of many placer mine gold mines. One remarkable specimen, known as the "Moon-Egg", was recovered from the Sixtymile area west of Dawson City by local gold miner, Manfred Peschke. While working his mine on Glacier Creek, Manfred noticed a curious egg-shaped object that had been washed out of the hillside by his high-pressure water monitor. The specimen was later donated to the Canadian Museum of Nature where an x-ray revealed it to be a complete mummified Arctic ground squirrel curled up in its hibernation position. It seems not all Arctic ground squirrels rise from their frigid hibernation cycle. This 47,000 year old mummy is one of only a handful of frozen mummified remains that have been found in Alaska and Yukon. This mummified arctic ground squirrel can be seen on display at the Yukon Beringia Interpretive Centre.

Today, arctic ground squirrel populations are quite restricted to isolated open ground in both southern and northern Yukon, but during the glacial periods of the Ice Age their range expanded into the Klondike goldfields. Arctic ground squirrels do not live in the areas around the Klondike goldfields today due to the shallow permafrost there —ground squirrels cannot dig through frozen ground and must have access to at least 100 cm of thawed ground to dig their hibernaculae.

The discovery of ice age ground squirrel burrows and middens in the goldfields presents a counterintuitive puzzle. During the cold glacial periods of the Ice Age ground, arctic ground squirrels were able to live in areas in which they are absent today because of shallow permafrost. This means that during these cold periods, there must have been greater seasonal permafrost thaw depths than there is today!

This discovery, combined with the knowledge gained from studying the plants and seeds preserved in Arctic ground squirrel seed caches, is allowing scientists to understand how the cold, treeless Mammoth Steppe vegetation could support immense numbers of large mammals—from woolly mammoths, to bison and horses, and the predators that hunted them.

Many ice age arctic ground squirrel did not survive the harsh, cold winters. Their skeletons can still be found preserved in their nests.

SAIGA ANTELOPE

Saiga tatarica

Saiga antelope are peculiar looking relatives of goats, sheep and antelope. During the Ice Age they roamed the Mammoth Steppe from England to the Mackenzie Delta of the Northwest Territories. Today, they are limited to the arid steppes and semi-deserts of central Asia around Kazakhstan and Mongolia. Fossil bones indicate that ice age saiga antelope were about 10-15 per cent larger than their modern counterparts. This suggests that, compared to their habitat today, the ice age steppes of Beringia supported richer vegetation with less competition for resources.

Saiga antelope were well-adapted to the ice age Mammoth Steppe. Their large bulbous nose with downward pointing nostrils contains a series of chambers with mucus glands to warm and moisten cold, dry air. These nostrils were also effective at filtering the dusty air that was kicked up when large herds moved across the dry landscape. Their low slung head, short limbs and gait are adaptions for efficiently travelling long distances on flat terrain in search of food.

One of the biggest factors limiting the current and ancient distribution of saiga antelope is snow depth. It might initially seem counterintuitive for an ice age mammal to not like snow, but deep snow is a real problem for saiga antelope. For the most part, they cannot dig through and forage on grasses when the snow cover is more than 30 cm thick. They also have difficulty dealing with hard, crusty snow that forms when snow melts and re-freezes. In Kazakhstan, these events are called *dhzuts*, and are known to cause massive die-offs among saiga antelope.

Did you know?

Saiga antelope, like a number of truly ice age animals, are not well suited for deep snow. Their presence in Yukon during the Ice Age is a strong indication that while the temperatures were very cold in the winter there was not much snowfall—likely even less than Yukon gets now. Windy conditions kept many areas free of snow and would have led to the formation of large snow drifts.

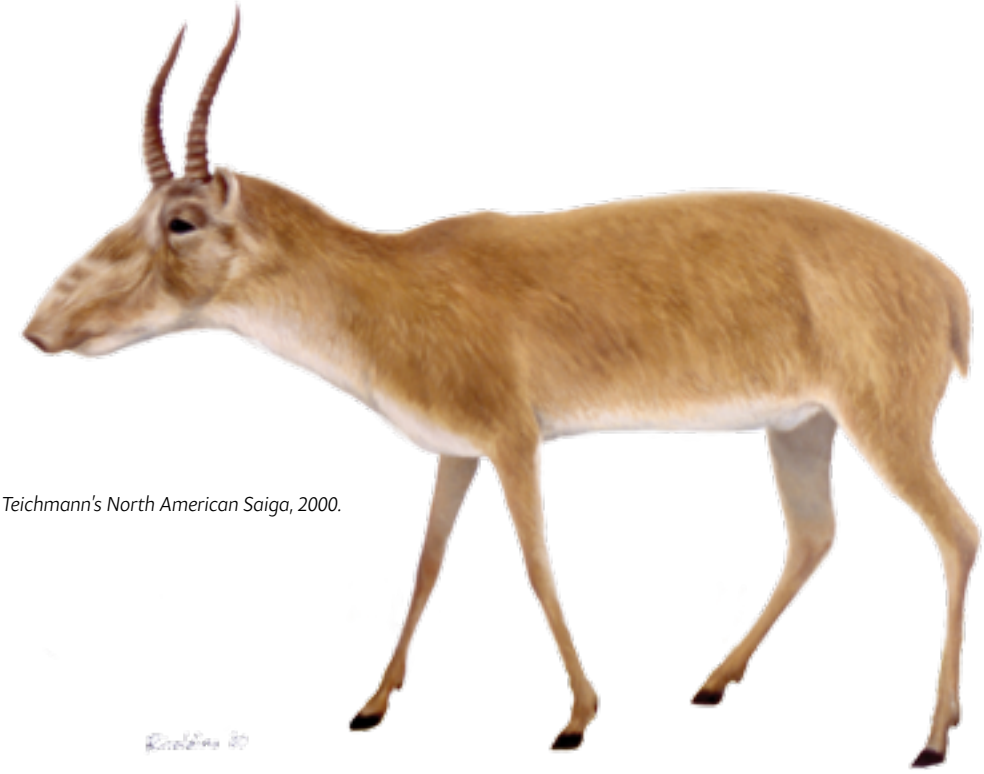
Yukon's History of Saiga Antelope

Fossils of saiga antelope are rare in Yukon. They have been found along the Old Crow River and in the Bluefish Caves of northern Yukon. A series of radiocarbon dated fossils from across Beringia indicate the first saiga antelope likely crossed the Bering land bridge eastward into Alaska around 40,000 years ago. This was a relatively warmer period during the Ice Age prior to the peak cold and dry times. A lack of radiocarbon dated fossils between 20,000 and 15,000 years ago points to a period of population decline for many ice age mammals, including the saiga antelope. Their populations rebounded as temperatures rose and they continued their journey eastward, reaching the Mackenzie Delta around 14,000 years ago. Saiga antelope got stuck in the north and did not make it south of the continental glaciers.

Unfortunately, like so many ice age animals, saiga did not survive in North America after the Ice Age. Their formerly widespread ice age distribution was reduced back to their

Status: Extanct, Endangered **In Yukon:** 40,000 – 14,000 years ago

core area of central Asia. Genetic studies on both ancient and modern bones indicate they have suffered repeated periods of significant population reduction around 12,000 years ago and in recent historic times, in particular the end of the Soviet era. Estimates suggest their populations have crashed by 95 per cent in the last couple decades, and these numbers continue to dwindle. They are currently listed as Critically Endangered by the International Union on Conservation of Nature's Red List of threatened species.



George Teichmann's North American Saiga, 2000.

BERINGIAN LION

Panthera leo spelaea

The Beringian lion (*Panthera leo spelaea*) was the largest and most abundant cat of ice age Yukon and a member of the well-known "cave lions" from Europe and Asia. Lion fossil bones from Beringia are smaller than the rest of the European cave lions, suggesting that they could be a separate sub-species.

The ice age lions of Eurasia and Beringia are genetically distinct from the populations that later became the modern African lion, even though their historic ranges may have overlapped in the ancient Near East. Groups of lions expanded their range dramatically out of Africa during the middle of the Ice Age, appearing in Europe and Britain by about 500,000 years ago. It is not certain when lions crossed Beringia and first appeared in North America. Genetic evidence suggests they may have inhabited Alaska around 300,000 years ago. Some of these lions made their way south into the mid-continent of the United States around 150,000 years ago. After thousands of years of separation from one another by continental ice sheets, the southern population evolved into a unique species, the American lion (*Panthera leo atrox*).

Lions are the only modern large cats that live in groups or prides. Because their closest relatives, tigers and leopards, don't live in groups, scientists believe group living evolved early in lion evolution, back near the start of the Ice Age around two million years ago. Scientists today are continually searching for evidence that Beringian lions and their ice age relatives did in fact live in prides.

Early Eye-Witness Accounts

Another interesting ice age lion puzzle is about what these large cats looked like. Paintings by ice age people in Chauvet Cave in France and others in Europe consistently depict lions without manes. These paintings are considered very accurate, lifelike representations of how lions looked and how they behaved. One painting shows a maneless, male lion standing beside a female in a posture related to mating. To date, this is our best evidence that these ice age lions were maneless.

Unlike these ice age lions, the lions that persisted in Southern Europe in historic times are consistently depicted in art with manes, suggesting they represent African lions that expanded north after the Ice Age. Manes in today's lions play an important role in sexual selection—in many populations, males with the largest, darkest manes are top choices for mating. This trait may well be linked to group living. Manes also play an important function in preventing heat loss, with large manes providing insulation.

Since the lions of Beringia faced cold ice age climates, it seems odd that male lions did not have manes. However, some suggest that the ice age lions were covered in a dense fur around their whole bodies, and not just the neck and head area. This factor, related to insulation, reduced the biological potential for the development of manes in ice age Beringian lions. Since lions with manes today seem to have a selective advantage, it suggests that the mane did not appear in the early stages of lion evolution. Also, since the African lions certainly had manes, it is possible that two different types of lions co-existed in central Europe during the Ice Age—those with manes and those without.

Status: Extinct **In Yukon:** 125,000 to 13,000 years ago

George Teichmann's American Lion, 1997.

Did you know?

Preserved on the flank of a mummified steppe bison carcass found near Fairbanks in the 1970s are the telltale marks of a hunt, but not by humans. Large claw marks stretch down the side of the bison's hide. The only ice age animal capable of making these marks is the Beringian lion.

You can see this bison carcass, known as the Blue Babe, on display at the Museum of the North in Fairbanks, Alaska.

Finds like this partial lion's skull are rare.

SHORT-FACED BEAR

Arctodus simus

Ice age short-faced bears were the largest mammalian land carnivore to ever live in North America. These bears were nearly 1.5 m high when walking normally, but stood about 3.4 m tall when up on their hind legs. They could have had a vertical reach of more than 4.3 m. This is about one and a half times the size of a present day Kodiak grizzly bear! Given its huge size and taste for meat, the short-faced bear has a surprising evolutionary history. Their closest living relative is the spectacled bear (*Tremarctos ornatus*), which lives amongst the trees in the mountainous regions of western and northern South America. Spectacled bears have short broad faces like the ice age short faced bear, but are nearly entirely herbivorous, preferring leaves, fruit and other vegetation.

Did you know?

Short-faced bears only lived in North America, while other ice age bears, like the grizzly ranged across Beringia into Eurasia. Competition with grizzly bears may have been a factor that led to the extinction of short-faced bears.

Yukon's Largest Hypercarnivore?

There is some debate regarding the diets and behavior of the ice age short-faced bear. Given its huge body stature, large molars and canine teeth, it is tempting to view them as menacing predators. However, investigation of their fossil skeletons reveals a much different picture. A prominent feature of the short-faced bear is their remarkably long, thin limb bones and feet that supported a heavy torso. These limbs were adapted for efficient long distance pacing, rather than explosive acceleration and high speed pursuits typical of other large predators like lions. The limbs and feet of a short-faced bear could not support their large bodies for the rapid acceleration or sudden changes in direction necessary to take down a fleeing bison or horse.

The cranium also provides some clues to short-faced bear behaviour. The nasal opening is very large suggesting they had a pronounced sense of smell. This, combined with their long limbs, point to the short-faced bear as a solitary, wide ranging scavenger of carcasses. Rather than killing on their own, the short-faced bear would probably smell the scent of meat in the wind, follow it to the carcass, chase off the lions or wolves, and dine on the leftovers. Their large cheek teeth were probably effective at cracking long bones for their marrow and sharp fangs could deflesh the carcass. The chemistry of short-faced bear fossil bones from Alaska and Yukon indicate a diet nearly completely composed of meat.

This model of short-faced bear's hyper-carnivorous scavenging, however, is not universally accepted. Some scientists have recently suggested the short-faced bear was neither particularly long-limbed nor short-faced and propose they were omnivorous, like most bears are today. More evidence, including new short-faced bear bones found in Yukon will be needed to help solve this question.

Status: Extinct **In Yukon:** 150,000 – 20,000 years ago

George Teichmann's Giant Short-faced Bear, 1999.

The spectacled bear from South America is the closest relative of the giant short-faced bear. Photo: Shutterstock.

Front-view of the short-faced bear skeleton on display at the Yukon Berigina Interpretive Centre.

GREY WOLF

Canis lupus

Grey wolves are probably the most iconic carnivores in the present-day boreal forest and Arctic tundra. They are social animals that form packs and prey on most animals in the North today, including large caribou and moose. Fossils from Yukon indicate they were also common on the Mammoth Steppe. In fact, grey wolves are the most commonly found carnivore fossils in Beringia. They were one of the few North American predators to survive from the Pleistocene until the present day. Grey wolves are found living all across North America, Asia, Europe and into Africa. It is likely that grey wolves evolved in Eurasia during the early part of the Pleistocene and eventually made their way across the Bering land bridge into North America.

George Teichmann's Grey Wolf, 2001.

Did you know?

It is important to note that the ice age grey wolf of Alaska and Yukon is not to be confused by the well-known dire wolf (*Canis dirus*). The dire wolf only lived south of the great ice sheets in North America, stretching as far south as Bolivia. The dire wolf was about 25 per cent larger than present-day grey wolves, with a more stocky build. The dire wolf is best known from the abundant and beautifully preserved fossils excavated from tar pits at Rancho La Brea, California.

Yukon's Modern and Ice Age Wolves

Although ice age fossils of the grey wolf are commonly found in Beringia, surprisingly, these bones are not from the direct ancestors of the populations living in Yukon today. Recent work on the DNA and body characteristics from grey wolf fossils and present day animals across North America reveals that this species underwent dramatic changes at the end of the Ice Age.

These ice age grey wolves of Yukon were more closely akin to those living today in Eurasia, demonstrating the close relationship between animals across Beringia during the Ice Age. As the Bering land bridge flooded near the end of the Ice Age, Yukon populations were cut off from those in Eurasia. Unable to cope with the period of rapid environmental change ice age grey wolves went extinct in Alaska and Yukon around 12,000 years ago. Soon, thereafter, populations of grey wolves that were centred south of the great ice sheets moved northward and re-colonized Yukon and Alaska. This population eventually gave rise to all the grey wolves found today in Yukon.

Measurements of fossil grey wolf skulls revealed that the ice age populations of Yukon and Alaska differed significantly from those in the rest of North America. The Beringian wolves tended to have short, broad mouths with broad cheek teeth relative to their overall skull size. These skull features were adaptations to producing

very large bite forces, suggesting specialization for killing or scavenging large prey. In addition, Beringian fossil skulls were found to have many more broken and heavily worn teeth. This is further evidence for consumption of bones similar to present day hyenas in Africa. Altogether, this new evidence paints the picture of a highly specialized meat- and bone-eating wolf that went extinct along with the other large mammals in Beringia.

A grey wolf skeleton is about twice the size of that of its ancestor the Eucyon.

HUMANS

Homo sapiens

The first people in Yukon migrated from Asia near the end of the Ice Age. Although considerable debate still occurs amongst scientists about when the first people arrived in North America, there is no reliable evidence for people before about 15,0 00 years ago. Several lines of evidence have helped scientists reach this conclusion. Some of the best sources of evidence are the similarities in DNA and blood types of aboriginal people across the Americas and people in Asia. New genetic evidence from a 24,000 year old burial at the Mal'ta archaeological site in central Siberia indicate that people from Europe spread eastward into Asia, mixing with local populations, and eventually crossed the Bering land bridge. Ancient DNA from a 13,000 year old human burial of the Clovis culture in Montana confirms that these early peoples and later North American First Nations peoples are both ancestrally derived from Siberia. Even thousands of years later there are still some clear similarities in the aboriginal languages of Siberia and people living today in Yukon.

The migration of people across northern Eurasia into North America was a major step in the human journey. The earliest evidence of people in the Arctic region dates to around 35,000 years ago at the Yana River Site in northern Siberia during a relatively warm period of the Ice Age. This site contains a wealth of bone and stone artifacts, including an awl or punch used to make clothes. The development of technologies to make warm clothes and adequate shelters was essential to enable human habitation of the Arctic and eventually make the journey to Yukon. Evidence of burnt bone used for camp fires indicates people found ways to survive in the harsh, treeless ice age Arctic. Small groups of people slowly made their way across Eurasia into Beringia and North America around 15,000 year ago. Remarkably, people found their way to the most southerly tip of South America within only a few hundred years of this. By the end of the Ice Age there were few places left in the New World that were not yet discovered by descendants of these first people that crossed the Bering land bridge from Siberia.

Yukon's Ice Age Human History

The Yukon has only a handful of prehistoric archaeological sites that provide glimpses into the lives of ice age people. One of the most famous is the Bluefish Caves, about 30 kilometres southwest of Old Crow. The tiny caves on a high bedrock ridge were discovered in the 1970s and excavations continued there until the 1990s. The Bluefish Caves contain one of the most important records of ice age mammal communities in Beringia. Stone tools recovered alongside fossil bones were left behind by a small group of people around 14,000 years ago.

Other glimpses of possibly more ancient people can also be found at the caves. Some bones dating as old as 25,000 years ago show marks which suggest that they were butchered. However, many archaeologists contest those findings and suggest that the fractured bones were the work of large prehistoric carnivores and other natural means, not people.

The Little John Site along the Alaska Highway, near Beaver Creek, is a prehistoric camp site also dating back roughly 14,000 years. A variety of stone tools, including distinctive "Chindadn" spear points have been excavated from the oldest sediments at Little John. The butchered remains of ice age steppe bison, caribou and elk are also found alongside bones of wolf, hare and swans. This site seems to be related to a number of other late ice age camps in the interior of Alaska along the Tanana River valley. Bones or skeletons of these first people have never been discovered in Yukon.

Status: Extant **In Yukon:** 14,000 years ago – present

Did you know?

The burial site of a three year old child, who was cremated about 11,500 years ago, was found on the Upward Sun River in the interior of Alaska in the summer of 2010. The ancient child's bones were excavated along with the remnants of a wooden structure used to house the burial.

The child has been named Xaasaa Cheege Ts'eniin by the local Alaskan Tribe.

With the end of the Ice Age and associated impacts on ecosystems and mammals, prehistoric cultures underwent radical change. People in Yukon had to learn to live in the newly established boreal forest. Technologies to inhabit the forest were developed and a more broad based way of life with fishing and hunting smaller game emerged. In many ways, life actually became more difficult because the steppe tundra of the late Ice Age was more productive with a greater diversity and abundance of game than was the boreal forest.

Ancestors of Yukon's First Nations likely arrived early in the Holocene in a subsequent migration out of Northeast Asia. They are part of what is known as the Dene or Athapaskan language speakers of Alaska and Yukon. Throughout the ensuing 10,000 years these early Yukoners colonized the entire territory and developed lifestyles and cultures dependent on an evolving resource base. Bison, caribou, salmon and moose were all critical food sources at different points in time and all contributed to the diverse and vibrant cultures of Yukon First Nations today.

A crew of archaeologists explores the Bluefish II caves in Yukon.

A diorama at the Yukon Beringia Interpretive Centre shows the survival techniques of humans near the Bluefish II Caves.