Woolly Mammoths

Have you ever watched the movie *Ice Age*? If so, do you remember the big elephant-like creature that was covered in fur? That creature was a Woolly Mammoth. The woolly mammoth was a species of mammoth that is now extinct. It originally diverged from the “steppe mammoth” about 200,000 years ago, and lived until the end of the Pleistocene and start of the Holocene era (Stuart). In the beginning of the species’ magnificent history, they were plentiful around the Arctic areas, including present-day Siberia, Canada, and Alaska. However, due to climate change, this great species had a drastic population drop, and eventually went extinct. Still, there is hope that the woolly mammoth will walk the earth like they did thousands of years ago. With the new technology that collective learning has offered, our future may one day have humans and woolly mammoths coexisting together once again.

Scientists have debated about the origin of the first woolly mammoth. We can’t know for sure where they came from, but geneticists were able to find out that the woolly mammoth is related to the modern day elephant. In the early years of scientific research, field scientists who found remains thought that what they found were elephant fossils; we know now they were woolly mammoth fossils. A scientist named Hans Sloane, who originally found the first known mammoth remains in 1729, originally turned to biblical explanations for finding a tropical animal’s fossils in the Arctic region (Sloane). He proposed that the elephants had been buried in the Great Flood, and that Siberia had originally been a warm tropical climate. Others also claimed that the Great Flood had carried the elephants from the Tropics to the Arctic (Sloane). Nine years later in 1738, scientist Johann Breyne argued that the mammoth fossils represented modern day elephants. (Breyne, J. P.; s., T.; Wolochowicz, M.) However, it would be 58 years until French anatomist Georges Cuvier would identify the remains not as elephant fossils, but as an entirely new and different species altogether, that had gone extinct long ago (Switek pg. 174-180).

Initially, the woolly mammoth’s binomial nomenclature, it’s scientific name, was *Elephas primigenius* (meaning firstborn elephant), putting it in the same genus as the Asian elephants. However, in 1892, Joshua Brookes recognized that the species was different enough from modern elephants that the Woolly Mammoth received a new scientific name, *Mammuthus primigenius* (Brookes 73). It is unclear where the word *mammoth* came from, however. Some think it could be from the Arabic version of the biblical word “behemoth”. The woolly mammoth is part of the proboscideans, which is a group of animals that contained elephant-like species from around 55 million years ago. The woolly mammoth’s full classification is: kingdom *Animalia,* phylum *Chordata*, class *Mammalia,* order *Proboscidea,* family *Elephantidae*, and the genus *Mammuthus* ("Mammoth Origins, Species, Heights & Weights, Teeth, and Tusk Information.").

Ancestors of the woolly mammoth included the mastodon, which is one of the only common ancestors between mammoths and modern elephants. Even though many people think that the mastodon and the woolly mammoth are the same species with different names, the mastodon is not biologically related to the mammoth or the African and Asian elephants. Using ancient DNA found in Siberia, geneticists revealed that they found woolly mammoths to be more related to Asian Elephants rather than African Elephants (Gross). This mitochondrial DNA also showed that the two common species of elephants diverged from each other much earlier than scientists originally thought. The Asian elephants and mammoths originally split off from the African elephants, and then suddenly split off into their own respective groups (Rohland, N.; Reich, D.; Mallick, S.; Meyer, M.; Green, R. E.; Georgiadis, N. J.; Roca, A. L.; Hofreiter, M.)  This is a parallel situation to how the humans and chimpanzees split off from the gorillas, then became the two separate species we know today.

Woolly mammoths had to develop several adaptations to be able to survive the cold climate of Siberia. Some of these adaptations included a layer of thick fur. Abnormally small ears were also an important adaptation, which protected their ears from frostbite, unlike today’s African and Asian elephants who use their large ears as shade against the desert sun. Woolly mammoths also had a layer of fat under their skin, similar to blubber in sea animals, to stay warm in the winters. A woolly mammoth’s tusks were also an adapted trait used to be able to find food in the snow and ice of the frozen tundra, but could have also been adapted as a form of protection and self defense (Lister pg. 82-87).

A noticeable trait of the woolly mammoths are their massive tusks. Compared to modern elephants, the mammoth’s tusks were much longer and curved at a steeper angle. The tusks were usually asymmetrical and were very different from one another, with some tusks curving down instead of outwards and some being shorter due to damage from both other mammoths and environmental factors. Similar to having sets of teeth, baby mammoths, or calves, develop a set of milk tusks that are replaced by permanent tusks a year later. Tusk growth continued throughout a mammoth’s life, but the speed of growth slowed as the mammoth aged. Some cave paintings depict woolly mammoths with small or no tusks, but it is not known whether this was true or not. Although female Asian elephants have no tusks, there is no fossil evidence that any adult woolly mammoths did not actually have tusks (Lister pg. 94-95).

The woolly mammoth’s coat consisted of an outer layer of coarse hair, which varied in lengths of 8 cm to 90 cm. Studies show that mammoths had sebaceous glands in the skin, which secreted oils into the hair, and would have helped contain heat, repelled water, and given the fur a glossy shine (Repin, V. E.; Taranov, O. S.; Ryabchikova, E. I.; Tikhonov, A. N.; Pugachev, V. G.). The coats could’ve also been used as shelter for early humans and the humans may have passed that knowledge on through the generations, thus adding to the Collective Learning aspect

Fully grown male woolly mammoths reached shoulder heights of 9-11 feet, while females averaged at around 8.5-9.5 feet. At birth, calves would normally weigh about 200 pounds. Woolly mammoths are roughly the size of modern African Elephants, though most would’ve been a bit smaller (Lister, pp. 82-83).

Like trees, a woolly mammoth’s age can be determined by the aging rings of its’ tusk when viewed as a cross section. The large lines represent years, and smaller lines can show the number of weeks, and even days that a woolly mammoth has lived (Lister pg. 94-95). Since dark bands are developed in the summer in both elephants and mammoths, scientists can also find out what season the individual died in. Despite teeth being some of the most important paleobiological evidence of this time, the growth of tusks was not regular, and slowed when physical and environmental factors became difficult, such as disease, drought, or extreme temperatures (Lister pg. 94-95).

The habitat and region where the woolly mammoth lived was called the “mammoth steppe”. It stretched from northern Asia to many parts of Europe and North America, since the continental plates shifted during the ice age and continue to shift, resulting in the area that woolly mammoths inhabited to be split up between continents. Scientists believe the woolly mammoth territory to have been similar to the modern day grassy Russian planes, except that there was more vegetation and grasses, and the herds could come back to different grazing areas sooner, since the flora grew faster. The habitat that woolly mammoths lived in could also support other grazing animals at that time, including woolly rhinoceroses, wild horses, and bison (Lister pp. 88-89).

Wooly mammoths were herbivorous, and fed on mainly grass, sedges, and shrubs. Diets of woolly mammoths varied depending on location. Like the modern day elephants and many other species, mammoths needed a variety of foods to support their growth (Lister pg. 88-91). An adult of about six tons would need to eat four hundred pounds of food, and may have foraged for about twenty hours, daily. The two-fingered tip of their trunks were most likely an adapted trait used to pick up short grasses by wrapping their trunk around them. Their trunks could also be used for pulling off large tufts of grass, gently picking flowers and buds, and tearing off leaves and branches from shrubs and trees (Lister pg. 88-91).

The only predators of the woolly mammoth were saber toothed cats, and humans. Due to the mammoth’s massive size, the saber tooths only hunted young calves. As elephants do today, woolly mammoths had enormous tusks used for digging and collecting food, but also for intimidation and defense against attackers. Other than human hunters who quickly wiped out vast populations of woolly mammoths in the area of the Arctic Tundra, the rapidly melting ice had an impact on the mammoths’ eventual extinction (Lister pg. 95-105).

Both modern humans and Neanderthals coexisted with woolly mammoths, and human survival sometimes even depended on the existence of the woolly mammoth. Before the 19th century, there was no evidence that mammoths and humans coexisted together, and if it was found it wasn’t thought of as important pieces of information. “However, in 1864, Édouard Lartet found an engraving of a woolly mammoth on a piece of mammoth ivory in the Abri de la Madeleine cave in Dordogne, France. This was the first widely accepted evidence for the coexistence of humans with prehistoric extinct animals and is the first contemporary depiction of such a creature known to modern science (Lister 116)”.

Early humans hunted woolly mammoths for a number of reasons. Their meat, pelts, and bones were very valuable to early human civilizations. Around 10,000 years ago, mammoths were most likely plentiful, so human hunting probably did not have an impact on the population size, and if it did it was a very small percentage. This could have been true since one fully grown woolly mammoth potentially had enough meat to feed 400 people for several weeks (Mammoth Genome Project). Also, early humans learned that they could preserve meat in the natural forms of refrigeration that was available to them, such as snow and ice. This meant that the tribes didn’t have to hunt as often, letting less food go to waste and more mammoths walk the plains.

Mammoths appear to have had a strong cultural relationship with humans, being depicted in cave paintings and handcrafted art (Stockdale, Musgrove). It is partly because of these cave paintings that scientists know more about the woolly mammoth than any other prehistoric animal. The Rouffignac cave in France has 158 depictions of mammoths, making up about 70% of the represented animals that date back to the Upper Paleolithic period. Also shown in cave paintings, the woolly mammoth was not the only “woolly” type of animal at the time. Like the woolly mammoth, the woolly rhino adapted to the cold with a furry coat, as was depicted by early humans in cave paintings, and became extinct around the same time as the woolly mammoth (Chung). A set of intact woolly mammoth figurines made of ivory were found in the Swabian Jura, a plateau in the state of Baden-Württemberg, Germany. The figure is believed to have been made by modern humans some 35,000 years ago, making them one of the earliest examples of figurative art in Europe (Mammoth Genome Project PSU).

Woolly mammoth bones were used as materials for housing for both modern humans and Neanderthals. More than 70 housing units have been found and explored, though most are in the Russian Plains, and the size of the shelters ranged from 86 square feet to 258 square feet (8-24 square meters). As for the bones that were used to build the shelters, it is possible that they came from mammoths that were killed by humans, however, based on the different states that the bones are in, and that the ages of the bones vary by thousands of years, scientists believe that most of the materials used to build the shelters were collected from already dead animals (Lister pp. 128-132).

Woolly mammoth ivory is very rare and very expensive. Mammoth ivory is anywhere from 10,000 to 200,000 years old and is found in the Arctic regions of the Earth, because to be available it needed to be preserved in permafrost. Since most of the tusks are currently frozen underground, it isn’t often that someone casually finds a mammoth tusk. However, gold miners and Eskimo hunters have been known to spot and dig up a tusk in the ground before, and spring floods combined with the melting of the ice caps have unearthed many ancient pieces of the mammoths ivory (Larmer).

The colors of the ivory range from shades a tan and brown to shades of blue, all depending on the minerals surrounding the burial site of the mammoth. Considering this, many jewelers consider each piece of mammoth ivory to be unique and irreplaceable, considerably raising the value. A kilogram of woolly mammoth ivory in Russia or around any harvesting areas usually fetches a price of about 300-400 US dollars. However, as the ivory travels to the Western markets, it can end up costing the end buyer up to $1,600 (Kramer). Even though the trade and harvesting of elephant ivory is illegal, professionals cannot find a way to do the same for mammoth ivory, since the species is already extinct and the harvesting of it is not harming any currently alive animal.

Even after extinction, the woolly mammoth has remained an important cultural figure in the indigenous peoples in Siberia. For many centuries, these populations would find and trade mammoth ivory without even knowing its significant value, and along with trading with each other, they traded with other grand civilizations, such as the Chinese and Mongols. In fact, it is thought that Güyük, the 13th century Khan of the Mongols, sat on a throne fashioned out of mammoth ivory. The trading of woolly mammoth ivory continued into the 19th century, and, until then, it had only been a trivial affair. However, from the start of the 19th century onwards, the demand for mammoth ivory and elephant ivory soared. However, since elephant ivory had been banned, many poachers and dealers turned to mammoth ivory as a replacement (Lister pp. 137-139). The ivory trade around the world is an aspect of the thresholds Collective Learning, and Expansion and Interconnection.

The woolly mammoth became extinct during the Quaternary extinction event. The extinction of the woolly mammoth is popularly believed to be caused by humans. Humans may have caused the woolly mammoth’s extinction by over-hunting; because of the woolly mammoth’s slow birth rate, producing enough offspring to make up for the number of deaths was difficult. Some of the last woolly mammoths that the world knew of were surviving as late as 1700 B.C.E (L’Agence France-Presse).

However, others argue that climate change was more to blame, leaving a species adapted for freezing climates ill-prepared to deal with a suddenly warming world. It has been long known that a herd of woolly mammoths survived up until about 4,000 years ago on what is now Russia’s Wrangel Island, north of Siberia in the Arctic Ocean. Once connected to the mainland by an ice bridge, Wrangel was gradually cut off by water 12,000 to 9,000 years ago. A loss of genetic variation could also have resulted from the shift in climate as Earth entered the interglacial period (L’Agence France-Presse). However, to researchers’ surprise, genetic diversity remained stable, and even increased slightly, right up to the extinction, making a disease the cause of the extinction less of an option. Humans appeared to have arrived on the island about 100 years after the woolly mammoths had vanished. This would exculpate humans from killing off the last of mammoths, but it is possible that humans arrived earlier and left no trace. Researchers hypothesize that a catastrophic event, such as a mega-storm, or bacteria or virus could have wiped out the remaining woolly mammoth population (L’Agence France-Presse).

In 2007, an international team of researchers announced the discovery of a perfectly preserved woolly mammoth calf that had been buried under western Siberia’s thick permafrost for at least 10,000 years until spotted by reindeer herder, Yuri Khudy ("Baby Mammoth: Frozen In Time."). Named “Lyuba” after Khudy’s wife, the carcass will provide researchers with the material necessary to decode the woolly mammoth’s genome. While other researchers plan to work on the mammoth’s genetic code, paleontologist, Daniel Fisher, of the University of Michigan, plans to study to mammoth’s teeth and tusks to learn more about the species’ development and maturation rates (Wayman).

Following the discovery of “Lyuba”, scientists proposed the idea to bring back the woolly mammoth; or to bring in another case of de-extinction. The process of de-extinction involves the idea that sequenceable DNA can be recovered from museum specimens and some fossils of extinct species. That discovery in the 1980s set into motion the idea that it might be possible to bring some extinct animals back to life. Genomic technology being developed today has the potential to revive extinct species and can be used to prevent extinction in some endangered species (Brand).

The idea of a possible de-extinction plan was introduced, and the topic was widely reported and discussed. Debate was encouraged, and the subject inevitably became “controversial”. Public worries centered on what would happen when formerly extinct animals are reintroduced to the wild. Conversationists voiced few concerns, because they know how common it is today to successfully reintroduce animals to the wild after a long absence. The two topics that worry conservation professionals are that the de-extinction would be so expensive that it would divert needed money and attention away from programs to protect endangered species. The other worry is that the great warning that “extinction is forever” will lose its meaning, and politicians will stop funding the protection of endangered species (Brand).

The most practical worries, however, are the more technical ones. These are focused mainly on the extreme complexity of resurrecting extinct genomes, because it has never been done. There is also the task of converting gene data into living genes. This is common in synthetic biology today, but shifting a whole organisms worth of extinct traits into a living genome has yet to occur. The final question scientists ask is whether the resurrected animal is really the extinct animal. If it looks the woolly mammoth and behaves like one, that doesn’t necessarily mean it is the woolly mammoth. Regardless of what occurs, reintroduction of the woolly mammoth will take a large amount of time and energy (Brand). The technological theories of the de-extinction of the woolly mammoth accentuates the true depth of the Modern Revolution.

In 2002, Blue Sky Studios released the first of many movies in the *Ice Age* franchise. The movies follow a group of animals surviving the Paleolithic ice age, including a woolly mammoth. So far throughout the franchise’s history, there have been four movies, and all together they have grossed over $2.8 billion worldwide. Blue Sky Studios have also made a number of video games relating to the *Ice Age* franchise for many gaming consoles, such as the *Wii, PlayStation, XBox,* as well as the *iPhone, iPad,* and other various *Android* devices. In 2016, various *Ice Age* themed attractions, along with another new film, will be featured in the first *20th Century Fox* theme park, opening as part of Malaysia’s Resorts World Genting (Han).

Woolly mammoths cross Big History’s 7th threshold, Agriculture and Civilization, because of their role takes place in early human civilization. Like mentioned above, humans hunted mammoths for the meat, pelts, and bones, and even foraged bones from previously dead mammoths to use as fuel and housing material. Using the mammoth bones, early *Homo sapiens* built villages and communities that were meant to be permanent, even though most continued with the traditional hunter-gatherer lifestyle. Humans also learned how to work together to hunt a woolly mammoth, since they could weigh up to almost 7 tons. In reality, the woolly mammoth also connected civilizations, since indigenous populations traded its ivory with larger civilizations and dynasties.

Threshold 6, Collective Learning, and Threshold 8, Expansion and Interconnection, is also crossed by the woolly mammoth because over time, humans have learned from hunting mammoths for meat, to trading and creating works of art out of ivory, to sequencing DNA to try and bring back the woolly mammoth from extinction. This all has to do with collective learning. In the beginning, humans learned how to hunt such a large animal, and that they could use not only their meat for food and pelts for clothing, but that their bones could also be used for substantial housing units. Early humans also began trading the woolly mammoth ivory, which, along with elephant ivory, eventually became a very big success on the black market. Finally, the amount of collective learning and interconnectedness needed to have the scientifical ability and technology to be able to sequence enough important DNA to have the possibility of bringing an extinct species back to life is astounding.

The main question of Threshold 10 is one of the main questions that we ask is relation to the future for the woolly mammoth; What does the future hold? We know that it is possible to bring a species back from extinction, even if it is only for a few minutes. The woolly mammoth was a great species, that inhabited the present-day Arctic regions. Scientists hope that one day, they can have an elephant, which is a close descendant of the woolly mammoth, give birth to a new generation of a previously extinct species. However, the future is not predictable. It could be that the answers scientists are looking for in relation to de-extinction have to do with the woolly mammoth. We can always predict what can happen, but we will never know until we try.