Encyclopedia of Extinct Animals

Dale Okeefe

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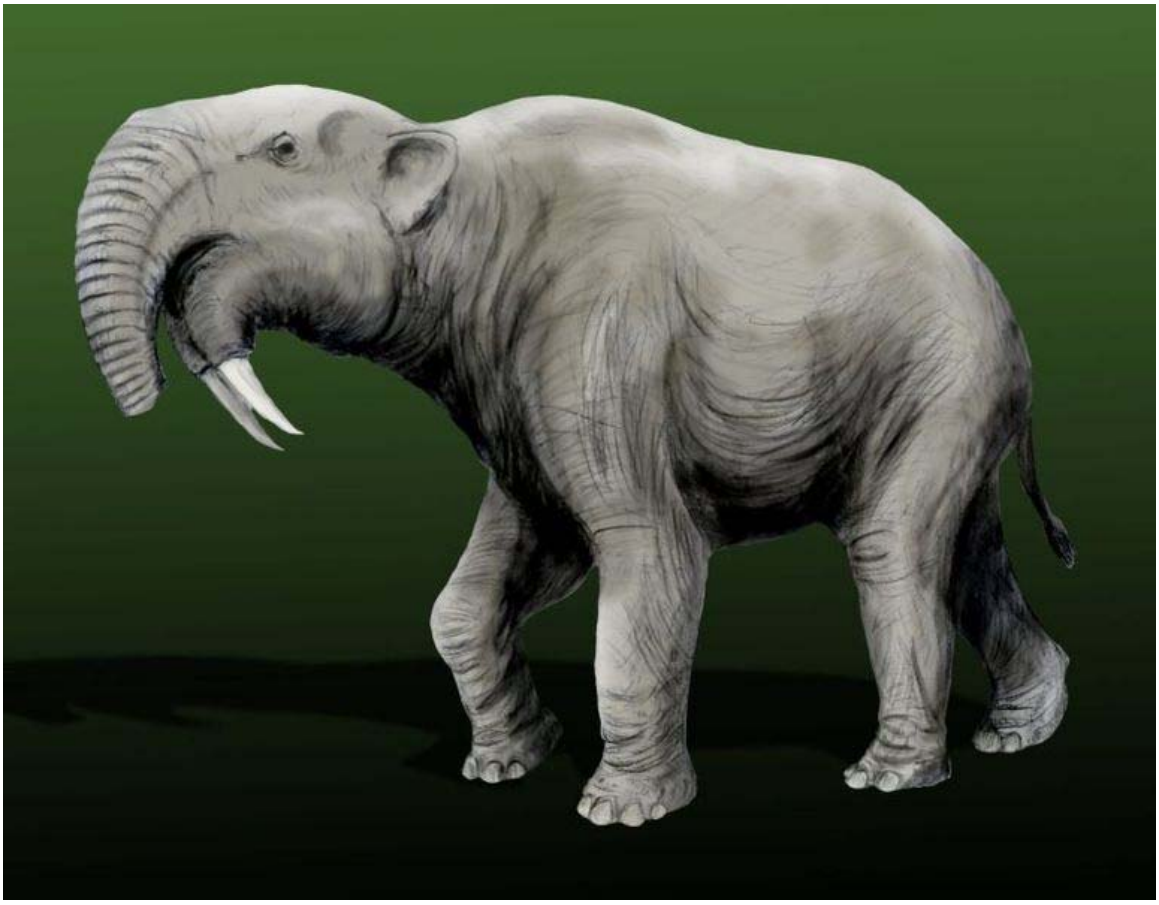
Chapter- 1

Deinotherium

Deinotherium ("terrible beast"), also called the **Hoe tusker**, was a gigantic prehistoric relative of modern-day elephants that appeared in the Middle Miocene and continued until the Early Pleistocene. During that time it changed very little. In life it probably resembled modern elephants, except that its trunk was shorter, and it had downward curving tusks attached to the lower jaw.

Deinotherium is the third largest land mammal known to have existed; only *Paraceratherium* and *Mammuthus sungari* were larger, although *Mammuthus imperator* may have rivaled it in size. Males were generally between 3.5 and 4.5 meters (12 and 15 feet) tall at the shoulders although large specimens may have been up to 5 m (16 ft). Their weight is estimated to have been between 5 and 10 tonnes (5.5 and 11 US Standard tons), with the largest males weighing in excess of 14 tonnes (15.4 US Standard tons). *Deinotherium's* range covered parts of Asia, Africa, and Europe. Adrienne Mayor, in *The First Fossil Hunters: Paleontology In Greek and Roman Times,* has suggested that deinothere fossils found in Greece helped generate myths of archaic giant beings. A tooth of a deinothere found on the island of Crete, in shallow marine sediments of the Miocene suggests that Crete was closer or connected to the mainland during the Messinian Salinity Crisis.

Evolutionary Relationships



Deinotherium giganteum

Deinotherium is the type genus of the family Deinotheriidae, evolving from the smaller, early Miocene *Prodeinotherium*. These proboscideans represent a totally distinct line of evolutionary descent to that of other elephants, one that probably diverged very early in the history of the group as a whole. The large group to which elephants belong formerly contained several other related groups: besides the deinotheres there were the gomphotheres (some of which had shovel-like lower front teeth), and the mastodons. Only elephants survive today.

Paleoecology

The way *Deinotherium* used its curious tusks has been much debated. It may have rooted in soil for underground plant parts like roots and tubers, pulled down branches to snap them and reach leaves, or stripped soft bark from tree trunks. *Deinotherium* fossils have been uncovered at several of the African sites where remains of prehistoric hominid relatives of modern humans have also been found.

Characteristics

Deinotherium skull from Oxford University Museum of Natural History

The following description is for *D. giganteus* but in general applies to the other two species as well.

Permanent tooth formula 0-0-2-3/1-0-2-3 (deciduous 0-0-3/1-0-3), with vertical cheek tooth replacement. Two sets of bilophodont and trilophodont teeth. Molars and rear premolars tapiroid, vertical shearing teeth, and show that deinotheres became an independent evolutionary branch very early on; other premolars used for crushing. The cranium is short, low, and flattened on the top (in contrast to more advanced proboscids, which have a higher and more domed forehead; the implication may be that deinotheres

were less intelligent than other proboscids), with very large, elevated occipital condyles. The nasal opening is retracted and large, indicating a large trunk. The rostrum is long and the rostral fossa broad. Mandibular symphyses (the lower jaw-bone) is very long and curved downward, which, with the backward curved tusks, is a distinguishing feature of the group; it possessed no upper tusks.

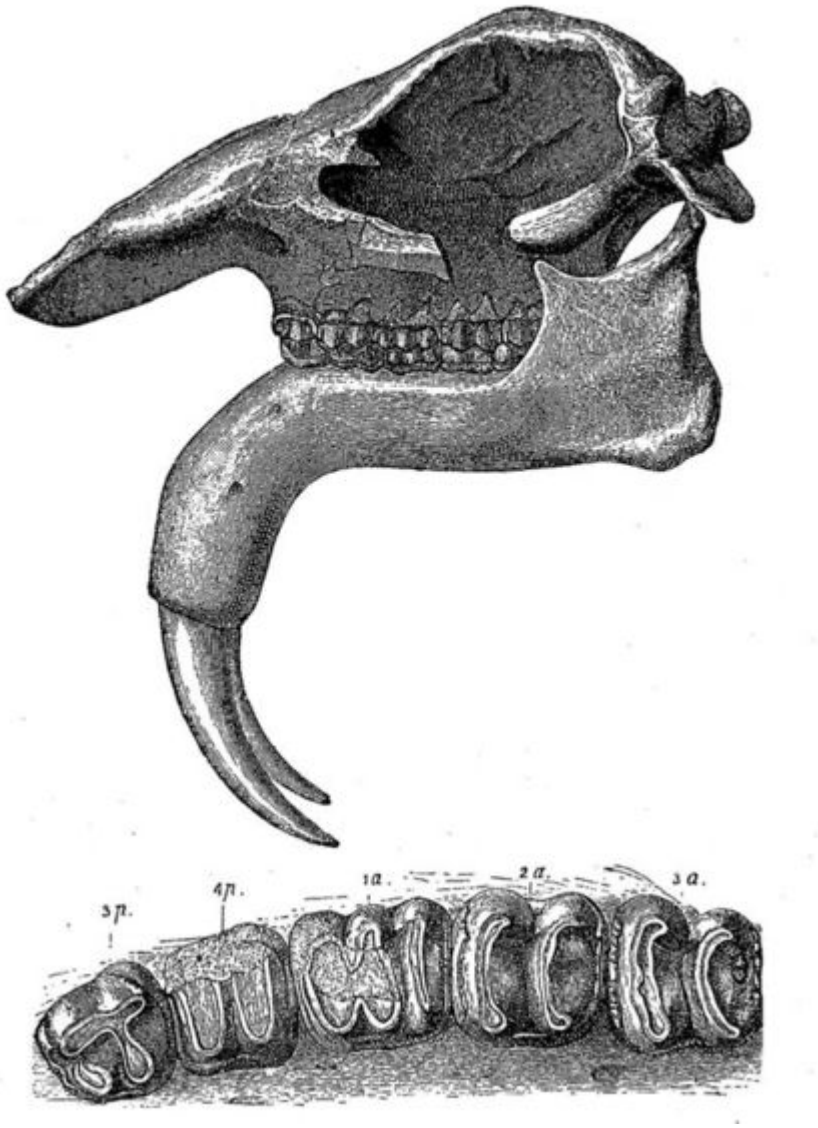
Mounted *Deinotherium* skelton

Deinotherium is distinguished from its predecessor *Prodeinotherium* by its much greater size, greater crown dimensions, and reduced development of posterior cingula ornamentation in the second and third molar.

Species

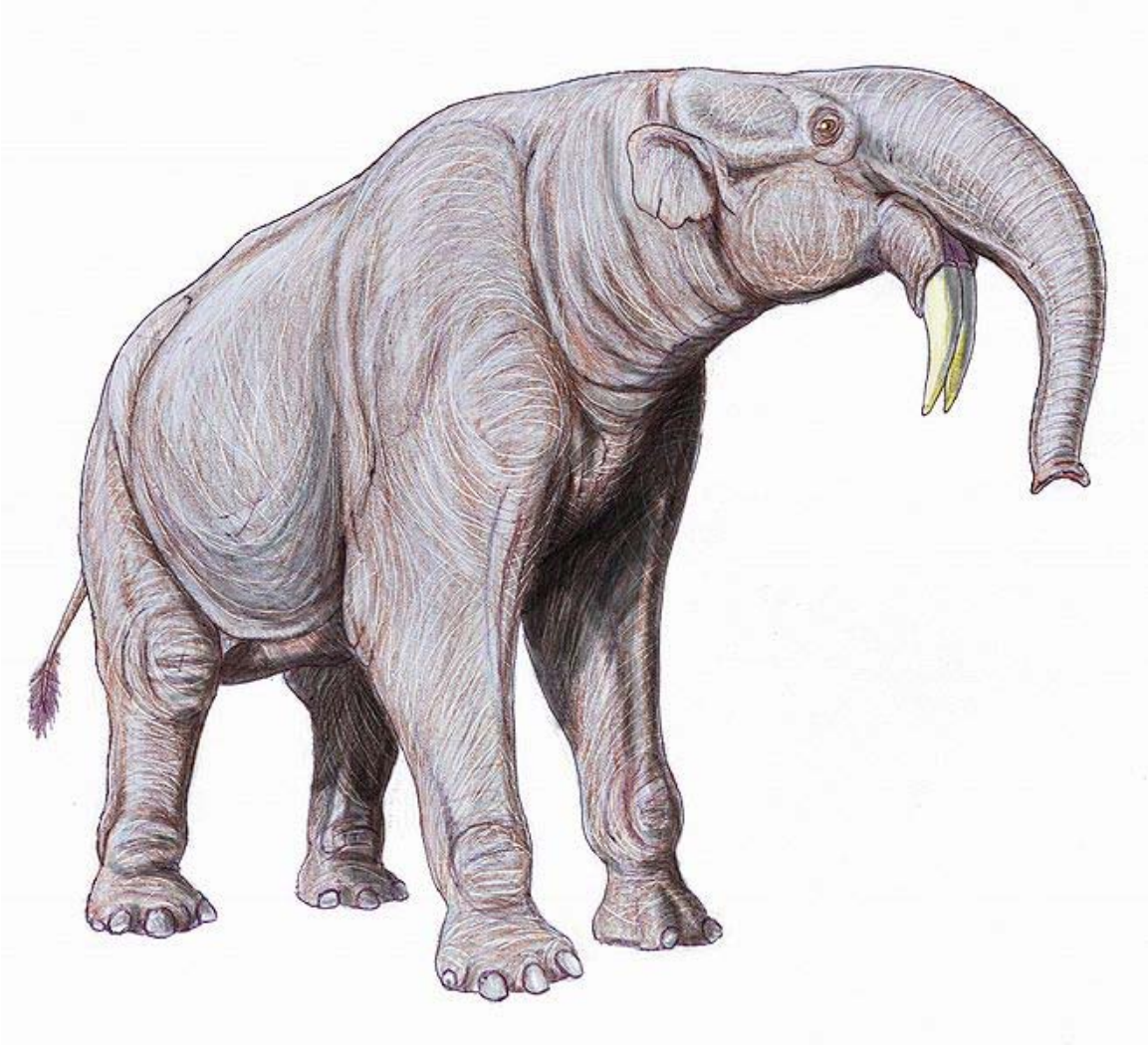
Three species are recognized, all of great size.

Deinotherium giganteum **Kaup 1829**



Head and teeth of *Deinotherium giganteum*

Deinotherium giganteum is the type species, and is described above. It is primarily a late Miocene species, most common in Europe, and is the only species known from the circum-Mediterranean. Its last reported occurrence is from the middle Pliocene of Romania (2 to 4 million BP). The "Grigore Antipa" museum of natural history in Bucharest, Romania, has the only complete skeleton of Deinotherium giganteum in the world. It was unearthed in 1894, in Vaslui county, by the Romanian paleontologist Gregoriu Stefanescu.



Deinotherium giganteum

An entire skull, found in the Lower Pliocene beds of Eppelsheim, Hesse-Darmstadt in 1836, measured 4 ft (1.2 m) in length and 3 ft (.9 meters) in breadth, indicating an animal exceeding modern elephants in size.

Deinotherium indicum Falconer 1945

Deinotherium indicum is the Asian species, known from India and Pakistan. It is distinguished by a more robust dentition and p4-m3 intravalley tubercles. *D. indicum* appears in the middle Miocene, and is most common in the late Miocene. It disappears from the fossil record about 7 million years BP (late Miocene).

Deinotherium bozasi Arambourg 1934

Deinotherium bozasi is the African species. It is characterized by a narrower rostral trough and smaller but higher nasal aperture, and a higher and narrower cranium, and

shorter mandibular symphysis, than the other two species. *D. bozasi* appears at the beginning of the late Miocene, and continues there after the other two species have died out elsewhere. The youngest fossils are from the Kanjera Formation, Kenya, about a million years old (early Pleistocene)

Chapter- 2

Dinofelis

Dinofelis ("terrible cat") is a genus of false sabre-toothed cats belonging to the tribe Metailurini. They were widespread in Europe, Asia, Africa and North America at least 5 million to about 1.2 million years ago (Early Pliocene to Early Pleistocene). Fossils very similar to *Dinofelis* from Lothagam range back to the Late Miocene, some 8 million years ago.

Description and ecology

In size they were between a modern leopard and a lion, most being about the size of a jaguar (70 cm tall and up to 120 kg), medium-sized but powerful cats that possessed two prominent sabre teeth. The front limbs were particularly robust compared to the modern cats (even the jaguar). This stout body may implicate a preference for dense or mixed habitats although it may also have been similar to the extant jaguar with its range from forest to open range including wetland.

Body mass

Two specimens were examined by Serge Legendre and Roth for body mass The first specimen was estimated to have a weight of 31.4 kg (69 lb). The second was estimated to have a weight of 87.8 kg (190 lb).

Dentition

The canine teeth of *Dinofelis* are longer and more flattened than those of modern cats but less so than those of true saber-tooths. *Dinofelis* and other Nimravids are generally referred to as "false saber-tooth" cats because of this. While the lower canines are robust, the cheek teeth are not nearly as robust as those of the lion and other modern big cats.

Fossils

Dinofelis fossils and bones have been found in South Africa along with those of the baboons that it possibly killed. Bones from several specimens of *Dinofelis* and baboons were found in a natural trap. *Dinofelis* may have entered the place to feed on trapped

animals or may have simply wandered into a location and was not able to escape again. Several fossils sites from South Africa seem to show that *Dinofelis* may have hunted and killed *Australopithecus afarensis* since they harbored fossilized remains of Dinofelis, hominids, and other large contemporary animals of the period. Also, since *Dinofelis* remains have been found near *Paranthropus* fossil skulls in South Africa, a few of which have peculiar twin holes in their crania matching the *Dinofelis* upper canines's spacing almost exactly, it is possible that *Dinofelis* was preying on robust hominids as well.

It is thought that the gradual disappearance of the forests in which *Dinofelis* hunted may have contributed to its extinction at the start of the ice age.

Diet

Dinofelis hunted animals including, mammoth calves, young and old mastodons, homo habilis (an ancestor of modern humans) and other animals.

Species

Other undescribed species may exist.

- *Dinofelis aronoki* (East Africa) - recently split from *D. barlowi*
- *Dinofelis barlowi* (South Africa)
- *Dinofelis cristata* (China) - includes *D. abeli*
- *Dinofelis darti* (South Africa)
- *Dinofelis diastemata* (Europe)
- *Dinofelis paleoonca* (North America)
- *Dinofelis petteri* (East Africa)
- *Dinofelis piveteaui* (South Africa)
- *Dinofelis* sp. "Langebaanweg"
- *Dinofelis* sp. "Lothagam"

Description of Some Above Species: -

Dinofelis aronoki

Dinofelis aronoki is a member of a Machairodontinae family the true sabre tooths. it lived in Villafranchian and Biharian stage in Kenya and Ethiopia.

Dinofelis barlowi

Dinofelis Barlowi "Barlow's terrible cat" is a probably the smallest subspecies of Dinofelis. It lived during the late Pleistocene in South Africa. It was 70 cm high and 1 m long. like all dinofelis species it belongs to family Machairodontinae "true sabre tooths", tribe Metailurini.

Dinofelis cristata

Dinofelis is an extinct prehistoric saber-toothed cat belonging to the family Felidae endemic to Southern Europe, Africa, and Southwest Asia from the Pliocene to Pleistocene living from 5.3 Ma—11,000 years ago and existed for approximately 5.289 million years. .

Dinofelis darti

Dinofelis darti is a subspecies of dinofelis, a genus of saber-toothed cats, which lived in South Africa during the Villafranchian stage (3.6–1.2 Ma BP) .

Dinofelis paleoonca

Dinofelis paleoonca ("terrible cat") is a genus of saber-toothed cats belonging to the tribe Metailurini of the family *Felidae* endemic to North America during the Pliocene living from 4.9—1.8 mya, existing for approximately 3.1 million years.

Taxonomy

Dinofelis paleoonca was named by Meade (1945) . Its type locality is Meade's Quarry 11, which is in a Blancan terrestrial horizon in the Blanco Formation of Texas. It was recombined as Dinofelis palaeoonca by Kurten (1972), Hemmer (1973), Dalquest (1975), Kurten and Anderson (1980), Schultz (1990) and Werdelin and Lewis (2001).

Morphology

Body mass

Two specimens were examined by Legendre and Roth for body mass The first specimen was estimated to have a weight of 31.4 kg (69 lb). The second was estimated to have a weight of 87.8 kg (190 lb).

Fossil distribution

Three specimens were found in Texas and Washington.

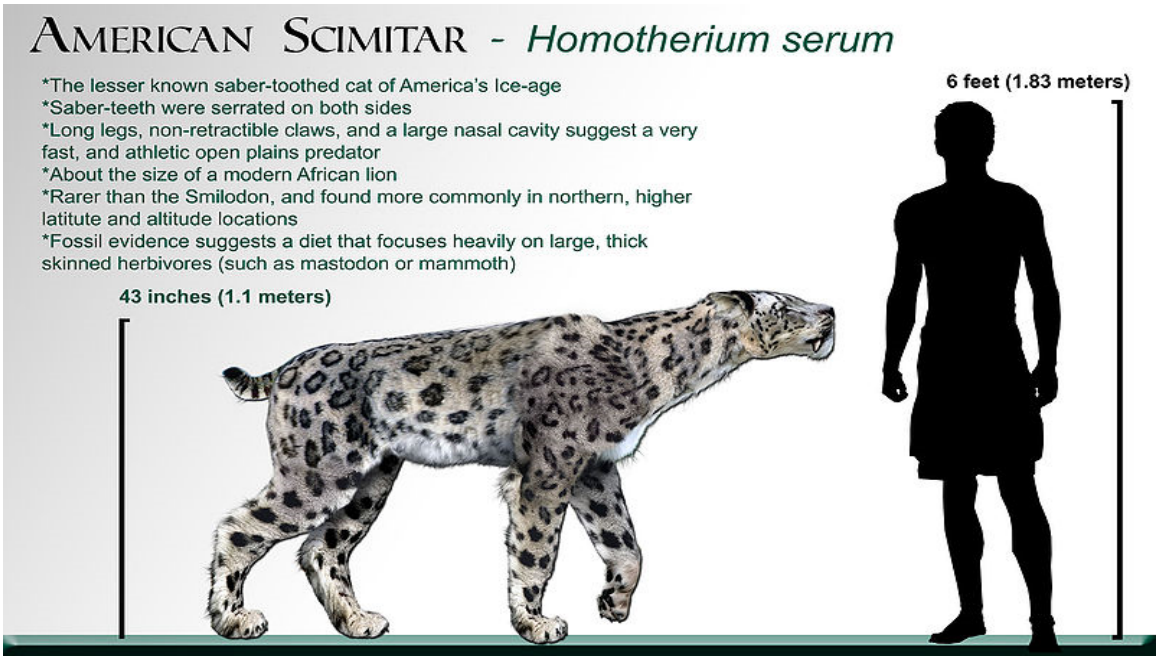
Chapter- 3

Homotherium

Homotherium is an extinct genus of machairodontine saber-toothed cats, often termed **scimitar cats**, endemic to North America, Europe, Asia, and Africa during the Pliocene and Pleistocene epochs (5 mya–10 000 years ago), existing for approximately 5 million years.

It first became extinct in Africa some 1.5 million years ago. In Eurasia it survived until about 30 000 years ago. The last scimitar cat could have survived in North America until 10 000 years ago.

Anatomy



Homotherium serum life-restoration.

Homotherium serum. a rare felid.

Homotherium reached 1.1 m at the shoulder and was therefore about the size of a lioness, weighing an estimated 190 kg. Compared to some other machairodonts, like *Smilodon* or *Megantereon*, *Homotherium* had relatively shorter upper canines, but they were flat, serrated and longer than those of any living cat. Incisors and lower canines formed a powerful puncturing and gripping device. Among living cats, only the tiger (*Panthera tigris*) has such large incisors, which aid in lifting and carrying prey. The molars of Homotherium were rather weak and not adapted for bone crushing. The skull was longer than in *Smilodon* and had a well-developed crest, where muscles were attached to power the lower jaw. This jaw had down-turned forward flanges to protect the scimitars. Its large canine teeth were crenulated and designed for slashing rather than purely stabbing.

It had the general appearance of a cat, but some of its physical characteristics are rather unusual for a large cat. The limb proportions of *Homotherium* gave it a hyena-like appearance. The forelegs were elongated, while the hind quarters were rather squat with feet perhaps partially plantigrade, causing the back to slope towards the short tail. Features of the hindlimbs indicate that this cat was moderately capable of leaping. The pelvic region, including the sacral vertebrae, were bear-like, as was the short tail composed of 13 vertebrae—about half the number in long-tailed cats.

The unusually large, square nasal opening, like that of the cheetah (*Acinonyx jubatus*), presumably allowed quicker oxygen intake, which aided in rapid running and in cooling the brain. As in the cheetah, too, the brain's visual cortex was large and complex, emphasizing the scimitar cat's ability to see well and function in the day, rather than the night, as in most cats.

Range and species

Homotherium crenatidens skull on display at the Paleozoological Museum of China

Homotherium probably derived from *Machairodus* and appeared for the first time at the Miocene-Pliocene border, about 5 million years ago. During the Pleistocene it occurred in vast parts of Eurasia, North America and until the middle Pleistocene (about 1.5 million years ago) even in Africa. A fossil of *H. crenatidens* was inadvertently dredged from the bed of the North Sea, which was a flat, low-lying extent of marshy tundra laced with rivers during the recent glaciation. There has also been a discovery of 1.8 million-year-old fossils in Venezuela, indicating that scimitar cats were able to invade South America along with *Smilodon* during the Great American Interchange. How long they lasted in South America is not yet evident. *Homotherium* survived in Eurasia and North America until about 30 000 and 10 000 years ago, respectively.

Several species (*H. nestianus*, *sainzelli*, *crenatidens*, *nihowanensis*, *ultimum*) are recognized from Eurasia, which differ mainly in the shape of the canines and in body size. But given the fluctuation range of the size of modern large cats, it is highly probable that all belong to just one species, *Homotherium latidens*.

Two species described form the early Pleistocene of Africa are *Homotherium ethiopicum* and *Homotherium hadarensis*. But they also hardly differ from the Eurasian forms. On the African continent the genus disappeared about 1.5 million years ago. In North America, a very similar species, *Homotherium serum* occurred from the latest Pliocene until the latest Pleistocene. Remains have been found at various sites between Alaska and Texas. In the southern parts of its range the American *Homotherium* co-existed with *Smilodon*; in the northern parts it was the only species of saber-toothed cat. The American *Homotherium* was originally described by the name *Dinobastis*.

Despite *Homotherium'*s vast range and the large amount of fossil remains from Eurasia, Africa and North America, complete skeletons of this cat are relatively rare. One of the most famous sites of *Homotherium* remains is Friesenhahn cave in Texas, where 30 *Homotherium* skeletons were found, along with hundreds of juvenile mammoths and several dire wolves.

Diet and habitat

Skull of *Homotherium serum* from Friesenhahn cave, Texas Memorial Museum, UT Austin, Austin, Texas

Friesenhahn cave in Texas contained the remains of over 30 *H. serum* individuals, which were discovered along with the remains of between 300 and 400 juvenile Columbian Mammoths (*Mammuthus columbii*). Besides mammoth, very few other potential prey species were found in the cave - it is therefore unlikely that *Homotherium* carried scavenged carcasses of already dead animals to the cave. Such specialization on prey of a particular species and age structure is not covenant with a scavenging lifestyle. For the same reason it is also unlikely that the dire wolves carried the mammoths into the cave.

Homotherium crenatidens skull

The worldwide association of *Homotherium* species with proboscidean (elephant and mastodon) and Rhinoceros remains, mainly those of juveniles, suggests that *Homotherium* preyed selectively on these tough-skinned animals and probably hunted in packs, carrying away the large animals it brought down. The decline of *Homotherium* could be due to the disappearance of large herbivorous mammals like mammoths in America at the end of the Pleistocene. In North America fossil remains of *Homotherium* are less abundant than those of its contemporary *Smilodon*. For the most part it probably inhabited higher latitudes and altitudes, and therefore was likely to be well adapted to the colder conditions of the mammoth steppe environment.

The suggested large prey species make it probable that *Homotherium* hunted in packs. Reduced claws, relatively slender limbs and the sloping back indicate adaptations for endurance running in open habitats.

Chapter- 4

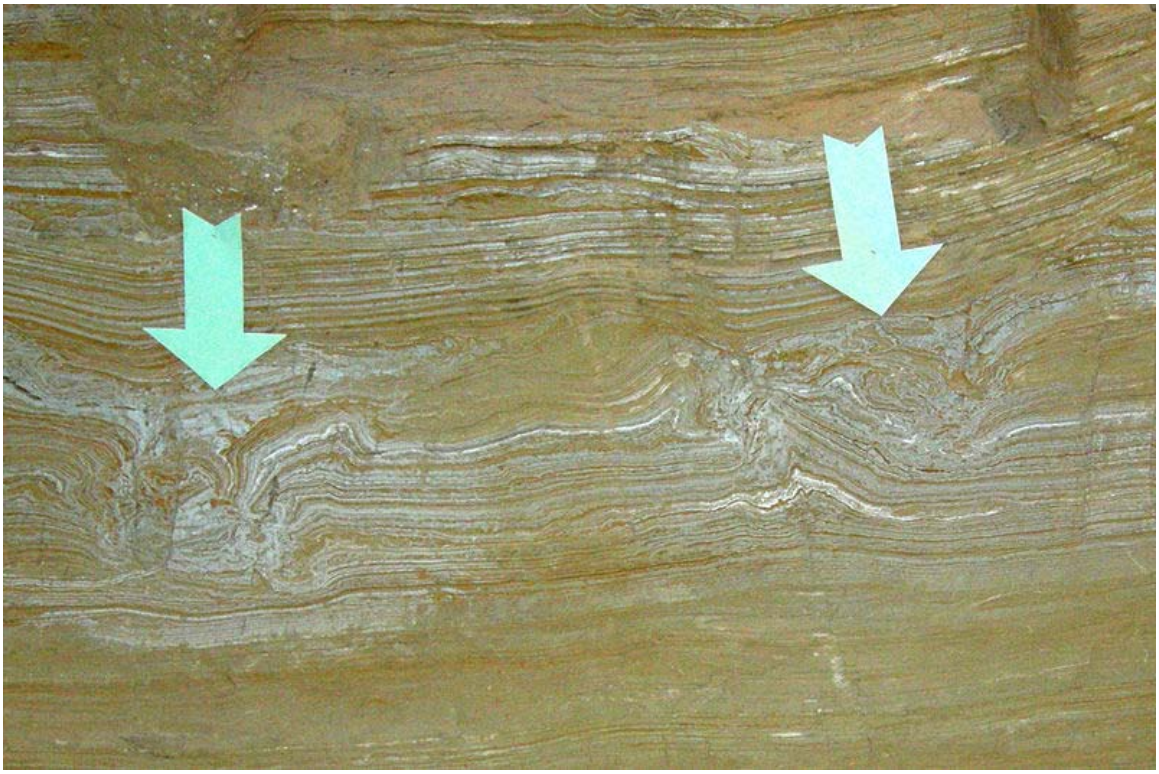
Mammoth

A **mammoth** is any species of the extinct genus ***Mammuthus***. These proboscideans are members of Elephantidae, the family of elephants and mammoths, and close relatives of modern elephants. They were often equipped with long curved tusks and, in northern species, a covering of long hair. They lived from the Pliocene epoch from around 4.8 million to 4,500 years ago. The word *mammoth* comes from the Russian мамонт *mamont*, probably in turn from the Vogul (Mansi) language, *mang ont*, meaning "earth horn".

Size

Like their modern relative the elephant (Asian or African), mammoths were quite large; in English the noun "mammoth" has become an adjective meaning "large" or "massive". The largest known species, Songhua River mammoth (*Mammuthus sungari*) , reached heights of at least 5 metres (16 feet) at the shoulder. Mammoths would probably normally weigh in the region of 6 to 8 tons, but exceptionally large males may have exceeded 12 tons. However, most species of mammoth were only about as large as a modern Asian elephant. Fossils of species of dwarf mammoth have been found on the Californian Channel Islands (*Mammuthus exilis*) and the Mediterranean island of Sardinia (*Mammuthus lamarmorae*). There was also a race of dwarf woolly mammoths on Wrangel Island, north of Siberia, within the Arctic Circle.

A full size reconstruction of a mammoth species, the woolly mammoth, at Ipswich Museum, Ipswich, Suffolk



Cross-section of mammoth footprints (a type of trace fossil) at the Hot Springs Mammoth Site in South Dakota

An 11-foot (3.4 m) long mammoth tusk was discovered north of Lincoln, Illinois in 2005.

Based on studies of their close relatives the modern elephants, mammoths probably had a gestation period of 22 months, resulting in a single calf being born. Their social structure was probably the same as that of African and Asian elephants, with females living in herds headed by a matriarch, whilst bulls lived solitary lives or formed loose groups after sexual maturity.

Well-preserved specimens and prospects of cloning

In May 2007, the carcass of a one-month-old female woolly mammoth calf was discovered in a layer of permafrost near the Yuribei River in Russia, where it had been buried for 37,000 years. Alexei Tikhonov, the Russian Academy of Science's Zoological Institute's deputy director, has dismissed the prospect of cloning the animal, as the whole cells required for cloning would have burst under the freezing conditions. Nonetheless, DNA is expected to be well-enough preserved to be useful for research on mammoth phylogeny and perhaps physiology. However, Dr Sayaka Wakayama from the RIKEN Center for Developmental Biology in Kobe, Japan, believes that a technique she has used to clone mice from specimens frozen for sixteen years could be used successfully on recovered mammoth tissue: she cites that in her experiments the dead mice had been

frozen to -20°C under simulated natural conditions, without using the usual preservative chemicals.

Researchers at Penn State University have sequenced about 85% of the gene map of the woolly mammoth, using DNA taken from hair samples collected from a selection of specimens, advancing the possibility of bringing the woolly mammoth back to life by inserting mammoth DNA sequences into the genome of the modern-day elephant, transferring it into an egg cell and, in turn, into the uterus of an elephant as a variant of interspecific pregnancy. Although the samples were washed with bleach to remove possible contamination by bacteria or fungi, some DNA bases identified may be from the contaminating organisms and these have yet to be distinguished. To this end, scientists at the Broad Institute are currently generating a comparison with the genome of the African elephant. The information cannot be used to synthesize mammoth DNA, but Dr Stephan Schuster, leader of the project, notes that the mammoth's genes differ at only some 400,000 sites from the genome of the African elephant and it would be possible (though not with presently available technology) to modify an elephant cell at these sites to make it resemble one bearing a mammoth's genome, and implant it into a surrogate elephant mother.

There is an estimate of 150 million mammoth remains in Russia's Siberian permafrost, which covers a vast sparsely inhabited area. Some of the remains are frozen complete, others in pieces of bone, tusk, tissue and wool, from less than a metre (3.3 ft) to 1 km (3300 ft) below ground.

Extinction

Mammuthus armeniacus skull

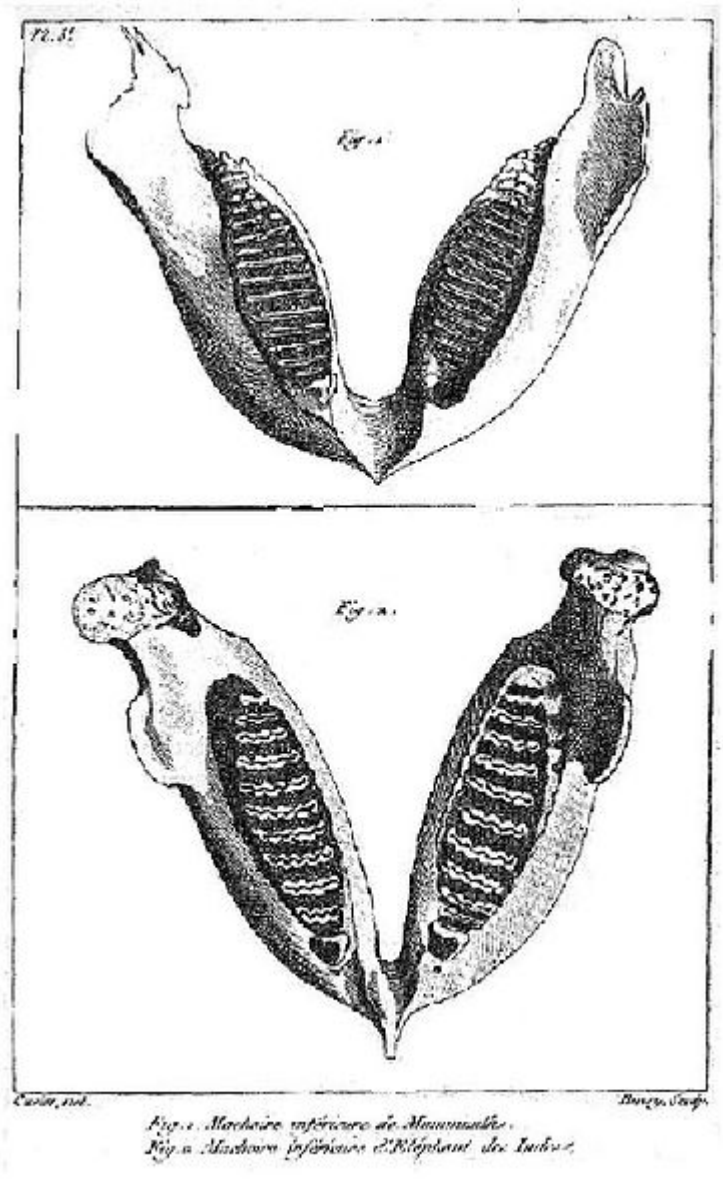
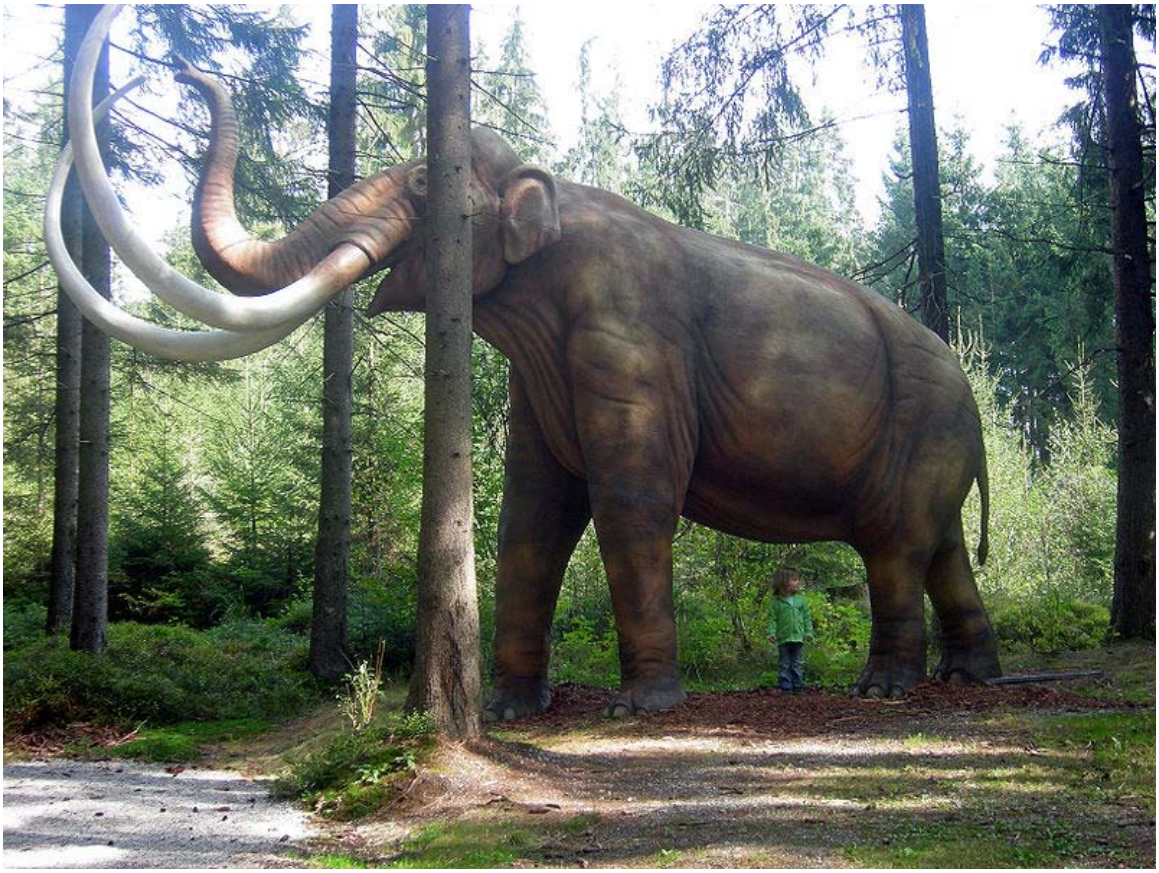


Illustration of an Indian elephant jaw and a mammoth jaw from Georges Cuvier's 1796 paper on living and fossil elephants.



Full size life reconstruction of a mammoth (*Mammuthus trogontherii*).

The woolly mammoth was the last species of the genus. Most populations of the woolly mammoth in North America and Eurasia, as well all the Columbian mammoths in North America, died out around the time of the last glacial retreat, as part of a mass extinction of megafauna in northern Eurasia and the Americas. Until recently, it was generally assumed that the last woolly mammoths vanished from Europe and southern Siberia about 10,000 BC, but new findings show that some were still present there about 8000 BC. Only slightly later, the woolly mammoths also disappeared from continental northern Siberia. A small population survived on St. Paul Island, Alaska, up until 3,750 BC, and the small mammoths of Wrangel Island survived until 1,650 BC.

A definitive explanation for their mass extinction is yet to be agreed upon. The warming trend (Holocene) that occurred 12,000 years ago, accompanied by a glacial retreat and rising sea levels, has been suggested as a contributing factor. Forests replaced open woodlands and grasslands across the continent. The available habitat may have been reduced for some megafaunal species, such as the mammoth. However, such climate changes were nothing new; numerous very similar warming episodes had occurred previously within the ice age of the last several million years without producing comparable megafaunal extinctions, so climate alone is unlikely to have played a decisive role. The spread of advanced human hunters through northern Eurasia and the Americas

around the time of the extinctions *was* a new development, and thus probably contributed significantly.

Whether the general mammoth population died out for climatic reasons or due to overhunting by humans is controversial. Another theory suggests that mammoths may have fallen victim to an infectious disease. A combination of climate change and hunting by humans has been suggested as the most likely explanation for their extinction.

Data derived from studies done on living elephants suggest human hunting was likely a strong contributing factor in the mammoth's final extinction . *Homo erectus* is known to have consumed mammoth meat as early as 1.8 million years ago.

However, the American Institute of Biological Sciences also notes bones of dead elephants, left on the ground and subsequently trampled by other elephants, tend to bear marks resembling butchery marks, which have previously been misinterpreted as such by archaeologists .

The survival of the dwarf mammoths on Russia's Wrangel Island was due to the island's very remote location and lack of inhabitants in the early Holocene period . The European discovery of the island (by American whalers) did not occur until the 1820s . A similar dwarfing occurred with the pygmy mammoth on the outer Channel Islands of California, but at an earlier period. Those animals were very likely killed by early Paleo-Native Americans, and habitat loss caused by a rising sea level that split Santa Rosae into the outer Channel Islands .

Recent research indicates that mammoths survived on the American mainland until 10,000 years ago. This conclusion is from research, by James Haile and Eske Willerslev of the University of Copenhagen, of sediments found in central Alaska, and reported in the Proceedings of the National Academy of Sciences.

Chapter- 5

Megantereon

Megantereon was an ancient machairodontine saber-toothed cat that lived in North America, Eurasia, and Africa. It may be the ancestor of *Smilodon*.

Fossil range

Fossil fragments have been found in Africa, Eurasia, and North America. *Megantereon* seems to have first appeared in the early Late Miocene roughly 11.61—5.33 million years ago with fossil evidence of *M. praecox* recovered in Punjab, Pakistan. In North America,

the oldest specimen was *M. hesperus* unearthed in Polk County, Florida, USA dating to 7.9—-7.8 Ma (AEO).

About 3-3.5 Million years ago it is firmly recorded also from Africa and Eurasia. At the end of the Pliocene it evolved into the larger *Smilodon* in North America, while it survived in the Old World until the middle Pleistocene. The youngest remains from east Africa are about 1.5 million years old. In southern Africa the genus is recorded from Elandsfontein, a site dated to around 700,000-400,000 years old. Remains from Untermaßfeld show that *Megantereon* lived until 900,000 years ago in Europe. In Asia it may have survived until 500,000 years ago, as it is recorded together with *Homo erectus* at the famous site of Zho-Khou-Dien in China. The only full skeleton was found in Senéze, France.

Morphology

Megantereon was built like a modern jaguar or somewhat heavier. It had stocky forelimbs with the lower half of these forelimbs lion-sized. It had large neck muscles designed to deliver a powerful bite. The elongated upper canines were protected by flanges at the mandible. Mauricio Anton's reconstruction in *The big cats and their fossil relatives* depicts the full specimen found at Seneze in France as 72 centimetres (28 in) at the shoulder. The largest specimens with an estimated body weight of 90–150 kilograms (200–330 lb) (average 120 kilograms (260 lb)) are known from India. Medium sized species of *Megantereon* are known from other parts of Eurasia and the Pliocene of North America. The smallest species from Africa and the lower Pleistocene of Europe have been estimated to only 60–70 kilograms (130–150 lb). However, other sources estimated *Megantereon* from the European lower Pleistocene at 100–160 kilograms (220–350 lb).

Hunting technique

It is unlikely that *Megantereon* simply bit its prey as the long, sabre-teeth that *Smilodon* is famed for are not strong enough to leave buried inside a struggling prey animal: the teeth would break off. It is possible that they bit their prey and then allowed it to bleed to death, but then they would have to protect that animal from other predators and thus their tactic for killing remains uncertain. It is now generally thought that *Megantereon*, like other saber-toothed cats, used its long saber teeth to deliver a killing throat bite, severing most of the major nerves and blood vessels. While the teeth would still risk damage, the prey animal would be killed quickly enough that any struggles would be feeble at best.

Species

The number of species is unclear, with some known from only fragmentary evidence. Some researchers have argued that three species should be distinguished: *M. cultridens* from North America, Asia (except the Indian subcontinent) and the European Pliocene, *M. whitei* from Africa and the European Lower Pleistocene and *M. falconeri* from India.

Therefore, the true number of species may be less than the full list of described species reproduced below.

- *Megantereon nihowanensis* - probably a junior synonym of *M cultridens*
- *Megantereon cultridens*
- *Megantereon whitei*
- *Megantereon gracile*
- *Megantereon eurynodon*
- *Megantereon megantereon*
- *Megantereon vakhshensis*
- *Megantereon ekidoit*
- *Megantereon falconeri*
- *Megantereon hesperus*
- *Megantereon spiryleris*

Chapter- 6

Bluebuck

The **Bluebuck** or **Blue Antelope** (*Hippotragus leucophaeus*), sometimes called **Blaubok**, is an extinct species of antelope, the first large African mammal to disappear in historic

times. It is related to the Roan Antelope and Sable Antelope, but slightly smaller than either. It lived in the southwestern coastal region of South Africa savannahs, but was more widespread during the last glacial. It was probably a selective feeder, preferring high-quality grasses.

Europeans encountered the Bluebuck in the 17th century, but it was already uncommon by then. European settlers hunted it avidly, despite its flesh being distasteful, while converting its habitat to agriculture. The Bluebuck became extinct around 1800. There are only four mounted specimens – in museums in Vienna, Stockholm, Paris, and Leiden – along with some bones and horns elsewhere. None of the museum specimens show a blue colour, which may have derived from a mixture of black and yellow hairs.

Characteristics

Illustration of a Bluebuck and a Klipspringer from 1851.

Total length: 250–300 cm (8.2–9.8 ft) (bull); 230–280 cm (7.5–9.2 ft) (cow)

Shoulder height: 100–120 cm (3.3–3.9 ft)

Skull length: 396 mm (15.6 in)

Horn length: 50–61 cm (20–24 in)

Body mass: 160 kg (350 lb)

Eighteenth century travellers provided contradictory descriptions of this species, perhaps because some were embellishing, while others had not actually seen it and were simply repeating hearsay - Peter Kolb in 1719 incorrectly described it as having a long goat-like beard and tail, straight horns like an oryx, and short ears . They did send some skulls and skins back to Europe. In 1967, Erna Mohr reported that the four existing mounted blue antelopes vary from 102 to 116 cm (3.35 to 3.81 ft) at the shoulder. Adult Bluebuck probably rarely exceeded 160 kg (350 lb). None of the four museum specimens show any sheen of blue. The dark skin showing through the thinning fur of older animals may have caused the blue colours described by several authors or the mix of black and yellow hairs.

Like most antelopes, the Bluebuck had six teeth along the cheek in each half of the upper and lower jaws. These formed two distinct series three premolars immediately followed by three molars. Its remains can be distinguished from those of the roan by smaller molars and premolars, and from the sable by larger premolars, and a higher ratio of premolar row length to molar row length.

The Bluebuck was a large, horse-like antelope, as heavy as a Javan or English horse, but smaller than the roan or sable. The proportions of its body were similar to that of the southern reedbuck .

It had a relatively long, strong neck with a very short, underdeveloped mane , long white legs with dark bands on the anterior, and a long tail, up to the hock, with a dark, horse-like whisk. It had a long muzzle. Its ears were long and donkey-like, rufous and narrow-pointed, without the black tufts of hair found in the roan.

The long, scimitar-shaped horns inserted directly above the orbits, extending upwards at almost right angles to the skull , and then curving back gently, without any torsion, towards the shoulders . These horns were heavily ridged, with 20-35 rings up to the tip of the horn, comparable to the roan (20-50 rings). Its horns were however more lightly built than those of the roan and sable, and slightly transversely compressed to the inside. The back-curved horns reminded Jan van Riebeeck of the European ibex, and he called it the 'steinbok'. It remains uncertain how long this name was used, or when it was changed to 'blaauwbok' or Bluebuck.

Its hair was short and glossy, and of a delicate light blue to grey - which quickly faded to a bluish grey after death. Its belly was pale white, and didn't actually contrast with the colour of the flanks. Its forehead and the upper muzzle was brown, becoming lighter towards the cheeks and upper lips. It had distinct white patches in front of the eyes not reaching the white muzzle.

The bulls resembled the cows up to the age of three years, after which they became paler (almost white) and developed large, more curved horns; the horns of the cows where more or less of the same length, although thinner and 10-20% smaller. The calves younger than 2 months were light tan, with no or very indistinct markings.

Range

When the Europeans settled in the Cape Colony in the 17th and 18th century, they found the Bluebuck on the coastal plains of the southwestern Cape Province , east of the Hottentots Holland mountains. It was never very common, and was probably restricted to a grassland area of less than 4 000 km^2 in the triangle formed by the towns of Caledon, Swellendam and Bredasdorp, South Africa. Lieutenant W.J. St. John also recorded 'roans' of a bluish grey colour at Liebenbergsvlei (28º15’S, 28º29’E) near Bethlehem in the Free State Province on 28–29 July 1853, and it is now thought that he actually saw the last remnants of a relict population of Bluebuck.

From archaeological and palaeontological evidence it is known that the Bluebuck had a wider distribution, and was more common, during the early Holocene Epoch 10,000 years ago. At one time it could be found on the coastal plain of the Cape Province from Elands Bay in the northwest to Uniondale in the east. Researchers of the National Museum in Bloemfontein have found San (Bushman) rock paintings near Ficksburg and Golden Gate Highlands National Park , while Pleistocene deposits (100 000 to 10 000 years ago) confirm its existence at Rose Cottage cave near Ladybrand .

Habitat

The early travellers found the Bluebuck only in rolling grassland with extensive marshes and open areas with medium to long (0,5-1,5 m), perennial tuft grass and little hillside shrub. It was also at home at higher elevations, up to 2 400 m above sea-level. It was susceptible to droughts, and water was a necessary habitat requirement.

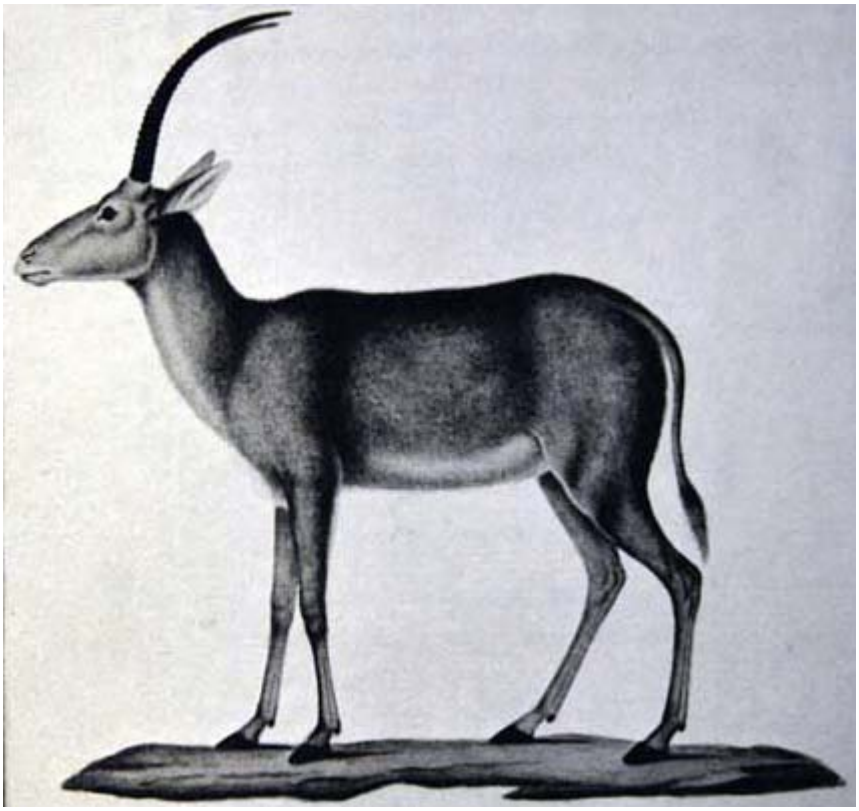
They avoided areas with short grass and woodland where trees formed a thick canopy or thickets. Habitat change, due to overgrazing of grassland by other species, like sheep, thus threatened this species.

Food

Like the roan and sable, it had to drink daily. Many other antelopes can obtain the moisture they need from the plants they eat and they can go for long periods without drinking.

The Bluebuck was a selective grazer of medium to long (0.5-1.5 m), perennial tuft grasses, like high-quality red grass (*Themeda triandra*), spear grass (*Heteropogon contortus*), buffalo grass (*Panicum* spp.) and love grass (*Eragrostis* spp.). Unlike most other antelope, it was not particularly attracted to fresh grass, except during the dry season, when it would graze for short periods along drainage-lines and on floodplains on the fresh growth following the yearly fires. However, like most grazers, it would probably browse during the dry season.

Behavior



Drawing from 1781, by Le Vaillant

Most of its activities took place during the day, especially early in the morning and late in the afternoon.

Bluebucks followed the conventional territorial system among the Hippotragini or 'horse antelopes': territorial bulls, herds of cows and calves, and bachelor herds which were kept segregate by the territorial bulls.

Bluebuck cows and calves lived in small to medium-sized herds of 5 to 20 individuals, although herds of 35 to 80 was not unusual. They normally occurred at a low density of about 4/km^2. Cows shared a traditional home range, which included the territories of several bulls and occupied it for up to 30 years. At very low densities in substandard habitat the cows ranged across larger areas, and were accompanied by the same bull, which in the absence of resistance by territorial neighbours, defended a movable space around his own private harem.

Because they were equipped with long, dangerous horns, cows tended to be more aggressive than those antelope whose females are hornless. Dominance hierarchies based on age and individual prowess were vigorously maintained by both sexes. Maternal herds, composed of animals that shared the same home range, were closed to outsiders. Herd members kept out of range of each other's horns, by increasing the individual space between them.

Herd composition changed daily and seasonally; members split into small groups during the rainy season, and concentrated into larger groups on the best available grazing near water during the dry season. The most cohesive groups were maintained by calves of different ages, which clustered around the youngest calf and usually lagged behind the herd.

Bulls were accepted in the natal herd up to the age of 15–18 months, which was unusually long. Until then, their similarity to cows suppressed the aggression of the territorial bulls. Subadult bulls were driven from the herd, and if these juveniles didn't escape quickly enough, they were killed. They then joined bachelor herds, where they stayed until they reached five or six years of age, when they would be strong enough to defend their own territory.

The adult bull would advertise his presence and high social status by standing or lying alone or away from the herd, at a conspicuous place. The bull stood in an erect manner, which was a sign of high status, and it was self-advertising if it was not directed. When another bull approached his herd, the dominant bull would stand with his neck arched, head high, and ears turned sideways. Unless the intruder showed submission by lowering his head, the bull kept his ears erect, and waved his tail or tucked it between his legs, and a clash of horns and head-butting would take place. Its sound was a blowing snort.

Reproduction

One calf, with a birth mass of 12–14 kg, was dropped after a gestation period of 268–281 days at any time of the year, with a peak during late summer. Bluebuck are thought to have lived for up to 18 years.

Predators

The calves were vulnerable to attacks from spotted hyenas (*Crocuta crocuta*), leopards (*Panthera pardus*) and wild dogs (*Lycaon pictus*). The adults were large and formidable, and resistant to predation in areas with low predator densities. They did sometimes fall prey to lions (*Panthera leo*), but were attacked with caution. Normally they would flee from predators, but when wounded, a bluebuck would lay down, preferably in a marsh, and defended itself with its razor-sharp horns - the angle-horn threat display indicating that it intended to stab sideways or over its shoulder.

History and population

The Bluebuck or Blue Antelope was the first large African mammal to become extinct in historical times.

Shortly after the last Ice Age, about 10 000 years ago, the Bluebuck must have been common in the far south of Africa, which was largely covered with grassy plains. Numerous finds of subfossil bones indicate a former distribution area from Elands Bay in

the present Cape Colony to about 25° E at Uniondale, as well as in the Eastern Free State. Bluebuck numbers dropped about 3 200-2 000 years ago, due to the change of grassland into bush and forest when the climate became warmer.

They showed a sharp decline around 400 A.D., which coincided with the introduction of livestock, particularly sheep, by man at about that time. Competition for grazing with sheep, the resulting habitat degradation due to overgrazing, and diseases may all have contributed to a decline in Bluebuck. Subsistence hunting could also have played a role - it is known that the Late Stone Age inhabitants of Rose Cottage cave hunted several game species, including Bluebuck. To the San (Bushman) the Bluebuck was an important animal, since rock art indicates that these animals contained supernatural power.

Jan van Riebeeck mentioned a "steinbok" or ibex with back-curved horns near Cape Town, while the German Peter Kolb was the first to write about the existence of a "blaauwbok" or Bluebuck in 1719. The Bluebuck was clearly on its way to extinction when European naturalists and hunters finally discovered it. Its range was already small when Europeans who settled in the Cape Colony in the 17th and 18th century first saw this antelope. The Swedish naturalist Carl Peter Thunberg noted in 1774 that these animals were becoming rare. European hunters and farmers hunted it mainly for its skin. Its meat was not fatty, and generally fed to the dogs, although it was just as tasty as that of deer. According to the German zoologist Martin Lichtenstein, the last Bluebuck in the Cape Province was killed in 1799/1800 in the Swellendam district . However, there is good evidence to suggest that an isolated remnant population still existed further north in the 18th century, and that the last Bluebuck died in the Eastern Free State more than fifty years later.

Extinction

A Bluebuck on display in the Naturhistorisches Museum Wien.

Cultivation of the Cape Colony and hunting with firearms quickly destroyed the last small herds. The Bluebuck disappeared before the early natural history cabinets and museums had a chance to obtain a fair number of specimens.

Museum specimens

There are four mounted Bluebuck skins: in the National Museum of Natural History "Naturalis" in Leiden (the Netherlands), and in the natural history museums of Stockholm (Sweden), Paris (France) and Vienna (Austria). Not counting the many bones excavated throughout the species' former range, there are two skulls, in Amsterdam (the Netherlands) and Glasgow (United Kingdom), and three pairs of horns, in Uppsala

(Sweden), London (United Kingdom) and Cape Town (South Africa). None of these specimens are properly documented. .

Relatives

Two close relatives of the Bluebuck are the roan antelope (*Hippotragus equinus*) and the sable antelope (*Hippotragus niger*). Although some naturalists in the past classified the Bluebuck merely as a subspecies of the roan, it is now generally accepted as a separate species. This is based on the fact that Bluebuck and roan occurred in sympatry on the coastal plain of the southwestern Cape from Oakhurst to Uniondale during the early Holocene.

There were a lot of speculations that the Giant or Giant Sable Antelope (*Hippotragus niger variani*) had become extinct. There had been unconfirmed sightings in recent years, but no confirmed sightings for 20 years. This subspecies of the Sable Antelope only occurred in Angola, and there are no specimens present in zoos.

An expedition headed to Angola on 14 August 2002 to search for the giant sable antelope. The expedition had tried hunting for the antelope by helicopter, but the animals avoid sound at all costs. Interviews with tribal chiefs revealed that locals often sighted the animals in the Luando reserve, so the expedition changed tactics and carried out ground surveys on foot. They recorded five separate sightings but were not able to take any photographs. These five animals were spotted in Cangandala National Park in Malanje province in north-central Angola by a team led by Professor Wouter van Hoven of the University of Pretoria.

Chapter- 7

Cave Bear

The **Cave Bear** (*Ursus spelaeus*) was a species of bear which lived in Europe during the Pleistocene and became extinct at the beginning of the Last Glacial Maximum about 27,500 years ago. Both the name *Cave Bear* and the scientific name *spelaeus* derive from the fact that fossils of this species were mostly found in caves, indicating that this species spent more time in caves than the Brown Bear, which only uses caves for hibernation. Consequently, in the course of time, whole layers of bones, almost entirely those of cave bears, were found in many caves.

History of cave bear discoveries

Rearing *Ursus spelaeus* skeleton

Cave bear skeletons were first described in 1774 by Johann Friederich Esper in his book *Newly Discovered Zoolites of Unknown Four Footed Animals*. Originally thought to belong to dragons, unicorns, apes, canids or felids, Esper postulated that they actually belonged to polar bears. Twenty years later, Johann Christian Rosenmüller, an anatomist at the Leipzig University, gave the species its binomial name. Cave bear bones were so numerous that most researchers held little respect for them. During World War I, large amounts of cave bear bones were used as a source of phosphates, leaving behind little more than skulls and leg bones.

Many caves in Europe have skeletons of cave bears on display, for example the *Heinrichshöhle* in Hemer or the *Dechenhöhle* in Iserlohn, Germany. In Romania, there is a cave called Peştera Urşilor (Bears' Cave) where 140 cave bear skeletons were discovered in 1983.

Description and Biology

Range and habitat

The cave bear's range stretched across Europe, from Spain to Eurasia, from Italy and Greece to Belgium, the Netherlands and possibly Great Britain, across a portion of Germany through Poland, then south into Hungary, Romania and parts of Russia, Caucasus and northern Iran. There have been no traces of cave bears living in northern Britain, Scandinavia or the Baltic countries, which were covered in extensive glaciers at the time. The largest numbers of cave bear remains have been found in Austria, Switzerland, southern Germany, northern Italy, northern Spain, Croatia, Hungary, and Romania. The huge number of bones found in south, central and east Europe has led some scientists to think that Europe may have once had literal herds of cave bears. Some however point out that though some caves have thousands of bones, they were accumulated over a period of 100,000 years or more, thus requiring only two deaths in a cave per year to account for the large numbers.

The cave bear inhabited low mountainous areas, especially in regions rich in limestone caves. They seem to have avoided open plains, preferring forested or forest-edged terrains.

Anatomy

Life restoration

The cave bear had a very broad, domed skull with a steep forehead. Its stout body had long thighs, massive shins and in-turning feet, making it similar in skeletal structure to the brown bear. Cave bears were comparable in size to the largest modern day bears. The average weight for males was 400-500 kilograms (880-1102 pounds), while females weighed 225–250 kg (496-551 lbs). Of cave bear skeletons in museums, 90% are male due to a misconception that the female skeletons were merely "dwarfs". Cave bears grew larger during glaciations and smaller during interglacials, probably to adjust heat loss rate. Cave bears of the last ice age lacked the usual 2-3 premolars present in other bears; to compensate, the last molar is very elongated, with supplementary cusps. The humerus of the cave bear was similar in size to that of the polar bear, as were the femora of females. The femora of male cave bears, however, bore more similarities in size to those of kodiak bears.

Dietary habits

Cave bear teeth show greater wear than most modern bear species, suggesting a diet of tough materials. However, tubers and other gritty food, which cause distinctive tooth wear in modern brown bears, do not appear to have constituted a major part of cave bears' diet on the basis of dental microwear analysis.

Skull of *Ursus spelaeus*. Cave bears lacked the usual 2-3 premolars present in other bear species

The morphological features of the cave bear chewing apparatus, including loss of premolars, have long been suggested to indicate that their diets displayed a higher degree of herbivory than the Eurasian brown bear. Indeed, a solely vegetarian diet has been inferred on the basis of tooth morphology. Results obtained on the stable isotopes of cave bear bones also point to a largely vegetarian diet in having low levels of nitrogen-15 and carbon-13, which are accumulated at a faster rate by meat eaters as opposed to herbivores.

However, some evidence points toward inclusion of at least occasional animal protein in the cave bear diet. For example, toothmarks on cave bear remains in areas where cave bears are the only recorded potential carnivores suggests occasional cannibalistic scavenging, possibly on individuals that died during hibernation, and dental microwear analysis indicates that the cave bear may have fed on a greater quantity of bone than its contemporary, the smaller Eurasian Brown Bear. Additionally, cave bear remains from Peştera cu Oase in the southwestern tip of the Carpathian mountains had elevated levels of nitrogen-15 in their bones, indicative of an omnivorous diet, although the values are within the range of those found for the strictly herbivorous mammoth.

Although the current prevailing opinion concludes that cave bears were largely herbivorous, and more so than any modern species of the genus *Ursus*, increasing evidence points to an omnivorous diet, based both on regional variability of isotopic composition of bone remains indicative of dietary plasticity, and on a recent reevaluation

of its craniodental morphology that places the cave bear squarely among omnivorous modern bear species with respect to its skull and tooth shapes.

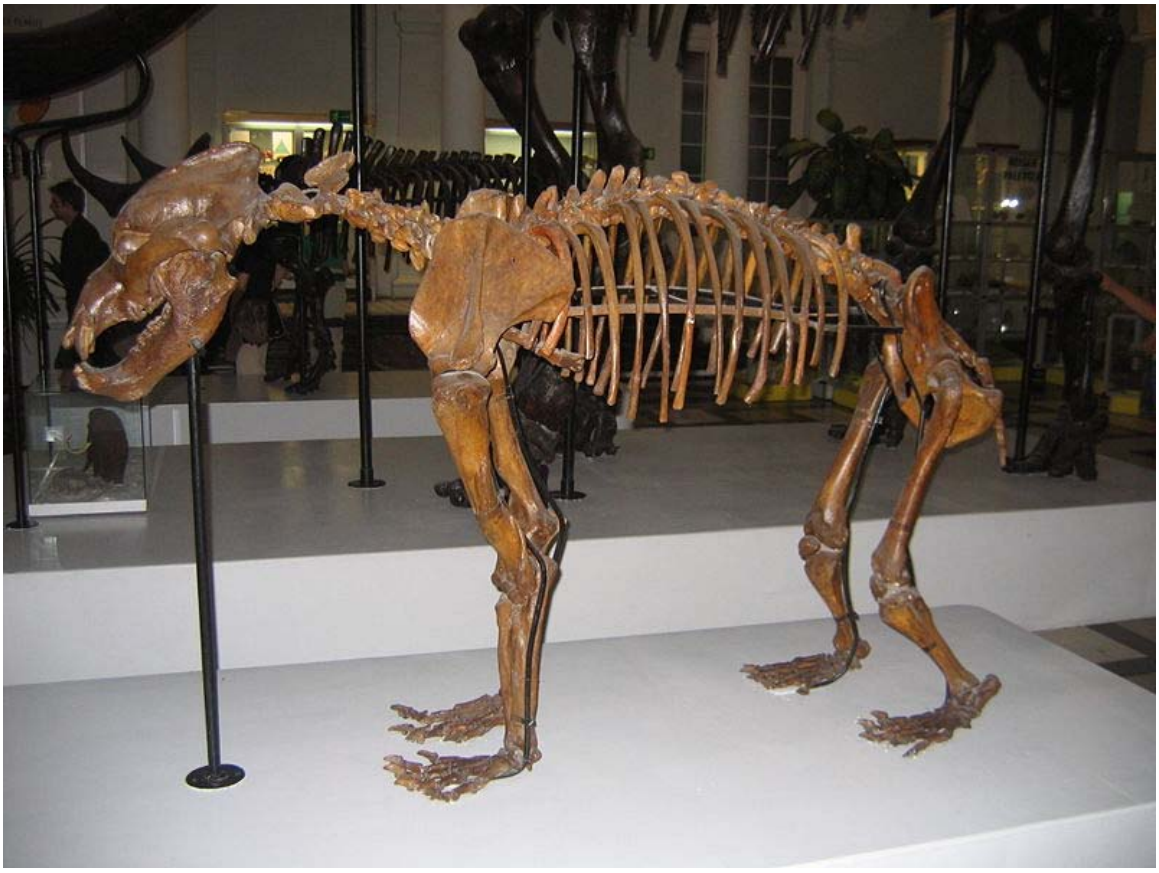
Mortality

Standing skeleton of juvenile cave bear

Death during hibernation was a common end for cave bears, mainly befalling specimens that failed ecologically during the summer season through inexperience, sickness or old age. Some cave bear bones show signs of numerous different ailments, including fusion of the spine, bone tumours, cavities, tooth resorption, necrosis (particularly in younger specimens), osteomyelitis, periostitis, rickets and kidney stones. Male cave bear skeletons have been found with broken baculums, probably due to fighting during

breeding season. Cave bear longevity is unknown, though it has been estimated that they seldom exceeded 20 years of age. Paleontologists doubt adult cave bears had any natural predators, save for pack hunting wolves and cave hyenas which would probably have attacked sick or infirm specimens. Cave hyenas are thought to be responsible for the dis-articulation and destruction of some cave bear skeletons. Such large carcasses were an optimal food resource for the hyenas, especially at the end of the winter, when food was scarce. The presence of fully articulated adult cave lion skeletons, deep in cave bear dens, indicates that lions may have occasionally entered dens to prey on hibernating cave bears, with some dying in the attempt.

Evolution



Skeleton mounted in quadrupedal posture

Both the cave bear and the brown bear are thought to be descended from the Plio-Pleistocene Etruscan bear (*Ursus etruscus*) that lived ~5.3 Mya to 10,000 years ago. The last common ancestor of cave bears and brown bears lived between 1.2 and 1.4 million years ago. The immediate precursor of the cave bear was probably *Ursus deningeri* (Deninger's bear), a species restricted to Pleistocene Europe ~1.8 Mya to 100,000 years ago. The transition between Deninger's bear and the cave bear is given as the last Interglacial, although the boundary between these forms is arbitrary and intermediate or

transitional taxa have been proposed, e.g. *Ursus spelaeus deningeroides*, while other authorities consider both taxa to be chronological variants of the same species.

Cave bears found in different regions vary in age, thus facilitating investigations into evolutionary trends. The three anterior premolars were gradually reduced, then disappeared, possibly in response to a largely vegetarian diet. In a fourth of the skulls found in the Conturines, the third premolar is still present, while more derived specimens elsewhere lack it. The last remaining premolar became conjugated with the true molars, enlarging the crown and granting it more cusps and cutting borders. This phenomenon known as molarization improved the mastication capacities of the molars, facilitating the processing of tough vegetation. This allowed the cave bear to gain more energy for hibernation while eating less than its ancestors.

Recovery of fossil DNA

In May 2005, scientists in California succeeded in recovering and sequencing nuclear DNA of a cave bear that lived between 42,000 and 44,000 years ago. The procedure used genomic DNA extracted from the animal's tooth. Sequencing the DNA directly (rather than first replicating it with the polymerase chain reaction), the scientists were able to recover 21 cave bear genes from remains that did not yield significant amounts of DNA with traditional techniques. This study confirmed and built on results from a previous study using mitochondrial DNA extracted from cave bear remains ranging from 20,000 to 130,000 years old. Both show the cave bear to be more closely related to the brown bear and polar bear than the American black bear, but having split from the brown bear lineage prior to the diversification of distinct eastern and western brown bear lineages and prior to the split of brown bears and polar bears. The divergence date estimate of cave bears and brown bears is ~1.2-1.4 Mya.

Causes of extinction

Recent reassessment of fossils indicate the cave bear probably died out 27,800 years ago. It has been suggested that a complex of factors, rather than a single factor, led to the extinction.

Compared with other megafaunal species that also became extinct during the last Glacial Maximum, the cave bear was believed to have had a more specialized diet of high-quality plants and a relatively restricted geographical range. This was suggested as an explanation as to why it died out so much earlier than the rest. Some experts have disputed this claim as the cave bear had survived multiple climate changes prior to extinction. Additionally, mitochondrial DNA research indicated that the genetic decline of the cave bear began long before it went extinct, demonstrating that habitat loss due to climate change was not responsible. Finally, high $\delta^{15}N$ levels were found in cave bear bones from Romania, indicating wider dietary possibilities than previously believed.

Overhunting by humans has been largely dismissed because human populations at the time were too small to pose a serious threat to the cave bear's survival, though there is

evidence that the two species may have competed for living space in caves. Unlike brown bears, cave bears are seldom represented in cave paintings, leading some experts to believe that the cave bear may have been avoided by human hunters or their habitat preferences may not have overlapped. One theory proposed by late paleontologist Bjorn Kurten states that the cave bear populations were fragmented and under stress even before the advent of the glaciers. It is possible that populations living south of the Alps survived significantly longer.

There is some evidence that the cave bear only used caves for hibernation and was not inclined to use other locations, such as thickets, for this purpose, in contrast to the more versatile Brown Bear. This specialized hibernation behavior would have caused a high winter mortality rate for Cave Bears that failed to find available caves. Therefore, as human populations slowly increased, the Cave Bear faced a shrinking pool of suitable caves, and slowly faded away to extinction, as both Neanderthals and anatomically modern humans sought out caves as living quarters, depriving the cave bear of vital habitat. This hypothesis is being researched at this time.

Cave bear worship

Collections of bear bones at several widely dispersed sites suggest that Neanderthals may have worshipped cave bears, especially at Drachenloch, in Switzerland, where a stone chest was discovered with a number of bear skulls stacked upon it. Neanderthals, who also inhabited the entrance of the cave, are believed to have built it. A massive stone slab covered the top of the structure. At the cave entrance, seven bear skulls were arranged with their muzzles facing the cave entrance, while deeper in the cave, a further six bear skulls were lodged in niches along the wall. Next to these remains were bundles of limb bones belonging to different bears. Consequently, it was at this site that the supposed symbol of the "Cult of the Cave Bear" was found. This consisted of the skull of a three-year-old bear pierced in the cheek by the leg-bone of younger bear. The arrangement of these bones of different bears are not believed to have happened by chance.

A similar phenomenon was encountered in Regourdou, southern France. A rectangular pit contained the remains of at least twenty bears, covered by a massive stone slab. The remains of a Neanderthal lay nearby in another stone pit, with various objects, including a bear humerus, a scraper, a core, and some flakes, which were interpreted as grave offerings.

The unusual finding in a deep chamber of Basua Cave in Savona, Italy, is thought to be related to cave bear worship, as there is a vaguely zoomorphic stalagmite surrounded by clay pellets. It was apparently used by Neanderthals for a ceremony; the fact that bear bones lay scattered on the floor further suggests that this was likely to have had some sort of ritual purpose.

Chapter- 8

Cave Hyena

The **Cave Hyena** (*Crocuta crocuta spelaea*) is an extinct subspecies of spotted hyena (*Crocuta crocuta*) native to Eurasia, ranging from Northern China to Spain and into the British Isles. Though originally described as a separate species from the spotted hyena due to large differences in fore and hind extremities, genetic analysis indicates no sizeable differences in DNA between Pleistocene cave hyena and modern day spotted hyena populations. It is known from a range of fossils and prehistoric cave art. With the decline of grasslands 12,500 years ago, Europe experienced a massive loss of lowland habitats favoured by cave hyenas, and a corresponding increase in mixed woodlands. Cave hyenas, under these circumstances, would have been outcompeted by wolves and

humans which were as much at home in forests as in open lands, and in highlands as in lowlands. Cave hyena populations began to shrink after roughly 20,000 years ago, completely disappearing from Western Europe between 14-11,000 years ago, and earlier in some areas.

Description

The main distinction between the spotted hyena and the cave hyena is grounded on different lengths of the hind and fore limb bones. The humerus and femur are longer in the cave hyena, indicating an adaptation to a different habitat to that of the spotted hyena. It is unknown if they showed the same sexual dimorphism of the spotted hyena. It has been estimated that they weighed 102 kg (225 lbs).

Little is known of their social habits. It is widely accepted that they used caves as dens, although sites in the open-air are also known. There is no indication of cave hyenas living in large clans or on a more solitary basis, though large clans are not considered likely in their Pleistocene habitat.

Dietary habits

Reconstruction of cave hyena

Like modern hyenas, cave hyenas accumulated the bones and horns of their food at den sites for later consumption or for play, though it is unknown if the discovered remains were from scavenged or killed animals. Studies of animal remains in hyena den sites in the Bohemian Karst show that Przewalski's Horses were apparently their most common prey, which amounted to 16-51% of the cave hyena's prey. Their largest prey was the woolly rhinoceros, the bones and skulls of which have been found in many hyena den sites. In some regions, rhino remains can comprise 25-30% of the total prey bone material in den sites. Reindeer were another important food source, as they made up 7-15% of the cave hyena's prey. The Steppe Wisent made up only 1-6% of the cave hyena's prey. Red deer only comprised 3% of found remains, with Irish elk being even rarer. The remains of alpine fauna including chamois and ibex are absent in some places, representing less than 3% of the prey, possibly due to their greater fragility. There is evidence that cave hyenas occasionally practiced cannibalism.

Interspecific predatory relationships

Cave hyenas were highly successful predators, and were especially numerous in Northeast Asia, where it seems they outcompeted most other predators. This was deduced from the relative scarcity of cave lion, cave bear and wolf remains in areas where they are sympatric with hyenas.

Cave hyenas are thought to be responsible for the dis-articulation and destruction of some cave bear skeletons. Such large carcasses were an optimal food resource for the hyenas, especially at the end of the winter, when food was scarce.

Cave hyenas were sympatric with gray wolves in Italy. Unlike the hyenas, which preferentially preyed on lowland animals such as horses, wolves relied more on smaller, slope-dwelling prey such as ibex and roe deer, thus minimizing competition. Wolves and cave hyenas seem to display negative abundance relations over time, with wolf populations expanding their ranges as hyenas disappeared.

Interactions with hominids

Cave hyena painting found in the Chauvet Cave in 1994.

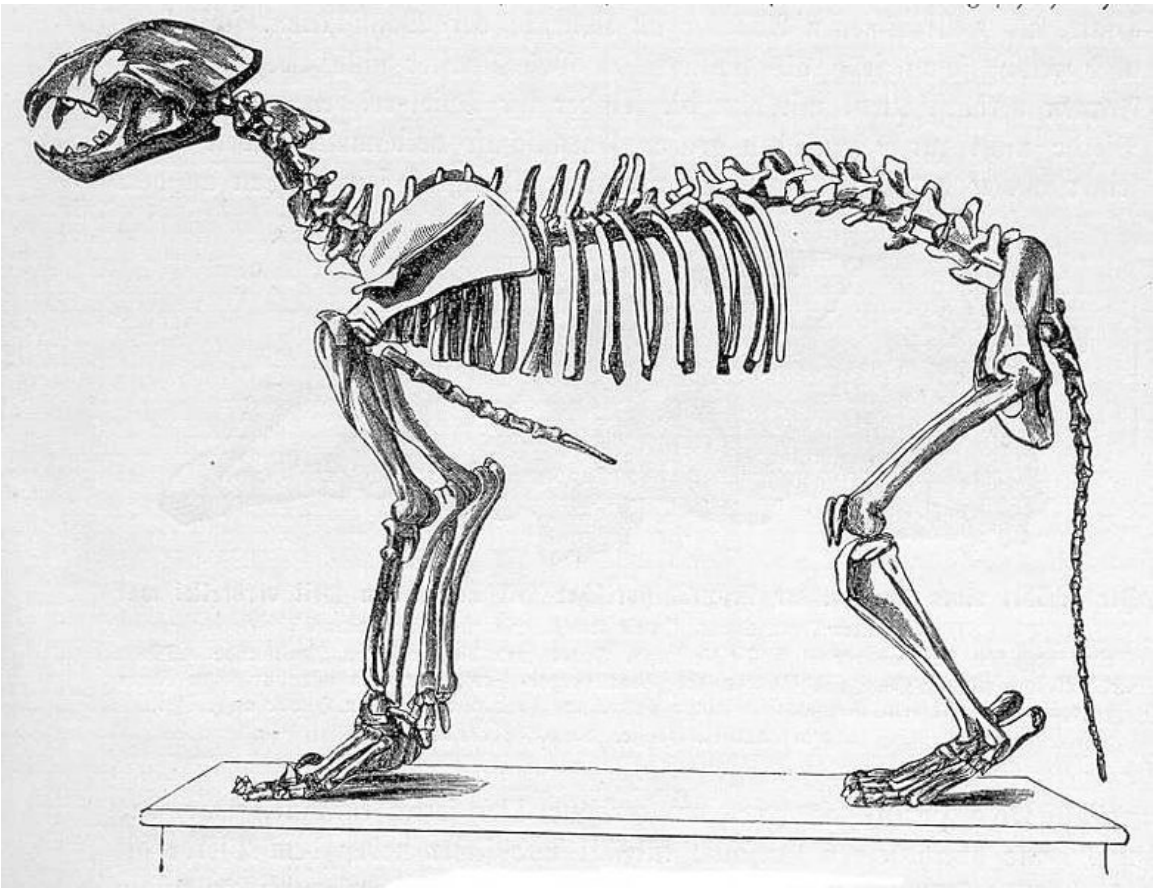
Kills partially processed by Neanderthal and then by cave hyena indicate that hyena would occasionally steal Neanderthal kills, and cave hyena and Neanderthal both competed for cave sites. Many caves show alternating occupations of hyenas and Neanderthals. Numerous hominid bones, including Neanderthal, have also been found partially consumed by cave hyena. Modern humans also lived alongside cave hyena, and may have had similar interaction with them. Some paleontologists believe that competition and predation by cave hyenas in Siberia was a significant factor in delaying human colonization of Alaska. Cave hyenas may have occasionally stolen human kills, or entered campsites to drag off the young and weak, much like modern spotted hyenas in Africa. The oldest Alaskan human remains coincide with roughly the same time cave hyenas became extinct, leading certain paleontologists to infer that hyena predation was what prevented humans from crossing the Bering strait earlier.

Chapter- 9

Panthera Leo Spelaea

Panthera leo spelaea also known as the **European** or **Eurasian cave lion**, is an extinct subspecies of lion known from fossils and many examples of prehistoric art.

Physical characteristics



Skeleton of a cave lion from the Sloup Caves near Brno in the Czech Republic

This subspecies was one of the largest lions. The skeleton of an adult male, which was found in 1985 near Siegsdorf (Germany), had a shoulder height of around 1.2 m (4 ft) and

a body length of 2.1 m (7 ft) without tail. This is similar to the size of a very large modern lion. The size of this male has been exceeded by other specimens of this subspecies. Therefore this cat may have been around 8%-10% bigger than modern lions, but it surpassed the reach of measures of the earlier cave lion subspecies *Panthera leo fossilis* or those of the huge American lion (*Panthera leo atrox*). The cave lion is known from Paleolithic cave paintings, ivory carvings, and clay figurines. These representations indicate that cave lions had rounded, protruding ears, tufted tails, possibly faint tiger-like stripes, and that at least some had a "ruff" or primitive mane around their neck, indicating males. Other archaeological artifacts indicate that they were featured in Paleolithic religious rituals.

Environment

Restoration by Heinrich Harder

The cave lion received its common name because large quantities of its remains are found in caves , but it is doubtful whether they lived in them. It had a wide habitat tolerance, but probably preferred conifer forests and grasslands , where medium-sized to large herbivores occurred. Fossil footprints of lions, which were found together with those of reindeer, demonstrate that lions once occurred even in subpolar climates. The presence of fully articulated adult cave lion skeletons, deep in cave bear dens, indicates that lions may have occasionally entered dens to prey on hibernating cave bears, with some dying in the attempt.

These active carnivores probably preyed upon the large herbivorous animals of their time, including horses, deer and bison. Some paintings of them in caves show several hunting together, which suggests the hunting strategy of contemporary lionesses.

Cave lions, *Chamber of Felines*, Lascaux caves in France

Small prey was usually brought down with a blow of the front paw and then held down with both front feet. The animal was finally killed by a powerful bite of the sharp teeth , at the back of the neck, in the region of the throat and even in the chest. A cave lion usually could not run as fast as its prey, but could pounce on it from behind or run up next to it and bring it down with the paws. In this manner a running animal's balance could very easily be disturbed.

It was most likely the most common predator (after the cave hyena) in plains ecosystems. Its extinction may have been related to the Quaternary extinction event, which wiped out most of the megafauna prey in those regions. Cave paintings and remains found in the refuse piles of ancient camp sites indicate that they were hunted by early humans, which also may have contributed to their demise.

Classification

The cave lion is sometimes considered a species in its own right, under the name *Panthera spelaea* , and at least one authority, based on a comparison of skull shapes, considers the cave lion to be more closely related to the tiger, which would result in the formal name *Panthera tigris spelaea*. However, recent genetic research shows that it was a close relative of the modern lion and that it formed a single population with the Beringian cave lion, which has been sometimes considered as to represent a distinct form.

Therefore the cave lion ranged from Europe to Alaska over the Bering land bridge until the latest Pleistocene. However it is still not completely clear, whether it was a subspecies of the lion or rather a very close relative

History and distribution

Cave lions with a reindeer (artist's impression).

The cave lion (*Panthera leo spelea*) was derived from the earlier *Panthera leo fossilis*, which first appeared in Europe about 700,000 years ago. The cave lion itself lived from 370,000 to 10,000 years ago, during the Pleistocene epoch. Apparently, it became extinct about 12,500 C-14 years ago , during the Würm glaciation, although there are some indications it may have existed into historic times in southeastern Europe, as recently as 2,000 years ago in the Balkans.

Cave lions were widespread in parts of Europe and Asia, from Great Britain, Germany and Spain (Arduini & Teruzzi, 1993) all the way to the Bering Strait and from Siberia to Turkistan.

Chapter- 10

Dwarf Elephant

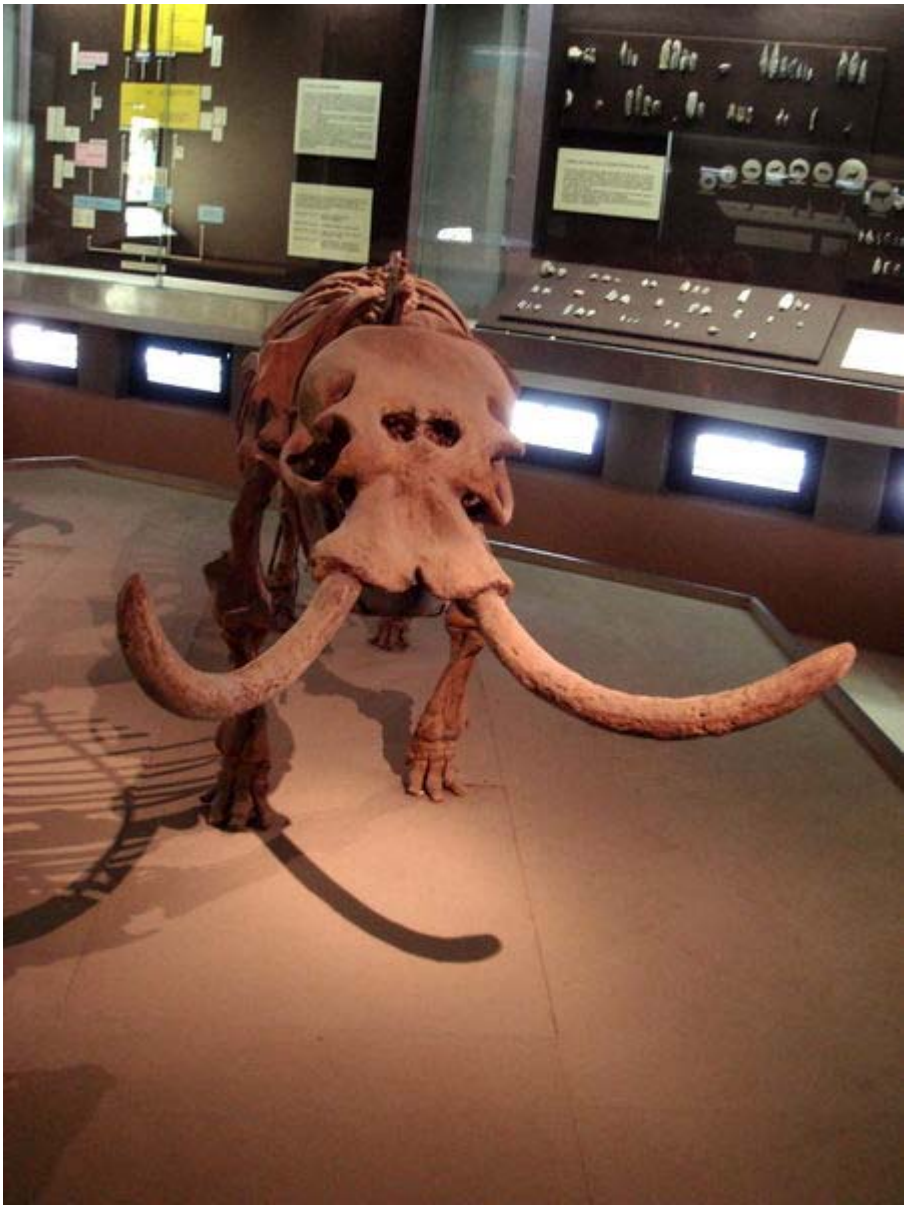
Dwarf elephants are prehistoric members of the order Proboscidea, that, through the process of allopatric speciation, evolved to a fraction of the size of their immediate ancestors. Insular dwarfism is a biological phenomenon by which the size of animals isolated on an island shrinks dramatically over time for the smaller animals have survived because of the underabundance of food.

Fossil remains of dwarf elephants have been found on the Mediterranean islands of Cyprus, Malta (at Ghar Dalam), Crete, Sicily, Sardinia, the Cyclades Islands and the

Dodecanese Islands. Other islands where dwarf elephants have been found are Sulawesi, Flores, Timor and other islands of the Lesser Sundas. The Channel Islands of California once supported a dwarf species descended from Columbian mammoths, while small races of woolly mammoths were once found on Wrangel Island and Saint Paul Island.

Mediterranean Islands

Dwarf elephants were, after the Messinian salinity crisis, part of the Pleistocene fauna of all the larger Mediterranean islands, with the apparent exception of Corsica and the Balearics. Mediterranean dwarf elephants have generally been considered as paleoloxodontine, derived from the continental Straight-tusked Elephant, *Elephas (Palaeoloxodon) antiquus* Falconer & Cautley, 1847. An exception is the dwarf Sardinian Mammoth, *Mammuthus lamarmorae* (Major, 1883), the only endemic elephant of the Mediterranean islands belonging to the mammoth line. A DNA research published in 2006 theorized that the *Elephas creticus* could be from the mammoth line too. This old theory, proposed by Dorothea Bate as early as 1905, is not widely accepted. A scientific study of 2007 demonstrates the mistakes of the DNA research of 2006.

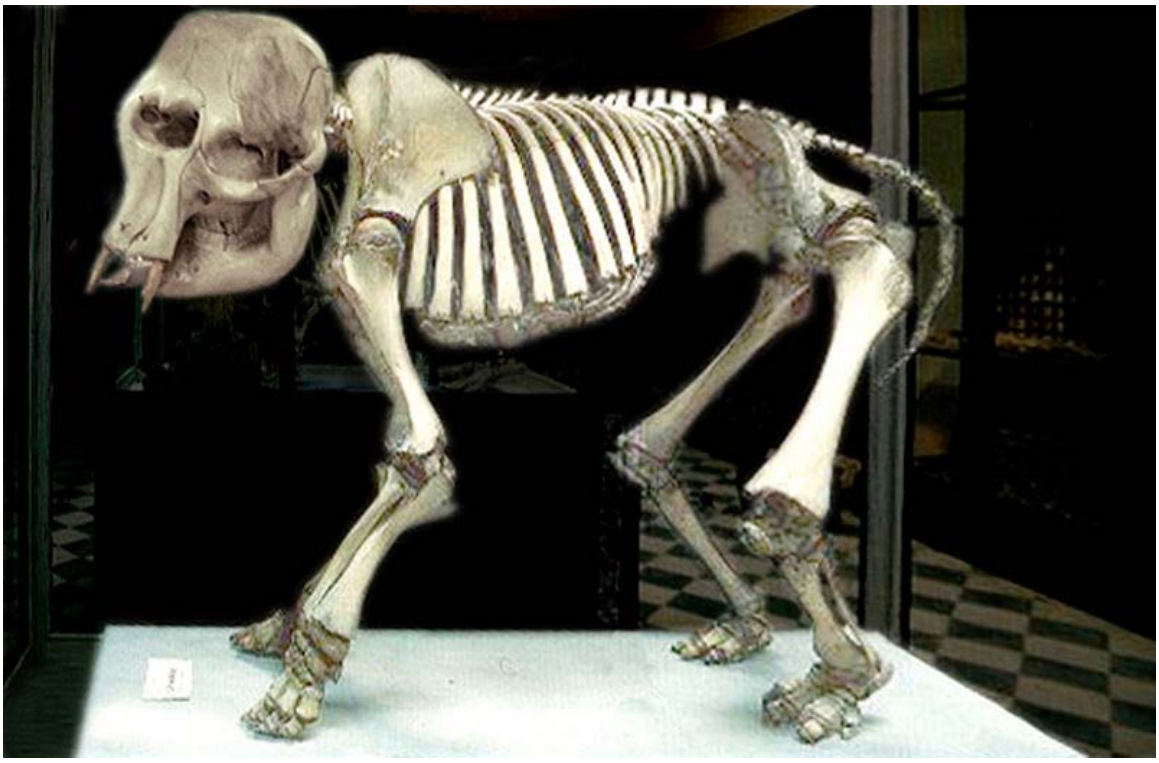


Elephas Falconeri

During low sea levels, the Mediterranean islands were colonised again and again, giving rise, sometimes on the same island, to several species (or subspecies) of different body sizes. These endemic dwarf elephants were taxonomically different on each island or group of very close islands, like the Cyclades archipelago.

There are many uncertainties about the time of colonisation, the phylogenetic relationships and the taxonomic status of dwarf elephants on the Mediterranean islands. Extinction of the insular dwarf elephants has not been correlated with the arrival in the islands of man. Furthermore, it has been suggested by the paleontologist Othenio Abel in 1914, that the finding of skeletons of such elephants sparked the idea that they belonged

to giant cyclopses, because the center nasal opening was thought to be a cyclopic eye socket.



Dwarf elephant skeleton of Malta

Sardinia

- *Mammuthus lamarmorae* (Major, 1883)
- *Elephas (Palaeoloxodon) antiquus* (Acconci, 1881)
- *Elephas (Palaeoloxodon) melitensis* Falconer, 1868

Sicily & Malta

- *Elephas (Palaeoloxodon) antiquus leonardii* Aguirre, 1969
- *Elephas (Palaeoloxodon) mnaidriensis* (Adams, 1874)
- *Elephas (Palaeoloxodon) melitensis* Falconer, 1868
- *Elephas (Palaeoloxodon) falconeri* Busk, 1867

Crete

Skeleton of a Cretan Dwarf Elephant.

- *Elephas (Palaeoloxodon) creticus* (Bate, 1907)
- *Elephas (Palaeoloxodon) creutzburgi* (Kuss, 1965)
- *Elephas (Palaeoloxodon) chaniensis* (Symeonides et al., 2001)

After DNA research, published in 2006, it has been proposed to rename *Elephas (Palaeoloxodon) creticus* into *Mammuthus creticus* (Bate, 1907). Others proposed (in 2002) to rename all the described specimens of larger size under the new subspecies name *Elephas antiquus creutzburgi* (Kuss, 1965). In a recent study of 2007, it was argued for the groundlessness of the theory by Poulakakis et al. in 2006, showing the weak points of that DNA research.

Cyprus

- *Elephas (Palaeoloxodon) cypriotes* Bate, 1903

The Cyprus dwarf elephant survived at least until 11,000 BP. Its estimated body weight was only 200 kg, only 2% of its 10,000 kg ancestor. Molars of this dwarf are reduced to approximately 40% the size of mainland straight-tusked elephants.

Remains of the species were first discovered and recorded by Dorothea Bate in a cave in the Kyrenia hills of Cyprus in 1902 and reported in 1903.

Cyclades Islands

Remains of paleoloxodontine elephants have been reported from the islands of Delos, Naxos, Kythnos, Serifos and Milos. The Delos elephant is of similar size to a small *Elephas antiquus*, while the Naxos elephant is of similar size to *Elephas melitensis*. The remains from Kythnos, Serifos and Milos have not been described.

Dodecanese Islands

On the island of Rhodes, bones of an endemic dwarf elephant have been discovered. This elephant was similar in size to *Elephas mnaidriensis*.

Two groups of remains of dwarf elephants have been found on the island of Tilos. They are similar in size to *Elephas mnaidriensis* and the smaller *Elephas falconeri*, but the two groups indicate sexual dimorphism. The remains had originally been designated to *Palaeoloxodon antiquus falconeri* (Busk, 1867). However, this name refers to the dwarf elephants from the island of Malta. As a result, since no migration route between the two islands can be proved, this name should not be used when referring to the elephant remnants from Tilos, although some scientists have accepted the temporary use of this name until further material can be examined.

The Tilos dwarf elephant is the first dwarf elephant whose DNA sequence has been studied. The results of this research are consistent with previous morphological reports, according to which *Palaeoloxodon* is more closely related to *Elephas* than to *Loxodonta* or *Mammuthus*. After the study of new osteological material <Theodorou et al. 2007> that has been excavated in anatomical connection in the Charkadio Cave on Tilos island the new species name *Elephas tiliensis* has been assigned to the Tilos dwarf elephants. It was the latest paleoloxodontine to survive in Europe. They became extinct just less than 4,000 years BP, so this elephant survived well into the Holocene.

Channel Islands of California

The Columbian mammoth (*Mammuthus columbii*) produced a separate, isolated population at the end of the Pleistocene. One of these isolated groups was formed on the Channel Islands of California, most likely about 40,000 years ago (although the time of isolation is not fully known). Selective forces on the Channel Islands resulted in smaller animals, forming a new species, the Pygmy Mammoth *Mammuthus exilis*. Channel Islands mammoths ranged from 150–190 cm in shoulder height.

Wrangel Island

During the last ice age, woolly mammoths (*Mammuthus primigenius*) lived on Wrangel Island in the Arctic Ocean. It has been shown that mammoths survived on Wrangel Island until 1700 BCE, the most recent survival of any known mammoth population. They also survived on Saint Paul Island in the Bering Sea until 6000 BCE. Wrangel Island is thought to have become separated from the mainland by 12,000 years BP. Survival of a mammoth population may be explained by local geographic, topographic and climatic features, which entailed preservation of communities of steppe plants, as well as a degree of isolation sufficient to delay colonization by humans. St. Paul Island shares this characteristic of geographic isolation, implying that human hunting played a role in the disappearance of the woolly mammoth. Wrangel Island mammoths ranged from 180–230 cm in shoulder height and were for a time considered "dwarf mammoths". However this classification has been re-evaluated and since the Second International Mammoth

Conference in 1999, these mammoths are no longer considered to be true "dwarf mammoths".

Indonesia

On Sulawesi and Flores evidence of a succession of distinct endemic island faunas has been found, including dwarfed elephants, dating until the Middle Pleistocene. Around the early Middle Pleistocene these dwarfed elephants were replaced by new immigrants of larger to intermediate sizes.

Flores

The present understanding of the succession of *Stegodon* species on Flores is that endemic dwarfs, represented by the Early Pleistocene species *Stegodon sondaarii*, became extinct around 840,000 years ago. These dwarf forms were then replaced by the medium to large-sized *Stegodon florensis*, a species closely related to the *Stegodon trigonocephalus* group found both in Java and in the islands of biogeographical Wallacea, separated by deep water from the Asian and Australian continental shelves. This Stegodon species went extinct about 12,000 years ago, presumably because of a volcanic eruption.

Sulawesi

The dwarfed *Stegodon sompoensis* lived during the Pleistocene on the island of Sulawesi. They had a shoulder height of only 1.5m.

Chapter- 11

Elasmotherium

Elasmotherium ("Thin Plate Beast") is an extinct genus of giant rhinoceros endemic to Asia during the Pliocene through Pleistocene living from 3.6 mya—126,000 existing for approximately 3.5 million years.

Taxonomy

Elasmotherium sibiricum

Elasmotherium stood, on average, 2.7 metres (8.9 ft) high and 6 metres (20 ft) long, with a single two-meter-long (depending on the size) horn in the forehead. The animal may have weighed up to 7 tonnes (7.7 short tons). Its legs were longer than those of other rhinos and were designed for galloping, giving it a horse-like gait. It was probably a fast runner, in spite of its size. Its teeth were similar to those of horses, and it probably grazed low herbs and for the low areas of tree leaves.

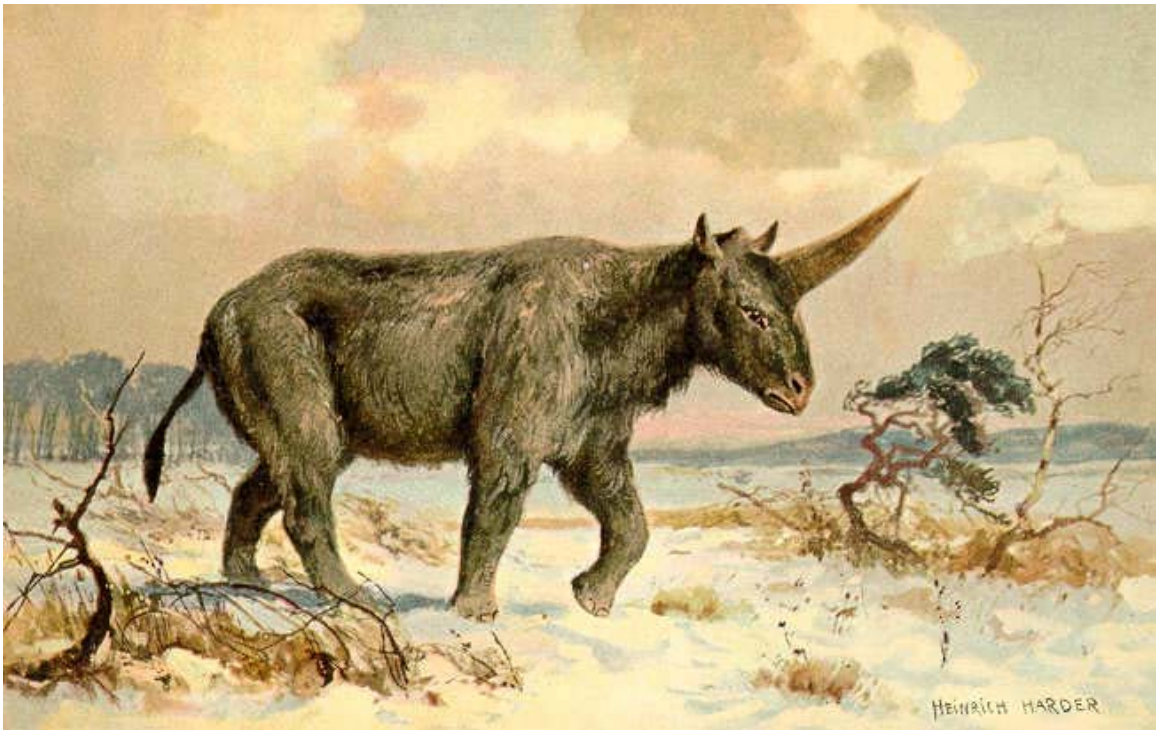
The genus appeared during the Late Pliocene in Central Asia, being derived from the genus *Sinotherium*. *E. inexpectatum* and *E. pei* inhabited Eastern China during the Upper Pliocene to Early Pleistocene. They disappeared approximately 1.6 Ma. The earliest records of *Elasmotherium* species in Russia are known from the Upper Pliocene assemblages near the Black Sea. *E. caucasicum* was widely distributed in this area between 1.1 Ma and 0.8 Ma. The more advanced (and largest member of the genus) *E. sibiricum* appeared in the Middle Pleistocene. It occupied all of the southwestern part of Russia, reaching eastward to western Siberia, then south into Ukraine and Moldova. Elasmotherians persisted in eastern Europe until the end of the Middle Pleistocene.

Description and paleobiology

Elasmotherium caucasicum

Morphological peculiarities of elasmotherians have generated two main hypotheses concerning their appearance and the character of their habitat. The first, most widely accepted view which was also described above, portrays them as large woolly animals with a large forehead horn that thrived on an open steppe. Fossils of the horn, however, have not been found. The other view assigns elasmotherians to riparian biotopes. It is probable that elasmotherians dwelt in both riparian and steppe biotope . The riparian biotope is suggested by dental and skull morphology. The combination of such characteristics as the absence of canines and strongly developed lateral processes of the atlas implies lateral movements of the head, presumably for grasping grass. The hypsodont dentition indicates presence of mineral grains in the food. Such food could be obtained by pulling out dense plants from the moist soil. These conditions are typical for riparian biotopes. On the other hand, a steppe biotope is indicated by their rather long and slender limbs, which would have served well for creatures grazing over vast areas.

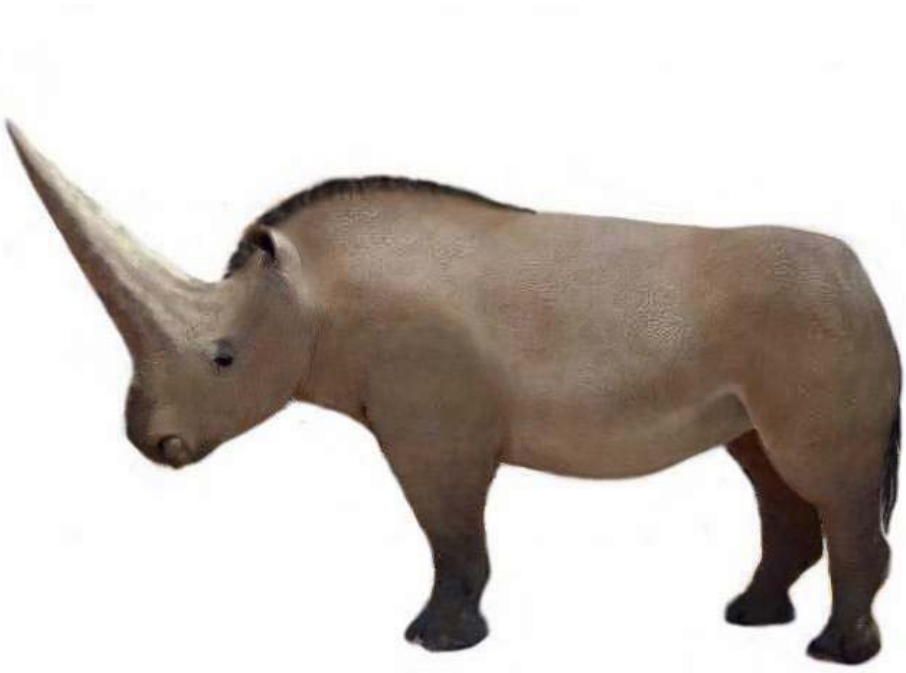
Possible historical witnesses



Elasmotherium by Heinrich Harder

It is believed that *Elasmotherium* died out in prehistoric times. However, according to science writer and cryptozoologist Willy Ley, the animal may have survived long enough to be remembered in the legends of the Evenk and Yakut people of Russia as a huge black or gray bull with long fur and a single horn in the forehead.

There is also a testimony by the medieval traveller Ibn Fadlan which has been interpreted by some to indicate that *Elasmotherium* may have survived into historical times.



Elasmotherium as the "zhi"

Ibn Fadlan's account states :

Near this river is a vast wilderness wherein they say is an animal that is less than a camel and more like a bull in size. Its head is like the head of a camel, and its tail is like the tail of a bull, while its body is like the body of a mule, and its hooves are like the cloven hooves of a bull. In the center of its head, it has a thick round horn, which as it rises from the head of the animal gets to be thinner until it becomes like the point of a lance. The length of some of these horns is from three to five cubits, and there are those that may attain to a greater or lesser length. The animal grazes on the leaves of trees, which are quite green. When it sees a horseman, it makes straight for him, and if he happens to have under him a fast horse, he is rendered safe from it with some effort. If it overtakes him, it removes him from the back of his horse with its horn, hurls him into the air, and then catches him with its horn. It continues in this manner until it kills him. It does not bother the horse in any form or manner. They seek out this animal in the forests in order to kill it. They do that by climbing the tall trees among which it is found, and with this object in mind, they assemble a number of archers with poisoned arrows. When it stands in their midst, they shoot at it until it is severely wounded and killed by them.

I saw in the king's house three large bowls which looked like [they were made of] the onyx of Yemen. The king informed me that it was made from the base of the horn of the animal. Some of the people of the country told me that it was a rhinoceros.

Some have argued that the survival of *Elasmotherium* into historical times may be the source of the unicorn myth, as the animal's description could be argued to fit with the Persian *karkadann* unicorn, and the Chinese *zhi* unicorn.

An article that appeared in a 1993 issue of French magazine *Le Point* refers to a sighting of a large horned animal, with a woolly fur coat in Siberia by a young man the previous year but gives no further details on the incident.

Chapter- 12

Woolly Rhinoceros

The **woolly rhinoceros** (*Coelodonta antiquitatis*) is an extinct species of rhinoceros native to the northern steppes of Eurasia that lived during the Pleistocene epoch and survived the last glacial period. The genus name *Coelodonta* means "cavity tooth". The woolly rhinoceros was a member of the Pleistocene megafauna.

Appearance

Life restoration

Skull with horns

An adult woolly rhinoceros was 3.7 metres (12 feet) in length on average, but they could probably grow to 4.3 - 4.4 meters (over 14 feet) at the largest. This is more than the modern white rhino. The Woolly rhinoceros could grow up to be 2 meters tall. Two horns on the skull were made of keratin, the anterior horn being 1 metre (3 feet) in length, with a smaller horn between its eyes. It had thick, long fur, small ears, short, thick legs, and a stocky body. Cave paintings suggest a wide dark band between the front and hind legs, but it is not universal and identification of rhinoceros as woolly rhinoceros is uncertain. The woolly rhinoceros used its horns to sweep snow away from vegetation so it could eat in the winter , and is also thought to have used its horns for defensive purposes and to attract mates.

As the last and most derived member of the Pleistocene rhinoceros lineage, the woolly rhinoceros was supremely well adapted to its environment. Stocky limbs and thick woolly pelage made it well suited to the steppe-tundra environment prevalent across the Palearctic ecozone during the Pleistocene glaciations. Its geographical range expanded and contracted with the alternating cold and warm cycles, forcing populations to migrate as glaciers receded. Like the vast majority of rhinoceroses, the body plan of the woolly rhinoceros adhered to the conservative morphology, like the first rhinoceroses seen in the late Eocene. A close relative, the Elasmotherium had a more southern range.

Diet

Controversy has long surrounded the precise dietary preference of *Coelodonta* as past investigations have found both grazing and browsing modes of life to be plausible. The palaeodiet of the woolly rhinoceros has been reconstructed using several lines of evidence. Climatic reconstructions indicate the preferred environment to have been cold and arid steppe-tundra, with large herbivores forming an important part of the feedback cycle. Pollen analysis shows a prevalence of grasses and sedges within a more complicated vegetation mosaic.

Coelodonta antiquitatis teeth

A strain vector biomechanical investigation of the skull, mandible and teeth of a well-preserved last cold stage individual recovered from Whitemoor Haye, Staffordshire, revealed musculature and dental characteristics that support a grazing feeding preference. In particular, the enlargement of the temporalis and neck muscles is consistent with that required to resist the large tugging forces generated when taking large mouthfuls of fodder from the ground. The presence of a large diastema supports this theory.

Comparisons with extant perissodactyls confirm that *Coelodonta* was a hindgut fermentor with a single stomach, and as such would have grazed upon cellulose-rich, protein-poor

fodder. This method of digestion would have required a large throughput of food and thus links the large mouthful size to the low nutritive content of the chosen grasses and sedges.

Extinction

Carcass with skin, as found in asphalt deposits in Starunia Oil Field, Poland, 1929

Many species of Pleistocene megafauna, like the woolly rhinoceros, became extinct around the same time period. Human and Neanderthal hunting is often cited as one cause. Other theories for the cause of the extinctions are climate change associated with the receding Ice age and the hyperdisease hypothesis.

Its shape was known only from prehistoric cave drawings until a completely preserved specimen (missing only the fur and hooves) was discovered in a tar pit in Starunia, Poland. The specimen, an adult female, is now on display in the Polish Academy of Sciences' Museum of Natural History in Kraków. The woolly rhinoceros roamed much of Northern Europe and was common in the then cold, arid desert that is southern England and the North Sea today. During Greenland Stadial 2 (the Last Glacial Maximum) the North Sea did not exist as sea levels were up to 125 metres (410 ft) lower than today.

Restoration by Charles R. Knight

The woolly rhinoceros co-existed with woolly mammoths and several other extinct larger mammals. No specimens have been dated in the U.K. after 15,000 ^{14}C years B.P.

Recent radiocarbon dating indicates that populations survived as recently as 8,000 B.C. in western Siberia. However, the accuracy of this date is uncertain as several radiocarbon plateaus exist around this time. The extinction does not coincide with the end of the last ice age but does coincide however, with a minor yet severe climatic reversal that lasted for about 1,000–1,250 years, the Younger Dryas (GS1 - Greenland Stadial 1), characterized by glacial readvances and severe cooling globally, a brief interlude in the continuing warming subsequent to the termination of the last major ice age (GS2), thought to have been due to a shutdown of the thermohaline circulation in the ocean due to huge influxes of cold fresh water from the preceding sustained glacial melting during the warmer Interstadial (GI1 - Greenland Interstadial 1 - ca. 16,000 - 11,450 ^{14}C years B.P.).

A relative, the hairy Sumatran rhinoceros (*Dicerorhinus sumatrensis*), still lives in Southeast Asia, as an endangered species.

Chapter- 13

Smilodon

Smilodon, often called **sabre-toothed cat** or **sabre-toothed tiger**, is an extinct genus of machairodontine. The sabre-toothed cat was endemic to North America and South America, living from the Early Pleistocene through Lujanian stage of the Pleistocene epoch (2.5 mya—10,000 years ago).

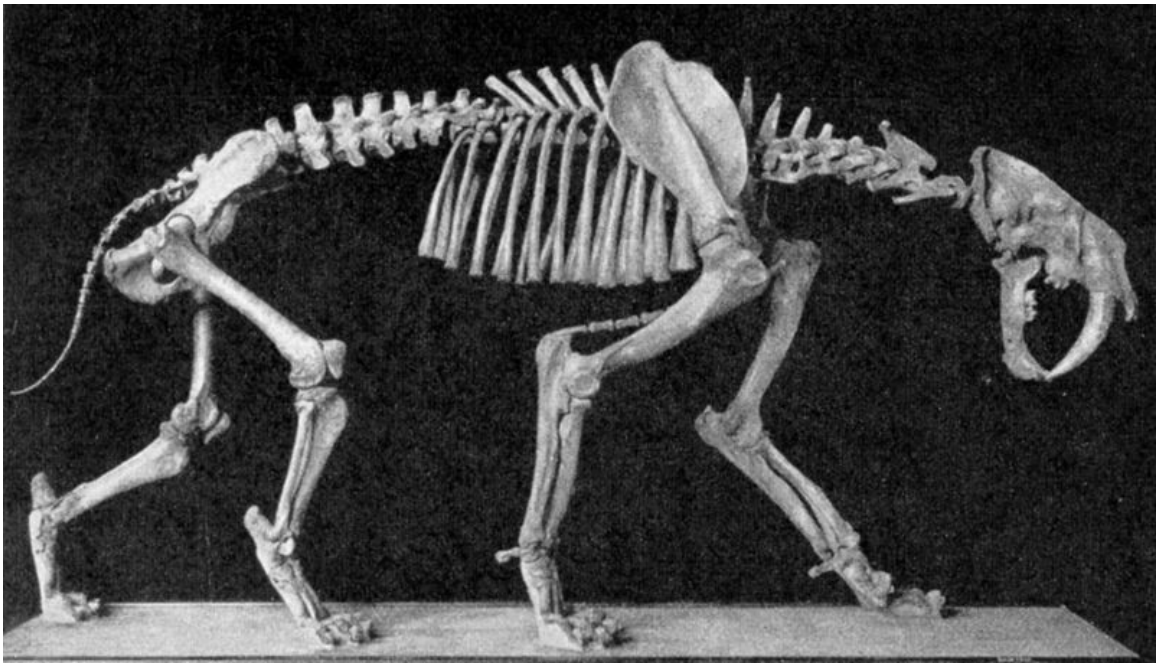
Etymology

The nickname "sabre-tooth" refers to the extreme length of their maxillary canines. Despite the colloquial name of "sabre-toothed tiger", *Smilodon* is not a tiger, which belong to the subfamily Pantherinae. The name *Smilodon* comes from Greek: σμίλη, *smilē*, "chisel" and Greek ὀδούς (*odoús*), "tooth", Genitive: ὀδούς, ὀδόντος,*odóntos*.

Classification and species

The genus *Smilodon* was described by the Danish naturalist and palaeontologist Peter Wilhelm Lund in 1841. He found the fossils of *Smilodon populator* in caves near the small town of Lagoa Santa, in the state of Minas Gerais, Brazil.

A number of *Smilodon* species have been described, but today usually only three are recognized.



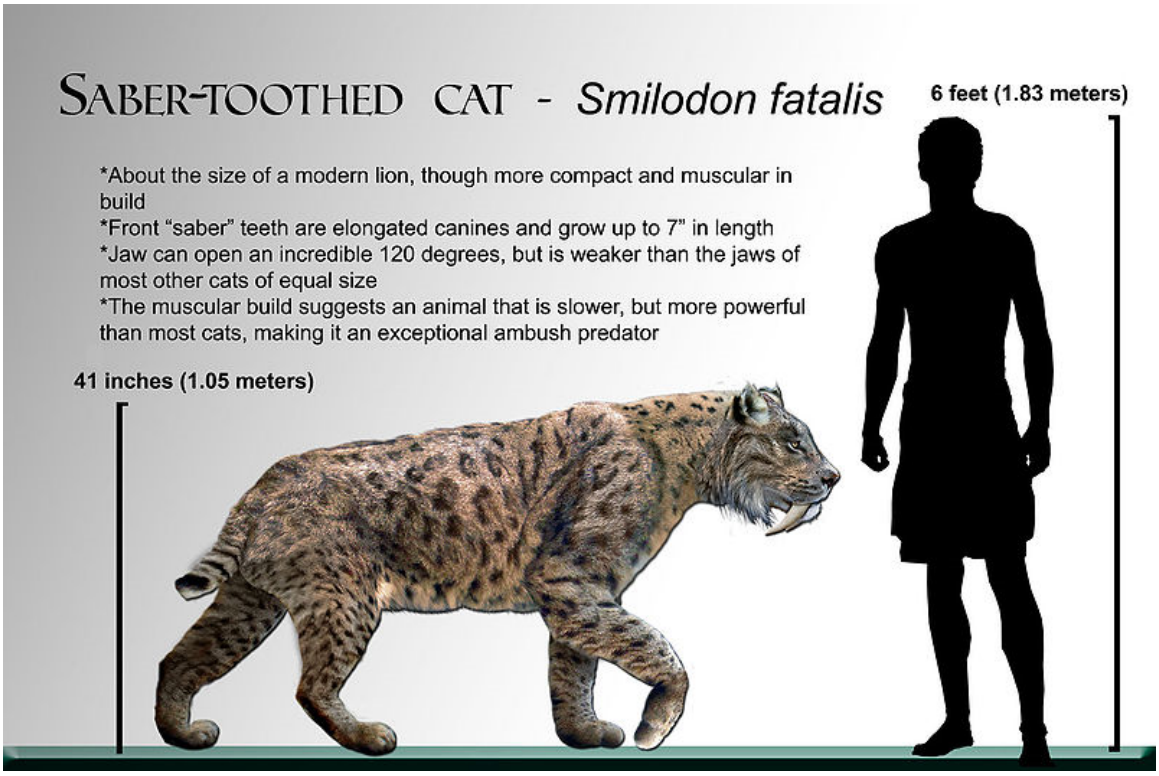
Smilodon neogaeus/populator skeleton

- *Smilodon gracilis*, 2.5 million-500,000 years ago; the smallest and earliest species (estimated to have been only 55 to 100 kg (120 to 220 lb)) was the successor of *Megantereon* in North America, from which it probably evolved. The other *Smilodon* species probably derived from this species.
- *Smilodon fatalis*, 1.6 million-10,000 years ago, replaced *Smilodon gracilis* in North America and western South America. In size it was between *Smilodon gracilis* and *Smilodon populator*, and about the same as the largest surviving cat, the Siberian Tiger. This species was about 1m high at the shoulder and is estimated to have ranged from 160 to 280 kg (350 to 620 lb). Sometimes two additional species are recognized, *Smilodon californicus* and *Smilodon floridanus*, but usually they are considered to be subspecies of *Smilodon fatalis*.
- *Smilodon populator* ("the devastating Smilodon"), 1 million-10,000 years ago; occurred in the eastern parts of South America and was the largest species of all machairodonts. It was much larger than its cousins, S. fatalis and S. gracilis, possessing a massive chest and front legs, and is the largest known variety of sabre-toothed cat, it was more than 1.22 m (48 in) high at the shoulder, 2.6 m (100 in) long on average and had a 30 cm (12 in) tail. With an estimated weight of 360 to 470 kg (790 to 1,000 lb), it was among the heaviest known felids. Its upper canines reached 30 cm (12 in) and protruded up to 17 cm (6.7 in) out of the upper jaw. Genetic evidence suggests that *Smilodon populator* and other members of the genus diverged from the main lineage of modern cats (subfamily Felinae) around 14-18 million years ago.

Smilodon populator is also known form the famous cave site of Ultima Esperanza, with well-preserved remains retaining endogenous DNA

Anatomy

The species of *Smilodon* were among the largest felids ever to live; the heaviest specimens of the massively built carnivore *S. populator* may have exceeded 500 kg (1,100 lb).



Smilodon fatalis shown to scale to demonstrate the compact muscular build

A fully-grown *Smilodon* weighed approximately 55 to 470 kg (120 to 1,000 lb), depending on species. It had a short tail, powerful legs, muscular neck and long canines. *Smilodon* was more robustly built than any modern cat, comparable to a bear. The lumbar region of the back was proportionally short, and the lower limbs were shortened relative to the upper limbs in comparison with modern pantherine cats, suggesting that Smilodon was not a very fast runner.

The largest species, the South American *S. populator*, had higher shoulders than hips and a back that sloped downwards, superficially recalling the shape of a hyaena, in contrast to the level-backed appearance of *S. fatalis*, which was more like that of modern cats. However, while its front limbs were relatively long, their proportions were extremely robust and the forearm was shorter relative to the upper arm bone than in modern big cats, and proportionally even shorter than in *S. fatalis*. This indicates that these front limbs were designed for power rather than fast running, and *S. populator* would have had immense strength in its forequarters.

Limbs

Smilodon had relatively shorter and more massive limbs than other felines. It had well developed flexors and extensors in its forepaws, which enabled it to pull down large prey. The back limbs had powerfully built adductor muscles which might have helped the cat's stability when wrestling with prey. Like most cats, its claws were retractable.

Teeth and jaws

Skeleton of *Smilodon californicus* at La Brea Tar Pits Museum

Smilodon is most famous for its relatively long canines. They are the longest canines of the sabre-toothed cats at about 28 cm (11 in) long in the largest species *Smilodon populator*. They were probably built more for stabbing than slashing. Despite being more powerfully built than other large cats, *Smilodon* actually had a weaker bite. Modern big cats have more pronounced zygomatic arches, while *Smilodon* had smaller zygomatic arches which restricted the thickness and therefore power of the temporalis muscles, and thus reduced *Smilodon*'s bite force. Analysis of its narrow jaws indicates that it could produce a bite only a third as strong as that of a lion. There seems to a be a general rule that the sabre-toothed cats with the largest canines had proportionally weaker bites. However, analyses of canine bending strength (the ability of the canine teeth to resist bending forces without breaking) and bite forces indicate that sabre-toothed cats' teeth were stronger *relative to the bite force* than those of modern "big cats". In addition,

Smilodon could open its jaws 120 degrees, whereas the lion can only open its jaws to 65 degrees.

It has been suggested that smilodon's smaller temporalis muscles (controlling much of the bite force) were not used in the killing of prey, but rather,the immense strength of the neck of smilodon allowed it to stretch its jaws around the throat and press its canines into the prey with the usage of immense neck and forelimb muscles rather than an actual bite; the penetration was the result of the neck flexors instead of the jaw muscles, as according to this hypothesis.

Ecology

Social behavior

Restoration of *Smilodon fatalis*

The social pattern of this cat is unknown. It has been suggested, based on the abundance of *S. fatalis* fossils in proportion to prey animals trapped in the La Brea tar-pits, that they

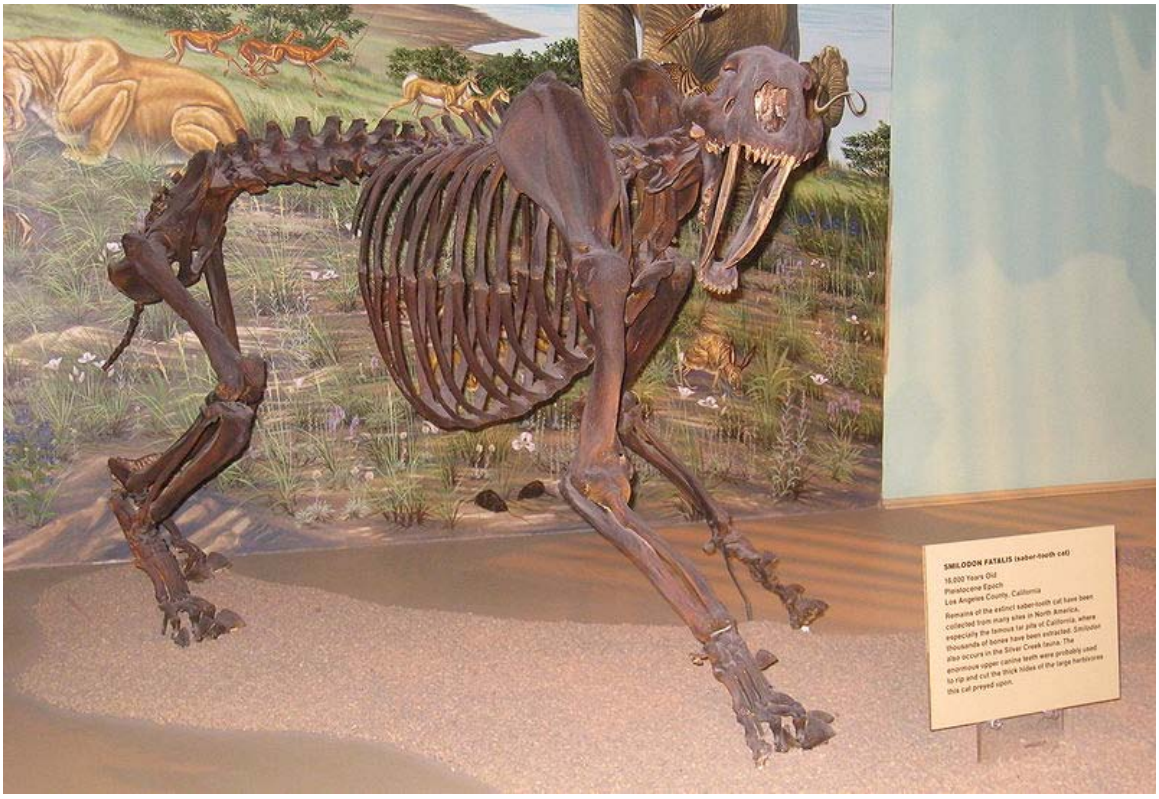
were packs of scavengers, lured in by the distress calls of trapped prey. This possibility was tested in 2008 by Chris Carbone (of the Zoological Society of London), who documented the responses of African predators of the Serengeti and Kruger National Park to recorded distress calls of prey species; it was determined that playbacks of prey sounds attract social carnivores, but not solitary hunters. Additionally, some fossils show healed injuries or diseases that would have crippled the animal. Some palaeontologists see this as evidence that sabre-toothed cats were social animals, living and hunting in packs that provided food for old and sick members. Living in groups might also allow more effective competition with social lions and wolves. The canine teeth and body size of *Smilodon* were about the same in both male and female cats. This suggests that one theory about their teeth – that they were used by males to attract mates – is incorrect.

Diet and hunting

Restoration of *Smilodon populator*

Smilodon probably preyed on a wide variety of large game including bison, deer, American camels, horses and ground sloths. As it is known for the sabre-toothed cat *Homotherium*, Smilodon might have killed also juvenile mastodons and mammoths. The La Brea tar pits in California trapped hundreds of *Smilodon* in the tar, possibly as they tried to feed on mammoths already trapped. The Natural History Museum of Los Angeles County has many of their complete skeletons.

Modern big cats kill mainly by crushing the windpipe of their victims, which may take a few minutes. *Smilodon*'s jaw muscles were probably too weak for this and its long canines and fragile skull would have been vulnerable to snapping in a prolonged struggle or when biting a running prey. Research in 2007 concluded that *Smilodon* most likely used its great upper-body strength to wrestle prey to the ground, where its long canines could deliver a deep stabbing bite to the throat which would generally cut through the jugular vein and / or the trachea and thus kill the prey very quickly. The leaders of this study also commented to scientific journalists that this technique may have made *Smilodon* a more efficient killer of large prey than modern lions or tigers, but also made it more dependent on the supply of large animals. This highly-specialized hunting style may have contributed to its extinction, as *Smilodon*'s cumbersome build and over-sized canines would have made it less efficient at killing smaller, faster prey if the ecosystem changed for any reason.



S. fatalis skeleton

Research upon which African carnivores response to playback of animals in distress has been used to analyse the finds of animal species and their numbers at the La Brea Tar Pits. Such playbacks find animal distress calls such as would come from an animal trapped in the tar pit would attract pack hunters such as lions and spotted hyenas, not lone hunters. Given the carnivores found at tar pits were predominately *Smilodon* and the social dire wolf, this suggests that the former like the latter was also a social animal. One expert, who found the study convincing, further speculated that if that was the case, then *Smilodon'*s exaggerated canine teeth might have been used more for social or sexual

signaling than hunting. However, the lack of sexual dimorphism in the canine teeth refutes this proposal.

Extinction

Smilodon became extinct around 10,000 BC, a time which saw the extinction of many other large herbivorous and carnivorous mammals.

Prehistoric humans, who reached North America at the end of the Ice age, are often viewed as responsible for this extinction wave. Others have suggested that the end of the ice age caused the extinction. As the ice age ended there would have been shrinking environments and changing vegetation patterns. Extensive grasslands, with different types of grasses, and isolated forests replaced healthy mixes of forests and grasslands. The summer and winter both became more extreme and North America began to dry out or began to be covered in snow, thus denying food sources for mammoths and in turn *Smilodon*. However, this hypothesis does not explain how *Smilodon* and its ancestors successfully survived many previous interglacials.

Chapter- 14

Arctodus

Arctodus (which translates as *Bear Tooth*) — known as the **short-faced bear** or **bulldog bear** — is an extinct genus of bear endemic to North America during the Pleistocene ~3.0 Ma.—11,000 years ago, existing for approximately 2.989 million years. *Arctodus simus* may have once been Earth's largest mammalian, terrestrial carnivore. It was the most common of early North American bears, being most abundant in California.

Taxonomy, classification and evolution

Restoration of *Arctodus simus*

The short-faced bears belonged to a group of bears known as the tremarctine bears or running bears, which are endemic to North America and Europe. The earliest member of the Tremarctinae was *Plionarctos edensis*, which lived in Indiana and Tennessee during the Miocene Epoch, (10 mya). This genus is considered ancestral to *Arctodus*, as well as to the modern spectacled bear, *Tremarctos ornatus*. *Tremarctos floridanus* was a contemporary. Although the early history of *Arctodus* is poorly known, it evidently became widespread in North America by the Kansan age (about 800 kya).

Species

Skeleton of *Arctodus simus*

A. simus compared to a human in size

Arctodus simus (2.0—1.9 Ma.), a species with 2 specimens weighing 110.2 kg (240 lb) and 800 kg (1,800 lb) as noted by Legendre and Roth, inhabiting a generally more northern and larger range. It was native to prehistoric North America from about 800,000 years ago, and became extinct about 12,500 years ago. It has been found from as far north as Ikpikpuk River, Alaska to Lowndes County, Mississippi. It is one of the largest bears in the fossil record and was among the largest mammalian land predators of all time. The type specimen came from Potter Creek Cave in Shasta County, California. Males from the Yukon region - the largest representatives of the species - would have stood about 1.80 m (5.9 ft) at the shoulder (on all fours), 4 m (13 ft) upright and may have weighed about 800 kg (1,800 lb).

Arctodus pristinus (3.0—2.2 Ma), a species with 2 specimens weighing 500.7 kg (1,100 lb) and 63.6 kg (140 lb) inhabiting more southern areas from northern Texas to New Jersey in the east, Aguascalientes, Mexico to the southwest, and with large concentrations in Florida, the oldest from the Santa Fe River 1 site of Gilchrist County, Florida paleontological sites.

Dietary habits

Arctodus skull

Researchers disagree on the diet of *Arctodus*. Analysis of *Arctodus* bones showed high concentrations of nitrogen-15, a stable nitrogen isotope accumulated by meat-eaters, with

no evidence of ingestion of vegetation. Based upon this evidence *A. simus* was highly carnivorous, and as an adult would have required 16 kilograms (35.3 lb) of flesh per day to survive.

One theory of its predatory habits envisions *Arctodus simus* as a brutish predator that overwhelmed the large mammals of the Pleistocene with its great physical strength. However, despite being very large its limbs were too gracile for such an attack strategy. Alternatively, long legs and speed (50–70 kilometres per hour (30–40 mph)) may have allowed it to run down Pleistocene herbivores such as steppe horses and saiga antelopes in a cheetah-like fashion. However, in this scenario, the bear's sheer physical mass would be a handicap. *Arctodus* skeletons do not articulate in a way that would have allowed for quick turns, an ability required of any predator that survives by killing agile prey. Dr. Paul Matheus, paleontologist at the University of Alaska Fairbanks, determined that *Arctodus'* moved in a pacing motion like a camel, horse, and modern bears, making it built more for endurance than for great speed. *Arctodus simus*, according to these arguments, was ill-equipped to be an active predator, leading some to conclude that it was a kleptoparasite, using its enormous size to intimidate smaller predators such as dire wolves, *Smilodon* and *American lion*s from their kills.

Recently, closer dietary research on the giant short-faced bear as well as the Cave Bear suggests that both bears were omnivores like most modern bears, and that the former did eat plants depending on availability.

Extinction

The giant short-faced bear became extinct about 12,000 ago, perhaps partly because some of its large prey died out earlier, and partly also because of competition with the smaller, more omnivorous brown bears that entered North America from Eurasia. Since its demise coincides with the development of the Clovis technology and improved hunting techniques by humans in North America, hunting pressure may also have contributed to its extinction, both directly (human hunting) or indirectly (due to the depletion of other large mammals which it may have followed to scavenge kills or depended upon as prey).

Chapter- 15

Macrauchenia

Macrauchenia ("long llama", based on the now superseded Latin term for llamas *Auchenia*, from Greek terms which literally mean "big neck") was a long-necked and long-limbed, three-toed South American ungulate mammal, typifying the order Litopterna. The oldest fossils date back to around 7 million years ago, and *M. patagonica* disappears from the fossil record during the late Pleistocene, around 20,000 years ago. *M. patagonica* was the best known member of the family Macraucheniidae, and is known only from fossil finds in South America, primarily from the Lujan Formation in Argentina. The original specimen was discovered by Charles Darwin during the voyage of the *Beagle*. In life, *Macrauchenia* resembled a humpless camel with a short trunk, though it is not closely related to either camels or proboscideans.

History

Macrauchenia patachonica

Macrauchenia appeared in the fossil record some 7 million years ago in South America (in the Miocene epoch). It is likely that *Macrauchenia* arose from either *Theosodon* or *Promacrauchenia*. Notoungulata and Litopterna were two ancient orders of ungulates which only occurred in South America. Many of these species became extinct through competition with invading North American ungulates during the Great American Interchange, after the establishment of the Central American land bridge. A few survivors of this invasion were the litopterns *Macrauchenia* and *Xenorhinotherium* and the large notungulates *Toxodon* and *Mixotoxodon*. These last original South American hoofed animals died out eventually at the time of the arrival of humans at the end of the Pleistocene, along with numerous other large animals on the American continent (such as American elephants, horses, camels, saber-toothed cats and ground sloths). As this genus was the last of the litopterns, its extinction ended that line of mammals.

Anatomy

Phenacodus primaevus (near) and *Macrauchenia patachonica* (far)

Macrauchenia had a somewhat camel-like body, with sturdy legs, a long neck and a relatively small head. Its feet, however, more closely resembled those of a modern rhinoceros, and had three hoofs each. It was a relatively large animal, with a body length of around 3 metres (9.8 ft).

One striking characteristic of *Macrauchenia* is that, unlike most other mammals, the openings for nostrils on its skull were atop the head, leading some early scientists to

believe that, much like a whale, it used these nostrils as a form of snorkel. Soon after some more recent findings , this theory was rejected. An alternative theory is that the animal possessed a trunk, perhaps to keep dust out of the nostrils.

One insight into *Macrauchenia*'s habits is that its ankle joints and shin bones may indicate that it was adapted to have unusually good mobility, being able to rapidly change direction when it ran at high speed. It is speculated that since *Macrauchenia* lived in an environment much like the savannas of modern-day Africa, it may have had a tawny coat to match the color of dried grass.

Macrauchenia is known, like its relative, *Theosodon*, to have had a full set of 44 teeth.

Diet and behavior

Macrauchenia patagonica

Macrauchenia was an herbivore, likely living on leaves from trees or grasses. Scientists believe that, because of the forms of its teeth, it ate using its trunk to grasp leaves and other food. It is also believed that it lived in herds like modern-day wildebeest or antelope, the better to escape predators.

Predators

When *Macrauchenia* first arose, it would have been preyed upon by the largest of native South American predators, terror birds such as *Andalgalornis*, and carnivorous marsupials such as *Thylacosmilus* and *Borhyaena*. During the late Pliocene/Early Pleistocene, the Panama Isthmus formed, allowing predators of North American origin, such as the puma, the jaguar and the saber-toothed cat, *Smilodon populator*, to emigrate into South America and replace the native forms.

It is presumed that *Macrauchenia* dealt with its predators primarily by outrunning them, or, failing that, kicking them with its long, powerful legs, much like modern-day vicuña or camels . Its potential ability to twist and turn at high speed could have enabled it to evade pursuers.

Fossil evidence

Macrauchenia was first discovered on 9 February 1834 at Port St Julian in Patagonia (Argentina) by Charles Darwin, when HMS *Beagle* was surveying the port during the voyage of the *Beagle*. As a non-expert he tentatively identified the leg bones and fragments of spine he found as "some large animal, I fancy a Mastodon". In 1837, soon after the *Beagle's* return, the anatomist Richard Owen revealed that the bones including vertebrae from the back an neck were actually from a gigantic creature resembling the Llama and the camel, which Owen named *Macrauchenia patachonica*. In naming it, Owen noted the original Greek terms Μακρος (large or long), and αυχην (neck) as used by Illiger as the basis of *Auchenia* as a generic name for the Llama, Vicugna and so on. The find was one of the discoveries leading to the inception of Darwin's theory. Since then, more *Macrauchenia* fossils have been found, mainly in Patagonia, but also in Bolivia, Chile and Venezuela.

Cultural references

Macrauchenia is featured in the episode "Saber-tooth" of the documentary *Walking with Beasts*, and individuals are featured in the 2002 Blue Sky film *Ice Age* and its sequel, the 2006 film *Ice Age: The Meltdown*. It was included in the simulation game Zoo Tycoon: Complete Collection as part of the Dinosaur Digs Theme Pack and in Wildlife Park 2: Crazy Zoo as a cloneable beast. The related genus *Cramauchenia* was named by Florentino Ameghino as a deliberate anagram of Macrauchenia.