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THE YUKAGIR MAMMOTH: BRIEF HISTORY, 14C DATES, INDIVIDUAL AGE, GENDER, SIZE, PHYSICAL AND ENVIRONMENTAL CONDITIONS AND STORAGE

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BRIEF HISTORY

The Yukagir Mammoth consists of a unique, well-preserved partial carcass of a woolly mammoth, *Mammuthus primigenius* (BLUMENBACH, 1799). This specimen was discovered in the autumn of 2002 by Mr. V. Gorokhov and sons near the Maxunuokha River in northern Yakutia, Arctic Siberia, Russia (GPS 71° 52′ 988” North - 140° 34′ 873′′ East) (Lazarev *et al.,* 2004 and Mol et. al., 2004).

In September 2002, the head of this mammoth without the trunk, but otherwise almost completely covered with skin, was extracted from the permafrost. In June 2003 a team from CERPOLEX/Mammuthus, headed by Mr. Bernard Buigues, conducted a brief survey of the Yukagir Mammoth site in close cooperation with scientists of the Mammoth Museum in Yakutsk, Yakutia, and the scientific secretary of the Russian Mammoth Committee, Saint Petersburg, Russia. More remains of the Yukagir Mammoth were discovered. Soon it became evident that even more remains of this specimen are in the permafrost, not far below the surface, apparently in anatomical order and in well-preserved condition.

In the beginning of September 2003 a small team travelled to the site and excavated the left front leg of the Yukagir Mammoth. This leg was in anatomical position (fig. 1) and frozen solid, with ice crystals covering some parts. The radius/ulna and the complete foot are covered with soft tissue, skin and hair, and the “toes” are clearly delineated. In addition, parts of the intestines were salvaged.

In June 2004, a team of Russian, Yakutian, Japanese and other scientists visited the site of the Yukagir Mammoth. The objective of this expedition was to clean and to protect the site for the coming summer. A thick layer of frozen snow was removed, exposing some fur and underfur of the Yukagir Mammoth.

Figure 1. Excavation of the entire left front leg of the Yukagir Mammoth. Photograph: Francis Latreille.

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6 Mammoth Museum, Institute of Applied Ecology, Academy of Sciences of Sakha (Yakutia) Republic, Yakutsk, Yakutia, Russia.
7 Mammoth Site of Hot Springs, South Dakota, United States of America.

Table 1

Field number	Sample	Laboratory number	Results
CM-DM-64	Bone (rib)	GrN-28258	18,510 +/- 80 BP
CM-DM-65	Skin	GrN-28259	18,510 +/- 100 BP
CM-DM-66	Hair	GrA-24288	18,680 +/- 100 BP

GrN = Groningen Conventional radiocarbon dating
GrA = Groningen AMS radiocarbon dating

Table 2

Field number	Sample	Laboratory number	Results
	Bone (rib), same sample as CM-DM-64	AA-59602	18,160 +/- 110 BP

Table 3

Field number	Sample	Laboratory number	Results
	Bone	GIN-12719	18,200 +/- 60 BP

The final expedition for extraction of remains of the Yukagir Mammoth took place in the first half of September 2004. Remains of the vertebral column and the rib cage were recovered, as well as remains of the intestine. Samples of sediments and vegetation, above and beneath the mammoth remains were collected to analyze the environment of this mammoth. The Yukagir Mammoth has been added to the inventory of the Mammoth Museum of Yakutsk, Yakutia, Institute of Applied Ecology, Academy of Sciences of Sakha (Yakutia) Republic (Lenina prospekt, 39, 677891 Yakutsk, Russia) and it is currently kept frozen in an ice cave in Yakutsk.

14C DATES

Three samples of bone, skin and hair from the June 2003 expedition were sent to Dr. Johannes van der Plicht, Groningen University, the Netherlands, for 14C dating. The results are in tab. 1.

Average value of these measurements: 18,560 +/- 50 BP which calibrates into ca. 22,500 calendar years ago from today, expressed as 22,500 cal. BP.

A 14C cross-check (AMS) has been run in Tucson, Arizona, USA, initiated by Dr. Alexei Tikhonov, the results are in tab. 2.

Another 14C cross-check (conventional) has been run in Moscow by Dr. L. Sulerzhitsky, the results are in tab. 3.

THE INDIVIDUAL AGE

Estimation of the individual age of a woolly mammoth is based on the assumption that the life span of a woolly mammoth is similar to that of modern elephants in Africa and Asia. To estimate the individual age of a woolly mammoth, molars in the mandible are compared to those of an African elephant of which the individual age is known. As an example, the estimated individual age for the Jarkov Mammoth, Taimyr Peninsula, is 47-49 African Elephant Years (AEY).

The head of the Yukagir Mammoth (fig. 2, 3, 4, and 5) is extremely well preserved; almost the entire head, including the mandible, is still covered with thick skin and the mouth is closed, Tikhonov, 2004. Consequently, the molars in the upper and lower jaws are not exposed, and it is not possible at this stage, to inspect the molars of this mammoth, without inflicting damage. Based on the size and the curvature of the tusks, however, the Yukagir Mammoth could be identified as a mature individual with remnants of the lower and upper m/M 3's in occlusion. Non-destructive investigations on the skull of the Yukagir Mammoth using a CT-scan and three-dimensional images of the upper and lower molars during the World Expo 2005 in Japan, will shed new light on the individual age of this mammoth compared to AEY. These studies will also allow more detailed investigations of the dental wear pattern in occlusion.

THE GENDER

Considering the size of the head and its long and spirally twisted tusks, the Yukagir Mammoth was probably a male. No remains of the pelvic girdle have been traced, which could have provided confirmation on the gender of the animal. Investigation of the right tusk of the Yukagir Mammoth in September 2004 by Daniel C. Fisher corroborated the identification of a male individual.

Figure 2. Lateral view of the head of the Yukagir Mammoth. Photograph: Francis Latreille.

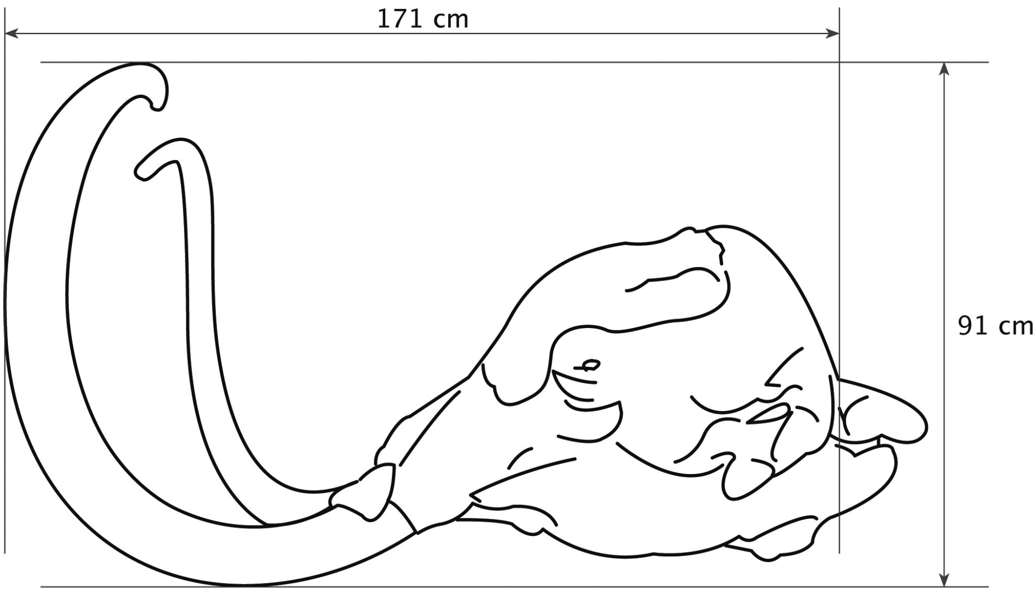

Figure 3. Measurements (lateral) of the head of the Yukagir Mammoth.

Figure 4. Frontal view of the head of the Yukagir Mammoth. Photograph: Francis Latreille.

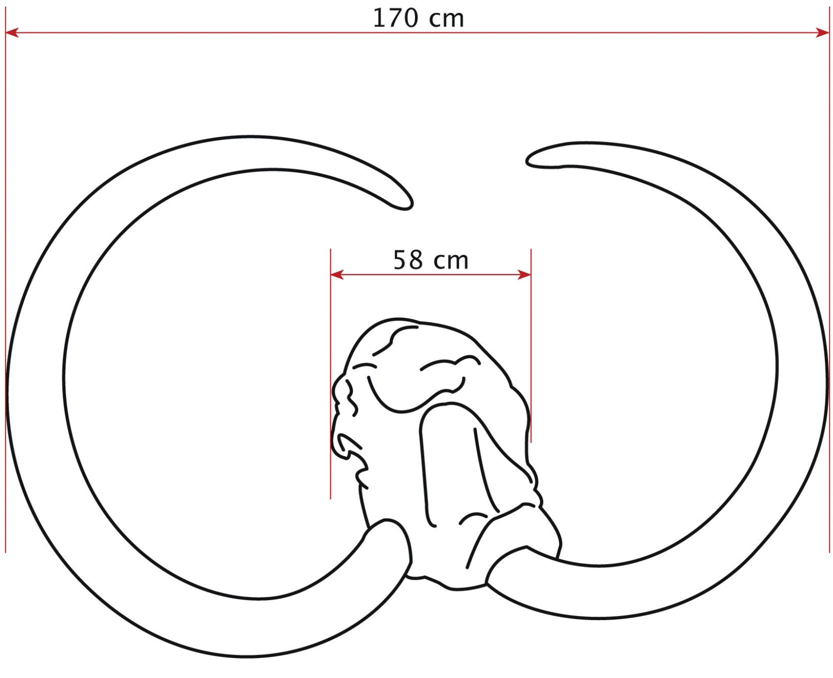

Figure 5. Measurements (frontal) of the head of the Yukagir Mammoth.

THE SIZE

The Yukagir Mammoth was average-sized for a male woolly mammoth. It had large spirally-twisted tusks (Cat. No. Mammoth Museum: N 7865), typical for an old individual. The shoulder height of the Yukagir Mammoth is estimated to have been 272.5 cm based on the measurements of the entire left front leg in anatomical position including 13 cm added for missing soft tissue at the shoulder (measurements see below). However, based on combined data from the entire left front leg and the forefoot circumference, the estimated shoulder height is 282.9 cm (Shoshani & Mol, 2004).

The excellent state of preservation of the Yukagir Mammoth provided a wealth of information on the exterior of a "woolly mammoth": the left side of the cranium is entirely covered with skin. Both the entire ear (fig. 6 and 7) and the eye opening (fig. 8), including eyelashes as well as the temporal gland opening are preserved (for measurements, see fig. 7).

The ear dimensions

Comparing the dimensions of the pinna, or external ear, of the Yukagir Mammoth (data given below) to those of an African elephant (after Shoshani *et al.,* 1987), we note the following. The height of the left ear Yukagir Mammoth is 30.7 cm, and that of the African elephant ("Ahmed") is 133.0 cm; the anterior-posterior distances of the ears are 17.5 cm and 90.0 cm, respectively; and the maximum thicknesses are 40.8 mm and about 10 mm, respectively. The surface area of the left ear of the Yukagir Mammoth is 537.25 square cm, and the surface area of the left ear of Ahmed is 11,970 square cm. It emerges that the surface area of Ahmed, the African elephant, is about 22 times larger than that of the Yukagir Mammoth. To our knowledge, this kind of comparison of the surface areas between the extinct mammoth and the living African elephant was not published previously.

Temporal gland

In living elephants this gland is known to function in establishing a hierarchy among males during breeding season (Easa, 2000; Poole, 2000; Schmidt, 2000). The gland secretes a chemical substance "temporin", which informs other males that the secretor with the highest chemical composition is in full musth (a word of Hindi origin, that means 'intoxicated', implying that the owner is in madness to win an estrus female), and this male is ready to mate with an estrus female. Among the lines of research under consideration is to search for temporin secretion in the woolly mammoth gland, if it did not decompose.

Figure 6. Complete ear of the Yukagir Mammoth. Photograph: Dick Mol.

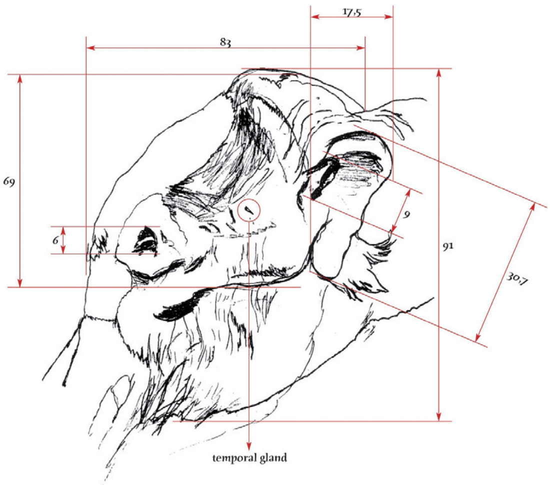

Figure 7. Measurements of the head, including the left ear, of the Yukagir Mammoth. Note the small size (30.7 cm) of the length of the ear. The position of the temporal gland opening indicated.

Figure 8. Eye of the Yukagir Mammoth. Photograph: Francis Latreille.

Figure 9. III, IV and V thoratic vertebrae of the Yukagir Mammoth. IV and V thoratic vertebrae are fused through bony outgrowths. Top: Ventral view of the vertebrae bodies. Below: Fused dorsal spines. Photograph: Dick Mol.

CT-scan of the Yukagir Mammoth head during World Expo 2005 in Japan will provide data on the interior ear organs (Suzuki, 2004). During the examination of the cranium in the Mammoth Museum in Yakutsk, June 2004, the left stylohyoideum was discovered *in situ*.

THE PHYSICAL CONDITION

The Yukagir Mammoth had backbone/spine problems. Thoracic vertebrae IV and V showed abnormal growth possibly as a result of auto-immune reaction to an inflammation somewhere else in the body. Only the thorn-shaped extremities of the two subsequent thoracic vertebrae (thoracic vertebrae VI and VII, No. 7885 and No. 7886) have been retrieved; these were naturally cut off just above the neural canal and were strongly deformed, showing some pus channels. The available vertebrae before and after these pathologically-modified specimens were in good condition. Dr. Erwin Kompanje of the Erasmus Medical Center and the Natural History Museum in Rotterdam, The Netherlands, diagnosed a form of Spondylarthropathy (also known as (Ankylosing) Spondylitis or Rheumatoid spondylitis) in the 4th and 5th thoracic vertebrae (fig. 9). Unfortunately, the pelvis bone and the sacrum bone are missing. Generally, this disease shows most clearly in the joint between these two bones.

Spondylarthropathy includes a group of inflammatory diseases comprising Reiter's syndrome, reactive arthritis, psoriatic arthritis and arthritis associated with inflammatory bowel disease. The bony outgrowths found on the vertebrae of affected individuals are called syndesmophytes (Francois *et al.,* 1995).

These are slim, bony outgrowths, parallel to the vertebral column, which replace the outer parts of the annulus fibrosus (part of the intervertebral disc) and the shorter and longer perivertebral ligaments, thus leading to an intervertebral bridge by means of complex processes involving ossification. The syndesmophytes can be distinguished from the vertical and chunky osteophytes (bone spurs) in degenerative vertebral disease, and the often bizarre new bone formation associated with primary bacterial infections.

These abnormal bony outgrowths on two thoracic vertebrae (IV and V) of the Yukagir Mammoth resemble the syndesmophytes usually found in Spondylarthropathy in man and other mammals (Rothschild, 1994; Kompanje, 1999; Kompanje *et al.,* 2000) A diagnosis of Reactive spondylarthropathy, most probably associated with inflammatory bowel disease seems plausible in this case.

These inflammations would have caused pain, especially in the early stages of abnormal bone growth but this was most likely not related to death. The event or condition triggering this growth might have occurred several years earlier. It will be interesting to see if Daniel Fisher finds signs of this event in the growth of the tusk, where a daily history of life is stored as variations in structural and compositional properties.

PLANT REMAINS IN THE YUKAGIR MAMMOTH DUNG AND AN ENVIRONMENTAL RECONSTRUCTION

Samples from the intestinal tract (fig. 10, 11 and 12) of the Yukagir Mammoth were studied for pollen, spores and macroscopic botanical remains (van Geel *et al.,* 2004). The dung consisted of compact plant material, mainly fibres and thin willow twigs, mixed with small mineral particles. Many of the observed mosses showed soil dust, caught between the leaves. The pollen record from the soil dust component reflects a mixed pollen deposition over a number of years. The pollen spectra demonstrate a typical biased distribution, related to the different pollen production and dispersal strategies of the various species. Wind-dispersed taxa such as grasses and *Artemisia* are overrepresented, whereas insect-pollinated species have been underrepresented. The pollen grains are well preserved. The dominance of pollen of grasses (Poaceae) and *Artemisia*, in combination with *Plantago*, *Armeria*, *Polemonium* and Caryophyllaceae, and the absence of tree pollen suggest a treeless steppe vegetation. Ascospores of the coprophilous (dung-inhabiting) fungus *Sporormiella* were recorded in the microfossil slides. *Sporormiella* does not form spores inside the gastrointestinal tract, implying that the spores were ingested together with the food plants. Earlier palynological studies (e.g. the study of the Jarkov Mammoth) have shown that spores of coprophilous fungi are common in the microfossil record of the mammoth steppe (Mol *et al.,* 2001; 2003 and *in press)*. The presence of these spores is related to the availability of herbivore dung as a substrate.

The record of macroscopic plant remains is strongly influenced by the food choice of the mammoth during its last meal (Ukraintseva, 1993), but the species composition supports and extends the reconstruction of the landscape based on the pollen record. Willow (*Salix*) twigs formed an important component of the meal. Species identification of the willow remains was not possible, but it was evident that small-leaved dwarf species had been consumed. Willow twigs were 1-2 (< 4) mm in diameter, and up to 7.5 cm in length. Thicker twigs had more than 20 year rings. Thinner twigs showed scars from where leaf stalks had originally been attached. Based on the observation that no remains of leaf stalks were connected with willow twigs, we infer that the Yukagir Mammoth died between two growing seasons (during the period from autumn to late winter). Fruits and many axillary buds of willow were recorded, some of the buds still in connection with twigs. The yellow-brown, thin twigs and axillary buds showed the typical cell pattern of willow epidermis, with numerous pits (originally bearing hairs). The preservation of willow leaves was poor; in most cases only fragments of the venation were preserved. Rarely, leaf cuticles were preserved and these showed the characteristic *Salix* cell pattern. As leaves are the softest parts of the willows, the degradation of the leaves may have partly been caused by the digestion process in the mammoth's gastrointestinal tract. Stem fragments of grasses (Poaceae) were common. The spectrum of the recorded fruits and seeds is indicative of a grassy willow-shrub landscape, but this does not contradict the steppe character of the

Figure 10. Part of the preserved intestine. Photograph: Jan van Arkel, University of Amsterdam.

Figure 11. Dung of the Yukagir Mammoth extracted from the intestine fragment (figure 10). Photograph: Jan van Arkel, University of Amsterdam.

Figure 12. Enlargement of the dung (figure 11). Photograph: Jan van Arkel, University of Amsterdam.

Figure 13. Storage of the Yukagir Mammoth remains in an artifical ice cave in Yakutsk, Yakutia, Russia. Photograph: Francis Latreille.

vegetation. In addition to the *Salix* fruits, we recorded, among others, *Poa* cf *arctica*, cf *Agrostis* sp., cf *Hordeum* sp., *Potentilla* sp., *Rumex acetosella*, several *Carex* spp., *Papaver* sp., Caryophyllaceae, Brassicaceae, Primulaceae (*Lysimachia*?) and possibly Asteraceae. The mosses (*Drepanocladus*/*Campylium*, *Polytrichum* sp., *Bryum* sp., and Pottiaceae) indicate a variety of environments, ranging from moist to dry conditions.

Based on the botanical record we conclude that the Yukagir mammoth died during the cold season in a treeless steppe. Grazing pressure and trampling by large herbivores, combined with the cold climate caused open patches of soils where mineral dust was eroded and deposited by wind extensively over the landscape and its vegetation (van Geel *et al.,* 2004). Based on the preservation of the willow twigs (broken, but not squashed), we question the ability of the Yukagir mammoth to absorb sufficient nutrients from its food.

THE STORAGE OF THE YUKAGIR MAMMOTH

The remains of the Yukagir Mammoth are stored in the collections of the Mammoth Museum in Yakutsk, the capital of Yakutia. The Mammoth Museum belongs to the Institute of Applied Ecology of the North, Academy of Sciences of the Sakha Republic (Yakutia), and is located in the capital of Yakutia, Yakutsk.

Permafrost creates unique conditions for preservation, not only of skeletal parts but also of soft tissues of extinct animals. Many of the permafrost fossils dating to the Quaternary have been found in the territory of the Sakha Republic (Yakutia) which occupies most of Eastern Siberia. The most interesting and spectacular collections of fossil mammals from the Quaternary are kept in museums in Yakutsk. The most important collections are housed in the following museums: the Regional Nature Museum, the Geological Museum of the Institute of Geology of Diamonds and Precious Metals of the Siberian Division of the Russian Academy of Sciences, and the Mammoth Museum (Boeskorov & Mol, 2004).

In 1991, the Mammoth Museum was founded; it specializes in mammoths and the mammoth fauna. The aim of this museum is to study the mammoth fauna and its environment during the Pleistocene. The collection of the Mammoth Museum consists of more than 1,000 remains of the larger mammals of the mammoth fauna. This collection needs further study to improve understanding of the late Pleistocene and the extinction of many large mammals at the end of the Pleistocene and the beginning of the Holocene.

The condition of many of the remains of the Yukagir Mammoth is excellent, and many soft parts have been collected, like the complete skin covering of the head, partly covered with fur. Therefore, it was decided to store the remains under the best possible conditions. Cerpolex/Mammuthus had experienced good results with the ice cave in Khatanga, where all the fossils of the Pleistocene mammals are stored at a constant temperature of -11 degrees Celsius. It was decided initially to store the Yukagir Mammoth remains in an artificial freezer at temperatures of about -15 degrees Celsius. However this proved to be too cold and too dry and it resulted in slowly freeze-drying the remains. So, the remains were transferred to an ice cave in the center of Yakutsk (fig. 13) where the temperature is not that low. It was still possible to carry out extensive examinations of the head in the cave.

INVENTORY OF THE YUKAGIR MAMMOTH REMAINS

SCAPULA SINISTER (Cat. # Mammoth Museum: N 7861/19)

Maximum length	79.4 cm
Maximum length a/p glenoid	18.7 cm
Maximum width m/l glenoid	9.5 cm
Antero-posterior diameter neck	20.5 cm
General remarks	Damaged by excavation activities No soft tissue remains

HUMERUS SINISTER (Cat. # Mammoth Museum: N 7861/21)

Maximum length	85.5 cm
Maximum width, distal epiphysis	24.8 cm
Maximum width, proximal epiphysis	21.6 cm
Minimum circumference shaft	33 cm
General remarks	Both epiphyses are fused, indicating a full grown animal No soft tissue remains

HUMERUS DEXTER (Cat. # Mammoth Museum: N 7894). Excavated September 2004.

Maximum length	89 cm
Maximum width, distal epiphysis	26 cm
Maximum width, proximal epiphysis	23.6 cm
Minimum circumference shaft	34 cm
General remarks	Both epiphyses are fused, indicating a full grown animal No soft tissue remains. Excavated in disturbed sediments just below the water level in September 2004. Some damage at distal epiphysis and proximal part of the shaft.

SCAPULA DEXTER (Cat. # Mammoth Museum: N 7861/20)

Maximum length	79.4 cm
Maximum length a/p glenoid	18.7 cm
Maximum width m/l glenoid	9.5 cm
Antero-posterior diameter neck	20.5 cm
General remarks	Damaged by excavation activities No soft tissue remains

Scapula sinister and humerus sinister together, in anatomical position, have a maximum length of 160 cm.

RADIUS-ULNA and COMPLETE FRONT FOOT SINISTER (Cat. # Mammoth Museum: N 7863)

General remarks on this part of the left front leg	• Completely covered with soft tissue like skin, fur and underfur, due to an ice-wedge in close proximity to this part of the disarticulated Yukagir Mammoth body • Muscles in good conditions • Excellent state of preservation • 3 Nails/hooves are preserved in good condition • X-ray is necessary
Maximum width of the proximal epiphysis of the left Ulna	21 cm
Maximum height of radius-ulna plus foot	99.5 cm
Number of nails/hooves	3 on the digits 2,3 and 4
Maximum width of nail/hoof III	14.5 cm
Maximum height of nail/hoof III	5 cm
Measurements of the left foot	
Antero-posterior diameter	42 cm
Medial-lateral diameter	50 cm
General remark	The foot is extremely big compared to the shoulder height

Professor Naoki Suzuki, a member of our research team from Tokyo, will investigate the head of the Yukagir thoroughly by CAT-scan when the remains are in Japan for Expo 2005. In this way we should obtain more details about the cranial cavity, the inner ear and other features. The condition of the molars in the upper and lower jaws, particularly wear patterns, should also be revealed. This will allow us to compare the Yukagir with known-age African elephants. With this information we can improve our estimate of the age of the Yukagir Mammoth.

Just before the start of the first scientific conference, "The Yukagir Mammoth: Outcome of the First Stage of Work" in Yakutsk (2004), we did a test on the foreleg or arm of the Yukagir Mammoth which had the complete foot, fully intact with muscles, skin and hair. The medical staff had agreed to scan this part of the animal with a CAT-scan. We were lucky; the foot barely fit. Any larger and it would not have been possible. The scans were made and a few moments later we had a very good impression of the lower foreleg and foot. The computer screen showed clearly that there were no fractures or abnormal growth. We also noticed that the radius and ulna had not fused (synostosis) as happens sometimes with mammoth of very advanced ages.

The scans of the foot (fig. 14) resulted in some outstanding images, and new facts were revealed. The forefoot wrist bones were clearly visible, the five metacarpal bones I - V were nicely arranged just as we see in modern elephants. The number of phalanges and sesamoids was clearly displayed. We see that the first metacarpal I (representing the thumb) has only one sesamoid but no phalanges as can be noticed in modern elephants (Neuville, 1935). Apparently the Yukagir Mammoth had no thumbs. We have seen this in isolated or separate first metacarpal bones. It seems that the woolly mammoth often had four digits on its forefoot.

CONCLUDING REMARKS

Skeletal remains of mammoths are not very rare; they have been found in many places in the world, except in Australia and Antarctica. Rarer are discoveries of whole carcasses or soft tissues of 40-20,000 years old mammoths that are found in the permafrost of Siberia, remains of which have been discovered since the 18th century. The Yukagir Mammoth, exposed in the autumn of 2002, is one example. This excellently preserved specimen has provided unique opportunity to study ancient tissues and retrieve valuable direct data and inferences. Some of our findings are summarized here. The Yukagir Mammoth was an adult male with estimated shoulder height of 282.9 cm and weighed between four and five tones; it lived in the late Pleistocene, approximately 18,560 years ago. This specimen is one of the best-preserved mammoths ever found because the head, partially covered with skin and hair with magnificent pair of tusks and includes a complete ear with all the features found in modern elephants. Also preserved are the external surface of the eye, and the external opening of the temporal gland. In living elephants this gland is known to function in establishing a hierarchy among males during breeding season. Some postcranial elements were also found, a few with soft tissues attached. In addition one of the stylohyoid bones was found *in situ*. The ecosystem of the Yukagir Mammoth at the end of the Pleistocene consisted of a steppe - grassland, treeless, except for ribbons and patches of forest. Today, this region is tundra - void of trees, but mosses and lichen thrive. Additional findings are presented by other contributors. The Yukagir Mammoth was displayed in EXPO 2005, held in Aichi prefecture in Japan. There are many mammothine projects to be conducted, and exciting discoveries are looming. Data from living elephants help us better understand life histories of mammoth and vice versa.

Figure 14. Scan of the left front foot of the Yukagir Mammoth, showing the inside of the left manus. Photograph: Francis Latreille.

METACARPAL BONE	Mc I	Mc II	Mc III	Mc IV	Mc V
Number of sesamoids	1	2	2	2	2
Number of phalanges	0	3	3	3	1
Hoofs or nails	?	X	X	X	?

X = Hoof or "nail" present, (the middle finger "nail" is 14 cm wide (5 1/2")

? = Hoof or "nail" not present but it appears that a hoof or nail was present before but it was lost in the decay process or a rodent may have scavenged it. Even though there are no phalanges on the first metacarpal bone, there appears to have been a hoof or nail at the end.

VERTEBRAL COLUMN
(Fig. 15 and 16)

Figure 15. Part of the vertebral column of the Yukagir Mammoth. Photograph: Dick Mol.

Figure 16. III, IV and IV thoratic vertebrae of the Yukagir Mammoth. Photograph: Dick Mol.

VERTEBRAL COLUMN YUKAGIR MAMMOTH

Vertebra	Mammoth Museum Number	Max. height (cm)	Max. width (cm)	Remarks
Atlas	(Cat. # Mammoth Museum: N 7861/1)	18.6	32.5	
Epistropheus or axis	(Cat. # Mammoth Museum: N 7861/13)	22.8	23.5	Some soft tissue on the top of the dorsal spine
Vertebra cervicalis III	(Cat. # Mammoth Museum: N 7861/14)	20.0	24.4	
Vertebra cervicalis IV	(Cat. # Mammoth Museum: N 7861/2)	21.0	24.5	
Vertebra cervicalis V	(Cat. # Mammoth Museum: N 7861/3)	24.7	24.0	
Vertebra cervicalis VI	(Cat. # Mammoth Museum: N7861/15)	29.2	25.1	Some soft tissue on the top of the dorsal spine
Vertebra cervicalis VII	(Cat. # Mammoth Museum: N 7861/4)	32.5	25.8	
Vertebra thoracalis I	(Cat. # Mammoth Museum: N 7861/16)	38.5	27.6	
Vertebra thoracalis II	(Cat. # Mammoth Museum: N 7861/5)	Damaged Since Sept. 2004 complete.	27.5	Dorsal spine is broken. Distal end which was missing is found at the site in September 2004.
Vertebra thoracalis III	(Cat. # Mammoth Museum: N 7861/17)	42.5	27.5	
Vertebra thoracalis IV	(Cat. # Mammoth Museum: N 7861/18)	42.5	Damaged	Fused with Vertebra thoracalis V
Vertebra thoracalis V	(Cat. # Mammoth Museum: N 7861/18)	42.5	Damaged	Fused with Vertebra thoracalis IV
Vertebra thoracalis VI	(Cat. # Mammoth Museum: N 7885)		Only the pathological neural spine Max. height 19.8	Excavated Sept. 2004.
Vertebra thoracalis VII	(Cat. # Mammoth Museum: N 7886)		Only the pathological neural spine Max. height 23.5	Excavated Sept. 2004.
Vertebra thoracalis VIII	(Cat. # Mammoth Museum: N 7887)		Complete vertebra 24.1	Excavated Sept. 2004.
Vertebra thoracalis IX	(Cat. # Mammoth Museum: N 7888) & # 7861/24		Now complete	7861/24 is vertebra body excavated Sept. 2003 Neural arch excavated Sept. 2004.
Vertebra thoracalis X	(Cat. # Mammoth Museum: N 7889)		Complete vertebra 21.3	Excavated Sept. 2004.
Vertebra thoracalis XI	Missing	XXXX	XXXX	XXXX
Vertebra thoracalis XII	(Cat. # Mammoth Museum: N 7890)		Complete vertebra 20.2	Excavated Sept. 2004.
Vertebra thoracalis XIII	Missing	XXXX	XXXX	XXXX
Vertebra thoracalis XIV	(Cat. # Mammoth Museum: N 7891)		Complete vertebra 19.2	Excavated Sept. 2004.
Vertebra thoracalis XV	Missing	XXXX	XXXX	XXXX
Vertebra thoracalis XVI	(Cat. # Mammoth Museum: N 7892)		Complete vertebra 16.8	Excavated Sept. 2004.
Vertebra thoracalis XVII	Missing	XXXX	XXXX	XXXX
Vertebra thoracalis XVIII	(Cat. # Mammoth Museum: N 7893)		Complete vertebra 15.9	Excavated Sept. 2004.

RIB CAGE REMAINS

Left side of the carcass	Rib #	Mammoth Museum Number	Remarks
	3	(Cat. # Mammoth Museum: N 7861/23)	Excavated Sept. 2003 Distal end damaged
	7 or 8	(Cat. # Mammoth Museum: N 7861/11)	Excavated Sept. 2003 Proximal portion missing
	16 or 17	(Cat. # Mammoth Museum: N 7884)	Excavated September 2004 expedition. Complete rib

Right side of the carcass	Rib #	Mammoth Museum Number	Remarks
	1	(Cat. # Mammoth Museum: N 7861/22)	Excavated Sept. 2003
	5	(Cat. # Mammoth Museum: N 7861/9)	Excavated Sept. 2003
	6	(Cat. # Mammoth Museum: N 7861/10 (2003) = fragment7876 (2004))	Excavated Sept. 2003. Fragment, Proximal portion.
	7	(Cat. # Mammoth Museum: N 7877)	Excavated September 2004 expedition. Complete rib
	8	(Cat. # Mammoth Museum: N 7878)	Excavated September 2004 expedition. Complete rib, length 108.6 cm
	9	(Cat. # Mammoth Museum: N 7879)	Excavated September 2004 expedition. Distal end missing.
	10	(Cat. # Mammoth Museum: N 7861/8 (2003) = fragment 7880 (2004))	Excavated September 2004 expedition. Distal end missing.
	11	(Cat. # Mammoth Museum: N 7881)	Excavated September 2004 expedition. Complete rib, length 99.4 cm
	12	(Cat. # Mammoth Museum: N 7882)	Excavated September 2004 expedition. Complete rib, length 92.3 cm
	13	(Cat. # Mammoth Museum: N 7883)	Excavated September 2004 expedition. Fragment, proximal portion.
General remarks			Ribs ## 7 – 13 all broken at the same position (solifluction??)

REMAINS OF THE HIND LEGS

Element	Cat. # Mammoth Museum	Remarks
Patella sinister	(Cat. # Mammoth Museum: N 7909)	Damaged, soft tissue on the internal side of the patella.

CRANIUM AND TUSKS

The tip of the right tusk was slightly damaged during the life of the animal. A chip of ivory is missing. The surface of the tusk tip is polished during the life of the animal after the tusk sustained damage.

The right tusk was taken from the cranium to obtain the following measurements. The left tusk is still in its original position in the cranium.

Dr. Daniel C. Fisher took samples from the right tusk of this mammoth. Examination of these samples would provide chemical and isotopic data and details about the life history of the animal (see Fisher, 2004).

Measurements of the right tusk of the Yukagir Mammoth
(Cat. # Mammoth Museum: N 7864)

Maximum length, measured along the outer curvature	316.4 cm
Maximum circumference at the end of alveolus	45 cm @ 73.4 cm measured from beginning of pulp cavity
Maximum diameter at the end of the alveolus	11.6 cm
Depth of the pulp cavity	26 cm
Maximum distance of the tip to the edge of the pulp cavity	112 cm
Straight line from the tip to the end of the part which was hidden in the alveolous	100.6 cm
Depth of the alveolus	>45 cm
Yakutsk, September 3, 2004	11 samples (cores) drilled by Dr Daniel C. Fisher for tusk analysis More measurements taken by Daniel C. Fisher on September 2nd, 2004

Measurements of the left tusk and the cranium of the Yukagir Mammoth
(Cat. # Mammoth Museum: N 7865)

Maximum length, measured along the outer curvature (from where it erupts from the alveolus)	296 cm
Maximum circumference at the end of alveolus	46 cm
Maximum width of both alveoli with skin cover	55 cm
Maximum thickness of skin near the nasal opening	3 cm
Maximum width of both tusks when in anatomical position in the alveoli	170 cm
Measurements of the cranium	See figure 3, 5 and 7
Maximum antereo-posterior length	83 cm
Maximum height including mandibula	91 cm
Maximum height lower side jugale to top of cranium	69 cm
Maximum diameter left eye	6 cm
Distance left eye to temporal gland opening	21 cm
Distance temporal gland opening ear opening	13 cm
Maximum length ear opening	9 cm
Maximum height left ear	30.7 cm
Maximum a-p diameter left ear	17.5 cm
Thickness of left ear from the top to the lower end	40.8 mm, 30.8 mm and 28.8 mm

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