Piotr Wojtal [1] & Krzysztof Sobczyk [2]
[1] Institute of Systematics and Evolution of Animals, Kraków
[2] Jagiellonian University, Kraków

Taphonomy of the Gravettian site - Kraków Spadzista Street (B)

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New excavations and analyses of paleontological and archeological materials from the Upper Paleolithic site Kraków Spadzista Street (B) indicate that 71 mammoths may have been killed at the site by paleolithic hunters or died there naturally, probably not all at the same time. Archeological materials belong to the Upper Paleolithic industries of the Kostenki type. Many tools were found, which could be used as points, arrowheads or knives. About 99% of mammal remains are from the woolly mammoth. At the site, all parts of mammoth skeleton were found. The age profile of the site is typical of a stable population. Carnivore gnawing marks, rodent gnawing marks, trampling marks, different weathering stages and root etching were observed at the bones. The lack of cutting marks on the bones must be mentioned here.

Correspondence: Piotr Wojtal, Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Slawkowska 17, 31-016 Kraków, Poland; e-mail: wojtal@isez.pan.krakow.pl; Krzysztof Sobczyk, Institute of Archeology, Jagiellonian University, Golebia 11, 31-007 Kraków, Poland; e-mail: sobczyk@argo.hist.uj.edu.pl

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INTRODUCTION

Six sites, belonging to the Upper Paleolithic, are situated on a rocky prominence overlooking the Rudawa Valley. These sites are known as the Kraków Spadzista sites and are attributed to the Aurignacian and Gravettian complexes. The sites are situated upon a height connected with the main summit of Saint Bronislawa hill and are surrounded from the north by a rock cliff and from the west and east by a large pleistocene depression. One of the six sites is Kraków Spadzista Street (B), one of the most famous Paleolithic sites in Poland. The site was discovered accidentally in late autumn 1967 during the levelling of a building site. Excavations were undertaken during the seventies and nineties of the last century. The excavations were undertaken jointly by the Institute of Archeology at the Jagiellonian University and the Institute of Systematics and Evolution of Animals (Polish Academy of Sciences). Prof. Kozlowski and dr Sobczyk described archeological material. Prof. Kubiak and Mrs Zakrzewska studied mammal remains during the seventies (Kubiak & Zakrzewska 1974). Grzegorz Lipecki and the first author are studying the mammal remains from the new excavations and revised materials from old excavations (Lipecki & Wojtal 1996; Wojtal 1996). Up till now there are two radiocarbon determinations for the Kraków Spadzista (B) site, viz. 20,600 ± 1050 yrBP and 23,040 ± 170 yrBP. The radiocarbon date of this site indicates the age of the Last Glacial Maximum. The archeological finds include

many stone artefacts belonging to the Upper Paleolithic industries of the Kostenki type (Kostenki knives, backed bladelets and Kostenki shouldered points) (Kozlowski *et al.* 1974; Sobczyk 1995).

The purpose of the paper is to give insight in the taphonomy of the site in relation to the mammoth remains.

RESULTS

Over 11 years about 140 square meters of the site were excavated. A total of 7407 stone artefacts associated with blanks and tools production and rejuvenation have been recorded. Proportions between the major technological groups are as follows:

cores - 144 artefacts (1.5 % all groups)
tools - 530 artefacts (7.1 % all groups)
blades and fragments - 1095 artefacts (1.5 % all groups)
flakes - 1055 artefacts (14.2 % all groups)
chips and fragments of small flakes - 4613 (62.3 % all groups)

The largest tool group is the one of the burins, consisting of 117 specimens (22.2 % of all retouched tools), but the proportion of end-scrapers is not very large (30 specimens it is 5.7 % of all retouched tools). The next groups are: '*pointes à cran*' - 92 specimens (17.4 %), backed points and blades - 83 specimens (15.7 %), retouched blades - 76 specimens (14.4 %) and Kostenki knives - 56 (10.6 %). Retouched flakes, end scrapers notched tools, combined tools, truncations, perforators and side scrapers are a small group under 10% of all retouched tools. Remarkable is the high number of Kostenki shouldered points ('*pointes à cran*') in comparison with other groups of tools in the inventory. It could be the result of specific functions of the site (killing and butchering of mammoths), that required a large quantity of hunting weapons and cutting tools. The presence of pointes à cran, Kostenki knives, backed points and blades characterised the horizon '*pointe à cran*' of eastern (part) Gravettian (Sobczyk 1995).

Excavations of the Kraków Spadzista (B) site produced about 9000 mammal remains of which 5860 are identifiable. About 99% of them are from woolly mammoth. Also single bones or teeth of woolly rhinoceros, horse, reindeer, bear, wolf and arctic fox were found (Table 1). The minimum number of mammoth individuals is 71 (MNI). All body parts of the mammoth are represented, including a large number of ribs, vertebrae, sesamoids and phalanges (Appendix). Most ribs are broken and only a small number of complete vertebrae have been recovered. Parts of skulls were present but their preservation is very poor. The great difference between the highest and lowest MNI's must reflect a number

Table 1 Frequency of mammal remains of Kraków Spadzista (B) site. NISP= number of identified specimens. MNI = minimal number of individuals.

species	NISP	MNI
Canis lupus	4	1
Alopex lagopus	3	2
Ursus sp.	2	1
Equus caballus	1	1
Coelodonta antiquitatis	1	1
Mammuthus primigenius	5845	71
Rangifer tarandus	4	1
total	5860	78

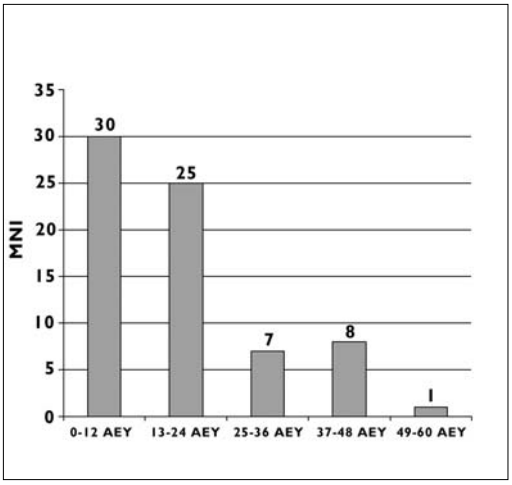

Figure 1 Age profile of Cracow Spadzista Street (B) mammoths.

of factors, including preservation and recovery techniques. The smaller bones of younger animals may have been filtered out of the assemblage by diagenetic processes after deposition. However, the assemblage did contain mammoth foetal bones, consisting of 2 humeri, 2 ulnae, 1 tibia, and 3 femora, from a minimum of 2 individuals, so the bone-subtractive processes were selective. Some bones may have been burned in hearths found at the site's southern part. In the mammoth population from the Kraków Spadzista (B) site 30 individuals being sub-adults (below 12 years old) and predominate, while the older animals (13-48 AEY = African elephants years) are less numerous, and only one individual represents the most senior adults category (49-60 AEY) (Fig. 1). The mammoth mortality profile in this site is characterised as a Haynes Type A, similar to a stable distribution in living population, indicating that natural deaths due to environmental stress or human kills were - in long run - not a selective processes and affect whole herds (Haynes 1991). Carnivores gnawed 329 (about 6%) of identifiable bones. Carnivore gnaw-marks are similar in morphology and size to marks made by wolf and spotted hyena. The gnawing marks are visible especially on the heads and condyles of limb bones and the diaphyses. It is possible that large carnivores broke part of the bones. Thirty-three of the mammoth bones show visible gnawing marks made by rodents. Most marks are situated on long bones and ribs. About 1% of identifiable elements show marks that may be the result of trampling, perhaps indicating that the bone deposit was visited several times by mammoths before final burial. Trampling broke some of the bones. Four-hundred-thirty-six (436) bones (about 8% of the identifiable bones) have marks that appear to be root-etching, a common bone-surface modification in wet grasses or sedges. This was predictable, because the mammoth bones had been deposited in tundra or tundra-steppe, and the bones were buried in wet, fine-grained sediments.

Most bones are in weathering stage 0 (no signs of decay). Only about 8% of the total assemblage show the first signs of weathering (Behrensmeyer stage 1), and only 9 bones show Behrensmeyer stage 2 and 3. Some bones therefore appear to have been exposed longer than others on ground surfaces. Only a few abnormalities on the bones and teeth were found. Some of them are common in recent elephant populations, for example broken ribs, others are rare, for example a broken fibula. On the site many stone tools that could be used as points or knifes were found. In spite of the numerous stone tools, associated with bones at the site, cut marks are very, very rare. Only a very few bones show the clear incisions that may have resulted from stone implements. Only one rib with intentional cut marks on both edges and only one bone tool were found in the site.

CONCLUSION

Originally, the bone accumulation had been interpreted as the remains of two or three possible dwellings, heavily disturbed by solifluction (Kozlowski *et al*. 1974). However, following more recent excavations, we have come to a new interpretation of these remains. The Spadzista (B) site may contain the remains of a mass-drive of the mammoths by Ice-age

Table 2 Concentrations of elephant and mammoth bones in recent and fossil sites. **a** - *Loxodonta africana* (die-offs) (Haynes 1991); **b** - *Loxodonta africana* (die-offs) (Haynes 1991); **c** - *Mammuthus primigenius* (cumulative site) (Vereschagin 1977).

site	MNI	number of square meters per 1 individual	bone densities	site surface
spadzista	71	1 individual/1.9 m^2	1 bone per 0.02 m^2	137 m^2
shabi shabi[a]	215	1 individual /35 m^2	1 bone per 7 m^2	1750 m^2
lememba[b]	21	1 individual /6.8 m^2	1 bone per 3 m^2	144 m^2
berelekh[c]	140	1 individual /3.2 m^2	1 bone per 0.05 m^2	450 m^2

humans, who later butchered the animals. It is also possible that this deposit is a non-cultural accumulation. But an assemblage of so many bones from 71 individuals in a very small area (about 140 square meters) suggests a place where a prolonged process of bone accumulation occurred, and not a location where a single event took place. Very large densities of mammoth individuals confirm the presence of long-term bone accumulation on the Kraków site.

At African sites Shabi Shabi and Lememba (Table 2) elephants died during a long period (a few years) near water holes. Berelekh is a cumulative site where mammoth carcasses were collected in a natural way in a bend of the river. It is clear that such a large number of mammoth remains at the Kraków Spadzista (B) site must be accumulated during a long period. Unfortunately, it is difficult to determine at this moment how many animals were killed, how many died of natural causes, how frequently the area was inhabited, and to what extend scavenging was practised. The difficulty has arisen, among others, from the fact that the concentration of bones at the site Spadzista (B) takes up a larger area than initially estimated. The tools discovered on the sites are mainly knife-like, indicating functions related to removing meat from dead mammoths. A possibility that some of these tools are hunting equipment, for example some of the tangled points (those bearing impact traces), blades or backed points, cannot be excluded. On the other hand, tools that are of a relatively small size - only a little longer than 5 cm - can hardly be regarded as hunting weapons or their important elements (inserts, arrowheads). If that should have been the case then the appropriate hunting strategies would have been exceptionally precise, requiring perfect mastery of the use of throwing weapons.

In spite of the numerous stone tools associated with bones at the site, cut marks are very rare on any bones, while on many parts of certain elements (especially the heads and condyles of humeri and femora) carnivore gnawing marks are clearly visible. Soffer (1993) suggests that the remains of large numbers of mammoths together with the evidence for the presence of all skeletal elements and all age classes, as well as a paucity of cut marks and an extensive record of scavenger gnaw marks, may indicate mammoth 'cemeteries'. However, it must be noted that experiments and ethnographic observations show that human utilisation of elephantids may leave few or no identifiable cut marks (Frison & Todd 1986; Haynes 1991). The Kraków Spadzista (B) site has four important characteristic features: (1) the mammoth population age profile is nonselective;(2) the bone representation at the site is nonselective; (3) carnivore gnaw damage is light and (4) bones have similar weathering stages. Haynes

(1999) suggests that presence of these features indicate that it is a mass death site and is of cultural in origin. The site Kraków Spadzista, just as the other sites in the Vistula valley near Kraków, shows very clearly the specific nature of the settlement of the Gravettian technocomplex, based on interrelations with mammoth, local raw materials and local stylistics of tools.

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Appendix Mammoth bone representation at Kraków Spadzista Street (B).

BONE	NISP	MNI
Mandible and lower cheek teeth	258	71
Atlas	92	62
Radius	119	45
Ulna	106	42
Fibula	80	33
Femur	125	31
Astragalus	59	30
Axis	51	30
Tibia	101	27
Humerus	84	26
Pelvis	135	26
Naviculare	52	26
Lunatum	40	25
Scapula	103	23
Troquetrum	41	23
Hamatum	38	21
Calcaneus	37	20
Cuneiforme laterale	32	19
II Metacarpale	30	17
IV Metacarpale	32	17
IV Metatarsale	24	17
III Metacarpale	29	16
Trapezoideum	28	15
Capitatum	25	14
III Metatarsale	28	14
Scaphoideum	24	13
V Metacarpale	16	13
Cuboideum	24	13
II Metatarsale	22	13
Trapezium	21	12
Cuneiforme intermedium	23	12
Pisiforme	17	9
Cuneiforme nediale	13	7
Sternum	8	7
V Metatarsale	10	6
I Metacarpale	8	5
Phalanx	172	-
Sesamoides	85	-
Costae	2065	-
Vertebrae	1026	-
Cranium	397	-

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