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7. UPPER PLEISTOCENE HOMININS AND WOOLLY MAMMOTHS IN THE EAST EUROPEAN PLAIN

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ABSTRACT

The main part of the Upper Pleistocene is marked by the Last Glacial Period. In Europe, it was mostly characterized by a dry and cold steppe environment that supported well-adapted animal taxa, notably woolly mammoth, which coexisted with Neanderthals and anatomically modern humans. This paper provides a synthesis of mammoth and human interactions in Eastern Europe, using the results of zooarcheological analyses of faunal assemblages from the valleys of the Dnieper and Dniester Rivers in Ukraine, Republic of Moldova and Russia. We identify the burial conditions of the skeletal remains, and the human strategies of resource acquisition and utilization. We highlight the different ways mammoth resources were acquired, either by hunting or dry bone gathering, and the different uses of soft and hard materials: food, fuel, wedging and building material, and raw material for tools and mobiliary art. The mammoth was an important influence in territorial human settlements and probably had major status among the dominant species in the assemblages, which included also reindeer, horse, canids, lagomorphs, rodents and bison. The trio

reindeer-horse-mammoth was important for human groups in each techno-cultural complex of the East European Plain.

Keywords: mammoth; East European Plain; zooarchaeology; Neanderthals; anatomically modern humans; Upper Pleistocene

7.1 INTRODUCTION

Human socio-ecological systems within particular environments are defined by technology, subsistence, symbolic practices and social partners, which may include human and non-human animals. During the Palaeolithic human groups interacted closely with many other animal species, which played a significant role in their culture, as evidenced in particular by archaeological assemblages containing animal remains linked to subsistence practices and symbolic animal representations. In this chapter, we present a synthesis about mammoths in Upper Pleistocene archaeological sites of Eastern Europe, with emphasis on the distinctiveness of mammoth remains in archaeological sites and interpretive results obtained from recent studies of mammoth assemblages.

7.2 CONTEXT

7.2.1 CHRONO-CLIMATIC CONTEXT, GEOGRAPHIC FRAMEWORK, AND PALAEOENVIRONMENT

7.2.1.1 Chrono-climatic context

The Upper Pleistocene began ~126,000 years ago and lasted until ~11,700 years ago. Most of the Upper Pleistocene (Marine Isotope Stages-MIS 2, 3, 4 and 5a–d) was marked by the last ice age. This cooling period resulted in a marine regression (a general drop in sea level) of ~120 meters and the establishment of a periglacial climate in Europe, leading to profound changes in fauna and flora (Velichko and Zelikson, 2005; Velichko et al., 2011). This ice cycle has been subdivided in different ways:

- a unique glaciation, Valdai (also known as Weichselian), with Briansk interstadial Item Blue;
- two distinct glaciations, the first and older one known as Kalinin, followed by the Mologo-Cheksna intermediate period, and the second and younger one known as Ostashkovo (Ivanova, 1969).

Although opinions differ on these episodes, they are unanimously recognized as three isotope stages: the Lower Pleniglacial (70,000–60,000 BP, MIS 4), the Middle Pleniglacial or Interpleniglacial (50,000–26,000 BP, MIS 3) and the Upper Pleniglacial (26,000–10,000 BP, MIS 2). However, there is some disagreement about the beginning and ending dates for these periods. For example, Clark et al. (2009) dated the end of the Upper Pleniglacial at ~13,500 yrs BP, at the Bölling oscillation, followed by the Tardiglacial period. Velichko and Kurenkova (1990) dated the end of the Ostashkovo glaciation, including the maximum extension of the ice sheet between 20,000 and 18,000 BP, to 16 000 BP, followed immediately by the Tardiglacial. In Haesaerts et al. (2003), the Pleniglacial is a single set of phases divided into three parts:

- the first part of the Upper Pleniglacial (26,000–20,000 BP) (Last Glacial Maximum-LGM: 23,000–20,000 BP);
- the second part of the Upper Pleniglacial (20,000–14,000 BP); and
- the final part of the Upper Pleniglacial, transition to the Holocene (14,000–10,000 BP).

According to simulations of the Last Glacial Maximum (Banks et al., 2008), the mean temperatures in Eastern Europe ranged from 0 to 6°C. The warm periods were characterized by mean temperatures between 16° and 20°C, and the coldest periods by mean temperatures between -13° and -4°C. Annual precipitation ranged from 80 to 150 mm.

7.2.1.2 Geographic framework

The East European Plain is the largest area of the European continent, near the boundary of Europe and Asia. It is delimited by the Carpathian, Ural and Caucasus mountain ranges. Several major rivers and their tributaries drain this territory: Vistula, Neman, Dnieper, Volga, Don, Southern Bug, Danube and its tributaries Siret and Prut, and Dniester. This area is divided into four main regions: the extracarpathic area, the plain, the pontic steppe and the Crimean Mountains (Fig. 7.1).

[Desired position of Figure 7.1; planned for whole page width]

Figure 7.1: The East European Plain in Europe, with the actual countries and the geographical configuration during the Last Glacial stage, including main rivers, mountains and geographic regions. Maps were taken from the freely available websites www.mapswire.com, www.freeworldmaps.net and made by Alexrk2 with the free to share license Creative Commons Attribution-ShareAlike 3.0 Unported License (https://upload.wikimedia.org/wikipedia/commons/7/79/Europe_relief_laea_location_map.jpg).

7.2.1.3 Palaeoenvironment

During the Pleniglacial, continental ice sheet and expanded mountain glaciers covered much of the Northern hemisphere. Continuous permafrost and active permafrost soil (mollisol)

were present in a large part of Europe. The extent of frozen ground varied according to seasonal and longer climatic variations. As today, mollisols then would have thawed in summer by supplying and conducting heat from the surface. Plants and small organisms (micromammals, molluscs and insects) could thus have survived in permafrost regions. An active zone of seasonally discontinuous frozen ground existed in the northern part of the East European Plain.

The ice sheet modified the circulation of the winds, allowing plants adapted to the cold climate to expand considerably (Novenko, 2006). Europea at that time was characterized by a tripartition of plant communities: a periglacial tundra and steppe in active permafrost environments, and boreal forests in some places (Klein, 1973; Velichko, 1981; Grichuk, 1982). There were also smaller local environments, such as mountains with steep cliffs with different biota. Generally, the periglacial steppe dominated with halophytic plants. This type of shrubby steppe, composed of herbaceous plants and scattered clumps of trees (pines, birches, junipers), is characteristic of a cold and dry climate with strong sunshine, and favored the existence of large herds of herbivores (Guthrie, 1982).

The Dnieper and Dniester river valleys in the Pleniglacial were characterized by sparse wooded areas along the rivers, of forest-periglacial steppe type (Łanczont and Madeyska, 2005). Forest was more extensive in the Dniester-Prut valleys.

7.2.2 PALAEOONTOLOGY AND ARCHAEOLOGY

7.2.2.1 Faunal spectrum

The mammalian fauna of the Late Pleistocene was distributed according to altitude, hydrographic network and type of vegetation. The largest species were *Mammuthus primigenius* (woolly mammoth) and *Coelodonta antiquitatis* (woolly rhinoceros). Other common large taxa were *Equus* sp. (horse), *Cervus elaphus* (deer), *Megaloceros giganteus* (giant deer), *Alces alces* (elk), *Bison* sp. (bison), *Bos primigenius* (auroch), *Ovibos moschatus/pallantis* (muskox) and *Ursus spelaeus* (cave bear). The medium-sized mammals were *Rangifer tarandus* (reindeer), *Capreolus capreolus* (roe deer), *Saiga tatarica* (saiga antelope), *Capra ibex* (ibex), *Rupicapra rupicapra* (chamois), *Canis lupus* (wolf), *Ursus arctos* (brown bear), *Panthera leo spelaea* (cave lion), *Lynx lynx* (lynx), *Crocota crocota spelaea* (cave hyena) and *Sus scrofa* (wild boar). The small-sized mammals were *Vulpes vulpes* (red fox), *Vulpes lagopus* (polar fox), *Vulpes corsac* (corsac fox), *Felis sylvestris* (wild cat), *Mustela putorius* (polecat), *Mustela erminea* (stoat), *Mustela nivalis* (weasel), *Martes foina* (beech marten), *Martes* sp. (pine marten), *Meles meles* (badger), *Gulo gulo* (wolverine), *Lutra lutra* (otter), *Lepus* sp. (hare), *Ochotona pusilla* (pika), *Marmota bobac* (marmot), *Castor fiber* (beaver), *Spermophilus* sp. (souslik or ground squirrel) and *Dicrostonyx* sp./ *Lagurus* sp./ *Lemmus* sp. (lemming).

7.2.2.2 Hominins and archaeology

Two hominin species were present, *Homo neanderthalensis* (Neanderthals) and *Homo sapiens* (anatomically modern humans). In Eastern Europe the last Neanderthals and the first anatomically modern humans coexisted between 36,000 and 28,000 BP in Crimea (as found at Kabazi II, Buran Kaya III and Siuren I; Demidenko et al., 1998; Chabai, 2004; Péan et al., 2013; Prat et al., 2018). Important stratigraphic sequences of Neanderthal occupations have been recorded in Ukraine (Molodova I and V, Korman IV and Dorochivtsy III), in Romania (Mitoc-Malu Galben) and Moldova (Cosăuți) (Chernysh, 1959; Goretsky and Ivanova, 1982; Ivanova and Tzeitlin, 1987; Haesaerts et al., 2007; Koulakovska et al., 2012).

The transition between the Lower and Middle Palaeolithic stages (Acheulean and Mousterian, respectively) took place during the glacial MIS 6 (Velyky Glybochok I/IIIb). Neanderthals were present in the Dnieper and Dniester valleys, in central Ukraine, and in Crimea during the succeeding Eemian interglacial (MIS 5e). Starting with MIS 5d, leaf-shaped bifacial implements appeared, notably in Kabazi II and Zaskalnaya V in Crimea (Stepanchuk and Sapozhnikov, 2010). Thereafter the Levallois-Mousterian and the Micoquian techno-complexes were developed (Chabai, 2003). Human groups settled in all types of biotopes, generally to establish hunting camps in connection with the presence of local lithic materials. Hunting was specialized on one or two to three animal species. The main exploited taxa were horse, ibex, mammoth, reindeer, bison, saiga antelope and rhinoceros (Patou-Mathis, 1993).

Between 43,000 and 28,000 BP, various lithic industries coexisted, including Micoquian, several transitional industries (Jerzmanowicien, Bacho-Kirian, Gorodsovian, Streletskian, Sungirian, Kiik-Kobian; Cohen and Stepanchuk, 1999; Flas, 2015) and Aurignacian (Anikovich, 1992). The latter is known from a few sites in Romania, Crimea and in the Don Valley. Human groups established camps linked to the exploitation of lithic and animal resources, notably to make antler points (Noiret, 2009). The first period of the oldest phase of the Gravettian techno-complex is known in Molodova V/10-9 between 29,600 and 28,100 BP. Tools are represented notably by retouched and pointed blades, and regional particularities appeared (Otte and Kozłowski, 1982; Chernysh, 1987; Noiret, 2009).

The Epigravettian succeeded the Gravettian during the Last Glacial Maximum and lasted from 21,000 to 13,500 BP. It is mainly characterized by microlithization of tools and the use of bone needles. Several facies are distinguished in geographic regions and some sites show epiaurignacian characteristics. Many facies develop with stemmed point type during the final phase. Animal resources, notably reindeer antlers, were widely used. The subsistence base was reindeer and horse (Krotova, 1995; Kitagawa et al., 2018).

7.2.3 MAMMOTH: A KEY SPECIES

The woolly mammoth was present in the northern part of Eurasia during the Upper Pleistocene. This species began to decline in Europe from 15,000 BP along with the warming of the climate (Vereshchagin and Baryshnikov, 1984; Velichko and Zelikson, 2005). Mammoths probably were a key species in Upper Palaeolithic human life, because of the massive amounts of meat, fat, functional resources such as ivory, their long lifespans, their seasonal migrations in and out of human ranges, and their influence on landscape-shaping. Equally important, it is likely that mammoths could have been perceived as almost human-like in behavior and psychology.

7.2.3.1 Mammoths characteristics

Because of close similarities in anatomy, size, lifespan and maturational scheduling, the biology and behavior of *Mammuthus primigenius* can be validly reconstructed based on our knowledge about the extant elephant species *Loxodonta africana* and *Elephas maximus*.

The height of adult males and females reached 2.50–3.50 meters, and body mass reached 3–4 tonnes. The thickness of the skin was up to 3 cm, covering a layer of fat 8 cm thick in places. Both sexes had large spiral tusks, which in older adult males could measure 2.50–3.50 m in length. The tusks are teeth mainly composed of dentin, a mineralized connective tissue with an organic matrix of collagen proteins.

Like humans, elephants pay attention to their dead to an extent unusual for ungulates. They emit different vocalizations when encountering elephant remains, especially by infrasounds, and often move the bones with feet and trunks. Sometimes they cover elephant carcasses with soil or branches (Pfeffer, 1989). Also like humans, the extant elephants are gregarious, living in family groups usually called mixed herds. The mixed herds are characterized by a highly developed sense of mutual aid. They also share resources within groups and when gathering with groups of other individuals. Both adult and juvenile individuals indulge in play. These sorts of human-like characteristics were probably also typical of mammoths.

An important characteristic of extant elephants, probably also present in mammoths, is their large-scale spatial memories over long periods of time, indicative of good cognitive mapping skills (Byrne et al., 2009). Elephant home ranges vary considerably from 15 to 1500 km², depending on the quantity and quality of food and the presence of other groups. Elephants regularly use the same paths, creating long-lasting trails connecting resource points such as feeding patches and water sources, which was undoubtedly the case for proboscideans in the Pleistocene and even deeper time (Bibi et al., 2012). These trails can be followed by humans to facilitate their movements and would have been valuable aids to navigating in unfamiliar ranges during the Pleistocene (Haynes, 2006). In dry seasons (which would have

been the cold period for woolly mammoths), separate elephant herd groups and adult males often come together at water points. Elephants also frequently visit sources of mineral salts. Mammoths also would have had the same regular need for water and minerals. In some of the less productive ranges, large movements occur during migrations, as seen with some African elephant populations (Blake et al., 2003) and Asian elephant populations (Sukumar, 2003). Elephant migration distances vary considerably from one population to another: some populations are almost sedentary, whereas others are nomadic or migrate seasonally. It is relatively rare for an elephant to migrate alone. Dry or monsoon conditions that lead to shortages of resources motivate different migration distances. Migrations tend to be recurring on circular routes. Three migratory habits are recorded: movements of family groups, movements together of bond groups consisting of two to five families and movements of several mixed herds forming a single large group. Similar patterns of movement may have characterized Columbian mammoth (*Mammuthus columbi*) populations in North America (Hoppe, 2004) and likely also woolly mammoth populations.

7.2.3.2 Resources from mammoths used by humans

Mammoths were huge sets of resources on the hoof for Pleistocene humans, such as skins, meat, brains, viscera, fat, marrow, bones and even the dung.

Mammoth skin was thick and rigid so its uses might have been limited. Hairs could have been used to make cordage. Fat could have been used as food, for skin treatments (human skin protection, fur tanning) and to feed fires (Mulville and Outram, 2005; Costamagno and Rigaud, 2014). Meat could have been consumed, also brains and viscera. As it is very oily, brain can also be used in tanning animal hides. Cushiony pads of connective tissue, adipose, and collagen within the feet could have been eaten. The intestines, once emptied of their contents and washed and dried, could have been twisted and made into cordage or used as containers to store bulk food. Blood could have been drunk and incorporated in the cooking.

The recovery of marrow from inside long limb bones is commonplace when humans butcher non-proboscidean carcasses, but the feasibility of accessing mammoth marrow is debatable. Proboscidean long bones do not have open medullary spaces full of edible yellow marrow, unlike most other ungulates' long bones. In proboscideans, the long bone interiors are densely packed full of hard trabecular bone with very small amounts of yellow marrow in the tiny spaces of the trabeculae. Red marrow is found mainly at the ends of the long bones where hematopoiesis takes place. Recent experiments suggest that this characteristic may vary by species, individual and type of bone (Boschian et al., 2019), but more research must be done to determine if the hard effort to extract yellow marrow would have been economically fruitful. The marrow could have been eaten raw or boiled, as it is with

non-proboscidean prey animals (Binford, 1978). Fresh bones could have been used as fuel (Perlès, 1977; Théry-Parisot et al., 2005).

The use of dry bone as a combustible material is controversial. Dry bone can be used if the fire has already reached relatively high energy (Costamagno et al., 2005; Glazewski, 2006). Mammoth bones were used as combustible fuel in Krems-Wachtberg (Austria; Fladerer et al., 2014). Bones also could have been used to make cooking stock or bone broth (Saint-Germain, 1997). Bones also were useful for making tools and ornaments, and as an artistic medium. The large cheek teeth could have been used as supports, such as a hypothesized seat (Goretsky and Ivanova, 1982). The enamel tooth plates could have been used to make ornaments. The bones could have functioned as material for building shelters and dwelling structures, as seen at archeological sites in Central and Eastern Europe (Pidoplichko, 1998). Ivory also could have been used as building material and was particularly preferred for tools, points and ornaments, and as an artistic medium. Ivory is a durable material that is not easily damaged or destroyed; it will not burn and is little affected by immersion in water except for slight softening of the outer (cementum) layer. It is both resistant and somewhat elastic, and can be carved and carefully shaped (Saunders, 1979).

Dry dung could have been used to start and fuel fires; dung fire smoke also would have been an effective insect repellent.

The different actions need to acquire so many useful materials from mammoths implies varying human strategies of hunting and careful management of carcasses, all taking into consideration the enormous weight of such an animal, the diverse features of morphology, the dangers encountered, and the peculiarities of each kind of material. We propose that resource-acquisition from dry found mammoth carcasses can be classified as a form of “gathering” and resource-harvesting from fresh found carcasses can be classified as “scavenging”.

Apart from age, the causes of proboscidean mortality in nature are numerous. Elephantids are susceptible to accidental trauma, natural trapping, diseases and predation by social predators (lions and spotted hyenas in Africa). The most common diseases in current elephant populations are viral and bacterial infections, along with other pathologies (Fowler and Mikota 2006). Several archaeological and palaeontological deposits have provided remains of woolly mammoths with pathologies or traumas (Leshchinskiy, 2009; Krzemińska, 2014). The extant elephants are sensitive to thermal variations and have significant water requirements, up to 150 liters per day for adults. In the event of water stress, some individuals become extremely aggressive against conspecifics, which can lead to the death of weaker individuals. Elephants also can suffer from cramps, tetany, or even heart attacks. Mammoths might have suffered similar problems, which could explain the formation of some fossil bone accumulations around water resources (springs, water holes, streams, rivers). Under conditions of

severe weather or shortages of water and food, mammoths might have been able to “semi-hibernate” by depressing metabolism and reducing activity levels for extended periods of time, as seen with Yakutian horses (Guil-Guerrero et al., 2014).

In terms of mammoth hunting, human groups would have confronted an extremely strong and dangerous animal (Agam and Barkai, 2018). Mammoths’ physiological characteristics were challenging to the effectiveness of prehistoric hunting weaponry. Like extant elephants, mammoths could move quickly to escape dangers such as predators, up to 40 km/h. In addition, the social solidarity of proboscideans would have been an important consideration when it came to hunting a matriarchal group of mammoths. Human hunting of mammoths would have required organized cooperation and the best in available technical equipment.

As with other proboscideans, the mammoth skeleton has vertical appendages that support the general mass of the animal; the capacity for oscillation at the top of the leg is weak (Hildebrand and Hurley, 1985), preventing proboscideans from running and jumping (Shoshani, 1993). Extant proboscideans can climb moderate slopes and cross mountainous regions, but for the most part are not able to go up or down steep slopes. All these particularities would have played an important role in human hunting strategies.

Ethnographic data and travelers’ tales from Central Africa include descriptions of tracking, killing and butchering elephants. The trails habitually used by elephants are easy to locate. Some African people dug pits or used spring-loaded spears on the trails, two methods which were most effective in regions with thick vegetation. Other people approached elephants closely and speared them, or hid in vegetation and injured an animal when it walked by (Thomas et al., 2011). One people in West Africa disguised themselves as animals and crawled towards elephants to surround them (Alpern, 1998).

Human groups could have chosen different hunting strategies, such as attacking a solitary male mammoth, isolating an individual from a mixed herd or going after an entire herd. To kill individuals on the spot, it would have been necessary to inflict several simultaneous attacks or mount an attack which caused the mammoth to charge while other hunters waited in ambush. Many spear-wounds might have been necessary to kill an individual, although Central African hunters once approached elephants very closely and stabbed them with a single spear jab, then allowed the wounded animal to run until it was exhausted or it died. When mixed herds of African elephants are confronted nowadays by hunters with high-powered rifles, the group is first approached on several flanks, causing herd members to regroup around the young with the matriarch facing the attackers. The matriarch is shot first, and as other individuals are killed their carcasses block others from running away, so all the herd can be killed together. Of course, this method was not available to mammoth hunters, but the killing of a family group’s leader probably would have had a similar effect in a

mammoth hunt, causing the rest of the group to mill about in confusion and make some of them easier to close in on and throw or thrust spears at them.

The evidence that mammoths were actively hunted is seldom obvious. However, hunting rather than scavenging has been demonstrated or suspected in several sites across Europe, practiced by different hominins. The evidence may be a direct association between projectiles and the bone remains such as point fragments embedded in bone or lying among the bones, or mortality profiles dominated by juveniles which would have been the most vulnerable age class, thus suggesting deliberate human choices of animals to kill, or the techno-typology of associated lithic artifacts which appear appropriate for killing and butchering proboscideans (Gaudzinski et al., 2005). The finds at Lehringen (Germany) attest that Middle Palaeolithic Neanderthals had wooden spears capable of killing ancient elephants. Hunting by Upper Palaeolithic *Homo sapiens* is strongly suggested by the mammoth bones at the Milovice site (Czech Republic; Péan, 2001) and Kraków Spadzista (Poland), where dozens of mammoths are represented in the faunal assemblages. Direct evidence of mammoth-killing in the Upper Palaeolithic is seen with the hunting lesions and projectile points embedded in bones at Yana RHS (Russia; Nikolskiy and Pitulko, 2013), Lugovskoe (Russia; Maschenko, 2004), Kraków Spadzista (Wojtal et al., 2019), Kostënki 14 (Russia; Sinitsyn et al., 2019) and Nikita Lake (Russia; Pitulko et al., 2016).

As with mammoths, the physical traces of butchering activities on extant elephantids can be scarce. Cut marks may be rare on bones because of the thickness of cartilage and periosteal tissue, effectively stopping sharp tool edges from penetrating to cortical bone surfaces (Haynes and Klimowicz, 2015). Crader (1983) recorded mostly heavy chop marks on recent elephant skeletons months after people had butchered them with metal tools. Only a few deposits testify to butchery activities on woolly mammoths (Péan and Patou-Mathis, 2003), such as La Cotte de St Brelade (Jersey) (Scott, 1980; Smith, 2015). Observations of butchering techniques on modern elephant carcasses have been described (Haynes, 1991; Jones, 1994; Haynes and Klimowicz, 2015). Butchering experiments by modern-day scientists (e.g., Toth and Schick, 1983; Jones, 1994) generally emphasize the difficulties and lengthy process of butchering an elephant. Jones (1994) suggested twenty people would need about two hours with fairly large tools to skin and strip meat from a proboscidean carcass.

The process when done by experienced butchers has been documented by Haynes (1991). Jones (1994) suggested this sequence (Fig. 7.2):

- the skin is removed from limbs, which can be done quickly by few people;
- the skin is removed from the torso and abdomen;
- several people remove large packages of muscle meat from limbs and ribs, while others cut off the ears and trunk;
- the head is rarely removed in modern butchery, but it can be removed with some hard

cutting and chopping and then rolling it on itself.

Only one side of a carcass can be worked at a time. The carcass can be turned upside down by a group of butchers pulling on the legs with ropes while another part of the butchers push it on the other side; it is also possible to enter the open rib cage and butcher the down-side of carcasses;

- remaining skin is removed, as well as remnant meat;
- the carcass is opened to recover the organs, in particular the stomach, taken in slices;
- all the scrap meat left on bones is scraped.

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Figure 7.2: Representation of a *chaîne opératoire* of mammoth butchering (graphism and permission acquired from J. Demay).

The meat and fat yields from full-grown adult mammoths are estimated at ~1800–2100 kg (Soffer, 1985; Davis and Reeves, 1990). Such a quantity of meat requires planned preservation treatment. Different processes are known with direct and indirect cooking, and for conservation:

Direct cooking could have been done several ways:

- grilling against hot coals;
- frying on a heated surface;
- roasting over an open fire;
- baking in a covered vessel;
- steaming.

Indirect cooking might have involved:

- boiling in water inside a vessel heated by hot stones;
- boiling in water inside a vessel placed on a fire;
- coating meat in clay and placing on a fire.

Preservation for future consumption might have involved:

- desiccation by air or sun;
- wood-smoking;
- pressing;
- coating meat in grease to keep bacteria or insects away;
- refrigeration and freezing;
- storing underwater;
- pounding the meat and drying it into a leather-like consistency.

Bones and grease could have been used to make bone broth or bouillon.

The management of ivory also involves specific actions (Heckel, 2009). Green ivory

taken from a recently dead elephantid tends to shrink as it dries. The outer layers of fresh or fossil ivory can be softened by soaking in water or mild acidic compounds (Christensen, 1999). Tusks cannot be removed from fresh carcasses without chopping, but a few days after death the natural process of decomposition weakens the connective tissue of the incisive sockets and the tusks can be pulled out of the cranium. They can then be soaked in water for several days, weeks or months. Ivory can be shaped by breakage and by sawing after making longitudinal, transverse, and circular grooving. It is possible to obtain a glossy surface by polishing (Semenov, 1957; Khlopachev, 2006; Khlopachev and Girya, 2010; Pitulko et al., 2015).

7.2.4 UNIQUE FACTORS IN ZOOARCHAEOLOGICAL AND TAPHONOMIC STUDIES OF MAMMOTH REMAINS

A taphonomic analysis of mammoth bone assemblages encounters particular problems. Cut marks are not common on butchered mammoth remains, making it difficult or impossible to determine butchering practices. Kill sites or scavenged carcass sites may have been used as camps, making it difficult to distinguish whether humans hunted mammoths or made use of natural bone accumulations.

Active hunting is often claimed on the basis of mortality profiles (Haynes, 1991, 2017), but without direct traces. It is likely that many times only mammoth meat from hunted animals was brought to campsites and no bones are present to show that hunting was done thus (Bocherens et al., 2005).

Proboscidean remains may be affected by taphonomic processes such as traumatic injuries to bones (Haynes and Klimowicz, 2014) or natural breakage of ivory during use in life or while fighting conspecifics (Haynes, 1991), which could be confused with human actions. Another possibly complicating factor in interpreting proboscidean bone assemblages is the behavior of proboscidean individuals which displace bones of dead conspecifics.

7.2.5 HISTORIOGRAPHY

Mammoths have a special place in studies of Palaeolithic human populations in the East European Plain. Indeed the first palaeolithic excavations discovered important sites containing not only abundant remains of mammoths, including some apparently used to construct multi-family dwellings, but also osseous artifacts and carefully shaped ivory pieces, such as Gontsy in 1871 (Scherbakivski, 1919), Kostënki in 1879 (Boriskovskyi, 1953), Kirillivska in 1893 (Khvoiko, 1913) and Mezin in 1907 (Shovkopliias, 1965).

Historical contexts and geopolitical implications played important roles in the interpretations of these discoveries (Miller, 1956; Soffer, 1985). Finds of presumed communal dwellings seemed to reinforce the validity of the palaeoethnological approach, which had

developed under the influence of Marxism. However, some of the features thought to be dwellings now have been questioned. However, the discoveries did inspire a pluridisciplinary approach to excavations and analysis with new methods such as taphonomy, which had been considerably restrained during the Cold War.

7.3 PROBLEMATIC, MATERIALS AND METHODS

7.3.1 RESEARCH OBJECTIVES

Our aim is to better estimate the place and the use of mammoth during Palaeolithic and to work again with this pluridisciplinary approach.

From old and new excavation materials, we need to determine better the conditions of burial, the modalities of acquisition and use of mammoth resources by humans, and to better apprehend the status of mammoth, among other species, according to the areas and periods, in order to highlight evolution of human behaviors.

7.3.2 MATERIALS AND METHODS

First of all, we specify the representation of the mammoth in relation to other species within archaeological assemblages, in quantitative terms, but also in terms of use. For this, we treat, from the analysis of data from previous works, the representativeness of the different species in archaeological assemblages, but also according to the techno-cultural complexes, the type of occupation and the type of hard materials of animal origin that could have been used.

The zooarchaeological approach is favored here, including palaeontological analyses. In addition, the description and quantitative analysis of the anatomical elements associated with taphonomy (climate and edaphic factors and non-human biological agents) make it possible to identify the conditions that make up the fossil assemblage. The combination of these analyses in relation to the marks that may have been left by humans, will lead to a better understanding of the anthropogenic impact on the assemblage (Binford, 1979; Lyman, 2008; Denys and Patou-Mathis, 2014). Concerning age and sex determination of elephant individuals, we used well-known specimens of Eurasia and data from Haynes (1991). Concerning age classes of mammoths and Laws's stages (1966), they are determined as follows:

- juvenile: stage IXa; 0–12 years old
- young adult: stages IXa–XVII; 12–25 years old
- intermediate adult: stages XVII–XVIIIa; 25–30 years old
- mature adult: stages XVIIIa–XXVI; 30–50 years old
- old adult: stages XXVI–XXX death; 50–60 years old

Mortality profiles patterns of mammoths are used to infer the origins of assemblages (Haynes, 1991). Type A, in which progressively decreasing proportions of successively older age categories are present. It is seen in some noncultural assemblages as a nonselective mortality in stable populations. Type B contains a large proportion of very young individuals, but very few prime-age and middleaged adults, and a relatively large proportion of old adults. It is seen in larger cultural assemblages as selective mortality events. Type C contains few very young and old individuals, but relatively many prime-aged individuals. It is possible that this type is the result of a different kind of selective mortality. Type D includes any shape other than these three.

All archaeological, and particularly faunal data, and references about the sites dated between 30,000 and 10,000 BP were synthesized in Demay (2017).

Concerning statistics, the adjusted residuals are the adjusted values (or the difference between the observed accounts and the expected accounts) divided by an estimate of the standard error. They allow variations due to differences in size between samples to be taken into account. Thus, it is possible to highlight the influence of each species on all of the samples.

7.4 RESULTS

We present data about Middle and Upper Palaeolithic sites. During these periods, mammoths are well represented in the East European Plain (Klein, 1973; Hoffecker, 2002), particularly in the plain (Vereshchagin and Kuzmina, 1977; Soffer, 1985) and some sites of the extracarpatic area in the Dniester and Prut valleys (Borziac and Obăda, 1999; Anisiutkin, 2003–2004).

7.4.1 THE MIDDLE PALAEOLITHIC

During the Middle Palaeolithic, four archaeological sites present important mammoth remains: Ketrosy, Ripiceni-Izvor, and Molodova I and V (Fig. 7.3).

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Figure 7.3: Middle Palaeolithic sites with significant mammoth assemblages. 1, Ketrosy; 2, Ripiceni-Izvor; 3, Molodova I and V.

The main layer (3) of Ketrosy is dated to ~100,000 BP (Cârciumaru, 1980; Stepanchuk and Sapozhnikov, 2010; Anisiutkin, 2013). This layer, excavated on 125 m², was 5–25 cm thick and furnished charcoals and burnt charcoals, also as ocre and 4000 lithic pieces. The

lithic industry is represented by nucleus and tools made on local and regional flint (pebbles and slabs) and is linked to typical Mousterian. The fauna is represented by ~500 bone remains belonging to mammoth (110 bones), bison, horse, marmot, woolly rhinoceros, bear and a large cervid (David, 1980). Some mammoth limb bones bear cut marks (David, 1980). A semicircular accumulation over 12 m² of large mammoth bones and tusks with a hearth and ochre inside, and with large stones was found. The outer side was facing north and the interior one south. Tools were around and debitage wastes in other sectors. This accumulation was interpreted as a windscreen.

The layer 4 of Ripiceni-Izvor, excavated on 4,000 m², is dated to >45,500 BP and furnished around 36,000 lithic remains and numerous hearths (Păunescu, 1993; Doboş and Trinkaus, 2012). Faunal remains are numerous, mainly mammoth, bison, giant deer and red deer. Moreover, subcircular areas composed by mammoth tusks, bones and molars, and by rocks were interpreted as windscreens and habitation structures.

The layer 4 of Molodova I was excavated by A.P. Chernysh on 1,200 m² and dated to a minimum age of >44,000 BP (Goretsky and Ivanova, 1982). It yielded many remains including 26 hearths, ocre, lithic tools and faunal remains. The inventory consists of 40,000 flint pieces, which are characteristic of typical Mousterian without bifacial form, with rare Quina elements. There are nucleus and tools coming from local desopits, mainly made for butchering and hunting activities. Five areas of activities were discovered: a pit with bones, an area with bones, which bear on-food parallel striations and ochre, two areas with accumulations of lithic flakes and bones, and a circular accumulation of bones. This bone accumulation was interpreted in different ways, notably as a dwelling structure. The fauna is quite diversified and dominated by mammoth. We conducted a zooarchaeological study (Demay et al., 2012) and we identified different large herbivores (mainly mammoth, but also red deer, bison, reindeer, horse and woolly rhinoceros), as well as carnivores (fox, wolf and leopard). The mammoth mortality profile is characterized by the presence of adults *sensu lato* (both males and females) and juveniles, and is more related to a slaughtering profile. Moreover, according to the taphonomy we highlighted two modalities of bone preservation, which could be related also to dry bone gathering. Mammoth bones bear marks of human activities, such as cut marks, breaking impacts, and series of grooves not related to food activities (Fig. 7.4). Concerning the circular bone accumulation, particular bones were selected, with different areas of activities inside, corresponding to a living space (Fig. 7.5). Therefore, this layer could correspond to a long-term camp or to repeated occupations, with exploitation of secondary game and mammoth as main game, for food, as technical support, and use of bones to make a structure, which can be interpreted as a windscreen (Fig. 7.6).

The layer 11 of Molodova V, excavated on 900 m², was dated to >45,600 BP (Chernysh, 1987). The lithic industry is attributed to Levallois-Mousterian industry. Although the sedi-

mentary context is difficult to understand, this layer could be potentially correlated to ~MIS 5 (Ivanova and Tzeitlin, 1987; Haesaerts et al., 2003). The mammalian fauna is composed of woolly mammoth, woolly rhinoceros, reindeer, bison, horse, red deer, cave lion and brown bear, (Chernysh, 1959). Mammoths were notably mature adults and according to A.P. Chernysh they were hunted.

According to these sites, mammoth carcasses were obtained by Neanderthals through hunting and gathering, for food and non-food utilization. Mammoths were used as building material to make windcreens. This practice is a very specific techno-cultural fact to this region.

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Figure 7.4: Mammoths mortality profile and bone modifications by humans in Molodova I/4 (Ukraine).

[Desired position of Figure 7.5; planned for whole page width]

Figure 7.5: Circular accumulation of mammoth bones in Molodova I/4 (Ukraine) and spatial distribution of other archaeological remains (modified from Ivanova, 1964 in Goretsky and Ivanova, 1982).

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Figure 7.6: Hypothetical reconstruction of the windscreen of Molodova I/4 (Ukraine) (permission acquired from Tactile Studio).

7.4.2 THE UPPER PALAEOOLITHIC

Concerning the Upper Palaeolithic, there are few Aurignacian sites. The proto-Gravettian site of Kostënki 14, dated to ~35,000 BP, furnished an ivory point embedded in a mammoth rib (Sinitsyn et al., 2019).

In Buran-Kaya III, results obtained from isotopic analyses of the material from the Upper Palaeolithic layers, dated between 35,000 and 30,000 BP, show that humans consumed mammoth meat (Drucker et al., 2017).

Many sites dated between 30,000 and 10,000 BP are known, correlated to the Gravettian, Epiaurignacian, Epigravettian and final Palaeolithic (Fig. 7.7).

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Figure 7.7: Geographic position of the main archaeological sites of the East European Plain between 30,000 and 10,000 BP. Mentioned sites in the text: 1, Eliseevichi 1; 2, Pushkari group; 3, Obollonia; 4, Radomysh'1; 5, Dorochivtsy III; 6, Valea Morilor; 7, Climăuți II.

7.4.2.1 Mammoth in Upper Palaeolithic archaeological sites

Of the 250 Upper Palaeolithic assemblages, 229 furnished faunal remains (92%). Mammoths are present in 135 of them (59%) and it is the dominant species in 51 assemblages (38%).

Concerning the sites between 28,000 and 23,000 BP, correlated to the Gravettian, mammoth is dominant in several of them, notably in Berdyzh (Stepanchuk and Cohen, 2000–2001) and Yurovichi (Soffer, 1985). In some sites, such as in Kraków Spadzista (flint tool embedded in rib; Wojtal et al., 2019) and Galich 1 (Wojtal et al., 2001), mammoths were hunted and butchered. In Khotylevo, ivory was used to make female statuettes and mammoth ribs were intentionally put vertically in small pits (Velichko et al., 1981; Soffer, 1985). In Sungir, ivory was used to make ornaments (pearl, ivory rings) and tools (assegais), which are associated to human skeletons in three burials (Bader, 1978; Abramova, 1995; Trinkaus et al., 2014) (Fig. 7.8).

[Desired position of Figure 7.8; planned for whole page width]

Figure 7.8: Main archaeological sites in the East European Plain between 28,000 and 23,000 BP, types of occupations, fauna and mammoths' resource exploitation (in red).

During the LGM (23,000–20,000 BP), mammoth is dominant in several sites, and ivory was used for female and animal statuettes: Avdevo (Gvozdover, 1995), Gagarino (Tarasov, 1969) and Zaráisk (Amirkhanov et al., 2009). In Kostënki 1, an accumulation of tusks could correspond to a dwelling structure and/or tusk storing (Lazukov, 1957). In Kostënki 11, a dwelling structure with mammoth bones was discovered (Rogachev, 1966). At Kostënki 21, mammoth calves and adult mammoths were hunted (Fig. 7.9; Reynolds et al., 2019).

[Desired position of Figure 7.9; planned for whole page width]

Figure 7.9: Main archaeological sites in the East European Plain between 23,000 and 20,000 BP, types of occupations, fauna and mammoths' resource exploitation (in red).

A set recent investigations focused on LGM sites, notably in the Dniester and Desna valleys in Ukraine: Pushkari 1, Pogon (Pushkari 8), Obollonia (Demay et al., 2016) and Dorochivtsy III (Demay et al., 2015); and in Republic of Moldova: Valea Morilor (Demay et

al., 2019) and Climăuți II (Demay et al., in press).

In the Pushkari 1 and Pogon, the faunal spectrum is similar, dominated by mammoth and followed by canids (fox and wolf), horse and reindeer. In Pushkari 1, the mammoth mortality profile corresponds to hunting by humans; tusks are overrepresented and put together, probably due to an intentional storage. In Pogon, bones were stored vertically in pits around a hearth, perhaps as a wedging structure (Fig. 7.10).

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Figure 7.10: Mammoths mortality profile, representation in percentage survivorship and bone exploitation in Pushkari group (Pushkari 1 and 8-Pogon; Ukraine): tusk storage and bones put vertically in pits around fireplace (permission acquired from P. M. Vasil'ev).

In Obollonia, mammoth is the dominant taxon and is associated with some bone remains of carnivores (fox and bear). In Obollonia, mammoth was butchered and ivory was used to make points and a tusk was engraved (Fig. 7.11).

[Desired position of Figure 7.11; planned for whole page width]

Figure 7.11: Skeletal preservation of adult mammoths (composite representation), and bone and tusk exploitation in Obollonia (Ukraine): engraved tusk, ivory points and rib with defleshing cut marks; bones of juveniles. Schematic drawing of the skeleton by C. Camaret.

In Valea Morilor, mammoth bones were used as combustible. For Obadă et al. (2012), a small structure with mammoth bones was present. In Climăuți II, mammoths were hunted and the bones were sorted by type of element, and put circularly around a hearth and a small pit (Borziac et al., 2007; Fig. 7.12).

[Desired position of Figure 7.12; planned for whole page width]

Figure 7.12: Mammoth mortality profiles, representations in percentage survivorship and bone exploitation in Valea Morilor and Climăuți II (Republic of Moldova): burnt bone and sorted mammoth bones (permission acquired from A. Simanovschi).

Between 20,000 and 14,000 BP, numerous sites are known. Mammoth is dominant mainly in sites of the plain, in some cases with a high number of individuals (up to hundred), mainly young and mature adults, and followed by juveniles. Mammoths were mostly hunted and butchered as in the case of Yudinovo (Germonpré et al., 2008). Otherwise, several sites are characterized by the use of mammoth bones to make

dwelling structure, such as in Mezhirich, Mezin and Gontsy. In all these latter sites, ivory was used to make tools, needles, ornaments and portable art (Fig. 7.13).

[Desired position of Figure 7.13; planned for whole page width]

Figure 7.13: Main archaeological sites in the East European Plain between 20,000 and 14,000 BP, types of occupations, fauna and mammoths' resource exploitation (in red).

On the contrary, recent researches, such as in Radomysh¹, permit to highlight that some mammoth bone accumulations are not remains of dwelling structure (Kononenko et al., 2006). In Eliseevichi 1 (Russia; Velichko et al., 1997), even if mammoth status was significant, canids (wolf and fox) were also important, in terms of number of specimens, and both of skinning activities and bone shaping. Mammoths are represented mainly by adults and are followed by juveniles, whose bones bear also butchering cut marks. A part of mammoth bones were more altered, so more ancient than other mammoth bones. Ivory was shaped to make tools and portable pieces. The first interpretations of pits with mammoth bones as dwelling structures were questioned. Indeed, they could be storage pits for ivory (Demay et al., 2017; Fig. 7.14).

[Desired position of Figure 7.14; planned for whole page width]

Figure 7.14: Interpretation of the spatial distribution in Eliseevichi 1 (Russia) linked to mammoth resource exploitation: 1, juvenile rib with cut marks; 2, adult phalanx with cut marks; 3, ivory piece; 4, ivory point; 5, needle; 6, conical transverse grooving on tusk. Spatial distribution maps from Grekhova in Velichko et al. (1997).

At the end of the Upper Pleistocene, between 14,000 and 10,000 BP, all the cold-adapted fauna decreased, as a result of the climatic change. Mammoth is still dominant in Kovaltsy (Fig. 7.15). The last mammoth remains are known in Bugorok (Pushkari 9; Khlopachev, 2008).

[Desired position of Figure 7.15; planned for whole page width]

Figure 7.15: Main archaeological sites in the East European Plain between 14,000 and 10,000 BP, types of occupations, fauna and mammoths' resource exploitation.

7.4.2.2 Use of hard matters

In Kostënki 18, a human child skeleton placed on its side in a flexed position, was covered with mammoth bones (notably a scapula). It was interpreted as a burial, correlated to the Gravettian complex of Kostënki-Avdeevo during the LGM; however, the lack of shaped pieces and the stratigraphy of the site do not allow to adhere to it with certainty (Klein, 1969).

Mammoth bones were used as support construction by the Gravettian and mainly by the Epigravettian humans in the plain. Bones, mainly of adults, were sorted and organized in a circular manner. The taphonomic data show that fresh carcasses and gathered dry bones were used. Mammoth bones were used as mobiliar support, particularly reindeer antler, hare, fox and bird bones. Concerning mammoth bones, we took here in account the number of occurrences, because of the difficulties to have the exact number of pieces. Ornaments were counted as artistic pieces.

Of the 135 assemblages with mammoth remains, 56 (41%) are characterized by the presence of mobiliar pieces made on mammoth bones. Of these 56 assemblages, 71% present bone industry and 61 % artistic pieces. Both bone industry and artistic pieces are present together? in 34 % of the assemblages. 21 sites (38%) present only bone industry and 16 sites (29%) only artistic pieces. The main material used is ivory (93%), followed by bone (14%). The majority of the sites (86%) are characterized by the exploitation only of ivory, whereas exploitation only of bone is recorded in only few sites (5%). Both ivory and bone together were used in 9% of the sites ().

Mammoth bones, including ribs, have been used as combustible material in several sites, including Kraków Spadzista (Wojtal et al., 2015) and Mezhyrich (Péan, 2015), both correlated to the LGM (Demay et al., 2016).

7.4.2.3 Mammoth in art

Among other species (woolly rhinoceros, bison, horse, cave lion, bear, wolf, caprins, birds and human), woolly mammoth is one of the most represented species. It is documented by sculptures, engravings and paintings (Abramova, 1995; Braun and Palombo, 2012). In the East European Plain, 9 archaeological sites furnished mammoth representations: an engraving on schist in Kostënki 21 (Abramova, 1995), sandstone and bone sculptures in Avdeevo (Gvozdover, 1995), a sculpture from calcareous concretion in Eliseevichi 1 (Grekhova, 1980), an ivory sculpture in Sungir (Abramova, 1995), marl sculptures in Kostënki 1 (Cook, 2013), IV and XI (Abramova, 1995), red ochre paintings and engravings in Kapova (Abramov et al., 1984), and red ochre paintings in Ignatievska (Petrin, 1992). Some doubts exist concerning potential representation of mammoth: an engraved mammoth on a ivory piece in the Desna valley and a tiny statuette from marl in Barmaki.

7.4.3 IMPORTANCE OF WOOLLY MAMMOTH FOR NEANDERTHALS AND ANATOMICALLY MODERN HUMANS POPULATIONS

We do not have enough data about the Middle Palaeolithic and the beginning of the Upper Palaeolithic, but we have more information concerning the period between 30,000 and 10,000 BP. Taking in account all the faunal spectrum about this period (Fig. 7.16), mammoth is dominant mammal, closely followed by reindeer, then by fox, horse, bison, lemmings, hare, wolf and marmot, and lastly by other species (woolly rhinoceros, pika, red deer, bear, muskox, wolverine, moose, wild boar, ibex, beaver, suslik, cave lion, giant deer, saiga antelope, chamois, roe deer, aurochs, lynx, badger, polecat, marten, wildcat and hyaena). Mammoth bones and mammoth worked bones are more common in archaeological sites, between 20,000 and 14,000 BP (Fig. 7.17). Looking at each site by period, mammoth is well represented during the LGM (Fig. 7.18).

[Desired position of Figure 7.16; ; planned for 2/3 page width]

Figure 7.16: Faunal spectrum in percentages of the Minimum Number of Individuals in the main archaeological sites studied here in of the East European Plain between 30,000 and 10,000 BP (5014 individuals in total).

[Desired position of Figure 7.17; planned for 2/3 page width]

Figure 7.17: Percentage of the number of archaeological sites, among the total number of sites, by periods, according to: A, presence of mammoths; B, presence of mammoth worked bones.

[Desired position of Figure 7.18; planned for whole page width]

Figure 7.18: Faunal spectrum in percentages of the Minimum Number of Individuals into the main archaeological sites studied here in of the East European Plain between 30,000 and 10,000 BP (5014 individuals in total).

Using statistical approach, within the entire faunal spectrum and throughout the studied period, mammoth, reindeer, horse, bison, canids and lagomorphs were the mammals mainly exploited. According to the comparative analyses (Fig. 7.19), we observe a continuous division of the representation of certain species according to the geographical zones: mammoth and canids in the plain (Dnieper and Don valleys), reindeer and horse in the extra-carpathic zone (Dniester valley).

[Desired position of Figure 7.19; planned for 2/3 page width]

Figure 7.19: Adjusted residuals of the main taxa present in archaeological sites of the East European Plain according to the number of individuals between 30,000 and 10,000 BP, by areas (total: 27 taxa; 3,827 individuals, 78 archaeological assemblages).

Even if mammoth is less represented in the Dniester valley, ivory was used during all the Upper Palaeolithic, for example in Molodova V/8 (Chernysh, 1961), Cosăuți/3a-3b-3c (Borziac et al., 1998), Dorochivtsy III/6 (Koulakovska et al., 2012; Demay et al., 2015) and Climăuți II/upper with high technical expertise (Fig. 7.20).

[Desired position of Figure 7.20; planned for half-page width]

Figure 7.20: Worked ivory fragment from Climăuți II/upper (Republic of Moldova).

Regarding the main exploited species during all the studied period, mammoth was exploited during all the Upper Palaeolithic. As we noted in the presented sites, mammoth was also exploited during the Last Glacial Maximum. During the second part of the Upper Pleniglacial, we observe an intensification of the exploitation of taxa in quantitative terms, even for mammoth. At the end of the Pleniglacial, the fauna adapted to the cold-zone steppe-tundra dropped considerably within the assemblages, in favor of ubiquitous species under temperate environments, reflecting the global warming at the transition to the Holocene (Fig. 7.21).

[Desired position of Figure 7.21; planned for 2/3 page width]

Figure 7.21: Adjusted residuals of the main taxa present in archaeological sites of the East European Plain according to the number of remains between 30,000 and 10,000 BP, by periods (total: 33 taxa; 239,409 remains; 121 archaeological assemblages).

7.5 CONCLUSIONS

The woolly mammoth was clearly an important species exploited by Upper Pleistocene human populations, ranking highly together with reindeer, horse and bison, along with other species of ungulates and carnivores, lagomorphs and rodents. Reindeer and horse were exploited more in the extracarpatic area and mammoth was more exploited in the east Euro-

pean Plain. The particular features of the mammoth behavior and biology had probably major influences on human adaptive strategies. During the Upper Pleistocene, Neanderthals and anatomically modern humans often hunted mammoths as well as gathered dry mammoth bones from natural deaths, strongly suggesting detailed planning resource acquisition and preservation. Bones were used as fuel and building material, and ivory was a privileged material for humans. Mammoth was exploited by all the techno-cultural complexes of the time, and the species can be seen as a substantial and perhaps even instrumental component in successful territorial exploitation. The mammoth was a fundamental part of human life-ways in this geographic area.

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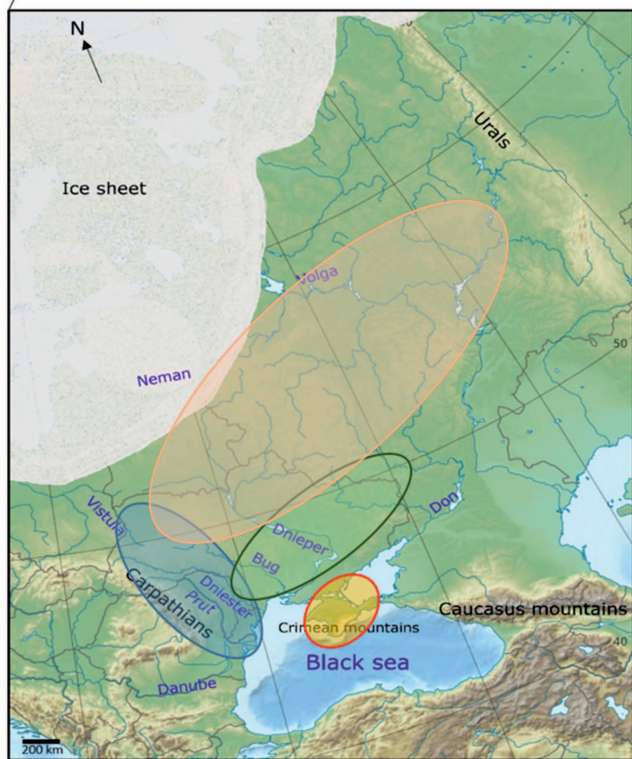
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-  Extracarpatic area
-  Plain
-  Pontic steppe
-  Crimean Mountains

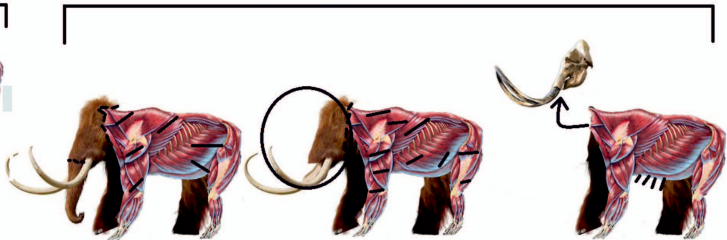
carcass



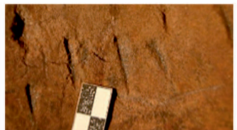
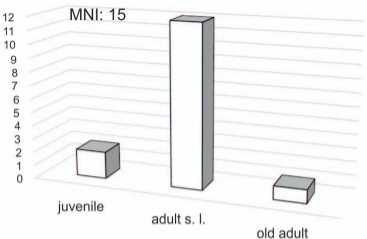
Skinning



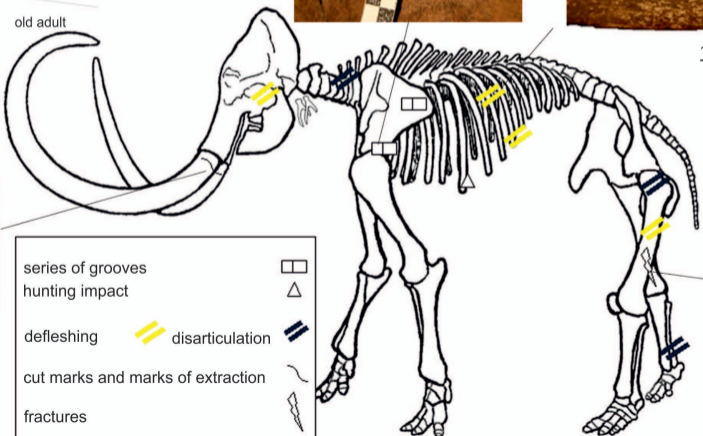
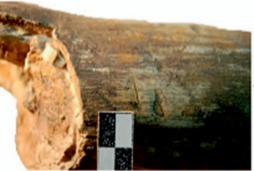
defleshing, disarticulation, evisceration







1 cm














series of grooves	
hunting impact	
defleshing	
disarticulation	
cut marks and marks of extraction	
fractures	



1 cm

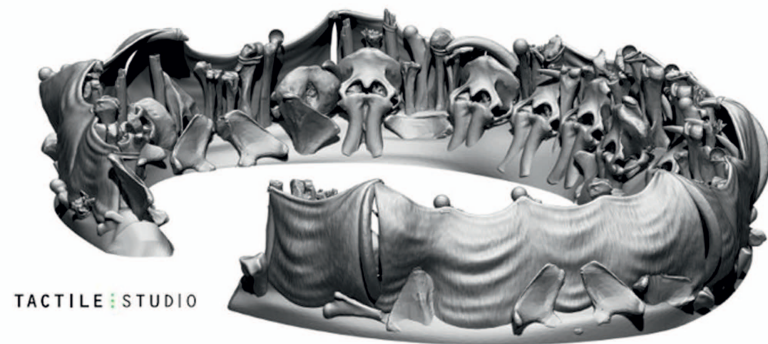
- selected mammoth bones (MNE):

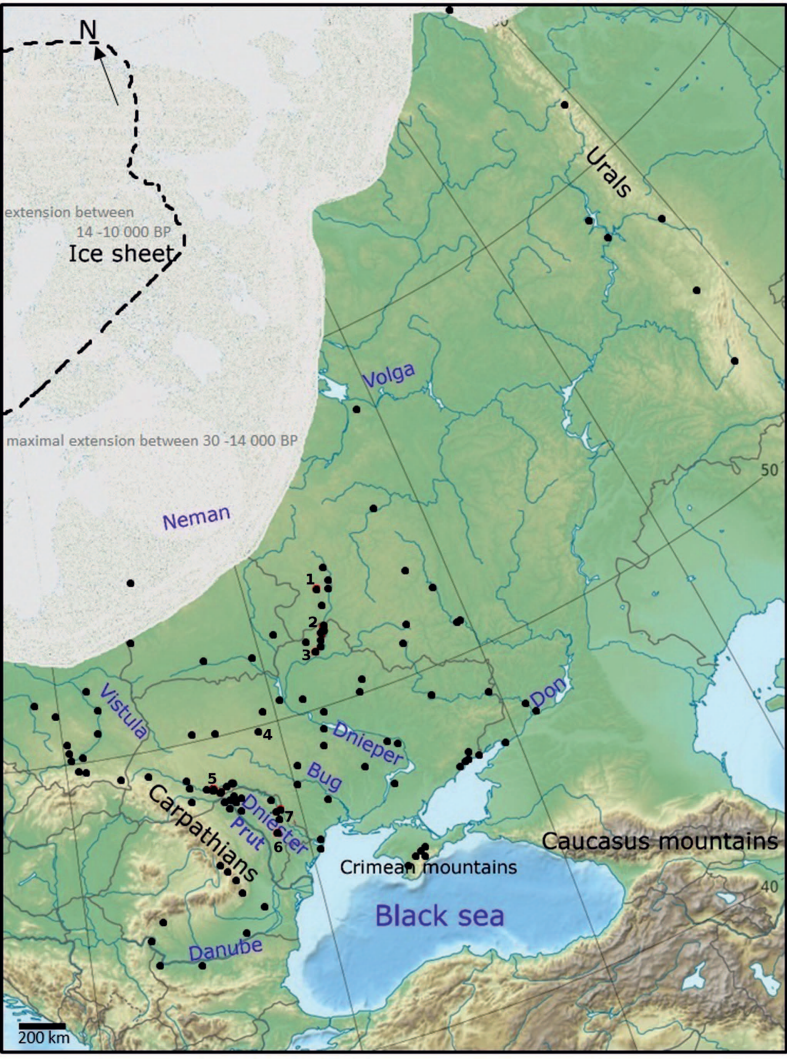
	skulls	12
	mandibles	5
	tusks	14
	long bones	51
	girdle bones	34
	vertebrae	>15
	teeth	

-  mammal bones (reindeer, red deer, bison; no mammoth)
-  hearths/ashy areas
-  lithic tools
-  ocher deposits



(from Ivanova, 1964)





N

extension between
14 -10 000 BP
Ice sheet

maximal extension between 30 -14 000 BP

Urals

Volga

Neman

Vistula

Don

Dnieper

Bug

Dniester
Prut

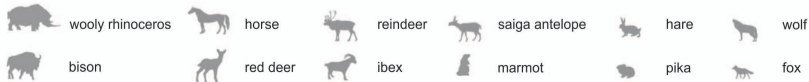
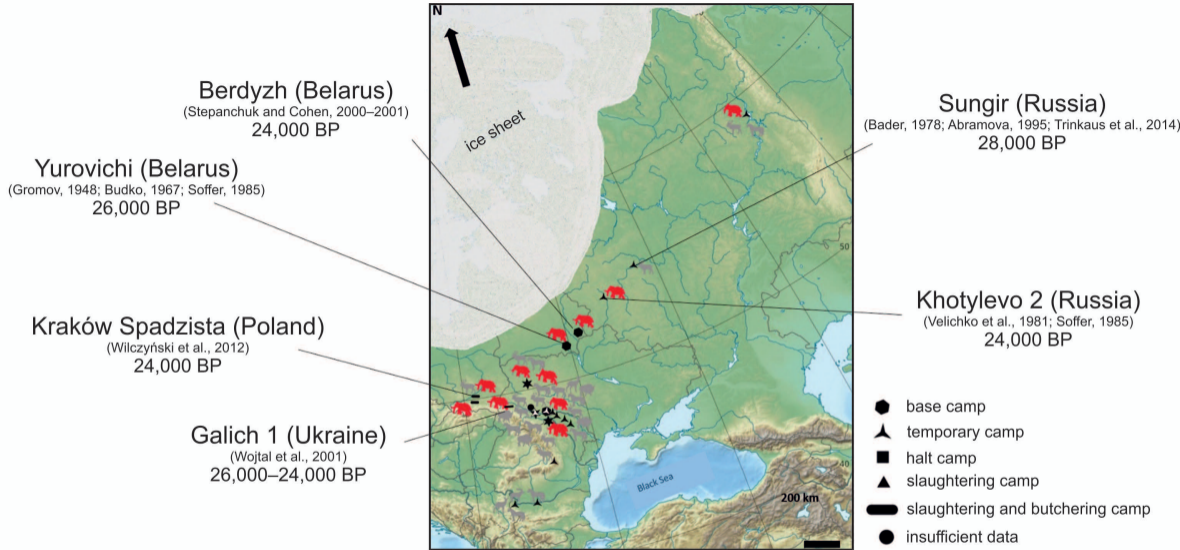
Danube

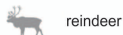
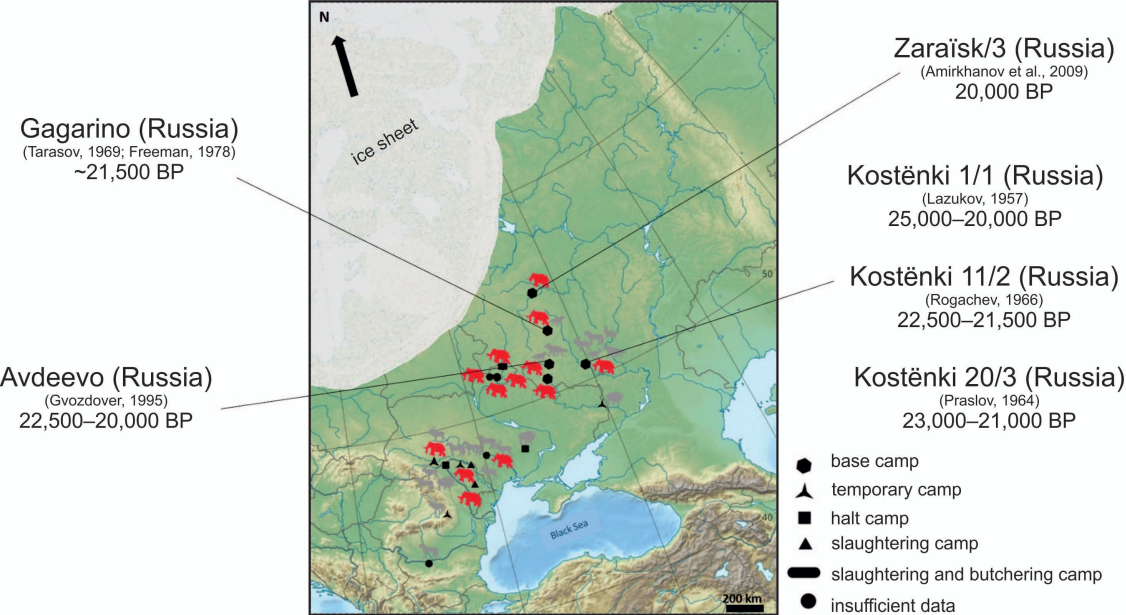
Caucasus mountains

Crimean mountains

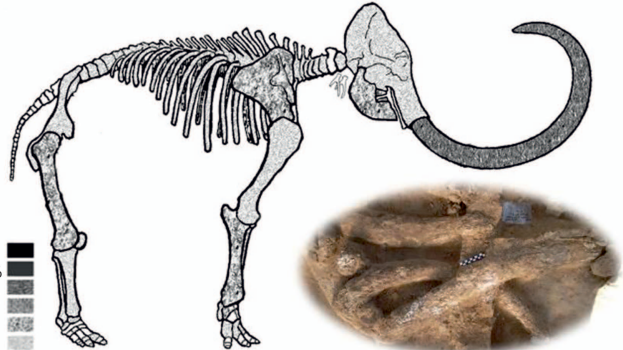
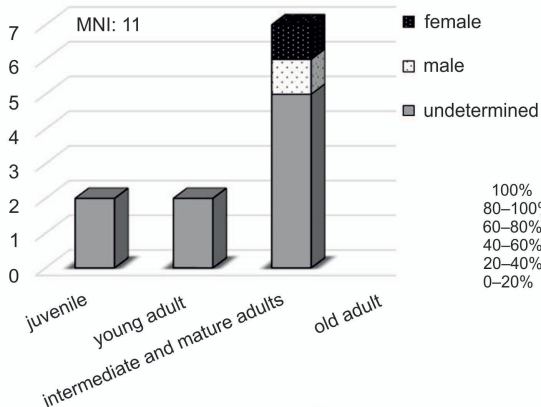
Black sea

200 km

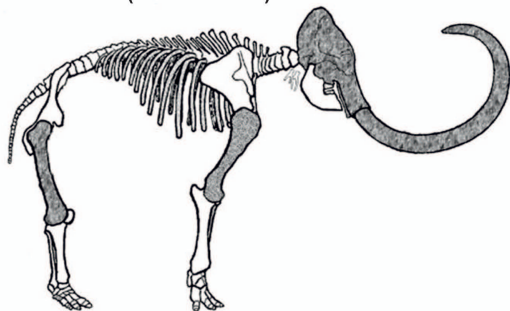




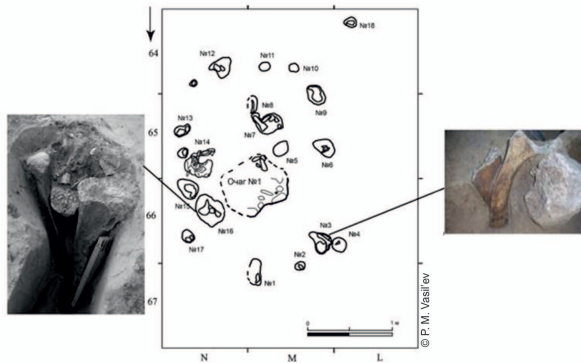
PUSHKARI 1/sector VII 1998–2018



POGON (PUSHKARI 8)/2011–2014

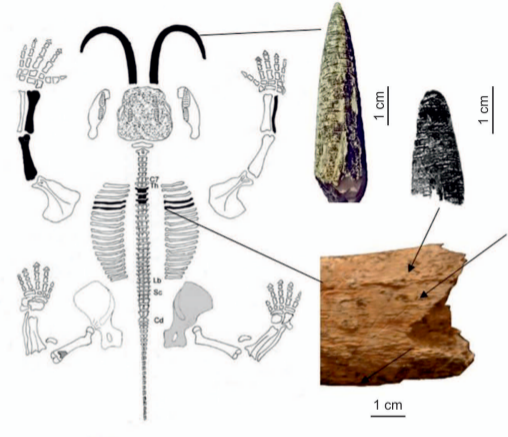
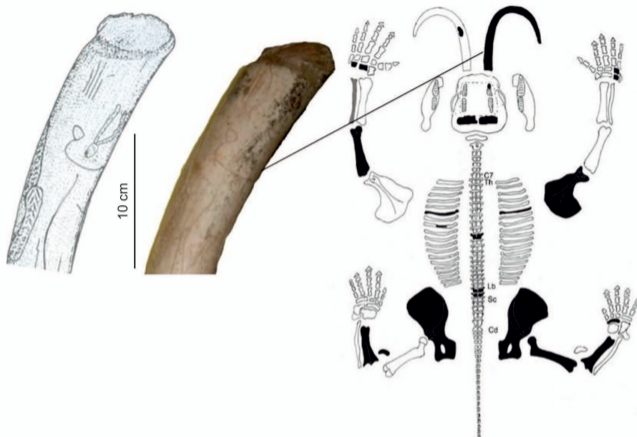


one juvenile and one subadult



MNI: 2 OBOLLONIA 2010

MNI: 2 OBOLLONIA 2011-2013



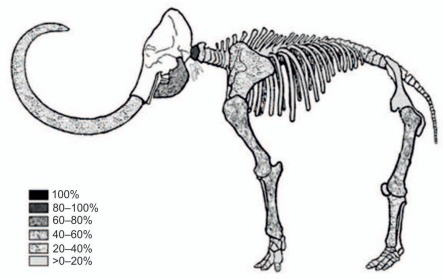
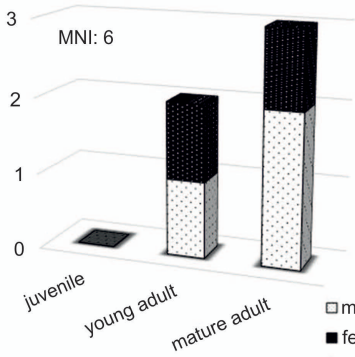
+ 1 juvenile



+ 1 juvenile



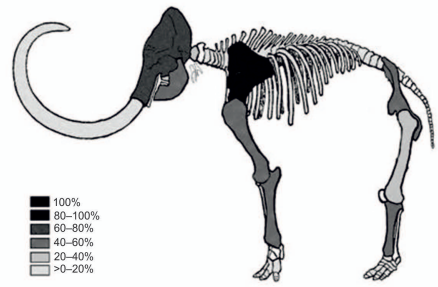
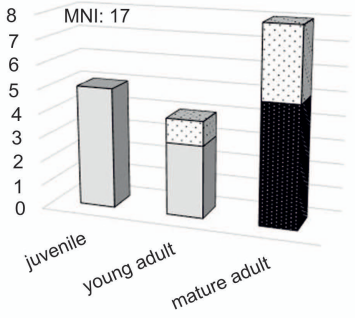
VALEA MORILOR



□ male
 ■ female
 □ undetermined sex

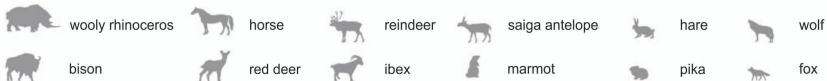
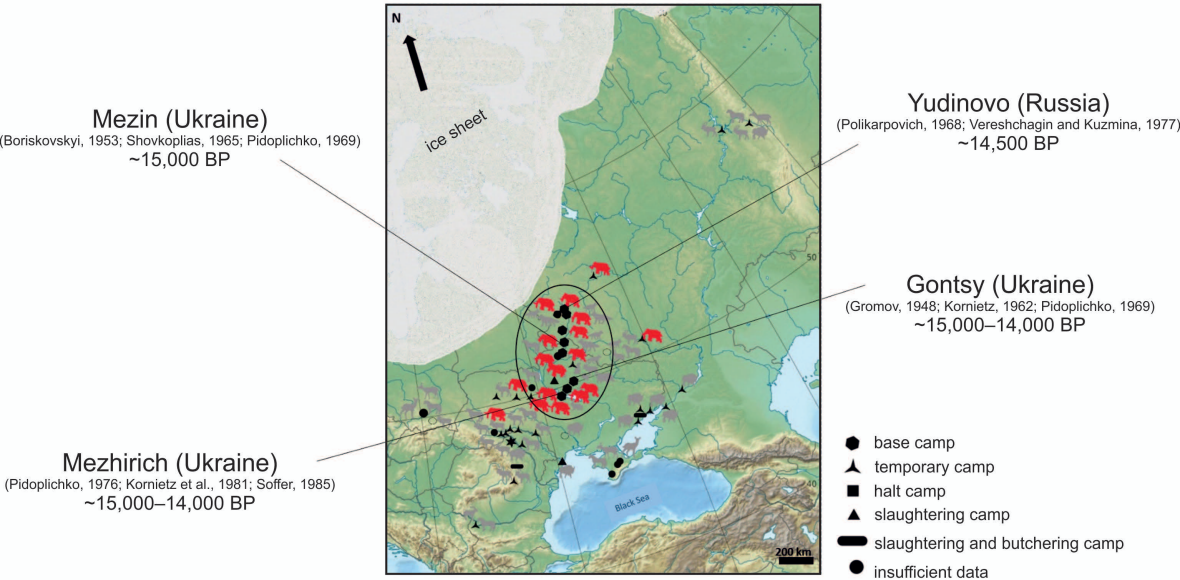


CLIMĂUȚI II/UPP

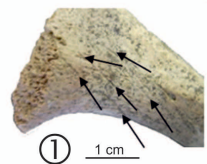
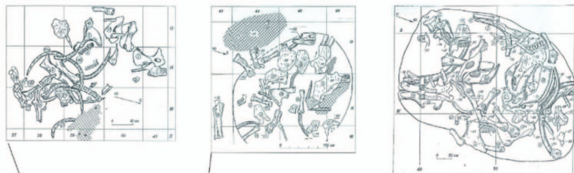


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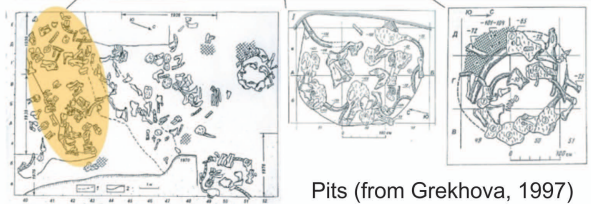
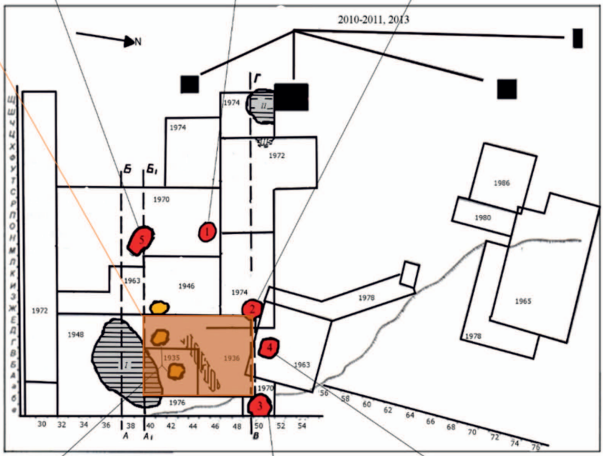
workshop, with wastes



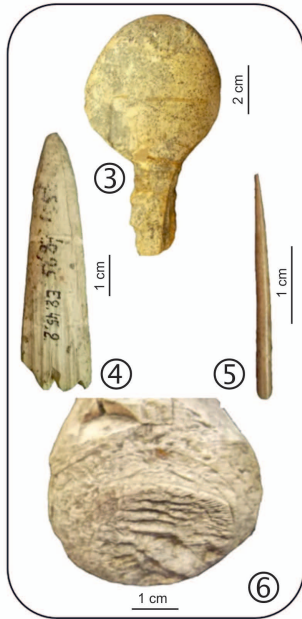
① 1 cm



② 1 cm



Pits (from Grekhova, 1997)



③ 2 cm

④ 1 cm

⑤ 1 cm

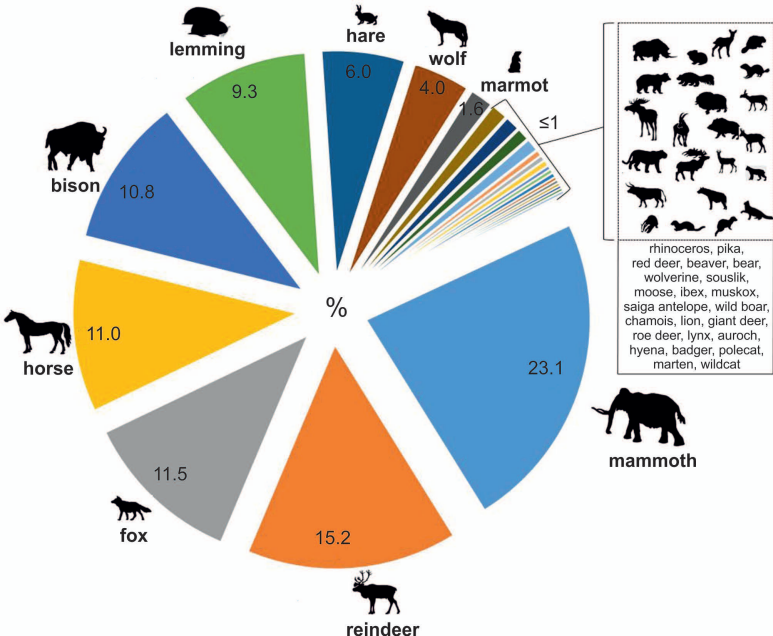
⑥ 1 cm

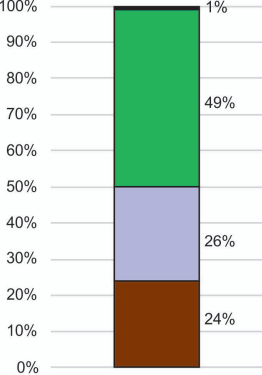
Kovaltsy (Belarus)

(Stančikaitė et al., 2011)

14,500 BP







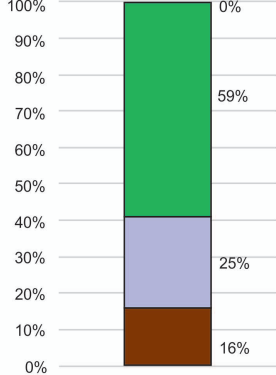
A

■ 14,000–10,000 BP

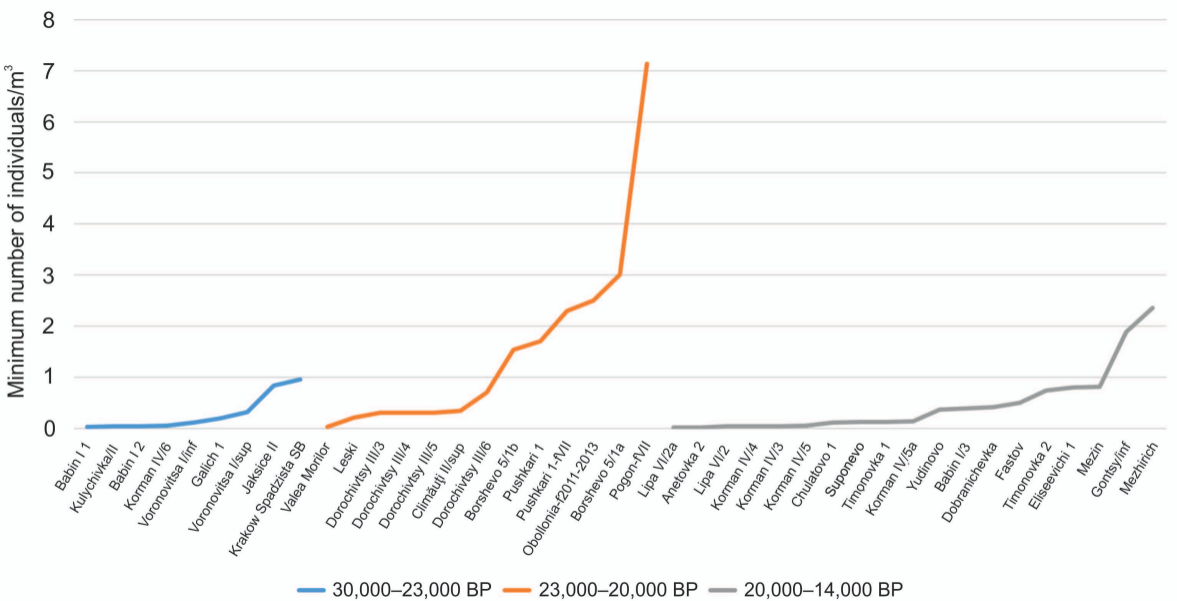
■ 20,000–14,000 BP

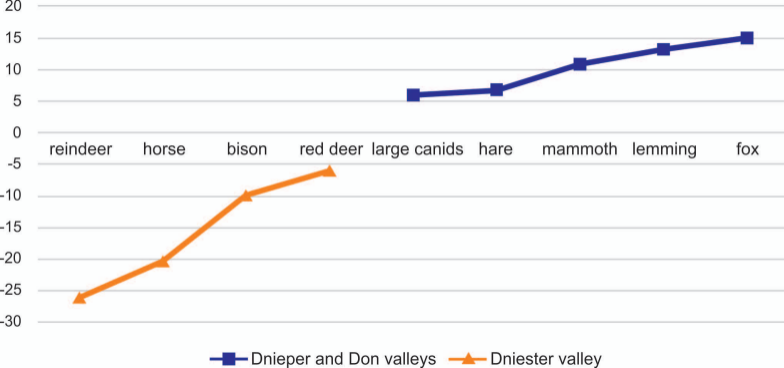
■ 23,000–20,000 BP

■ 30,000–23,000 BP



B







2 cm

