

Paleopathology of brown bears (*Ursus arctos*, L. 1758) from Liptovská Mara, Northern Slovakia

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Abstract

During the archaeozoological investigations in Liptovská Mara, 13 bones belonged to brown bear skeleton were identified. The materials were analysed macroscopically in order to determine the presence of the pathological bone changes. Moreover, X-ray imagination and microscopical analysis of the dental root cross-sections were done. The age of animal was estimated to 10-15 years. The pathological changes in periodontal area (chronic periodontitis) and in the metacarpal bones (hypertrophic bone formations) were described. According to accessible literature, archaeological and archaeozoological investigations results in the above-mentioned site, the bears from Liptovská Mara were killed, because of their potential attacks on domestic animals herds.

Keywords: brown bear, *Ursus arctos*, paleopathology, archaeozoology, teeth

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Introduction

The available literature does not contain descriptions of wider paleopathological changes in wild-living animals (Fabis et al., 2008). Most scientific papers concentrate on domestic animals (Bartosiewicz and Bartosiewicz, 2002; Daugnora and Thomas, 2005; Bartosiewicz, 2008; Bartelle et al., 2010; Janeczek et al., 2010; Janeczek et al., 2012). Information about sickness in wild and domestic animals can offer a major contribution to our understanding of past human-animal relationship (Chaix et al., 1997). Liptov is an important region along the trade and migration routes from the Carpathian Basin to the Baltic Sea, resulting in its inhabitation during the Bronze and Iron ages, the Roman period and the Middle Ages. The settlement area of Liptovská Mara was inhabited by the humans

of the Púchov culture that is supposed to be an archaeological manifestation of the Celtic tribe of Cotini who lived in the region during the La Tène and Roman Periods (Pieta, 1996 & 2008). The artefacts analysed have been dated back to the La Tène period.

In general, the Púchov culture is supposed to be an archaeological manifestation of a Celtic tribe of Cotini (Pieta, 1996). During the Middle La Tène period (300 BC-150 BC), there was substantial economic growth in the above mentioned region. In the subsequent centuries of La Tène phase D (LTD) period (150 BC-25 AD) development rapidly increased (Pieta, 1996; 2008). However, the prosperity of Celtic settlement and its advancement was strongly limited by the neighbouring Dacians and Germanic tribes. In the first decades AD (Eggers B1a phase), the whole area of Púchov culture shows so called horizon of catastrophe. Occurrence of a new population in southern Slovakia probably was the

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main reason. It is suspected that Liptovská Mara had been destroyed by Markomanni and Quadi tribes. In this period the fortified settlement in Liptovská Mara at LM I sanctuary/refuge vanished (Pieta, 1996). Finally, Púchov culture collapsed at the end of the Early Roman period during Marcomannic Wars (Pieta 1996; 2008). The aim of this study was to analyze the brown bear (*Ursus arctos*) skeletal remains with special regard to this animal's role in the context of the Celtic agricultural community.

Materials and Methods

Study area-archaeological site

This investigation was carried out on the archaeozoological material from one of the largest Middle European settlement complex from the early Iron Age in Liptovská Mara. The whole Liptov region located in the North of Slovakia (Fig. 1) is a historically important area due to traditional trade routes from the Carpathian Basin to the Baltic Sea. As a result of such location the Liptovská Mara site had been strongly inhabited during several periods of the Slovak pre- and protohistory. According to the knowledge (Pieta, 1996 & 2008) in the Iron Age the site consisted of seven settlement areas located on Havránok Hill (Fig. 2). At that time the settlement was inhabited by the people of the so-called Púchov culture that emerged in the Middle La Tène period on a basis of the Orava Group of the Lusatian culture. Territorially it occupies the hilly areas in northern Slovakia, southern Poland and, even partially, northern Moravia (Pieta, 2008).

Identification and anatomical distribution of brown bear skeletal fragments

Among the archaeozoological remains excavated from the site 13 bones of brown bear were identified (0.87% NISP). The assemblage consists of two mandible fragments with teeth coming from different animals, one symphysis of the mandible without teeth, one maxilla fragment with teeth and seven metacarpal bones, one phalanx and one fragment of skull (Table 1). Macroscopical and paleopathological analysis was done. Additionally, X-ray investigation was undertaken using a PROSCAN CR-system 35 digital radiographic system with CONAXX® software. 10040 HF Orange radiographic apparatus was used. The parameters 2.5 mAs and 50 kV were used. The radiographs were interpreted with Promis® digital software. Photographic documentation was also carried out. For both mandibles isolated M1 specimens age at death was determined by the analysis of dental tissues (dentine and cementum) in cross sections through the root, about 7.5 mm below the crown (Debeljak, 2007).

Results

During archaeozoological investigations in Liptovská Mara 6373 identified animal bones fragments (NISP, Eng.

Table 1: Anatomical distribution of brown bear skeletal fragments in Liptovská Mara

Skeletal fragment	Number of bone fragments
Cranium	2
Mandibula	3
<i>Os metacarpale</i>	7
Phalanx	1
Total	13

Table 2: NISP and TNF in Liptovská Mara

Bone fragment	LM I	LM II	LM III	LM IV	LM VII	Total
<i>Equus ferus f.caballus</i>	13	73	0	2	0	88
<i>Bos primigenius f.taurus</i>	680	2124	7	43	14	2868
<i>Sus scrofa f.domestica</i>	53	487	0	4	0	544
<i>Ovis/Capra</i>	231	1850	2	48	0	2131
<i>Canis lupus f.familiaris</i>	4	186	0	2	0	192
Wild living species	38	385	0	4	0	427
Undetermined bone	879	3628	34	134	3	4678
Aves	14	108	0	1	0	123
TNF	1912	8841	43	238	17	11051

TNF – total number of specimens; LM I – LM VII – excavation areas within the Liptovská Mara site



Fig. 1: Liptovská Mara site, Liptov region in Northern Slovakia

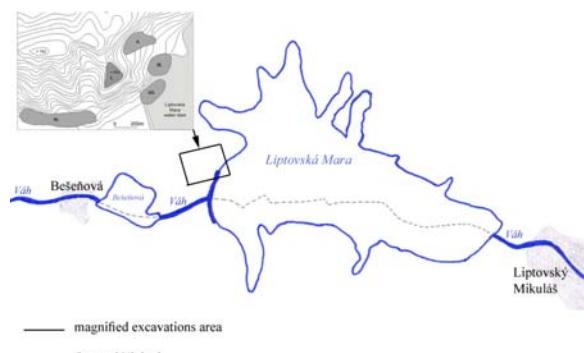


Fig. 2: Liptovská Mara I-VII archaeological sites

number of identified specimens) were found. It is 57.7% TNF (Eng. total number of fragments). The wild-living animal remains were 427 it and is 6.7% of all identified bones (Table 2).

Animal age was estimated to 10-15 years in three individuals on the basis of tooth structure analysis (two mandibles and one maxilla). In the one mandible, the

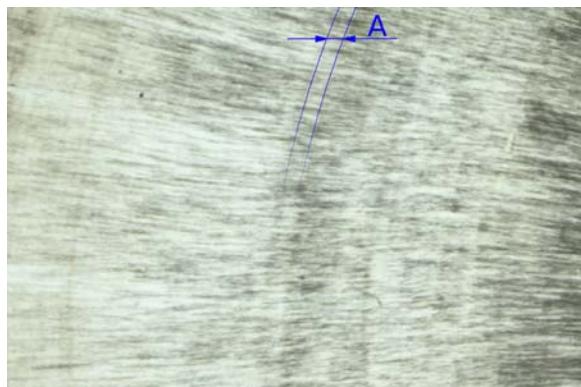


Fig. 3: Histogram of the brown bear molar tooth (M_1). A - abnormally small growth space

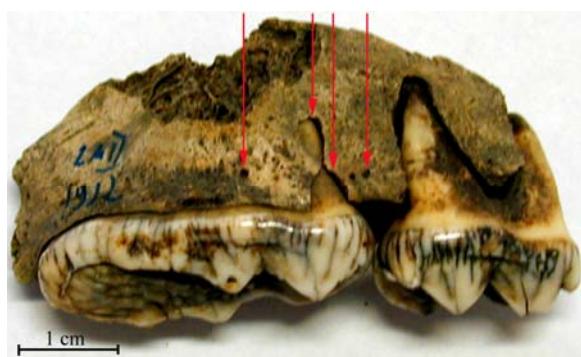


Fig. 4: The brown bear superior dental arch fragment with chronic periodontitis



Fig. 5: Proximal extremity of the brown bear third metacarpal bone with exostoses, dorsal view

abnormally small growth sphere was found (Fig. 3), which suggests sickness or some kind of deficiency in this life period. Some pathological changes were observed in cranial and postcranial skeleton remains. Alveolar process regression in the maxilla was observed. The dental neck and partial dental root was exposed (Fig. 4) as a result of the process of complex periodontal inflammation. This medical image was typical of chronic periodontal disease (*periodontitis chronica*). Other pathological changes were observed in the metacarpal bones (Fig. 5). Massive osteophytes occurred in the proximal extremities of four



Fig. 6: Radiograph of the brown bear metacarpal bone, mediolateral projection

metacarpal bones (II-V) coming probably from one individual. X-ray investigations allow for the exclusion of neoplastic or osteomyelitis processes. Hypertrophic bone formation did not expand into the cortical bone tissue (Fig. 6). Cortical bone invasion was typical of osteomyelitis and could occur during neoplastic destruction, so the medical image should be diagnosed as advanced chronic osteoarthritis.

Discussion

The brown bear is the largest and strongest carnivore in the Middle European environment (Saco and Valkenburgh, 2004). Modern brown bears have an omnivorous seasonal diet, but about 30% of the digested food comes from meat, though the amount of meat eaten varies from year to year (Mattson, 1997; Ćwiklowski and Ćwiklowski, 2011). Bears usually avoid areas of human inhabitation and live in large forests. An estimation of age, based on the histological analysis of teeth, suggests 10-15 years. The mean life-span of brown bear is 25-35 years (Ćwiklowska and Ćwiklowski, 2011), so all investigated individuals cannot be classified as an advanced age for animals living in the wild. Pathological changes observed in the metacarpal bones can be typical of an old individual or may be caused by chronic inflammatory process as a result of injury (Fig. 5) (Kitchener, 2004; Withalm, 2004; Bendrey, 2007, Bourne et al., 2010). It is clear that this chronic disease brings with it suffering and animal discomfort. These types of changes cause intensive pain especially during thoracic limb use. These symptoms are probably severe during

humid springs and autumns. It is important to underline the fact that the brown bear's natural behaviour includes thoracic limb usage in short distance running, climbing, hollowing and the catching and killing of its prey. Osteoarthritis as a pathological process of the locomotive apparatus has a significant influence on hunting and other food acquisition abilities. Locomotive apparatus diseases are frequently (51%) observed in old bears from zoological gardens (Föllmi, 2005). Sick animals become less active, weaker, cachectic, sleep more, climb less and are generally slower or more irritable. Interestingly, osteoarthritis in cave bears (*Ursus spelaeus*) living in cold damp caves in Italy was extremely rare (Capasso and Caramiello, 1999). In contrast, osteoarthritis and osteoarthritis in cave bears from Potocka Zijalka (Slovenia) occurred more frequently (Withalm, 2004). Advanced periodontitis is described in modern brown bears. Investigations carried out on bears living in the wild in Norway have proved oral cavity status deteriorate with age. Similar results were obtained from the observations conducted in Zoos (Kitchener, 2004; Störmquist et al., 2009). Capasso and Caramiello (1999) described many oral cavity pathologies, including periodontal disease in cave bears. They posit that the above sicknesses could be one of the reasons why cave bears died out. Periodontal disease was also mentioned by Withalm (2004). Dental analysis proved the age at death on 11-15 years.

The human population of Liptovská Mara in the La Tène period consisted of Celtic farmers and breeders. Analysis of archaeofaunal material suggests well-organized and developed animal husbandry practices in this settlement. Analysis of animal bone remains from Liptovská Mara has proved that the hunt was not an important and frequent activity in this community. Cattle and small ruminant breeding was the main sort of animal production (Chrószcz et al., 2010). These animals were an important source of milk and wool; moreover, meat production was not the primary aim of the breeding. Sheep were probably, like today, fed in mountain pastures. It is clear that domestic animals in large groups are an easier target for predator attack than other species living in the wild. Older and disabled or injured bears could try to hunt sheep, causing counteractions from shepherds. Similar incidents take place today too (Sagor et al., 1997).

There is another potential interpretation, but the injury hypothesis rather excludes it. Wild bears aged about 11-15 years are usually strong and healthy and mortality caused by factors other than human activity is extremely low in this age group (McNamee, 1997). A similar situation was described for the cave bear population in the Mokrica Cave (Debeljak, 2007). It is well known that November–March (4–5 months) represents the period of torpidity for the Carpathian

population of brown bear (Micu, 1998). During the hibernation period brown bears do not eat, drink, defecate, urinate or have any physical activity (Hissa, 1997). Black bears are characterized by similar observations (Hellgren et al., 1989). In hibernating animals the loss of body mass is the consequence of the consumption of fat reserves and varies from 250 to 500 g per day, depending on the size of the animal and ambient temperature (Hissa et al., 1998a; 1998b). The main protein and fat source in the bear diet after hibernation is animal meat, especially that of ungulates (Clevenger and Purroy, 1991). It is possible that after the winter hibernation the weakened and hungry bears hunted on easy prey like domestic animals, and in this situation herders might protect the breeding flock by killing bears.

If bears were special objects of hunting, the occurrence of these animal remains would be more frequent and more varied in terms of age in La Tène Liptovská Mara site. In our opinion, the bears from Liptovská Mara were killed because of their attacks on domestic sheep, and not as quarry on targeted hunting expeditions for meat.

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