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MORPHOMETRIC AND TAPHONOMIC ANALYSIS OF THE UPPER PLEISTOCENE FAUNAL ASSEMBLAGE FROM HIJENSKA PEĆINA, CROATIA

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ABSTRACT

Hijenska pećina, an Upper Pleistocene cave site, is located in the Plovunija quarry, north of Buje in Istria, Croatia. A detailed taxonomic, metric and taphonomic analysis of the faunal assemblage is presented in this work. Material consists of about 453 bones, bone fragments and teeth. A big portion of the remains belong to cave hyena (*Crocuta crocuta spelaea*) and the thesis will try to answer the question if Hijena cave was a hyena den or a natural trap as suggested in earlier works.

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1. INTRODUCTION

Hijenska pećina ("Hyena cave") is an Upper Pleistocene site in Plovunija quarry north of Buje in Istria, Croatia (Fig.1). It was discovered in August 1972. (Malez, 1973; Malez et al., 1974). The bones found in the cave were collected by Mirko Malez who published just a preliminary list of some of the fossil material. The excavation was not carried out in accordance with today's archaeological and paleontological standards and there is no field journal or a record about the methods and proceedings of excavation.

Malez published about Hijenska pećina on several occasions (e.g. Malez, 1973; 1975; 1986; Malez et al., 1974) but each time only briefly mentioning some of the species present and more focusing on the geology of the site. All the bones were stored in the Institute for Quaternary Paleontology and Geology of the Croatian Academy of Sciences and Arts in Zagreb and before this work nobody has studied them in detail.

This thesis is a complete analysis of the faunal assemblage found in Hijenska pećina. All the bones were studied taxonomically, metrically and taphonomically. According to the identified species, a brief description of the paleoenvironment is given, challenging the view from Malez (1974) that this was a niche with animals adapted to a cold environment.

Special attention is given to answering the question, how did the bones get into the cave and who or what was responsible for their accumulation (carnivores, humans or some other causes)? According to Malez et al. (1974) and Malez (1975), this was a fallen-in pit, a subterranean cavity that was connected with the surface of the terrain by a vertical canal. The animals that lived in the area at that time would accidentally fall into the pit and would not be able to get out of it anymore. Malez et al. (1974) also says that this was a lair of Pleistocene cave hyenas and that almost all the bones found in the cave exhibit characteristic traces of gnawing by the cave hyena. Therefore, the thesis will also deal with the question "What is a hyena den?" and it will re-examine the hypothesis given by Malez.

Figure 1. Map of Istria with location of Hijenska pećina (HP).

2. GEOLOGICAL SETTING

The Istrian peninsula is a part of the Outer Dinarides which belong to the north-western part of the former Mesozoic Adriatic-Dinaridic carbonate platform (AdCP; Vlahović et al., 2005). It is characterized by layers of Middle and Upper Jurassic which are situated in the core of western Istrian anticline, of lower and upper Cretaceous limestones and dolomites in the wings of the anticline, of flysch in the central Istrian syncline and of Cretaceous-Paleogene structure Ćićarija in the north east (Bahun & Juračić, 2002).

Velić et al. (1995, 2003) distinguished four megasequences or sedimentary units, which are separated from each other by emersional borders (Fig.2): 1.) Bathonian – Lower Kimmeridgian; 2.) Upper Tithonian – Upper Aptian; 3.) Upper Albian – Lower Campanian; 4.) Paleocene – Eocene. In some published papers (Velić et al., 2003), the Quaternary is distinguished as the last megasequence characterized by alluvial deposits, terra rosa, bone breccias and deposits in caves.

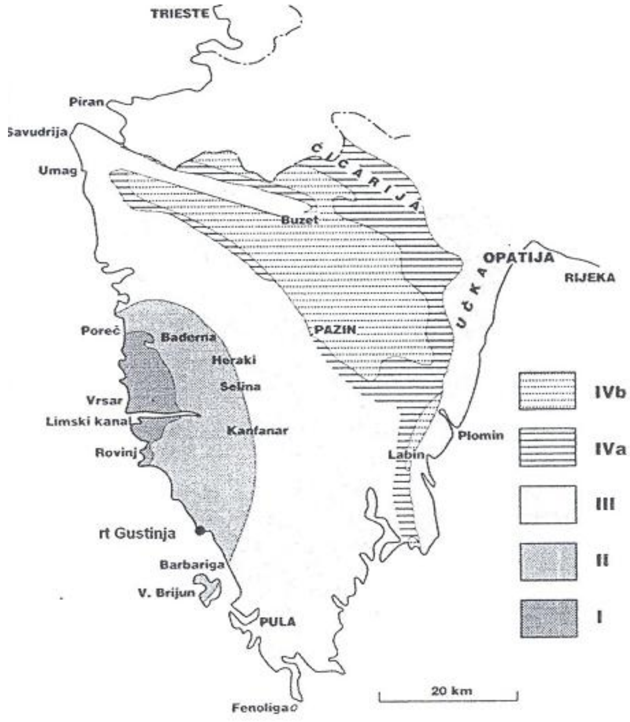


Figure 2. Geological map of Istrian peninsula (from Velić et al., 1995).
I: Bathonian – Lower Kimmeridgian; II: Upper Tithonian – Upper Aptian;
III: Upper Albian – Lower Campanian; IVa: carbonate Paleocene-Eocene;
IVb: Flysch Paleocene-Eocene.

The Plovunija quarry, where the Hijenska pećina is located, is situated in the area of Kaldanija, an anticline, which is a part of a broad fault build of Cretaceous and Paleogene deposits (Malez et al., 1974; Fig.3). The area is cut by reverse faults and well pronounced dolines which extend in a NW-SE direction. Malez et al.(1974) reported tectonic mirrors and numerous parallel diaclases in some places of the Hijenska pećina. According to him, the cave itself was formed sometime during the Lower or Middle Pleistocene.

The original entrance to the cave is closed, while the secondary entrance was opened by mining. This artificial entrance leads to a small chamber sized 15 meters by 10 meters. From the small chamber, two wings extend towards a hall which is about 30 meters long and wide (Malez et al., 1974; Fig.4). Today, there is no access to the cave because the artificial entrance collapsed and the only way in was closed off.

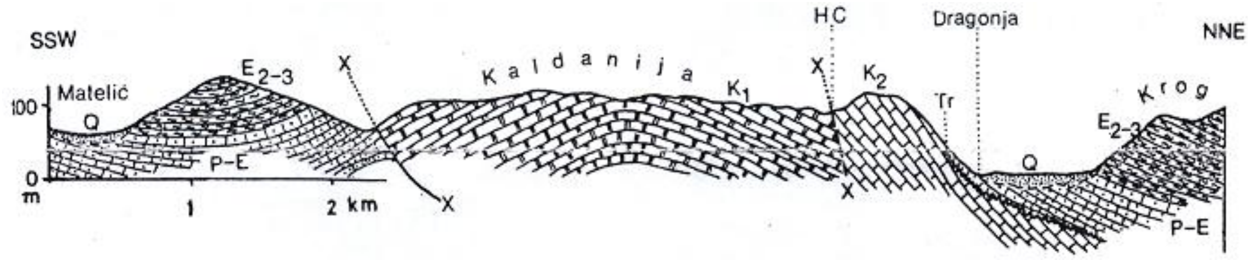


Figure 3. Geological profile of Kaldanija (from Malez et al., 1974). K_1 – Lower Cretaceous limestone; K_2 – Upper Cretaceous limestone; P-E – Paleocene and Eocene limestone; E_{2-3} – Eocene marls and sandstones (flysch); Q – Quaternary deposits; X-X – reverse faults; Tr – transgressive boundary; HC – position of Hijenska pećina.

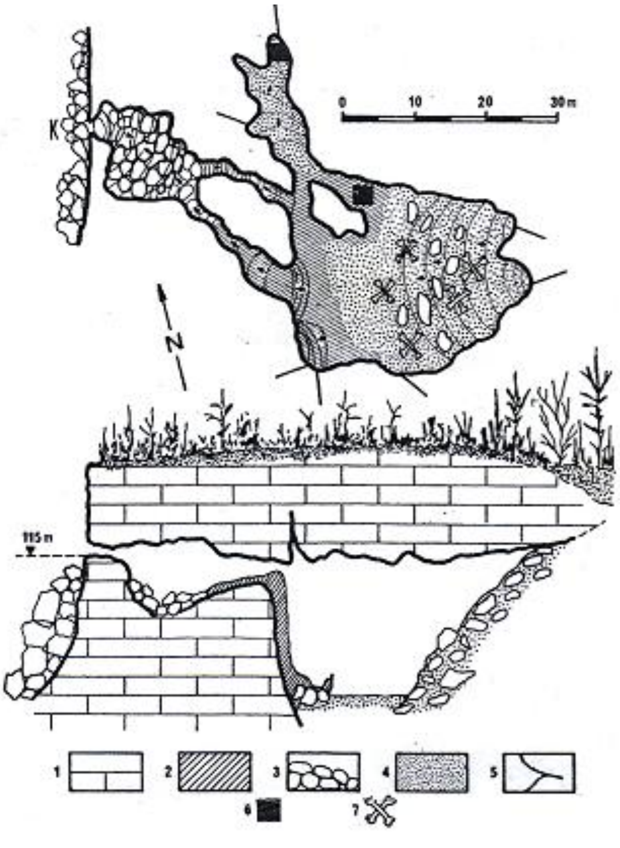


Figure 4. Ground plan and longitudinal profile of Hijenska pećina (from Malez et al., 1974): 1 – stratified Cretaceous limestone; 2 – dripstone formation; 3 – stone blocks; 4 – cave loam; 5 – fissures; 6 – positions of two complete skeletons of cave hyenas; 7 – sites of remains of Pleistocene mammals; K – rim of quarry.

3. MATERIAL AND METHODS

The fossil material from Hijenska pećina consists of 453 bones, bone fragments and teeth plus eight hyena coprolites. All of the material, excluding the coprolites, was labeled with letters the HP (abbreviated for Hijenska pećina – “Hyena cave”) followed by a sequential number.

The next step was taxonomical and morphological determination. Most of the material was compared with the recent as well as fossil material that is stored at the Institute for Quaternary Paleontology and Geology of the Croatian Academy of Sciences and Arts, Zagreb. The fossil material which was used for comparison comes from the paleontological and archaeological sites Šandalja II, Velika pećina, Cerovačke pećine and Romualdova pećina in Croatia. Furthermore, when needed, different bibliographical resources were used. Hyena metapodials were not part of the comparative collection and for their determination the drawings from Pales & Lambert (1971) were consulted. Guèrin (1980) was used for determination of *Stephanorhinus cf. hemitoechus*. For the determination of *Megaloceros giganteus* articles from Breda (2005) and Lister et al. (2005) were used. Determination of large bovids was made following Bibikova (1958), Lehmann (1949), Sala (1986), Schertz (1936) and Stampfli (1963).

Metric analysis of large mammal remains was performed mostly following von den Driesch (1976), as well as Eisenmann (1981, 1986) in the case of horses and Guèrin (1980) for rhinoceroses. Measurements of *Chionomys nivalis* molars were made following Mauch Lenardić (2005). All the values of parameters are in millimeters. Some measures are a few millimeters higher than they are supposed to be due to the large amount of $CaCO_3$ on some of the bones. In those cases, the parameter shows an approximate value and therefore the sign “~” was added in front of the number. When a portion of the bone is missing, affecting the measurement, the sign “*” was added next to the number.

For each bone the age at death as well as orientation and completeness of the element was determined. The age of dental remains was determined according to the use wear on occlusal surface and the presence of deciduous or permanent teeth (Hillson, 2005; Levine, 1982). Dental eruption is a good indicator of the age of the animal. Deciduous teeth are from infant to sub-adult, permanent teeth are from juvenile to old adult. The more precise age depends on the tooth in question and when it erupts. As soon as the tooth erupts it starts to wear. Although the rate of tooth wear depends on many factors, in general it can be said that unworn deciduous teeth belong to infants, worn deciduous teeth are from juveniles to sub adults, unworn permanent teeth are from sub adults to adults and heavily worn teeth are from adults to old adults.

The age of the skeletal remains was estimated according to the stage of fusion of the epiphysis with diaphysis, fusion of cranial sutures and the bone surface structure. While using this method of age determination one has to take into account that not all the epiphyses fuse at the same time. It varies between the proximal and distal epiphyses of the same bone, but also between different bones and different animals (Schmid, 1972). The material was classified into four age groups: infant, sub adult, adult, old adult.

Taphonomic analysis included determining the presence or absence of recent breaks and type of breakage pattern of long bones. Broken long bones without recent breaks were classified into two main groups according to the types of fractures: dry bones with angular fracture (type I spiral fracture) and green bones with true spiral fracture (type II spiral fracture) (Lyman, 1994). Another part of the taphonomic analysis was identification of the weathering type that affected the bone, and the presence and type of gnawing marks.

The number of identified specimens NISP was calculated. In the case of mandible or maxilla with teeth, the mandible/maxilla was considered as one anatomical element but also each tooth from the jaw was counted as a separate element as well. Furthermore, minimum number of individuals MNI was calculated first for the same skeletal element of a taxon and then for each taxon.

4. RESULTS

4.1. Taxonomic and metric analysis

Taxonomic analysis of the faunal assemblage has confirmed the presence of some of the taxa determined by Malez (1986), but also it has added some new taxa and taken away some others (Table 1.). Malez published different preliminary faunal lists (Malez et al., 1974; Malez, 1986). Confirmed taxa, which are mentioned in Malez (1986) are *Crocuta crocuta spelaea*, *Panthera leo spelaea*, *Canis lupus*, *Meles meles*, *Ursus spelaeus*, *Equus ferus*, *Sus scrofa*, *Cervus elaphus*, *Capreolus capreolus* and *Bos primigenius*. Added taxa are *Erinaceus sp.*, Chiroptera indet., Rodentia indet., *Chionomys nivalis*, Lepus sp., *Lynx lynx*, Stephanorhinus cf. hemitoechus, *Megaloceros giganteus,* and *Vulpes/Alopex*. Vuples sp. was identified by Malez in 1974 but in 1986 he removed the fox from the list. Malez et al. (1974) does mention that numerous remains of micromammalia and amphibia were collected as well, but he did not describe these remains in detail. During the revion, remains of amphibia were not found. Also, the presence of taxa *Asinus hidruntinus* (*Equus hidruntinus*), *Alces alces* and Bison cf. priscus could not be confirmed and therefore were removed form the faunal list.

From 453 bones and teeth in the assemblage, 175 remain unidentified (Tab.2). Out of those 174 unidentified specimens, 15% belongs to unidentified ribs and rib fragments, 10,2% to unidentified long bone fragments, 9,7% to indeterminate bones and the rest are bones and bone and teeth fragments which can be morphologically identified but who they belong remains unknown.

Order	Taxon	Malez (1986)	Revision
Erinaceomorpha	Erinaceus sp.	-	+
Chiroptera	Chiroptera indet.	-	+
Rodentia	Rodentia indet.	-	+
	Chionomys nivalis	-	+
Lagomorpha	Lepus sp.	-	+
Carnivora	*Crocuta crocuta spelaea*	+	+
	Lynx lynx	-	+
	Panthera leo spelaea	+	+
	Canis lupus	+	+
	Vulpex/Alopex	-	+
	(Vulpes sp.)		
	Meles meles	+	+
	Ursus spelaeus	+	+
Perissodactyla	Stephanorhinus cf. hemitoechus	-	+
	Equus caballus fossilis		
	(Equus ferus)	+	+
	Asinus cf. hidruntinus		
	(Equus hidruntinus)	+	-
Artiodactyla	*Sus scrofa*	+	+
	Megaloceros giganteos	-	+
	Cervus elaphus	+	+
	Alces alces	+	-
	Capreolus capreolus	+	+
	Bos primigenius	+	+
	Bison cf. priscus	+	-
	Bos/Bison	-	+

Table 1. The Pleistocene mammal assemblage from Hyena cave determined by Malez (1986) and by revision. Taxa that is present is indicated with “+” while taxa that is not present is indicated with”-“.

IDENTIFIED REMAINS	UNIDENTIFIED REMAINS			
278	Unidentified ribs and rib fragments	Unidentified long bone fragments	Unidentified bones	Morphologically identified and taxonomically unidentified
	68	46	44	17
	175			

Table 2. Number of identified and unidentified faunal remains in Hijenska pećina

4.1.1. Micromammalia indet.

Inventory number: HP417; HP418
Element: Vertebrae

Inventory number: HP419
Element: Long bone

4.1.2. Reptilia indet.

Inventory number: HP420
Element: Vertebrae

4.1.3. Order Erinaceomorpha

4.1.3.1. Erinaceus sp.

Family: Erinaceidae G. Fischer 1814.
Subfamily: Erinaceinae, G. Fischer 1814.
Genus: *Erinaceus* Linnaeus 1758.

For a long time hedgehogs were clasified as members of the mammalian order of Insectivora. Only recently they were assigned to their own taxonomic order – the Erinaceomorpha (Hutterer, 2005). According to Kurtén (1968) the genus *Erinaceus* arose in the Early Miocene. In the European fossil record Erinaceus sp. appeared for the first time during the Lower Pleistocene.

The genus *Erinaceus* contains four species: *E. amurensis* Schrenk 1859, *E. concolor* Martin 1838, *E. europaeus* Linnaeus 1758 and *E. rouminacus* Barrett-Hamilton 1900. *E. concolor* is sometimes called as a synonim for *E rouminacus*, but *E. rouminacus* is, just like *E. Europaeus*, exclusively an European form. These two European species shared a common ancestor and there are two hypothesis about the time of their divergence: Pliocene divergence 3,2-4,5 Myr ago (Seddon et al., 2001.) and Pleistocene divergence 0,4-0,5 Myr ago (Suchentrunk et al., 1998.).

Femur

Inventory number: HP177
Portion: Proximal epiphysis and diaphysis
Side: Right

Taxonomical determination:
The specimen was compared with the recent *Erinaceus* material which is a part of the Dipartimento di Biologia ed Evoluzione paeontological collection at the University of Ferrara. As the distal epiphysis and a part of the proximal epihysis are missing, it could not be determined which species the femur belongs to.

4.1.4. Order Chiroptera

Bats are known in the fossil record from the beginning of the Cenozoic. Although today they are a very diverse group of animals, in the fossil record they are rare because of their light and slender bones which do not preserve well. Famous bat fossils with skin impressions come from the Eocene Messel pit in Germany. There are two main groups of bats: the megachiropterans (fruit bats) and microchiropterans (insect-eater bats) (Benton, 2005.).

4.1.4.1. Chiroptera indet.

Humerus

Inventory number: HP400
Portion: Distal epiphysis and diaphysis
Side: Left

Inventory number: HP401
Portion: Distal epiphysis and diaphysis
Side: Right

Long bones

Inventory numbers: HP402; HP403; HP404

Taxonomical determination:
The two humeri were compared with the drawings from Honauer (1997) while the other three bones are for now classified only as long bones of Chiroptera due to the lack of comparative material.

4.1.5. Order Rodentia

4.1.5.1. *Chionomys nivalis*

Family: Cricetidae J. Fischer 1817.
Genus: *Chionomys* Miller 1908.
Species: *Chionomys nivalis* Martins 1842.

Chionomys nivalis, the snow vole, appeared in Europe in the Middle Pleistocene (Janeau & Aulagnier, 1997) and is found today from south-west Europe to the Caucasus, Turkey, Israel, Lebanon, Siria and Iran. It is considered a glacial relict. After the last glacial period, populations from southwestern Europe colonized the area of the western Alps, while the central Alps were colonized by the populations from eastern Europe (Mauch-Lenardić, 2005.).

The snow vole usually inhabits alpine areas but it can also be found in lower elevations, in rocky areas without woods. Furthermore, it can also inhabit cave environments (Mauch Lenardić, 2005).

Mandible with teeth

Inventory number: HP405; HP405.1 (Plate I, Fig.1); HP405.2 (Plate I, Fig.2)
Element: Mandible with M_1-M_2
Side: Left

(1)IN	(2)Element	(3)L	(4)a	(5)W	(6)A/L
HP405.1	M_1sin	3,21	1,47	1,19	45,8
HP405.2	M_2sin	1,88	-	1,01	-

Table 3. Measurements of *Chionomys nivalis* M_1sin and M_2sin (following Mauch Lenardić, 2005): (3)L – Greatest length; (4)a – length of anteroconid compleks; (5)W – greatest width; (6)A/L – index (length of anteroconid complex/greatest length).

4.1.5.2. Rodentia indet.

Teeth

Inventory numbers: HP406; HP407; HP408; HP409; HP410; HP411; HP412; HP414; HP415
Element and side: one I^1 left, three I^1 right, two I_1 right, four I_1 left

Femur

Inventory number: HP416
Portion: Complete
Side: Right

4.1.6. Order Lagomorpha

4.1.6.1. Lepus sp.

Family: Leporidae Fischer de Waldheim 1817.
Genus: *Lepus* Linnaeus 1758.
Species: *Lepus timidus* or *Lepus europaeus*

Hares, together with rabbits, are part of the family Leporidae. Just like rodents, they have ever growing incisors, but unlike the rodents they have a second small pair of incisors in the upper jaw. Benton (2005) mentions *Palaeolagus*, a distant relative of leporids from the Oligocene of North America which looks very alike the modern rabbits. The true leporids arrose in Pliocene and the genus *Lepus* is already present in the early Middle Pleistocene (Kurtén, 1968).

The two species, *Lepus timidus* and *Lepus europaeus*, were contemporaries during the Pleistocene and both are still living today. The mountain hare (*Lepus timidus*) inhabits boreal and arctic forest belt as well as open moors (Kurtén, 1968). It lives in the Alpine area and in the northern belt of Eurasia from Poland to Japan. The brown hare (*Lepus europaeus*) is a highly adaptable species which is today spread almost all over Europe.

Femur

Inventory number: HP 108
Portion: Almost complete
Side: Left

Taxonomical determination:

HP 108 belongs to a hare because of several features which are characteristical for a hare femur: *trochanter major* is higher than *caput ossis femoris*; proximal part of the femur is cranio-caudaly flattened; presence of *trochanter tertius*; *corpus ossis femoris* is slightly cranially convex. It could not be determined to species owing to damage on the proximal and distal epiphysis and heavily coverage by $CaCO_3$.

(1)#	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6
HP108	~121,9*	~26,8*	20*	~7,4*	7,8	~22,5

Table 4. Measurements of Lepus sp. femur: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Greatest breadth of the region of the Trochanter tertius; (5)M4 – Depth of the Caput femoris; (6)M5 – Smallest breadth of diaphysis; (7)M6 – Greatest breadth of the distal end.

4.1.7. **Order Carnivora**

4.1.7.1. ***Crocuta crocuta spelaea***

Suborder: Feliformia Kretzoi 1945
Family: Hyaenidae Gray 1821
Genus: *Crocuta* Kaup 1828
Species: *Crocuta crocuta* Erxleben 1777
Subspecies: *Crocuta crocuta spelaea* Goldfuss 1823

The hyenas arose from the Viverridae and they appeared for the first time in Euroasia during the Miocene (Kurtén, 1968.). The spotted hyena (*Crocuta crocuta*) lineage may be traced back to the Middle Pliocene of Africa (Barry, 1987), while in Europe they were present for at least 1 million years (Garcia and Arsuaga 1999; Carrión et al., 2001). The bones of European spotted hyena were described for the first time by Cuvier (1805).

According to some authors European spotted hyena should be regarded as a separate species (*Crocuta spelaea*) (e.g. Musil, 1962; Markova et al., 1995.) but others consider it a subspecies of the African spotted hyena (*Crocuta crocuta spelaea*) (e.g. Kurtén 1968; Werdelin and Solounias, 1991; Nagel et al., 2004; Varela et al. 2010; Diedrich, 2011). Rohland et al. (2005) showed that the European spotted hyena is genetically related to the extanct spotted hyena and therefore here the European spotted hyena will be considered as a subspecies of African spotted hyena.

Crocuta crocuta spelaea was spead during the Pleistocene all over Europe and it had a capacity to inhabit a wide range of climatic conditions (Varela et al., 2010). Because of its wide range, the spotted hyena, living and extinct, shows great morphological variability (Klein and Scott, 1989; Dockner, 2006; Reynolds, 2007). In the opinion of Palmqvist (2011), the body of spotted hyena is heavily built and is more massive than the body of other hyenas who need to cover long distances in the search for food. Klein and Scott (1989) argue that the size of spotted hyena is, according to Bergmann's rule, inversely related to temperature. In colder (glacial) periods hyenas were significantly larger than during the interglacials. Another difference in size is due to sexual dimophism; females are larger while males are stronger and smaller (Diedrich, 2011). European spotted hyenas disappeared between 13,000-11,000 years ago (Stuart, 1991).

In the hyena family there are four members still living today: *Crocuta crocuta* – spotted hyena (Fig.5), *Hyaena hyaena* – striped hyena (Fig.6), *Hyaena brunnea* – brown hyena (Fig.7) and *Proteles cristata* – aardwolf (Fig. 8). Striped and brown hyenas are strict scavangers (Rieger, 1981; Mills, 1982), while spotted hyenas are also active predators (Kruuk, 1972; Gasaway et al., 1991; Lansing et al., 2009). Nevertheless, European spotted hyenas probably had a lower aptitude for active hunting (Lewis and Werdelin, 2000). Today, hyenas visit garbage dumps and cemeteries in their search for food (Horwitz and Smith, 1988; Leakey et al., 1999). The analysis of recent stripped hyena scats has shown that their diet includes mammals, reptiles, birds, beetles, vegetable matter, fruit and vegetables and human refuse (Horwitz & Goldberg, 1989). Cases of cannibalism have also been recorded (Kruuk, 1972).

The modern spotted hyenas are heavier (~52 kg) than striped hyenas (~27 kg) (Gittelman & Harvey, 1982). The stripped hyenas are mostly solitary animals but the females take care of their young for up to two years (Kruuk, 1972).

Figure 5. *Crocuta crocuta*

http://www.wildlife-pictures-online.com/hyena-knp01.html

Figure 6. *Hyaena hyaena*

http://www.hyaenidae.org/the-hyaenidae/striped-hyaenas-hyaena-hyanea.html

Figure 7. *Hyaena brunnea*

http://www.trasafricasafaris.com/brown%20%20hyena.html

Figure 8. *Proteles cristata*

http://www.factzoo.com/mammals/aardwolf-termite-eating-den-dweller.html

Cranium

Inventory number: HP1 (Plate II, Fig.3)
Portion: Occipital and parietal

Inventory number: HP2
Portion: occipital and temporal

Taxonomical determination:

HP1 and all other speciments which were determined as belonging to hyenas were compared with felids as they are morphologically similar.

HP1 (Plate I., Figure 1.) displays a prominent sagittal crest which is typical for bone-cracking hyenas which have strong masticatory muscles and therefore an enlarged attachment for the temporalis muscle on the skull. Felids also have a strong sagittal crest but the parietal bones almost make an 90° angle to the crest which makes the skull appear broader. On the other side, hyenas skull looks narrower because the parietal bones are continuing straight downwards from the crest and therefor the skull has a dome-like profile.

Os temporale of felids is not as robust as the one of the hyena. HP2 displays a robust temporal bone and therefore it also belongs to a hyena. Furthermore, the structure of the bone HP2 is the same as the structure of HP1 so these two parts of the cranium could belong to the same individual.

Inventory number: HP3
Portion: Maxilla with teeth
Side: Right

Inventory number: HP4 (Plate II, Fig.4)
Portion: Maxilla with teeth
Side: Left

Taxonomical determination:

Determining if the maxilla HP3 and HP4 (Plate I., Figure 2.) belong to felids or a hyena is quite simple due to the different dental formula in hyenas and felids. In the upper jaw felids have three incisives, one canine, three premolars and one molar, while a hyena has one additional premolar.

Teeth

Inventory numbers: HP3.1; HP3.2; HP3.3; HP4.1; HP4.2; HP4.3
Element: Maxilla with teeth

Inventory numbers: HP5.1; HP5.2; HP5.3; HP6.1; HP6.2; HP6.3; HP6.4; HP6.5; HP338.1
HP338.2; HP338.3; HP338.4; HP338.5; HP339.1; HP339.2; HP339.3;
HP340.1; HP340.2; HP340.3; HP340.4
Element: Mandible with teeth

Inventory numbers: HP8; HP9; HP10; HP11; HP12; HP 13; HP14; HP341; HP342
Element: Isolated teeth

(1)IN	(2)Tooth	(3)M1	(4)M2	(5)M3	(6)M4	(7)M5
HP3.1	right P^4	41,1	21	17,1	17	19,2
HP3.2	right P^3	24,1	17,6	23,8	22,9	23,8
HP3.3	right P^2	15,9	12,7	10,8	11	11,6
HP4.1	left P^4	~42,1	~21,9	~17,6	~18,4	~19,8
HP4.2	left P^3	~24	~17,8	-	-	-
HP4.3	left P^2	-	-	-	-	-
HP5.1	left P_4	22,6	14,8	8,2	11,8	16,9
HP5.2	left P_3	20,8	17	-	-	20,1
HP5.3	left P_2	15,6	11,2	-	7,8	10,3
HP6.1	right M_1	~33	~14,9	~16,9	~13,5	~20,1
HP6.2	right P_4	~17,5	~158	~129	~12,2	~19
HP6.3	right P_3	~21,1	~17,2	-	-	~21
HP6.4	right P_2	~17,3	~12,4	-	-	~13
HP6.5	right C_1	~15,9	~175	-	-	~29,1
HP8	left C_1	14,9	12,4	-	-	22,5
HP9	right C^1	17,2	13,3	-	-	30,7
HP10	right C_1	15,2	13,1	-	-	22
HP11	C	~15,1	-	-	-	-
HP12	C	16,9	13,4	-	-	31,9
HP13	left M_1	~34	~15	~15,3	~14,4	~18,7
HP14	left C^1	17	13,3	-	-	30,4
HP338.1	right M_1	29,6	13,2	16	13,9	17,1
HP338.2	right P_4	18,9	13,6	9,8	9,5	16,7
HP338.3	right P_3	18,4	15,7	-	7,7	18,8
HP338.4	right P_2	12	~12,8	3	4,6	9,1
HP338.5	right C_1	14,7	~12,9	-	-	-

HP339.1	left P_4	21,3	~15,6	12	12,4	17,3
HP339.2	left P_3	20,6	~16,4	-	-	22,1
HP339.3	left P_2	11,7	~12,9	~6,1	8,8	12,2
HP340.1	left M_1	30,5	13,6	16,3	13,7	17
HP340.2	left P_4	18	13,9	6	8,8	14,2
HP340.3	left P_3	19,1	15,5	-	-	18,9
HP340.4	left P_2	14,1	11,1	-	-	9
HP342	left P^4	38,5	~22,1	-	-	20,7

Table 5. Measurements of *Crocuta crocuta spelaea* teeth: (1) Inventory number; (2) Tooth; (3) M1 – Length at crown-root junction; (4) M2 – Greatest breadth at crown-root junction; (5) M3 – Height on mesial – measured from buccal side; (6) M4 – Height m-d or distal – measured from buccal side; (7) M5 – Greatest height – measured from buccal side

Mandible

Inventory numbers: HP5; HP339; HP340

Portion: Mandible with teeth

Side: Left

Inventory numbers: HP6 (Plate III, Fig.5); HP338 (Plate III, Fig.6)

Portion: Mandible with teeth

Side: Right

Taxonomical determination:

Just like in the upper jaw, the lower jaw also has a different dental formula in felids and hyenas. Felids have three incisives, one canine, two premolar and one molars. Hyena has one additional premolar. In the lower part of *rami mandibulae* on the lateral side, felids have a dent whose lower edge is laterally protruding. A mandible of a hyena does not display such a deep dent.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7	(9)M8	(10)M9
HP5	-	-	-	-	-	-	-	-	~34,5
HP6	~192,9	~188,3	~161,3	~156,8	89,7	28,2	~92,9	~47,9	~40,8
HP338	-	-	-	-	87	-	-	-	35,2
HP339	-	-	-	-	89,9	27,2	-	~40,4	-
HP340	-	-	-	-	84,5	29,6	-	49	33

Table 6. Measurements of *Crocuta crocuta spelaea* mandible: (2) M1 – Total length: length from the condyle process – Infradentale; (3) M2 – Length from the indentation between the condyle process and zhe angular process – Infradentale; (4) M3 – Length: the condyle process – aboral border of the canine alveolus ; (5) M4 - Length from the indentation between the condyle process and the angular process – aboral border of the canine alveolus; (6) M5 – Length of the cheektooth row, P2-M1, measured along the alveoli; (7) M6 - Length of the carnassial alveolus; (8) M7 – Height of the vertical ramus: basal

point of the angular process – Coronion; (9) M8 – Height of the mandible behind M1, Measured on the buccal side; (10)M9 – Height of the mandible in front of P2, measured on the buccal side

Vertebrae

Inventory number: HP 15 (Plate IV., Fig.7)
Element: Atlas

Taxonomical determination:
Left *massae lateralis* and a part of *arcus ventralis* of HP15 are missing. Nevertheless, it was possible to determine that HP15 belongs to a hyena. The *massae lateralis* of hyena has a more rounded edge, while the felids have two sharper edges. Also *fovea articulares caudales* is big and rounded in felids, while in hyena it is flat and smaller.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7
HP15	-	~68,3	~53,8	-	~61,5	32,9	~47,7

Table 7. Mesurement of *Crocuta crocuta spelaea* atlas: (2) M1 – Greatest breadth over the wings; (3) M2 – Greatest length; (4) M3 – Greatest breadth of cranial articular surface; (5) M4 – Greatest breadth of caudal articular surface; (6) M5 – Greatest length from cranial articular surface to caudal articular surface; (7) M6 – Length of dorsal arch; (8) M7 - Height

Inventory number: HP 16
Element: Axis

Taxonomical determination:
In hyena, the distal upper part of *processus spinosus* is separated into two small braches, while in felids there is no separation. The caudal surface of the body of axis in felids has a hexagonal shape. In hyena the caudal surface dispalys a pentagonal shape and the edges of the pentacle are milder, not as sharp and pronounced as in felids.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7	(9)M8	(10)M9
HP16	~69,1	~77,8	~52,1	~27,6	~56,8	~59,2	~30,1	~72,8	~21,3

Table 8. Measurements of *Crocuta crocuta spelaea* axis: (2) M1 – Greatest length in the region of the corpus; (3) M2 – Greatest length of the arch; (4) M3 – Greatest breadth of cranial articulation; (5) M4 – Greatest breadth of caudal articlar surface (*Facies terminalis caudalis*); (6) M5 – Greatest breadth across the *Processus articulares caudales*; (7) M6 - Greatest breadth across the *Processus transversi*; (8) M7 – Smallest breadth of vertebrae; (9)M8 – Greatest height; (10)M9 – Height of cranial articular surface

Inventory numbers: HP17; HP18

Element: Cervical vertebrae

Taxonomical determination:

HP17 is almost complete, only missing the caudal part of the *corpus vertebrae*. HP17 is the seventh cervical vertebrae of a hyena. It is not the sixth vertebrae because in the sixth vertebrae the *processus transversi* is much larger and it divided into three parts. Also, it is not a thoracic vertebrae because the *processus spinosus* is not as long and robust as in thoracic vertebrae and HP17 is missing the articular surface for ribs which is present in thoracic vertebrae.

HP17 belongs to a hyena because it has a shorter *processus spinosus* than the felids and *processus transversus* in hyena is marking an angle of ~45° ventrally with the horizotal plane. In felids this angle is ~10°.

HP18 is missing *processus transversus* and the caudal part of the body. Besides, it is wearing a heavy cover of $CaCO_3$ and due to that it was not possible to determine exactly which vertebrae HP18 is. However, the sixth cervical vertebrae has an elongated body which is caudally inclined ventrally and HP18 does not have that, so it can be said that HP18 is either 3rd, 4th or 5th cervical vertebrae.

The difference between felids and the hyena 7th cervical vertebrae is that in hyena the proximal part of the body is almost equall in width and height, while in felids the width is bigger than the height.

(1)IN	(2)Element	(2)M1	(4)M2	(5)M3	(6)M4	(7)M5	(8)M6	(9)M7	(10)M8	(11)M9	(12)M10
HP17	7th cervical vertebrae	~27,1	~45,8	~64,3	~58,2	~74,2	~25,6	~29,7	~21,8	~22,4	~65,8
HP18	3rd-5th cervical vertebrae	-	~57,7	~62,3	~67,8	~66,6*	~18	~27,2*	~12,9	~19*	~51,5

Table 9. Measurements of *Crocuta crocuta spelaea* cervical vertebrae: (3) M1 – Physiological length of the body; (4) M2 – Greatest length from the *Processus articulares craniales* to the *Processus articulares caudales*; (5) M3 – Greatest breadth across *Processus articulares craniales*; (6) M4 – Greatest breadth across the *Processus articulares caudales*; (7) M5 – Greatest breadth across the *Processus transversi*; (8) M6 – Greatest breadth of cranial articular surface; (9) M7 – Greatest breadth of caudal articular surface; (10) M8 – Greatest height of cranial articular surface; (11)M9 – Greatest height of caudal articular surface; (12)M10 – Greatest height

Inventory numbers: HP19; HP20; HP21; HP22; HP23; HP24; HP25; HP26; HP27; HP28; HP29
Element: Thoracic vertebrae

Taxonomical determination:

HP19 is a second thoracic vertebrae because it has a long *processus spinosus* and a clearly marked rib articulation. The *processus spinosus* is laterally divided in two parts, while in the 3rd vertebrae the *processus* is not so clearly divided.

HP20 is either a 7th, 8th, 9th or 10th thoracic vertebrae because the caudal articular surfaces on the body of the vertebrae are projecting high dorsally over the body, more than in the 6th or 11th thoracic vertebrae. In felids, the same articulations are projecting more to the laterally. Another distinction is the vertebrae body, which is in felids elongated anterio-posteriorly, while in hyena the body is elongated dorso-ventrally.

HP21 and HP22 are either a 14th or 15th thoracic vertebrae. They cannot be lumbar vertebrae because they have articulations for ribs and they can not be 13th thoracic vertebrae because the 13th thoracic vertebrae has additional lateral projections on *processus transversus*. Both HP21 and HP22 are hyena vertebrae because in felids the body of the vertebrae is longer and the *processus spinosus* is inclined anteriorly, while in a hyena it is inclined posteriorly.

HP23 is the 11th thoracic vertebrae because the 12th thoracic vertebra does not have a caudal articular surface on the body of the vertebrae and the 10th thoracic vertebrae has caudal articular surfaces on the body but they are projecting more dorsally. In felids, the body of the vertebrae is much longer than the vertebrae body of HP23 and therefore HP23 belongs to a hyena.

In HP24 only the *processus spinosus* is present. It belongs to a hyena because the cranial articular surfaces are positioned far away from each other, while in felids these surfaces are positioned very close to each other.

HP25 and HP26 are either one of the three last thoracic vertebrae or one of the lumbar vertebrae. In HP25 only the *processus spinosus*, left cranial articular surface and parts of caudal articular surfaces are present. In HP26 there are only the *processus spinosus* and caudal articular surfaces. Due to the fragmentary state of HP25 and HP26 these vertebrae could not be compared with felid vertebrae but the structure, size and the appearance of the bones resembles the other hyena vertebrae from the collection and therefore they are described as belonging to hyena.

HP27 has *processus spinosus* and cranial articular surfaces, while HP29 has also *processus spinosus* and parts of the cranial and caudal articular surfaces. Both of them are thoracic vertebrae and belong to a hyena. Felids have a narrow groove on caudal side of *processus spinosus* and the articular surfaces are very close to each other. In HP27 and HP29, just like in hyena, the groove is deep and wide and the articular surfaces are wide apart.

HP28 is a 14th or a 15th thoracic vertebrae because it does not have additional small lateral processes on *processus transversus* like the 13th vertebrae and it is not a lumbar vertebrae because it has articular surfaces for the ribs. It belongs to a hyena because the body of the vertebrae is not as long as it is in felids.

(1)IN	(2)Element	(3)M1	(4)M5	(5)M6	(6)M7	(7)M8	(8)M9	(9)M10
HP19	2nd thoracic vertebrae	~22	~70,1	~24,1	41,2	20,1	21,9	101,5*
HP20	7th-10th thoracic vertebrae	23,9	47,8*	31,5*	38,3*	~28,5*	29,2	82,3*
HP21	14th-15th thoracic vertebrae	27,2	42,1*	32,8	32	23,4	22	68,1*
HP22	14th-15th thoracic vertebrae	26,1	41,6*	30	30,9	23	22,6	54*
HP23	11th thoracic vertebrae	25,7	39*	26,8	35	~27,1	24,3	46,2*
HP24	thoracic vertebrae	-	-	-	-	-	-	40,5*
HP25	last 3 thoracic or lumbar vertebra	-	-	-	-	-	-	44*
HP26	last 3 thoracic or lumbar vertebra	-	-	-	-	-	-	40,8*
HP27	thoracic vertebra	-	-	-	-	-	-	74,3*
HP28	14th-15th thoracic vertebra	28,8	39*	26,2*	31,7	23	21,8	73,1
HP29	thoracic vertebra		-	-	-	-	-	69,1*

Table 10. Measurements of *Crocuta crocuta spelaea* thoracic vertebrae: (3) M1 – Physiological length of the body; (4) M5 – Greatest breadth across the *Processus transversi*; (5) M6 – Greatest breadth of cranial articular surface; (6) M7 – Greatest

breadth of caudal articular surface; (7) M8 – Greatest height of cranial articular surface; (8)M9 – Greatest height of caudal articular surface; (9)M10 – Greatest height

Inventory number: HP30 (Plate IV, Fig.8)
Element: Lumbar vertebrae

Taxonomical determination:

HP30 is a lumbar vertebrae but it can not be said which one because it is missing *processus transversus*, caudal articular surfaces and a big part of the *processus spinosus*. It belongs to a hyena because it has a processus spinosus pointing dorsally and not inclined cranially like in felids. Aalso, felids have a longer body of the vertebrae.

(1)IN	(2)Element	(3)M1	(4)M5	(5)M6	(6)M7	(7)M8	(8)M9	(8)M10
HP30	lumbar vertebrae	29,5	46*	32,8	30,7*	21	22,3	62,2*

Table 11. Measurements of *Crocuta crocuta spelaea* lumbar vertebrae: (3) M1 – Physiological length of the body; (4) M5 – Greatest breadth across the *Processus transversi*; (5) M6 – Greatest breadth of cranial articular surface; (6) M7 – Greatest breadth of caudal articular surface; (7) M8 – Greatest height of cranial articular surface; (8)M9 – Greatest height of caudal articular surface; (9)M10 – Greatest height

Scapula

Inventory number: HP32
Side: Left

Taxonomical determination:

HP32 belongs to a hyena because the scapula of felids has a wider *fossa infraspinata* and *fossa supraspinata*, while in hyena these fossae are more narrow.

Humerus

Inventory number: HP33	Inventory number: HP34
Portion: Proximal epiphysis	Portion: Proximal epiphysis
Side: Left	Side: Right

Inventory number: HP36 (Plate V, Fig.11&12) Inventory numbers: HP344; HP345

Portion: Distal epiphysis and diaphysis
Side: Right
Inventory number: HP343
Portion: Complete
Side: Left

Portion: Distal epiphysis and diaphysis
Side: Left
Inventory number: HP35 (Plate V, Fig.9&10)
Portion: Complete
Side: Right

Taxonomical determination:

The *tuberculum majus* in a hyena (HP33, HP34, HP343) is much higher and pronounced than it is in felids. In the distal epiphysis , in hyenas there is a small lateral part of the *trochlea humeri – capitulum humeri* (HP35, HP36, HP343, HP344, P345). In felids *capitulum humeri* is not present. *Crista supracondylaris lateralis* in felids is very pronounced and in a hyena it is not (HP35, HP36, HP343, HP344, HP345). Furthermore, *epicondylus medialis* is bigger in felds than in a hyena.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7
HP33	-	-	-	~59	-	-	-
HP34	-	-	-	~60,9	-	-	-
HP35	~189,1*	-	-	-	~23,6	~57,1	~45,3
HP36	-	-	-	-	23,2	53,3*	47,8
HP343	242,9	237,8	227,9	~53,1	21,3	60	46,4
HP344	-	-	-	-	-	~59,6	44,5
HP345	-	-	-	-	-	51,3*	~40,1

Table 12. Measurements of *Crocuta crocuta spelaea* humerus: (2) M1 – Greatest length; (3) M2 – Greatest length of the lateral part; (4) M3 – Greatest length from caput; (5) M4 – Greatest breadth of the proximal end; (6) M5 – Smallest breadth of diaphysis; (7) M6 – Greatest breadth of distal end; (8) M7 – Greatest breadth of trochlea

Radius

Inventory numbers: HP37; HP38
Portion: Complete
Side: Left

Inventory numbers: HP39; HP40
Portion: Complete
Side: Right

Taxonomical determination:

Caput radii in felids is orientated anterio-posteriorly, while in a hyena it is orientated medio-laterally. *Fovea capitis radii* in a hyena has two separated grooves - one bigger and one smaller (HP37, HP40), while felids have only one groove. The articulation for ulna, *circumferentia articularis,* is much bigger in felids than in a hyena. *Margo lateralis* and *margo medialis* in felids are very pronounced and are making almost sharp edges, while in a hyena they are not pronounced at all. Also, the *processus styloideus* is more pronounced in felids than in a hyena. *Incisura ulnaris,* the place of the distal articulation of radius and ulna, is deeper in felids than in a hyena.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP37	~202,3	~30,1	~23,4	~45,8
HP38	219,2	24*	24,3	43
HP39	222,2	31,3	23,5	46
HP40	~202,2	~31,9	~26	~48,3

Table 13. Measurements of *Crocuta crocuta spelaea* radius: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth od diaphysis; (5)M4 – Greatest breadth of distal end

Ulna

Inventory number: HP41
Portion: Proximal epiphysis and diaphysis
Side: Right

Inventory number: HP42
Portion: Proximal epiphysis and diaphysis
Side: Left

Inventory number: HP43
Portion: Complete
Side: Right

Inventory number: HP44 (Plate VI, Fig.13&14)
Portion: Complete
Side: Left

Inventory number: HP45
Portion: Proximal shaft
Side: Left

Taxonomical determination:
Tuber olecrani in felids has a higher cranial part than the caudal, while in a hyena the caudal part is higher than the cranial (HP41, HP42, HP43, HP44). *Processus anconeus* in felids has a semi-circular shape, while in a hyena this shape is milder and is inclined medially (HP41, HP42, HP43, HP44). *Processus coronoideus medialis* in felids is bigger and wider compared to the one in hyena (HP42, HP43, HP45). Moreover, *incisura radialis* is deeper in a hyena than in felids (HP42, HP43, HP44).

(1)IN	(2)M1	(3)M2**	(4)M3	(5)M4	(6)M5
HP41	-	55,2	43,2	37,1	-
HP42	245,3	55,7	45,8	39	35,1
HP43	~226,6	~56,3	~44,8	~38	~37,2
HP44	~226,1	~52,8	~44,8	~35,3	~41,4*
HP45	-	-	-	-	-

Table 14. Measurements of *Crocuta crocuta spelaea* ulna: (3)M1 – Greatest length; (4)M2 – Length of the olecranon; (5)M3 – Depth across the *Processus anconaeus*; (6)M4 – Smallest depth of the olecranon; (7)M5 – Greatest breadth across the coronoid process

Metacarpal

Inventory number: HP49; HP53	Inventory number: HP50
Element: Metacarpal II	Element: Metacarpal II
Side: Right	Side: Left

Taxonomical determination:

On the proximal posterior side of the diaphysis, felids have a double incisure and a hyena does not. Also, the distal epiphysis of felids is extended downwards while in a hyena it is not.

(1)#	(2)M1	(3)M2	(4)M3	(5)M4
HP49	82	11,3	18,1	17,1*
HP50	82,1	11,3	18,1	17,1
HP53	79,2	10,2	15	14

Table 15. Measurements of *Crocuta crocuta spelaea* metacarpal II: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Inventory numbers: HP46; HP52	Inventory numbers: HP51; HP257
Element: Metacarpal III	Element: Metacarpal III
Side: Right	Side: Left

Taxonomical determination:

Felids have, on the medial side of the proximal epiphysis, two conspiciuous processes, one on the cranial side and one on the caudal. In hyena these processes are absent. HP257 has both its epiphysis destroyed but due to the size, shape and structure of the bone it can be supposed that it belongs to a hyena.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP46	94,7	9,1	14,9	10,7*
HP51	94	12	17,6	17
HP52	92,8	11	16,2	16,1
HP257	91*	10,9	14,3	-

Table 16. Measurements of *Crocuta crocuta spelaea* metacarpal III: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Inventory number: HP47
Element: Metacarpal V
Side: Left

Inventory numbers: HP48; HP258
Element: Metacarpal V
Side: Right

Taxonomical determination:
The distal epiphysis of felids is prolonged distally and it is extending medially to the side, while the whole diaphysis is bending laterally. In a hyena the whole body is also bending laterally but the distal epiphysis is following the direction of the bending.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP47	75,2	10,9	16,8	18,1
HP48	75,8	11,6	16,8	18
HP258	~77,8	~12,8	~19,1	~19,8

Table 17. Measurements of *Crocuta crocuta spelaea* metacarpal V: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Coxa

Inventory number: HP62
Element: Ischium

Taxonomical determination:
Only small part of the ischium is present. It is determined as belonging to a hyena because a groove extending from the acetabulum towards ischium is deeper in felids than it is in a hyena and HP62.

Femur

Inventory numbers: HP63; HP347 (Plate VII,Fig.17&18)
Portion: Proximal epiphysis and diaphysis
Side: Left

Inventory number: HP346
Portion: Distal epiphysis and diaphysis
Side: Right

Inventory number: HP 65
Portion: Distal epiphysis (condyles)
Side: Right

Inventory number: HP64 (Plate VII, Fig.19)
Portion: Distal epiphysis and diaphysis
Side: Left

Taxonomical determination:

Trochanter minor in felids is more distaly separated from *fossa trochanterica* than in a hyena. Also, in felids the *crista intertrochanterica* is more pronounced than in a hyena and on the medial side in felids there is a small *trochanter tertius*, while in a hyena it is almost absent (HP63, HP346, HP347). On the distal epiphysis, *fossa intercondylaris* is deeper than in a hyena (HP64, HP65).

(1)IN	(2) Portion	(3)M1	(4)M2	(5)M3	(6)M4	(7)M5	(8)M6
HP63	proximal end +diaphysis	-	53,3*	31,8*	~29,1	20,4	-
HP64	distal end (epiph+shaft)	-	-	-	-	-	53,1
HP65	distal epipysis (only condyles present)	-	-	-	-	-	~52
HP346	-	214,2	53,1*	~34*	26,2	21,8	40,9
HP347	proximal end +diaphysis	-	61,4*	29	29,9	25,9**	-

Table 18. Measurements of *Crocuta crocuta spelaea* femur: (3)M1 – Greatest length; (4)M2 – Greatest breadth of proximal end; (5)M3 – Greatest breadth of the region of the *Trochanter tertius*; (6)M4 – Depth of the *Caput femoris*; (7)M5 – Smallest breadth of diaphysis; (8)M6 – Greatest breadth of the distal end

Tibia

Inventory number: HP66

Inventory numbers: HP67; HP348 (Plate VII, Fig.20)

Portion: Complete
Side: Left

Portion: Complete
Side: Right

Inventory number: HP68
Portion: Distal epiphysis and diaphysis
Side: Left

Taxonomical determination:

In the body of the tibia the caudal surface of felids has a strong *linea musculi poplitei* and sharp lateral and medial edges. Hyena on the other side does not have that (HP66, HP67, HP68, HP348). On *coclea tibiae*, in felids the medial groove is deeper than in a hyena and therefore the cranial, medial part of the epiphysis of felids is prolongued downwards while in a hyena it is not (HP66, HP68, HP67).

(1)IN	(2) Portion	(3)M1	(4)M2	(5)M3	(6)M4	(7)M5
HP66	-	203,2	56,2	22	41,2	27,1
HP67	-	~182,8	~49,1	17,1	~44,1	~30,1
HP68	distal end (epiph+shaft)	-	-	18,1	39,2	27,3
HP348	-	191,7	47,1*	21,2	36,1*	25,2*

Table 19. Measurements of *Crocuta crocuta spelaea* tibia: (3)M1 – Greatest length; (4)M2 – Greatest breadth of the proximal end; (5)M3 – Smallest breadth of the diaphysis; (6)M4 – Greatest breadth of the distal end; (7)M5 – Greatest depth of the distal end

Calcaneus

Inventory numbers: HP69; HP70
Portion: Complete
Side: Left

Taxonomical determination:

The calcaneus of a hyena and felids are morphologically very similar. *Tuber calcanei* of felids is laterally more inclined than in a hyena. Moreover, the articular surface on *sustentaculum tali* in felids is connected to the articular surface on *tuber calcanei*, while in a hyena it is not.

(1)IN	(2)M1	(3)M2
HP69	66	26,8
HP70	64,9	27,8

Table 20. Measurements of *Crocuta crocuta spelaea* calcaneus: (2)M1 – Greatest length; (3)M2 – Greatest breadth

Navicular (tarsi centrale)

Inventory number: HP71
Portion: Complete
Side: Right

Taxonomical determination:
In felids, medio-distaly there is a high bulge facing upwards. In a hyena the bulge is not as high. In felids the navicular is cranio-caudaly prolonged. In a hyena it has a squarer shape.

(1)IN	(2)M1
HP71	29,2

Table 21. Measurements of *Crocuta crocuta spelaea* navicular: (2)M1 – Greatest breadth

Metatarsals

Inventory number: HP256
Element: Metatarsal II
Side: Right

Inventory number: HP255
Element: Metatarsal II
Side: Right

Taxonomical determination:
In felids, the proximal epiphysis is caudally very elongated while in a hyena it is not. Also, in felids medially on the proximal part of the diaphysis there is a protuberance which hyena does not have. Furthermore, the distal epiphysis of felids is elongated downwards and in a hyena it is not.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP256	74,4	10,9	15,7	11,8

Table 22. Measurements of *Crocuta crocuta spelaea* metatarsal II: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Inventory number: HP72
Element: Metatarsal III
Side: Right

Taxonomical determination:

Proximal articular surface in a hyena has a small inclination but in felids this inclination is much bigger. When viewed from the posterior side, the proximal articular surface of felids is medio-laterally elongated, while in a hyena it is not elongated.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP72	82,1	12,6	17,1	14,7
HP255	~77,2	~14,9	-	~16,3

Table 23. Measurements of *Crocuta crocuta spelaea* metatarsal III: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Inventory number: HP73
Element: Metatarsal V
Side: Left

Taxonomical determination:

In the proximal epiphysis the difference is that in felids the cranial part is elevated and in a hyena it is not. The whole body of the metatarsus of the hyena is bended and in felids it is straight.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP73	69,8	6,2	11*	10,5

Table 24. Measurements of *Crocuta crocuta spelaea* metatarsal V: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

Inventory number: HP306

Element: Metapodial

Side: IN

Taxonomical determination:

HP306 is completely covered with $CaCO_3$ and therefore it was impossible to say if it is a metacarpal or a metatarsal. However, the shape and the size of the bone entirely resembles a metapodial of a hyena.

Phalanges

Inventory numbers: HP54; HP55; HP56 (Plate VI, Fig.15)

Element: Phalanx I

Taxonomical determination:

Proximal articular surface of felids has a deep groove, while a hyena does not have one. The shape of the proximal epiphysis also differs. Felids have a crescent shape and hyena a squared shape.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP54	33	13,3	11,2	13,2
HP55	31	13,6	11,1	13,2
HP56	31,2	14*	9,8	12,9*

Table 25. Measurements of *Crocuta crocuta spelaea* phalanx I: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth of diaphysis; (5)M4 – Greatest breadth of distal end

Inventory numbers: HP57; HP58 (Plate VI, Fig.16); HP59; HP60; HP61

Element: Phalanx II

Taxonomical determination:

In felids the length of the phalanx is much greater than the breadth, while in a hyena the difference between the length and breadth of the phalanx is much smaller. Also, the distal epiphysis of felids is bending laterally and in a hyena it is not.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP57	18,1	14,2	9,9	13,9
HP58	18,5	12,8*	6,5	11,2*
HP59	19,1	14,3	9,1	13
HP60	17,2	13,9	10,1	12,3
HP61	18,2	14,5	10,1	13,6

Table 26. Measurements of *Crocuta crocuta spelaea* phalanx II: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth of diaphysis; (5)M4 – Greatest breadth of distal end

Inventory number: HP74

Element: Phalanx III

Taxonomical determination:

There is a difference in size between hyena and felids 3rd phalanges, but also the proximal epiphysis of a hyena has a squared shape, whereas in felids it has a rectangular shape.

4.1.7.2. ***Lynx lynx***

Suborder: Feliformia Kretzoi 1945
Family: Felidae G. Fischer de Waldheim 1817
Genus: *Lynx* Kerr 1792
Species: *Lynx lynx* Linnaeus 1758

The ancestor of the Eurasian lynx (*Lynx lynx)* is probably the Issoire lynx (*Lynx issiodorensis)* (Kurtén, 1968) which was larger than *Lynx lynx*. According to Ficcarelli & Torre (1975), the earliest find of Eurasian lynx come from the end of the Middle Pleistocene. This species of *Lynx* is still present today, although in Europe their numbers are drastically reduced. They are solitary animals whose habitats are all types of forests.

Calcaneus

Inventory number: HP253
Portion: Complete
Side: Right

Taxonomical determination:
The body of calcaneus of a lion and a hyena is anterio-posteriorly flattened. In HP253, just like in the lynx, it is latero-medially flattened instead.

(1)IN	(2)M1	(3)M2
HP253	~63,5	23

Table 27. Measurements of *Lynx lynx* calcaneus: (2)M1 – Greatest length; (3)M2 – Greatest breadth

4.1.7.3. *Panthera leo spelaea*

Suborder: Feliformia Kretzoi 1945
Family: Felidae G. Fischer de Waldheim 1817
Genus: *Panthera* Oken 1816
Species: *Panthera leo* Linnaeus 1758
Subspecies: *Panthera leo spelaea* Goldfuss 1810

The first lion in Europe (*Panthera leo fossilis*) appeared in the early Middle Pleistocene 600,000 years ago in Atapuerca (Garcia Garcia, 2001; Sala, 1990; Schutt, 1969; Schutt & Hemmer, 1978), while the last fossil remains of a cave lion (*Panthera leo spelaea*) were found in Zigeuenerfels, Germany and were dated to 12,375±50 BP (Stuart and Lister, 2007). Today the lions are found only in some parts of Africa and India.

Phylogenetic analysis has revealed that during the Upper Pleistocene there were three distinct populations of lions in the world: modern lions (*Panthera leo*), cave lions (*Panthera leo spelaea*) and American lions (*Pantera lea atrix*) (Barnett, 2009). The cave lion was spead throughout Eurasia across Beringia, Alaska and western Canada.

Although it was shown that modern lion and Pleistocene cave lions are highly distinct from each other (Burger et al., 2004), the status of these groups as species or subspecies is still unclear. Some authors claim that they should be taxonomically separated at a species level into *Panthera leo* and *Panthera spelaea* (e.g. Baryshnikov and Boeskorov, 2001; Sotnikova, 2006). Most authors support taxonomical separtion at a subspecies level within the species *Panthera leo* (e.g. Kurtén, 1968; Burger et al, 2004) and this is the view that is adopted in this work as well.

Teeth

Inventory number: HP109 (Plate IX, Fig.25); HP341 (Plate IX, Fig.26)
Element: Isolated teeth

Taxonomical determination:
HP341 has a very large and thick root indicating it belongs to a big carnivore with a strong lower jaw. The specimen was compared with the lower canines of *Ursus arctos* and *Panthera*

leo spelaea from Velika pećina. Although the tip of the tooth is missing it was possible to determine that the tooth belongs to a cave lion because the tooth is not making an „S“ shape, unlike the tooth of *Ursus arctos*.

(1)IN	(2)Tooth	(3) M1	(4) M2	(5) M5
HP109	left P_2	-	10,1	15
HP341	right C_1	20,2	14,1	22,3*

Table 28. Measurements of *Panthera leo spelaea* tooth: (3) M1 – Length at crown-root junction; (4) M2 – Greatest breadth at crown-root junction; (4) M5 – Greatest height – measured from buccal side (from crow-root junction til the tip of the crown)

Vertebrae

Inventory number: HP31
Element: Lumbar vertebrae

Taxonomical determination:
HP31 is a 12th or a 13th thoracic vertebrae and it belongs to a lion because the whole vertebrae is much bigger than the hyena vertebrae and the length of the vertebrae body is much larger than the hegight, while in hyena this difference is smaller.

(1)IN	(2)M1	(3)M5	(4) M6	(5) M7	(6) M8	(7) M9	(8) M10
HP31	39,3	54,8*	37,9	43,3	29,8	30,7	56,6*

Table 29. Measurements of *Panthera leo spelaea* lumbar vertebrae: (2) M1 – Physiological length of the body; (3) M5 – Greatest breadth across the *Processus transversi*; (4) M6 – Greatest breadth of cranial articular surface ; (5) M7 – Greatest breadth of caudal articular surface; (6) M8 – Greatest height of cranial articular surface; (7) M9 – Greatest height of caudal articular surface; (8) M10 – Greatest height

Metatarsals

Inventory number: HP110
Element: Metatarsus III
Side: Left

Taxonomical determination:

The 3rd metatasus of a cave lion is much bigger than the 3rd metatarsus of a hyena. Furthermore, the proximal articular surface in a lion has a sharper inclination than the proximal epiphysis of a hyena. The proximal articular surface of a lion is medio-laterally elongated, while in a hyena it is not elongated at all.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP110	132,7	17,9	23,8	24,6

Table 30. Measurements of *Panthera leo spelaea* metatarsus III: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end

4.1.7.4. *Canis lupus*

Suborder: Caniformia Kretzoi 1943
Family: Canidae G. Fischer de Waldheim 1817
Genus: *Canis* Linnaeus 1758
Species: *Canis lupus* Linnaeus 1758

The first species of the genus Canis sp. arose in the late Miocene of North America (Nowak, 2003). The first wolves appeared during the Pliocene and early Pleistocene. These Canids were small and they inhabited North America and Eurasia. One branch entered South America where they began their separate evolution (Kurtén, 1968). The most probable ancestor of the later wolf is *Canis lepophagus* which spread from North America to Eurasia (Nowak, 2003).

The grey wolf (*Canis lupus*) appeared in the Middle Pleistocene and was common in Upper Pleistocene as well as today. In the past it was spread all over the northern hemisphere but it disappeared from most parts of Western Europe, Mexico and the USA. Today it is distributed in wilderness and remote areas of Canada, Alaska, northern USA, Europe and Asia (Mech & Boitani, 2004).

Teeth

Inventory numbers: HP96.1; HP96.2; HP96.3; HP96.4; HP96.5

(1)IN	(2)Tooth	(3) M1	(4) M2	(5) M5
HP96.1	left M_2	9,2	7,9	6,8
HP96.2	left M_1	25,3	11	15
HP96.3	left P_4	13,2	6,9	8,8
HP96.4	left P_3	11,1	5,9	7,2
HP96.5	left P_2	10,7	5,2	7

Table 31. Measurements of *Canis lupus* teeth: (3) M1 – Length at crown-root junction; (4) M2 – Greatest breadth at crown-root junction; (5) M5 – Greatest height – measured from buccal side (from crow-root junction til the tip of the crown)

Mandible with teeth

Inventory number: HP96

Portion: Almost complete

Side: Left

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7	(9)M8	(10)M9	(11)M10	(12)M11	(13)M12
HP96	168,3*	148,8	138,4	146,9	98,3	91,9	86,6	43	47,9	41,3	24,8	30,9

(14)M13	(15)M14	(16)M15	(17)M16	(18) M17	(19) M18
65,1	29,9	23,4	203,856	202,064	2621,1

Table 32. Measurements of *Canis lupus* madible: (2) M1 – Total length; (3) M2 – Length: the condyle process – aboral border of the canine alveolus; (4) M3 – Length from the indentation between the condyle process and the angular process – aboral border of the canine alveolus; (5) M4 – Length: the angular process – aboral border of the canine alveolus; (6) M5 – Length: the aboral border of the alveolus of M_3 – aboral border of the canine alveolus; (7) M6 – Length of the cheektooth row, M_3 – P_1, measured along the alveoli; (8) M7 - Length of the cheektooth row, M_3 – P_2, measured along the alveoli; (9) M8 – Length of the molar row, measured along the alveoli; (10) M9 – Length of the premolar row, P_1 –P_4, measured along the alveoli; (11) M10 - Length of the premolar row, P_2 –P_4, measured along the alveoli; (12) M11 – Length of the carnassial alveolus; (13) M12 – Greatest thickness of the body of jaw (below M_1); (14) M13 – Height of the vertical ramus: basal point of the angular process – *Coronion*; (15) M14 – Height of the mandible behind M1, measured on the lingual side and at the right angles to the basal border; (16) M15 – Height of the mandible between P2 and P3, measured on the lingulal side and at right angles to the basal border; (17) M16 – Calculation of the basal length: measurement no. 3 multiplied by 1.37; (18) M17 - Calculation of the basal length: measurement no. 4 multiplied by 1.46; (19) M18 - Calculation of the basal length: measurement no. 7 multiplied by 2.9, minus 44 mm

Vertebrae

Inventory number: HP97

Element: Axis

Taxonomical determination:

Vertebrae body of a fox is latero-medially compressed and more narrow than the vertebrae body of HP97 and the wolf. *Processus articulares craniales* is larger in *Canis lupus* than in a hyena and there is a slight difference in shape.

(1)IN	(2)Element	(3)M6
HP97	axis	33,1

Table 33. Measurements of *Canis lupus* cervical and thoracic vertebrae: (3) M6 – Greatest breadth of cranial articular surface

Inventory numbers: HP98; HP186; HP368; HP369

Element: Cervical vertebrae

Taxonomical determination:

HP98 is a cervical vertebrae because *processus transversus* is divided in a ventral and dorsal part and it has *foramen transversarium*. The body of the vertebrae HP98 is shorter than the vertebrae body of the 3rd and 4th cervical vertebrae. The ventral part of *processus transversus* is much larger in the 6th vertebrae than it is in HP98. Therefore, HP98 can only be the 5th vertebrae. The 5th vertebrae of *Vulpes vulpes* is much smaller. *Panthera pardus* has a shorter vertebrae body which is medio-laterally elongated. HP98, like a wolf, has the ventral surface of the vertebrae body descending caudally downwards.

HP186 is either the 3rd or the 4th cervical vertebrae and not the 5th because the ventral surface of the vertebrae body has a sharp ridge in the middle and the 5th cervical vertebrae does not have that. *Panthera pardus* has a more broader vertebrae body than HP186 and therefore HP186 belongs to *Canis lupus*.

HP368 is the 6th cervical vertebrae and not the 5th or the 7th because the ventral part of *processus transversus* is much smaller in them. *Panthera pardus* has a more broader vertebrae body than *Canis lupus* and the proximal part of the body has a rectangular shape in *Panthera pardus and* squared shape in *Canis lupus*.

HP369 is the 7th cervical vertebrae because it does not have *foramen transversarium* like the other cervical vertebrae and it is not a thoracic vertebrae because thoracic vertebrae have more robust *processus spinosus* and *processus transversus*. The 7th cervical vertebrae of *Panthera pardus* has a more broader vertebrae body than HP369 and *Canis lupus*.

(1)IN	(2)Element	(3)M1	(4)M2	(5)M3	(6)M4	(7)M5	(8)M6	(9)M7	(10)M8	(11)M9	(12)M10
HP98	5th cervical vertebrae	24,6	37,1	37,7	35,4	-	15,8	19,5	14,5	19,7	32,8
HP186	3rd or 4th cervical vertebrae	-	-	-	-	-	-	20,9	-	16,3	-
HP368	6th cervical vertebrae	24,4	-	-	-	-	16,8	19,2	15,1	18,8	-
HP369	7th cervical vertebrae	21,3	32,7	33,9	30,3	51,8	15,2	20,8	16,3	16,7	48,9*

Table 34. Measurements of *Canis lupus* cervical vertebrae: (3) M1 – Physiological length of the body; (4) M2 – Greatest length from the *Processus articulares craniales* to the *Processus articulares caudales*; (5) M3 – Greatest breadth across *Processus articulares craniales* ; (6) M4 – Greatest breadth across the *Processus articulares caudales*; (7) M5 – Greatest breadth across the *Processus transversi*; (8) M6 – Greatest breadth of cranial articular surface; (9) M7 – Greatest breadth of caudal articular surface; (10) M8 – Greatest height of cranial articular surface; (11)M9 – Greatest height of caudal articular surface; (12)M10 – Greatest height

Inventory number: HP99
Element:6th – 9th thoracic vertebrae

Taxonomical determination:
In the 5th thoracic vertebrae *processus spinosus* is not so caudally inclined as it is in the 6th and the 10th thoracic vertebrae has a shorter *processus spinosus* than the 9th. Therefore, HP99 can be the 6th, 7th, 8th or 9th thoracic vertebrae. Caudal articular surfaces of *Panthera pardus* are orientated laterally, while in *Canis lupus* they are pointing upwards.

(1)IN	(2)Element	(3)M1	(4)M5	(5)M6	(6)M7	(7)M8	(8)M9	(9)M10
HP99	6th-9th thoracic vertebrae	20,7	37,3	18,9	22,7	14,6	16	37,2*

Table 35. Measurements of *Canis lupus* thoracic vertebrae: (3) M1 – Physiological length of the body; (4) M5 – Greatest breadth across the *Processus transversi*; (5) M6 – Greatest breadth of cranial articular surface; (6) M7 – Greatest breadth of caudal articular surface; (7) M8 – Greatest height of cranial articular surface; (8)M9 – Greatest height of caudal articular surface; (9)M10 – Greatest height

Humerus

Inventory number: HP100
Portion: Complete
Side: Right

Taxonomical determination:

In HP100 both epiphysis are fused indicating that this was an adult. The humerus of a hyena is more robust than a humerus of a wolf. Also, the distal epiphysis of *Crocuta crocuta* and *Panthera pardus* is wider than the one of a *Canis lupus*. *Fossa olecrani* of a wolf has a „U“ shape, while in hyena it is much wider. *Panthera pardus* has a shaper *crista supracondylaris laterilis* than a wolf.

(1)IN	(2) M1	(3) M2	(4) M3	(5) M5	(6) M6	(7) M7
HP100	197,7	194,6	191,7	14,6	32,2	24,8

Table 36. Measurements of *Canis lupus* humerus: (2) M1 – Greatest length; (3) M2 – Greatest length of the lateral part; (4) M3 – Greatest length from caput; (5) M5 – Smallest breadth of diaphysis; (6) M6 – Greatest breadth of distal end; (7) M7 – Greatest breadth of trochlea

Metacarpals

Inventory number: HP259
Element: Metacarpal II
Portion: Proximal epiphysis and shaft
Side: Right

Taxonomical determination:

Proximal epiphysis has a shape of a triangle and on the lateral side of the proximal epiphysis there is an articular surface – *facies articularis intermetacarpea*. The diaphysis is slightly bended.

(1)#	(2)Portion	(3)M1	(4)M2	(5)M3
HP259	proximal epiphysis+shaft	53,8	9,1	7,8

Table 37. Measurements of *Canis lupus* metacarpal II: (3)M1 – Greatest length; (4)M2 – Greatest breadth of proximal end; (5)M3 – Smallest breadth of diaphysis

Femur

Inventory number: HP252 (Plate X, Fig.27)
Portion: Complete
Side: Left

Taxonomical determination:

The diaphysis of *Panthera pardus* is straight, while in HP252, just like in *Crocuta crocuta* and *Canis lupus*, it is a bit curved making an arch. Although HP252 is completely covered with $CaCO_3$ it was still possible to determine which species it belongs to. On HP252 caudaly under the proximal epiphysis is *trochanter minor* which is positioned medialy and connected to *linea intertrochanterica*, just like in a wolf. In a hyena, on the other hand, *trochanter minor* is positioned more in the middle of the shaft.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6
HP252	~226,3	~46,8	~27,8	~24,1	~15,9	~56,6

Table 38. Measurements of *Canis lupus* femur: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Greatest breadth of the region of the *Trochanter tertius*; (5)M4 – Depth of the *Caput femoris*; (6)M5 – Smallest breadth of diaphysis; (7)M6 – Greatest breadth of the distal end

Tibia

Inventory number: HP101
Portion: Proximal epiphysis and diaphysis
Side: Left

Inventory number: HP102 (Plate X, Fig.28)
Portion: Distal epiphysis and diaphysis
Side: Left

Taxonomical determination:

The diaphysis of *Panthera pardus* is flattened medio-laterally and on the caudal side it has pronounced edges and *linea musculi poplitei*. HP101 and HP102 do not have that and the diaphysis is not flattened and therefore *Panthera pardus* can be eliminated. *Margo cranialis* of *Crocuta crocuta* is streching over half of the diaphysis, while in *Canis lupus* it is present only in the proximal part of the diaphysis. Moreover, when looked at from the medial or lateral side, *margo cranialis* in a hyena is making a bigger curve than it is in a wolf.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5
HP101	90,1	-	14,9	-	-
HP102	96	-	14,9	26,2	19,1

Table 39. Measurements of *Canis lupus* tibia: (2)M1 – Greatest length; (3)M2 – Greatest breadth of the proximal end; (4)M3 – Smallest breadth of the diaphysis; (5)M4 – Greatest breadth of the distal end; (6)M5 – Greatest depth of the distal end

Metatarsals

Inventory number: HP370
Element: Metatarsal II
Side: Left

Taxonomical determination:

The diaphysis is slightly bended with the epiphysis going to the medial side. Cranially, in the middle part, diaphysis is forming an edge. On the distal epiphysis the lateral side is more elongated than the medial side.

(1)IN	(2)Portion	(3)M1	(4)M2	(5)M3
HP370	Distal epiphysis+diaphysis	53,2	8,1	11,6

Table 40. Measurements of *Canis lupus* metacarpal: (3)M1 – Greatest length; (4)M2 – Smallest breadth of the diaphysis; (5)M3 – Greatest breadth of the distal end

4.1.7.5. ***Vulpes/Alopex***

Suborder: Caniformia Kretzoi 1943
Family: Canidae G. Fischer de Waldheim 1817
Genus: *Vulpes* Frisch 1775
Species: *Vulpes vulpes* Linnaeus 1758

The red fox (*Vulpes vulpes*) originated in Eurasia. It probably arose from the Middle Villafranchian *Vulpes alopecoides* (Kurtén, 1968). The modern red fox became widespread during the Middle Pleistocene. Its current distribution ranges through North America, Eurasia, north Africa and it was introduced to Australia (Larivière & Pasitschniak-Arts, 1996).

Suborder: Caniformia Kretzoi 1943
Family: Canidae G. Fischer de Waldheim 1817
Genus: *Alopex* Kaup 1829
Species: *Alopex lagopus* Linnaeus 1758

The arctic fox (*Alopex lagopus*), just like the red fox, probably arose from the Middle Pleistocene *Vulpes alopecoides* (Kurtén, 1968). During the Upper Pleistocene it was common all over Europe down to Spain. Today, it is restricted to circumpolar and tundra regions (Audet et al., 2002). It is a bit smaller than *Vulpes vulpes* and it differs in the number of dental traits due to its mainly carnivorous diet (Kurtén, 1968).

The five bones that are described here are all classified as *Vulpes/Alopex* because all of them are not complete and not all measurements could be taken and therefore they could not be compared with the measurements of *Vulpes vulpes* and *Alopex lagopus* from the literature (eg. with Poplin, 1976).

Vertebrae

Inventory number: HP103
Element: 1st-5th lumbar vertebrae

Taxonomical determination:

HP103 is not a thoracic vertebrae because it does not have *processus transversus* and it is not the sixth lumbar vertebrae because the *processus spinosus* is longer than in the sixth vertebrae. HP103 belongs to a fox because the whole vertebrae body is cranio-caudally elongated and latero-medially compressed.

(1)IN	(2)Element	(2) M1	(3) M6	(4) M7	(5) M8	(6)M9	(7)M10
HP103	1th-5th lumbar vertebrae	23,7	15,1	15,3	9,4	9,3	25,3*

Table 41. Measurements of *Vulpes/Alopex* lumbar vertebrae: (2) M1 – Physiological length of the body; (3) M6 – Greatest breadth of cranial articular surface ; (4) M7 – Greatest breadth of caudal articular surface; (5) M8 – Greatest height of cranial articular surface; (6)M9 – Greatest height of caudal articular surface; (7)M10 – Greatest height

Humerus

Inventory number: HP104

Portion: Distal epiphysis and diaphysis

Side: Left

Taxonomical determination:

The distal epiphysis of HP104 is completly fused indicating that this is an adult individual. The distal epiphysis of a fox and a wolf are morphologically the same but the humerus of a wolf is much bigger in size than the humerus of a fox.

(1)IN	(2) M1	(3) M5	(4) M6	(5) M7
HP104	55,8	9,1	18,6	8,2*

Table 42. Measurements of *Vulpes/Alopex* humerus: (2) M1 – Greatest length; (3) M5 – Smallest breadth of diaphysis; (4) M6 – Greatest breadth of distal end; (5) M7 – Greatest breadth of trochlea

Radius

Inventory number: HP105

Portion: Distal epiphysis

Side: Right

Inventory number: HP106

Portion: Proximal epiphysis and diaphysis

Side: Right

Taxonomical determination:

HP105 and HP106 could be a part of the same bone, although this could not be determined because a big part of the diaphysis is missing. Under the *collum radii* (HP106) on the lateral side there is a bulge, *fovea capitis* is shallow and on the *collum radii* on the cranial side there is a dent. On the distal epiphysis (HP105) on the cranial surface there are grooves for the passage of tendons. Also, the medial side of the distal epiphysis is elongated downwards and the *articulati radioulnaris distalis* can be seen.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP105	27,8	-	-	12,5
HP106	58,6	12,3	8,9	-

Table 43. Measurements of *Vulpes/Alopex* radius: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth od diaphysis; (5)M4 – Greatest breadth of distal end

Ulna

Inventory number: HP107

Portion: Proximal epiphysis and diaphysis

Side: Right

Taxonomical determination:

Processus coronoideus lateralis is very small and underneath it there is a small bulge. *Processus coronoideus medialis*, on the other hand, is larger. *Incisura radialis* is shallow. On the diaphysis, on the lateral side, *margo interosseus* is well pronounced. All these features indicate that HP107 belongs to a fox.

(1)IN	(2)M1	(3)M5
HP107	84,1	10,3*

Table 44. Measurements of *Vulpes/Alopex* ulna: (2)M1 – Greatest length; (3)M5 – Greatest breadth across the coronoid process

4.1.7.6. *Meles meles*

Suborder: Caniformia Kretzoi 1943
Family: Mustelidae G. Fischer de Waldheim 1817
Genus*:* *Meles* Brisson 1762
Species: *Meles meles* Linnaeus 1758

The European badger (*Meles meles*) is present in Europe since the early Middle Pleistocene (Kurtén, 1968). Its predecessor is the Thoral's badger (*Meles thorali*) that appeared during the Early Pleistocene and whose form is very close to the form of the modern badger (Kurtén, 1968). Today, the European badger inhabits the area west of the Volga river, while the Asian badger (*Meles leucurus*) inhabits the area to the east (Kranz et al, 2008).

Cranium

Inventory number: HP75 (Plate VII, Fig.21)
Portion: Parietal and parts of temporal, frontal and occipital

Taxonomical determination:
HP75, just like *Meles meles*, has a more pronounced sagittal crest than *Vulpes vulpes*. On the other hand, it does not have a dome-like profile like a hyena and the parietal bones are not going straigh down from the crest but are making an angle with the crest.

Mandible with teeth

Inventory numbers: HP76 (Plate VII, Fig.22); HP77
Side: Right

Taxonomical determination:
Both mandibles belong to badgers because they both have an enlarged and flattened first molar with multiple cusps which is typical for badgers.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP76	77,8	~23,3	16,8	7,1
HP77	55,9	~24,5	16,2	6,1

Table 45. Measurements of *Meles meles* mandible: (2)M1 – Total length; (3)M2 – Length from mesial part of M2 til distal part of M3; (4)M3 – Height of the mandible behind M2 (measured on lingual side); (5)M4 – Greatest thickness of the body of the jaw (below M2)

Teeth

Inventory numbers: HP76.1; HP77.1; HP78

Taxonomical determination:

Size and morphology of all the three teeth point to *Meles meles*. The first molars are enlarged, flattened and contain several cusps. The canine has flatter part on the lingual side and a more rounded part on the buccal side.

(1)IN	(2)Tooth	(3)M1	(4)M2	(5)M3	(6)M4	(7)M5
HP76.1	right M_1	15,9	6,9	0,9	1,1	2,2
HP77.1	right M_1	18,4	8,5	4,3	4,1	6,1
HP78	right C^1	5,9	-	-	-	13,7

Table 46. Measurements of *Meles meles* teeth: (3) M1 – Length at crown-root junction; (4) M2 – Greatest breadth at crown-root junction; (5) M3 – Height on mesial – measured from buccal side; (6) M4 – Height m-d or distal – measured from buccal side; (7) M5 – Greatest height – measured from buccal side (from crow-root junction til the tip of the crown)

Humerus

Inventory number: HP79 (Plate IX, Fig.23)
Portion: Diaphysis
Side: Left

Taxonomical determination:

Proximal and distal epiphysis are not fused and are missing, indicating that this was a young individual. Proximal part of the diaphysis has a sharp edge which is descending on the lateral side towards the middle cranial part of the diaphysis. Distal part of the diaphysis has a rim on the lateral side which is descending from the middle part on the caudal side.towards lateral side where it is expanding until the distal epiphysis. Medially, upper edge of *foramen supratrochleare* can be seen.

(1)IN	(2)M1	(3)M4	(4)M5
HP79	81,4	26*	9,1

Table 47. Measurements of *Meles meles* humerus: (2) M1 – Greatest length; (3) M4 – Greatest breadth of the proximal end; (4) M5 – Smallest breadth of diaphysis

Ulna

Inventory number: HP80
Portion: Proximal epiphysis and diaphysis
Side: Left

Taxonomical determination:

Ulna of a badger is more robust than an ulna of a fox. Diaphysis is slightly bending to the medial side. *Processus coronoideus lateralis* is very small and behind it there is a concavity. *Processus coronoideus medalis* is large. The articular surfaces of these two processes are connected. The articular surface of *processus anconeus* has a crescent shape.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5
HP80	87,8	13*	18,6	21,1	13,1

Table 48. Measurements of *Meles meles* ulna: (2)M1 – Greatest length; (3)M2 – Length of the olecranon; (4)M3 – Depth across the *Processus anconaeus*; (5)M4 – Smallest depth of the olecranon; (6)M5 – Greatest breadth across the coronoid process

Tibia

Inventory number: HP81
Portion: Complete
Side: Left

Taxonomical determination:

Tibia of a badger is more robust than a tibia of a fox and the diaphysis is shorter and not as slender as the diaphysis of a fox. Caudally, on the medial side of the distal epiphysis there is a small bulge just above the epiphysis.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5
HP81	106,6	28,2	8,8	20,5	13,8

Table 49. Measurements of *Meles meles* tibia: (3)M1 – Greatest length; (4)M2 – Greatest breadth of the proximal end; (5)M3 – Smallest breadth of the diaphysis; (6)M4 – Greatest breadth of the distal end; (7)M5 – Greatest depth of the distal end

4.1.7.7. ***Ursus spelaeus***

Suborder: Caniformia Kretzoi 1943
Family: Ursidae G. Fischer de Waldheim 1817
Genus: *Ursus* Linnaeus 1758
Species: *Ursus spelaeus* Rosenmüller 1794

Figure 9. Illustration of *Ursus spelaeus* by Jakub Kowalski.

The story of the bears started in the early Miocene (Kurtén, 1968). The small and primitive *Ursus minimus* appeared in the Pliocene and all Pleistocene bears descended from it. *Ursus spelaeus* desceded from *Ursus etruscus*. *Ursus spelaeus* (Fig.9) was a large omnivorous bear whose remains are often found in caves. It was calculated that the weight was between 400 and 500 kg for the males and for the females it was between 225 and 250 kg (Christiansen, 1999). Morphologically they do not differ much from the extant *Ursus arctos* but they were larger and heavier. Diaphysial diameter of cave bear long bones is wider than the brown bears and they tend to be more robust (Viranta, 1994).

All the bear bones from Hyena cave were compared with the *Ursus spelaeus* bones from Romualdova pećina and Cerovačke pećine. Some of the bones matched the bones from the comparative material perfectly and were of the same size. Those bones were classified as *Ursus spelaeus*. Others, classified as Ursus cf. spelaeus, were smaller than the ones from the comparative collection. This could be due to sexual dimorphism between males and females or they could belong to *Ursus arctos*.

Vertebrae

Inventory numbers: HP 82 (Plate X, Fig.29); HP 83
Element: Thoracic vertebrae

Taxonomical determination:
The size of the vertebrae HP82 and HP83 point to a large carnivore. They are much bigger than the vertebrae of *Ursus arctos* but the same size as *Ursus spelaeus*. HP82 is the 6th thoracic vertebrae because it has caudal articular surfaces and the 7th thoracic vertebrae does not have them. It is not the 5th thoracic because the caudal part of the vertebrae body has a heart shape on the upper side while in the 5th it is straight.
HP83 is either the 4th, 5th or the 6th thoracic vertebrae. It can not be the 3rd thoracic vertebrae because the vertebrae body of the 3rd thoracic vertebrae is broader and it can not be the 7th thoracic vertebrae because the 7th vertebrae does not have caudal articular surfaces.

(1)IN	(2)Element	(3)M1	(5)M6	(6)M7	(7) M8	(8) M9	(9) M10
HP82	6th thoracic vertebra	37,1	48	62,6	47,6	47,9	93
HP83	4th-6th thoracic vertebra	~42,1	-	-	-	40,5	-

Table 50. Measurements of *Ursus spelaeus* thoracic vertebrae: (3) M1 – Physiological length of the body; (5) M6 – Greatest breadth of cranial articular surface ; (6) M7 – Greatest breadth of caudal articular surface; (7) M8 – Greatest height of cranial articular surface; (8) M9 – Greatest height of caudal articular surface; (9) M10 – Greatest height

Radius

Inventory number: HP 85
Portion: Proximal epiphysis and diaphysis
Side: Right

Taxonomical determination:

The proximal epiphysis is medially sloping downwards. Caudally, towards the lateral side there is a bulge under the epiphysis. The lateral side of the diaphysis has a sharp edge and the whole radius is curved medially. The radius clearly belongs to a bear but it is much smaller than the *Ursus spelaeus* radius from Romualdova pećina. Therefore, it is classified as Ursus cf. spelaeus.

(1)IN	(2)M2	(3)M3	(4)M4
HP85	~49,2	27,2	-

Table 51. Measurements of Ursus cf. spelaeus radius: (2)M2 – Greatest breadth of proximal end; (3)M3 – Smallest breadth od diaphysis; (4)M4 – Greatest breadth of distal end

Ulna

Inventory numbers: HP 354; HP 355

Portion: Proximal epiphysis and diaphysis

Side: Left

Taxonomical determination:

Incisura trochlearis has articular surfaces of *processus coronoideus medialis* and *processus anconeus* connected. *Processus anconeus* continues laterally upwards in a vertical position. *Processus coronoideus lateralis* is small and vertical. Under the *processus coronoideus medialis* there is an incisura. Both, HP345 and HP355, are much bigger than the ulna from *Ursus arctos* and the same size or even bigger than the ulna of *Ursus spelaeus* from Cerovačke pećine.

(1)IN	(2)Portion	(3)M1	(4)M2	(5)M3	(6)M5
HP354	proximal end+diaphysis	~232,7	86,1*	-	63*
HP355	proximal end+diaphysis	256,7	63,3*	60,5	52,2

Table 52. Measurements of *Ursus spelaeus* ulna: (3)M1 – Greatest length; (4)M2 – Length of the olecranon; (5)M3 – Depth across the *Processus anconaeus*; (6)M5 – Greatest breadth across the coronoid process

Femur

Inventory number: HP 89
Portion: Distal epiphysis (right condyle)
Side: Left

Taxonomical determination:

On the medial side next to the condyle there is a depression and there is another small depression right over the condyle. The shape and the size points to *Ursus spelaeus* but the fragment of the epiphysis is too small to be certain and because of that it is classified as Ursus cf. spelaeus.

Inventory numbers: HP 356 (Plate XI, Fig.30); HP 357 (Plate XI, Fig.31)
Portion: Proximal epiphysis and diaphysis
Side: Left

Taxonomical determination:

HP356 has a pronounced *trochater minor* and a long *collum ossis femoris.* On the *caput ossis femoris* there is a small hollow. HP357 on latero-caudal side of the diaphysis has a pronounced edge and a foramen. Both, HP356 and HP357 are smaller than the femur from Cerovačka and Romualdova pećina and are classified as Ursus cf. spelaeus.

(1)IN	(2)M1	(3)M2	(4)M4	(5)M5
HP356	352,3	-	~53	41,7
HP357	120,3	41,8	21,2	21,4

Table 53. Measurements of Ursus cf. spelaeus femur: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M4 – Depth of the *Caput femoris*; (5)M5 – Smallest breadth of diaphysis

Tibia

Inventory number: HP90 (Plate XI, Fig.32)	Inventory number: HP91
Portion: Distal epiphysis and diaphysis	Portion: Proximal epiphysis and diaphysis
Side: Left	Side: Right

Taxonomical determination:

HP90 has a deep incisure on the medial side of the distal epiphysis. Distal part of the diaphysis has an incisure cranially on the medial side which goes all the way to the distal epiphysis. HP91 is a part of the proximal epiphysis and a small part of diaphysis because on the epiphysis small foramens can be seen and a bulge cranially on the distal part of the diaphysis. HP90 and HP91 are the same size as the tibia from Cerovačke pećine and therefore they belong to *Ursus spelaeus*.

(1)IN	(2)M4	(3)M5
HP90	~65	31,8

Table 54. Measurements of *Ursus spelaeus* tibia: (2)M4 – Greatest breadth of the distal end; (3)M5 – Greatest depth of the distal end

Fibula

Inventory number: HP 92

Portion: Proximal epiphysis and diaphysis

Side: Left

Taxonomical determination:

While the fibula of a lion is more gracile and slender and fibula of a hyena even more so, HP 92 is more robust like a fibula of a bear. HP92 is smaller than the fibula from Romualdova pećina and is classified as Ursus cf. spelaeus.

(1)IN	(2)M1
HP92	214,9

Table 55. Measurements of Ursus cf. spelaeus fibula: (2)M1 – Greatest length

Calcaneus

Inventory number: HP 93

Portion: Complete

Side: Left

Taxonomical determination:

HP93 belongs to *Ursus spelaeus* for several reasons. First of all, the calcaneus is very robust with broadened distal part. The articular surface on *sustentaculum tali* is positioned almost vertically on the medial side. *Tuber calcanei* carries a flat articular surface on the top and another one projecting laterally and which is orientated cranially. It is much bigger than the calcaneus of *Ursus arctos*.

(1)IN	(2)M1	(3)M2
HP93	103,6	72,8

Table 56. Measurements of *Ursus spelaeus* calcaneus: (2)M1 – Greatest length; (3)M2 – Greatest breadth

Astragalus

Inventory number: HP 94

Portion: Complete

Side: Right

Taxonomical determination:

Ventrally, two articular surfaces are positioned aslope. Dorsally, there is a condyle. It is smaller than the *Ursus spelaeus* astragali from Cerovačke pećine, so it is classified as Ursus cf. spelaeus.

(1)IN	(2)M1
HP94	47,3

Table 57. Measurements of Ursus cf. spelaeus astragalus: (2)M1 – Greatest length

Metacarpal

Inventory number: HP88

Portion: Metacarpus I

Side: Left

Taxonomical determination:

HP88 is robust with a large proximal epiphysis. On the distal epiphysis, the lateral part is elongated. HP88 is larger than the *Ursus spelaeus* first metacarpus from Romualdova pećina and therefore it surely belongs to *Ursus spelaeus*.

(1)IN	(2)Element	(3)M1	(4)M2	(5)M3	(6)M4
HP88	metacarpal I	74,8	15,1	21,7	27,8

Table 58. Measurements of *Ursus spelaeus* metacarpal: (3)M1 – Greatest length; (4)M2 – Smallest breadth of the diaphysis; (5)M3 – Greatest breadth of the distal end; (6)M4 – Greatest breadth of the proximal end

Metatarsal

Inventory number: HP86
Element: Metatarsus I
Side: Right

Inventory number: HP87
Element: Metatarsus II
Side: Left

Inventory number: HP95
Element: Metatarsus I
Side: Left

Inventory number: HP262 (Plate XI, Fig.33)
Element: Metatarsus I
Side: Left

Inventory number: HP353
Element: Metatarsus III
Side: Right

Taxonomical determination:

The distal epiphysis of HP86 is pointing laterally. The proximal epiphysis is large. The diaphysis has a ridge on the lateral side. HP86 belongs to *Ursus spelaeus* and is the same size as the first metatarsus from Romualdova pećina.

HP262 is clearly a first metatarsus of a large carnivore. The shape of the diaphysis resembles the diaphysis of a bear but because the proximal epiphysis is lacking it can not be determined if it is *Ursus arctos* or *Ursus spelaeus*. Therefore, HP262 is classified as Ursus cf. spelaeus.

HP87, the second metatarsus, is longer and more slender than the first metatarsus. The proximal epiphysis has a shape of a triangle and it is a bit medially inclined. The diaphysis is bended with both epiphysis going towards the caudal side. HP87 is smaller than the second metatarsus from Romualdova pećina and is classified as Ursus cf. spelaeus.

HP353 has a flat proximal inclined medially with two articular surfaces on the lateral side. It is the same size as the third metatarsus from Romualdova pećina, although the metatarsus from Romualdova is a bit more robust. Still, HP353 was classified as *Ursus spelaeus*.

HP95 is long and robust with a large proximal epiphysis. Distal epiphysis is bended medially. HP95 is the same size as the fifth metatarsal from Romualdova pećina and it belongs to *Ursus spelaeus*.

(1)IN	(2)Element	(3)M1	(4)M2	(5)M3	(6)M4
HP86	metatarsus I	~59,2	13,5	20,2	~30,1
HP87	metatarsus II	73,3	13,1	20,2	14,3
HP95	metatarsus V	89,9	17,9	25,2	29,7
HP262	metatarsus I	43,8	14,5	10,2	12,9
HP353	metatarsus.III	78,3	16,2	22,6	16,9

Table 59. Measurements of *Ursus spelaeus* and Ursus cf. spelaeus metatarsal: (3)M1 – Greatest length; (4)M2 – Smallest breadth of the diaphysis; (5)M3 – Greatest breadth of the distal end; (6)M4 – Greatest breadth of the proximal end

4.1.8. Order Perissodactyla

4.1.8.1. Stephanorhinus cf. hemitoechus

Family: Rhinocerotidae Gray 1820

Genus: *Stephanorhinus* Kretzoi 1942

Species: *Stephanorhinus hemitoechus (*Falconer 1868)

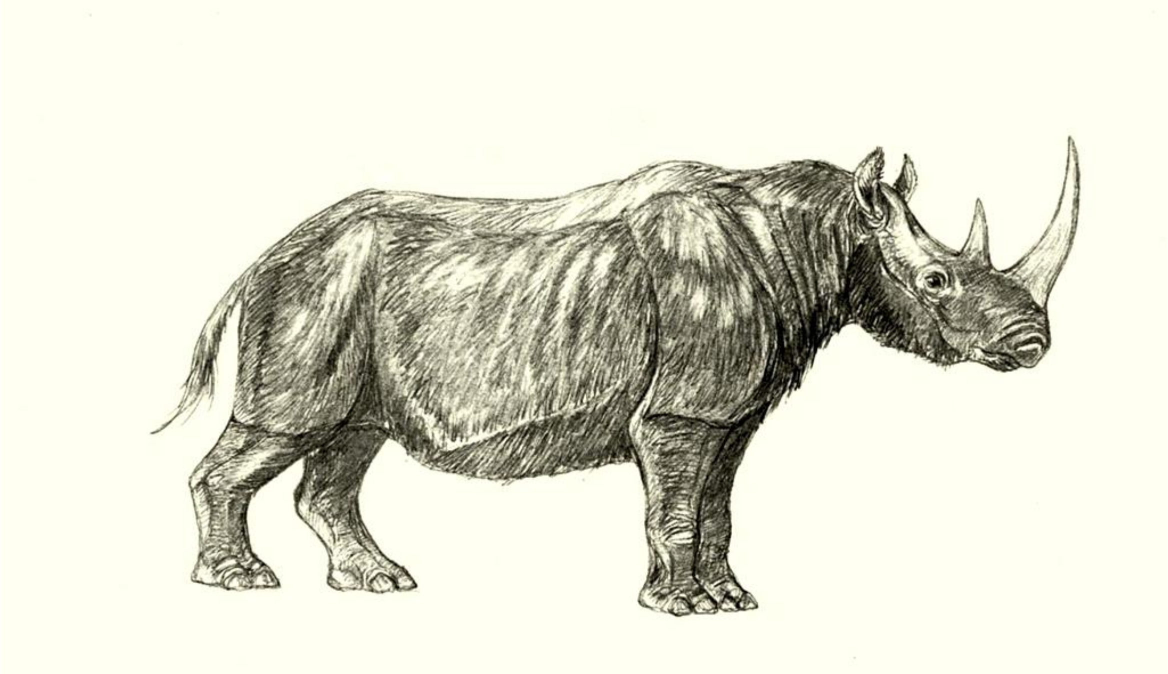


Figure 10. Illustration of *Stephanorhinus hemitoechus* by Jakub Kowalski.

During the Pliocene and Pleistocene in Europe there were five species of *Stephanorhinus*: *S. jeanvireti, S. etruscus, S. hundsheimensis*, *S. kirchbergensis* and *S. hemitoechus* (Fig.10). Guérin (1980) proposed that *S. etruscus*, which went extinct at the end of the Middle Pleistocene, was a direct ancestor of *S. hemitoechus*. However, it should not be excluded that *S. hemitoechus* might have arrived to Europe from Asia (Cerdeño, 1997). It was present in Europe during the Middle and Upper Pleistocene. *S. hemitoechus* inhabited mostly prairie-park environments and open forests feeding on branches, leaves and bushes (Guérin, 1980). There are two other species of rhinoceros living in Upper Pleistocene: *Coelodonta andtiquitatis and Stephanorhinus kirchbergensis*.

Metacarpus III

Inventory number: HP 238 (Plate XVIII, Fig.45)

Portion: Proximal epiphysis and diaphysis

Side: Right

Taxonomical determination:

To determine which out of three species (*Coelodonta andtiquitatis*, *Stephanorhinus kirchbergensis* or *Stephanorhinus hemitoechus)* this metacarpus belongs to, two measurements (Tab.61) were taken and compared with measurements from Guérin (1980) (Tab.62). Other measurements, including the measurements on the proximal epiphysis, could not be taken because the metacarpus is not complete and it is missing a part on the proximal epiphysis. After comparing the measurements of DAP dia (antero-posterior diameter of the diaphysis) and DT dia (transversal diameter of the diaphysis), it came out that the measurements of HP 238 are in the range of *Stephanorhinus hemitoechus* (Fig.8). However, if HP238 is a subadult individual, the metacarpus could belong to *Stephanorhinus kirchbergensis* and because the distal epiphysis is missing we can not be certain if this individual was a fully grown adult *Stephanorhinus hemitoechus* or a subadult *Stephanorhinus kirchbergensis*. Therefore, HP238 is classified as *Stephanorhinus cf. hemitoechus*.

(1) Species	(2)DT dia	(3) DAP dia
Coelodonta antiquitatis	66	36,5
Stephanorhinus hemitoechus	52,17	21,47
Stephanorhinus hemitoechus	42,5	19
Stephanorhinus hemitoechus	57	26,5
Stephanorhinus kicrhbergensis	61,4	23,63
Stephanorhinus kicrhbergensis	54	22
Stephanorhinus kirchbergensis	70,5	26,5

Table 60. Measurements of *Coelodonta antiquitatis*, *Stephanorhinus hemitoechus*, *Stephanorhinus kirchbergensis* metacarpal III (Guérin, 1980): (2) DT dia – transversal diameter of the diaphysis in the middle of the shaft; (3) DAP dia – antero-posterior diameter of the diaphysis in the middle of the shaft taken perpendicularly to DT dia.

(1) IN	(2)DT dia	(3) DAP dia
HP238	51	19,4

Table 61. Measurements of Stephanorhinus cf. hemitoechus metacarpal III: (2) DT dia – transversal diameter of the diaphysis in the middle of the shaft; (3) DAP dia – antero-posterior diameter of the diaphysis in the middle of the shaft taken perpendicularly to DT dia.

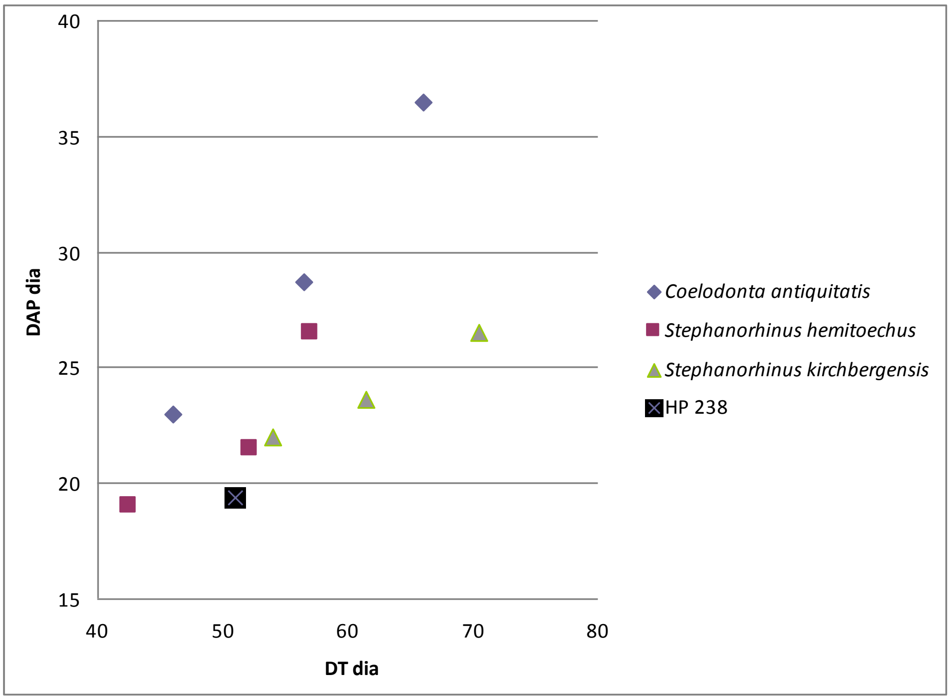


Figure 11. DAP dia and DT dia measurements of HP238 compared with the minimum, maximum and mean DAP dia and DT dia measurements of *Coelodonta antiquitatis*, *Stephanorhinus hemitoechus* and *Stephanorhinus kirchbergensis* as presented in Guérin (1980).

4.1.8.2. *Equus ferus*

Family: Equidae Gray 1821
Genus: *Equus* Linnaeus 1758
Species: *Equus ferus* Boddaert 1785

The history of the horse is one of the most famous textbook examples of evolution in paleontology. The first horse, *Hyracotherium*; from the Eocene period was a browser with small molars and had four toes in the front and three in the back. His successor *Mesohippus* from the Oligocene had three toes and *Pliohippus* from the Pliocene had one. The evolution of the horse was not only characterized by the redution in the number of toes, but also by the increasing size of the horses and deepening of the molars which means that horses went from being browsers to being grazers (Benton, 2005).

According to Eisenmann (2006) the first modern representative of the genus *Equus* emerged about 2,3 Ma. Species *Equus ferus* arrived in Europe during the Middle Pleistocene. Its ancestors are probably the early forms of *Equus* from central Asia (Azzaroli, 1983).

During the last few decades there has been much confusion about the systematics of caballine horses. The International Commission on Zoological Nomenclature (ICZN, 2003) proposed that the name *Equus caballus* should be used for domestic horses, while the term *Equus ferus* should be used for wild horses.

Teeth

Inventory numbers: HP138; HP139; HP140; HP141; HP142; HP143; HP144; HP145; HP146 HP147; HP148; HP149; HP150; HP151; HP152; HP153; HP154; HP155 HP156; HP157

(1)IN	(2)Tooth	(3) M1	(4) M2	(5) M5
HP138	right P^3-M^2	27	27,2	72,8
HP139	P_2-M_3	37,3	17,8	~83,7
HP140	left P^3-M^2	30,8	23,8	28,9
HP141	P^2-M^3	24	25,2	69,1
HP142	left P^2	35,5	26,1	74,8
HP143	right P_3-M_2	27,7	20,3	7,1
HP144	left P_3-M_2	28,1	18,8	95,3
HP145	right $P^{3-}M^2$	30,5	23,2	61
HP146	right P^3-M^2	29	23,2	76,1
HP147	right P^3-M^2	30,1	25,7	78,2
HP148	right P^3-M^2	33,1	28	69,2
HP149	right M_3	32	13,4	77,2
HP150	left I3	18,6	13	66,3
HP151	P^2-M^3	23,8	18,1	47,6
HP152	left P^3-M^2	19,1	23,8	65,7
HP153	I1-I3	11,8	15,6	59,9
HP154	left P^3-M^2	34,2	22,3	35,1
HP155	left I1-I3	15,2	12,4	63,2
HP156	I1-I3	12,4	14,4	55,2
HP157	I1-I3	15,9	14,1	50,8

Table 62. Measurements of *Equus ferus* teeth: (3) M1 – Greatest length ; (4) M2 – Greatest breadth ; (5) M5 – Greatest height

Radius

Inventory number: HP350
Portion: Proximal epiphysis
Side: Right

Taxonomical determination:

The medial tuberosity in HP350, just like in horses, is vaulted. Also, the proximal epiphysis is long and narrow.

(1)IN	(2)M1	(3)M2	(4)M3
HP350	260,2	95,1	47,3

Table 63. Measurements of *Equus ferus* radius: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth od diaphysis

Metacarpal

Inventory number: HP159 (Plate XVII, Fig.44)
Element: Metacarpus III
Portion: Proximal epiphysis and diaphysis
Side: Left

Taxonomical determination:

The proximal epiphysis of the horse has two identations, one on medial and one on lateral side, for the insertion of metacrpus II and metacarpus IV.

(1)IN	(2)Element	(3)M1	(4)M2	(5)M4	(6)M5	(7)M6	(8)M7
HP159	metacarpus III	241,3	42,9	59,1	33,8	114,1	30,4

Table 64. Measurements of *Equus ferus* metacarpus III: (3)M1 – Greatest length; (4)M2 – Smallest breadth of the diaphysis; (5)M4 – Greatest breadth of the proximal end; (6)M5 – Greatest depth of the proximal end; (7)M6 – Smallest circumference of the diaphysis; (8)M7 – Smallest depth of the diaphysis

Inventory number: HP160
Element: Metacarpus II/IV

Inventory number: HP161
Element: Metacarpus II/IV

Taxonomical determination:

On the proximal epiphysis there is an articular surface. The diaphysis is flattened and it is thinning distally.

(1)IN	(2)Element	(3)M1	(4)M4
HP160	metacarpus II/IV	~131,1	~36,7
HP161	metacarpus II/IV	83,7	21,8

Table 65. Measurements of *Equus ferus* metacarpus II/IV: (3)M1 – Greatest length; (4)M4 – Greatest breadth of the proximal end

Tibia

Inventory number: HP165
Portion: Distal epiphysis and diaphysis
Side: Right

Taxonomical determination:

The *malleolus medialis* is very pronounced in Artiodactyls but in in horse it is not. On the distal epiphysis, the articular surface is inclined.

(1)IN	(2)M1	(3)M3	(4)M4	(5)M5
HP165	233	52,4	74,1	53,7

Table 66. Measurements of *Equus ferus* tibia: (2)M1 – Greatest length; (3)M3 – Smallest breadth of the diaphysis; (4)M4 – Greatest breadth of the distal end; (5)M5 – Greatest depth of the distal end

Astragalus

Inventory number: HP163
Side: Left

Taxonomical determiation:

Astragalus of a horse is very distinct from all other ungulate astragalus. It is large and it has a flat *caput tali* which is in other animals cylindrical forming *trochlea tali distalis*. *Trochlea tali* of a horse is big and inclined on the side.

(1)IN	(2)M6
HP163	68

Table 67. Measurements of *Equus ferus* astragalus: (2)M6 – Greatest breadth of the distal end

Tarsal III

Inventory number: HP349
Portion: Complete
Side: Left

(1)IN	(2)M1
HP349	51,8

Table 68. Measurements of *Equus ferus* tarsal III: (2)M1 – Greatest breadth

Phalanx I

Inventory numbers: HP167	Inventory number: HP168
Portion: Complete	Portion: Proximal epiphysis
Side: Right	Side: Right

Taxonomical determination:

The first phalanx of a horse is longer than the one from a bovid and wider than the one from a cervid. The proximal epiphysis is dorso-ventrally compressed and medio-laterally extended.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7
HP167	89,7	57,9	39,5	48,7	53,1	36,5	46
HP168	-	-	-	48,7	-	-	-

Table 69. Measurements of *Equus ferus* phalanx I: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth of diaphysis; (5)M4 – Greatest breadth of distal end; (6)M5 – Greatest breadth of proximal articular surface; (7)M6 – Depth of the proximal end; (8)M7 – Greatest breadth of the distal articular surface

Phalanx III

Inventory numbers: HP170	Inventory number: HP171
Portion: Complete	Portion: Proximal part ot the phalanx
Side: IN	Side: IN

Taxonomical determination:

The third phalanx of a horse is an ungular bone.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6
HP170	72,1	81,7	31,1	53,2	65,9	49,9
HP171	-	-	27,2	46,6	-	-

Table 70. Measurements of *Equus ferus* phalanx III: (2)M1 – Greatest length; (3)M2 – Greatest breadth; (4)M3 – Length of the articular surface; (5)M4 – Breadth of the articular surface; (6)M5 – Length of the dorsal surface; (7)M6 – Height in the region of the extensor process

4.1.8.3. Equus sp.

Inventory number: HP124

Element: Tooth fragment

Taxonomical determination:

Due to its shape, the tooth surely belongs to an ungulate and because there is a very sharp 90° angle between the two sides of the tooth, it probably belongs to an equid.

4.1.9. Order Artiodactyla

4.1.9.1. *Sus scrofa*

Family: Suidae Gray 1821
Subfamily: Suinae Gray 1821
Genus: *Sus* Linnaeus 1758
Species: *Sus scrofa* Linnaeus 1758

The family Suidae arose during the Upper Oligocene in Europe (Benton, 2005) and their closest relatives are the peccaries (family Tayassuidae) (Groves, 2007.). The wild boar (*Sus scrofa*) appeared in Europe for the first time during the late Early Pleistocene corresponding to the mammal age Galerian of Italian biochronology (Faure & Guérin, 1982.; van der Made, 1999.), possibly overlapping with and finally replacing a Villafranchian species *Sus strozzii* (Lister et al., 2010).

Coxa

Inventory number: HP 352
Portion: Ilium and acetabulum
Side: Right

Taxonomical determination:
Ilium and acetabulum are not only the same size as the the ilium and acetabulum of a wild boar but also have the same morphology. Feature that is typical of a wild boar and that can be seen on HP 384 is *spina ischiadica* which is well marked.

4.1.9.2. *Megaloceros giganteus*

Family: Cervidae Goldfuss 1820
Subfamily: Cervinae Goldfuss 1820
Genus: *Megaloceros*
Species: *Megaloceros giganteus* Blumenbach 1799

Figure 12. Illustration of *Megaloceros giganteus* by Jakub Kowalski.

The giant deer (*Megaloceros giganteus*) (Fig.12) appeared 400,000 years ago and went extinct about 8,000 years ago. Its range extended from Ireland to central Siberia. The giant deer is the largest known member of the subfamily Cervinae with a shoulder hight of 2 meters and with antlers height up to 3,5 meters. Phylogenetic analysis, which included morphological and DNA sequence data, proved that the giant deer is a sister group of the fallow deer (Lister et al., 2005).

Mandible with teeth

Inventory number: HP 111 (Plate XIII, Fig.36)

Side: Left

Taxonomical determination:

The mandible contains typical cervid hypsodont teeth: M_2 with posterior and anterior crest and M_3 with an additional distal element. What distinguishes HP111 and *Megaloceros giganteus* mandible from other cervid mandibles is the size of the bone and teeth. *Megaloceros giganteus* has a thickened and more robust mandibular bones than other cervids.

(1)IN	(2)M1	(3)M2	(4)M3
HP111	36,8	53,6	45,8

Table 71. Measurements of *Megaloceros giganteus* mandible: (2)M1 – Length of the molar row; (3)M2 – Height of the mandible behid M3 from the most aboral point of the alveolus on the buccal side; (4)M3 – Height of the mandible in front of M1

Teeth

Inventory numbers: HP 111.1; HP 111.2

Side: Left

(1)IN	(2)Tooth	(3) M1	(4) M2
HP111.1	left M_3	36,9	20,5
HP111.2	left M_3	31,2	21,2

Table 72. Measurements of *Megaloceros giganteus* teeth: (3) M1 – Length measured near the bitting surface; (4) M2 – Greatest breadth measured at the crown-root junction

Metacarpus

Inventory number: HP 363 (Plate XII, Fig.34&35)

Portion: Complete

Side: Right

Taxonomical determination:

HP363 is more robust and shorter, than the *Alces Alces* metacarpus which is more slender and longer. On the proximal epiphysis two articular facets are not separated like in *Cervus* but are connected (Lister et al., 2005). Breda (2005) listed several features that distinguish *Megaloceros* metacarpus from Alces metacarpus and those that were recognized in HP363 are the following: on the proximal epiphysis, the dorsal outline is more rounded in *Alces* and more squared in *Megalocerus*; between the proximal articular surfaces, the synovial hollow is smaller and dorso-palmary elongated in *Alces*, while in *Megaloceros* the hollow is bigger and isodiametric. In *Alces* the dorsal longitudinal groove ends in a distal interosseus canal and in *Megaloceros* it ends more proximally and it is not connected with the interosseus canal. The gap between the distal trochleae, when viewed from the dorsal side, shows two parallel edges of the trochleae in the giant deer, while in moose it shows a „keyhole shape". On the dorsal side, the outline of the proximo-dorsal edge of the articular surfaces of the distal trochleae is squared in *Megaloceros* and more rounded in *Alces*. Also on the dorsal side, the part of the diaphsis just above the trochleae is a bit concave in *Megaloceros* and flat in *Alces*.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7
HP363	323,3	46,3	67,8	~69,2	47,2	30,8	43,1

Table 73. Measurements of *Mealoceros giganteus* metacarpus: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end; (6)M5 – Greatest depth of the proximal end; (7)M6 – Smallest depth of the diaphysis; (8)M7 – Greatest depth of the distal end (condyles)

Metatarsus

Inventory number: HP 364
Portion: Proximal epiphysis and diaphysis
Side: Right

Taxonomical determination:

HP364 is similar morphologically and by its size both to *Alces alces* and *Megaloceros giganteos*. The characters on the proximal epiphysis, such as the articular surface to the navico-cuboid whose lateral part is elongated backwardly and bended proximally, can not be seen because HP364 is heavily weathered and is missing the part of the epiphysis that can be used in determination. However, it was decided to assign HP364 to Megaloceros cf. gigantous because no *Alces alces* remains have been identified in the site of Hijenska pećina.

(1)IN	(2)M1	(3)M4
HP364	156,9	60,6

Table 74. Measurements of Megaloceros cf. giganteus metatarsus: (2)M1 – Greatest length; (3)M4 – Greatest breadth of the proximal end

4.1.9.3. *Cervus elaphus*

Family: Cervidae Godlfuss 1820
Subfamily: Cervinae Goldfuss 1820
Genus: *Cervus* Linnaeus 1758
Species: *Cervus elaphus* Linnaeus 1758

The deer lineage has its roots in the Oligocene (Benton, 2005.). Forms similar to the three extant major groups of deer (roe deer, red deer and elk) in Europe appeared during the Pliocene (Kurtén, 1968.). The red deer (*Cervus elaphus*) was a common species during the Pleistocene, especially during the Upper Pleistocene of Europe. Today, the species has a global distribution and inhabits a wide range of habitats, from Eurasia and northern Africa to North America.

Teeth

Inventory number: HP112
Element: M^2
Side: Right

Taxonomical determination:
HP112 has an anterior and a posterior crest with a parastyle, mesostyle and metastyle pointing labially and a protocone and a hypocone in a shape of a half moon. The tooth has three roots indicating it is an upper molar. The tooth was also compared with the *Cervus elaphus* molars from Velika pećina.

(1)IN	(2)Tooth	(3) M1	(4) M2
HP112	right M^2	27,5	24,5

Table 75. Measurements of *Cervus elaphus* teeth: (3) M1 – Length measured near the bitting surface; (4) M2 – Greatest breadth measured at the crown-root junction

Phalanx I

Inventory number: HP 261
Portion: Lateral side
Side: Right

Inventory number: HP 367
Portion: Distal epiphysis and diaphysis
Side: Right medial or left lateral

Taxonomical determination:

The first phalanx (HP261) is elongated dorso-ventrally, while in a bovid it is more square shaped and shorter. The distal epiphysis (HP267) is narrow when compared with the distal epiphysis of a bovid or a horse. The distal epiphysis of HP261 and HP367 is fused with the diaphysis which means they belonged to an adult individual that reached its maximum size. The size of the phalanx HP261 and HP367 corresponds to the size of the cervid *Cervus elaphus*.

(1)IN	(2)M1	(3)M4
HP261	57,6	-
HP367	-	24,1

Table 76. Measurements of *Cervus elaphus* phalanx I: (2)M1 – Greatest length; (3)M4 – Greatest breadth of the distal end

4.1.9.4. Cervidae indet.

Inventory numbers: HP113; HP114
Element: Antler fragments

Inventory number: HP180
Element: Mandible
Portion: Articular+ascending+coronoid

Taxonomical determination:

The coronoid process of HP180 seems to be sloping backwards forming a curve on the posterior side like in the cervids. In bovids the coronoid process in pointing upwards and is more robust than in cervids.

Inventory number: HP134
Element: Metatarsus
Portion: Diaphysis

Inventory numbers: HP117; HP173
Element: Metapodial
Portion: Distal epiphysis - condyle

Taxonomical determination:

Although there is only a small portion of the diaphysis (HP134) present, it was possible to determine that due to its size and morphology it belongs to a cervid. Also, HP134 is a metatarsus because it has a thick cortical part of the bone and the angle between the two sides of the diaphysis present is 90°.

4.1.9.5. *Capreolus capreolus*

Family: Cervidae Goldfuss 1820
Subfamily: Capreolinae Brookes 1828
Genus: *Capreolus* Gray 1821
Species: *Capreolus capreolus* Linnaeus 1758

The roe deer (*Capreolus capreolus*) has been present in Europe from the Middle Pleistocene (Lister et al., 1998.). The species is found through most of Europe except in Ireland, some Mediterranean islands, northern Russia and tundra regions (Baker, 2011.). Today there are three main lineages of roe deer in Europe: a western lineage in Iberian Peninsula; an eastern lineage in the Balkans and; a central lineage which is spread across central Europe (Baker, 2011).

Radius

Inventory number: HP358
Portion: Proximal epiphysis and diaphysis
Side: Left

Taxonomical determination:
The radius was assigned to *Capreolus* instead of *Rupicapra* because in the proximal epiphysis *fovea capitis radii* is deeper and more prononced than it is in *Rupicapra*.

(1)IN	(2)M1	(3)M2	(4)M3
HP358	97,9	28,7	19

Table 77. Measurements of *Capreolus capreolus* radius: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth of diaphysis

Tibia

Inventory number: HP371
Portion: Distal epiphysis and diaphysis
Side: Right

Taxonomical determination:

The tibia belongs to *Capreolus* because it exhibits a well defined *sulcus malleolaris* which is in *Rupicapra* less marked.

(1)IN	(2)M1	(3)M3	(4)M4	(5)M5
HP371	138,3	15,2	22,8	18,3

Tabel 78. Measurements of *Capreolus capreolus* tibia: (2)M1 – Greatest length; (3)M3 – Smallest breadth of the diaphysis; (4)M4 – Greatest breadth of distal end; (5)M5 – Greatest depth of the distal end

Phalanx II

Inventory number: HP 263 (Plate XIV, Fig.38)
Portion: Complete
Side: Right lateral or left medial

Taxonomical determination:

The second phalanx of *Capreolus*, just like HP 263, is a bit longer and more slender than the second phalanx of *Rupicapra*. The lengths of the second phalanx of *Capreolus* and *Rupicapra* from the comparative collection were. The length of the phalanx of *Rupicapra* is 29 mm, of *Capreolus* 31,1 mm and of HP263 31,5 mm. Therefore, the length of HP 263 indicates that the phalanx belongs to *Capreolus*.

HP 263 and *Capreolus* have a well pronounced dorsal part on the proximal articular surface, unlike *Rupicapra* which has a pronounced ventral part on the same articular surface.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4
HP263	31,5	13	8,8	9,8

Tabel 79. Measurements of *Capreolus capreolus* phalanx II: (2)M1 – Greatest length; (3)M2 – Greatest breadth of proximal end; (4)M3 – Smallest breadth of the diaphysis; (5)M4 – Greatest breadth of the distal end

4.1.9.6. *Bos primigenius*

Family: Bovidae Gray 1821
Subfamily: Bovinae Gray 1821
Genus: *Bos* Linnaeus 1758
Species: *Bos primigenius* Bojanus 1827

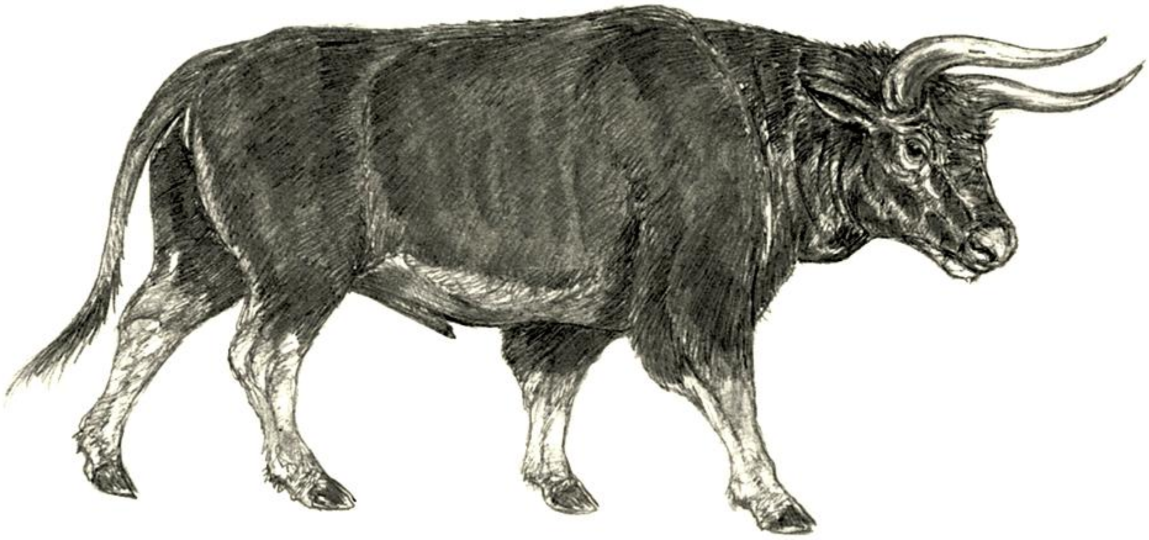


Figure 13. Illustration of *Bos primigenius* by Jakub Kowalski.

Bos primigenius (Fig.13) is a wild ancestor of domestic cattle. The aurochs first appeared in India 2 million years ago from where they spread to other parts of Asia, Europe and northern Africa. They were not well adapted to cold as some other animas, so in Europe during the colder periods in Pleistocene they would retreat to the Mediterranean area (Von Koeningswald, 1999). The aurochs in Europe went extinct at the beginning of the 17th century probably due to hunting pressure by men (Vuure, 2002).

Radius

Inventory number : HP360
Portion: Distal epiphysis and diaphysis
Side: Right

Taxonomical determination:

In *Bos* the distal end of the diaphysis on the dorsal side is less curved and the articular surface for the carpo-radial extensor muscle is less pronounced and not as deep as in *Bison*. Furthermore, the articular surface on the distal epiphysis in *Bos* is wider than in *Bison* and the edge on the medial side on the articular surface in *Bos* shows an inflection (Stampfli, 1963). All these features, characteristical of *Bos primigenius,* can be observed in HP360.

The index of distal articular surface and Ulnare-intermedium indeks (Lehmann, 1949) could not be calculated because the posterio-lateral part of the epiphysis is missing.

(1)IN	(2)M1	(3)M4
HP360	202	84,2

Table 80. Measurements of *Bos primigenius* radius: (2)M1 – Greatest length; (3)M4 – Greatest breadth of distal end

Tibia

Inventory number: HP365 (Plate XV, Fig.41)

Portion: Distal epiphysis and diaphysis

Side: Right

Taxonomical determination:

In HP365, just like in *Bos*, the two articular facets for malleolus are not separated like in *Bison* but are confluent. The dorsal malleolar facet is flat like in *Bos* unlike the *Bison* where it is curved (Stampfli, 1963).

(1)IN	(2)M1	(3)M3	(4)M4	(5)M5
HP365	368,3	66,9	~100,7	76,9

Table 81. Measurements of *Bos primigenius* tibia: (2)M1 – Greatest length; (3)M3 – Smallest breadth of the diaphysis; (4)M4 – Greatest breadth of the distal end; (5)M5 – Greatest depth of the distal end

Calcaneus

Inventory number: HP135

Portion: Complete

Side: Right

Taxonomical determination:

HP 135 was assigned to *Bos* due to several distinguishing features. The articular surface for centro tarsale is narrowing in the upper part (Bibikova, 1958; Stampfli, 1963). However, it seems that the edges of this surface are a bit abraded so by taking into account only this feature it can not be said with certainty that the calcaneus belongs to *Bos*. Fortunately, there are other features that support this conclusion. In plantar view, on the medial side, the edge is forming a medial angle in the middle of the plantar edge (Bibikova, 1958).

The length index of the outer articular surface (Lehmann, 1949) was calculated. The length indeks for *Bison* varies between 87 and 100,2 (Lehmann, 1949) and between 86,4 and 105,5 according to Stampfli (1963). For *Bos* the index varies between 70,9 and 82,6 (Lehmann, 1949). Therefore, it can be concluded that HP 135 belongs to *Bos*.

The length index for HP 135 = (M4×100)÷M3 = (38,1×100)÷55,9 = 68,16

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6
HP135	204,7	78,2	55,9	38,1	19,6	16

Table 82. Measurements of *Bos primigenius* calcaneus: (2)M1 – Greatest length; (3)M2 – Greatest breadth; (4)M3 – Length of outer articular suface for centrotarsale; (5)M4 – Length of outer articular suface for astragalus; (6)M5 – Breadth of outer articular suface for centrotarsale; (7)M6 – Breadth of outer articular suface for astragalus

Astragalus

Inventory number: HP137 (Plate XIV, Fig.40)
Portion: Complete
Side: Left

Taxonomical determination:

On the planar side the body of the astragalus is robust, unlike the *Bison* astragalus which is more slender. On the same side the meeting point of calcaneus articular surface and centrotarsale articular surface displays a sharp angle of 90° which is a characteristic of *Bos* astragalus. Viewed from the lateral side, the contour between two articular surfaces continues over each other while in *Bison* there is a separating pit.

The length-width index was calculated according to Bibikova (1958). For *Bos* the index should be over 70 and under 67 for *Bison* (Bibikova, 1958). Acoording to Stampfli (1963) the index for *Bison* varies between 62,6-72,3.

The length-width index for HP137 = (M5×100)÷M1 = (71,4×100)÷98,3 = 72,63

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5
HP137	98,3	88,8	54,8	56,9	71,4

Table 83. Measurements of *Bos primigenius* astragalus: (2)M1 – Greatest length of the lateral half; (3)M2 – Greatest length of the medial half; (4)M3 – Greatest depth of the lateral half; (5)M4 – Greatest depth of the medial half; (6)M5 – Greatest breadth (of the distal end)

Metatarsal

Inventory number: HP359 (Plate XVI, Fig.42&43)
Portion: Complete
Side: Left

Taxonomical determination:

According to Schertz (1936) in *Bos primigenius* the width between the diaphysis and the distal epiphysis is noticeably less than the width of the distal articular surface. In *Bison priscus* the difference in width between the diaphysis and the distal epiphysis and the distal articular surface is not as great as in *Bos primigenius*.

In the case of HP359 the width between the diaphysis and the distal epiphysis (69,7) is noticeably less than the width of the distal articular surface (73,2) and therefore this feature indicates that HP359 belongs to *Bos primigenius*.

In HP359, the lateral and medial borders, when viewed anteriorly or posteriorly, continue more or less straight from the diaphysis into the distal epiphysis like in *Bos primigenius* while in *Bison* this line is more curved (Schertz, 1936).

Moreover, on the proximal epiphysis, the articular surfaces for tarsal III and tarsal IV , on the caudal part of the joint, are positioned closer than in *Bison*. The angle between these two articular surfaces is *Bos* is 13°-22°, while in *Bison* it is 22°-40° (Schertz, 1936) and 35°-55° according to (Stampfli, 1963). In HP359 the angle between the tarsal III and Tarsal IV articular surfaces is 15°.

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5	(7)M6	(8)M7
HP359	284	38,1	73,9	64,5	64,2	33,8	41,1

Table 84. Measurements of *Bos primigenius* metatarsus: (2)M1 – Greatest length; (3)M2 – Smallest breadth of the diaphysis; (4)M3 – Greatest breadth of the distal end; (5)M4 – Greatest breadth of the proximal end; (6)M5 – Greatest depth of the proximal end; (7)M6 – Smallest depth of the diaphysis; (8)M7 – Greatest depth of the distal end (condyles)

4.1.9.7. *Bos/Bison*

Teeth

Inventory numbers: HP118; HP119; HP120; HP121(Plate XIV, Fig.39); HP122; HP123; HP125; HP126; HP127;HP129; HP132

Taxonomical determination:
HP121 is a complete upper molar. Upper molars of *Bison* and *Bos* can be distinguished: *Bison* has a narrowed neck and above it there is a swelling where the enamel starts, while in *Bos* the swelling is absent (Sala, 1986). HP121 has a narrowed neck and a swelling but because there are no other *Bison* remains present in the fossil material from Hijenska pećina and because this is the only tooth that displays this feature, it was decided to classify it as *Bos/Bison* for the time beeing. All other teeth are incomplete and no distinguishing features can be seen. Therefore, they are also classified as *Bos/Bison.*

(1)IN	(2)Tooth	(3) M1	(4) M2	(5) M5
HP118	M_1-M_2	29,3	18	58,5
HP119	right M_2-M_3	25,2	19,7	62,5
HP120	left M_1-M_2	~29,3	~22,8	47,9
HP121	right M^1-M^3	25,4	28,3	25
HP122	left M^1-M^3	20,1	23	19,2
HP123	left M_1-M_3	-	-	-
HP125	left dP_4	30,8	16,1	28,3
HP126	left M^1-M^3	20	22,2	27,9
HP127	left M^1-M^3	21,5	-	-
HP129	M1-M3	-	-	-
HP132	left P_3	20,3	14,4	8,9

Table 85. Measurements of *Bos/Bison* teeth: (3) M1 – Length at crown-root junction; (4) M2 – Greatest breadth at crown-root junction; (5) M5 – Greatest height – measured from buccal side (from crow-root junction til the tip of the crown)

Humerus

Inventory number: HP84
Portion: Distal epiphysis
Side: Right

Taxonomical determination:

Morphologically and by its size, HP84 belongs to *Bos/Bison*. Unfortunatelly, all the features that can tell us if it is a *Bos* or a *Bison*, such as trochlea-index (Lehmann, 1949) or if the *fossa olecrani* is curved or not (Stampfli, 1963), can not be seen on HP84 because the epiphysis is lacking the diagnostic parts.

Astragalus

Inventory number: HP136

Side: Left

Taxonomical determination:

HP136 seems to be more robust than a *Bison* astragalus but this feature alone is not enough to be certain that it belongs to *Bos*. Other diagnostic features could not be observed.

Centrotarsale

Inventory number: HP361

Side: Right

Taxonomical determination:

HP361 is incomlete, missing 50% of the bone and therefore it could only be classified as *Bos/Bison.*

Phalanx III

Inventory number: HP133

Side: Lateral left or medial right

Taxonomical determination:

HP133 has a triangular shape typical of *Bos/Bison* which differs from a cervid by a cranio-caudally elongated and caudally widening proximal articular surface.

4.1.10. Ungulate indet.

Teeth

Inventory number: HP172; HP130; HP131

Taxonomical determination:
In HP172 only a small fragment of the tooth enamel is present. HP172 is an ungulate tooth because of its size (height: 31,2 mm; width: 22,6 mm) and shape. HP130 and HP131 are even smaller fragments than HP172 but by its morphology it can be concluded that they also belong to an ungulate.

Metacarpus

Inventory number: HP366
Portion: Dorsal side of the proximal epiphysis and diaphysis

Taxonomical determination:
Although the ventral part of HP366 is completly missing, HP366 is an ungulate metacarpus because the dorsal side of the diaphysis is slightly curved and towards the epiphysis the outline of the articular surfaces can be observed.

Calcaneus

Inventory number: HP 115
Portion: Shaft
Side: Right

Taxonomical determination:
The calcaneus is missing most of the *corpus calcanei* and *processus anterior*. Only small part of the shaft is present with part of the *sustentaculum tali* and *facies articularis talaris*. Due to its size and morphology it was only possible to say that it belongs to an ungulate indet..

Astragalus

Inventory number: HP 116 (Plate XIII, Fig.37)
Portion: Complete
Side: Right

Taxonomical determination:

HP116 is missing the outer cortical part of the bone and therefore it is hard to determine which species, genus or family this bone belongs to. However, HP116 seems not to be as robust as the bovid astragalus and it resembles more an astragalus of a cervid but still this is a very subjective observation so it was decided to classify HP116 as an ungulate indet..

(1)IN	(2)M1	(3)M2	(4)M3	(5)M4	(6)M5
HP116	62,3*	58*	34,8*	29,2*	40,8*

Table 86. Measurements of ungulate indet. astragalus: (2)M1 – Greatest length of the lateral half; (3)M2 – Greatest length of the medial half; (4)M3 – Greatest depth of the lateral half; (5)M4 – Greatest depth of the medial half; (6)M5 – Greatest breadth of the distal end

4.2. MNI & NISP

Total minimum number of identified specimens NISP is 278 which is 61,4% of the whole assemblage. The remaining 175 specimens are unidentifiable. Bones and teeth belonging to *Crocuta crocuta spelaea* are the most abundant with 41% of the total NISP. *Equus ferus* is mostly represented by teeth, making up 13,7% of the total NISP. After the wild horse, follow *Bos/Bison* (7,6%), *Ursus spelaeus* (6,8%) and *Canis lupus* (6,5%). All other taxa each make up less than 4% of the assemblage (Fig.14).

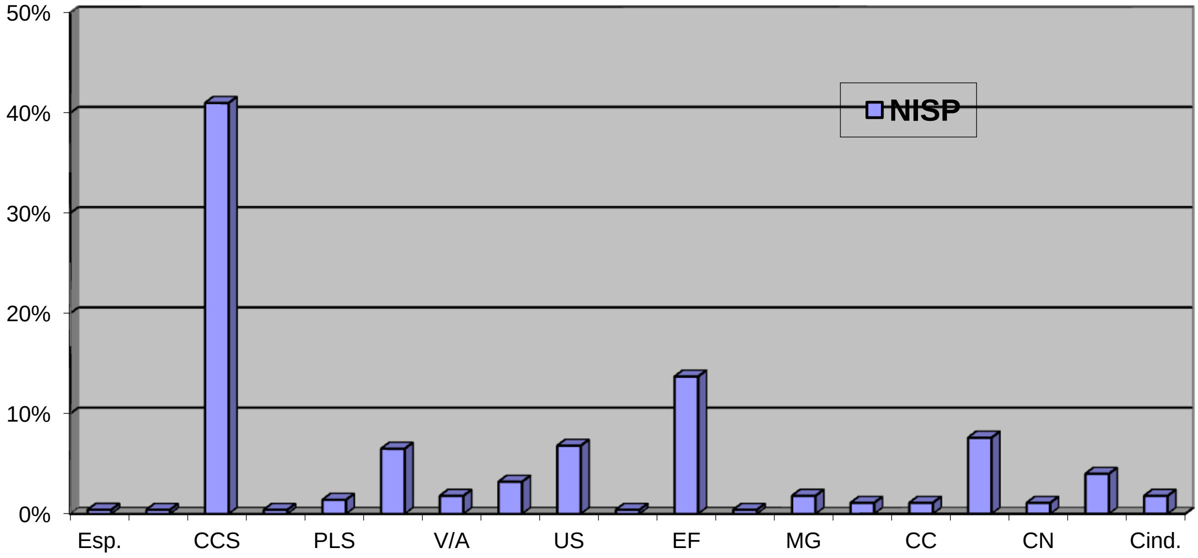


Figure 14. Frequency distribution of taxa (NISP = 247) Abbreviations: Esp. = Erinaceus sp.; Lsp. = Lepus sp.; CCS = *Crocuta crocuta spelaea*; LL = *Lynx lynx*; PLS = *Panthera leo spelaea*; CL = *Canis lupus*; V/A = *Vulpes/Alopex*; MM = *Meles meles*; US = *Ursus spelaeus* (including Ursus cf. spelaeus); SH = Stephanorhinus cf. hemiothecus; EF = *Equus ferus* (including Equus sp.); SS = *Sus scrofa*; MG = *Megaloceros giganteus*; CE = *Cervus elaphus*; CC = *Capreolus capreolus*; B/B = *Bos/Bison* (including *Bos primigenius)*; CN = *Chionomys nivalis*; Rind. = Rodentia indet.; Cind. = Chiroptera indet.

Minimum number of individuals MNI was calculated first for the same skeletal element of a taxon and then for each taxon. If two bones were of the same species, from the same side and of the same skeletal element but they were from the different parts of the bone (e.g. one proximal epiphysis and one distal epiphysis), they were counted as one bone.

The relative age of the individual was also taken into account during the calculation. The age determination was possible for MNI of 20 individuals belonging to different species (Tab. 87).

SPECIES	Infant	Subadult	Adult	Old adult	MNI of each species
Crocuta crocuta spelaea	1	1	1	0	3
Panthera leo spelaea	0	0	1	0	1
Canis lupus	0	0	1	0	1
Vuleps/Alopex	0	0	1	0	1
Meles meles	1	0	1	1	3
Ursus cf. spelaeus	1	0	1	0	2
Equus ferus	0	1	1	0	2
Megaloceros giganteus	0	0	1	0	1
Cervus elaphus	0	0	1	0	1
Capreolus capreolus	1	0	1	0	2
Bos/Bison	1	0	1	1	3
MNI of each age class	5	2	11	2	= 20

Table 87. Number of individuals in each age class and each species and MNI of each species according to age determination.

Canis lupus, Vulpes/Alopex, Lepus sp., *Panthera leo spelaea* and *Cervus elaphus* are represented by only adult individuals. *Crocuta crocuta spelaea* is presented by at least one adult, one sub adult and one infant individual. There are at least three individuals of *Meles meles* present: one old adult (HP76; Plate VIII., Fig. 22) due to the very heavy use wear on M_1; one adult (HP77, HP78, HP81); one infant (HP79; Plate IX., Fig. 23) because both epiphyses are unfused. *Ursus spelaeus/*Ursus cf. spelaeus is presented by a minimum number of two individuals, one adult and one infant. Presence of an infant bear was determined because of a femur (HP357; Plate XI., Figure 31.) which is small in size and has unfused epiphyses. Although there are only three bones of *Capreolus capreolus*, they represent a minimum of two animals, one adult (HP263, Plate IV, Fig. 38; HP358) and one sub adult (HP371). All the bones of *Bos/Bison* point to presence of only adult animals, but when we look at the teeth it is clear that except the adult individual, there is also an old adult with very heavily worn teeth (e.g. HP132) and an infant with deciduous teeth (HP125). The age of *Equus ferus* individuals was determined by the use wear on teeth and according to this method there is at least one old adult, one adult and one sub adult, but because this method is subjected to possible errors (some teeth can wear out faster than the others), when calculating MNI of the wild horse it was decided to put teeth which are pointing to an old adult and adult into one category (OA/A).

Minimum number of individuals for the same skeletal element of a taxon and of each taxon is shown in tables 88. and 89. The total MNI is 28, including Lepus sp., Erinaceus sp., *Chionomys nivalis,* Rodentia indet. and Chiroptera indet.. The MNI of each taxa is shown in Figure 15. From the carnivores the most represented animals are *Crocuta crocuta spelaea* and *Meles meles* with MNI 3 (Figure 17.), followed by Ursus cf. spelaeus (MNI = 2) and from the ungulates by *Bos/Bison* with MNI 3 and followed by *Capreolus capreolus* (MNI = 2) and *Equus ferus* (MNI = 2) (Figure 16.).

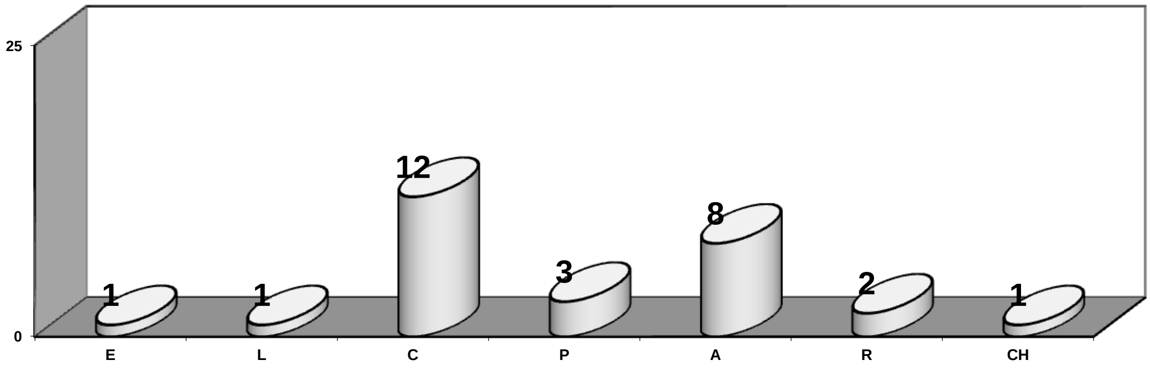


Figure 15. MNI of each taxa. x-axis: orders; y-axis: number of individuals.

	Cranius	Maxilla	Mandibula	Teeth	Vertebrae	Scapula	Humerus	Radius	Ulna	Mc I	Mc II	Mc III	Mc V	Coxa	Femur	Tibia	Fibula	Calcaneus	Astragalus	Navicular	Mt I	Mt II	Mt III	Mt V	MNI
Cave hyena	1	1	3		2	1	3	2	3	-	-	2	2	1	3	2	-	2	-	1	-	2	1	1	3
Eurasian lynx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Cave lion	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Grey wolf	-	-	1	-	1	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	1	-	-	1
Red fox	-	-	-	-	1	-	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Badger	1	-	2	-	-	-	1	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-		-	3
Cave bear	-	-	-	-	1	-	-	1	2	1	-	-	-	-	2	1	1	1	1	-	1	1	-	1	2
Minimum number of carnivore individuals (MNI)																									12

Table 88. MNI of the same skeletal element of a taxon, MNI of each taxon, total carnivore MNI. Dark orange colour indicates modification of MNI due to presence of different age classes.

	Mandible	Teeth	Humerus	Radius	Metacarpus	Coxa	Femur	Tibia	Calcaneus	Astragalus	Tarsal III	Metatarsus	Phalannx I	Phalanx II	Phalanx III	MNI
Wild boar	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Giant deer	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	1
Red deer	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Roe deer	-	-	-	1	-	-	-	1	-	-	-	-	-	1	-	2
Auroch	-	3	-	1	-	-	-	1	1	2	-	1	-	-	-	3
Steph	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Wild horse	-	2	-	1	1	-	1	1	-	-	1	-	1	-	1	2
Minimum number of ungulate individuals (MNI)														11		

Table 89. MNI of the same skeletal element of a taxon, MNI of each taxon, total ungulate MNI. Dark orange colour indicates modification of MNI due to presence of different age classes.

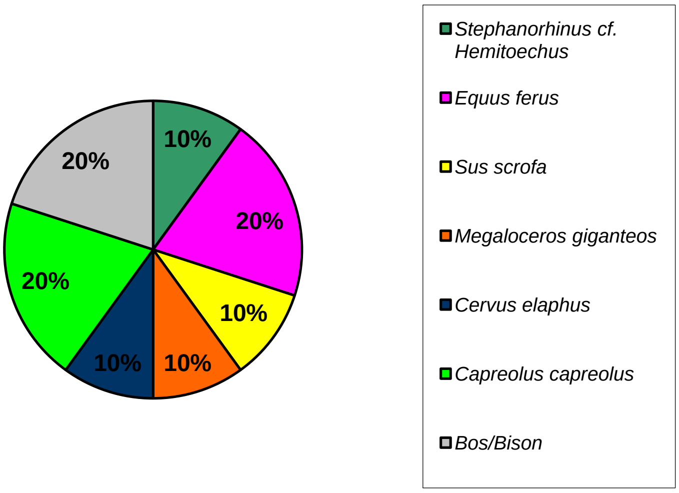


Figure 16. Percentages of ungulate taxa represented in Hijenska pećina

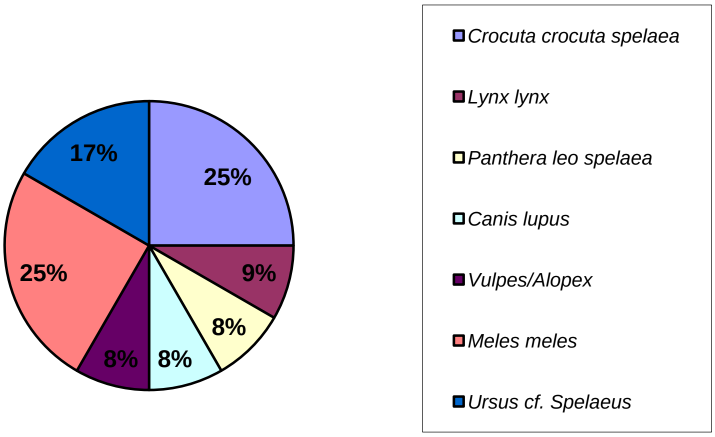


Figure 17. Percentages of carnivore taxa represented in Hijenska pećina

4.4. Taphonomic analysis

Taphonomy (Efremov, 1940) is a branch of paleontology that studies processes and modifications that affected an organism from the moment of its death until the moment it is excavated. Taphonomic analysis of Hijenska pećina was conducted in order to give us clues on who or what might have accumulated the assemblage. Therefore, breakage pattern, gnawing by animals as well as possible hominid made modifications were studied. To get a better understanding of the microenvironmental conditions and how these conditions affected the fossil material and their preservation, weathering patterns on the bones were examined.

4.4.1. Recent breaks

A bit less than half of the fossil material, excluding the micromammals, has recent breaks. On one bone it was not possible to determine if there was a recent break or not, so instead of 430 bones, 429 were taken into account. From those 429 bones, 244 (56,9%) do not have recent breaks, while 185 do have recent breaks (33,6% have recent breaks with reduced length and 9,6% also have recent breaks, but the length was not affected). These numbers indicate that the material, for unknown reasons, was considerably damaged during the excavation.

4.2.2. Breakage pattern

The breakage pattern of most of the bones (73,5%) could not be determined due to recent breaks and/or $CaCO_3$ cover. 22,3% of the bones are unbroken and the rest (4,2%) display angular (dry bone – type I spiral fracture), spiral (green bone – type II spiral fracture) or angular and spiral fracture (Fig.18; 19). Spiral fracture is the most common type of fracture in the assemblage. This type of fracture tells us that the bone broke while it was still fresh (green) but what it does not tell us is the agency involved in the breaking of bone (Lyman, 1994). 50% of the identifiable broken bones display spiral fracture, 33,3% show spiral and angular fracture and 16,7 display just angular fracture.

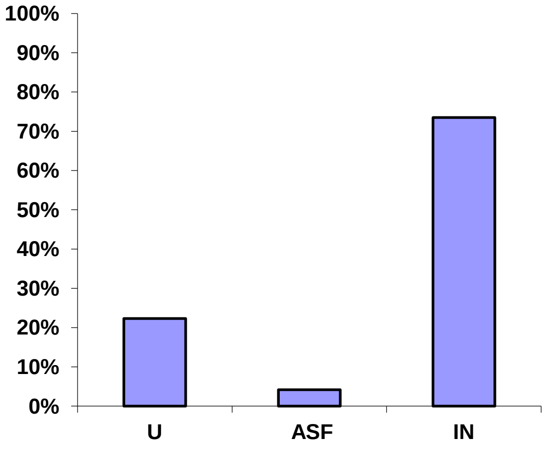


Figure 18. Frequency of unbroken, broken bones displaying a breakage pattern and broken bones with indeterminate breakage pattern. Abbreviations: U – unbroken, ASF – angular and/or spiral fractures, IN - indeterminate

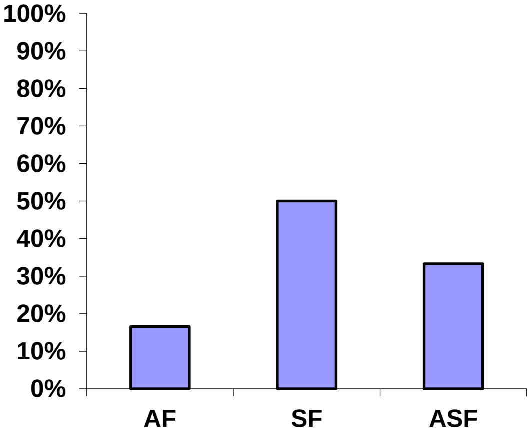
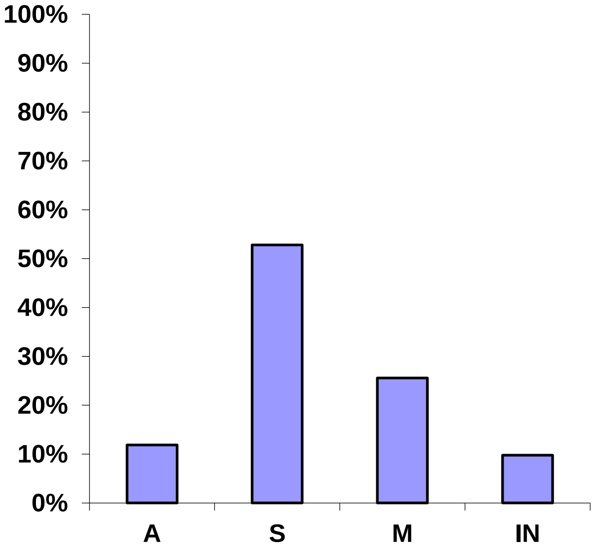


Figure 19. Frequency of broken bones with angular, spiral or angular and spiral fractures. Abbreviations: AF - angular fracture, SF – spiral fracture, ASF - angular and spiral fracture.

4.2.3. Weathering type

Most of the bones from the assemblage show some degree of weathering (Fig.20). Weathering is absent on only 11,9% of the bones, while on 9,8% of the bones weathering degree could not be determined. The most abundant types of weathering found on the bones are chemical etching, fine line fractures and sometimes spalling (Fig.21). A few of the bones are so heavily weathered (e.g. HP364 – metatarsus from *Megaloceros giganteus*) that the surface structure of the bone is rough and almost unrecognizable with large open cracks. These bones correspond to Behrensmeyer (1978) weathering stage 4.

The amount and rate of weathering on the bones is a result of the microenvironmental conditions inside the cave. Although bones usually have an excellent preservational potential inside the caves, still there are factors which can influence their outer appearance and structure. The moist environment, circulation of water and dissolution of karstic rock have an impact on the bones.



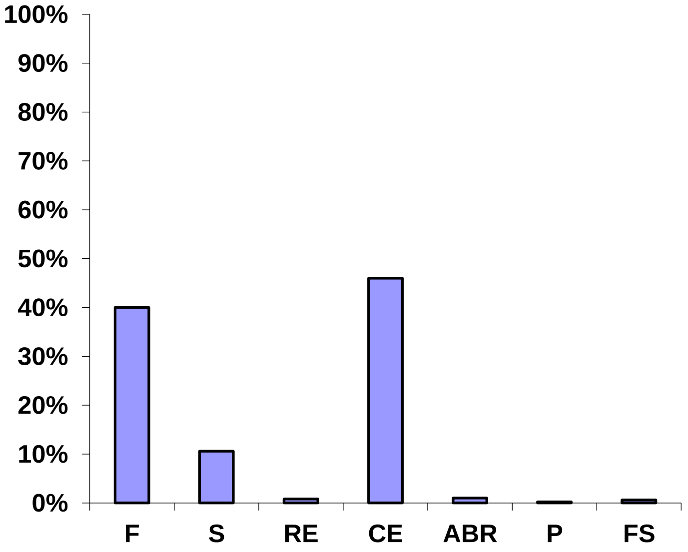


Figure 20. Frequency of weathered bones. Abbreviations: A – weathering absent; S – slightly weathered; M – weathering marked; IN – indeterminate.

Figure 21. Frequency of weathering types. Abbreviations: F – fine line fractures; S – spalling; RE – root etching; CE - chemical etching; ABR – abrasion; P – pitting; FS – fine line fractures and spalling.

4.2.4. $CaCO_3$

42,1% of the assemblage has some degree of calcium carbonate on the bone. Most commonly they have a light calcium carbonate cover (e.g. HP338, Plate III, Fig.6), a few have a moderate cover (e.g. HP6, Plate III, Fig.5; HP356, Plate XI, Fig.30), but also some bones are completely covered with $CaCO_3$ (e.g. HP4, Plate II, Fig.4; HP15, Plate IV, Fig.7; HP35, Plate V, Fig.9&10; HP44, Plate VI, Fig.13&14; HP252, Plate X, Fig.27) (Fig.22).

Speleothems found on the bones are a typical component of karstic (limestone and dolomite) solution caves. They were formed by water passing through the cracks and fissures in the rock and during the passage, dissolving the bedrock and some of the compounds. Water in the cave, containing the compounds (calcite and aragonite) from the rock, can release the compounds which precipitate and with time can accumulate to form speleothems.

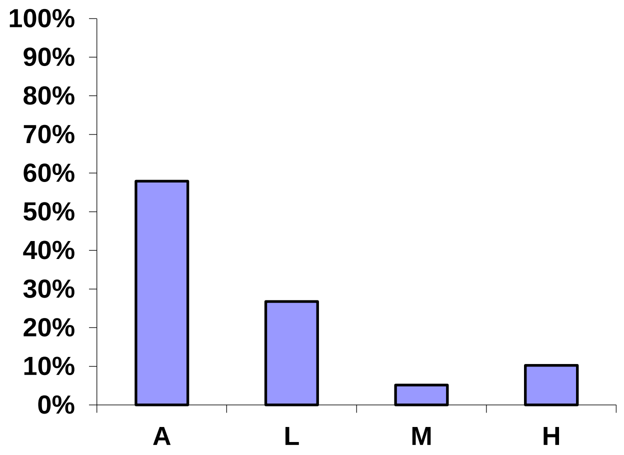


Figure 22. Frequency of CaCO3 covers on the bones.

Abbreviations: A – absent; L – light; M – moderate; H – heavy

4.2.5. Gnawing

In 74,4% of the assemblage gnawing is absent and in 11,9% absence or presence of gnawing could not be determined. This means that 59 bones show some kind of gnawing or possible gnawing and modification due to action of animals. The most common type of gnawing observed is rodent gnawing (61%; Fig.23).

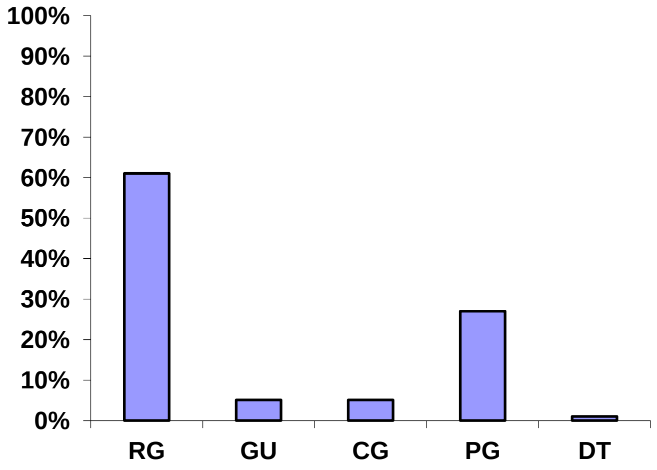


Figure 23. Frequency of different gnawing marks.

Abbreviation: RG – rodent gnawing; GU – gnawing form unknown;

CG – carnivore gnawing; PG – possible gnawing;

DT – passed through digestive tract

Possible gnawing is found in 27,1% out of 59 bones, gnawing from an unknown source on 6,8% and carnivore gnawing on 5,09% of the bones. Only one bone, an astragalus, has passed through the digestive tract (Plate XIII, Fig.37). This astragalus is completely lacking the outer compact part of the bone because it was etched by the stomach acid.

Three bones that have carnivore gnawing marks are the following: HP159, a third metacarpus from a wild horse, has on the shaft a number of hyena striations made by their incisors. These can be compared with the hyena striations from Makapansgat (Fig.24; Schrenk, 1984; Schrenk, 1985; Schrenk & Maguire, 1988). Furthermore, the distal epiphysis was bitten off. (Plate XVII, Fig.44). HP263, a second phalanx from a roe deer, has one carnivore puncture mark on the lateral side of the phalanx (Plate XIV, Fig.38). HP357, a femur from Ursus cf. spelaeus, has on the proximal part of the shaft, just under the epiphysis, on the cranial side, one carniovore bite mark, produced by a canine (Plate XI, Fig.31).

Figure 24. Hyena striations from the Makapansgat bone breccias (from Schrenk, 1984)

HP365 is a tibia from *Bos primigenius* and it is interesting because on one side of the shaft it shows several marks which could be either cut marks, although they are a bit too unregular, or trampling marks because they are more randomly orientated. In favour of the trampling marks also goes the fact that the marks are located on the shaft, while cut marks are found more often closer to the epiphysis. However, it seems those marks appeared before the cracks as there is no flaking off at the transgression points. Another option is that they could be incisor marks produced by very young hyenas (Plate XV, Fig.41).

4.2.6. Pathology

Only one bone displays pathological modification. This one bone is HP357, a femur from a young bear. Pathology can be seen on the distal part of the shaft on the lateral side (Plate XI, Fig.31). On the shaft there is some additional bone growth. Some sort of pathology on cave bear bones is not unusual and there are several examples of this happening (e.g. Bendík et al., 2009).

4.2.7. Other modifications

Bone HP373 (Plate XVIII, Fig.46) is a long bone fragment displaying a semi-circular structure on one side of its edge where the bone was broken. This resembles an impact scar which could be produced by humans.

5. DISCUSSION

5.1. How did the bones get into the cave?

One of the most interesting and challenging questions in paleontology and archaeology, when dealing with a fossil assemblage, is what caused the death of those animals and how did they get accumulated in a certain place? The same question can be asked about the fossil assemblage from Hijenska pećina. There are three possible candidates which might have been responsible for their accumulation: hyenas, hominids or natural trap.

5.1.1. Hyenas as bone collectors

William Buckland (Fig.25), after studying the bone assemblage discovered in 1821 at Kirkendale in Yorkshire, proposed that the bones found in the cave were accumulated by hyenas (Buckland, 1824). According to him, the marks found on some of the bones fit the forms of the canine teeth of hyena and he said „*..they dragged into its recesses the other animal bodies whose remains are found mixed indiscriminately with their own.*“ (Buckland, 1824; p.19-20). The cave was rich in hyena bones (Fig.26), bones of other animals (23 species in total) with hyena bite marks and hyena coprolites. These observations led him to conclude that this was once a hyena den. His hypothesis, that hyenas were bone accumulators at Kirkendale was supported by Captain Sykes who had the opportunity to observe live hyenas in their natural habitat and to examine their dens (Buckland, 1826/27).

Figure 25. William Buckland entering the Kirkendale cave. Caricature by the Rev. W. Conybeare. (from Gordon, 1894)

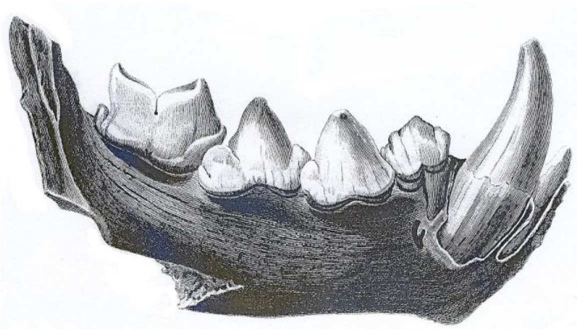


Figure 26. Drawing by William Buckland of a right lower jaw of the Kirkendale hyena. (from Buckland, 1824)

Buckland’s hypothesis was challenged by Raymond Dart and his „Osteodontokeratic (bone, tooth, horn) culture“(Fig.27) hypothesis. Dart believed that australopithecines were the ones responsible for bone accumulations and that they used those bones as tools (Dart, 1957). Raymond Dart's interpretation was rejected (Maguire et al., 1980; Schrenk, 1984; 1985; Shipman & Phillips-Conroy, 1977; Thenius, 1961), but it initiated the interest in the role of hyenas and carnivores in archaeological and paleontological contexts (Brain, 1976; 1981; Binford, 1981; Binford et al., 1988; Haynes, 1980; Hill, 1976; 1978; 1984). Many actualistic studies followed concentrating on the behavior of living hyenas (e.g. Faith & Behrensmeyer, 2006; Hill, 1980; Kruuk, 1972; Lansing et. al, 2009; Lam, 1992; Pokines & Kerbis Peterhans, 2007).

Figure 27.Illustration of Osteodontokeratic culture.
(from Schrenk, 1985)

Spotted hyenas hunt their own pray (Kruuk, 1972; Gasaway et al., 1991; Lansing et al., 2009) and after dismembering a carcass they may transport parts of it to their dens. The fact that they accumulate bones in their dens was confirmed by several studies (e.g. Hill, 1980; Skinner et al., 1986; Sutcliffe, 1970). According to Pokines et al. (2007) there are three taphonomic types of hyena dens: cave dens, burrow dens and artificial dens. All the three types of dens are used by hyenas as the center of their activity. It is the place where individuals meet their clan members, raise their young and bring their prey or pieces of it to eat it undisturbed (Kruuk, 1972).

Several criteria have been proposed for determining if the fossil assemblage was accumulated by hyenas and if the place where the assemblage is found was once a hyena den. Stiner (2004) listed three main features of a carnivore den: remains of cubs, gnawing damage on the bones and coprolites in the case of hyenas. All these features are also present in

Hijenska pećina to some extent. In Hijenska pećina only one remain of a cub can be confirmed and of least one sub adult individual. Hyena coprolites (Plate XIX, Fig.47) are present but not in significant numbers (only eight pieces).

Hyenas leave different kinds of damage on bones. Sutcliffe (1970) mentioned four types of damage produced by hyenas: splintering, gnawing, scooping of cancellous bone and partially digested and regurgitated bone. Digested bones are called acid-etched by Cruz-Uribe (1991) and are characterized by rounding of edges (Andrews&Nesbit Evans, 1983). Joints of the long bones are frequently chewed off and bone shafts have corners with irregular margin, and many bone fragments are turned into "nibbling sticks", with their ends rounded (Diedrich, 2005; Diedrich, 2011). Marks on the bones range from long striations to more abrupt marks, both are usually perpendicular to the main axis of the bone (Pokines & Kerbis Peterhans, 2007). Different hyena teeth leave different marks on the bone because the teeth are used for different activities (Fig.25; Sutcliffe, 1970; Diedrich, 2005) (Fig.28).

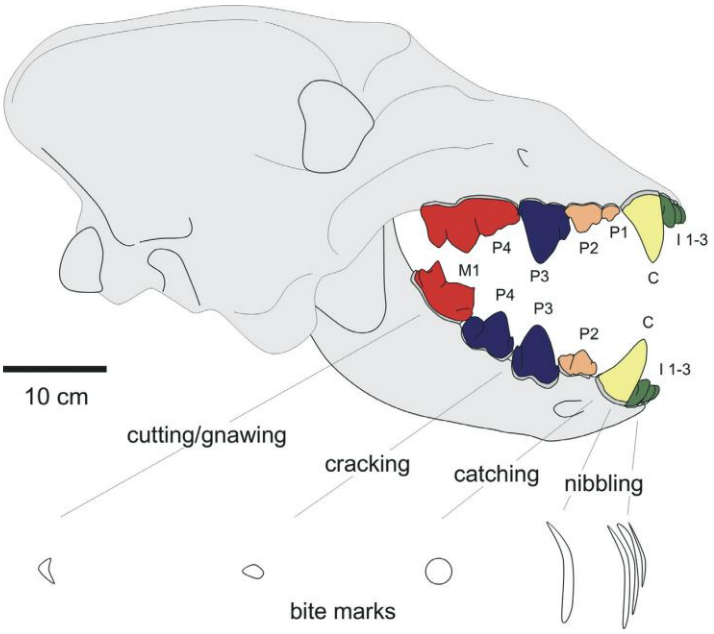


Figure 28. Specialization of hyena teeth for different activities
and types of typical marks left by the teeth (from Diedrich, 2005)

Damage left by a carnivore, probably by a hyena, has been found on the bones from Hijenska pećina. There is one digested bone, HP116 (Plate XIII, Fig.37), which is lacking the compact part of the bone. Striations produced by nibbling with incisors are seen on one bone, HP159 (Plate XVII, Fig.44). HP159 also has the distal epiphysis chewed off. HP263 (Plate

XIV, Fig.38) has one mark on the phalanx produced by cracking and HP357 (Plate XI, Fig.31) has also one mark on the shaft but produced by catching with the incisor.

The four bones displaying clear carnivore damage could point to a hyena as the accumulator of bones in Hijenska pećina. However, there are several problems with this conclusion. First of all, other carnivores, such as lions and leopards, can produce similar types of damages on the bones (Lymann, 1994; Dominguez-Rodrigo, 1999; Pickering, 2002). Moreover, according to Cruz-Uribe (1991) and Villa et al. (2010), carnivore gnawing marks should be found on at least 50% of the assemblage before it is interpreted as a hyena den. Faith (2007) suggested that modern spotted hyenas leave tooth marks on more than 70% of the assemblage. In Hijenska pećina this is clearly not the case because carnivore gnawing is found on only three bones out of 430 bones in the assemblage. If we add possible gnawing marks and gnawing marks from an unidentified animal and assign them to the activity of hyena, still the percentage of carnivore gnawed bones would be only 7,67%.

Other criterion which has been suggested for recognizing hyenas as the accumulators of bone assemblages are a carnivore to ungulate MNI ratio of 20% or more (Cruz-Uribe, 1991; Pickering, 2002; Kuhn et al., 2010). The percentage carnivore MNI can be calculated by finding the percentage of carnivore from the ungulate-carnivore MNI (Kuhn et al., 20101). The carnivore to ungulate MNI ratio in Hijenska pećina is 52%. Diedrich (2011) claims that a typical hyena den in the Upper Pleistocene of Europe should have 15-45% of hyena remains in the assemblage. In Hijenska pećina the NISP of cave hyena remains is 41%. These percentages could be an indicator of a hyena den.

Representation of skeletal parts can also give us a clue on what kind of a depositional habitat we are dealing with (Lyman, 1994). In a hyena den assemblage the least represented skeletal parts should be the skull bones, while the limbs should be the most represented because hyenas selectively remove parts of the carcass and bring it to their dens (Pokines et al., 2007). After calculating the total number of skeletal parts represented in Hijenska pećina (Tab.91; Fig.29), it was clear that Hijenska pećina displays a pattern that would be expected for a hyena den. In the calculations individual teeth were not taken into account.

Binford (1981) proposed a method of distinguishing between assemblages that were ravaged by carnivores from the assemblages where no destruction has occurred. This method is based on the fact that skeletal parts that have a lower density are absent or very rare in ravaged assemblages. According to Binford (1981), proximal epiphyses of long bones are less dense then the distal epiphyses. Therefore, assemblages that have significantly larger MNE of distal epiphyses then the proximal were ravaged by carnivores. Following Binford (1981) and

Lyman (1994), MNE of proximal humerus, distal humerus, proximal tibia and distal tibia was calculated (Tab.90). The MNE values were then divided by the largest values of the four and plotted in Binford's bone destruction graph. The values fall into the zone of destruction and suggest that the assemblage was ravaged by carnivores.

	HUMERUS	TIBIA
PROXIMAL	1	2
DISTAL	4	5

Table 90. MNE of proximal humerus, distal humerus, proximal tibia and distal tibia.

Another proposed distinctive feature of a fossil hyena den is a U-shaped attritional prey mortality profile (Cruz-Uribe,1991). Attritional mortality profile means an overrepresentation of very young and old individuals and an underrepresentation of adults. U-shaped mortality profile appears when there is a dramatic rise in mortality. In Hijenska pećina more than half of the animals, whose age was possible to estimate, are adults. The pattern observed seems to be more similar to L-shaped mortality profile where all age classes are randomly affected. L-shaped mortality profile is typical for faunal accumulations from natural traps.

The faunal assemblage from Hijenska pećina seems to give conflicting information about whether or not it served as a hyena den. What can be said with certainty is that in the cave there were hyenas, at least three individuals of different age classes, and they did feed on some of the carcass in the cave. The hyenas might have used the cave as their den, which could be confirmed by the presence of a hyena cub. On the other hand, only four bones, out of 430 bones in the assemblage, display hyena gnawing marks or digestion traces and it is not even certain if these marks come from a hyena or from some other carnivore.

	Crocuta crocuta spelaea	*Meles meles*	*Lynx lynx*	*Ursus spelaeus/* Ursus cf. spelaeus	*Canis lupus*	*Vulpes/Alopex*	*Bos/Bison*	*Equus ferus*	*Capreolus capreolus*	*Megaloceros giganteus*	Stephanorhinus cf. hemitoechus	TOTAL (without the hyena bones)
SKULL	9	3	0	0	1	0	0	0	0	1	0	14 (5)
VERTEBRA	17	2	0	2	6	1	0	0	0	0	0	28 (10)
FORELIMBS	29	2	0	6	1	4	2	1	1	1	1	49 (15)
HINDLIMBS	18	1	1	10	3	0	6	2	1	1	0	43 (20)

Table 91. Number of skull, vertebra, forelimbs and hindlimbs for each taxon and total number for all the taxons from Hijenska pećina.

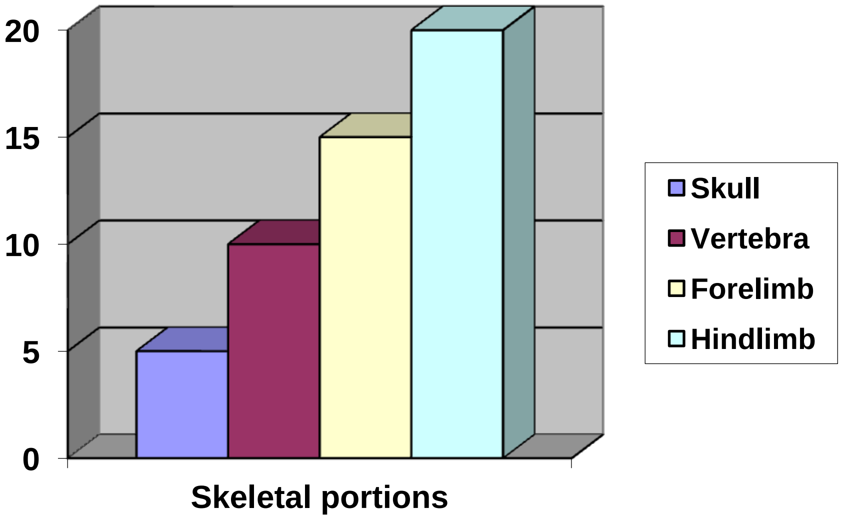


Figure 29. Frequencies of skeletal portions in Hijenska pećina.
x axis – skeletal portions; y axis – number of bones present.

5.1.2. Humans as bone collectors

First evidence of human presence in Istria comes from Šandalja I; which corresponds to Lower Paleolithic, where a chopper was found including a pebble which might have been used during the crafting of the chopper (Karavanić & Janković, 2007). Šandalja II, just like Šandalja I, is located near Pula in the south western part of the Istrian peninsula. Šandalja II is an Upper Paleolithic cave site whose lithic material was attributed to the Aurignacian and to the Epigravettian (Karavanić & Janković, 2007). The finds were studied in detail: lithic and bone artifacts (Karavanić, 2003; Janković et al., 2011), faunal assemblage (Miracle 1995; 1996; Brajković, 1998) and Epigravettian human (*Homo sapiens*) remains (Janković et al., 2012). Except Šandalja II, there are also other sites in Istria that testify about human activity in the area during the Paleolithic. Some of these sites are Romualdova pećina near Rovinj on the western coast of the peninsula (Malez, 1968; 1986), Pupićina peć in the north eastern part of the peninsula (Miracle & Forenbaher, 2006) and an open air site in Ivišće in Polje Čepić situated on the eastern side of the Istrian peninsula (Balbo et al., 2006).

Although the Istrian peninsula was inhabited by humans during the Upper Pleistocene, the evidence that they are responsible for the bone accumulation in Hijenska pećina is weak. The criteria for determining that hominids deposited the bones includes: presence of lithic artifacts and/or bone tools; cut marks and technology marks; burning marks; comminution of bone; increased mineralization, weathering and staining of bones; presence of taxa with lesser relative skeletal completeness (Lyman, 1994).

In Hijenska pećina there is only one bone (HP365 – *Bos primigenius* tibia) that has several possible cut marks. However, as already mentioned, there are two other possibilities what or who could of produced these marks. One of them is trampling which can also produce scratch marks. Trampling has a more randomly orientated scratches and it is usually located on the diaphysis, while cut marks are located closer to the epiphysis and have a more organized pattern (Lyman, 1994). The marks on HP365 are located on only one side of the shaft and there are none close to the epiphysis. Although this could mean that they were produced by trampling, it seems they are too organized. Another option is that the marks were produced by the incisors of young hyenas, and because the presence of a hyena cub was confirmed, this seems like a very plausible option. If the marks were produced by hyenas, it can also be hypothesized that the proximal part of the shaft was gnawed off by hyenas (F. Schrenk, pers. comm..)

HP373 (Plate XVIII, Fig.46), shows a possible impact scar on one of its edges. While the hyenas usually tend to gnaw on the long bone starting from the softer epiphysis, hominids first attack the diaphysis to get to the bone marrow (Cruz-Uribe, 1991). They use stone tools to hit the bones by direct percussion and this is what produces impact scars on the bones. Another feature that could point to hominids being responsible for the assemblage is the presence of type II spiral fracture. However, this type of fracture could have been caused also by carnivores or trampling (Lyman, 1994). Therefore, the only possible conclusion is that there might have been some human activity in Hijenska pećina, but probably hominids were not responsible for the faunal assemblage found in the cave.

5.1.3. Natural trap

According to Malez et al. (1974), Hijenska pećina was a natural trap - when animals would fall into to it, they would not be able to get out. Malez et al. (1974, p.9) explained it in the following way:

> “Over the flattened and vegetation covered surface of the terrain there grazed in the Upper Pleistocene herds of wild cattle, bison, horses, donkeys, stags and other animals. Some of them would have fallen onto the floor of the cave owing to lack of caution, or when driven by wild beasts, maybe also by fires. The stink of carcasses will have attracted cave hyenas, which would have jumped onto the floor of the Cave, but were then quite unable to reach the surface through the vertical part of entrance in the form of a pit with steep walls.”

Natural traps, such as karstic sink holes, were common during the Pleistocene, e.g. Sima de los Huesos in Sierra de Atapuerca in Spain (Arsuaga et al., 1997; Garcia et al., 1997) and the Emine-Bair-Khosar in Ukraine (Vremir & Ridush, 2005). According to Wolverton (2001) a natural trap should have an L-shaped mortality profile, which means that different age classes are randomly affected. Wolverton (2001; 2006), who concentrated his study on bear mortality profiles in natural traps, claims that more prime adult individuals should be expected in the assemblages from natural traps. In Hijenska pećina adult individuals predominate, followed by infants. The mortality profile of animals in Hijenska pećina seems to indicate that this indeed could be a natural trap. Various carnivore and herbivore animals are represented in the assemblage and no real pattern can be distinguished except that the bones from hyenas are the most abundant remains.

Malez et al. (1974) did not indicate the location of original entrance to the cave beyond stating that the original entrance was south east from the artificial entrance. As there is no access to the cave today and no possibility of further investigation, the articles written by Malez (Malez, 1973; 1975; 1986; Malez et al., 1974) are the only testimony that the original entrance was located vertically, forming a natural trap for animals.

6. CONCLUSION

Detailed analysis of the faunal material from Hijenska pećina has revealed that there are at least 20 different species present in the assemblage, including large and small mammals and one reptile, with total NISP of 278 bones out of 453 bones in the assemblage. Malez et al. (1974) have recognized some taxa, such as *Alces alces*, in the assemblage which are indicative of a colder climate. After the analysis, some of the taxa determined by Malez et al (1974) and Malez (1986), which are indicative of a colder climate, were excluded from the faunal list. The presence of taxa, such as *Capreolus capreolus* and *Sus scrofa,* indicate a temperate climate with forested environment (Randi et al., 2004). *Crocuta crocuta spelaea* usually inhabits open grassland-like landscape (Mangano, 2001). *Stephanorhinus hemitoechus, Equus ferus* and *Chinomys nivalis* point to an arid and a more open steppe or prairie environment.

The determined faunal assemblage confirms that this is an Upper Pleistocene site and because fauna indicative of a colder environment is absent it can be concluded that the area around Hijenska pećina was not a protected area and it did not serve as a refugium. Therefore, it can be supposed that the assemblage from Hijenska pećina belongs to the first part of the last glacial period (Würm) or OIS5

Malez et al. (1974) claimed that Hijenska pećina was once a natural trap, but at the same time they said it was ravaged by hyenas. Therefore, my goal was to answer the question if hyenas were the ones accumulating the assemblage or did they, together with other animals, get to the cave by accident and once they got in they could not get out? Hominids as accumulators of bones in Hijenska pećina can be eliminated because there are only two bones displaying possible human activity marks. Even if those marks came from hominids, statistically this is too insignificant to come as an option.

Hyenas, on the other hand, seem to be a very good candidate on whom we can put the blame on for the accumulation. The evidences in favour of hyenas as bone accumulators in Hijenska pećina are: presence of cubs, hyena coprolites, gnawing marks on bones, digested bone (Sutclife, 1970), carnivore to ungulate MNI ratio of 51% (Cruz-Uriba, 1991; Pickering, 2002; Kuhn et al., 2011), mostly limb bones represented, more distal than proximal epiphyses and 41% of the assemblage identified as cave hyena. There are also evidences saying against hyenas as bone accumulators in Hijenska pećina: L-shaped mortality profile, rare carnivore gnawing marks and a statement from Malez et al. (1974) that the original entrance to the cave was a vertical shaft. If the original entrance was a vertical entrance, then it would seem an unlikely place to use as a den. However, even if there was a vertical entrance to the cave, there might have been another horizontal entrance that was used by hyenas. Caves with two entrances are common (e.g. Wolverton, 2001) and although this can not be proven in the case of Hijenska pećina, it should be considered as an option.

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APPENDIX

Faunal coding system for Hijenska pećina

Column 1: **# -** ordinal number

Column 2: INb – inventory number

Column 3: **Species**

Column 4: **Element**

Column 5: **Portion**

Column 6: **R Br** (Recent break)

Y1	recent break, length reduced
Y2	recent break, length not affected
N	no recent breaks

Column 7: **Art** (Articulation)

A	articulated see succeeding
F	fused with preceding
PBA	probably articulated
PSA	possibly articulated
NA	indeterminable/not articulated

Column 8: **Side**

Column 9: **Complete** (Completeness – relative to complete bone)

expressed to closest of following precents
10
25
50
75
90
100

Column 10: **A/P** (Portion present – anterior/posterior)

A	anterior portion present
C	central portion present
P	posterior portion present
AP	complete anterior- posterior

Column 11: **M/L** (Portion present – medial/lateral)

M	medial portion present
C	central portion present
L	lateral portion present
ML	complete medial-lateral
IN	indeterminate

Column 12: **S/I** (Portion present – superior/inferior)

S	superior portion present
C	central portion present
I	inferior portion present
SI	complete superior-inferior
IN	indeterminate

Column 13: **Age criteria**

EFD	epipysis fused
EF	epipysis fusing (epiphyseal line)
EU	epiphysis unfused
PFD/DFD	proximal fused/distal fused (for vertebra, proximal=anterior, distal=posterior)
PFD/DF	proximal fused/distal fusing
PFD/DU	proximal fused/distal unfused
PF/DFD	proximal fusing/distal fused
PF/DF	proximal fusing/distal fusing
PF/DU	proximal fusing/distal unfused
PU/DFD	proximal unfused/distal fused
PU/DF	proximal unfused/dstal fusing
PU/DU	proximal unfused/distal unfused
CSF	cranial sutures fused
CSU	cranial sutures unfused
TB	tooth bud (root unformed)
ET	erupting tooth
OTR	open tooth root
NWT	no wear on tooth (unworn for horses-Levine)
SWT	slight wear on tooth (slightly worn for horses-Levine)
MWT	moderate wear on tooth (worn with infundibulum for horses-Levine)
HWT	heavy wear on tooth (very worn without infundibulum for horses-Levine)
VHWT	very heavy wear on tooth (extremely worn for horses-Levine)
RA	resorption of alveolus
DT	deciduous tooth
PT	permanent tooth
DPT	dental arcade with both deciduous and permanent teeth
BT/S	bone texture and/or size
M	measurement
AL	arthritic lipping
IN	indeterminate

Column 14: **Age** (Relative age)

I	infant
SA	subadult
A	adult
OA	old adult
IN	indeterminate

Column 15: **Sex criteria**

Column 16: **Sex**

F	female
M	male
IN	indeterminate

Column 17: **Reference Malez**

Column 18: **Comments**

TAPHONOMY

Column 1: **#** **-** ordinal number

Column 2: INb – inventory number

Column 3: **Weathering**

A	absent
S	slight
M	marked
IN	indeterminate

Column 4: **WT** (Weathering type)

A	absent
F	fine line fractures
S	spalling (flaking in planes)
RE	root etching
CE	chemical etching
ABR	abrasion (impact of wind and/or waterborne particles)
P	pitting
FS	fine line fractures and spalling
WW	water wear
O	other
E	eroded

Column 5: **Br pat** (breakage pattern)

U	unbroken
AF	angular fraction (dry bone)
SF	spiral fracture (green bone)
ASF	angular and spiral fractures
IN	indeterminate

Column 6: **Gnaw** (gnawing)

A	absent
RG	rodent gnawing
AG	artiodactyl gnawing
CG	carnivore gnawing
DT	passed through digestive tract
HG	human gnawing
RCG	rodent and carnivore gnawing

GU	gnawing form unknown
MGF	multiple gnawing form not already listed
PG	possible gnawing
IN	indeterminate

Column 7: **$CaCO_3$** (Calcium carbonate)

A	absent
L	light (covering <40% surface area)
M	moderate (covering 40-60% surface area)
H	heavy (covering >60% surface area)

Column 8: **Comments**

Inventory of the Hyena cave mammalian remains

(1) #	(2) INb	(3) Species	(4) Element	(5) Portion	(6) R Br	(7) Art	(8) Side	(9) Compl	(10) A/P	(11) M/L	(12) S/I	(13) Age criteria	(14) Age	(15) Sex criteria	(16) Sex	(17) Ref Malez	(18) Comments
1.	HP1	*Crocuta crocuta spelaea*	calvaria	occipital +parietal	Y1	NA	right/left	25	AP	ML	S	IN	IN	IN	IN	-	-
2.	HP2	*Crocuta crocuta spelaea*	calvaria	occipital +temporal	Y1	NA	left	10	P	ML	I	IN	IN	IN	IN	-	-
3.	HP3	*Crocuta crocuta spelaea*	maxilla with teeth	-	Y2	F	right	50	P	ML	I	PT	A	IN	IN	-	-
4.	HP3.1	*Crocuta crocuta spelaea*	maxilla with teeth	upper P4	N	A	right	100	AP	ML	SI	MWT	A	IN	IN	-	-
5.	HP3.2	*Crocuta crocuta spelaea*	maxilla with teeth	upper P3	N	A	right	100	AP	ML	SI	MWT	A	IN	IN	-	-
6.	HP3.3	*Crocuta crocuta spelaea*	maxilla with teeth	upper P2	N	A	right	100	AP	ML	SI	SWT	A	IN	IN	-	-
7.	HP4	*Crocuta crocuta spelaea*	maxilla with teeth	-	Y2	NA	left	50	C	ML	I	PT	A	IN	IN	-	-
8.	HP4.1	*Crocuta crocuta spelaea*	maxilla with teeth	upper P4	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	
9.	HP4.2	*Crocuta crocuta spelaea*	maxilla with teeth	upper P3	N	A	left	100	AP	ML	SI	-	-	IN	IN	-	
10.	HP4.3	*Crocuta crocuta spelaea*	maxilla with teeth	upper P2	N	A	left	100	AP	ML	SI	-	-	IN	IN	-	
11.	HP5	*Crocuta crocuta spelaea*	mandible with teeth	-	Y2	NA	left	75	AP	ML	SI	PT	A	IN	IN	-	HP7 was added: articular+ ascending+ coronoid+heel
12.	HP5.1	*Crocuta crocuta spelaea*	mandible with teeth	lower P4	N	A	left	100	AP	ML	SI	SWT	A	IN	IN	-	
13.	HP5.2	*Crocuta crocuta spelaea*	mandible with teeth	lower P3	N	A	left	100	AP	ML	SI	SWT	A	IN	IN	-	
14.	HP5.3	*Crocuta crocuta spelaea*	mandible with teeth	lower P2	N	A	left	100	AP	ML	SI	NWT	A	IN	IN	-	
15.	HP6	*Crocuta crocuta spelaea*	mandible with teeth	-	N	NA	right	100	AP	ML	SI	PT	A	IN	IN	-	
16.	HP6.1	*Crocuta crocuta spelaea*	mandible with teeth	lower M1	N	A	right	100	AP	ML	SI	-	-	IN	IN	-	
17.	HP6.2	*Crocuta crocuta spelaea*	mandible with teeth	lower P4	N	A	right	100	AP	ML	SI	-	-	IN	IN	-	
18.	HP6.3	*Crocuta crocuta spelaea*	mandible with teeth	lower P3	N	A	right	100	AP	ML	SI	-	-	IN	IN	-	

19.	HP6.4	*Crocuta crocuta spelaea*	mandible with teeth	lower P2	N	A	right	100	AP	ML	SI	-	-	IN	IN	-	
20.	HP6.5	*Crocuta crocuta spelaea*	mandible with teeth	lower C	N	A	right	100	AP	ML	SI	SWT	A	IN	IN	-	
21.	HP8	*Crocuta crocuta spelaea*	lower C	-	Y1	NA	left	75	AP	ML	S	MWT	A	IN	IN	-	
22.	HP9	*Crocuta crocuta spelaea*	upper C	-	N	NA	right	100	AP	ML	SI	SWT	A	IN	IN	-	
23.	HP10	*Crocuta crocuta spelaea*	lower C	-	N	NA	right	100	AP	ML	SI	HWT	OA	IN	IN	-	
24.	HP11	*Crocuta crocuta spelaea*	C	-	N	NA	IN	25	AP	ML	-	-	-	IN	IN	-	
25.	HP12	*Crocuta crocuta spelaea*	C	-	N	NA	IN	100	AP	ML	-	TB	SA	IN	IN	-	
26.	HP13	*Crocuta crocuta spelaea*	lower M1	-	N	NA	left	90	AP	ML	SI	MWT	A	IN	IN	-	
27.	HP14	*Crocuta crocuta spelaea*	upper C	-	Y1	NA	left	100	AP	ML	SI	SWT	A	IN	IN	-	
28.	HP15	*Crocuta crocuta spelaea*	atlas	-	N	PSA	medial	75	AP	ML	SI	IN	IN	IN	IN	-	
29.	HP16	*Crocuta crocuta spelaea*	axis	-	N	PSA	medial	100	AP	ML	SI	IN	IN	IN	IN	-	
30.	HP17	*Crocuta crocuta spelaea*	7th cervical vertebra	-	Y2	PSA	medial	90	AP	ML	SI	IN	IN	IN	IN	-	
31.	HP18	*Crocuta crocuta spelaea*	3rd-5th cervical vertebra	-	Y2	PSA	medial	90	AP	ML	SI	IN	IN	IN	IN	-	
32.	HP19	*Crocuta crocuta spelaea*	2nd thoracic vertebra	-	Y2	NA	medial	90	AP	ML	SI	PU/?	I	IN	IN	-	
33.	HP20	*Crocuta crocuta spelaea*	7th-10th thoracic vertebra	-	N	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
34.	HP21	*Crocuta crocuta spelaea*	14th-15th thoracic vertebra	-	Y2	PSA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
35.	HP22	*Crocuta crocuta spelaea*	14th-15th thoracic vertebra	complete except for spinous process	N	PSA	medial	75	AP	ML	SI	PFD/DFD	A	IN	IN	-	
36.	HP23	*Crocuta crocuta spelaea*	11th thoracic vertebra	complete except for spinous process	Y2	PSA	medial	75	AP	ML	SI	PFD/DFD	A	IN	IN	-	
37.	HP24	*Crocuta crocuta spelaea*	thoracic vertebra	spinous process	N	NA	medial	25	AP	ML	S	IN	IN	IN	IN	-	
38.	HP25	*Crocuta crocuta spelaea*	last 3 thoracic or lumbar vertebra	spinous process	Y1	NA	medial	25	AP	ML	S	IN	IN	IN	IN	-	
39.	HP26	*Crocuta crocuta spelaea*	last 3 thoracic or lumbar vertebra	spinous process	Y1	NA	medial	25	AP	ML	S	IN	IN	IN	IN	-	

40.	HP27	*Crocuta crocuta spelaea*	thoracic vertebra	spinous process	Y2	NA	medial	25	AP	ML	S	IN	IN	IN	IN	-	
41.	HP28	*Crocuta crocuta spelaea*	14th-15th thoracic vertebra	-	Y2	PSA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
42.	HP29	*Crocuta crocuta spelaea*	thoracic vertebra	spinous process	Y2	NA	medial	25	AP	ML	S	IN	IN	IN	IN	-	
43.	HP30	*Crocuta crocuta spelaea*	lumbar vertebra	-	Y2	PSA	medial	75	AP	ML	SI	PFD/DFD	A	IN	IN	-	
44.	HP31	*Panthera leo spelaea*	12th-13th thoracic vertebra	-	Y2	NA	medial	75	AP	ML	SI	PFD/DFD	A	IN	IN	-	
45.	HP32	*Crocuta crocuta spelaea*	scapula	-	Y2	NA	left	75	AP	ML	SI	EFD	A	IN	IN	-	
46.	HP33	*Crocuta crocuta spelaea*	humerus	proximal epiphysis	Y1	NA	left	10	AP	ML	S	IN	IN	IN	IN	-	
47.	HP34	*Crocuta crocuta spelaea*	humerus	proximal epiphysis	Y1	PBA	right	10	AP	ML	S	IN	IN	IN	IN	-	
48.	HP35	*Crocuta crocuta spelaea*	humerus	-	Y1	PBA	right	90	AP	ML	I	?/DFD	IN	IN	IN	-	proximal epiphysis is missing
49.	HP36	*Crocuta crocuta spelaea*	humerus	distal end (epiph+shaft)	Y1	NA	right	75	AP	ML	I	?/DFD	IN	IN	IN	-	
50.	HP37	*Crocuta crocuta spelaea*	radius	-	Y1	PSA	left	90	AP	ML	SI	PF/?	SA	IN	IN	-	
51.	HP38	*Crocuta crocuta spelaea*	radius	-	Y1	PSA	left	90	AP	ML	S	?/DFD	A	IN	IN	-	
52.	HP39	*Crocuta crocuta spelaea*	radius	-	Y1	PSA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
53.	HP40	*Crocuta crocuta spelaea*	radius	-	Y2	PSA	right	100	AP	ML	SI	PF/?	SA	IN	IN	-	
54.	HP41	*Crocuta crocuta spelaea*	ulna	proximal end (epiph+shaft)	Y1	PSA	right	75	AP	ML	S	PFD/?	A	IN	IN	-	
55.	HP42	*Crocuta crocuta spelaea*	ulna	proximal end (epiph+shaft)	Y1	PSA	left	90	AP	ML	S	PFD/?	A	IN	IN	-	
56.	HP43	*Crocuta crocuta spelaea*	ulna	-	Y2	PSA	right	100	AP	ML	SI	IN	IN	IN	IN	-	
57.	HP44	*Crocuta crocuta spelaea*	ulna	-	Y1	PSA	left	90	AP	ML	S	IN	IN	IN	IN	-	
58.	HP45	*Crocuta crocuta spelaea*	ulna	proximal shaft	Y1	NA	left	50	AP	ML	S	IN	IN	IN	IN	-	
59.	HP46	*Crocuta crocuta spelaea*	metacarpal 3	-	Y1	NA	right	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
60.	HP47	*Crocuta crocuta spelaea*	metacarpal 5	-	Y2	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
61.	HP48	*Crocuta crocuta spelaea*	metacarpal 5	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
62.	HP49	*Crocuta crocuta*	matacarpal 2	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	

		spelaea															
63.	HP50	*Crocuta crocuta spelaea*	metacarpal 2	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
64.	HP51	*Crocuta crocuta spelaea*	metacarpal 3	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
65.	HP52	*Crocuta crocuta spelaea*	metacarpal 3	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
66.	HP53	*Crocuta crocuta spelaea*	metacarpal 2	-	Y2	NA	right	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
67.	HP54	*Crocuta crocuta spelaea*	phalanx I	-	N	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
68.	HP55	*Crocuta crocuta spelaea*	phalanx I	-	N	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
69.	HP56	*Crocuta crocuta spelaea*	phalanx I	-	N	NA	-	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
70.	HP57	*Crocuta crocuta spelaea*	phalanx II	-	N	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
71.	HP58	*Crocuta crocuta spelaea*	phalanx II	-	Y2	NA	-	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	
72.	HP59	*Crocuta crocuta spelaea*	phalanx II	-	N	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
73.	HP60	*Crocuta crocuta spelaea*	phalanx II	-	Y2	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
74.	HP61	*Crocuta crocuta spelaea*	phalanx II	-	N	NA	-	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
75.	HP62	*Crocuta crocuta spelaea*	coxa	ischial acetabulum portion	Y1	NA	right	10	C	ML	SI	IN	IN	IN	IN	-	
76.	HP63	*Crocuta crocuta spelaea*	femur	proximal end +diaphysis	Y1	NA	left	75	AP	ML	S	PU/?	I	IN	IN	-	
77.	HP64	*Crocuta crocuta spelaea*	femur	distal end (epiph+shaft)	Y1	NA	left	25	AP	ML	SI	?/DFD	A	IN	IN	-	
78.	HP65	*Crocuta crocuta spelaea*	femur	distal epipysis (only condyles present)	N	NA	right	10	AP	ML	I	?/DU	I	IN	IN	-	
79.	HP66	*Crocuta crocuta spelaea*	tibia	-	Y2	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
80.	HP67	*Crocuta crocuta spelaea*	tibia	-	Y1	NA	right	90	AP	ML	SI	PU/?	SA	IN	IN	-	
81.	HP68	*Crocuta crocuta spelaea*	tibia	distal end (epiph+shaft)	Y1	NA	left	75	AP	ML	I	IN	IN	IN	IN	-	
82.	HP69	*Crocuta crocuta spelaea*	calcaneus	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	HP	
83.	HP70	*Crocuta crocuta spelaea*	calcaneus	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	
84.	HP71	*Crocuta crocuta spelaea*	centrall tarsal (navicular)	-	N	NA	right	100	AP	ML	SI	IN	IN	IN	IN	-	
85.	HP72	*Crocuta crocuta*	metatarsal 3	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	

		spelaea															
86.	HP73	*Crocuta crocuta spelaea*	metatarsal 5	-	Y2	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	
87.	HP74	*Crocuta crocuta spelaea*	phalanx III	-	N	NA	-	100	AP	ML	SI	IN	IN	IN	IN	-	
88.	HP75	*Meles meles*	calvaria	parietal	Y1	NA	medial	25	AP	ML	SI	IN	IN	IN	IN	Hijenska p. Buja	parts of temporal, frontal and occipital still attached
89.	HP76	*Meles meles*	mandible with teeth	-	Y1	NA	right	75	AP	ML	SI	PT/VHWT	OA	IN	IN	-	-
90.	HP76.1	*Meles meles*	mandible with teeth	lower M1	N	A	right	100	AP	ML	SI	VHWT	OA	IN	IN	-	-
91.	HP77	*Meles meles*	mandible with teeth	-	Y1	NA	right	50	AP	ML	SI	PT	A	IN	IN	-	-
92.	HP77.1	*Meles meles*	mandible with teeth	lower M1	N	A	right	100	AP	ML	SI	SWT	A	IN	IN	-	-
93.	HP78	*Meles meles*	upper C	-	Y1	NA	right	90	AP	ML	SI	MWT	A	IN	IN	-	-
94.	HP79	*Meles meles*	humerus	diaphysis	N	NA	left	90	AP	ML	C	PU/DU	I	IN	IN	Hijenska peć Buje	-
95.	HP80	*Meles meles*	ulna	proximal end+diaphysis	Y1	NA	left	75	AP	ML	SI	IN	IN	IN	IN	-	missing the tip of olecranon
96.	HP81	*Meles meles*	tibia	-	N	NA	left	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
97.	HP82	*Ursus speleus*	6th thoracic vertebra	-	Y2	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
98.	HP83	*Ursus speleus*	4th-6th thoracic vertebra	centrum/sagittal split	N	NA	left	25	AP	L	SI	IN	IN	IN	IN	-	-
99.	HP84	*Bos/Bison*	humerus	distal epiphysis	N	NA	right	25	AP	ML	SI	IN	IN	IN	IN	-	lateral part of trochlea is missing and posteriorly meadial part of trochlea
100.	HP85	Ursus cf. speleus	radius	proximal end+ diaphysis	Y1	NA	right	75	AP	ML	I	IN	IN	IN	IN	-	-
101.	HP86	*Ursus speleus*	metatarsal I	-	N	NA	right	100	AP	ML	SI	?/DFD	A	IN	IN	-	-
102.	HP87	Ursus cf. speleus	metatarsal II	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
103.	HP88	*Ursus.speleus*	metacarpal I	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
104.	HP89	Ursus cf. speleus	femur	distal epiphysis (right condyle)	N	NA	left	10	P	ML	S	IN	IN	IN	IN	-	-
105.	HP90	*Ursus speleus*	tibia	distal end+diaphysis	Y1	NA	left	50	AP	ML	I	?/DFD	A	IN	IN	-	-
106.	HP91	*Ursus speleus*	tibia	proximal epiphysis+ shaft	Y2	NA	right	10	A	ML	S	IN	IN	IN	IN	-	-
107.	HP92	Ursus cf. speleus	fibula	proximal epiphysis+ shaft	Y1	NA	left	90	AP	ML	S	PFD/?	IN	IN	IN	-	-

108.	HP93	*Ursus speleus*	calcaneus	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
109.	HP94	Ursus cf. speleus	astragalus	-	N	NA	right	50	AP	ML	SI	IN	IN	IN	IN	-	-
110.	HP95	*Ursus speleus*	metatarsus V	-	N	NA	left	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
111.	HP96	*Canis lupus*	mandible with teeth	-	Y1	NA	left	90	AP	ML	SI	PT	A	IN	IN	Hijenska pećina	-
112.	HP96.1	*Canis lupus*	mandible with teeth	lower M2	N	A	left	100	AP	ML	SI	HWT	A	IN	IN	-	-
113.	HP96.2	*Canis lupus*	mandible with teeth	lower M1	N	A	left	100	AP	ML	SI	HWT	A	IN	IN	-	-
114.	HP96.3	*Canis lupus*	mandible with teeth	lower P4	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
115.	HP96.4	*Canis lupus*	mandible with teeth	lower P3	N	A	left	100	AP	ML	SI	SWT	A	IN	IN	-	-
116.	HP96.5	*Canis lupus*	mandible with teeth	lower P2	N	A	left	100	AP	ML	SI	SWT	A	IN	IN	-	-
117.	HP97	*Canis lupus*	axis	centrum epiphysis anterior	Y1	NA	medial	50	AP	ML	SI	IN	IN	IN	IN	-	-
118.	HP98	*Canis lupus*	5th cervical vertebra	-	Y2	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	missing processus spinossus and processus transversus on one side
119.	HP99	*Canis lupus*	6th-9th thoracic vertebra	-	Y2	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	missisng the tip of processus spinosus
120.	HP100	*Canis lupus*	humerus	-	Y1	NA	right	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
121.	HP101	*Canis lupus*	tibia	proximal epiphysis+diaphysis	Y1	NA	left	50	AP	ML	C	IN	IN	IN	IN	-	-
122.	HP102	*Canis lupus*	tibia	distal epiphysis+diaphysis	Y1	NA	left	50	AP	ML	I	?/DFD	A	IN	IN	-	-
123.	HP103	*Vulpes/Alopex*	1st-5th lumbal vertebra	-	Y2	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
124.	HP104	*Vulpes/Alopex*	humerus	distal end+diaphysis	N	NA	left	50	AP	ML	I	?/DFD	A	IN	IN	-	-
125.	HP105	*Vulpes/Alopex*	radius	distal end	Y1	NA	right	25	AP	ML	I	IN	IN	IN	IN	-	-
126.	HP106	*Vulpes/Alopex*	radius	proximal end+diaphysis	Y1	NA	right	50	AP	ML	S	IN	IN	IN	IN	-	-
127.	HP107	*Vulpes/Alopex*	ulna	proximal end+diaphysis	N	NA	right	75	AP	ML	S	IN	IN	IN	IN	-	tip of olecranon is missing
128.	HP108	*Lepus sp.*	femur	-	N	NA	left	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
129.	HP109	*Panthera leo spelaea*	lower P2	-	N	NA	left	50	P	ML	SI	IN	IN	IN	IN	-	-
130.	HP110	*Panthera leo spelaea*	metatarsus III	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
131.	HP111	*Megaloceros*	mandible with		Y1	NA	left	50	C	ML	SI	PT	A	IN	IN	-	-

		giganteus	teeth														
132.	HP111.1	*Megaloceros giganteus*	mandible with teeth	lower M3	N	A	left	100	AP	ML	SI	SWT	A	IN	IN	-	-
133.	HP111.2	*Megaloceros giganteus*	mandible with teeth	lower M2	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
134.	HP112	*Cervus elaphus*	tooth	upper M2	Y1	NA	right	90	AP	ML	SI	MWT	A	IN	IN	-	-
135.	HP113	*Cervidae indet.*	antler fragment	-	Y1	PA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
136.	HP114	*Cervidae indet.*	antler fragment	-	Y1	PA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
137.	HP115	Large Ungulata indet.	calcaneus	shaft	N	NA	right	50	AP	ML	S	IN	IN	IN	IN	-	-
138.	HP116	Large Ungulata indet.	astragalus	-	N	NA	right	100	AP	ML	SI	IN	IN	IN	IN	-	-
139.	HP117	*Cervidae indet.*	metapodial	distal epiphysis (condyle)	N	NA	IN	10	AP	ML	I	IN	IN	IN	IN	-	-
140.	HP118	*Bos/bison*	lower M1-M2	-	Y2	NA	right	90	AP	ML	SI	SWT	A	IN	IN	-	-
141.	HP119	*Bos/bison*	lower M2-M3	-	N	NA	right	100	AP	ML	SI	MWT	A	IN	IN	-	HP128 was added
142.	HP120	*Bos/bison*	lower M1-M2	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
143.	HP121	*Bos/bison*	upper M1-M3	-	N	NA	right	100	AP	ML	SI	HWT	OA	IN	IN	-	-
144.	HP122	*Bos/bison*	upper M1-M3	-	N	NA	left	75	AP	ML	SI	HWT	OA	IN	IN	-	-
145.	HP123	*Bos/bison*	lower M1-M3	-	N	NA	left	10	AP	L	S	IN	IN	IN	IN	-	-
146.	HP124	*Equus sp.*	IN	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
147.	HP125	*Bos/bison*	lower dP4	-	Y2	NA	left	75	AP	ML	SI	MWT	I	IN	IN	-	-
148.	HP126	*Bos/bison*	upper M1-M3	-	N	NA	left	75	AP	ML	S	MWT	A	IN	IN	-	-
149.	HP127	*Bos/bison*	upper M1-M3	-	N	NA	left	75	AP	ML	S	HWT	OA	IN	IN	-	-
150.	HP129	*Bos/bison*	M1-M3	-	N	NA	IN	10	IN	IN	C	IN	IN	IN	IN	-	-
151.	HP130	*Ungulate indet.*	tooth fragment	-	Y1	NA	IN	10	IN	IN	IN	IN	IN	IN	IN	-	-
152.	HP131	*Ungulate indet.*	tooth fragment	-	N	NA	IN	10	IN	IN	IN	IN	IN	IN	IN	-	-
153.	HP132	*Bos/bison*	lower P3	-	N	NA	left	90	AP	ML	SI	VHWT	OA	IN	IN	Hijenska p. Buje	-
154.	HP133	*Bos/bison*	phalanx III		N	NA	lateral left or medial right	100	AP	ML	SI	IN	IN	IN	IN	-	-
155.	HP134	*Cervidae indet.*	metatarsus	diaphysis	N	NA	IN	10	P	IN	C	IN	IN	IN	IN	-	-
156.	HP135	*Bos primigenius*	calcaneus	-	N	NA	right	100	AP	ML	SI	IN	IN	IN	IN	-	-
157.	HP136	*Bos/bison*	astragalus	-	N	NA	left	50	AP	ML	SI	IN	IN	IN	IN	Hijenska p. Buje	-
158.	HP137	*Bos primigenius*	astragalus	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
159.	HP138	*Equus ferus*	upper P3-M2	-	N	NA	right	100	AP	ML	SI	HWT	A/OA	IN	IN	-	6y-20y
160.	HP139	*Equus ferus*	lower P2-M3	-	N	NA	IN	90	AP	ML	SI	IN	IN	IN	IN	-	-

161.	HP140	*Equus ferus*	upper P3-M2	-	Y2	NA	left	75	AP	ML	SI	HWT	A/OA	IN	IN	Hijenska peć. Buje	6y-20y
162.	HP141	*Equus ferus*	upper P2-M3	-	N	NA	IN	75	AP	ML	SI	NWT	SA	IN	IN	-	pren.-4y6m
163.	HP142	*Equus ferus*	upper P2	-	N	NA	left	90	AP	ML	SI	HWT	A/OA	IN	IN	Hijenska p. Buje	6y-20y
164.	HP143	*Equus ferus*	lower P3-M2	-	Y2	NA	right	90	AP	ML	SI	HWT	OA	IN	IN	-	9y-20y
165.	HP144	*Equus ferus*	lower P3-M2	-	N	NA	left	90	AP	ML	SI	HWT	OA	IN	IN	-	9y-20y
166.	HP145	*Equus ferus*	upper P3-M2	-	Y1	NA	right	75	AP	ML	SI	NWT	SA	IN	IN	-	1y4m-2y
167.	HP146	*Equus ferus*	upper P3-M2	-	N	NA	right	100	AP	ML	SI	NWT	SA	IN	IN	-	1y4m-2y
168.	HP147	*Equus ferus*	upper P3-M2	-	N	NA	right	100	AP	ML	SI	HWT	A/OA	IN	IN	-	6y-20y
169.	HP148	*Equus ferus*	upper P3-M2	-	N	NA	right	75	AP	ML	SI	NWT	SA	IN	IN	-	1y4m-2y
170.	HP149	*Equus ferus*	lower M3	-	N	NA	right	90	AP	ML	SI	HWT	OA	IN	IN	-	15y-25y
171.	HP150	*Equus ferus*	I3	-	N	NA	left	90	AP	ML	SI	MWT	A	IN	IN	-	5y-11y6m; oval infundibulum 5-9y
172.	HP151	*Equus ferus*	upper P2-M3	-	N	NA	IN	75	AP	ML	SI	HWT	A/OA	IN	IN	-	6-20y
173.	HP152	*Equus ferus*	upper P3-M2	-	N	NA	left	90	AP	ML	SI	NWT	SA	IN	IN	-	1y4m-2y
174.	HP153	*Equus ferus*	I1-I3	-	N	NA		100	AP	ML	SI	HWT	A/OA	IN	IN	-	8-13y
175.	HP154	*Equus ferus*	upper P3-M2	-	N	NA	left	50	AP	ML	SI	NWT	SA	IN	IN	-	1y4m-2y
176.	HP155	*Equus ferus*	I1-I3	-	N	NA	left	100	AP	ML	SI	MWT	A	IN	IN	-	oval infundibulum 3-10y
177.	HP156	*Equus ferus*	I1-I3	-	N	NA	IN	100	AP	ML	SI	HWT	A/OA	IN	IN	-	8-13y
178.	HP157	*Equus ferus*	C	-	N	NA	IN	100	AP	ML	SI	NWT	SA/A	IN	IN	-	2y6m-5y
179.	HP158	*Equus ferus*	humerus	fragment of diaphysis	N	NA	right	10	P	M	C	IN	IN	IN	IN	-	-
180.	HP159	*Equus ferus*	metacarpus III	proximal epiphysis+diaphysis	N	NA	left	90	AP	ML	SI	PFD/?	IN	IN	IN	-	-
181.	HP160	*Equus ferus*	metacarpus II/IV	-	N	NA	IN	100	AP	ML	SI	IN	IN	IN	IN	-	-
182.	HP161	*Equus ferus*	metacarpus II/IV	-	N	NA	IN	90	AP	ML	SI	IN	IN	IN	IN	-	-
183.	HP162	*Equus ferus*	femur	diaphysis	Y1	NA	right	25	AP	ML	C	IN	IN	IN	IN	-	conjoined with 164!
184.	HP163	*Equus ferus*	astragalus	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
185.	HP165	*Equus ferus*	tibia	distal epiphysis+diaphysis	N	NA	right	50	AP	ML	I	?/DFD	A	IN	IN	-	-
186.	HP166	*Equus ferus*	tibia	diaphysis	Y2	NA	left	25	AP	L	C	IN	IN	IN	IN	-	-
187.	HP167	*Equus ferus*	phalanx I	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
188.	HP168	*Equus ferus*	phalanx I	proximal epiphysis	N	NA	right	10	AP	ML	S	IN	IN	IN	IN	-	-
189.	HP169	*Equus ferus*	phalanx I	medial or lateral part of distal epiphysis+shaft	N	NA	IN	10	AP	IN	I	IN	IN	IN	IN	-	-
190.	HP170	*Equus ferus*	phalanx III	-	N	NA	IN	100	AP	ML	SI	IN	IN	IN	IN	-	-
191.	HP171	*Equus ferus*	phalanx III	proximal part of the	N	NA	IN	25	AP	ML	S	IN	IN	IN	IN	-	-

				phalanx (articular surface)													
192.	HP172	*Ungulata indet.*	tooth	fragment of crown of buccal/lingual side	N	NA	IN	10	IN	IN	C	IN	IN	IN	IN	-	-
193.	HP173	*Cervidae indet,*	metapodial	distal epiphysis	N	NA	IN	10	AP	IN	SI	IN	IN	IN	IN	-	-
194.	HP174	Large carnivora indet.	sternum	-	N	NA	medial	90	AP	ML	SI	IN	IN	IN	IN	-	-
195.	HP175	Large carnivora indet.	sternum	-	N	NA	medial	90	AP	ML	SI	IN	IN	IN	IN	-	-
196.	HP176	Large carnivora indet.	sternum	-	N	NA	medial	100	AP	ML	SI	IN	IN	IN	IN	-	-
197.	HP177	*Erinaceus sp.*	femur	proximal epiphysis+diaphysis	N	NA	right	75	AP	ML	C	IN	IN	IN	IN	-	-
198.	HP178	indeterminate	tooth	-	N	NA	IN	100	AP	ML	SI	HWT	OA	IN	IN	-	-
199.	HP179	indeterminate	mandible	base+alveolar	N	NA	IN	10	C	IN	C	IN	IN	IN	IN	-	-
200.	HP180	Cervidae indet.	mandible	articular+ascending+ coronoid	Y1	NA	right	10	AP	ML	S	IN	IN	IN	IN		
201.	HP181	indeterminate	calvaria	occipital condyle	N	NA	IN	10	AP	IN	I	IN	IN	IN	IN	-	-
202.	HP182	indeterminate	calvaria	-	N	NA	IN	10	IN	IN	IN	IN	IN	IN	IN	-	-
203.	HP183	indeterminate	calvaria	-	Y1	NA	IN	10	IN	IN	IN	IN	IN	IN	IN	-	-
204.	HP184	indeterminate	vertebra	centrum epiphysis anterior	N	NA	medial	10	A	C	I	IN	IN	IN	IN	-	-
205.	HP185	indeterminate	vertebra	fragment of neural arch	Y1	NA	medial	10	IN	C	C	IN	IN	IN	IN	-	-
206.	HP186	*Canis lupus*	III cervical vertebrae	centrum epiphysis posterior	Y1	NA	medial	25	P	ML	I	?/DFD	A	IN	IN	-	-
207.	HP187	indeterminate	vertebra	IN	Y1	NA	medial	10	C	C	C	IN	IN	IN	IN	-	-
208.	HP188	indeterminate	vertebra	fragment of neural arch	Y1	NA	medial	10	AP	ML	SI	IN	IN	IN	IN	-	-
209.	HP189	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
210.	HP190	indeterminate	rib	epiphysis+shaft	Y1	NA	IN	90	AP	ML	SI	EU	SA	IN	IN	-	-
211.	HP191	indeterminate	rib	-	N	NA	IN	100	AP	ML	SI	EU	SA	IN	IN	-	-
212.	HP192	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
213.	HP193	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
214.	HP194	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
215.	HP195	indeterminate	rib	epiphysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
216.	HP196	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
217.	HP197	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
218.	HP198	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
219.	HP199	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
220.	HP200	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	EUF	SA	IN	IN	-	-
221.	HP201	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
222.	HP202	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
223.	HP203	indeterminate	rib	epihysis+shaft	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
224.	HP204	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
225.	HP205	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	SI	IN	IN	IN	IN	-	.

226.	HP206	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
227.	HP207	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
228.	HP208	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
229.	HP209	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	SI	IN	IN	IN	IN	-	-
230.	HP210	indeterminate	rib	small fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
231.	HP211	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
232.	HP212	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
233.	HP213	indeterminate	rib	small fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
234.	HP214	indeterminate	rib	small fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
235.	HP215	indeterminate	rib	small fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
236.	HP216	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
237.	HP217	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
238.	HP218	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
239.	HP219	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
240.	HP220	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
241.	HP221	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
242.	HP222	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
243.	HP223	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
244.	HP224	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
245.	HP225	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
246.	HP226	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
247.	HP227	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
248.	HP228	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
249.	HP229	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
250.	HP230	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
251.	HP231	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
252.	HP232	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
253.	HP233	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
254.	HP234	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
255.	HP235	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
256.	HP236	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	ENF	SA	IN	IN	-	-
257.	HP237	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	ML	IN	IN	IN	IN	IN	-	-
258.	HP238	Stephanorhinus cf. hemitoechus	metacarpus 3	epiphysis+shaft	Y1	NA	right	50	AP	ML	S	PFD/?	IN	IN	IN	-	-
259.	HP239	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
260.	HP240	indeterminate	rib	epihysis+shaft	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
261.	HP241	indeterminate	rib	epihysis+shaft	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
262.	HP242	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
263.	HP243	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
264.	HP244	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
265.	HP245	indeterminate	rib	epiphysis+diaphysis	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
266.	HP246	indeterminate	rib	small fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
267.	HP247	indeterminate	rib	small fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
268.	HP248	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
269.	HP249	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
270.	HP250	indeterminate	rib	epiphysis+shaft	Y1	NA	IN	90	AP	ML	SI	IN	IN	IN	IN	-	-

271.	HP251	Equus cf. ferus	pelvis	ilium+acetabulum	Y1	NA	right	10	P	ML	I	IN	IN	IN	IN	Hijenska pećina Buje 1976	-
272.	HP252	*Canis lupus*	femur	-	Y1	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
273.	HP253	*Lynx lynx*	calcaneus	-	N	NA	right	100	AP	ML	SI	IN	IN	IN	IN	-	-
274.	HP254	indeterminate	metapodial	proximal epiphysis	N	NA	IN	10	A	ML	S	IN	IN	IN	IN	-	-
275.	HP255	*Crocuta crocuta spelaea*	metatarsus 2	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
276.	HP256	*Crocuta crocuta spelaea*	metatarsus 2	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
277.	HP257	*Crocuta crocuta spelaea*	metacarpal 3	-	N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
278.	HP258	*Crocuta crocuta spelaea*	metacarpal 5	-	N	NA	right	100	AP	ML	SI	IN	IN	IN	IN	-	-
279.	HP259	*Canis lupus*	metacarpal 2	-	Y1	NA	right	50	AP	ML	S	PFD/?	IN	IN	IN	-	-
280.	HP261	*Cervus elaphus*	phalanx I	lateral side	N	NA	right	25	AP	L	SI	IN	IN	IN	IN	-	-
281.	HP262	Ursus cf. spelaeus	metatarsus I	-	N	NA	left	90	AP	ML	I	?/DFD	IN	IN	IN	-	-
282.	HP263	*Capreolus capreolus*	phalanx II	-	N	NA	right lateral or left medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
283.	HP264	*Crocuta crocuta spelaea*	ulna	distal epiphysis	N	NA	left	10	AP	ML	I	IN	IN	IN	IN	-	-
284.	HP265	indeterminate	caput		N	NA	IN	10	IN	IN	S	IN	IN	IN	IN	-	-
285.	HP266	indeterminate	long bone	fragment	Y2	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
286.	HP267	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
287.	HP268	indeterminate	long bone	fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
288.	HP269	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
289.	HP270	indeterminate	long bone	fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
290.	HP271	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
291.	HP272	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
292.	HP273	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
293.	HP274	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
294.	HP275	indeterminate	long bone	fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
295.	HP276	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
296.	HP277	indeterminate	long bone	fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
297.	HP278	indeterminate	long bone	fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
298.	HP279	indeterminate	long bone	shaft fragment	Y1	NA	IN	25	AP	C	SI	IN	IN	IN	IN	-	-
299.	HP280	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
300.	HP281	indeterminate	long bone	shaft fragment	Y1	NA	IN	10	AP	C	SI	IN	IN	IN	IN	-	-
301.	HP282	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
302.	HP283	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
303.	HP284	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
304.	HP285	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
305.	HP286	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
306.	HP287	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
307.	HP288	indeterminate	long bone	shaft fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-

308.	HP289	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
309.	HP290	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
310.	HP291	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
311.	HP292	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
312.	HP293	indeterminate	long bone	diaphysis	N	NA	IN	25	AP	ML	C	IN	IN	IN	IN	-	-
313.	HP294	indeterminate	long bone	diaphysis	Y1	NA	IN	50	AP	ML	C	IN	IN	IN	IN	-	-
314.	HP295	indeterminate	long bone	shaft fragment	Y1	NA	IN	25	AP	C	SI	IN	IN	IN	IN	-	-
315.	HP296	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
316.	HP297	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
317.	HP298	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
318.	HP299	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
319.	HP300	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
320.	HP301	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
321.	HP302	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
322.	HP303	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
323.	HP304	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
324.	HP305	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
325.	HP306	*Crocuta crocuta spelaea*	metapodial	-	Y1	NA	IN	90	AP	ML	SI	IN	IN	IN	IN	-	combined with 260
326.	HP307	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
327.	HP308	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
328.	HP309	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
329.	HP310	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
330.	HP311	indeterminate	indeterminate	-	Y2	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
331.	HP312	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
332.	HP313	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
333.	HP314	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
334.	HP315	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
335.	HP316	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
336.	HP317	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
337.	HP318	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
338.	HP319	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
339.	HP320	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
340.	HP321	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
341.	HP322	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
342.	HP323	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
343.	HP324	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
344.	HP325	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
345.	HP326	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
346.	HP327	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
347.	HP328	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
348.	HP329	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
349.	HP330	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
350.	HP331	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
351.	HP332	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
352.	HP333	indeterminate	indeterminate	-	IN	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-

353.	HP334	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
354.	HP335	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
355.	HP336	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
356.	HP337	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	IN	IN	IN	IN	IN	-	-
357.	HP338	*Crocuta crocuta spelaea*	mandible with teeth	-	Y2	NA	right	75	AP	ML	SI	PT	A	IN	IN	-	-
358.	HP338.1	*Crocuta crocuta spelaea*	mandible with teeth	lower M1	N	A	right	90	AP	ML	SI	MWT	A	IN	IN	-	-
359.	HP338.2	*Crocuta crocuta spelaea*	mandible with teeth	lower P4	N	A	right	100	AP	ML	SI	HWT	A	IN	IN	-	-
360.	HP338.3	*Crocuta crocuta spelaea*	mandible with teeth	lower P3	N	A	right	100	AP	ML	SI	HWT	A	IN	IN	-	-
361.	HP338.4	*Crocuta crocuta spelaea*	mandible with teeth	lower P2	N	A	right	100	AP	ML	SI	SWT	A	IN	IN	-	-
362.	HP338.5	*Crocuta crocuta spelaea*	mandible with teeth	lower C	Y1	A	right	100	AP	ML	SI	IN	IN	IN	IN	-	-
363.	HP339	*Crocuta crocuta spelaea*	mandible with teeth	-	Y1	NA	left	50	AP	ML	SI	PT	A	IN	IN	-	-
364.	HP339.1	*Crocuta crocuta spelaea*	mandible with teeth	lower P4	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
365.	HP339.2	*Crocuta crocuta spelaea*	mandible with teeth	lower P3	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
366.	HP339.3	*Crocuta crocuta spelaea*	mandible with teeth	lower P2	N	A	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
367.	HP340	*Crocuta crocuta spelaea*	mandible with teeth	-	Y1	NA	left	50	AP	ML	SI	PT	A	IN	IN	-	-
368.	HP340.1	*Crocuta crocuta spelaea*	mandible with teeth	lower M1	Y2	A	left	100	AP	ML	SI	HWT	A	IN	IN	-	-
369.	HP340.2	*Crocuta crocuta spelaea*	mandible with teeth	lower P4	N	A	left	100	AP	ML	SI	HWT	A	IN	IN	-	-
370.	HP340.3	*Crocuta crocuta spelaea*	mandible with teeth	lower P3	N	A	left	100	AP	ML	SI	HWT	A	IN	IN	-	-
371.	HP340.4	*Crocuta crocuta spelaea*	mandible with teeth	lower P2	N	A	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
372.	HP341	*Panthera leo spelaea*	lower C	lower C	N	NA	right	75	AP	ML	I	IN	IN	IN	IN	-	
373.	HP342	*Crocuta crocuta spelaea*	upper P4	-	N	NA	left	100	AP	ML	SI	MWT	A	IN	IN	-	-
374.	HP343	*Crocuta crocuta spelaea*	humerus	-	N	NA	left	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	issing part of the caput
375.	HP344	*Crocuta crocuta spelaea*	humerus	distal end (epiph+shaft)	N	NA	left	50	AP	ML	SI	?/DFD	IN	IN	IN	-	-
376.	HP345	*Crocuta crocuta spelaea*	humerus	distal end (epiph+shaft)	N	NA	left	50	AP	ML	SI	?/DFD	IN	IN	IN	-	-
377.	HP346	*Crocuta crocuta spelaea*	femur	-	N	NA	right	90	AP	ML	SI	PU/DU	I	IN	IN	-	-
378.	HP347	*Crocuta crocuta*	femur	proximal	N	NA	left	75	AP	ML	SI	PFD/?	A	IN	IN	-	-

		spelaea		end+epiphysis													
379.	HP348	*Crocuta crocuta spelaea*	tibia	-	N	NA	right	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
380.	HP349	*Equus ferus*	tarsal III	-	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
381.	HP350	*Equus ferus*	radius	proximal epiphysis	N	NA	right	50	AP	ML	S	PFD/?	A	IN	IN	-	-
382.	HP351	*Equus ferus*	tibia	diaphysis fragment	N	NA	left	25	AP	ML	C	IN	IN	IN	IN	-	mostly posterior part
383.	HP352	*Sus scrofa*	coxa	ilium+acetabulum	Y1	NA	right	25	C	ML	SI	IN	IN	IN	IN	-	-
384.	HP353	*Ursus speleus*	metatarsal III	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
385.	HP354	*Ursus speleus*	ulna	proximal end+diaphysis	N	NA	left	75	AP	ML	SI	PFD/?	A	IN	IN	-	-
386.	HP355	*Ursus speleus*	ulna	proximal end+diaphysis	Y1	NA	left	75	AP	ML	SI	PFD/?	A	IN	IN	-	-
387.	HP356	Ursus cf. speleus	femur	proximal end+diaphysis	Y2	NA	left	75	AP	ML	SI	PFD/?	A	IN	IN	-	-
388.	HP357	Ursus cf. speleus	femur	proximal end+diaphysis	Y1	NA	left	75	AP	ML	S	PU/?	I	IN	IN	-	pathology on the shaft; bite mark near proximal epiphysis
389.	HP358	*Capreolus capreolus*	radius	distal epiphysis+diaphysis	Y1	NA	left	50	AP	ML	S	PFD/?	A	IN	IN	-	-
390.	HP359	*Bos primigenius*	metatarsus		N	NA	left	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
391.	HP360	*Bos primigenius*	radius	distal epihysis+shaft	Y1	NA	right	50	AP	ML	I	?/DFD	A	IN	IN	-	-
392.	HP361	*Bos/Bison*	centrotarsale	-	Y1	NA	right	50	A	ML	SI	-	IN	IN	IN	-	-
393.	HP362	*Bos/Bison*	ilium	-	Y2	NA	right	25	P	L	I	IN	IN	IN	IN	-	-
394.	HP363	*Megalocerus giganteos*	metacarpus	-	N	NA	right	100	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
395.	HP364	Megalocerus cf. giganteos	metatarsus	proximal epiphysis+ shaft	N	NA	right	25	AP	ML	I	?/DFD	A	IN	IN	-	-
396.	HP365	*Bos primigenius*	tibia	distal epiphysis+ diaphysis	N	NA	right	75	AP	ML	I	?/DFD	A	IN	IN	-	-
397.	HP366	*Ungulata indet.*	metacarpus	part of proximal epiphysis and diaphysis	Y1	NA	left	10	A	ML	I	IN	IN	IN	IN	-	-
398.	HP367	*Cervus elaphus*	phalanx I	distal epiphysis+diaphysis	Y1	NA	right medial or left lateral	25	A	ML	SI	?/DFD	IN	IN	IN	-	-
399.	HP368	*Canis lupus*	6th cervical vertebra	-	Y2	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
400.	HP369	*Canis lupus*	7th cervical vertebra	-	N	NA	medial	90	AP	ML	SI	PFD/DFD	A	IN	IN	-	-
401.	HP370	*Canis lupus*	metatarsal 2	distal epiphysis+diaphysis	N	NA	left	50	AP	ML	I	?/DFD	A	IN	IN	-	-
402.	HP371	*Capreolus capreolus*	tibia	distal epiphysis+diaphysis	Y1	NA	right	50	AP	ML	I	?/DU	I	IN	IN	-	-

403.	HP372	indeterminate	humerus	caput	N	NA	IN	10	AP	ML	S	IN	IN	IN	IN	-	-
404.	HP373	indeterminate	tibia	diaphysis	Y1	NA	IN	25	IN	IN	C	IN	IN	IN	IN	-	-
405.	HP374	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
406.	HP375	indeterminate	rib	shaft fragment	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
407.	HP376	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
408.	HP377	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
409.	HP378	indeterminate	rib	shaft fragment	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
410.	HP379	indeterminate	rib	shaft fragment	N	NA	IN	IN	IN	ML	SI	IN	IN	IN	IN	-	-
411.	HP380	indeterminate	rib	proximal part of the corpus	Y1	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-
412.	HP381	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
413.	HP382	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
414.	HP383	indeterminate	long bone	shaft fragment	Y2	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
415.	HP384	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
416.	HP385	indeterminate	long bone	shaft fragment	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
417.	HP386	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
418.	HP387	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
419.	HP388	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
420.	HP389	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
421.	HP390	indeterminate	indeterminate		N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
422.	HP391	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
423.	HP392	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
424.	HP393	indeterminate	indeterminate		N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
425.	HP394	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
426.	HP395	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
427.	HP396	indeterminate	indeterminate	-	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
428.	HP397	indeterminate	long bone	shaft fragment	N	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
429.	HP398	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
430.	HP399	indeterminate	indeterminate	-	Y1	NA	IN	IN	IN	IN	C	IN	IN	IN	IN	-	-
431.	HP400	Chiroptera indet.	humerus	distal epiphysis+diaphysis	N	NA	left	50	AP	ML	I	IN	IN	IN	IN	-	-
432.	HP401	Chiroptera indet.	humerus	distal epiphysis+diaphysis	N	NA	right	50	AP	ML	I	IN	IN	IN	IN	-	-
433.	HP402	Chiroptera indet.	long bone	-	N	NA	-	100	AP	ML	SI	IN	IN	IN	IN	-	-
434.	HP403	Chiroptera indet.	long bone	-	N	NA	-	100	AP	ML	SI	IN	IN	IN	IN	-	-
435.	HP404	Chiroptera indet.	long bone	-	N	NA	-	100	AP	ML	SI	IN	IN	IN	IN	-	-
436.	HP405	Chionomys nivalis	mandible with teeth	-	N	NA	left	75	AP	ML	SI	IN	IN	IN	IN	-	-
437.	HP405.1	Chionomys nivalis	mandible with teeth	lower M1	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
438.	HP405.2	Chionomys nivalis	mandible with teeth	lower M2	N	NA	left	100	AP	ML	SI	IN	IN	IN	IN	-	-
439.	HP406	Rodentia indet.	tooth	upper I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
440.	HP407	Rodentia indet.	tooth	upper I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
441.	HP408	Rodentia indet.	tooth	upper I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
442.	HP409	Rodentia indet.	tooth	upper I	N	NA	right	IN	AP	ML	SI	IN	IN	IN	IN	-	-
443.	HP410	Rodentia indet.	tooth	lower I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-

444.	HP411	Rodentia indet.	tooth	lower I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
445.	HP412	Rodentia indet.	tooth	lower I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
446.	HP413	Rodentia indet.	tooth	lower I	N	NA	left	IN	AP	ML	SI	IN	IN	IN	IN	-	-
447.	HP414	Rodentia indet.	tooth	lower I	N	NA	right	IN	AP	ML	SI	IN	IN	IN	IN	-	-
448.	HP415	Rodentia indet.	tooth	lower I	N	NA	right	IN	AP	ML	SI	IN	IN	IN	IN	-	-
449.	HP416	Rodentia indet.	femur	-	N	NA	right	IN	AP	ML	SI	IN	IN	IN	IN	-	-
450.	HP417	Microvertebrate indet.	vertebrae	-	N	NA	IN	100	AP	ML	SI	IN	IN	IN	IN	-	-
451.	HP418	Microvertebrate indet.	vertebrae	-	N	NA	IN	100	AP	ML	SI	IN	IN	IN	IN	-	-
452.	HP419	Microvertebrate indet.	long bone	-	N	NA	IN	IN	AP	ML	SI	IN	IN	IN	IN	-	-

(1) #	(2) INb	(3) Weathering	(4) WT	(5) Br pat	(6) Gnaw	(7) $CaCO_3$	(8) Comments
1.	HP1	S	F/CE	IN	IN	L	3-4 possible carnivore gnawing marks but could be produced by erosion or chemical/mechanical weathering
2.	HP2	S	F	IN	A	L	
3.	HP3	IN	-	IN	IN	M	maxilla is covered with CaCO3
4.	HP3.1	A	A	U	A	A	
5.	HP3.2	A	A	U	A	A	
6.	HP3.3	A	A	U	A	A	
7.	HP4	IN	-	IN	IN	H	maxilla is covered with CaCO3
8.	HP4.1	A	A	U	A	M	
9.	HP4.2	A	A	U	A	M	
10.	HP4.3	A	A	U	A	H	
11.	HP5	S	F	IN	A	M	
12.	HP5.1	A	A	U	A	L	
13.	HP5.2	A	A	U	A	L	
14.	HP5.3	A	A	U	A	A	
15.	HP6	S	F	U	IN	H	mandibula is covered with CaCO3
16.	HP6.1	A	A	U	A	M	
17.	HP6.2	A	A	U	A	M	
18.	HP6.3	A	A	U	A	M	
19.	HP6.4	A	A	U	A	H	
20.	HP6.5	A	A	U	A	M	
21.	HP8	S	F	IN	A	A	
22.	HP9	S	FS	IN	A	L	
23.	HP10	M	S+P	U	A	A	
24.	HP11	M	FS+CE	IN	A	A	
25.	HP12	S	F	IN	A	A	
26.	HP13	IN	-	IN	A	H	
27.	HP14	S	F	IN	A	A	
28.	HP15	S	CE	IN	A	H	
29.	HP16	IN	-	U	IN	H	
30.	HP17	IN	-	IN	IN	H	
31.	HP18	IN	-	IN	IN	M	
32.	HP19	IN	-	IN	IN	H	
33.	HP20	S	CE	IN	RG	A	gnawing on the proximal lower part and on one of the sides of *processus spinosus*
34.	HP21	S	CE+F	IN	A	A	
35.	HP22	S	CE	IN	A	A	
36.	HP23	S	CE	IN	A	A	
37.	HP24	S	CE	IN	RG	A	gnawing on the proximal lower part of *processus spinosus*
38.	HP25	M	CE	IN	A	A	
39.	HP26	S	CE	IN	A	A	

40.	HP27	S	CE	IN	RG	A	gnawing on the proximal lower part of *processus spinosus*
41.	HP28	M	CE+F	IN	A	A	
42.	HP29	S	CE	IN	A	A	
43.	HP30	M	CE	IN	GU	A	*processus spinosus* and parts of the corpus and *processus transversus* are gnawed off; the animal that did this could be a rodent but could also be a small carnivore
44.	HP31	S	CE	IN	A	A	
45.	HP32	M	CE	IN	IN	H	
46.	HP33	S	CE	IN	A	A	
47.	HP34	IN	-	IN	IN	H	
48.	HP35	IN	-	IN	IN	H	
49.	HP36	M	CE+F	IN	RG	A	gnawing on the cranial, lateral and medial side of the shaft and parts of the epiphysis are gnawed off
50.	HP37	S	CE	U	PG	H	it seems like one part of the diaphysis was bitten off but it could be just a break
51.	HP38	M	CE+F	U	RG	A	gnawing on the shaft, especially on the proximal part and proximal epiphysis is gnawed off
52.	HP39	S	CE+F	U	PG	A	the distal part of the diaphysis is almost rounded from possible chewing and above the epiphysis there are three possible bite marks
53.	HP40	IN	IN	U	IN	H	
54.	HP41	S	CE+F	IN	RG	L	gnawing all over the shaft
55.	HP42	M	CE+F	U	RG	L	some gnawing on the shaft
56.	HP43	IN	IN	U	IN	H	
57.	HP44	S	CE	U	IN	H	
58.	HP45	S	CE+F	IN	PG	L	possible rodent gnawing on the shaft
59.	HP46	S	CE	U	A	L	
60.	HP47	M	CE	U	PG	A	possible two-three small carnivore puncture marks on the proximal epiphysis and three rodent gnawing marks on the lateral side
61.	HP48	M	CE	U	RG	A	gnawing on distal part of the shaft
62.	HP49	S	CE	U	A	A	
63.	HP50	S	CE	U	RG	A	gnawing on the medial side of the shaft
64.	HP51	S	CE	U	A	A	
65.	HP52	M	CE+F	U	RG	A	gnawing on the lower cranial, medial and lateral part of the shaft
66.	HP53	S	CE	U	A	A	
67.	HP54	S	CE	U	A	A	

68.	HP55	IN	-	U	IN	L	
69.	HP56	S	CE	U	RG	A	heavily gnawed especially on the proximal part of the phalanx
70.	HP57	S	CE	U	A	A	
71.	HP58	S	CE	U	RG	A	heavily gnawed all over the phalanx
72.	HP59	A	-	U	A	A	
73.	HP60	S	CE	U	A	A	
74.	HP61	S	CE	U	A	A	
75.	HP62	M	CE+F+S	IN	A	A	
76.	HP63	M	CE	IN	RG	L	gnawing on the caudal, medial lower part of the shaft
77.	HP64	M	CE	IN	RG	A	heavily gnawed all over the epiphysis and shaft; could be also carnivore gnawing
78.	HP65	IN	-	IN	IN	H	
79.	HP66	S	CE+F	U	RG	A	gnawing on the medial side of the shaft
80.	HP67	M	CE	U	A	L	
81.	HP68	S	CE	IN	A	L	
82.	HP69	S	CE	U	A	A	
83.	HP70	M	CE	U	RG	A	gnawing on the proximal part of the calcaneus
84.	HP71	A	-	U	A	A	
85.	HP72	M	CE	U	A	A	
86.	HP73	M	CE	U	RG	A	on the distal part of the shaft and the epiphysis is gnawed off
87.	HP74	M	CE	U	A	A	
88.	HP75	S	CE	IN	A	A	
89.	HP76	S	CE+F	IN	A	A	
90.	HP76.1	A	-	U	A	A	
91.	HP77	M	S+F+CE	IN	A	A	
92.	HP77.1	A	-	U	A	A	
93.	HP78	S	F	IN	A	A	
94.	HP79	S	CE+F	IN	A	A	
95.	HP80	S	CE+F+S	IN	A	A	
96.	HP81	M	CE+F	U	A	A	CE on proximal epiphysis
97.	HP82	M	CE+F	IN	IN	H	
98.	HP83	S	CE	IN	A	L	
99.	HP84	S	S+F+ABR	ASF	A	A	green break is clearly seen while dry break is not so visible due to abrasion

100.	HP85	M	CE+F	IN	A	L	
101.	HP86	S	F	U	A	M	
102.	HP87	S	F	U	A	L	
103.	HP88	S	F+CE	U	A	L	
104.	HP89	S	CE	IN	A	L	
105.	HP90	S	F	IN	A	M	
106.	HP91	S	CE	IN	IN	H	
107.	HP92	IN	IN	IN	IN	M	
108.	HP93	S	F+CE+S	U	A	A	
109.	HP94	M	S+CE	IN	A	A	maybe was gnawed on the side (instead of ce)
110.	HP95	M	F+CE	U	A	L	
111.	HP96	S	F+S	IN	A	L	
112.	HP96.1	A	-	U	A	A	
113.	HP96.2	A	-	U	A	A	
114.	HP96.3	A	-	U	A	A	
115.	HP96.4	A	-	U	A	A	
116.	HP96.5	A	-	U	A	A	
117.	HP97	S	CE	IN	A	L	
118.	HP98	S	F	IN	A	A	
119.	HP99	S	CE	IN	PG	A	possible gnawing on the lower cranial part of the *processus spinosus* and on *processus transversus*
120.	HP100	S	F	IN	RG	L	on the cranial side of the shaft and part of the epiphysis is gnawed off
121.	HP101	S	S+F	IN	RG	A	gnawing caudally on the proximal part of the shaft and two bite marks on the cranial side
122.	HP102	S	F	IN	RG	A	gnawing on the shaft
123.	HP103	S	CE	IN	A	A	
124.	HP104	S	CE	IN	RG	A	gnawing on the caudal side of the shaft
125.	HP105	S	F	IN	A	A	
126.	HP106	S	F+CE	IN	A	A	
127.	HP107	S	F	IN	A	A	
128.	HP108	IN	-	IN	IN	H	
129.	HP109	S	S+F	IN	A	L	
130.	HP110	S	S+CE+F	U	PG	A	two short parallel marks on the proximal epiphysis
131.	HP111	S	F+S	IN	A	A	

132.	HP111.1	A	-	U	A	A	
133.	HP111.2	A	-	U	A	A	
134.	HP112	S	CE	IN	A	L	
135.	HP113	S	CE	IN	A	L	
136.	HP114	S	CE+F	IN	A	L	
137.	HP115	M	CE	SF	PG	A	probably gnawed on the distal and proximal part of the calcaneus
138.	HP116	M	CE	U	DT	A	
139.	HP117	M	CE	IN	A	A	
140.	HP118	M	F+S+CE	IN	A	L	
141.	HP119	M	CE+F	IN	A	A	
142.	HP120	IN	IN	U	IN	H	
143.	HP121	S	F+CE	U	A	L	
144.	HP122	S	F+CE	IN	A	A	
145.	HP123	S	CE	IN	A	A	
146.	HP124	S	CE	IN	A	L	
147.	HP125	S	S	IN	A	A	
148.	HP126	S	S	IN	A	A	
149.	HP127	IN	IN	IN	A	S	
150.	HP129	A	-	IN	A	A	
151.	HP130	A	-	IN	A	A	
152.	HP131	S	CE	IN	A	A	
153.	HP132	S	S+F	U	A	L	
154.	HP133	M	CE+S	U	A	A	
155.	HP134	IN	IN	IN	IN	H	
156.	HP135	M	F+CE	U	A	L	
157.	HP136	M	CE	IN	A	L	
158.	HP137	M	S+CE	U	A	L	
159.	HP138	S	S	IN	A	A	
160.	HP139	M	S+F	IN	A	M	
161.	HP140	IN	IN	IN	A	A	
162.	HP141	S	CE	IN	A	L	

163.	HP142	A	A	IN	A	A	
164.	HP143	S	S+F	IN	A	A	
165.	HP144	S	F	IN	A	A	
166.	HP145	S	F	IN	A	L	
167.	HP146	S	S	IN	A	A	
168.	HP147	S	S	IN	A	L	
169.	HP148	A	A	IN	A	A	
170.	HP149	S	S	IN	A	A	
171.	HP150	S	F	IN	A	A	
172.	HP151	M	CE+F	IN	A	A	
173.	HP152	S	F	IN	A	A	
174.	HP153	S	S+F	U	A	A	
175.	HP154	A	A	IN	A	L	
176.	HP155	S	S+F+CE	U	A	L	
177.	HP156	S	F+S	U	A	L	
178.	HP157	S	CE	U	A	L	
179.	HP158	S	F	ASF	A	A	
180.	HP159	S	F	U	GU	L	
181.	HP160	A	A	SF	RG	M	few gnawing marks on the shaft
182.	HP161	M	CE+F	U	IN	A	
183.	HP162	M	F+CE	SF	A	L	
184.	HP163	M	CE	U	A	A	
185.	HP165	S	F	IN	A	L	
186.	HP166	S	F+S	IN	A	L	mostly green break
187.	HP167	S	F	U	PG	A	gnawing on the distal epiphysis but could be root etching instead
188.	HP168	S	CE	U	A	L	
189.	HP169	M	CE+F+ABR	IN	A	A	
190.	HP170	S	CE	U	A	A	
191.	HP171	M	CE	IN	A	A	
192.	HP172	A	A	IN	A	A	
193.	HP173	M	CE+S	SF	A	A	
194.	HP174	S	CE	IN	A	A	

195.	HP175	S	CE	IN	A	A	
196.	HP176	S	CE	IN	A	A	
197.	HP177	A	A	AF	A	A	
198.	HP178	S	S	U	A	A	
199.	HP179	S	S+F	IN	A	L	
200.	HP180	S	F	IN	A	A	
201.	HP181	S	CE	IN	A	A	
202.	HP182	M	CE	IN	A	A	
203.	HP183	IN	IN	IN	IN	H	
204.	HP184	M	CE	IN	A	A	
205.	HP185	A	A	IN	A	A	
206.	HP186	S	S	IN	A	L	
207.	HP187	IN	IN	IN	A	L	
208.	HP188	S	CE+F	IN	A	L	
209.	HP189	S	F	IN	A	A	
210.	HP190	IN	IN	IN	IN	H	
211.	HP191	IN	IN	IN	IN	H	
212.	HP192	M	F+CE	IN	A	A	
213.	HP193	S	F	IN	A	L	
214.	HP194	S	CE	IN	A	A	
215.	HP195	M	CE	IN	PG	M	it looks like one side of the rib is chewed off
216.	HP196	S	F	IN	A	L	
217.	HP197	S	F+CE	IN	RG	A	few gnawing marks on the shaft
218.	HP198	S	F	IN	A	A	
219.	HP199	IN	IN	IN	IN	H	
220.	HP200	A	A	IN	A	A	
221.	HP201	IN	IN	IN	IN	H	
222.	HP202	S	F+CE	IN	RG	A	gnawing along the rib
223.	HP203	S	F+CE	IN	A	A	
224.	HP204	S	F	IN	RG	A	three gnawing marks
225.	HP205	M	F+CE	IN	A	A	
226.	HP206	S	F+CE	IN	RG	L	three gnawing marks
227.	HP207	S	F+CE	IN	A	A	

228.	HP208	S	F+CE	IN	A	A	
229.	HP209	S	CE	IN	A	A	
230.	HP210	S	F+CE	IN	A	A	
231.	HP211	S	F+CE	IN	A	A	
232.	HP212	S	CE	IN	A	A	
233.	HP213	S	F+CE	IN	A	A	
234.	HP214	S	F+CE	IN	A	A	
235.	HP215	S	F+CE	IN	A	A	
236.	HP216	S	F+CE	IN	A	L	
237.	HP217	S	F+CE	IN	A	L	
238.	HP218	S	S+F	IN	A	L	
239.	HP219	S	CE	IN	A	M	
240.	HP220	S	F+CE	IN	A	A	
241.	HP221	IN	IN	IN	IN	H	
242.	HP222	S	F	IN	A	A	
243.	HP223	S	F	IN	A	L	
244.	HP224	S	F+CE	IN	A	L	
245.	HP225	S	F+CE	IN	RG	L	several gnawing marks along the rib
246.	HP226	S	F	IN	RG	L	several gnawing marks along the rib
247.	HP227	S	CE	IN	A	L	
248.	HP228	S	F+CE	IN	A	L	
249.	HP229	S	F+CE	IN	A	L	
250.	HP230	S	F+CE	IN	A	L	
251.	HP231	S	F+CE	IN	A	L	
252.	HP232	S	F+CE	IN	A	A	
253.	HP233	S	F+CE	IN	A	L	
254.	HP234	S	F+CE	IN	A	L	
255.	HP235	S	F+CE	IN	A	A	
256.	HP236	S	F+CE	IN	A	L	
257.	HP237	S	F+CE	IN	A	L	
258.	HP238	S	F+S	IN	A	A	
259.	HP239	S	F	IN	A	M	
260.	HP240	M	CE	IN	A	L	
261.	HP241	IN	IN	IN	IN	H	
262.	HP242	S	F+CE	IN	A	L	
263.	HP243	S	F+CE	IN	A	L	
264.	HP244	S	F+CE	IN	A	A	
265.	HP245	S	F+CE	IN	A	A	
266.	HP246	S	F+CE	IN	A	A	
267.	HP247	S	F+CE	IN	A	L	
268.	HP248	IN	IN	IN	IN	A	
269.	HP249	M	F+CE	IN	A	A	
270.	HP250	S	F+CE	IN	A	A	
271.	HP251	M	F	IN	PG	L	possible small carnivore gnawing but could also be trampling. The width of the marks is 1-1,5 mm
272.	HP252	IN	IN	U	IN	H	

273.	HP253	S	F	U	A	L	
274.	HP254	S	CE	IN	A	A	
275.	HP255	S	CE	U	A	H	
276.	HP256	S	CE	U	A	L	
277.	HP257	S	F	U	A	A	
278.	HP258	IN	IN	U	IN	H	
279.	HP259	S	S	AF	A	L	
280.	HP261	M	ABR+F+CE	IN	IN	A	
281.	HP262	M	CE	IN	RG	L	gnawing on the lower caudal part of the shaft
282.	HP263	S	CE	U	CG	L	one puncture hole
283.	HP264	M	CE	U	A	A	possible DT
284.	HP265	M	CE	IN	A	L	
285.	HP266	M	F	IN	A	A	
286.	HP267	S	F+RE	SF	RG	A	two gnawing marks
287.	HP268	IN	S	IN	IN	H	
288.	HP269	S	F+CE	IN	A	A	
289.	HP270	M	CE	IN	A	L	
290.	HP271	S	F	ASF	A	A	
291.	HP272	S	CE+F	IN	A	L	
292.	HP273	S	F	IN	A	A	
293.	HP274	S	CE+F	IN	A	A	
294.	HP275	S	F	IN	A	A	
295.	HP276	S	F	IN	A	A	
296.	HP277	S	CE	IN	A	A	
297.	HP278	M	CE	IN	IN	A	
298.	HP279	S	F+CE	IN	PG	L	two possible rodent gnawing marks
299.	HP280	S	CE	IN	RG	L	gnawing on the shaft
300.	HP281	S	F	IN	A	A	
301.	HP282	S	S	SF	A	A	
302.	HP283	A	A	IN	A	A	
303.	HP284	S	F+CE+RE	IN	A	A	mostly green break
304.	HP285	M	CE+F	IN	A	L	
305.	HP286	S	F	IN	A	A	
306.	HP287	M	CE+F	IN	A	A	
307.	HP288	M	F+CE+S	IN	A	A	
308.	HP289	M	F	IN	A	A	
309.	HP290	M	F+CE	IN	PG	A	possible carnivore gnawing
310.	HP291	S	F	IN	A	A	
311.	HP292	S	F	IN	A	L	
312.	HP293	M	CE+F	IN	IN	H	
313.	HP294	M	CE+S+F	IN	A	L	
314.	HP295	S	S	IN	A	A	
315.	HP296	S	CE	IN	PG	A	possible gnawing on the shaft
316.	HP297	S	CE	IN	A	A	
317.	HP298	M	CE+F	IN	A	A	
318.	HP299	S	F+CE	IN	A	L	

319.	HP300	S	F	SF	GU	A	possible gnawing from a smaller carnivore
320.	HP301	S	F	IN	A	A	
321.	HP302	IN	IN	IN	IN	H	
322.	HP303	M	CE	IN	A	L	
323.	HP304	S	CE	IN	A	L	
324.	HP305	S	CE	IN	A	A	
325.	HP306	IN	IN	IN	IN	H	
326.	HP307	S	CE	IN	A	A	
327.	HP308	A	A	IN	A	A	
328.	HP309	S	CE	IN	A	A	
329.	HP310	M	CE	IN	IN	L	
330.	HP311	M	CE+S	IN	A	A	
331.	HP312	S	CE	IN	A	A	
332.	HP313	S	F	IN	A	A	
333.	HP314	M	CE	IN	A	L	
334.	HP315	M	CE	IN	A	A	
335.	HP316	M	CE	IN	A	A	
336.	HP317	M	F	IN	A	A	
337.	HP318	M	CE	IN	A	L	
338.	HP319	M	CE	IN	IN	L	
339.	HP320	M	CE	IN	A	L	
340.	HP321	S	CE	IN	A	A	
341.	HP322	IN	IN	IN	IN	H	
342.	HP323	IN	IN	IN	IN	H	
343.	HP324	S	CE	IN	A	A	
344.	HP325	IN	IN	IN	IN	H	
345.	HP326	M	CE	IN	A	L	
346.	HP327	S	CE	IN	A	A	
347.	HP328	A	A	IN	A	L	
348.	HP329	M	CE	IN	A	A	
349.	HP330	A	A	IN	A	A	
350.	HP331	S	S	IN	A	A	
351.	HP332	A	A	IN	A	L	
352.	HP333	IN	IN	IN	IN	H	
353.	HP334	M	CE	IN	A	A	
354.	HP335	S	CE	IN	IN	A	
355.	HP336	M	CE	IN	A	A	
356.	HP337	M	CE	IN	A	L	
357.	HP338	M	F	IN	RG	L	on the lower part of the mandible
358.	HP338.1	A	-	IN	A	A	
359.	HP338.2	A	-	IN	A	A	
360.	HP338.3	A	-	IN	A	A	
361.	HP338.4	A	-	IN	A	A	
362.	HP338.5	IN	IN	IN	IN	H	
363.	HP339	IN	IN	IN	IN	H	
364.	HP339.1	A	-	IN	A	A	

365.	HP339.2	A	-	IN	A	A	
366.	HP339.3	A	-	IN	A	A	
367.	HP340	M	F	IN	A	L	
368.	HP340.1	A	-	IN	A	A	
369.	HP340.2	A	-	IN	A	A	
370.	HP340.3	A	-	IN	A	A	
371.	HP340.4	A	-	IN	A	A	
372.	HP341	M	S	IN	A	A	
373.	HP342	IN	IN	U	A	M	
374.	HP343	M	F+CE	U	A	A	
375.	HP344	IN	-	IN	IN	H	
376.	HP345	S	FS	AF	IN	M	
377.	HP346	S	F+CE	IN	A	L	
378.	HP347	M	F+CE	IN	RG	A	heavily gnawed on the lateral side of the shaft and proximal epiphysis
379.	HP348	M	F+CE	U	RG	A	heavily gnawed all along the medial side of the shaft
380.	HP349	S	F	IN	A	L	
381.	HP350	M	F+CE+S	ASF	A	L	
382.	HP351	M	F	IN	A	A	
383.	HP352	S	F	IN	A	A	
384.	HP353	M	CE+F+S	U	A	A	
385.	HP354	M	F	IN	A	L	
386.	HP355	S	CE+F	IN	A	L	
387.	HP356	M	F+CE	IN	RG	M	gnawing on the lower medial part of the shaft
388.	HP357	S	CE	IN	CG	L	Pathology
389.	HP358	M	F+S	IN	A	M	
390.	HP359	S	F	U	A	L	
391.	HP360	S	F+CE+RE	IN	A	A	
392.	HP361	S	F+CE	IN	A	L	
393.	HP362	M	F	IN	A	A	
394.	HP363	M	F	U	A	L	
395.	HP364	M	F	IN	A	L	
396.	HP365	M	F+RE	ASF	GU	L	marks could be caused by trampling or young hyena gnawing/possible cut marks
397.	HP366	M	F+CE+ABR	IN	A	A	
398.	HP367	S	F+CE	IN	A	A	
399.	HP368	S	CE	IN	A	L	
400.	HP369	S	CE	IN	A	A	
401.	HP370	S	F	IN	A	A	probably dry bone
402.	HP371	S	F	IN	RG	A	gnawing on the shaft
403.	HP372	M	CE	IN	A	A	
404.	HP373	S	F	ASF	A	A	possible impact scar
405.	HP374	S	CE+F	IN	A	A	
406.	HP375	S	F	IN	A	L	

407.	HP376	M	CE+F	IN	A	A	
408.	HP377	M	CE+F	IN	A	A	
409.	HP378	S	CE	IN	A	A	
410.	HP379	S	F	IN	PG	A	possible rodent gnawing
411.	HP380	M	F	IN	PG	A	possible gnawing from a smaller carnivore on the shaft
412.	HP381	M	S+F+CE	IN	PG	L	possible gnawing on the shaft
413.	HP382	M	F	IN	A	A	
414.	HP383	S	CE+F	IN	A	A	mostly green break
415.	HP384	S	CE+F	SF	A	A	
416.	HP385	S	CE+F	IN	A	A	
417.	HP386	S	F	IN	A	A	
418.	HP387	S	CE+S+F	IN	A	M	
419.	HP388	M	S+ABR	IN	A	A	
420.	HP389	S	CE	SF	A	A	
421.	HP390	S	F	IN	A	A	
422.	HP391	M	CE+S+F	IN	A	A	
423.	HP392	M	CE+S	IN	A	L	
424.	HP393	S	F	IN	A	A	
425.	HP394	S	F+CE	IN	A	A	
426.	HP395	M	S+CE	IN	A	A	
427.	HP396	M	CE+F	IN	A	A	
428.	HP397	M	S+F	IN	A	A	
429.	HP398	S	F	IN	A	A	
430.	HP399	IN	F	IN	IN	H	

PLATES I - XIX

PLATE I.

Figure 1.

HP405.1 - *Chionomys nivalis* left lower M1

Figure 2.

HP405.2 – *Chionomys nivalis* left lower M2

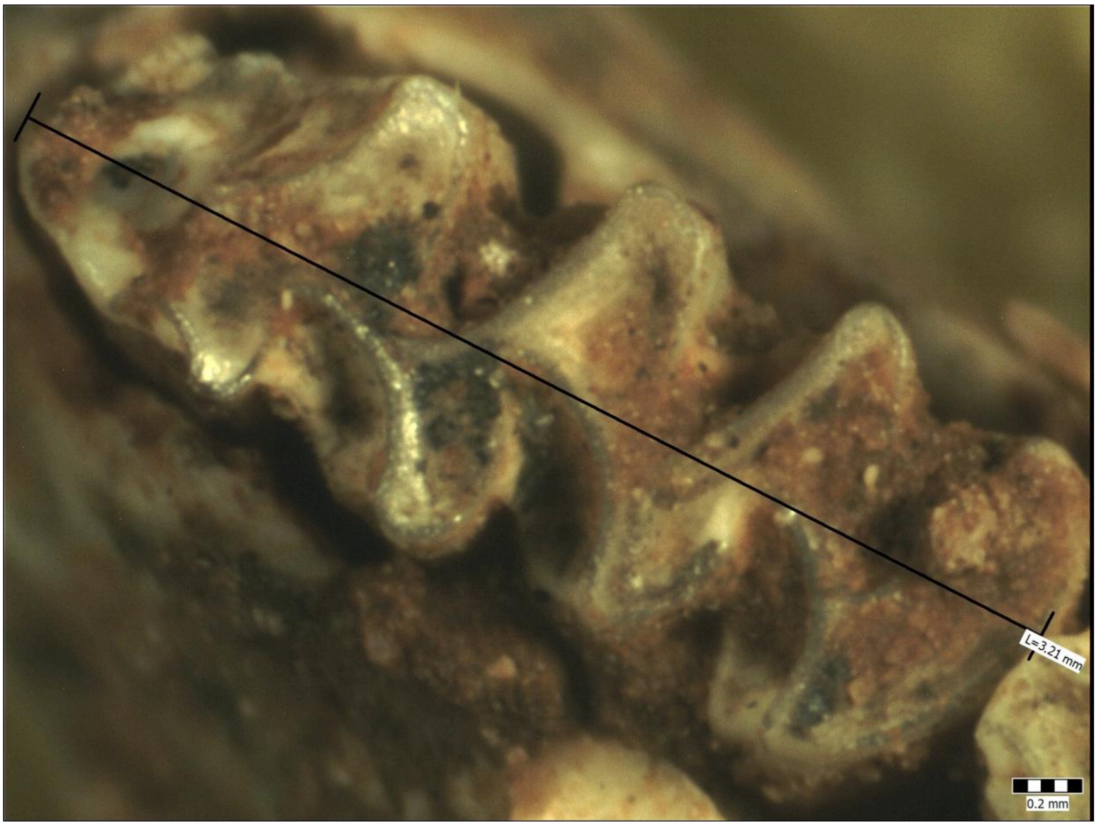

Figure 1.

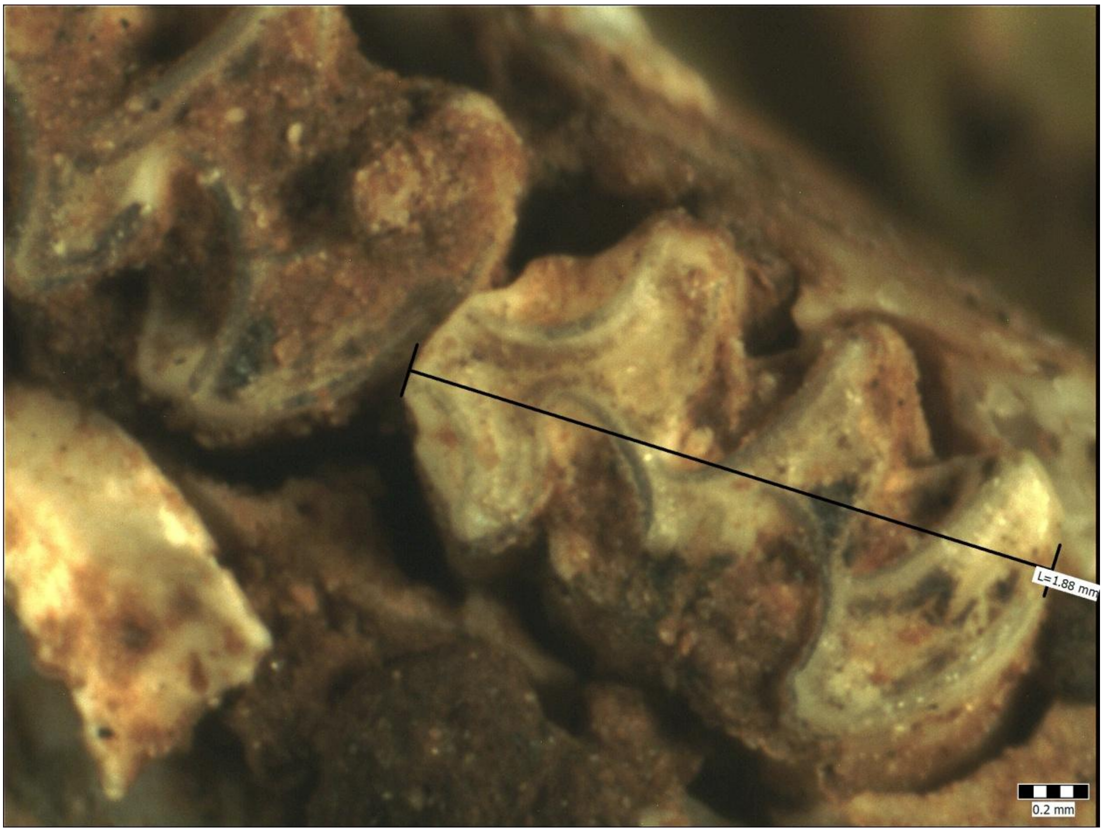

Figure 2.

PLATE II.

Figure 3.

HP1 – *Crocuta crocuta spelaea* cranium - occipital and parietal (lateral view)

Figure 4.

HP4 – *Crocuta crocuta spelaea* maxilla with teeth (buccal side)

Figure 3.

Figure 4.

PLATE III.

Figure 5.

HP6 – *Crocuta crocuta spelaea* mandible with teeth (buccal side)

Figure 6.

HP338 – *Crocuta crocuta spelaea* mandible with teeth (buccal side)

Figure 5.

Figure 6.

PLATE IV.

Figure 7.

HP16 - *Crocuta crocuta spelaea* atlas (dorsal view)

Figure 8.

HP30 - *Crocuta crocuta spelaea* lumbar vertebrae (lateral view)

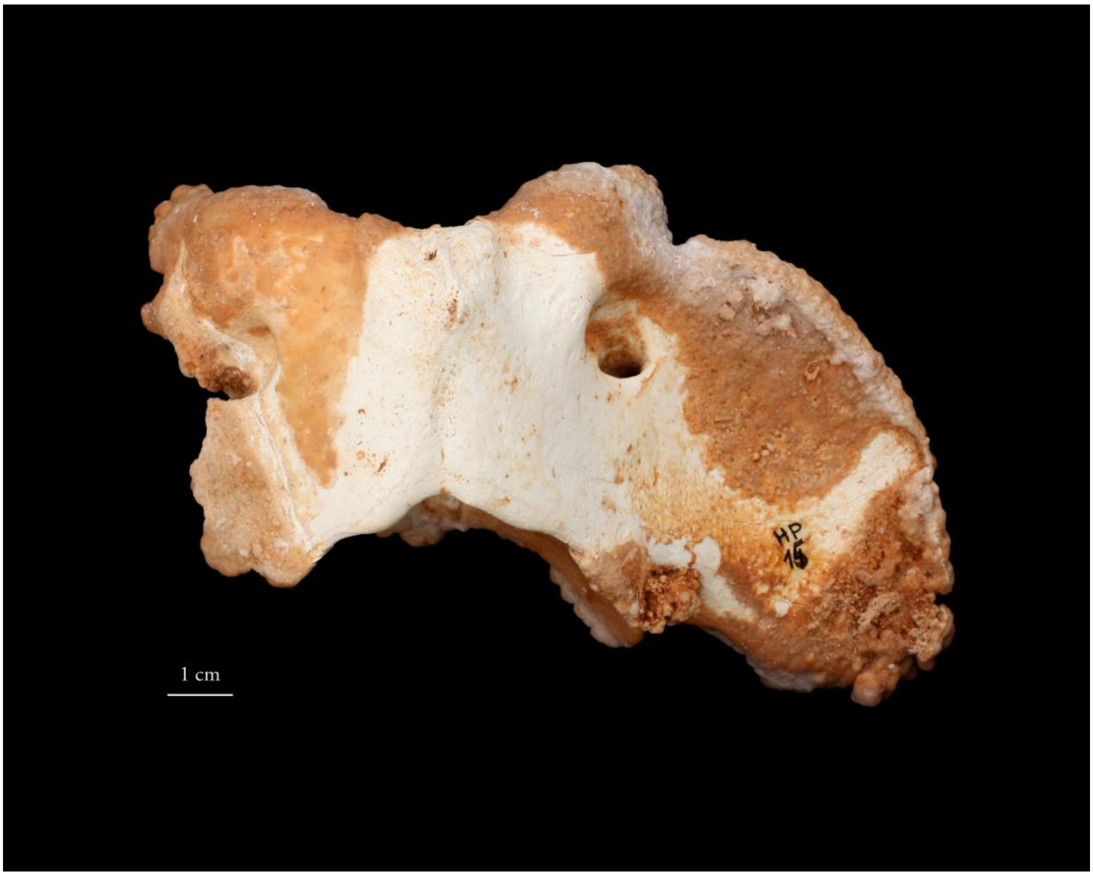

Figure 7.

Figure 8.

PLATE V.

Figure 9. & 10.

HP35 – *Crocuta crocuta spelaea* humerus (anterior and medial view)

Figure 11. & 12.

HP36 – *Crocuta crocuta spelaea* humerus (anterior and medial view)

Figure 9.

Figure 10.

Figure 11.

Figure 12.

PLATE VI.

Figure 13. & 14.

HP44 – *Crocuta crocuta spelaea* ulna (medial and lateral view)

Figure 15. & 16.

HP56 – *Crocuta crocuta spelaea* phalanx I (dorsal view)

HP58 – *Crocuta crocuta spelaea* phalanx II (dorsal view)

Figure 13.

Figure 14.

Figure 15.

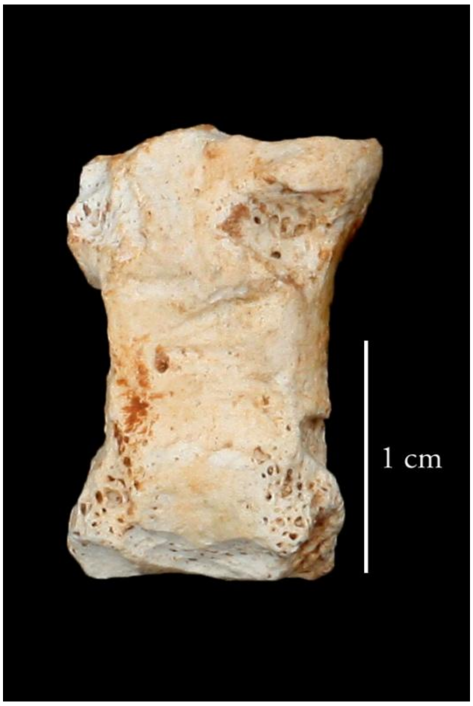

Figure 16.

PLATE VII.

Figure 17. & 18.

HP347 – *Crocuta crocuta spelaea* femur (anterior and lateral view)

Figure 19. & 20.

HP64 – *Crocuta crocuta spelaea* distal end of a femur (anterior view)

HP348 – *Crocuta crocuta spelaea* tibia (posterior view)

Figure 17.

Figure 18.

Figure 19.

Figure 20.

PLATE VIII.

Figure 21.

HP75 – *Meles meles* cranium – mostly parietal (lateral view)

Figure 22.

HP76 – *Meles meles* mandible with teeth (buccal side)

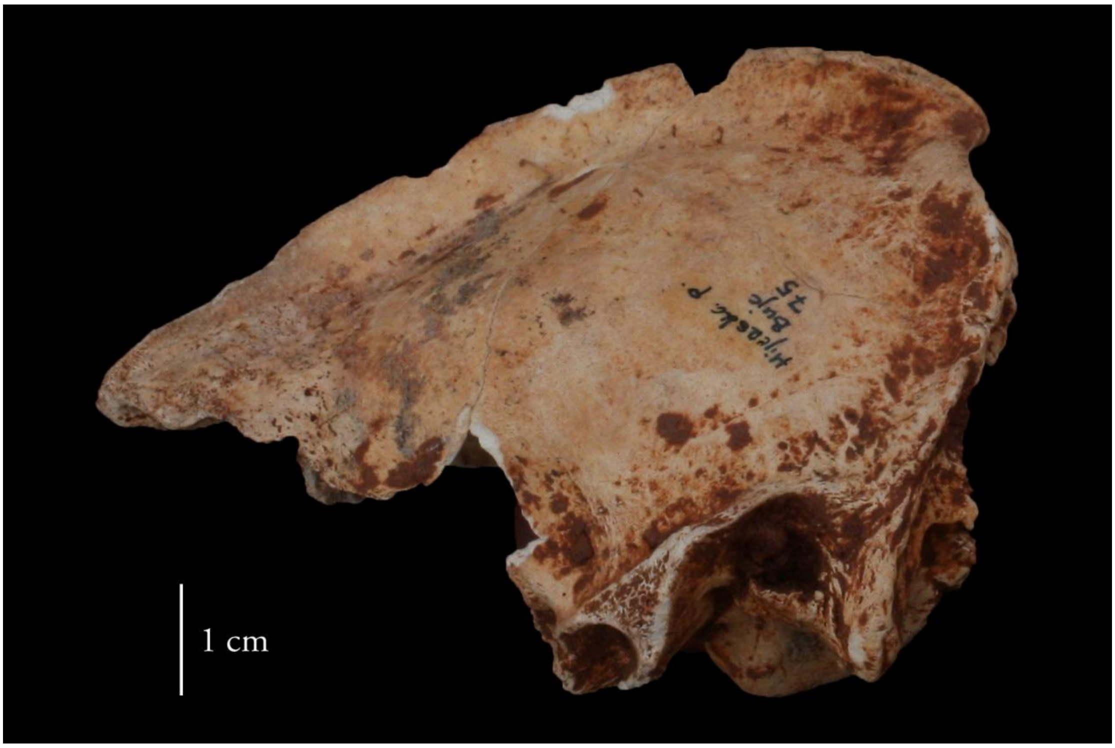

Figure 21.

Figure 22.

PLATE IX.

Figure 23. & 24.

HP79 – *Meles meles* humerus (anterior view)

HP108 – *Lepus sp.* femur (anterior view)

Figure 25. & 26.

HP109 – *Panthera leo spelaea* left lower P2 (buccal side)

HP341 – *Panthera leo spelaea* right lower C

Figure 23.

Figure 24.

Figure 25.

Figure 26.

PLATE X.

Figure 27. & 28.

HP252 – *Canis lupus* femur (anterior view)

HP102 – *Canis lupus* tibia (posterior view)

Figure 29.

HP82 – *Ursus spelaeus* 6th thoracic vertebrae (anterior view)

Figure 27.

Figure 28.

Figure 29.

PLATE XI.

Figure 30. & 31.

HP356 – Ursus cf. spelaeus femur (posterior view)

HP357 – juvenile Ursus cf. spelaeus femur (posterior view)

Figure 32. & 33.

HP90 – *Ursus spelaeus* tibia (posterior view)

HP262 – Ursus sp. metatarsus I (medial view)

Figure 30.

Figure 31.

Figure 32.

Figure 33.

PLATE XII.

Figure 34.

HP363 - *Megalocerus giganteos* metacarpus (anterior view)

Figure 35.

HP363 - *Megalocerus giganteos* metacarpus (posterior view)

Figure 34.

Figure 35.

PLATE XIII.

Figure 36.

HP111 - *Megalocerus giganteos* mandible with teeth (lingual side)

Figure 37.

HP116 – Large ungulate astragalus (dorsal side)

Figure 36.

Figure 37.

PLATE XIV.

Figure 38. & 39.

HP263 – *Capreolus capreolus* phalanx II (lateral or medial view)

HP121 – *Bos/Bison* right upper M1-M3 (lingual side)

Figure 40.

HP137 – *Bos primigenius* astragalus (dorsal side)

Figure 38.

Figure 39.

Figure 40.

PLATE XV.

Figure 41.

HP365 – *Bos primigenius* tibia

Figure 41.

PLATE XVI.

Figure 42.

HP359 - *Bos primigenius* metatarsus (posterior view)

Figure 43.

HP359 - *Bos primigenius* metatarsus (anterior view)

Figure 42.

Figure 43.

PLATE XVII.

Figure 44.

HP159 – *Equus ferus* metacarpus III (anterior view)

Figure 44.

PLATE XVIII.

Figure 45.

HP238 – Stephanorhinus cf. hemitoechus metacarpus III (anterior side)

Figure 46.

HP373 – Long bone fragment with possible impact scar

Figure 45.

Figure 46.

PLATE XIX.

Figure 47.

Crocuta crocuta spelaea coprolites

Figure 47.