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1 **A site with mixed occupation: Neanderthals and carnivores at Érd (Hungary).**

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Éva J. Daschek<sup>a1</sup>, Zsolt Mester<sup>b</sup>

<sup>a</sup> Muséum National d'Histoire Naturelle – UMR 7194 HNHP CNRS/MNHN/UPVD, Équipe NOMADE; IPH,  
1 rue René Panhard, 75013 Paris, France

<sup>b</sup> Institute of Archaeological Sciences, Eötvös Loránd University – UMR 7194 HNHP CNRS/MNHN/UPVD,  
Équipe NOMADE; Múzeum krt. 4/B, 1088 Budapest, Hungary

10  
11 **Abstract**

12 The Middle Palaeolithic open-air site of Érd, near Budapest (Transdanubia, Hungary), with its specific lithic  
13 industry on quartzite pebbles, combustion structures and abundant animal bone material dominated by  
14 cave bears, was long time considered as one of the best example of a long-term camp of Neanderthals  
15 specializing in cave bear hunting. This interpretation of the site was based on the knowledge of the late  
16 1960s. However, the association of carnivore remains and lithic artefacts found in cave or sheltered sites of  
17 the Palaeolithic period raises questions about the formation processes of the bone accumulations and  
18 about the relationships between these different agents. The development in methodology, both in  
19 archaeozoology and lithic technology, allows to apply new approaches in the study of this complex  
20 problematic. Independent new analyses of the lithic assemblage and the osteological material of Érd  
21 resulted completely new conclusions concerning past human activities at the site as well as the presence  
22 and the role of cave bear and cave hyena. An interpretation of the site as a refuge or den for these  
23 predators together with the undeniable presence of humans implies a mixed functioning through recurrent  
24 occupations.

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27 **Keywords**

28 Hungary; Middle Palaeolithic; Neanderthal; Quina Mousterian; Bear Exploitation; Archaeozoology; Lithic  
29 Technology

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32 **1. Introduction**

33 The Middle Palaeolithic site of Érd was long-time famous by its unique archaeological context: a faunal  
34 assemblage largely dominated by cave bear, found in an open-air settlement together with Quina type  
35 Mousterian (Charentian) tool-kit in six levels, dated before the first glacial maximum of the Weichselian  
36 (Würmian) glaciation (Gábori-Csánk, 1968a; Gábori, 1976: 74–77; Gamble, 1986: 169, 318; Otte, 1996: 120;  
37 Dobosi, 2000, 2005: 56–57). Due to this context, the site was interpreted as a camp of Neanderthals,  
38 specialized in cave bear hunting, showing cultural development along the sequence (Gábori-Csánk, 1968a;  
39 Gábori, 1976: 202, 1979: 243; Gábori and Gábori-Csánk, 1977; Gamble 1999: 235), however some scholars  
40 disputed this conclusion (e.g. Gamble, 1986: 318–319; Tillet and Binford, 2002).

41 The base of the interpretation of the site as a hunting camp was the observation that the lithic artefacts  
42 have been usually found inside the bone accumulations. The excavators regarded this as a proof of the  
43 direct relation between human occupation and the bone accumulation. Since the publication of the  
44 monograph of the site (Gábori-Csánk, 1968a), the coexistence of lithic artefacts and carnivore, especially  
45 cave bear, bones in cave sites have been arised many questions, therefore hypotheses have been proposed  
46 for alternative interpretation (Stiner, 1994, 1998; Villa and Soressi, 2000; Faith et al., 2007; Torres et al.,  
47 2007; Rosell et al., 2010, 2017; Diedrich, 2011; Discamps, 2011; Airvaux et al., 2012; Discamps et al., 2012),  
48 including hunting and scavenging (Auguste, 1995; Armand et al., 2003, 2004, 2018; Münzel and Conard,  
49 2004, Romandini et al., 2018). Several researchers have attempted to characterize ursid assemblages and  
50 their importance in the food cycle (Quilès, 2004; Diedrich, 2012; Fourvel et al., 2014; Fourvel et al., 2017),  
51 but also their role as a taphonomic agent (Crégut-Bonnoure and Fosse, 2001; Quilès et al., 2006; Rabal-

1 Corresponding author.

*E-mail address:* [eva.daschek@mnhn.fr](mailto:eva.daschek@mnhn.fr)/[ejadsk@gmail.com](mailto:ejadsk@gmail.com) (É.J. Daschek).

52 Garcés et al., 2012; Pinto and Andrews, 2004; Stiner, 1999; Stiner et al., 1996). Hominids and carnivores  
53 used the same spaces and consumed/hunted the same species during the Pleistocene (Brugal and Fosse,  
54 2004). Thus, their co-occurrences in terms of hominid-carnivore relationship arised questions and studies  
55 about (their) competition of resources, interactions, avoidance of confrontation by both of them (e.g.  
56 Rosell and Blasco, 2009). Several palaeontological and actualistic researches focused on carnivores' and  
57 scavengers' behaviour, their interactions, and its archaeological implications (Brain, 1981; Bunn, 1983;  
58 Haynes, 1983; Fosse, 1994; Brugal et al., 1997; Fosse et al. 1998; Horwitz, 1998; Castel, 2004; Brugal and  
59 Fosse, 2004; Quilès, 2004; Selvaggio and Wilder, 2001; Stiner, 2004; Diedrich, 2006a, 2006b; Beauval and  
60 Morin, 2010; Brugal, 2011; Diedrich, 2012; Fourvel, 2012; Fourvel et al., 2014; Camarós et al., 2013; Arilla  
61 et al., 2014), especially since the hyena is well known as a bone collector and modifier (e.g. Sutcliffe, 1970).  
62 These studies shed light on the potential traces of animal activities in archaeological sites and help to  
63 distinguish between agents in animal bone assemblages (Cruz-Urbe, 1991; Villa et al., 2004; Fourvel, 2012;  
64 Costamagno et al., 2005; Kuhn et al., 2010; Pickering, 2002).

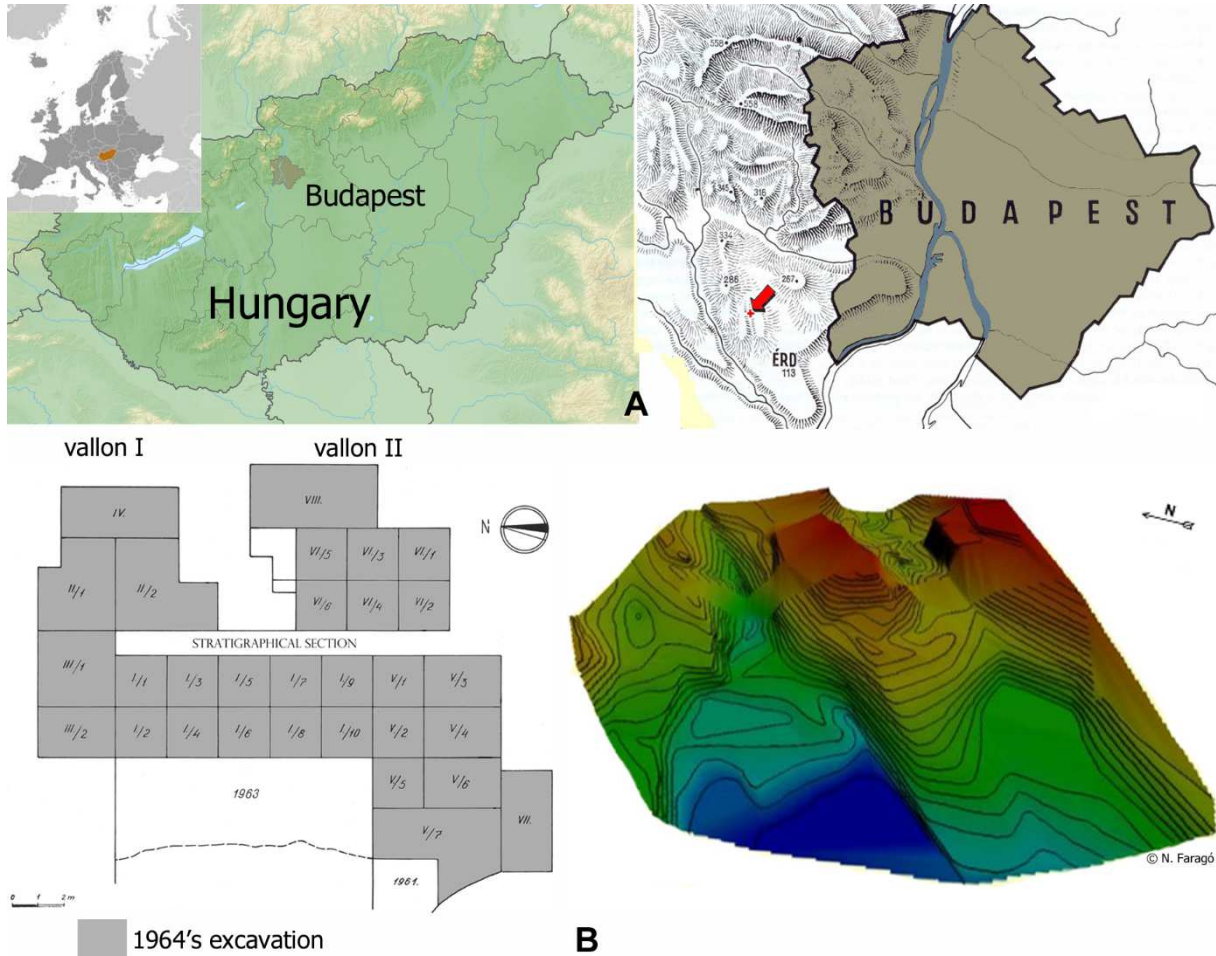
65 At Érd, the idea of a slow cultural development along the levels of the site was based on the increasing  
66 number of the tools and of the tool-types (according to Bordes' classification), the increasing percentage of  
67 the so-called Upper Palaeolithic types, of the non-quartzite raw materials and of the smaller tools  
68 (<30 mm) (Gábori-Csánk, 1968a: 183–196, 1968c). Parallely, a shifting in the orientation of hunting was  
69 also supposed by the increasing ratio of the horses and the rhinos in the bone material (Gábori-Csánk,  
70 1968a, 1968c). The tool production technology of the industry was thought to be a specific method linked  
71 to the local raw material for slicing the pebbles, similar to the technique applied in the Pontinian of Central  
72 Italy (Gábori-Csánk, 1968a: 115–125). Due to the methodological development in French Prehistory, from  
73 1980 onward, the technological approach in the study of the Palaeolithic tool production became a new  
74 research axis with elaborated research methodology, terminology, and analytical tools (Tixier et al., 1980;  
75 Inizan et al., 1999; Tixier, 2012). Based on the *chaîne opératoire* concept (Leroi-Gourhan, 1964: 164,  
76 1965: 9–62; 1993: 114, 219–255; Pelegrin et al., 1988; Boëda et al., 1990; Karlin et al., 1991; Sellet, 1993;  
77 Bar-Yosef and Van Peer, 2009; Soressi and Geneste, 2011; Audouze and Karlin, 2017) and on the results of  
78 a lot of knapping experimentations, a series of different debitage concepts and modalities were recognized  
79 and (re)defined (Boëda, 1993, 1994; Bourguignon, 1996; Inizan et al., 1999; Peresani, 2003). The  
80 application of the technological approach brought new elements to characterize the Quina type  
81 Mousterian (Charentian) industries (Turq, 1989; Bourguignon, 1997; Geneste et al., 1997; Hiscock et al.,  
82 2009), to reconsider the Pontian tool production (Bietti and Grimaldi, 1993, 1996; Grimaldi, 1996), as well  
83 as to study the industries using quartzite as raw material (Jaubert and Mourre, 1996; Mourre, 1997;  
84 Moncel, 1998; Cologne and Mourre, 2009; Di Modica and Bonjean, 2009).

85 All these results and developments provided to study the problematic of the human and carnivore  
86 presence in the site of Érd in much more complex way. Detailed re-analyses of the lithic and faunal  
87 assemblages of the site permitted to formulate new conclusions concerning the human technical activities  
88 and the presence and the role of cave bear and cave hyena (Daschek, 2014). The technological analysis of  
89 the lithic assemblage revealed the presence of different debitage concepts with the aim of producing  
90 special blanks and an expressed homogeneity of the blank morphometry along the sequence (Mester,  
91 2004, 2012; Mester and Moncel, 2006). The comprehensive archaeozoological analysis of the animal bone  
92 assemblage demonstrated that, beside human occupation, the site have been used as a den by cave bears,  
93 as well as a refuge by cave hyenas (Daschek, 2014). In this paper, we consider the possible interpretation of  
94 a mixed occupations of the site by human and carnivores in the light of these new results.

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## 97 **2. The archaeological site of Érd**

98 The site is located SW of Budapest, the capital of Hungary, on the Érd–Tétény Plateau (Fig. 1: A). The upper  
99 part of this plateau is built up of younger middle Miocene (Sarmatian) limestone. An important valley,  
100 named Fundoklia, developed along a fault line in NW-SE direction, cutting in the plateau (Hunyadi, 1962;  
101 Kriván in Gábori-Csánk, 1968a: 33). In the slope of the Fundoklia valley, erosional processes formed small  
102 depressions, interpreted as short vallons (Gábori-Csánk, 1968a), which were filled up and covered by  
103 quaternary sediments. The whole archaeological site was unearthed in two, 18–20 m long and 3–4 m deep,  
104 parallel depressions (“vallon I and II”) in the upper section of the Fundoklia (Kriván in Gábori-Csánk,  
105 1968: 33–38) (Fig. 1: B).



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Fig. 1. Geographic location of Érd near Budapest (A) and morphological character (B) of the site (3D model by © N. Faragó).

The stratigraphic sequence of the vallons is composed of weathered limestone and loessic sediments, deposited during the Upper Pleistocene (Fig. 2). Traces of periglacial (ice wedges, solifluction) and pedogenetic (rendzines) processes were observed in the sequence, demonstrating different climatic conditions during the accumulation period.

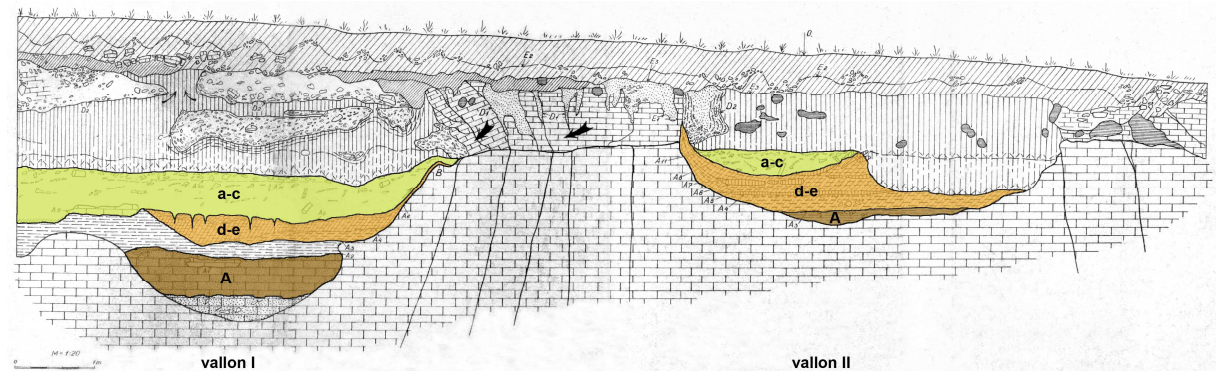


Fig. 2. Stratigraphic sequence of the site in the main cross-section (after the original drawing, which was never published entirely, cf. Gábori-Csánk, 1968a: Fig. 10A, modified). A: lower archaeological layer; d-e: lower horizon of the upper archaeological layer; a-c: upper horizon of the upper archaeological layer.

122 The site was discovered in 1961 by local people who found fossil bones. L. Hunyadi (1962) made geological  
123 observations and a small-scale palaeontological excavation. He supposed that there was a collapsed cave  
124 because of the presence of species of cave fauna. Next year lithic artefacts have been found also.  
125 Archaeological excavations of the site took place on a surface of 214 m<sup>2</sup> in 1963–1964 led by V. Gábori-  
126 Csánk from the Budapest History Museum (Gábori-Csánk, 1967, 1968a, 1968b). Animal bones and lithic  
127 artefacts have been found in loessic sediments in a depth between 130–150 cm (level a) and 215–240 cm  
128 (level e) in the upper archaeological layer, as well as in 260–280 cm in the lower archaeological layer (level  
129 A) (Gábori-Csánk, 1968a: 17–32) (Fig. 2). Based on the published observations, it seems to be rational to  
130 distinguish the lower (level d–e) and the upper parts (level a–c) of the upper archaeological layer because  
131 of some changes in the sediment sequence, already marked on the stratigraphic section. The two  
132 archaeological layers was separated by a 20 cm thick sterile layer. Two hearths were unearthed in level d in  
133 both vallons, and traces of combustions were observed in other levels too. During the excavations, a rich  
134 archaeological material was collected: about 15,000 determinable (14,930 after the table of fauna  
135 spectrum) animal bones and 3093 lithic artefacts according to Gábori-Csánk (1968a: 61, 62, 111).  
136 Palaeontological analysis of the osteological assemblage was performed by M. Kretzoi with a  
137 palaeoecological and chronostratigraphic conclusion (Gábori-Csánk, 1968a: 59–104). Petrographic  
138 description and characterization of the raw materials was made by I. Dienes, concluding to a local origin of  
139 them from a pebble formation of Burdigalian (Helvetian) age (Dienes in Gábori-Csánk, 1968: 111–114). A  
140 global description of the technology and a very detailed analysis of the typology of the tools were  
141 performed by V. Gábori-Csánk. V. Gábori-Csánk and M. Kretzoi evaluated the zoological material in terms of  
142 the reconstruction of hunting strategies and acquisition of food, based on their original methodology  
143 named “archaeological zoology” (Gábori-Csánk and Kretzoi in Gábori-Csánk, 1968: 223–244).  
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### 146 3. Material and methods

147 The re-analyses of this archaeological material was motivated by the international methodological  
148 development of the concerned research fields, archaeozoology and lithic technology. Both of us are trained  
149 by the “French school” of the field (Patou-Mathis, 1993, 1997a, 1997b; Inizan et al., 1999; Tixier, 2012).  
150 Because the site was re-covered after the excavations, direct study of the stratigraphic and  
151 geomorphologic situation was not possible. We can base our analyses on the archaeological  
152 documentation, which is stored in the Archives of the Budapest History Museum. Planigraphic and  
153 stratigraphic drawings according to levels, photographs and diapositives recorded by Miklós Gábori during  
154 the excavation works, and published observations were at our disposal.

155 The excavation methodology applied at the site was common in the early 1960s. During the first excavation  
156 season in 1963 a big trench (10 m × 4 m) was dug out, while the excavation area was subdivided in 2–3 m  
157 wide trenches (in total 30), opened according to the progress of the excavation. The digging was carried  
158 out with hand tools, all the sediments were dry sieved (Gábori-Csánk, 1968a: 15) with 15–20 mm mesh  
159 size. Provenience data of the finds (lithics and bones) were recorded with the identification of the trench  
160 and the level.  
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#### 163 3.1 Lithic assemblage

164 The lithic artefacts are stored at the Prehistory collection of the Budapest History Museum Aquincum  
165 Museum. Altogether 1,844 pieces have been studied, including retouched tools, cores, blanks, stone  
166 hammers and raw material blocks (pebbles) (Table 1). The main aims were to verify if the tool production  
167 system of the industry is really specific and adapted to the pebble raw material, as it was supposed; if the  
168 standardization of the tool-kit correspond to the size of the raw material or to some cultural aspect; if the  
169 apparent homogeneity of the industry along the occupation levels reflect a very low tendency for cultural  
170 changes over long time periods (from the end of the Last Interglacial to the Lower Pleniglacial) or it  
171 suggests rather problems of interpretation concerning the archaeological stratigraphy of the site.  
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Level	vallon I					vallon II					Total
	Tool	Flake	Core	Pebble	Total	Tool	Flake	Core	Pebble	Total	
a	189	258		38	485	15	27	8	17	67	552
b	148	272	4	72	496	32	16	3	3	54	550
c	122	86	7	20	235	48	78	1	6	133	368
d	88	88	3	7	186	22	11	2	6	41	227
e	80	21	1	1	103	3	4			7	110
A	11	15	1	7	34	2	1			3	37
<b>Total</b>	<b>638</b>	<b>740</b>	<b>16</b>	<b>145</b>	<b>1539</b>	<b>122</b>	<b>137</b>	<b>14</b>	<b>32</b>	<b>305</b>	<b>1844</b>
%	41.46	48.08	1.04	9.42	100.00	40.00	44.92	4.59	10.49	100.00	

Table 1. Composition of the industry in vallon I and II according to the levels.

According to these aims technological studies was performed using the technological reading method (*lecture technologique*) (Inizan et al., 1999; Tixier, 2012). Because of the specific features of the quartzite pebbles, dominant raw material of the industry, special methodologies applied to the study of such assemblages were also taken into consideration (Jaubert and Mourre, 1996; Mourre, 1997). The problem of the standardization have been studied by reconstructing the objective of the blank production using a morphometric analysis based on the statistic distribution of selected metric parameters. We calculated statistic distribution of the length, width and thickness values, as well as two ratios, which can describe the overall character of the blank (Mester, 2004, 2012; Mester and Moncel, 2006). These are the *length/width* (hereafter length-width ratio) and the *min(length, width)/thickness* (hereafter thickness ratio). For the length-width ratio, a blank is called “short” having a value below 1.0, “ordinary” between 1.0 and 1.9, and “allongated” equal or over 2.0. For the thickness ratio, a blank is called “thick” having a value below 3.0, “ordinary” between 3.0 and 4.9, and “thin” equal or over 5.0. For studying the problem of occupation levels, a spatial analysis were performed, based on the distribution of technological groups of artefacts as well as on refittings. Concerning this latter analysis, it is important to highlight that the archaeological material, as the osteological one, were recorded according to excavation units: by trenches of different size and by levels of 20 cm. These conditions limit the scope of the analysis and the conclusions.

### 3.2 Animal bone assemblage

Bone material is stored in the Mines and Geology Department and the Prehistory collection of the Budapest History Museum Aquincum Museum, as the lithic collection.

The osteological material currently includes 18,074 remains studied in total, uncovered from the 1961, 1963, 1964's excavations seasons.

Taxonomic identification revealed the following species (in descending order for the entire site and excluding microvertebrates and other identified small species, cf. Kretzoi, 1968: 59–204): *Ursus spelaeus* (average 86% NISP), *Equus caballus*, *Coelodonta antiquitatis*, *Crocuta spelaea*, *Canis lupus*, *Bos/Bison*, *Mammuthus primigenius*, *Equus hydruntinus*, *Megaloceros giganteus*, *Panthera (Leo) spelaea* and, with less than 20 remains: *Cervus elaphus*, *Lepus timidus*, *Rangifer tarandus* and *Mustela sp.* and *Vulpes vulpes/sp.*, *Felis silvestris* (not identified by M. Kretzoi) and *Ursus arctos*. The upper layers have delivered almost the same species in both vallons: the *Mustelidae* and the fox are absent in vallon II, while the cave lion and the brown bear are absent in the other (vallon I). There is a great diversity among large mammals. Ursid and perissodactyls are the most abundant groups of the 17 species of large mammals, which represent a major ecological type, the mammoth steppe (Kretzoi, 1968).

The Danube and its alluvial plain, less than 5 km to the east, could be transformed into a grassy (Kretzoi, 1968: 240) or a marshy area, depending on the climate or the season. For climatological and climatostatigraphical interpretations, it is risky to rely on small vertebrates, which are too few in number (excavation bias), while large mammals appear to be less anthropogenic than interpreted (Gábori-Csánk, 1968a) (a priori completely collected and taxonomically identified by a renowned palaeontologist). Based on the large mammals, the environment was open with a coniferous forest and the climate (in the upper levels) was cold (woolly rhinoceros presence) and relatively humid. In the absence of reliable levels (in

220 addition, grouped), it is not possible to know whether it represents contemporary palaeoecological  
221 conditions or reflects a chronological change (Daschek, 2014). For the moment, we do not have modern  
222 analyses concerning sediments and stratigraphy, whose data are lacking for further interpretation,  
223 including in climatological terms.

224

225 This study deals with only the osteological remains of 1964's excavation period and focusing on the  
226 determined remains of large and mega-herbivores (*Equus sp.*, *Coelodonta antiquitatis*) that are analysed in  
227 comparison with those of the main carnivores at Érd (*Ursus spelaeus*, *Crocuta c. spelaea*). The whole of  
228 these 4 species constitutes a sample of 8,070 remains (from the excavation in 1964, with partly new  
229 remains). Indeed, a previous study was carried out and published on the available bone material (Daschek,  
230 2014), to which new materials have been added since then.

231 In order to answer these questions, an archaeozoological (including taphonomic observations) analysis was  
232 conducted to describe and characterize the assemblage of these species (skeletal and age representations,  
233 modification of bone surfaces). Ultimately, the final objective is to know the place of these species in the  
234 diet of Neanderthal groups of Érd and to know if our analysis/study can bring some inferences on duration  
235 of human occupations.

236 Thus, for the description of bone material and the assessment of taxonomic abundance, quantitative  
237 variables such as the NISP (number of identified specimen) and the MNI (minimum number of individuals)  
238 (Lyman, 1994) of combination were used. Age classes, employed in archaeozoological studies, permit to  
239 interpret the use of shared spaces. Age at death is calculated almost exclusively based on isolated teeth,  
240 were established according to dental wear according to the work of Louguet-Lefebvre (2005) for rhinos,  
241 Fernandez (2009) for horses, Brugal et al. (1997), Mills (1982), Kruuk (1972) and Stiner (1994) for hyenas,  
242 Quilès (2003) – the results obtained are similar to those obtained according to Stiner's (1998) –, for bears,  
243 as well as the fusion of epiphyses. The age of death was calculated according to methods established by  
244 the authors listed above. Then, they were grouped into 4 age groups: infantile, subadult, adult and  
245 old/senile, in order to simplify comparisons.

246 The taphonomic study of bones (% NISP) is based on the identification of the stigmas of diagenetic  
247 alterations, as well as non-human and anthropogenic origins. Their precise identification and the  
248 description of their characteristics (stages, aspects) allows the distinction of accumulators-modifying agents  
249 (e.g. Behrensmeyer, 1978; Binford, 1981; Brain, 1981; Bunn, 1983; Blumenschine, 1986; Blumenschine and  
250 Selvaggio, 1988; Haynes, 1983; Lyman, 1994; 1995; Fisher, 1995; Stiner et al., Guadelli, 2008), which in turn  
251 makes it possible to highlight the order of access to carcasses (e.g. Costamagno et al., 2005). The type of  
252 fragmentation-fracturing contributes to this interpretation (types and aspects – Villa and Mahieu (1991),  
253 circumference – Bunn (1983), and diaphysis length, stigmas). Tooth-mark distribution on bone portions was  
254 done by following the methods of (Selvaggio and Wilder, 2001). Skeletal representations include shafts and  
255 are standardized by Minimum Animal Unit (% MAU, defined by Binford, 1981).

256 The study carried out by M. Kretzoi (in Gábori-Csánk, 1968: 59–104) is based on an analysis of the material  
257 by levels (*i.e.* occupation levels a-e, A). In addition, he grouped the bones of the two vallons together  
258 because of the supposed synchrony of their deposits (Gábori-Csánk, 1968a). In our study, the vallons were  
259 distinguished and treated separately in order to compare them, particularly with the hypotheses on their  
260 respective roles. Conversely, the levels were grouped, based on lithic and then bone refitting. In this study,  
261 we deal with the upper grouped levels' osteological material only and such for both vallons.

262

263 The interpretation of the site as an open-air area at the beginning of the excavations influenced the  
264 excavations (methods) and subsequent analyses: (1) choice of the use of dry sieving and little or no use of  
265 water sieving, although commonly used since the 1950s in palaeontological excavations, (2)  
266 archaeozoological interpretations (long-term settlement with hunting strategies, hunting of cave bears and  
267 most species/individuals, secondary specialisation in horses and rhinos, seasonality). They were thought to  
268 be necessarily linked to human activities. However, the researchers (Gábori-Csánk and Kretzoi, 1968) took  
269 into account observations of direct spatial relationships of bone and lithic material and different vertical  
270 and horizontal densities ("heaps") to refine their interpretations.

271 The 50,000 remains (Gábori-Csánk, 1968a) are probably an estimate based on the amount of  
272 undetermined material not studied. The essential part (taxonomically-anatomically and quantitatively, at  
273 least statistically) of the material is preserved. The undetermined bone fragments were not treated by M.

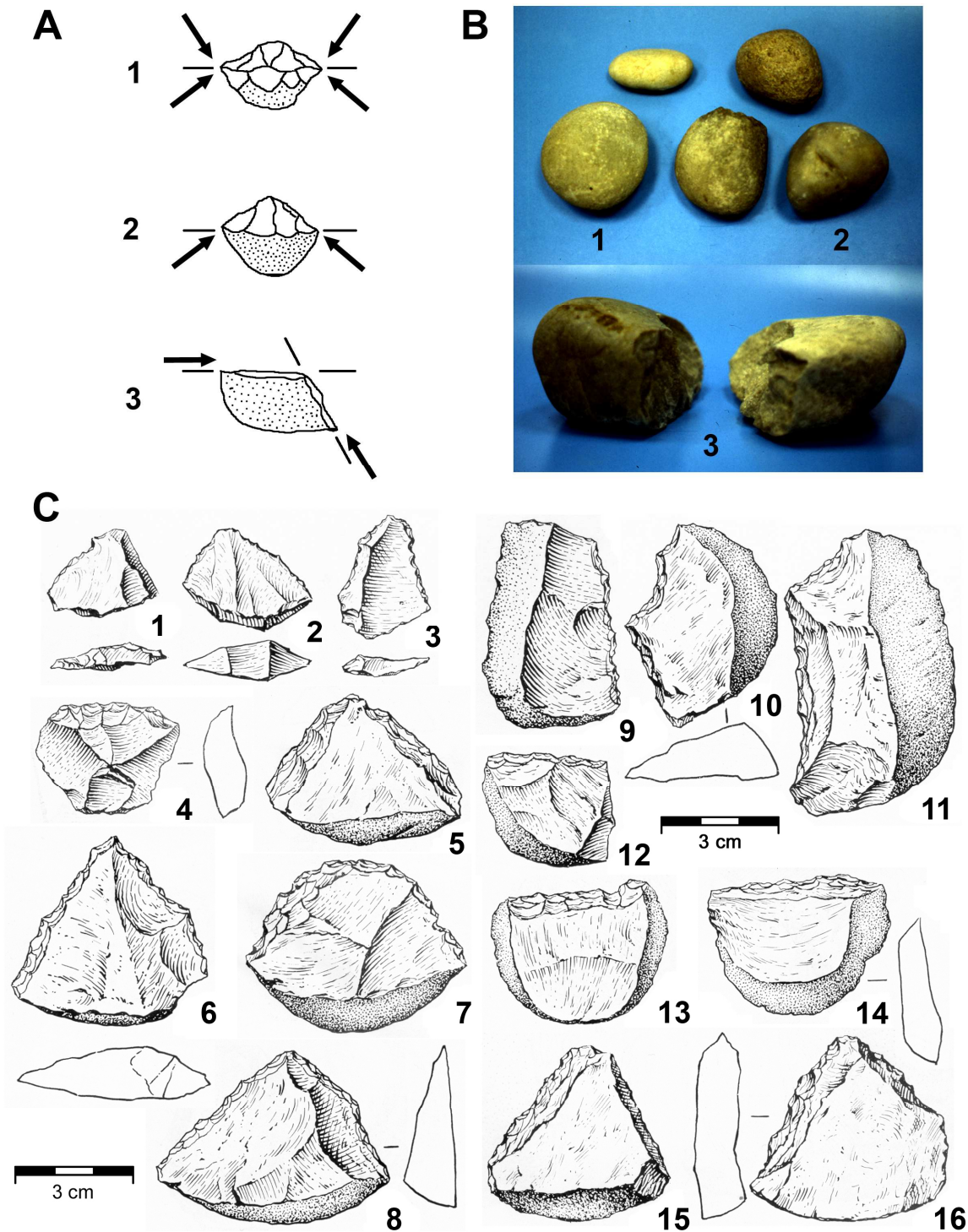
274 Kretzoi (Kretzoi and Gábori-Csánk, 1968). In addition, some of the 35,000 remains thought as lost have  
275 been found recently, representing several thousand remains (under study). The characteristics of the  
276 osteological material are: 1) 15000 remains determined out of 50,000 (estimated in total) thus, 30%  
277 determination rate; 2) 45 species in total including 31 for 1964's year; 18 species of micro-vertebrates and  
278 7 small vertebrates (<100 remains including 1/3 by sieving): variety of taxa, variety of animals of sizes and  
279 masses, variety of skeletal items; 3) presence of (fragments of) shaft more numerous than epiphyses (large  
280 > mega > medium > small size mammals frequencies); 4) presence of shaft among the taxonomic and  
281 anatomical determined taxa; 5) taxa discovered by sieving of 25 (micro-to-small size).  
282 An original study was recently carried out on the analysis of old material, highlighting the very significant  
283 impact of excavation and incomplete recovery methods. This, in fact, can result in substantial biases not  
284 only on skeletal part profiles, but also on taxonomic frequencies (Discamps and Favre, 2017). Among the  
285 Hungarian and even Transdanubian sites excavated until the 1970s, Érd is the site with the most abundant  
286 material without comparison. We do not know what the term indeterminate meaning covers (Kretzoi,  
287 1968; Gábori-Csánk and Kretzoi, 1968a), and how much anatomically identifiable remains (in terms of size  
288 classes at least) may be missing and in what proportion of the shaft fragments or anatomically identified  
289 fragments are included. However, bear remains (especially) and anatomically determined remains assigned  
290 to diverse mammalian size classes testify to the presence in each them bone (including shafts) fragments  
291 (even if <2 cm remains are very scarce); thus only (very) "small" (as mentioned in the monograph, Gábori-  
292 Csánk, 1968a) pieces or fragments of undetermined remains would be partly absent/unconserved. Nothing  
293 can replace the loss of equipment and related information. However, this information and the excavation  
294 methods, already described in the methodology, make it possible to use the species spectrum and skeletal  
295 representations as reliable.

#### 296 297 298 **4. Results**

##### 299 *4.1 Lithic analyses*

300 Our technological analysis revealed that the pebble slice as blanks were produced with Quina debitage  
301 concept. Moreover the Pontinian industry of Central Italy was also reconsidered in the 1990s by A. Bietti  
302 and S. Grimaldi who recognized the application of debitage systems by which the pebbles have been  
303 exploited as uni- and bidirectional or centripetal flake cores (Bietti and Grimaldi, 1993, 1996; Grimaldi,  
304 1996). In the blank production at Érd, we recognized three different debitage concepts: bifacial discoid,  
305 unifacial discoid or semi-discoid and Quina (Mester, 2004: 238–239; Mester and Moncel, 2006: 225–228)  
306 (Fig. 3: A). These concepts were applied according to the original morphology of the pebble as raw material  
307 block, in other words, the prehistoric knapper selected those pebbles for raw material which corresponded  
308 the most to the expected debitage (Mester, 2012: 11–12) (Fig. 3: B). As a consequence, characteristic flakes  
309 types could be linked to each debitage: the bifacial discoid debitage yielded triangular or subtriangular  
310 flakes with non-cortical butt, the unifacial discoid resulted similar flakes with convex cortical butt, and the  
311 Quina produced the pebble slices with quasi parallel faces and cortex on the butt or the back (Mester,  
312 2004: Fig. 4–5, 2012: Fig. 3–4; Mester and Moncel, 2006: Fig. 6–8) (Fig. 3: C).



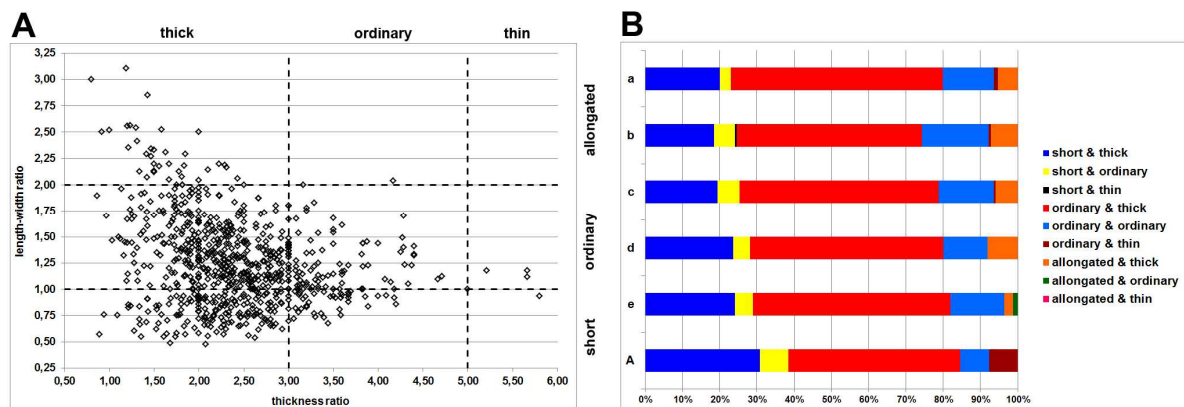


315  
 316 Fig. 3. Lithic production of the industry. A: schemas of the recognized bifacial discoid (1), unifacial discoid  
 317 (2) and Quina (3) debitage; B: pebble morphologies for these debitage (respectively 1, 2 and 3); C:  
 318 characteristic blanks of the bifacial discoid (1-4), the unifacial discoid (5-8) and the Quina (9-16) debitage.

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321 Respecting the attribution of the artefacts to level made by V. Gábori-Csánk and recorded in the inventory  
 322 book or on the labels, the composition of the studied assemblage according to main categories show a high  
 323 ratio of retouched tools which reach 40% in both vallon I and II (Table 1). The category “pebble” contains all  
 324 non-modified pebble which could be either raw material blocks or hammerstones. In some cases,

325 characteristic traces of a use as hammerstone can be observed too. About the cores it is important to  
 326 mention that all but one are of quartzite, however 22% of the assemblage were made on non-quartzite raw  
 327 materials, such as cherts (including nummulitic chert – Markó and Kázmér, 2004, and Buda hornstone –  
 328 Faragó et al., 2018), silicified wood, jasper, radiolarite. The exception is a huge block of silicified wood of  
 329 very bad quality, found in level b of vallon I. This block is so special that one can easily recognized the flakes  
 330 originated from the block.  
 331 Concerning the question of standardization in the tool production at the site, we carried out morphometric  
 332 analysis of the tool blanks. It was demonstrated that the blank production respected quite well defined  
 333 parameters (Mester, 2012: 12–13). The mean size of the tools is 42 × 36 × 15 mm, and 50.78% of the 575  
 334 analysed tools fit within the standard deviation of all the three dimensions, as well as 53.57% of them fit  
 335 within that of the two ratios (Mester, 2012: 12–13). Combining the two ratios, it become clear than the  
 336 knappers at Érd preferred the short and thick or ordinary flakes for tool making, regardless the raw  
 337 material (Fig. 4: A, Table 2 and 3). Moreover, no any modification in this sense could not be observed  
 338 between the assemblages of each level (Mester and Moncel, 2006: 232) (Fig. 4: B). The size of the blanks is  
 339 not determined by the size of the raw material because we found in the lithic assemblage partly exploited  
 340 pebbles the dimensions of which are largely over the size variability of the tools. Based on her typological  
 341 study according to the occupation levels within the upper archaeological layer, V. detected some  
 342 tendencies showing a kind of inner evolution of the industry during the life time of the site. These results of  
 343 the morphometric analyses did not confirm the abovementioned conclusions of Gábori-Csánk (1968a: 183–  
 344 196) concerning correlate shift in tool type composition, raw material ratio, length of tools. Differences  
 345 could be observed but no any tendency should be recognized. Even the question should be raised if these  
 346 occupation levels really existed at the site. Lithic remains and heaps of animal bones were unearthed  
 347 together. In these conditions, it is quite difficult to accept the existing of horizontal occupation levels in  
 348 each 20 cm approximately (Gábori-Csánk, 1968a: 183). Refittings of pieces found in different levels argue  
 349 also for the reconsideration of this aspect. The most spectacular refitting is represented by the  
 350 abovementioned silicified wood block which has a huge block and 20 flakes in the whole assemblage. Four  
 351 flake could be directly refitted on the block. The proveniences of the refitted flakes in their chronological  
 352 order of the removal are level c→a→b→a in vallon I, while the block (core) have been found in level b also  
 353 in vallon I (Mester, 2012: Fig. 9). The other corresponding flakes were unearthed in levels a, b, c and d in  
 354 vallon I as well as in level a, b and e in vallon II.  
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357 Fig. 4. Morphometric characteristics of the blanks. A: distribution of length-width and thickness ratios; B:  
 358 distribution of blank types according to levels.  
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		Length-width ratio						Total	%	
		0.1–0.4	0.5–0.9	1.0–1.4	1.5–1.9	2.0–2.4	2.5–2.9			3.0–3.4
Thickness ratio	0.5–0.9		2		1		1	1	5	0.87
	1.0–1.4		8	7	11	4	5	1	36	6.26
	1.5–1.9		22	38	32	15	1		108	18.78
	2.0–2.4		50	72	48	4			174	30.26
	2.5–2.9		39	81	17	1			138	24.00
	3.0–3.4		14	50	5	1			70	12.17
	3.5–3.9		10	16	2				28	4.87
	4.0–4.4		4	8		1			13	2.26
	4.5–4.9			1					1	0.17
	5.0–5.4			1					1	0.17
5.5–5.9			1					1	0.17	
>5.9										
Total			149	275	116	26	7	2	575	100.00
%			25.91	47.83	20.17	4.52	1.22	0.35	100.00	0

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Table 2. Morphometrics characteristics of the tools on quartzite.

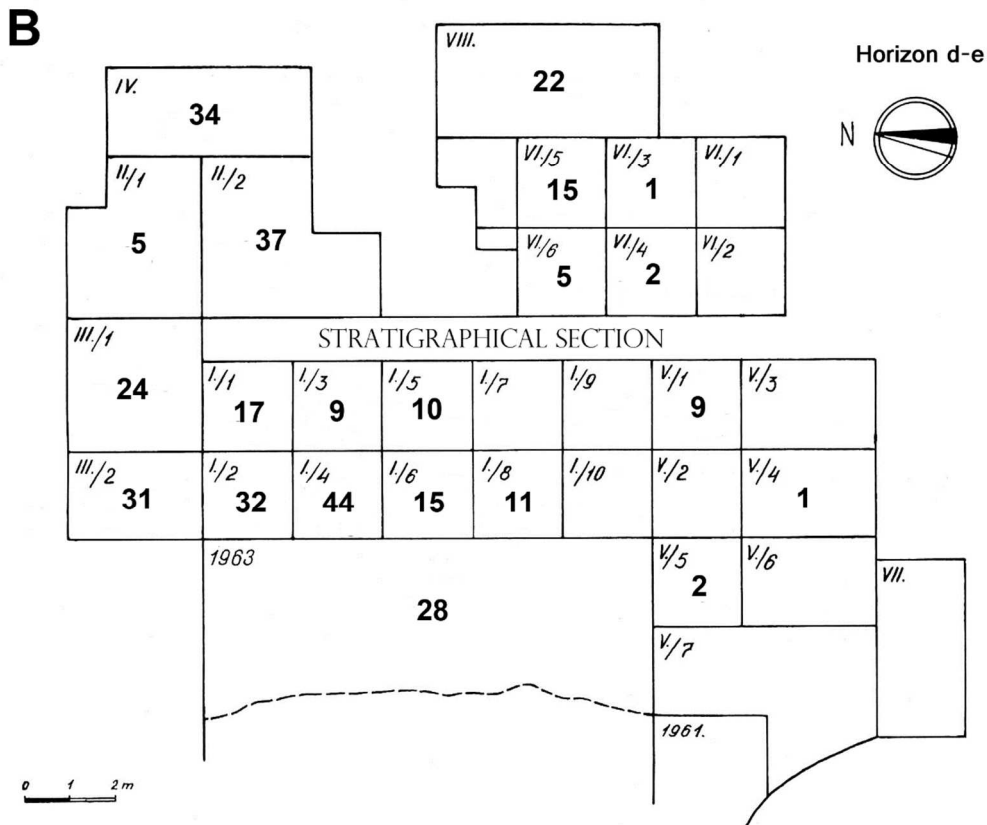
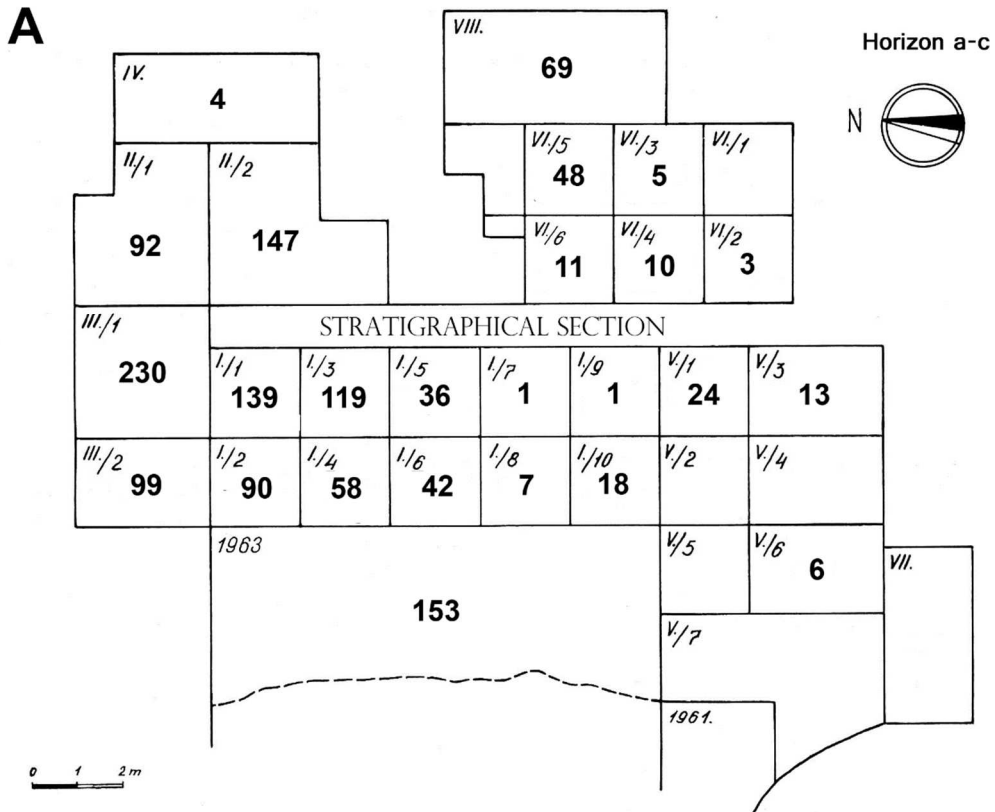
		Length-width ratio						Total	%	
		0.1–0.4	0.5–0.9	1.0–1.4	1.5–1.9	2.0–2.4	2.5–2.9			3.0–3.4
Thickness ratio	0.5–0.9									
	1.0–1.4		6	4	9	2			21	11.35
	1.5–1.9		6	11	12	4			33	17.84
	2.0–2.4		14	24	7	5	1		51	27.57
	2.5–2.9		10	21	8				39	21.08
	3.0–3.4		5	8	6				19	10.27
	3.5–3.9		3	5	3				11	5.95
	4.0–4.4			4	2				6	3.24
	4.5–4.9			1					1	0.54
	5.0–5.4			1					1	0.54
	5.5–5.9		1	1					2	1.08
>5.9			1					1	0.54	
Total			45	81	47	11	1		185	100.00
%			24.32	43.78	25.41	5.95	0.54		100.00	

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Table 3. Morphometric characteristics of the tools on non-quartzite raw materials.

375 For the spatial distribution study of the artefacts, artefact frequencies show the importance of the larger  
376 section of the bigger vallon I, closer to the Fundoklia valley, as well as the rear section of the smaller vallon  
377 II (Fig. 5). It is interesting that a very similar pattern was recorded in cave sites of the Bükk Mountains in  
378 Northeastern Hungary. In layer 11 of Subalyuk Cave, dated approximately to the end of MIS 4 stage  
379 (Mester and Patou-Mathis, 2016), people of the Quina type Mousterian occupied at the entrance of the  
380 cavity like in the vallon I of Érd (Mester, 2008: Fig. 9). In the Szeleta Cave, which should be dated to the  
381 Interpleniglacial (MIS 3), artefact density occurs, on the one hand, at the entrance and, on the other hand,  
382 at the very rear part of the cavity like in the vallon II of Érd (Ringer and Szolyák, 2004: Fig. 2). These  
383 analogies provide us to raise the original idea of L. Hunyadi (1962) whether there was a collapsed cavity at  
384 the site of Érd. V. Gábori-Csánk (1968a: 216) mentioned three workshops recognized by the frequency of  
385 cores and debris. According to the data of the inventory book, these were located at the rear part of the  
386 area (trenches II/1, III/1 and VIII). However, cores, hammerstones and raw material pebbles have been

387 found dispersed over almost the whole excavated surface.  
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392 Fig. 5. Spatial distribution of the lithic artefacts according to the archaeological horizons. A: upper horizon  
 393 of the upper archaeological layer; B: lower horizon of the upper archaeological layer (basic plan after  
 394 Gábori-Csánk, 1968a: Fig. 2 modified).

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397 *4.2. Archaeozoological analyses*

398 Although some data from the entire stratigraphic sequence are available, this study focuses exclusively on  
 399 the upper level (group) in each vallon (I and II) uncovered during the 1964's excavations, which involves the  
 400 largest osteological material and an up-to-date archaeozoological studies (Daschek, 2014).

401 Among 18,074 remains of the entire stratigraphic sequence, more than 13,000 belongs to large mammals  
 402 of the 1964's excavation, and among them, 8,070 NISP belongs to the 4 species studied here (horse, wholly  
 403 rhinoceros, cave bear and cave hyena) (Table 4). By vallon, these remains correspond to 3,885 NISP (vallon  
 404 I) and 4,185 NISP (vallon II). Among them, herbivores are represented by 786 remains, mainly from horse,  
 405 corresponding to at least 33 individuals. Ungulates represent 10% taxonomic NISP (75% without Ursids)  
 406 from the 1964's excavation, while carnivores constitute the bulk of the remains with 90% (3.8% without  
 407 Ursids) with 7,284 remains. The relative frequency indicates that cave bears are the most abundant among  
 408 carnivores and clearly stand out the cave hyena. The former is present with at least 246 individuals, and 15  
 409 hyenas.

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	vallon I	vallon II	Total
<i>Equus sp.</i>	446	123	<b>569</b>
<i>C. antiquitatis</i>	176	41	<b>217</b>
Total Herbivore	622	164	<b>786</b>
<i>U. spelaeus</i>	3,121	3,935	<b>7,056</b>
<i>C. c. spelaea</i>	142	86	<b>228</b>
Total Carnivore	3,263	4,021	<b>7,284</b>
<b>Total</b>	<b>3,885</b>	<b>4,185</b>	<b>8,070</b>

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Table 4. Number of identified specimen (NISP) for the 4 main species in the upper (grouped) layers in vallon I and vallon II at Érd.

417 The characteristics of the ungulate (*Equus sp.* and *C. antiquitatis*) and carnivore (*U. spelaeus* and *C. c. spelaea*) bone assemblages will be describe by mortality profile or age groups and body part frequencies. It will be followed by a taphonomical description (bone surface conservation, bone fragmentation, carnivore damage and finally anthropogenic marks). As the minimum number of individuals is low for some vallons and species (except for cave bears), interpretations are based mainly on the higher results of vallon I for the other 3 species.

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The study of age structures makes it possible, on the one hand, to determine the function of the site, as for example, in the case of bears and hyenas, and/or to interpret the accumulating agent (contribution by natural or at least in situ mortality, carnivore...).

427 At Érd, the data for these 4 taxa indicate the presence of individuals of all age groups, except for rhino (both vallons) and hyena (both vallons). Old individuals are systematically present. Table 5 presents the allocation of ungulate and carnivore, individuals to 4 age classes. Adults (sensu lato), represented by permanent teeth showing several stages of wear, are most common in ungulates. In horses, the prime-adults group is well represented at Érd. In rhino, calves younger up to 1 year old is surprisingly rare, than adults s.l.

433 It is generally accepted that hominids hunt preferentially prime-adult (6-9 years) preys. However, individuals in this age group may also be well represented/present in hyena dens. Thus, according to Dusseldorp (2009: 140), taking the example of the horse, the respective age profile is indistinguishable between Lunel-Viel or Camiac (dens, cf. Guadelli, 1989) and Bau de l'Aubesier (camp). Nevertheless, social carnivores tend to hunt weak individuals (young, senile ones) (Brugal and Fosse, 2004). These two age

438 groups are also well represented at Érd. This, and as well as the presence of different age groups, suggest a  
439 partial accumulation by carnivores and also by hominids, testifying to a mixed origin of the ungulate  
440 accumulations. According to Diedrich (2017), hyena hunts more particularly horses/any prey weighing  
441 >250 kg and less than 1 year's rhinos in groups or clans. The presence of adult individuals indicates a  
442 collaborative hunt by carnivores (hyena or wolf) or by hominids.  
443 Among carnivores, subadults predominates among the different age groups, to which in total five unfused  
444 or synostosing post-cranial remains contribute (also) in the case of the hyena.  
445 Very young (foetuses/newborns) and first winter young (only few worned teeth with resorption signs lost  
446 during their life) bear cubs are uncommon. Adult (sensu lato) males and (especially) females (pregnant or  
447 young mothers with their cubs) died in the site. The baculum confirms the presence of at least 15 and 14  
448 males, respectively in vallon I and II. "Repeated predation on hibernating bears in a cave therefore should  
449 affect prime adults, old adults, infants, and adolescents randomly, emulating their natural proportions in  
450 the living population sequestered in dens each year" (Stiner, 1998: 309). At Érd, this category is not  
451 prevailing, but well represented, and can represents multiple hunting/scavenging events.  
452 At Érd, age profile analysis show a mortality of recently independent and inexperienced subadults for cave  
453 bears, which is similar to those found in cave bear dens (Quilès, 2003, 2004; Fourvel 2012) and attest to in  
454 situ winter/spring (hibernating, farrowing) mortality of all or some of the individuals identified.  
455 Furthermore, in hyenid, many permanent teeth with fresh enamel and/or open or forming root with a thin  
456 root wall were not classified in the juvenile group (<1 year old, according to Fourvel, 2012), but in subadult  
457 group. Such inexperienced subadults can have died or may have been killed on site by other carnivores  
458 during intra- or interspecific competitions (Fosse, 1994). In the absence of juveniles (by deciduous teeth),  
459 the site cannot be interpreted as a nursery (natal den). However, this lack can be the result of sieving or  
460 diagenetic bias. If we consider, that these teeth were initially present at this site, the site can have played a  
461 role of nursery – in the case where the configuration of the site (cavity?), the suitability and the availability  
462 of space and resources may have been appropriate for such use –, or a consumption site (scavenging,  
463 communal den).  
464  
465 There is little evidence to indicate the seasonality of these multiple occupations at the site. Despite the  
466 presence of juveniles in horses and rhinos, and bear cubs, all of which are possible prey for carnivores, and  
467 without anthropogenic traces on their remains, their summer mortality (if the rhino was borned at the  
468 same period of year as the other ungulates in periglacial context) could indicate acquisition by a pack of  
469 carnivores. Bear cubs died during winter/spring occupation as has already been proposed (Gábori-Csánk  
470 and Kretzoi, 1968; Daschek, 2014). As the hyena can have young all year round, it cannot provide us with  
471 more details on the period of occupancy. However, if the absence of juveniles is not or only slightly  
472 artificial/diagenetic, and if that of subadults is linked either to a socio-educational presence in the  
473 communal den, and not due to an incursion where they have died, then, it is not a question of  
474 occupation/ephemeral presence.  
475  
476

Species	vallon	Infantile*	Subadult*	Adult	Old+Senile	Total	MNIc
<i>Equus sp.</i>	I	20.0	36.0	20.0	24.0	100.0	25
<i>Equus sp.</i>	II	25.0	12.5	37.5	25.0	100.0	8
<i>C. antiquitatis</i>	I	33.3	16.6	33.3	33.3	100.0	6
<i>C. antiquitatis</i>	II	0.0	25.0	25.0	50.0	100.0	4
<i>U. spelaeus*</i>	I	11.8	57.5	18.9	11.8	100.0	127
<i>U. spelaeus*</i>	II	8.7	64.4	23.1	3.8	100.0	104
<i>C. c. spelaea</i>	I	0.0	55.6	22.2	22.2	100.0	9
<i>C. c. spelaea</i>	II	0.0	33.3	16.7	50.0	100.0	6

477  
478 Table 5. Age classes of the 4 main species at Érd (*Equus sp.*, *C. antiquitatis*, *U. spelaeus*, *C. c. spelaea*) at Érd,  
479 in vallon I and II. MNIc: Minimum Number of Individuals. \*For *U. spelaeus*, Infantile=Foetal+Infantile;  
480 Subadult=Juvenile+Subadult (modified, after Quilès 2003).  
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483 For these herbivores and carnivores dental remains are dominant. With respect to skeletal remains of the  
484 ungulates, we observe that the anatomical parts that are best represented are cranial and appendicular  
485 bones. There is little or no presence of axial skeletons and belts, whatever the species or the vallon, except  
486 for cave bears (better). The remains of horses in vallon II are much less numerous than in vallon I. In the  
487 former, the teeth are as frequent as the elements of the autopodials.

488 The distribution of the skeletal elements in %MAU in both ungulates reveals, that almost all elements are  
489 represented (Fig. 6: A, B) and that the majority of the elements belong to the cranium (isolated teeth or  
490 dental crowns, often whole, but few skull bones) and to the autopodial. In both, humeri and tibiae are the  
491 most common items. The femur is absent in horses, but present in rhino (2 remains) just like the patella (2  
492 and 1 remains, respectively, in horse and rhino). We can assume that the entire limb was transported to  
493 the site initially, at least sometimes. Except humerus, the fleshy part of the limbs (scapula, femur) is almost  
494 absent, but marrow rich content bones as tibiae are frequent. The denser elements of the autopodial are  
495 not necessarily better represented than long bones or upper limb bones, except in bears and horses and  
496 lesser in hyena. These biases could be interpreted as the result of better conservation of the more resistant  
497 autopodial bones to destruction by both carnivores and geological processes, but only.

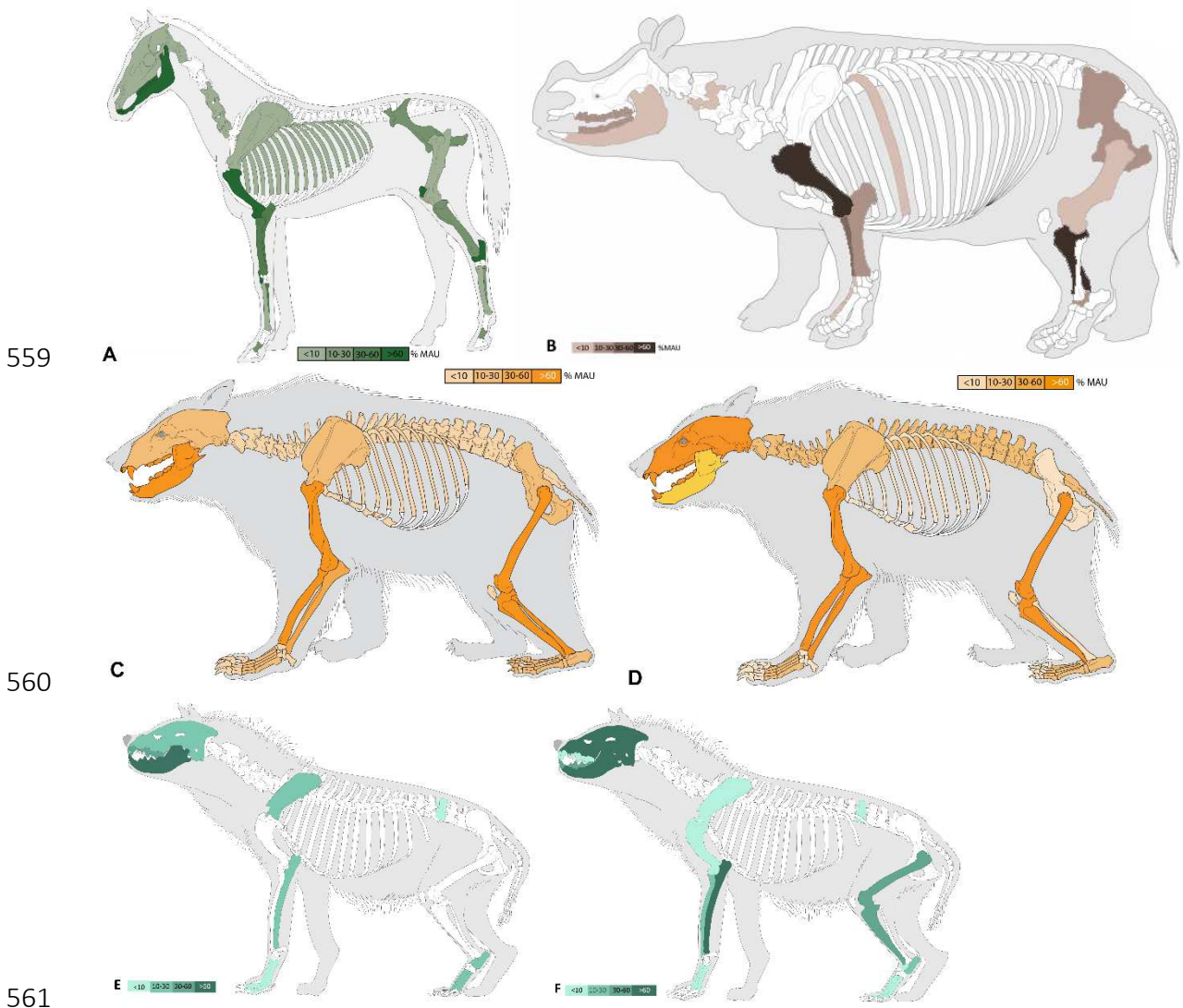
498 There is a partial relationship between bone density (after Lam et al., 1999) and the anatomical  
499 representation in horses in both vallons (test on the entire skeletal elements including absent  
500 element/portion, respectively, in the vallon I:  $r_s=0,425$ ,  $p<0,0001$ , and in the vallon II:  $r_s=0,489$ ,  $p<0,0001$ ,  
501 for  $N=104$ ). No long bones are whole, except some metapodials.

502  
503 In general, within a den, the femur is one of the least abundant or absent element and the presence of  
504 (sub)complet metapodials is characteristic. Carnivores often disdain these latter in the presence of more  
505 interesting elements because they are very compact in their proximal epiphyses (Michel, 2005). It cannot  
506 be ruled out that the rhino's meat was brought in the site without bones. Although fracturing their long  
507 bones is not interesting nutritionally, it is observed nevertheless, as the marrow is not accessible (Niven,  
508 2006), unlike (sometimes) mammoth bones, from which artefacts can be manufactured (Boschian et al.,  
509 2019). Teeth are more represented than bones. This difference, beyond intraspecies differential  
510 conservation sensu lato can reflect the existence of several episodes of limb accumulation. Various factors  
511 seem to be involved in the representation of the skeletal elements of these ungulates, especially for the  
512 rhinos' remains, which should be better represented because of the intrinsic characteristic of their bones.  
513 The carcass of an adult pachyderm is likely to be available for longer, especially if hyenas have to wait for  
514 human intervention to access subcutaneous contents (Dusseldorp, 2009: 140).

515  
516 The distribution of the skeletal elements in %MAU in both carnivores reveals that all skeletal units and each  
517 skeletal part are represented in bears and, in vallon II almost in hyenas (Fig. 6: C–F). This latter species  
518 ranks second after bears in terms of abundance of these skeletal remains (NISP, MNI) among the six  
519 carnivore species identified in these treated levels with 228 remains (25% NISP and 50% MNI when  
520 excluding bears). Cave bear remains are more numerous in vallon II, but fewer in MNI. Overall, the half of  
521 the osteological material consists of isolated teeth of both. Unlike ungulates, numerous and varied cranial  
522 bone fragments testify to the presence of the bears' head, few in hyenas. Long bones are the second best  
523 represented unit in %MAU (but not in NISP, in vallon I). Bones that can remain in the skin and small  
524 basipodials bones are rare in both, mainly in hyena. Epiphyseal destruction is very high in bears (<5%NISP).  
525 The epiphyses of preserved long bones are often the densest, but not always indicating a conservation bias,  
526 at least, not completely diagenetic. Axial and belts are under-represented, including in bears. However,  
527 many anatomically identified fragments that may belong to the same mammalian size class have been  
528 found in these levels. Especially in hyenas, the diversity of skeletal representation is greater in vallon II, in  
529 which the bones of the limbs are better represented thanks to the ulnae and the tibiae. No carnivore long  
530 bones are whole and the circumference of their diaphysis is almost complete. 12 (fragments of) coprolites,  
531 not mentioned in the monograph (Gábori-Csánk, 1968a), were unearthed at the same depths as their  
532 bones. They indicate the use of the site or some areas such as latrine. The features (according to Jouy-  
533 Avantin et al., 2003) of the bigger and complete fragments suggest that they belong to hyena. Some  
534 massive bones have been discovered, which may belong to female hyenas. The remains of the hyena were  
535 discovered near the walls (wall effect) (Gábori-Csánk, 1968a).

536

537 To sum up, assuming, that the carcasses were complete at least for carnivores and probably partially for  
 538 horse, the bone deficit is very high regardless of species (11 to 18 in ungulates, 15 and 16 in hyena,  
 539 respectively in vallon I and II); it is better for the bear (30 and 38 per singula, respectively in vallon I and II).  
 540 The isolated teeth clearly show a conservation bias in their favour (differential conservation). The even  
 541 elements are balanced in cave bear and more variable among the other species with less remains per  
 542 element. No anatomical connections were found.  
 543 "The presence of (partially) complete bear skeleton is one of the most significant criteria for bear  
 544 hibernation characterization (e.g. Stiner et al., 1996; Quilès, 2004)" (Fourvel et al., 2014). This kind of  
 545 skeletal distribution suggests typical natural (living) "population" from bear hibernation levels. "In the case  
 546 of [this kind of] level, it appears difficult to determine carnivore impact based on skeletal part distribution"  
 547 (Fourvel et al., 2014). However, we cannot exclude an occasional contribution of carcass pieces by  
 548 carnivores. Carnivore (hyena) dens, in general, regularly contain gnawed bear remains, who seem  
 549 (according to Fourvel et al., 2014: 237) to collect few, preferentially meaty parts, of them.  
 550 The horse carcasses were transported in part complete to the site or in several pieces, in both vallons, and  
 551 the rhino in pieces (including rare axial and foot), as well as the head. This confirms the observation of V.  
 552 Gábori-Csánk and M. Kretzoi (Gábori-Csánk and Kretzoi in Gábori-Csánk, 1968: 232) regarding the proximity  
 553 of the slaughter/acquisition and the site. At Bolomor Cave (Spain), Neanderthals carried proboscidean  
 554 skulls on a difficult path to reach their camp because of its nutritional value (Agam and Barkai, 2015, 2018).  
 555 The description of the age groups and skeletal remains of preys and carnivores show, that Érd corresponds  
 556 to a consumption/catch site, with periods of using as a den/refuge, but not as a nursery (natal den).  
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562  
563 Fig. 6. Skeletal representation for the 4 main species in upper levels at Érd, expressed by % MAU. A: *Equus*  
564 *sp.* (left, green); B: *Coelodonta antiquitatis* (right, red-brown) in vallon I. C: *Ursus spelaeus* in vallon I (left);  
565 D: *Ursus spelaeus* in vallon II (right); E: *C. Crocuta* in vallon I (left); F: *C. Crocuta* in vallon II (right).  
566

567  
568 **4.3. Taphonomy**

569 The taphonomic study will allow us to evaluate the respective roles of humans and carnivores in the  
570 accumulation and modification of this assemblage, especially through the information provided by the  
571 traces left by carnivores and humans on bone remains.  
572

573 The general conservation of the remains of this material is often good and do not prevent the reading of  
574 surfaces, although some of them (horse remains and especially rhinoceros) are particularly altered (stage 3  
575 of weathering and severe root edges traces). Bone surfaces show various diagenetic or biological  
576 alterations: mainly oxidation (mainly stage 1, black oxid), breccia (upper part of the upper level), traces of  
577 plant roots (coloration to total surface dissolution, Plate 1: c), trampling (17% on average). Evidence of  
578 rounding or polishing of the bone remains were found. The remains belonging to the hyenas are more  
579 altered in vallon II, while the other species are more altered in vallon I. Advanced weathering, various  
580 stages of alteration (absent to very damaged), sometimes on the same item, indicate the presence of: 1)  
581 fleshless (elements) carcasses, 2) the remains in open-air or at shallow depths. So, these show  
582 difficult/slow burial or re-exposure and, therefore, multiple burial conditions and periods, and (sub)surface  
583 disturbances. We must temper this statement since bones and teeth (rarely broken and with fragments not  
584 always found) have a well-preserved appearance, which is due to either: 1) rapid burial (sedimentation rate  
585 unknown for the site), 2) burial in a cavity context protecting from direct external weathering, 3) weak or  
586 moderate biological disturbances (trampling, other activities by bears...) leading to re-exposure, for  
587 example.  
588

589 Excavation and conditioning-damages have been identified on the material (recent breaks on 43% NISP, but  
590 only 1.5% NISP, <100 items, were particularly damaged). The cranial fragments and the abundance of  
591 isolated teeth show that the heads were transported to the site and exploited (mandibles, green  
592 fracturation patterns) in cave bear and rhino, and horse (also tooth crown/pillar fracturation, cf. Plate 3: e).  
593 Fresh fracture patterns observed on bones due to intentional breakage and carnivore consumption are  
594 much more frequent than those implying fragmentation on dry bone (Plate 1: d). There are in situ post-  
595 depositional fractures and we can therefore conclude that it is a primary deposit. Fragmentation of  
596 ungulate and bear (long) bones is important. Indeed, except for horse metapodials, long bones are rather  
597 incomplete, including in bears. Shaft circumference is often complete for whatever species. The absence of  
598 marrow cavity in rhino's long bones and the thickness of them explain the absence of fracturation and their  
599 consumption by hyenas only, who gnawed them from their epiphyses. The absence of diagenetic or  
600 biological fragmentation does not explain the abundance of rhino remains; the incomplete elements are  
601 due to gnawing, not to a fragmentation. However, it can explain, at least in part, that of large herbivores –  
602 anatomically determined fragments and undetermined) – belonging mainly of the size-class "large  
603 herbivores/large mammals/large carnivores".  
604

605 The results of the taphonomic study show that within this bone assemblage at Érd, traces from carnivores'  
606 activity are the most common biologic damages, regardless of these species. Such damage were observed  
607 on 21% NISP bone surfaces. Among the remains of the 4 species, a total of more than nearly 800 remains  
608 testify to the presence of tooth marks or a special morphology (Plate 1: a, b, e, f, g, h, i). These marks are  
609 pits, scores, furrowing, punctures, crenulated edges, gnawing. 65 remains have been digested (Plate 1: j, k).  
610 The ingested remains found belong to the horse and bear, both young and adult. They are small; larger  
611 ones have only been gnawed as observed by Beauval and Morin (2010).

612 Carnivore activity (tooth marks and bone breakage) in herbivores is less varied. Tooth marks were observed  
613 on long bones and autopodials. Items with traces of gnawing are variable in types and intensities.

614 Carnivore activity (tooth marks and bone breakage) appears on all skeletal elements (balanced even  
615 elements) in bears, predominantly on long bones, especially on humeri. Trabecular bones often carry the

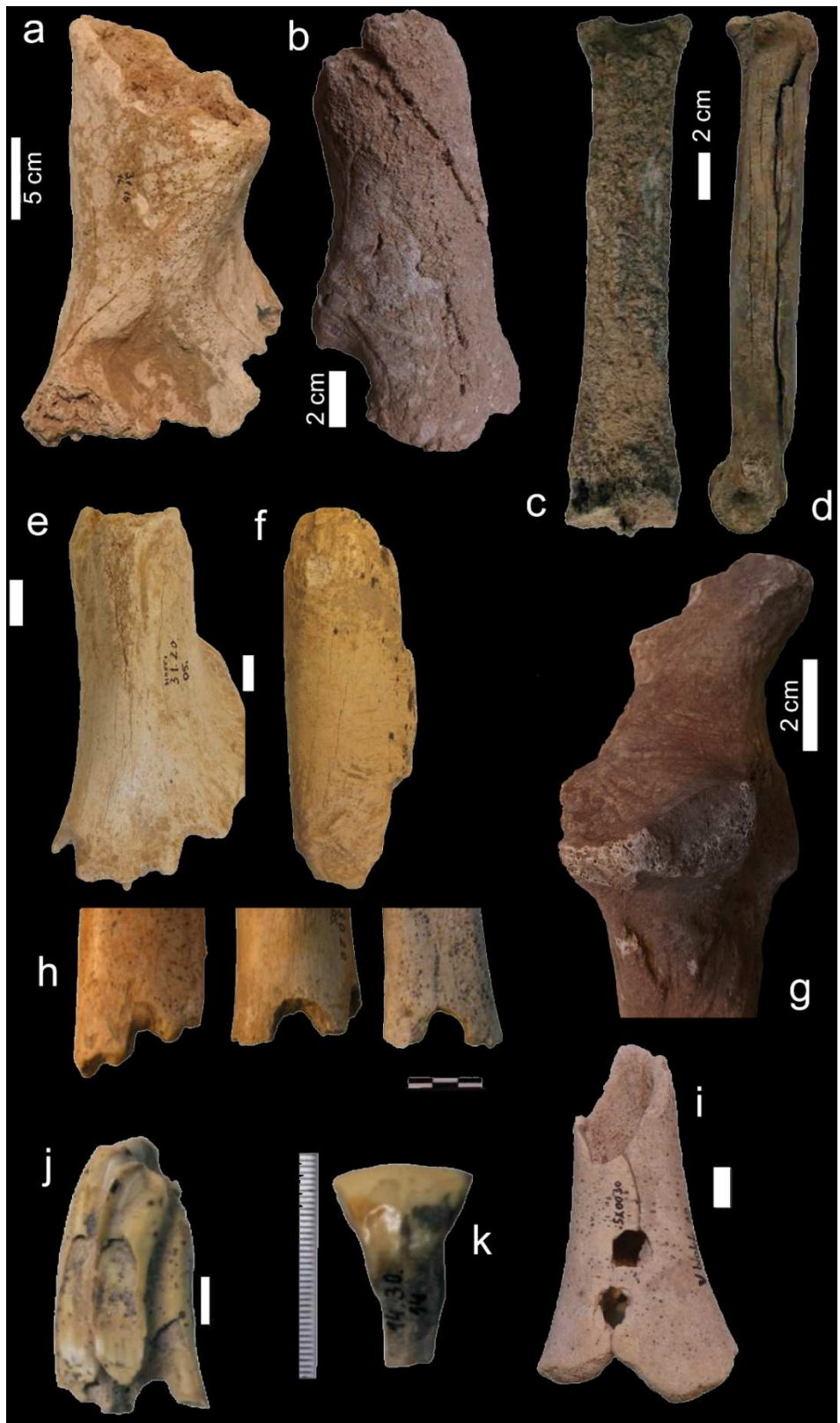
616 full range of various traces, especially grooves and perforations. Tooth mark distribution on long bone  
617 portions appears most frequently on the shaft (mainly like pittings, scorings). Gnawed extremities forming  
618 often a cylindrical shape are abundant. Gnawing at the ends of long bones indicates rapid access to  
619 carcasses. This suggests that these marks correspond to activities of consumption of external (meat...) and  
620 internal (marrow) resources and, on the other hand, to a complete carcass sequence consumption by  
621 carnivores (Rosell and Blasco, 2009: 312). This corroborates an on-site mortality.  
622 Skeletal elements damaged by carnivores belong in both young and adult individuals. They are divided  
623 among 80 individuals (MNIf), half of whom are juveniles (bear cubs, foals, calves of rhinos). Some of the  
624 same types of traces are observed on juvenile elements than on those of adults. Hyena bear some slight  
625 tooth mark of other carnivores and doesn't seem to be due to cannibalism. Taking into account all these  
626 aspects, neither bears nor herbivore carcasses were not systematically attractive for carnivores.  
627 Overall, the carnivore damage observed at Érd correspond to medium-sized carnivores (hyenas and/or  
628 wolves), some tooth mark indicates small or large carnivores' activities at the site.  
629

630 The results of the taphonomic study show that within this bone assemblage at Érd, traces from hominids'  
631 activity are also present. Anthropogenic damage are cut marks (Plate 2-4), intentional bone breakage (Plate 3-4),  
632 some burned bones. The anthropogenic action is visible on more than 250 remains at least, or 3% NISP of  
633 these 4 species. Butchery marks appear on adult remains only (except in bears and possibly a sub-adult  
634 hyena). These marks were found in both vallons, except in hyena and rhino where they appear in vallon I.  
635 Several mandibles of hyenas (vallon I-II), 1-3 horse remains (vallon I), 4-5 long rhino bones (vallon I, radius,  
636 humerus, tibias) and more than 100 bear remains (vallon I-II, mandibles, rib, vertebrae, scapula, long fleshy  
637 and marrow bones, metapodials, acropodials) bear cut marks. These are striae (Plate 2: a1-3) of defleshing  
638 (rhinoceros, bear, horse), disarticulation (bear), skinning (bear, hyena).  
639 The visible cut marks are either thin (most of the traces) or wide appearing here on rhino's bones (Plate 2:  
640 a1-3). The width of the striae would come either from worn tool edges or from a raw material other than  
641 flint, such as quartzite, unearthed at the site. The use of this locally manufactured rock could support the  
642 hypothesis that it could be used for on-site activities, available in the vicinity of the site. The butchering  
643 process steps vary from species to species and correspond presumably to different acquisition episodes.  
644 Indeed, different strategies had to be implemented for the acquisition of rhinoceros and the bear  
645 (dangerous), such as the horse (high leakage speed and fast). As for the rhinoceros, based on the ethology  
646 of extant species, the mother and her young calves only separate when they reach a water point  
647 independently, in order to minimize the possibility of a possible attack by carnivores (and humans?). If this  
648 behaviour has existed in the past, this was a moment that have had certainly been used by the human and  
649 carnivore predators to kill the juveniles.

650 Impact points were observable, with sometimes notches, on the remains of rhinos, horses and especially  
651 bears. Traces of fire were observed on remains of bears (half of them, or nearly 40 remains), horses, rhinos,  
652 hyenas. A hyena mandible seems had been used as a retouchoir (external face).  
653 From all these elements, we can deduce that butchery and consumption activities of these preys had taken  
654 place at the Érd site. Some of the horses may be, but certainly rhinos have undergone pre-treatment  
655 butchering at the acquisition site with a selected transport of anatomical portions or all in quartered  
656 sections to the Érd site (appendicular meaty and marrow-rich content bones and heads).  
657 Some of the striae appear on the shaft (defleshing), and the presence of long bones of the upper limbs  
658 (including tibia) fleshy or containing marrow, suggest primary and rapid access to the carcasses of  
659 ungulates and bears. The combined presence, but not crossed, of gnawing and butchery marks appears on  
660 the remains of adult individuals of the 4 species (horse, rhino, hyena, bear) and juveniles (bear, cf. Plate 3).  
661 They were observed on shafts, except those of the hyena (vallon II) and cubs. This means, that in these  
662 cases also, human had primary access to the corresponding carcasses parts.  
663 Very few remains are affected in horse (possible extraction of the tongue, cf. Plate 3: c) with a single tibia,  
664 and 9 long bones (without metapodials) have green fracture patterns (including 2 with notches, cf. Plate 3:  
665 d) without carnivore gnawing, and hemimandibles (Plate 4: c, d) and long bones in hyena (occasional  
666 removal of the skin and possibly consumption). Bear remains show the most numerous marks on fleshy or  
667 marrow-rich content bones suggesting a complete carcass processing (or resulting from an average of  
668 multiple processing events). As in the case of the rhinoceros, nearly half of these bones are eaten by a  
669 carnivore (Plate 1: a, b, Plate 2).

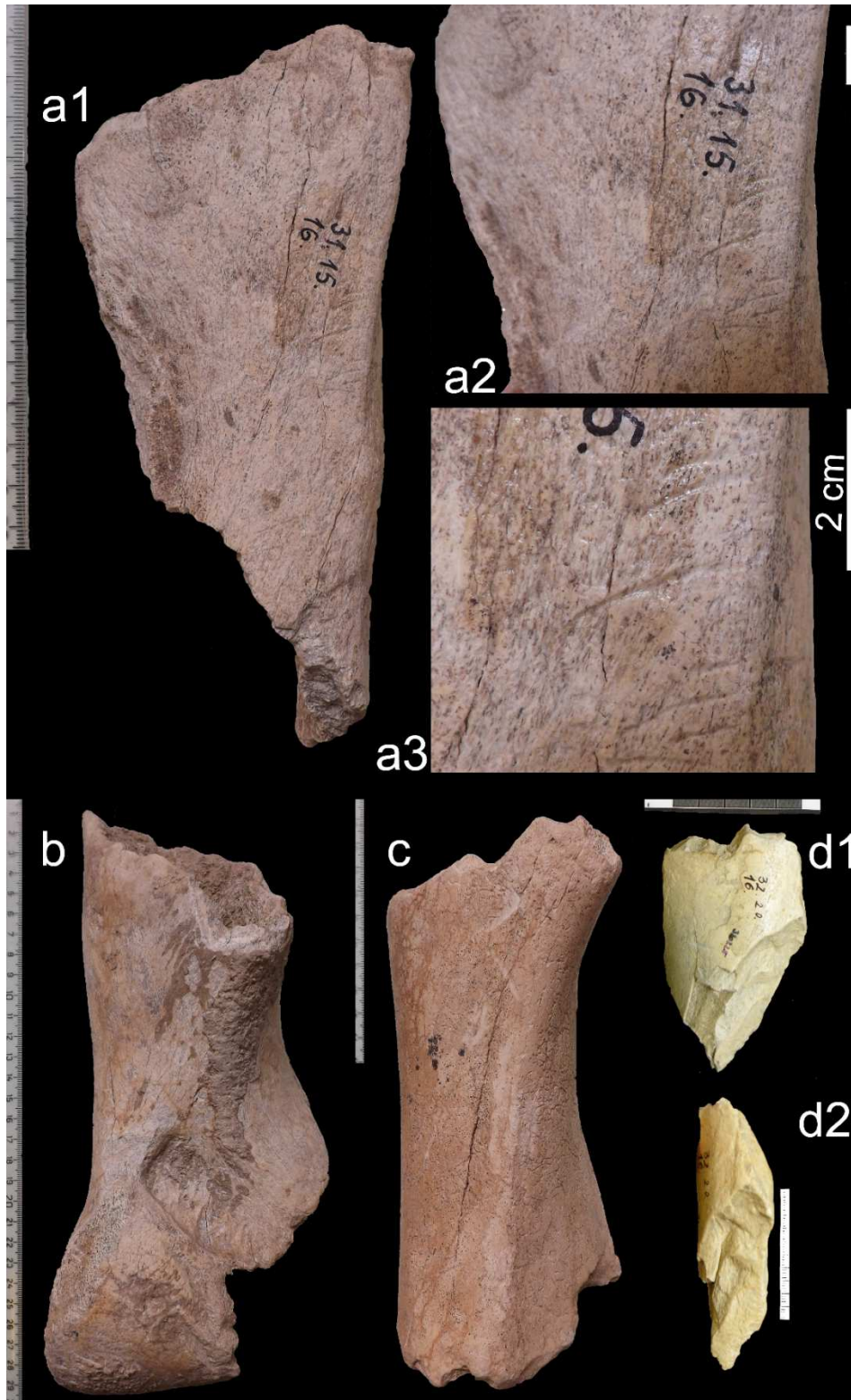
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To sum up, carnivore activities are frequent, but not systematic, neither on bear remains nor on ungulates. Carnivores have contributed to bone accumulation and modification in two ways: by scavenging or killing bears, by scavenging abandoned ungulate remains by humans, and by a primary acquisition of ungulates (therefore by bringing some elements, even maybe bears), but also perhaps by taking them elsewhere. The two vallons seem to function differently: human action is very weak and can correspond to movements (by trampling or secondary consumption) by carnivores in the vallon II.



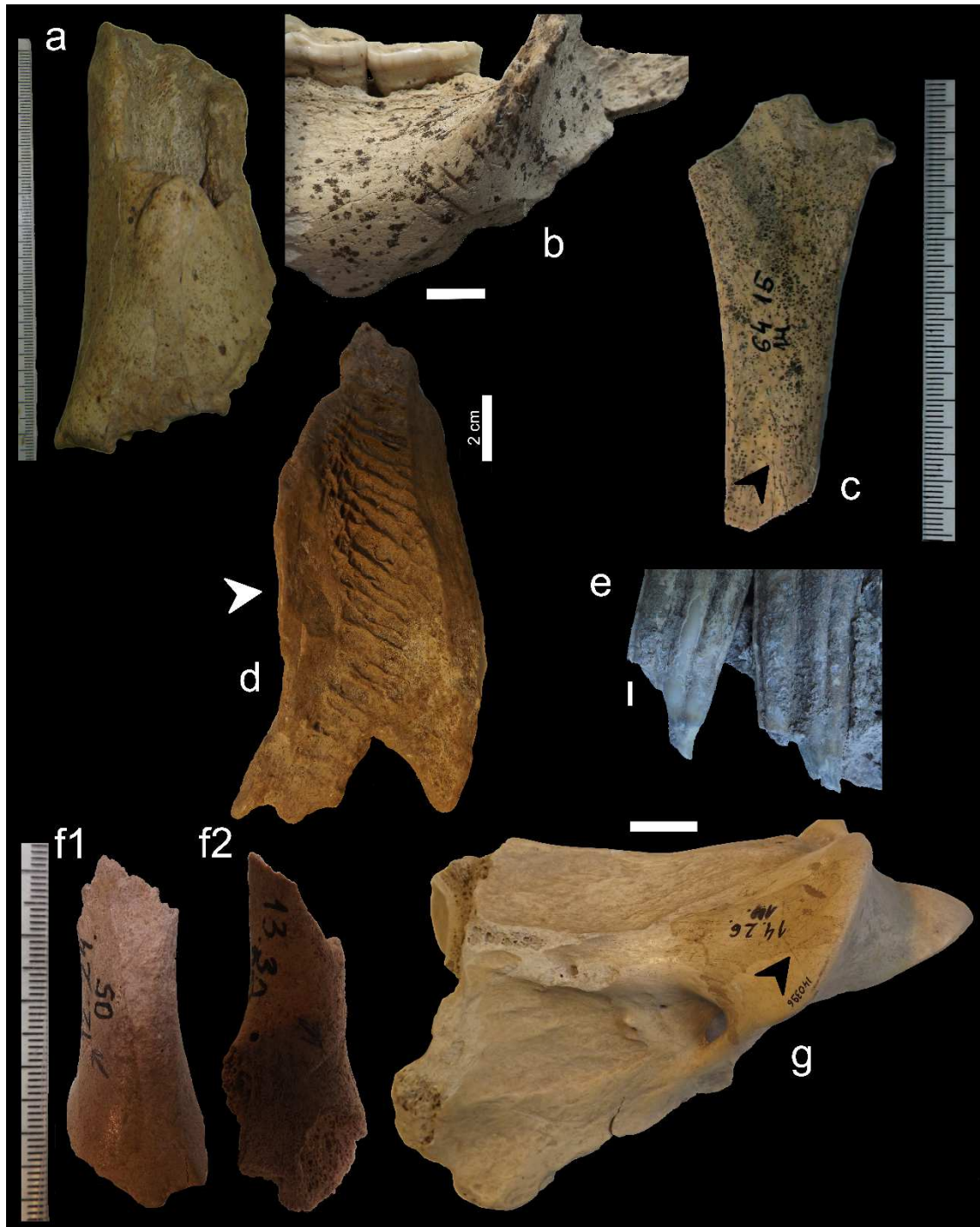
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Plate 1. Illustrations of elements of the site of Érd (from upper level): rhinoceros (a, b), horse (c, d, j, k), cave bear (e, g, h, i) remains and an indeterminate long bone shift fragment (f). © É.J. Daschek.



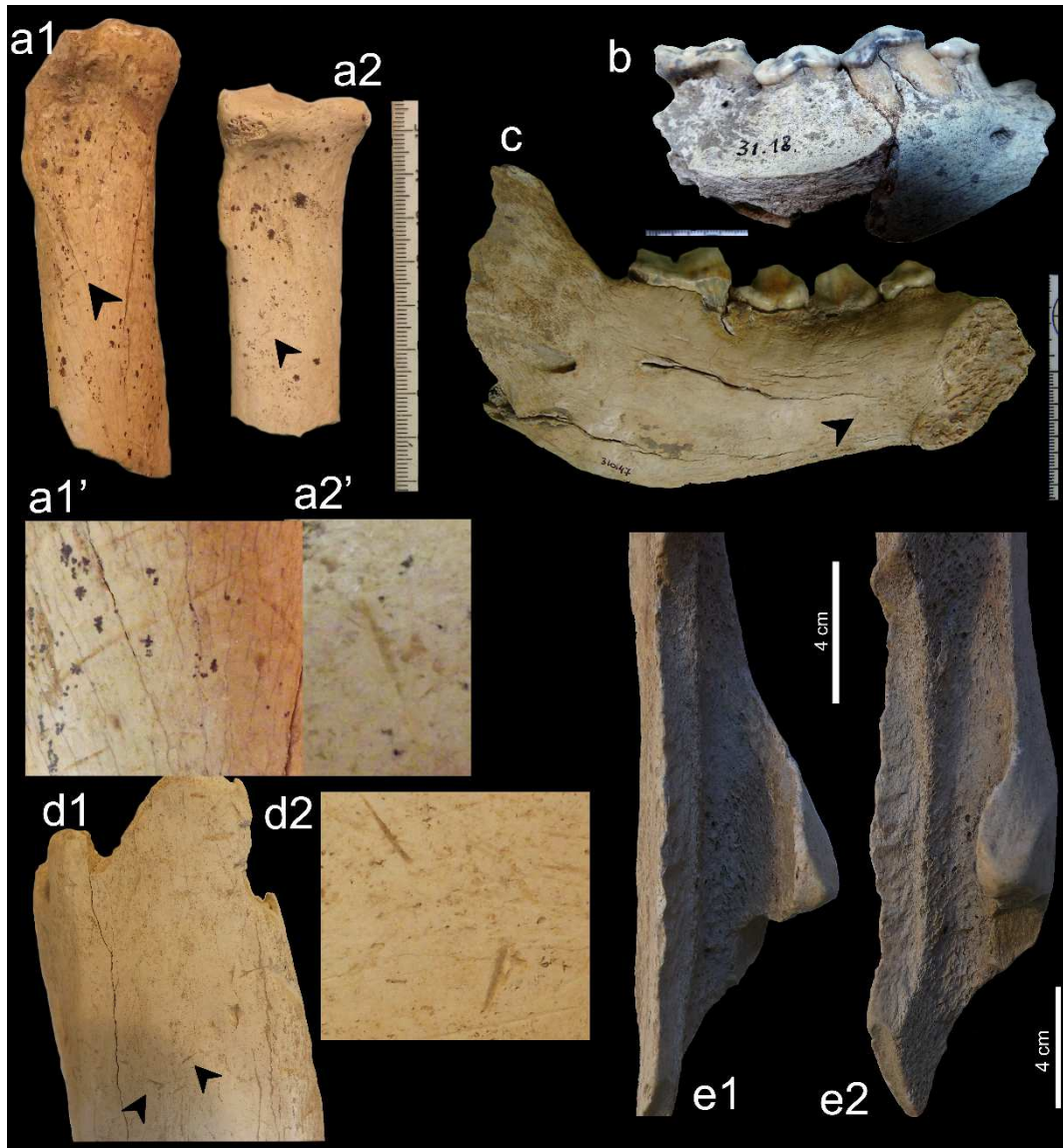
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Plate 2. Illustrations of elements of the site of Érd (from upper level) Érd: rhinoceros elements showing a1-3) cut marks; b) carnivore ravaging with characteristic hyena consumption morphotype; c) carnivore ravaging; d1-2) hominid-made fracturation splinter on fresh bone a mega-sized ungulate. © É.J. Daschek.



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Plate 3. Illustrations of elements of the site of Érd (from upper level): a) crenulated edges on cave bear; b) butchery striae on cave bear; c) probable butchery on horse hyoid bone; d) impact notch on horse bone; e) pillar fracturation on horse; f1-2) butchery striae on very young cave bear bone; g) probable butchery striae on horse axis. © É.J. Daschek.



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702 Plate 4. Illustrations of elements of the site of Érd (from upper level): a1) and a2) and their details a1') and  
703 a2') butchery striae on hyena; b) fresh fracturation on hyena; c) butchery striae on hyena; d1-2) butchery  
704 striae on cave bear; e1-2) human or rodent-made edge on cave bear bone and hyena ravaging fracturation  
705 type. © É.J. Daschek.

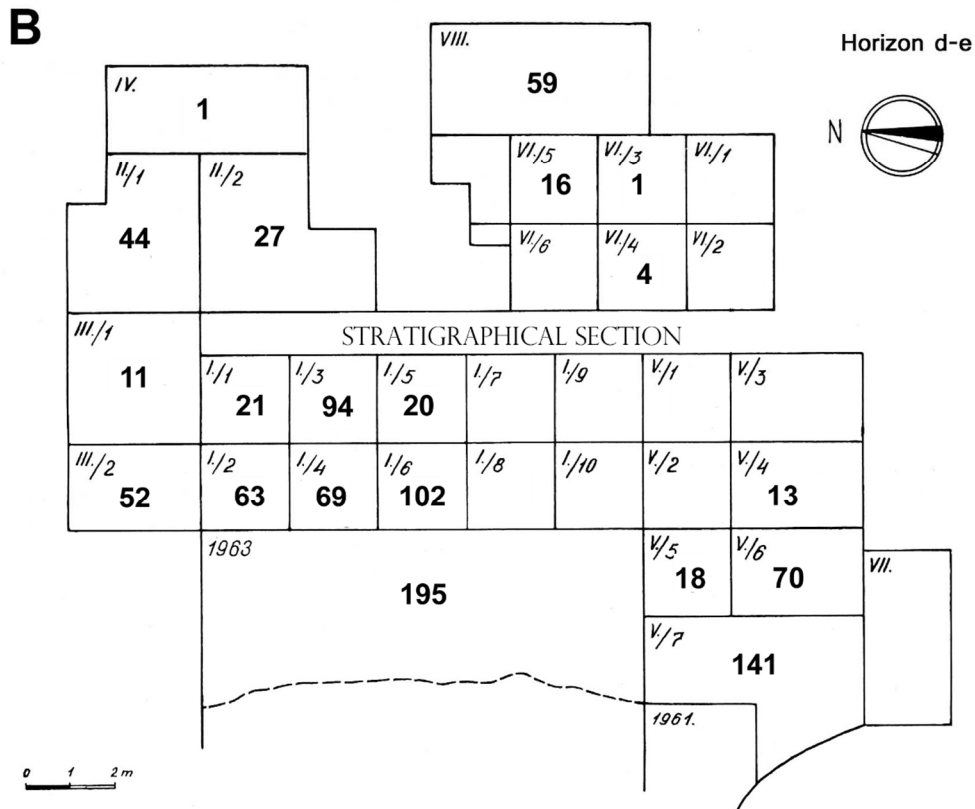
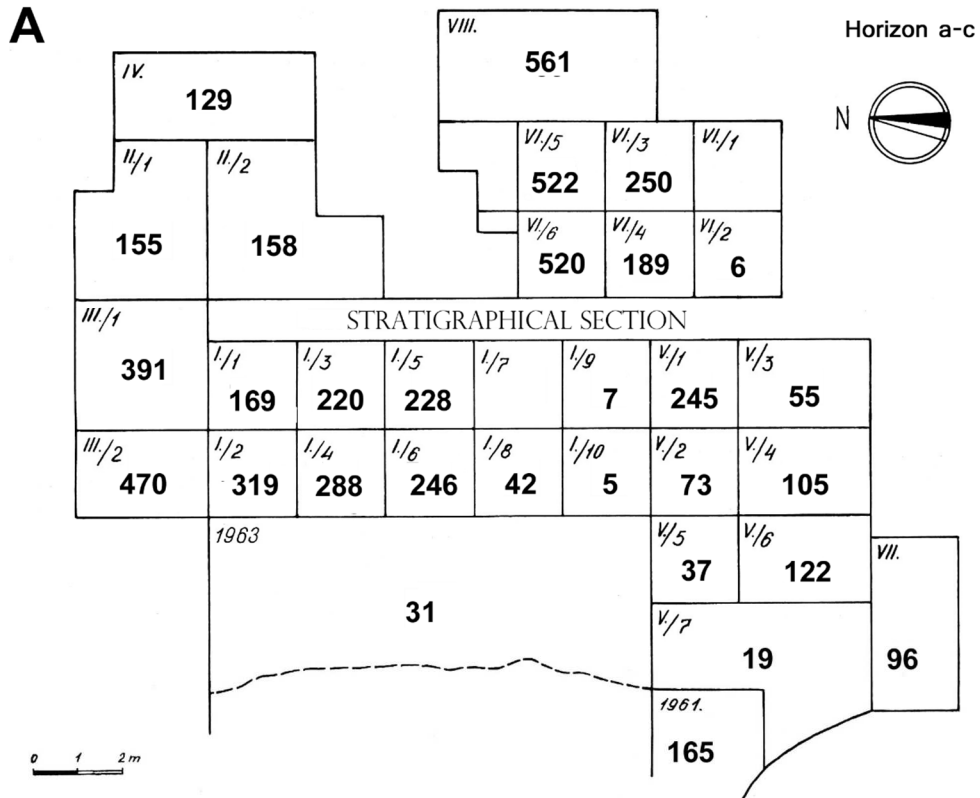
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708 For the spatial distribution study of the artefacts, artefact frequencies show the importance of the larger  
709 section of the bigger vallon I, closer to the Fundoklia valley, as well as the rear section of the smaller vallon  
710 II (Fig. 7). M. Kretzoi and Gábori-Csánk (1968: 237, 237–244) mentioned 11 heaps recognized by the  
711 frequency and the density of bones and some recurring species, mostly horse and cave bear. According to  
712 the Fig. 43 in the monograph (Gábori-Csánk, 1968a: 243), these were located at the front part of the vallon  
713 I (trenches II, I/1-8 and continue partly in the area of the 1963's excavation) and the vallon II (trenches VI  
714 and mostly VIII, so the innermost area). Horse and other ungulate remains have been found dispersed in  
715 these same areas (in grouped layers) (Daschek, 2014: Fig. 83–84). It is the same for the cut marks, which  
716 were found in the same areas, but with a greater extension to other excavated surfaces (trenches of square  
717 V) (Daschek, 2014: Fig. 86). We can observe here (Fig. 7), despite a similarity in the distribution of lithic (Fig.  
718 5) and bone materials in both horizons (upper and lower), that bone material is not only much more  
719 frequent, but is also present in areas where the lithic is not (e.g. 1961's excavation area, VII, partly trench  
720 V) or very little (partly trench V). In contrast, three trenches (I/8, V/1, VI/6) in the lower horizon are empty  
721 of bone remains; only lithic material was found there. This may mean a distinct temporality, at least

722 partially, between lithic and bone accumulations. As indicated, all the lithic remains and almost (<~2 cm?)  
723 of bones were collected, the dominant activity on the site was butchery and/or consumption.  
724 The same approach to spatial distribution by horizon has shown that the bones (in NISP) are distributed in  
725 the same areas of the vallons (Fig. 7) as the lithic material and confirms the main use of the large vallon in  
726 its front part and the rear of the smaller one. The two vallons were interconnected (Gábori-Csánk, 1968a:  
727 10).  
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Fig. 7. Spatial distribution of the osteological material according to the archaeological horizons. A: upper horizon of the upper archaeological layer; B: lower horizon of the upper archaeological layer (basic plan after Gábori-Csánk, 1968a: Fig. 2 modified).

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## 5. Discussion

### 5.1. Lithics

Based on the results of our analyses of the lithic assemblage, the interpretation of the site as a hunting camp used over a long time period could be supported no longer. The local tool production is demonstrated by the presence of all the technological categories, including raw material blocks, cores, blanks, retouched tools and hammerstones. But such high ratio of the retouched tools is uncommon at camp sites. Moreover, only short debitage sequences could be identified, and several raw material types are represented only by less than a dozen of pieces. Besides the two hearths uncovered in level d in trenches I/4 and V/4 (Gábori-Csánk, 1968a: Fig. 6–7), there are no indications of longer human staying at the site. These data argue for recurrent short occupations by small human groups or passages of hunters during some activities or mobility. Non-quartzite raw materials allow to suppose a wider territory in the northeastern part of Transdanubia for the groups frequenting the site of Érd. The presence, in very few quantity and only in form of blank or tool, of the Buda hornstone and the radiolarite extend this territory 15 km north-eastward and 40 km north-westward. Though the nummulitic chert has outcrops not far from the site too, the common use of this raw material is recorded in Middle Palaeolithic sites in the region of the Cserhát Mountains in northern Hungary about 90 km from Érd (Markó and Kázmér 2004: Map 1).

### 5.2. Fauna

As for the lithic assemblage, based on the results of our analyses of the osteological assemblage, the interpretation of the site as a hunting camp used over a long time period could be supported no longer. The 1) recurrent human occupations with hearths, 2) short seasonal periods (summer according to foals from family herds and probably rhino calves, winter according to bears cubs (with 1-2 bones with butchery mark), and indefinite but not long-term in hyenas, 3) consumption of the carcasses by hyenas even those abandoned by hominids or brought by themselves (prey deposit or consumption site, so, post-human and post-ursine), 4) trampling marks (post-hyeneine occupation), 5) incomplete butchery sequence (maybe what survived the consumption of hyenas), 6) part of which was carried out at the place of killed/dead (rhinoceros) with a view to transport to Érd, 7) gnawed rhinoceros remains (presence of hyenas before and after the Neanderthal abandonment), 8) “chaîne opératoire” complete of the manufacture of quartzite lithic tools, 9) in situ from local origin but with short sequences with few remains concerned, 10) “couche-repaire” (short-time bear-den level), 11) origin of local species (only regional migration of both ungulates), one can say that all these 11 aspects suggest short but recurring occupations at Érd. We do not have any information concerning the available analyses (*cf.* Gábori-Csánk, 1968a).

One of the sine qua non criteria for characterizing a hyena den (Fosse, 1994; Pickering, 2002; Kuhn et al., 2010) is that of the mortality structure of hyenas, in particular the presence of juveniles (native den and communal until the definitive weaning of cubs until about 30 months according to Kruuk, 1972), that of the abundance of hyenas (in NISP and MNI, see Fourvel, 2012 for a detailed census), and to a lesser extent, the presence of digested elements and coprolites; their absence would not exclude (rule out) the presence of hyena (Sauqué et al., 2014: 16). Except for juveniles, all age groups are represented in Érd in both vallons (NMIc=15) and the number of remains is quite significant in Europe (NISP=204). A few dozen remains have been ingested (mainly horses/foals and bears/cubs), but other species/taxonomic groups are also concerned; most of them are herbivores. The 12 coprolites and fragments attest to the use of certain areas as latrines.

In terms of the length of time occupied by hyenas, since (current) hyenas can give birth all year round and occupy a place for less than 4 months (such as a season), this species does not provide precise information on the period or length of time a site has been occupied, except for a multiplicity of episodes and therefore recurrences. Except for the winter and spring seasons when bears occupied the site, it had to be available the rest of the year (Diedrich, 2012). At least some of the foals could attest to their presence during the summer.

The apparent specialization of hominids (in horses, rhinos) observed by V. Gábori-Csánk and M. Kretzoi (1968), may be the consequence of the activity of hyenas and other carnivores (in pack), both are able to

790 hunt adult ungulates or preys heavier than 250kg of weight. Wolves are very frequently associated with  
791 *Crocuta* after Brugal and Fosse (2004), that may be able to consume/reduce the entire carcass of small-to-  
792 medium-sized species and; only the teeth of the most frequently consumed species would be represented.  
793 Among the elements ingested, we note the presence of milk teeth and permanent teeth with buds/unused  
794 or worn in addition to bone remains, but only the remains of a vulpine, a small undetermined mammal, a  
795 wolf and, for the larger ones, the five remains of *E. hydruntinus* only in the upper parts and especially in  
796 valley I and a hyena (data including other years of excavations and levels), in addition to a few dozen  
797 remains belonging to large- and mega-herbivores. All these species are also represented by undigested  
798 (adult) dental or bone remains. These small/medium sized herbivores, although not included in this study,  
799 were included in this discussion to shed light on the possible loss of smaller bone remains due to  
800 excavation, registration or sorting bias in the specific determination (Gábori-Csánk, 1968a). This category of  
801 species is identified only by cranial (almost always dental) and autopodial (often whole metapodials,  
802 basipodial, rarely acropodial) remains, which is entirely consistent with those observed in other lair sites  
803 (e.g. Fouvent, Fourvel et al., 2014). They are present exceptionally by elements of long bone, belt or axial  
804 bone (lion, mammoth, hare, fox, wolf, large bovine, in one and/or the other valley), including rare young or  
805 subadult, whether small/medium or larger species. Juveniles are not very common in Érd, including large  
806 and mega-herbivores. Juveniles are not very common in Érd, including large and mega-herbivores. In  
807 addition, some of these species such as reindeer, migratory (beyond a region) and those such as small  
808 bovids, occupying a mountain/rock environment (qualified as "alpine" species by Diedrich, 2012: 75) are,  
809 therefore, naturally not or poorly represented near the site (valley bottom-plateau 15m difference in  
810 altitude).

811 The hyena is able to transport pieces of carcasses over long distances (Dusseldorp, 2009). Thus, carnivores  
812 consuming most of the animals killed on site and bringing only a few elements back to their refuges and  
813 being able to consume the entirety of a smaller carcass (size class or juvenile of larger species including  
814 mega-herbivores) (ethology), the presence or not of an ecological niche near the site, differential  
815 conservation (size class or juvenile), differential representation (dental and autopodials almost exclusively),  
816 can also explain the rarity of this category of ungulates. However, since the very large quantity of  
817 osteological material is lost, it is not possible to exclude only large mesh sieving and specific determination  
818 sorting from the "undetermined" (what exactly are they: anatomical items?, fragments?). Potential harms  
819 are difficult to quantify in terms of skeletal representations (including shafts), the infant-juvenile age group,  
820 the smallest species and elements in general.

821  
822 However, several arguments can be put forward in favour of a correct, significant, representation of Érd's  
823 osteological material. These arguments concern the different species studied in this article and are of  
824 different kinds: odontological, taphonomic, ethological.

825 For bears (for both vallons), the main species (>80%NISP), the representation of all ages with a peak at the  
826 younger and vulnerable subadults (1<sup>st</sup> and 2<sup>nd</sup> years, then inexperienced like in Fate, Basura, Hortus or  
827 Abreda, cf. Quilès, 2004) and a significant decrease in prime-age adult mortality is consistent with those  
828 observed in other mixed (bears sites) sites/levels. The individuals come from living populations (complete  
829 skeletons with balanced sides, stigmas of fracturing teeth in vivo) with on-site mortality reflecting  
830 hibernation and not reported exclusively or so from hunting (contrary to what has been stated, see Gábori-  
831 Csánk and Kretzoi, 1968). The individuals found perished during their wintering and calving periods,  
832 sometimes in vulnerable situations (isolated inexperienced subadults, females with young, seniles), or  
833 following a possible attack by predators such as hyena (Diedrich, 2012). Various age groups, especially for  
834 horse and rhinoceros, could reflect a mixed, carnivore-hyena and human procurement at Érd. Competitive  
835 with humans, this large predator-scavenger has hunted/scavenged the same species as humans. The faunal  
836 spectrum of Érd, associating gregarious and (semi-)migratory species, is as diverse as that of hyena dens  
837 (notably OIS 3) with carnivores (hyena, lion, wolf, fox, bear, not to mention here the mustelidae and wild  
838 cat), small and medium sized ungulates (reindeer, *E. hydruntinus*, red deer and, if we add species outside  
839 the sector/layer, wild boar, chamois, small bovidae), large ungulates (horse, bison and aurochs, megaceros)  
840 and mega-herbivores (rhinoceros and mammoth). Some of the pleistocene dens show similar association,  
841 as in Fouvent (Fourvel et al, 2014), Camiac (Guadelli, 1989), Les Plumettes (Beauval and Morin, 2010) or  
842 Unikoté (Michel, 2005).  
843

844 According to Fourvel et al (2014: 234), the remains of bears killed on-site or brought as carrion to mixed  
845 (hominid-carnivore) sites or more specifically to hyena dens concern: either remains belonging to the head  
846 and limbs, or random and varied remains. According to the same author (ibid., 2014: 234), "In the case of  
847 bear hibernation level, it appears difficult to determine carnivore impact based on skeletal part  
848 distribution". Each skeletal part is represented which is typical to a natural 'population', despite a strong  
849 differential conservation process where isolated teeth are the dominant material. Carnivores came to take  
850 advantage of naturally dead bear carcasses; each representative item of a bear carcass shows carnivore  
851 tooth mark (significant fragmentation, bone consumption morphotypes).

852  
853 The skeletal representation, even if very large artificial biases are admitted, shows a similar profile to those  
854 of bear sites described as "bear hibernation level" of "short" duration, such as Hortus or Abreda (Quilès,  
855 2004: Fig. 2), both in terms of types of remains and proportions of units with skeletal elements indicating  
856 whole carcasses and the absence of transport (at least in visible quantity) with selection, although hyenas  
857 may have removed or brought pieces (Diedrich, 2012; Fourvel et al, 2014). There is no significant over-  
858 representation between the anterior and posterior anatomical parts and between even items (balanced).  
859 Bone loss in favour of isolated teeth (about 50%NISP, but many as bones in vallon II, NMIf close between  
860 dental and some postcranial in vallon I but double to the benefit of teeth in vallon II, in both humerus and  
861 radius-ulna are the most frequent) appears to be due to several factors (trampling, differential  
862 identification of the axial skeleton very present among the anatomical determined, differential  
863 conservation with elements sometimes very fragile).

864 The bear mortality structure and the taphonomic analysis suggest that the site was used primarily as a  
865 wintering site for cave bears.

866  
867 In terms of spatial distribution (average by at least 4m<sup>2</sup>), one observe a bimodality of the spatial  
868 distribution (Fig. 5 and 7): human groups (lithic remains, cut marks) tended to concentrate their activities at  
869 the "entrance" of the site (mainly in the larger vallon), whereas carnivores seemed to use of the inner areas  
870 (tranche VIII is the main concentration of cave bear), even if any sex and age are located in all squares (high  
871 dispersion, trampling, refitting). According to the experimental study by Camarós et al (2013), the bear is  
872 the most intense modifier carnivore, which can destroy and reorganize space and structures (hearths  
873 dispersed, destroyed). At least two certain fireplaces are preserved (level d in both vallons) in Érd, but  
874 several ash and charcoal areas have been observed, which at least partially limits their destructive action.

875  
876 The taphonomic analysis made it possible to highlight, that carnivores (<10%NISP, without bear remains)  
877 played a significant role in the site's bone accumulation. Gnawing damage is observed on the limb bones of  
878 ungulates; skeletal elements in herbivores and carnivores are differently represented", few coprolites are  
879 present (latrine). The absence of juveniles among non-ursine carnivores can result either from a diagenetic  
880 problem or from a function of the place other than a nursery (natal den). Young hyena remains might be  
881 collected by other bone-accumulating animals (Kuhn et al., 2010: 33). Cannibalism seems to be absent.

882 The action of hyenas appears on each of the elements of a bear carcass (or an average of the different  
883 episodes), young or adult s.l., but not systematically (20% NISP) and explain the relatively  
884 frequency/position of "survived" (?) anthropogenic cut marks. The morphotypes of fragmentation and  
885 consumption (by the hyena, see Fourvel et al., 2014: Fig. 3 and 4) of long bones ranging from cylinders to  
886 small fragments with very incomplete and variable circumference coexist, the appendicular skeleton  
887 represents, respectively, 1/3 and 1/2 bear remains.

888 Skeletal part profiles constitute an important analytical approach to the understanding of site formation  
889 processes and to the reconstruction of the carcasses' acquisition strategies by hominids (vs carnivore-  
890 made), especially by the derived data and inferences from the appendicular skeleton (i.e. epiphyses only vs  
891 shaft and epiphyses). According to Costamagno et al. (2005; and e.g. Marean and Kim, 1998), the skeleton,  
892 although subjected to various destructive factors/processes that can lead to the same result, recommends  
893 the integration and use of shafts in taphonomic analysis. Shafts are resistant post-cranial elements, in  
894 relation to the axial skeleton and compact bones, more intensely destroyed by carnivores, shaft that can be  
895 used to interpret human and carnivorous subsistence strategies by studying the marks observed on the  
896 different bone portions (epiphyses, metaphyses and shaft). According to Rosell et al (2017: 207) in  
897 particular, « a high proportion of limb bones and cut marks on the mid-shaft of these bones (which are

898 associated to removal of large muscle masses), leads us to suggest a probably human primary access to the  
899 prey (...) [indicating strategies] based on the transport of selected anatomical portions of the hunted  
900 ungulates to the cave, which includes mainly the appendicular bones with higher content of meat and  
901 marrow (...). The long bones of adult rhinos are a perfect example of this, but they have probably been  
902 scavenged, with enough early/quick access, by both hominid and hyena to consume the same element. The  
903 game was butchered on-site for meat and marrow, and partly on the kill-site/scavenging place (rhino).  
904 According to Dusseldorp (2009: 140), hyenas could not scavenge pieces of adult rhino carcasses because of  
905 its thick skin that only after the human butcher treatment.

906 However, hyena animal has played a major role in the constitution of this assemblage, explaining probably  
907 in part the rarity of small-to-medium-sized species and, above all, the relatively frequency/position of  
908 anthropogenic marks (cut marks).

909 Very few remains are affected in horse (possible extraction of the tongue, marrow consumption), hyena  
910 (occasional removal of the skin and possibly consumption) and rhino (rapid access with meat consumption  
911 and perhaps occasional marrow extraction in spite of inadequate characteristic of rhino's long bones). Bear  
912 remains show the most numerous marks on fleshy or marrow-rich content bones suggesting a complete  
913 carcass processing (or resulting from an average of multiple processing events). As in the case of the  
914 rhinoceros, nearly half of these bones are eaten by a carnivore (bone consumption morphotypes).

915 Entire epiphyses, abundant in hominid-made accumulations, are very few in both herbivores and  
916 carnivores and suggest various attrition processes. Processed carnivore remains have been occasionally  
917 documented (e.g. Rosell and Blasco, 2009). Bear hunting has been demonstrated in rare cases. At Érd, no  
918 evidence was found of such a fragment of arm embedded in cave bear bone attesting the existence of a  
919 hunt. Only at Hohle Fels in Germany (Münzel and Conard, 2004) or at Kraków-Spadzista in Poland (Wojtal  
920 et al., 2019) that such proof were discovered, flint fragment in a vertebra in a cave bear and in a rib in a  
921 woolly mammoth. Both sites date back to the Gravettian period.

922 While hunting is difficult to identify, based on indirect elements, hunting has been demonstrated in Mujina  
923 Pećina (Miracle, 2005), Taubach (Bratlund, 1999), Biache-Saint-Vaast (Auguste, 1995, 2003) while bear  
924 exploitation (without inferring the method of acquisition) is increasingly documented, as for example in Rio  
925 Secco (Romandini et al., 2018 and for a list of sites see Fig. 1), Le Regourdou (Cavanhié, 2009-2010). D.  
926 Armand (2018: Fig. 1, 4-7) recently published an update of 53 sites/levels indicating exploitation (including  
927 hunting) of bears (*U. deningeri*, *spelaeus*, *thibetanus*, *arctos*, sp.). According to M. Patou-Mathis (2012:  
928 286-287), in Eastern Europe carnivores are not exploited, except towards the Balkans (Crimea), but would  
929 involve "transitional industries". In Érd, despite a higher frequency of anthropogenic marks on cave  
930 bear bones, no specialization can be retained, even less a secondary specialization (horse, rhino), although  
931 all these species indicate human acquisition, at least partially and to different degrees. However, the  
932 detection of anthropogenic traces (cut marks, percussion stigmas) involving butchery activities (skinning,  
933 defleshing, bone marrow consumption) shows that these bears and much lesser, ungulates and hyenas are  
934 being exploited. Hunting/scavenging took place in close vicinity and in site, thus confirming previous  
935 interpretations (Gábori-Csánk and Kretzoi, 1968; Daschek, 2014).

936 These two carnivores are cavernicolous and show mortality and skeletal profiles, as well as the result of a  
937 characteristic consumption (gnawing and fragmentation morphotypes), which could be interpreted in  
938 relation to their ethology. Excluding bears because of the nature of their deposition and their possible  
939 occasional carnivory or scavenging without being an accumulator, the proportion of the other categories  
940 follows the following order: majority herbivores (¾) then hyena and finally carnivores (without the  
941 hyenidae), in both vallons. The respective proportions could also correspond to a hyena den, such as Joint  
942 Minor Cave, as well as to a presence in a mixed site, such as Pair-non-Pair c. FF' (Fosse, 1996: Table 4), to  
943 which wolves and other small carnivores had to contribute. This is corroborated, at Érd, by the  
944 carnivore/ungulate ratio, according to K. Cruz-Urbe (1991), allowing discernment between hominid-made  
945 accumulations (below 13% NISP), versus those of hyena/carnivore's-made (>20%). In both vallons, without  
946 bear remains, this ratio is above the 13%, (15 and 24%NISP) and suggests multiple occupations of various  
947 intensities. All this attests to the complex history of this site.

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## 952 6. Conclusions

953 In conclusion, new interpretations were proposed and discussed in our paper. The study of this museum  
954 collection has therefore proved its significant value and good quality, through a careful taphonomic study,  
955 in the understanding of the subsistence behaviours of these Neanderthals and their settlement patterns  
956 at this site. Indeed, the reinterpretation of the spatial data according to the evident two large stratigraphic  
957 units (at the upper level treated in this study) with the combination of other aspects, in particular  
958 taphonomic, has made it possible to propose not only a distinct occupation/use of the site by hominids and  
959 carnivores, but also a new interpretation of the (morphological) formation of the Érd.

960 The debate on the type of site, our new suggestion and other clues on the site formation process make it  
961 necessary to carry out a thorough study (with the limitations that an old excavation implies) and will be the  
962 subject of an upcoming publication.

963 Possible evidence of (at least partly) non-selective carcass transport suggests that, for these large and  
964 mega-herbivores, hunting/scavenging took place in close vicinity the site (presence on a regional scale:  
965 plateaus overlooking the site and the alluvial plain of the Danube) and, all the more so, since these species  
966 are highly dependent on the presence of water and (seasonally) abundant ecological resources. The bears  
967 represented individuals from a local living population who came to settle in this site, where some of them  
968 died.

969 Palimpsest (or "amalgam" according to Brugal and Fosse, 2004: 591) were generated, mainly, by hominids,  
970 bears, hyenas. The presence of various carnivores, – of different families –, by both sexes in bears, and  
971 Neanderthals tend to underlie two aspects of site use: 1) mutual and temporal avoidance 2) and distinct  
972 use of the space between carnivores, mainly at the bottom of the vallons, and hominids, mainly in front of  
973 the great vallon (I) in the widest space (at the assumed access area). Mutual avoidance has sometimes  
974 been broken. Indeed, direct and indirect temporal contact between these occupants could be identified.  
975 Direct contact concerns: 1) the action of carnivores on bear carcasses (killed or scavenged) and 2) the  
976 action of hominids on bear and hyena carcasses (killed or scavenged). Indirect contact occurs through the  
977 action of carnivores on ungulate remains abandoned by humans (secondary scavenging) as evidenced the  
978 better by striae and tooth marks present jointly on several bones without overlapping. As a matter of fact,  
979 an undisputable faunal/lithic relationship has been demonstrated based on the presence of stigma,  
980 evidence of past human activities and indirect observations (choice of individuals' ages, species, and  
981 carcass pieces), in addition to a spatial relationship. This latter can result from a disturbance by carnivores,  
982 such as that highlighted by experimental work by Camarós et al. (2013). The faunal/lithic, not always  
983 associated suggests, on the one hand, that there are occupations that are less or not anthropized  
984 occupations (ursines, carnivores or hyenines), 150-180cm (level b), 180-200cm (c), 200-220cm (d), and  
985 maybe the lower layer (A) can be subdivided in two sublevels, and on the other hand, they would be  
986 interrupted by periods of tranquillity (or of lower intensity) long enough for the development of a thin  
987 vegetal soil (plant root edges, formation of an early humus soil/rendzine).

988  
989 The presence of these ungulates, of mixed origin, corresponds to the food choice of hyenas and hominids  
990 of predatory/scavenging activities. Almost exclusively, it is the large and mega-herbivores, that constitute  
991 the basis of their respective diets (herein, for the other species, see Daschek, 2014 and forthcoming  
992 publication) in a topographical context favourable to the implementation of variable acquisition strategies,  
993 mainly on the mammoth steppe. The palaeotopography of the site is located on a passage of herbivores  
994 and in an advantageous crossroads situation of several regional-local biotopes: swamp or alluvial plain,  
995 plateau, "shelter" with the presence coniferous trees *Larix-Picea* and species with varying behaviour during  
996 the year in terms of family/specific links (grouping-separation) and/or territorial use (territoriality, routine  
997 paths, time or place of birth).

998  
999 As far as the lithic industry is concerned, the production is neither specific nor specially adapted to the local  
1000 raw material, the proven standardization cannot be linked to any cultural trait and the homogeneity of the  
1001 industry does not reflect any internal evolution, nor a co-evolution parallel to the supposed specializations.  
1002 On the other hand, it suggests a stratigraphic problem. Indeed, the study of lithic refitting (but also bony  
1003 refitting) points in this direction. In addition, the unprecedented spatial distribution of the lithic remains by  
1004 horizon (upper and lower and lower layer A), not by individual level or grouping, highlights the two same,  
1005 denser, occupancy areas at the entrance to the site (vallon I) and at the bottom of the smaller vallon (II).

1006  
1007 Many aspects of taphonomy, ethology, sedimentology, geology/geomorphology, (micro-  
1008 )climatology/environment and biology would support the idea of a (more) closed/protected structure type  
1009 or an "open/opening" structure type (in the dynamic sense of the term), at least partially or temporarily  
1010 (Daschek, ongoing research) and/or quick burial process (sedimentation rate unknown). Among these  
1011 aspects, archaeological one permit too to formulate a similar problem. The abovementioned bimodal  
1012 spatial distribution of accumulations would support the hypothesis of a possible roof, present above at  
1013 least part of the space (or spaces), which would gradually recede and disappear completely at the end of  
1014 the LGM (Late Glacial Maximum), giving rise to an open-air site during part of the last (human) occupations.  
1015 This progressive destruction at work is quite visible on the stratigraphic section (Fig. 2: black arrows,  
1016 fragments of limestone tilted towards the interior of the vallon). Erosion of the cavity walls (and roof?)  
1017 would be allowed by the very nature of the surrounding limestone, porous and friable, between much  
1018 harder layers, due to natural erosion. The relatively large size of the site excludes from the outset any  
1019 formation or expansion due to biological agents (digging of bears and effects of their bioglyphs, burrowing  
1020 animals, as can be seen today in the current environment). Thus, despite the absence of a karstic  
1021 environment, sensu L. Straus (1990), a double cavity have had could form in areas of geological  
1022 "weaknesses" along tectonic faults, providing a relatively protected and adequate environment for the  
1023 various occupants of the site.

1024  
1025 In that respect, on the basis of human activity (butchery activities, sequential carcass processing and  
1026 transport, few(er) species concerned by the anthropogenic activities, seasonal occupation), on the high  
1027 rate of retouched tools, on short debitage sequences, several raw material type poorly represented, makes  
1028 it possible to propose an alternative interpretation of the duration of occupations: recurrent short  
1029 occupations by small human groups or passages of hunters during some activities or mobility. However, the  
1030 lithic industry do not support the hypothesis of an internal cultural evolution. Archaeozoological data do  
1031 not prove bear hunting or specialization; however, there is no doubt about the exploitation of this and  
1032 other animals. Hyenas' role is predominant in the site formation. Hominids and hyena hunted or scavenged  
1033 the same big games. So, the site is much more complex in its functioning and history than previously said.  
1034 New absolute datation and new taphonomic data appear as a necessity for a climato-chronological re-  
1035 evaluation in order to place the site in a broader regional and European context, at the Late Middle  
1036 Palaeolithic.

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1038

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- 1581 Figures:
- 1582 Fig. 1. Geographic location of Érd near Budapest (A) and morphological character (B) of the site (3D model  
1583 by N. Faragó).
- 1584 Fig. 2. Stratigraphic sequence of the site in the main cross-section (after the original drawing modified). A:  
1585 lower archaeological layer; d-e: lower horizon of the upper archaeological layer; a-c: upper horizon of the  
1586 upper archaeological layer.
- 1587 Fig. 3. Lithic production of the industry. A: schemas of the recognized bifacial discoid (1), unifacial discoid  
1588 (2) and Quina (3) debitage; B: pebble morphologies for these debitage (respectively 1, 2 and 3); C:  
1589 characteristic blanks of the bifacial discoid (1-4), the unifacial discoid (5-8) and the Quina (9-16) debitage.
- 1590 Fig. 4. Morphometric characteristics of the blanks. A: distribution of length-width and thickness ratios; B:  
1591 distribution of blank types according to levels.
- 1592 Fig. 5. Spatial distribution of the lithic artefacts according to the archaeological horizons. A: upper horizon  
1593 of the upper archaeological layer; B: lower horizon of the upper archaeological layer (basic plan after  
1594 Gábori-Csánk 1968a: Fig. 2 modified).
- 1595 Fig. 6. Skeletal representation for the 4 main species in upper levels at Érd, expressed by % MAU. A: *Equus*

1596 *sp.* (left, green); B: *Coelodonta antiquitatis* (right, red-brown) in vallon I. C: *Ursus spelaeus* in vallon I (left);  
1597 D: *Ursus spelaeus* in vallon II (right); E: *C. Crocuta* in vallon I (left); F: *C. Crocuta* in vallon II (right).

1598 Fig. 7. Spatial distribution of the osteological material according to the archaeological horizons. A: upper  
1599 horizon of the upper archaeological layer; B: lower horizon of the upper archaeological layer (basic plan  
1600 after Gábori-Csánk 1968a: Fig. 2 modified).

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1603 Plates:

1604 Plate 1. Illustrations of elements of the site of Érd (from upper level): rhinoceros (a, b), horse (c, d, j, k),  
1605 cave bear (e, g, h, i) remains and an indeterminate long bone shaft fragment (f). © É.J. Daschek (with accord  
1606 of the Mining and Geological Survey of Hungary). © É.J. Daschek.

1607 Plate 2. Illustrations of elements of the site of Érd (from upper level): rhinoceros elements showing a1-3)  
1608 cut marks; b) carnivore ravaging with characteristic hyena consumption morphotype; c) carnivore ravaging;  
1609 d1-2) hominid-made fracturation splinter on fresh bone a mega-sized ungulate. © É.J. Daschek.

1610 Plate 3. Illustrations of elements of the site of Érd (from upper level): a) crenulated edges on cave bear; b)  
1611 butchery striae on cave bear; c) probable butchery on horse hyoid bone; d) impact notch on horse bone;  
1612 e) pillar fracturation on horse; f1-2) butchery striae on very young cave bear bone; g) probable butchery  
1613 striae on horse axis. © É.J. Daschek.

1614 Plate 4. Illustrations of elements of the site of Érd (from upper level): a1) and a2) and their details a1') and  
1615 a2') butchery striae on hyena; b) fresh fracturation on hyena; c) butchery striae on hyena; d1-2) butchery  
1616 striae on cave bear; e1-2) human or rodent-made edge on cave bear bone and hyena ravaging fracturation  
1617 type. © É.J. Daschek.

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1620 Tables:

1621 Table 1. Composition of the industry in vallon I and II according to the levels

1622 Table 2. Morphometric characteristics of the tools on quartzite

1623 Table 3. Morphometric characteristics of the tools on non-quartzite raw materials

1624 Table 4. Number of identified specimen (NISP) for the 4 main species studied here in the upper (grouped)  
1625 layers in vallon I and vallon II.

1626 Table 5. Age classes of the 4 main species at Érd (*Equus sp.*, *C. antiquitatis*, *U. spelaeus*, *C. c. spelaea*) at Érd,  
1627 in vallon I and II. MNIC: Minimum Number of Individuals. \*For *U. spelaeus*, Infantile= Foetal+Infantile;  
1628 Subadult= Juvenile+Subadult (modified, after Quilès 2003).