Level U3.1, a new archaeological level discovered at BK (Upper Bed II, Olduvai Gorge) with evidence of megafaunal exploitation

José Yravedra[a, b*], David M. Martín-Perea[b, c, d], David Uribelarrea[b, d], Fernando Díez-Martín[e], M. Soledad Domingo[d, f], Mari Carmen Arriaza[b,g,h], Elia Organista[b], Julia Aramendi[a,b], Rebeca Barba[b] Enrique Baquedano[b, i], Manuel Domínguez-Rodrigo[a, b, j]

a. Prehistory Department, Complutense University of Madrid, Madrid, Spain
b. Institute of Evolution in Africa (IDEA), Covarrubias 36, 28010 Madrid, Spain
c. Paleobiology Department, National Natural Sciences Museum – CSIC, Madrid, Spain
d. Geodynamics, Stratigraphy and Paleontology Department, Complutense University of Madrid, Madrid, Spain
e. Prehistory Department, Valladolid University, Valladolid, Spain
f. Department of Evolutionary Ecology, Doñana Biological Station – CSIC, Seville, Spain
g. School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Private Bag 3, 2050 South Africa.
h. Centre of Excellence in Palaeosciences, University of the Witwatersrand, Johannesburg, South 10 Africa.
i. Regional Archaeological Museum, Alcalá de Henares, Spain
j. Real Colegio Complutense at Harvard, Cambridge, Massachusets, USA

*corresponding author: joyravedra@hotmail.com

Abstract:

Excavations at Bell Korongo (BK) have yielded important evidence to infer different behaviours of early hominins in several archaeological levels since 1935. The present study shows the results for a new geological and archaeological level discovered at BK (Level U3.1). The main goal is to describe geologically this newly discovered level, alongside a preliminary taphonomical analysis of the archaeological remains embedded in it in order to better understand assemblage formation processes. This new level was deposited at the base of LA Unit 3, in decantation facies over a point-bar. Although these facies, found throughout the site furnish ideal conditions for preservation, this is the first time that any archaeological or paleontological remains have been found embedded in them. The preliminary taphonomic study suggests the assemblage is the result of a short time span involving processes accumulating remains from different thanatocoenoses created over a time span of less than one year, also leading to believe the sedimentation process was triggered by flooding of the channel during the annual heavy rains in the wet season. Furthermore, a considerable percentage of bones, including megafaunal remains, appear cutmarked and with percussion marks. Level U3.1 is the youngest level at BK, and adds to the evidence of the megafaunal exploitation behaviour of early Pleistocene hominins, which has already been extensively reported in BK Levels 4 and 5 and other African Lower Pleistocene sites.

Key words: Taphonomy, Lower Pleistocene, Homo erectus, Cut marks, Percussion marks, Olduvai Gorge

1. Introduction

The Bell Korongo (BK) site was discovered by L. Leakey in 1935, and was intensely excavated from 1952 to 1958, uncovering remains of a minimum of 24 individuals of *Pelorovis olduwayensis* (Leakey, 1954). Initially, L. Leakey interpreted the site as a megafaunal mass killing site, whereas later in the sixties M. Leakey classified the site as a swamp to which most of these animals were driven, dispatched and consumed by hominins (Leakey, 1971). However, modern taphonomical analyses carried out by Monahan (1996), Egeland and Domínguez-Rodrigo (2008) and Domínguez-Rodrigo et al (2009a) have shown that the assemblages have a diachronic history in which hominin and non-hominin agencies intervened (frequently independently) and affected the archaeofaunal concentration.

Excavations carried out by TOPPP (The Olduvai Palaeoanthropology and Paleoecology Project) between 2006 and 2012, following the archaeological levels and stratigraphic sequence described by M. Leakey revealed that Levels 1, 2 and 3 were characterized by anthropic activity on medium and small sized animals (size 1-3 according to Bunn, 1982) and on large sized animals (sizes 4-5 according to Bunn, 1982) in the lower Levels 4 and 5 (Domínguez-Rodrigo et al., 2009a, 2014a; Organista et al., 2015). Taphonomic analyses revealed primary early human access to small, and medium carcasses and very likely, an early access to large carcasses also (Monnahan, 1996; Egeland and Domínguez-Rodrigo, 2008; Domínguez-Rodrigo et al., 2009a, 2014a; Organista et al., 2015).

Very large mammal such as hippopotamids, giraffids and large bovid exploitation as seen at BK is common in the Lower Pleistocene at Olduvai Gorge. Several sites throughout the gorge show this kind of behaviour: hippopotamus bones at Sam Howard Korongo (SHK; Domínguez-Rodrigo et al., 2014b) and, large bovid bones in the lower Bed II site of Frida Leakey Korongo West (FLKW; Díez-Martín et al., 2015). Furthermore, several sites from other African archaeological localities also present anthropogenic traces on large mammal bones. For instance, El Kherda in Algeria (Sanhouni et al., 2013), Koobi Fora in Kenya (Bunn, 1994) and Buia in Eritrea (Fiore et al., 2004) revealed hippopotamus carcass remains bearing cut marks, and at Peninj (Tanzania), cutmarks are found also on giraffid remains (Domínguez-Rodrigo et al., 2002). Alongside these sites, there are others with association of megafaunal remains and lithic industry, although cutmarks are not visible on the bones. Such is the case of Frida Leakey Korongo North 6 (FLKN6) in uppermost Bed I, Olduvai Gorge, where elephant bone remains show no evidence of anthropic activity (Domínguez-Rodrigo et al., 2007) or Thiongo Korongo (TK) in Bed II-III, Olduvai Gorge (Yravedra et al., 2015).

During the 2016 field season, excavations at BK were resumed. Although the original aim of these excavations was to proceed with the study of the lower levels described by Organista et al. (2015), a new level was discovered before reaching them. This fortuitous find motivated the present study, which has as its main aim to describe geologically and archaeologically this newly discovered level. Furthermore, a preliminary taphonomical analysis of the remains embedded in this level has been conducted in order to better understand the formation of this archaeological assemblage. Although results presented in this work are undoubtedly preliminary, an extensive excavation of the encountered level is logistically unviable at the moment. Since further excavations of this level will not be carried out in the near future, a report of this new geological and archaeological level with evidence of megafaunal exploitation was deemed necessary.

2. Geologic setting

Olduvai Gorge is located on the western margin of the southern bifurcation of the Gregory Rift, the eastern branch of the East African Rift in northern Tanzania (Hay, 1976; Figure 1).The site is situated on the South wall of the Side Gorge, 3 km upstream from its junction with the Main Gorge (Figure 1). The Side Gorge is only 20 m deep in the BK area and therefore only the uppermost part of Bed II, small sections of Bed III and Ndutu are naturally exposed (Hay, 1976). The present study focuses on the westernmost section of the site, in Trench 14.

Figure 1.

Stratigraphically, BK is situated directly above Tuff IID (Hay, 1976), which was recently dated at 1.338 +/- 0.024 Ma (Domínguez-Rodrigo et al., 2013). The site is placed in a large meandering river, where most of the archaeological levels are found in the point-bar and the thalweg (Uribelarrea and Domínguez-Rodrigo, 2017). The channel deposit consists of three sedimentary Lateral Accretion (LA) units of low-energy fluvial deposits (LAU1-3) overlain by a channel macroform (CHU4) filling the channel with very fine overbank sediments (Figure 2, Uribelarrea and Domínguez-Rodrigo, 2017). The two lowermost LA units (LA Units 1 and 2) contained the only archaeological levels known before this study: Levels 3a, 3b, 4a and 4b (Domínguez-Rodrigo et al., 2014a) along with Levels 4c and 5 (Organista et al., 2015; Organista et al., 2017) are found in LA Unit 1, whereas Levels 1 and 2 (Domínguez-Rodrigo et al., 2009a) in LA Unit 2. These five archaeological levels are found in fluvial deposits mainly composed of clay, silt and sand (ranging from very fine to very coarse sand). The archaeological levels vary in thickness, from 15 cm to 1 m with different concentration patterns (Domínguez-Rodrigo et al., 2009a; Domínguez-Rodrigo et al., 2014a; Organista et al., 2015; Organista et al., 2017).

Figure 2.

3. Materials and methods:

3.1 Geology

Stratigraphical levels and LA unit limits in Trench 14 were measured and georeferenced with sub-centimetre precision using a laser total station (TOPCON) and correlated to previous levels and their uncovered boundaries as measured and described by Uribelarrea and Domínguez-Rodrigo (2017) throughout the rest of the site. Macro and microscale stratigraphical and sedimentological features of the profile were logged in detail and photographed.

3.2 Zooarchaeology and taphonomy

Additionally, a preliminary taphonomical and zooarchaeological analysis has been carried out over the 103 fossil remains found in the new level described. Taxonomic identifications were based mainly on teeth and compared with reference faunal material. In cases where such determination was not possible, specimens were classified considering animal weight/size classes following Bunn (1982), where sizes 1-2 are considered "small-sized" (size 1 animals weighing <50 kg, such as Thompson's gazelles and size 2 animals weighing 50-125 kg, like impalas), size 3a and 3b as "medium sized" (size 3a animals weighing 125-250 kg, like topis and size 3b animals weighing 250-500 kg, like zebras), and "large" species include size 4 (>500-1000 kg, like elands or buffaloes), size 5 (1000-4000 kg, like rhinoceros) and size 6 (>4000 kg, like elephants).

Faunal remains were quantified by Number of Identified Specimens (NISP), Minimum Number of Individuals (MNI) and Minimum Number of Elements (MNE). NISP determination follows the protocol described in Yravedra and Domínguez-Rodrigo (2009). MNI estimates considered element side and ontogenetic age (Brain, 1969). For skeletal profiles, elements were organized into four anatomical regions: cranial (i.e., horn, cranium, mandible, and teeth), axial (vertebrae, ribs, pelvis, and scapula, *sensu* Yravedra and Domínguez-Rodrigo, 2009); upper appendicular limbs (humerus, radius, ulna, femur, patella, and tibia), and lower appendicular limbs (metapodial, carpals, tarsals, phalanges and sesamoids). Long limb bones were further divided into upper (humerus and femur), intermediate (radius and tibia), and lower (metapodial) bones (Domínguez-Rodrigo, 1997). We are aware that pelvis and scapulae have traditionally been classified separately from axials but, given their overall similarity in bone texture and taphonomic properties to traditional axial bones, we decided to classify them together with vertebrae and ribs, since all respond exactly the same to post-depositional weathering and carnivore ravaging processes (see Yravedra and Domínguez-Rodrigo, 2009 for explanation).

It is now well-known that MNE estimates of long limb bone MNE at Olduvai and elsewhere often differ substantially depending on whether epiphyses or shafts were used for element identification (Pickering et al., 2003; Cleghorn and Marean, 2004; Domínguez-Rodrigo et al., 2007). For this reason, for MNE estimates we have applied the bone section divisions proposed by Patou-

Mathis (1984, 1985), Münzel (1988), and Delpech and Villa (1993) as described in detail by Yravedra and Domínguez-Rodrigo (2009). In this system, shafts are divided into equal-sized sectors, regardless of the area of muscular insertion. These sectors (upper shaft, mid-shaft, lower shaft) can be easily differentiated and oriented (cranial, caudal, lateral, medial). Yravedra and Domínguez-Rodrigo (2009) describe the criteria used in the division of each shaft sector, taking into account the orientation of each specimen. Long limb element identification considers Barba and Domínguez-Rodrigo's (2005) division by shaft thickness, section shape, and medullary surface properties. Following element and shaft sector identification, MNE is quantified by comparing all the specimens of the same element and size group by element size, side, ontogenetic age, and biometrics (Lyman, 1994).

Bone surface modifications such as cut, percussion, and tooth marks were systematically examined with a 10X-20X hand lens following Blumenschine (1988, 1995). The diagnostic criteria defined by Bunn (1982), Potts and Shipman (1981), and Domínguez-Rodrigo et al. (2009b) guided the identification of cut marks. Trampling and cut marks were distinguished according to Olsen and Shipman (1988) and Domínguez-Rodrigo *et al*. (2009b). Tooth marks were recorded following Binford (1981) and Blumenschine (1988, 1995). Finally, the identification of percussion marks was based on Blumenschine and Selvaggio (1988) and Blumenschine (1995).

For comparative purposes, surface modification frequencies (based on NISP) were calculated separately for epiphyses and shafts (Blumenschine, 1988, 1995) and quantified by element type and bone section (Dominguez-Rodrigo, 1997) as well. The presence of tooth, percussion, and cut marks was considered for the whole assemblage, whereas estimated percentages included only well-preserved bone surfaces.

Weathering was estimated according to Behrensmeyer (1978), measured on a scale from Stage 0 (not weathered, exposed for less than one year before burial) to Stage 5 (extremely weathered, exposed for 6 -15 years before burial). The impact of water activity was estimated with the presence of abrasion, polishing, and carbonates coatings. Abrasion is indicative of the erosion caused to the remains by means of friction with sedimentary particles. Stages proposed by Alcalá (1994) were used to analyse abrasion: intact bone (Stage 1), rounded bone (Stage 2) and polished and smoothed bone (Stage 3).

For breakage analysis, fractures on long bones are considered according to Villa and Mahieu (1991) and Lyman (1994) criteria. Perpendicular and smooth (dry) fractures often occur in recrystallized or permineralized bones and are produced by diagenetic processes, whereas spiral, irregular and saw-toothed (green) fractures occur in fresh, collagen-rich bones, usually produced by carnivoran or anthropic activity and trampling (Lyman, 1994).

The analysis of bone fragmentation was carried out according to three variables: 1) the size of bones samples, 2) the preserved shaft circumference of long bones and 3) the green or dry fracture pattern.

Bone specimens were divided into several categories according to their length: <30 mm, 31-40 mm, 41-50 mm, 51-60 mm, 61-70 mm, 71-80 mm, 81-90 mm, 91-100 mm and >101 mm. According to Bunn (1982) we use the three categories for shaft circumference where (1) stands for shaft circumference <50%, (2) covers the >50% range and (3) the shaft circumference is 100>75%.

4. Results:

4.1. Geology

Level U3.1 is a 40-60 cm tuffaceous silt level found overlying a 3-4 cm white and heavily cemented carbonate hard pan (Figure 3). This is carbonate level adapts to a chute channel erosive surface scarred into a 10-40 cm clayey silt layer, part of the LA Unit 2 as described by Uribelarrea and Domínguez-Rodrigo (2017).

The uppermost surface of the LA Unit 2 is undulated, especially towards the thalweg (westwards), where swales and irregular depressions are found, corresponding to small chute channels. The same hard pan can be found throughout the site and is used as a marker unit separating LA Units 2 and 3 (Uribelarrea and Domínguez-Rodrigo, 2017). Archaeological and palaeontological remains are found embedded at the base of the tuffaceous silt, resting on top of the carbonate layer and therefore at the base of LA Unit 3.

Figure 3.

4.2. Taxonomical and skeletal profiles

BK level U3.1 shows 5 MNI of *Hippopotamus* sp., *Equus oldowayensis, Alcelaphini* size 3a and Size 3b and *Antilophini* size 2 (Table 1). Furthermore, skeletal remains of a size 4 taxon have been found, but have not been taxonomically classified. All individuals found are adults. Unidentified size 3b taxa dominate de assemblage (19.4%), followed by *Equus oldowayensis* (12.6%, Table 1). These species have been previously identified in other archaeological levels at BK (Monahan, 1996; Domínguez-Rodrigo et al 2007, 2009a, 2014a; Egeland & Domínguez-Rodrigo, 2008; Organista et al, 2015, 2017).

Table 1

Table 2 shows the skeletal element proportions represented in Level U3.1. A total of 40.78% of the remains were anatomically unidentifiable. Ribs (13.59%) and teeth (9.71%) constitute the most abundant skeletal elements of the assemblage. All skeletal remains were disarticulated and isolated, with no evidence of association. All anatomical regions are represented in the assemblage, with axial bones being the most abundant and shafts are more abundant than epiphyses (table 3).

Table 2.

4.3 Bone modification data

Over two thirds (67%) of *Equus oldowayensis* bones were cutmarked (Table 1): a mandible (Figure 4A), rib, pelvis and tibiae. A *Hippopotamus* sp. rib was also cutmarked (Figure 4B), along with a size 2 tibiae (Figure 4C), size 3b tibiae, pelvis and two ribs and size 4 humerus and femur. These marks are straight, long and deep with a V-section and are normally found in groups of two or more parallel marks. Furthermore, percussion marks were found on a *Hippopotamus* sp. rib, a size 3b radius (Figures 4D and E) and pelvis and a size 4 radius. No carnivore marks were observed throughout the assemblage. Trampling marks were identified in 14.6% of the remains (Table 1), diagnostically superficial, discontinuous and with a U-section.

Figure 4.

Bones showing no weathering (Stage 0) are the most abundant in Level U3.1. No bones displayed weathering Stages 2 or higher. The vast majority of the remains (92.23%) remained intact with no abrasion (Stage 1); only 7.77% of the remains had some abraded surfaces attributable to abrasion Stage 2. No bones displayed abrasion Stage 3.

Fragmentation of the fossil remains is not very intense (Figure 5A). Fossil remains longer than 3 cm dominate the assemblage, with a high representation of bones with sizes over 10 cm. Type 3 long bone circumferences are most abundant, whereas Type 2 is very underrepresented (Figure 5B). Spiral, irregular and saw-toothed (green) fractures (Figures 4D, E, F and G) were most abundant in long bones (NISP = 18, 90% of all fractured long bones) and only 2 specimens of long bones presented perpendicular and smooth (dry) fractures.

Figure 5.

4.3. Lithics

A total of 17 lithic specimens have been retrieved, out of which 15 are elaborated in quartz (88.2%) and 2 in basalt (17.8%). The collection is distributed by technological categories as follows:

a) 1 vesicular basalt oval nodule (79x53x39 mm, 219 g); b) 2 modified battered blocks, showing multifacial-multipolar arrangement of negative scars. One of them has no evidence of percussion stigma units surfaces and can be typologically defined as a sub-spheroid. The other is a heavy hemi-nodule (619 g) with signs of intense crushing in ridges; c) 2 multifacial-multipolar exhausted cores and 1 core fragment; d) 11 detached pieces, including 2 whole flakes (mean 26x36x12 mm) with plain butts, no bulb of percussion, linear dorsal patterns and Toth types 5 and 6; 1 non-cortical, longitudinally broken flake; 4 flake fragments (including 1 basalt specimen); 3 debris (maximum length <15 mm), and 1 non-cortical retouched flake, in which two opposed notches (one distal and one proximal) have been identified.

The lithic sample is small and no important conclusions can be drawn. However, the sample shares common elements found in other archaeological levels at BK: 1) raw materials present are the same (quartz and basalt), with quartz being clearly predominant in the sample and 2) sub-spheroid elements have been found (Díez et al., 2009; Sánchez-Yustos et al., 2016).

5. Discussion:

Level U3.1 was deposited in decantation facies, such as those explained by Uribelarrea and Domínguez-Rodrigo (2017) for archaeological sites in meandering rivers. These quick and low energy sedimentation processes furnished ideal conditions for preservation. The low percentage of abraded (Stage 2, according to Alcalá, 1994) remains reinforces this interpretation. Level U3.1 is the first documented archaeological level to be found in this type of facies at BK, which although are theoretically more favourable for fossil preservation, had up to date contained no remains whatsoever (Uribelarrea and Domínguez-Rodrigo, 2017). Furthermore, this new level is also the youngest archaeological assemblage found at the site, since it is found in LA Unit 3 (Figure 6).

Figure 6.

The occurrence of *Equus oldowayensis*, antilophini size 2, alcelaphini size 3a and alcelaphini size 3b remains alongside *Hippopotamus* sp. bones is related to an open environment near water. These results are shared with the rest of the archaeological levels at BK, inferring an open habitat in a fluviatile basin with periodic wetlands (Domínguez-Rodrigo et al., 2009a, 2014a; Organista et al., 2015).

The evidence at hand, particularly the predominance of unweathered remains (weathering Stage 0, according to Behrensmeyer, 1978) and the homogeneous distribution of the remains on top of the same isochronal layer suggest that the assemblage is most probably the result of multiple depositional events burying thanatocoenoses created over a time span of less than one year. This can also suggest the sedimentation process, triggered by an overflow of water over the riverbank and subsequent flooding of the floodplain (Uribelarrea and Domínguez-Rodrigo, 2017), probably took place during heavy rains in the wet season, when water regimes would reach such high flow discharge levels.

The low occurrence of perpendicular and smooth fractures is indicative of a low impact of diagenetic processes. Spiral, irregular and saw-toothed fractures, often related to carnivoran or anthropic activity and trampling were found in 90% of long bones. However, no carnivore marks have been found and trampled bones only account for 14.6% of the sample. Fragmentation of the fossil remains is not very intense, with large specimens (> 10 cm) due to the occurrence of size 3b, 4 and 5 taxa. The fact that bones from all anatomical regions are represented in the assemblage also reinforces the idea that carnivores played little to no role in the accumulation of the remains.

Level U3.1 constitutes yet another example of a lower Pleistocene level showing evidence of large mammal (>1000 kg) exploitation. This new level embeds percussion and cut marked hippopotamus bones, adding to the list of the aforementioned sites of SHK in Olduvai Gorge (Domínguez-Rodrigo et al., 2014b), El Kherda in Argelia (Sanhouni et al., 2013), Koobi Fora in Kenia (Bunn, 1994) and Buia in Eritrea (Fiore et al., 2004).

The repeated occurrence of archaeological levels preserving evidence of megafaunal exploitation spanning a large amount of time throughout LA Units 1, 2 and 3 implies that this particular area of the landscape was for some reason preferred by hominins for this type of activity. Uribelarrea and Domínguez-Rodrigo (2017) hypothesize whether or not this was due to the concentration of water resources and vegetation along the channel banks, offering greater protection against predators than an open plain.

Further investigations should enquire about the circumstances which motivated these megafaunal anthropized assemblages at BK throughout several different time frames, and try to test the different hypotheses proposed, such as that by Uribelarrea and Domínguez-Rodrigo (2017).

6. Conclusions

Level U3.1 was deposited in quick and low energy sedimentation processes in decantation facies inside a meandering river channel. This level is the first documented archaeological level to be found in this type of facies at BK and is the youngest archaeological assemblage found at the site, since it is found in LA Unit 3.

Taphonomically, the predominance of unweathered remains and the homogeneous distribution of the remains on top of the same isochronal layer suggest that the assemblage is most probably comprised of thanatocoenoses created over a time span of less than one year, buried by multiple depositional events during heavy rains in the wet season, when water regimes would reach such high flow discharge levels.

The occurrence of large mammal exploitation in Level U3.1 adds to the rest of archaeological levels preserving such evidences, spanning a large amount of time through LA Units 1, 2 and 3, implying a preferred use of this area by hominins for these activities throughout time. The reasons behind this recurring behaviour remain unknown, and should be further studied.

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Captions of Figures and Tables

Figure 1. A. Map of East Africa, showing the location of Olduvai Gorge. Modified from Ashley and Hay (2002). B. Map showing the Ngorongoro Volcanic Highlands and Olduvai Gorge. Modified from Hay (1976) and McHenry (2012). C. Location of the mentioned sites along the Main and Secondary Gorges at Olduvai Gorge. Modified from Hay (1976).

Figure 2. A. Bell's Korongo (BK) profile and Trench 14 location. B. Transversal stratigraphic section of the four Lateral Accretion Units and location of archaeological levels and detailed stratigraphic sections. C. Detailed stratigraphic sections. Modified from Organista et al. (2015).

Figure 3. A. Trench 14 eastern wall. B. Geological interpretation of eastern wall. C. Detailed photograph of *Hippopotamus* sp. rib in Level U3.1.

Figure 4.A. Cutmarked *Equus* mandible. B. Cutmarked *Hippopotamus* sp. rib. C. Detailed photograph of cutmarks on *Hippopotamus* sp. rib. D. Cutmarked size 2 tibiae. E. Size 3b radius with percussion marks. F. Detailed photograph of percussion marks on size 3b radius. G. *Hippopotamus* sp. rib with green fracture and peeling. H. *Hippopotamus* sp. rib with green fracture.

Figure 5. Level U3.1 bone remains fragmentation. A. Length of Level U3.1 fossil remains B. Circumference completeness according to Bunn (1982).

Figure 6. Level U3.1 geological interpretation and location inside the meandering channel and its relationship with the different depositional and geological processes.

	NISP	MNE	MNI	NISP CM	CM %	NISP PM	PM %
Equus oldowayensis	13	12	1	4	67	-	-
Hippopotamus sp.	5	5	1	1	20	1	20
Antilophini size 2	1	1	1	-	-	-	-
Alcelaphini size 3a	1	1	1	-	-	-	-
Alcelaphini size 3b	1	1	1	-	-	-	-
Undet. Size 2	5	4	-	1	20	-	-
Undet. Size 3	5	4	-	-	-	-	-

Undet. Size 3a	1	1	-	-	-	-	-
Undet. Size 3b	20	13	-	5	26	2	10
Undet. Size 4	8	7	-	2	25	1	13
Undet.	43	-	-	-	-	-	-
Total	**103**						

Table 1. Faunal representation of Level U3.1. NISP CM: Number of cutmarked specimens; NISP PM: Number of percussion marked specimens. Teeth have been excluded for the calculation of cut mark (CM %) and percussion mark (PM %) percentages.

	Size 2		Size 3		Size 3a		Size 3b		Size 4		Size 5		Undet.	Total	
	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	NISP	%
Horn	1	1	-	-	-	-	-	-	-	-	-	-	-	1	0.97
Skull	-	-	-	-	-	-	1	1	-	-	-	-	-	1	0.97
Mandible	-	-	-	-	-	-	1	1	-	-	-	-	-	1	0.97
Tooth	-	-	-	-	1	1	9	9	-	-	-	-	-	10	9.71
Vertebrae	-	-	1	1	-	-	3	2	1	1	-	-	1	6	5.83
Rib	-	-	1	1	-	-	9	3	1	1	3	3	-	14	13.59
Scapula	-	-	-	-	1	1	1	1	-	-	-	-	-	2	1.94
Humerus	-	-	-	-	-	-	-	-	2	1	-	-	-	2	1.94
Radius	1	1	-	-	-	-	1	1	1	1	1	1	1	5	4.85
Pelvis	-	-	-	-	-	-	2	2	1	1	-	-	-	3	2.91
Femur	1	1	-	-	-	-	1	1	1	1	-	-	-	3	2.91
Tibia	2	1	1	1	-	-	5	4	1	1	-	-	-	9	8.74
Metapodial	-	-	1	1	-	-	1	1	-	-	1	1	-	3	2.91
Metatarsal	1	1	-	-	-	-	-	-	-	-	-	-	-	1	0.97
Undet.	-	-	1	1	-	-	-	-	-	-	-	-	41	42	40.78
Total	**6**	**5**	**5**	**5**	**2**	**2**	**34**	**26**	**8**	**7**	**5**	**5**	**43**	**103**	**100**
Cranial %	16.7	20	0	0	50	50	32.4	42.3	0	0	0	0	-		
Axial %	0	0	40	40	50	50	44.1	30.8	37.5	42.9	60	60	-		
Upp. Apend. %	66.7	60	20	20	0	0	20.6	23.1	62.5	57.1	20	20	-		
Low. Apend %	16.7	20	20	20	0	0	2.94	3.85	0	0	20	20	-		

Table 2. BK Level U3.1 skeletal profiles.

		Size 2	Size 3	Size 3a	Size 3b	Size 4	Size 5
Humerus	P. Epif.	-	-	-	-	-	-
	Shaft	-	-	-	-	2	-
	D. Epif.	-	-	-	-	1	-
	MNE	-	-	-	-	1	-
Femur	P. Epif.	-	-	-	-	-	-
	Shaft	1	-	-	1	1	-
	D. Epif.	-	-	-	-	-	-

	MNE	1	-	-	1	1	-
Radius	P. Epif.	-	-	-	-	-	1
	Shaft	1	-	1	1	1	1
	D. Epif.	-	-	-	-	-	-
	MNE	1	-	1	1	1	1
Tibia	P. Epif.	1	-	-	1	-	-
	Shaft	2	1	-	5	1	-
	D. Epif.	1	-	-	1	-	-
	MNE	1	1	-	4	1	-
Metapodial	P. Epif.	1	-	-	-	-	1
	Shaft	1	1	-	-	-	1
	D. Epif.	1	-	-	-	-	1
	MNE	1	1	-	-	-	1

Table 3. NISP and MNE for long bone epiphyses and diaphyses.