The zooarchaeological remains from Early Iron Age hill-top fortress at Klisura- Kadića Brdo, eastern Bosnia: a taphonomic assessment

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I. Introduction – history and goals of excavation

The archaeological site of Klisura-Kadića Brdo (Gorge-Judge's Hill) is located on the Glasinac plateau in eastern Bosnia, overlooking the modern and Medieval town of Knežina (Fig. 1). Kadića Brdo is a multi-period "gradina" or hill-fort site, with occupation during the Eneolithic and the Early and Late Iron Ages. The site was abandoned at the end of the Iron Age as much of the regional population relocated to the lowlands. The activity at the settlement ceased during the period of the Late Iron Age. Judging by the scarce number of chronologically diagnostic finds, the life at the plateau stopped during or soon after the 5th century BC. During the period of the Early Iron Age, the settlement was very likely a regional center and was the locus of elite activities. It is larger than most of its contemporaries on the plateau. Furthermore, several stone covered tumuli dot the mountain heights above the settlement.

The Glasinac plateau and surrounding areas are well known in the literature from the extensive excavations of the Bronze and Iron Age burial mounds. These have been excavated on and off since the 1890's and have provided one of the linchpins of the Central European typo-chronological system proposed by Reinecke. This system was adopted by the Yugoslavian school of archaeology.[1] While the region's funerary complexes were well-known, little was known about domestic or other kinds of archaeological deposits. Hence, beginning in 1980, the Bosnia-Herce-

[1] E.g. Benac 1987; Benac and Čović 1956-7; Čović 1981, 1983, 1987; Garašanin 1973.

govinian (BiH) Academy of Sciences and Arts embarked upon an ambitious campaign to survey and excavate post-Neolithic (Eneolithic, Bronze and Iron Age) sites on the plateau. Based on an extensive survey and test excavations, Kadića Brdo was selected for large-scale excavation since it was the best preserved of the "gradina" on the Glasinac plateau.[2] It was to provide an inventory of domestic and other artifacts and information that were sorely lacking from the region.

From the author's perspective, it was also a unique opportunity to test hypotheses that developed out of his previous work in neighboring Serbia. In particular, the Serbian data indicated that a major reorientation of subsistence occurred in the region at the advent of the post-Neolithic: 1) Domestic animal exploitation shifted from primary (meat, bone, and hide) to a mixture of both primary and secondary animal products (milk, wool, and traction). 2) Land use shifted from a primary focus upon the low and mid-altitude (<500 m asl) to include the colonization and permanent settlement of sites in the agriculturally marginal highlands (>500 m asl). The zooarchaeological (animal remains) data from neighboring regions suggested that the colonization of agriculturally marginal zones may have been accompanied by the advent of transhumant pastoralism in the region, which is the movement of domestic flocks up and down the mountains in order to take advantage of seasonally available pastures.[3] Kadića Brdo provided an opportunity to collect a systematic zooarchaeological sample from eastern Bosnia, in a region traditionally associated with stock rearing and transhumant pastoralism. This report describes the results of the taphonomic analysis of the zooarchaeological remains from Kadića Brdo.

II. History of research

A test trench was excavated at the site in 1980. Preserved Early Iron Age and Eneolithic deposits were found to be *in situ*.[4] On this basis, large-scale, spatially extensive excavations were conducted at the site in 1987-88, and 1990. Plans for subsequent seasons were aborted by the 1990's Bosnian civil war. The excavations were directed by Dr. Blagoje Govedarica, then of the BiH Academy of Sciences and Arts. Between 1987 and 1990, most of the recovered faunal remains were identified by the author in Bosnia-Herzegovina.

[2] Govedarica 1985.
[3] Greenfield 1986, 1988, 1989, 1991, 1999a, 2001, 2005.
[4] Govedarica 1985.

III. Site description

The Glasinac plateau in southeast Bosnia (altitude 850-880 m) is over 1000 km^2 in size. It is situated between the large mountain massifs of *Romanija* and *Devetak*, to the west and north, respectively. The region is bounded by the mountains overlooking the Drina and Prača Rivers in the east and south, respectively (Fig. 1).

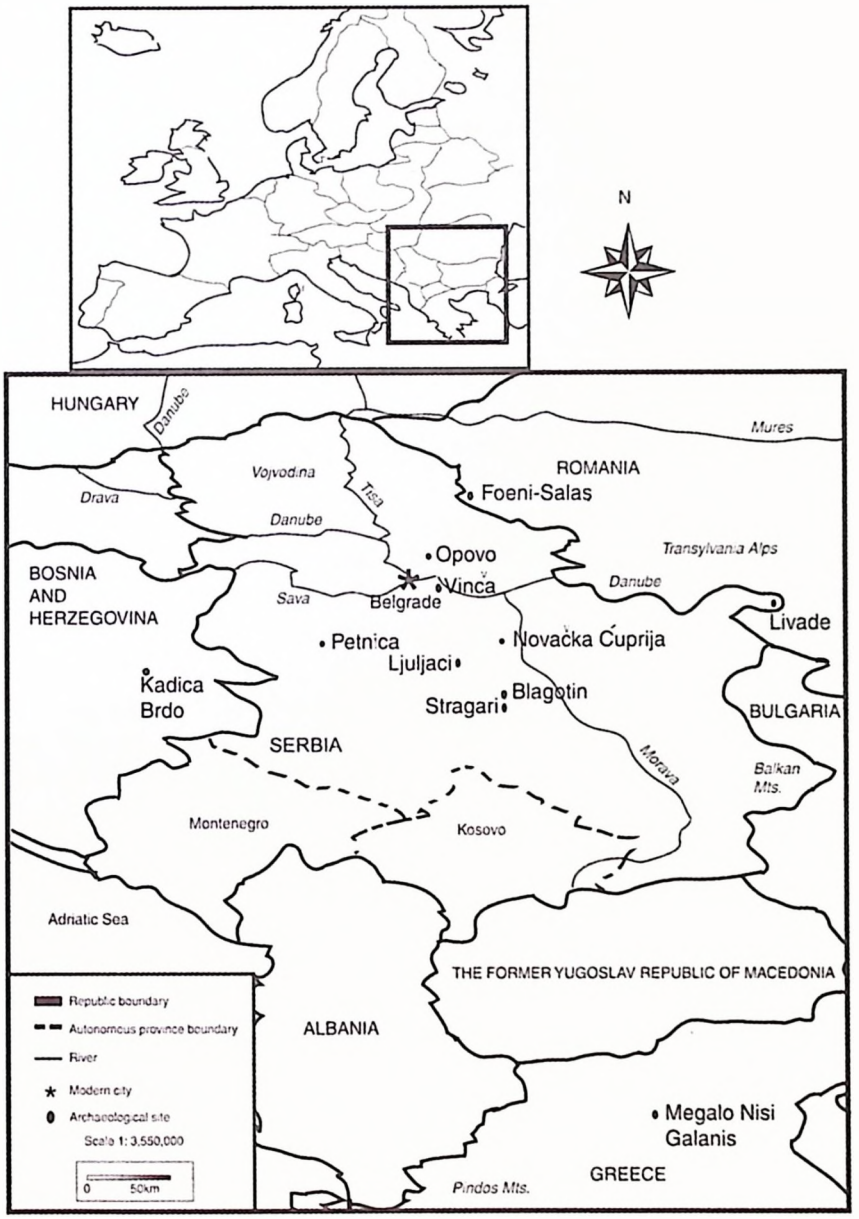

Fig. 1. *Map of Eastern Bosnia, Glasinac Plateau, showing location of Kadića Brdo* (based on Bertić 1988: 35). *Insert shows location in relation to Sarajevo.*

The site is located on a small natural rise overlooking the surrounding countryside (Fig. 2,a.b). It strategically dominates the valley of the river Bioštica. The settlement is built on the elongated cliff-edge, loosely connected in its western part to the neighboring massive (alt. 785). The eastern side of the gradina is rocky and falls precipitously towards the river. The other three sides of the settlement were fortified by a massive stone wall and dominate a small plateau between the gradina and the neighboring mountain to the west. The entrance onto the plateau, in the southern corner, was flanked by a stone and earth construction resembling a tower. The area within the walls of the settlement before the excavation was flat and covered with grass. Its shape was semi-circular, with dimensions of 75 m in length and 33 m in wide at its widest in the center.

A. Spatial characteristics of the site

Five sectors (large excavation areas) were opened during these field seasons in different parts of the site to examine its spatial characteristics (Fig. 3). Sectors I and III appears to be largely composed of domestic activity areas (Fig. 4). Sector I is the largest excavated area. Sectors II and IV investigated the fortification system of the site. Sector II cuts across the surrounding fortification walls (Fig. 5), while Sector IV investigates what was probably the guard tower overlooking the probable entrance to the site. Sector V is thought to be the High Place, a locus for ritual activities. No faunal remains were recovered from two of the areas (Sectors 4 and 5). This report summarizes the data from the other three sectors (I-III).

The size of excavation in the various sectors differed quite considerably. The standard trench size was a 4x4 m area (called quadrats). The first sector consisted of twelve quadrats, the second sector contained two quadrats, the third sector contained four quadrats. It is not surprising that the largest variety and count of species from both Horizons 1 and 2 is from sector one because of its large size. Any future comparisons between areas must control for the relative size of excavation areas.

B. Culture history

The site was excavated following the natural stratigraphy. As a result, it has been possible to group the various deposits into a series of temporally distinct units. The data are organized into eight major temporal categories for this analyses based upon the stratigraphic analysis of the settlement, taking into account the mixing processes mentioned above:

Fig. 2. *Photographs of site and valley:*
a. *View of site from mountain top to the west.*
b. *View of valley beneath site and town of Knežina in distance. Photograph taken from site. Facing northeast.*

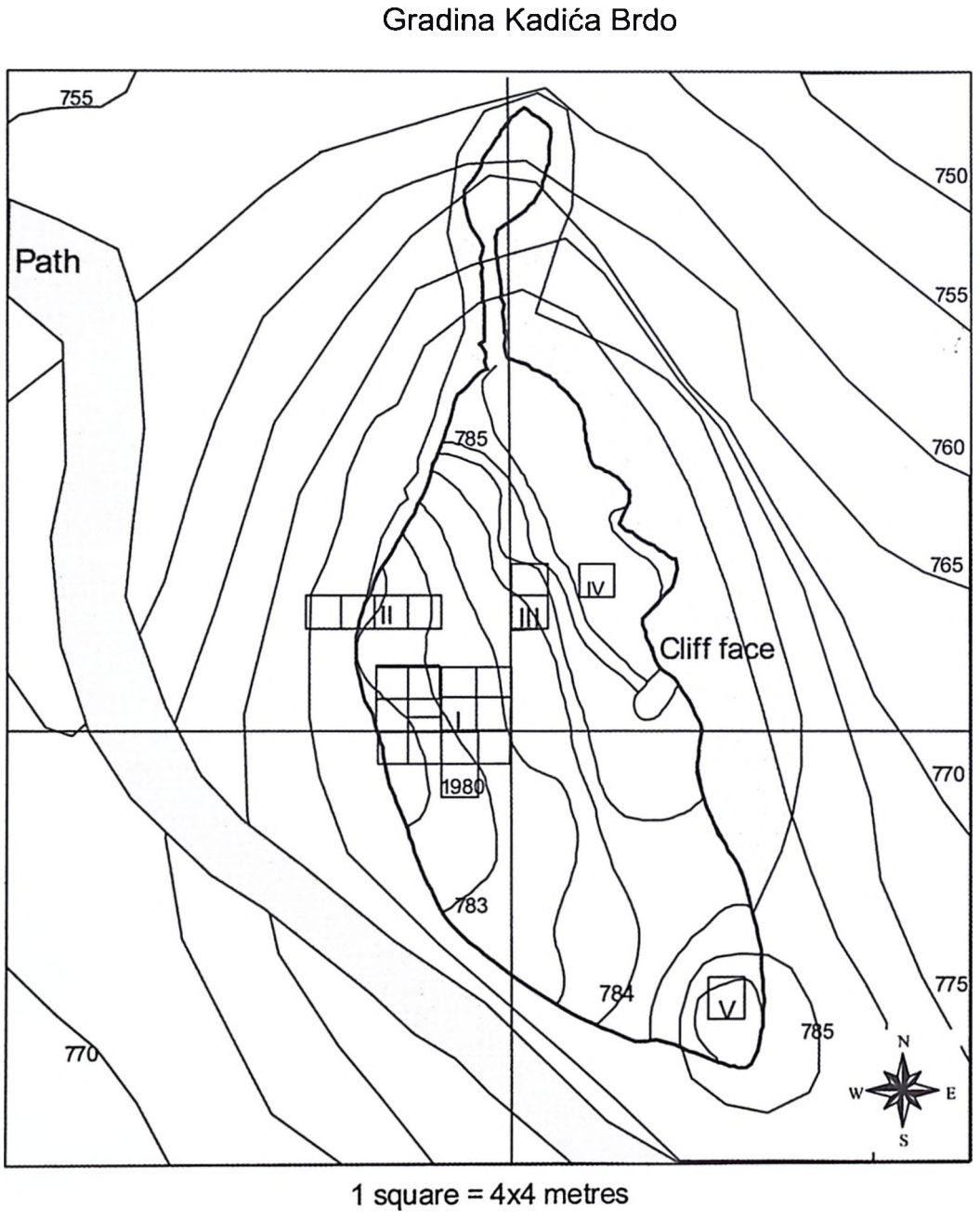

Fig. 3. *Map of site, showing terrain and excavation areas. Redrawn based on Govedarica* (1988: 85) *and various field maps of HG.*

Fig. 4. *Photograph of Early Iron Age levels, sector I. Reprinted from Govedarica and Babić* (1992, Fig. 6).

Fig. 5. *Photograph of top of Early Iron Age fortification wall, sector* II, *trenches* (sonda) SIV/ZIV-V, *facing south, wall* (bedem) *and cultural horizon* I.

- Horizon I - this represents mixed deposits from the EIA and LIA, likely including some cultural deposits (Greek – late 5th century). Nothing later than the Iron Age was found on the site, until the First World War (when it was cut by slit trenches and was a gun emplacement position).
- Horizon II - this represents pure deposits from the Early Iron Age mixed with some LIA deposits. This horizon appears to represent the foundations of EIA houses that eroded off the mound before Horizon 1 was deposited.
- Horizon III (EIA upper) - this represents mainly Early Iron Age deposits, with a few intrusions from the LIA. This horizon may represent the collapse of the Horizon 4 EIA houses;
- Horizon IV (EIA lower) - this represents pure deposits from the Early Iron Age. It consists of mostly house foundations;
- Horizon V - this represents pure deposits from the LBA;
- Horizon VI - this represents pure deposits from the Eneolithic. The ceramic material shows strong affinity towards the Kostolac-Vučedol culture types;

There may have been two distinct major EIA occupational horizons, with the earlier represented by Horizons III and IV and the later represented by Horizon II.

- Horizons I-III - this represents mixed deposits of the EIA and LIA;
- Horizons II-III - this represents mixed deposits from the Iron Age;
- Bronze Age – Later Bronze Age deposits were found at the end of the 1990 field season. Unfortunately, they are not represented in this analysis since the bones were lost during the war.
- Unknown Provenience- this represents the plow zone and other deposits that could not be specifically associated with a particular phase.

The top two cultural stratigraphic horizons (I-II) were mixed temporally. They contained ceramics from the Eneolithic through the LIA period. They were formed through the erosion and conflation of the upper horizons of the site. However, most of the ceramics were from the end of the LBA and beginning of the EIA, and were very similar to the materials in horizons III and IV.

The middle horizons from the site (III-IV) are composed of pure EIA materials. They are the best preserved at the site. The preserved remains included palimpsest of ash and charcoal deposits, and numerous bases of posts for supporting wooden structures on the sloping terrain. These were found dispersed throughout the center of the site.

The situation with respect to the Eneolithic deposits is different. The excavations were just beginning to delve into these deposits at the site when they were forced to stop. As a result, a much smaller quantity

of Eneolithic faunal material was recovered (n =111), all of which derive from the 1980 test trench.

C. Bone recovery procedures

The author was invited to analyze the zooarchaeological remains and to direct a systematic recovery system (including dry sieving and flotation) at the site. Due to limited funding and time-constraints, a sampling scheme was decided upon. Three types of collection systems were employed at the site: hand-collection, dry sieving, and wet-sieving.

In the upper disturbed horizons, all remains were collected in the trench by hand. In the lower preserved horizons, all three types of recovery systems were employed. In most trenches, the remains were hand-collected. However, large quantities of sediment from each horizon of each trench were passed through a wet-sieving and flotation tank built at the edge of the site (Fig. 6). This sampling was designed to correct for any spatial characteristics in the sample. The heavy fraction was collected on superimposed 3 mm and 5 mm screen meshes in the center of the tank. These were separately bagged for eventual examination. Unfortunately, this never took place due to the interruption of field research. The bags were stored with the rest of the fauna that have since disappeared.

During the 1987 and 1988 field seasons, a 4x4 m trench (SII/ZII) was chosen as a control for systematic recovery. All sediments from this trench were dry sieved with a 1 cm sq. screen mesh (Fig. 7).

During the 1990 field season, dry screen meshes were placed over the wheelbarrows and all of the sediments were sieved and remains from all trenches were systematically collected. This last addition to the sample, however, was lost during the war. As a result, most of the artifacts and bones at the site were recovered through hand-collection in the trench and as the sediment was deposited on the back-dirt piles. Few remains of medium or large mammals were missed during the hand-collection process. The back dirt piles were frequently examined once the excavation was beneath the plow zone in order to control for loss of bones through careless collection. Few bones were found during examination of the back dirt.

In general, the larger and more visible fragments of bone were generally collected by hand in the trench. In the sieved control trench, the hand-collected bones were then put into the same bags with the dry sieve-recovered bones. As a result, the two sub-samples cannot be distinguished. The bones from the wet-sieves and flotation were separately bagged for analysis. Bones were placed in separate bags to minimize damage caused by impact from heavier artifacts during transport from the site to the lab.

Fig. 6. *Photograph of flotation crew - Rachael Greenfield, Haskel Greenfield, and unidentified worker* (right to left).

Fig. 7. *Photograph of sieve on top of wheelbarrow.*

Temporally, there is some control over the EIA remains since they were dry-sieved and analyzed. The Eneolithic remains were entirely hand collected, so this bias has been taken into account in the discussion of bone attrition (below).

IV. Method of analysis

The faunal data from the 1980, 1987-88 field seasons was collected, identified, and quantified by the author during and after the field seasons. The faunal remains described in this report derive from a sequence of temporally differentiated deposits spanning from the Eneolithic to the Late Iron Age (Tab. 2). It was, however, often difficult to assign the faunal remains to specific time periods due to mixing of the upper levels from a variety of sources (erosion, prehistoric construction, rodent action, and excavation technique). Further, the excavators encountered several problems correlating the distinct stratigraphic horizons in the settlement with the chronology established for the region. The regional chronological sequence is based almost entirely upon materials recovered from mortuary contexts.

The remains from Horizons I and II were completely analyzed by the author while in the field in 1987-90, but those from the lower horizons (in particular, IV) were never finished due to the war. The zooarchaeological data from the various horizons will be separately presented. The material from Horizons V and VI were analyzed in 1987, since they were excavated in 1980. Even though this report is based on data of the author that was salvaged before the war, it may change dependant upon locating the excavation archives and their subsequent analysis. The goal of this paper is to be able to make some information available.

A. Identification

Each bone was separately identified to as fine a taxonomic level as was possible (e.g. size category, genus, species). The bones were identified with the aid of a combination of the author knowledge, a small comparative osteological sample, and several standard osteological atlases.[5] The biggest identification problem was the difficulty of distinguishing sheep from goat (Caprine). Every attempt was made to distinguish between them, including the use of clear morphological criteria and measurements were occasionally helpful (breadth and depth of metacarpal distal condyles). However, the vast majority of Caprine remains could not be identified to such a fine taxonomic level.

[5] E.g. Schmid 1972; see extensive bibliography in: Greenfield 1986.

Where mammal bones could not be assigned to a particular genus/species, they were assigned to several size-classes: Large mammals - similar in size to cattle, red deer, and horse; Medium mammals - similar in size to domestic pigs, caprines, and canids; and Small mammals - similar in size to hares or squirrels. Occasionally, fragments could be assigned more specifically, but still not to a specific taxon - red deer/cattle or sheep/goat/roe deer. Each is separately listed in the tables.

These less well defined taxonomic categories are important since many bone elements (e.g. ribs, vertebrae) could not be confidently assigned to the species level. It is important to recognize that missing elements may have been assigned to the size categories rather than specific species. Otherwise, the significance of the presence or absence of certain categories of data may be skewed.[6]

Specimens were identified with respect to a number of other criteria – element (e.g. humerus), part of element (e.g. distal end), side of the body, age at death, sex, size of fragment, pathology, tools, ornaments, burning, etc. Also, any evidence for and postmortem deformation was identified (e.g. weathering). Each of these variables is discussed in detail in Greenfield (1986).

B. Quantification

Quantification of bone assemblages has been the subject of numerous debates.[7] Several techniques have been proposed, but only two are used for assemblages in the Balkans: number of individual specimens (NISP) and minimum number of individuals.[8] MNI is a poor measure of taxonomic description.[9] Only NISP counts are given here due to the large size of the assemblage and the well-known affect of sample size on quantification procedures.[10] There are several reasons why NISP has been chosen over more complex, albeit more common statistical indexes among faunal analysts such as *minimum number of individuals* (MNI). The analytical criteria for calculating MNI's as practiced by zooarchaeologists is not universal. Not only are there are no set criteria, but the criteria used in various analyses are rarely specified in publications. This leads to the questionable results since it is not certain how the MNI's were calculated. The MNI can be an outcome of the composition of the data set or the choice of analytical criteria. Some zooarchaeologists may count 125 left humeri as 125 individuals, while others would take into

[6] Lyman 1994.
[7] See Grayson 1984; Reitz and Wing 1999.
[8] MNI - cf. Greenfield 1986, 1991.
[9] Grayson 1984, 90.
[10] Cf. Grayson 1984; Gilbert, Singer and Perkins 1982.

account the number of distal versus proximal ends. Others will include the depositional context and micro-stratigraphic relationships between bones. Others will include information on sex, age, pathology, etc. in an effort to find the closest approximation to the "real" world.[11] Since there is no "universal law" with the use of MNI, and if an analyst does not specify how they are using the method, the MNI is not a good indicator of taxonomic abundance. A second issue with calculating relative abundance using MNI is the definition of faunal *aggregates*. Since excavation methods differ between sites and problems always arise as to the possible mixture of deposits and the defining of micro-strata, any attempt to create a MNI statistic will always be flawed ultimately resulting in an inaccurate portrayal of the sites faunal assemblage.[12] Further, almost no zooarchaeological analyses utilize MNI for the various other statistics employed in the analyses – e.g. age, sex, etc. It is largely used for relative abundance of taxa, alone.

NISP in this study has been altered (and controlled for) by the number of articulations that could be identified on the bone, and the number of the fragments that a single element breaks up into. Therefore, if three teeth belong to the same mandible, then the NISP would be one and not four. If four fragments of bone appeared to come from the same element, this would be recorded as one element and not four. Therefore, some of the bias that results from the use of NISP [13] is avoided.

Articulations are accounted for in the following way: when articulations between bones or fragments were recognized, they were analyzed as belonging to the same individual and quantified as equal to one specimen regardless of the number of bones that were present. Therefore, each separate specimen or group of articulated specimens was quantified only once. No whole or partial skeletons were found in the assemblage. A very small part of the sample was either articulated or fused (n=214) with other bones in the entire sample (1.06% of Total), and many of these represent fused specimens (e.g. proximal radius and ulna of goats – Tab. 3).

Two conventions are employed in describing the composition of the vertebrate faunal sample below. First, percentages are commonly rounded off in the text, and therefore will not coincide precisely with the numbers given in the tables. Second, indistinguishable sheep (*Ovis aries*) and goat (*Capra hircus*) remains are described under the heading of Ovis/Capra, as the difficulty in distinguishing the two species in paramount in faunal identification. All three of these categories (sheep, goat, Ovis/Capra) are also described under a separate category termed Caprine. These terms

[11] Bökönyi 1970; Grayson 1984.
[12] Grayson 1984, 91.
[13] As outlined by Klein and Cruz-Uribe 1984, 24.

are used to distinguish between identified, unidentified, and all the sheep and/or goat remains.

In the discussion of the data, below and in Tab. 6, several types of measures were used. Each type of quantification was used in a specific manner. The Number of Identified Specimens (NISP) was used for quantifying the relative proportions of the different taxa, and for the analysis of most of the variables (e.g. ageing, modification, etc.). Number of fragments represents the number of articulations combined with the NISP. This was used in analysis of size classes and unidentifiable material because there were not any observable articulations. In effect, they were the NISP's for these classes of data. Percentages for the representation of the different taxa are given only with respect to the identified taxa, excluding rodent and human remains. For lack of a better term, these are referenced in the tables under Food Taxa.

C. Curation

The 1980 sample was stored in a room at the Academy of Sciences in Sarajevo. The 1987-90 bone assemblage was stored in a shed on a farm near the site. These have now been lost due to the war. One or two boxes were brought to Istraživačka Stanica Petnica, near Valjevo for analyses. These were left there (since it was impossible to return the material to war-torn Sarajevo) and are stored in their zooarchaeological collection. A small number of specimens were removed to the University of Manitoba for more detailed analysis. The identification of the birds, micro-fauna, molluscs, and other partially identified specimens is incomplete because they were lost during the war prior to their fuller analysis.

Most of the documentation of the excavations was stored in Sarajevo. The documentation has in the meantime been lost or destroyed by the war and the (analyzed and unanalyzed) bone remains lost.

V. Taphonomy of sample

A number of variables have been identified as sources of assemblage attrition or taphonomy. These help us to understand how much of the assemblage might have been destroyed prior to analysis. These include recovery methodology, soil conditions, weathering, burning, gnawing, butchering, and tool and ornament production. In this section, each will be discussed for the site as a whole.

A. Recovery Methodology

The remains were collected mostly by hand. One trench was systematically dry-sieved and this can provide a partial control on what might have been lost in the hand-collected sample. The wet-sieved remains were lost with the rest of the unanalyzed sample. As a result, while attempts to control for differential collection of remains were made, the data were lost during the war. Hence, it is likely that the remains of smaller and/or younger animals were not collected as systematically as those of older and/or larger animals. Therefore, there are likely analytical problems deriving from differential recovery due to bone size. This is a common problem in the region.[14] It is difficult to reconstruct the ancient economy and proportionate contributions to the diet by each of the species with such samples.[15] In this analysis, the data from both the hand-collected and dry-sieved samples have been merged and are not separately analyzed.

A good example of the level of data that were lost is the fish scales. Large quantities of fish scales were recovered during the flotation, but were lost in the fighting. This indicates that fishing occurred even at highland sites.

B. Soil Conditions

Soil pH readings were taken during excavation. In general, they ranged from 5.5 to 7.0 pH. The soil pH was not a major factor in bone attrition. The sediment was mixed with a substantial quantity of ash and charcoal, which may have reduced the effect of the more acidic soils from the region.

C. Weathering

Kadića Brdo is found in a sub-alpine climatic zone, at a very high altitude. The site is subjected year-round to extensive rain, ice and snow conditions, leading to expectations of a highly fragmented bone sample. Furthermore, there was extensive erosion of remains in the uppermost horizons.

The assemblage was analyzed with respect to weathering through the identification of various features on each bone. Different levels of weathering on the bones were noted. Bones were coded as to whether they looked fresh, with little or no discoloration; or were weathered (slight weathering - bones were lightly discolored, and the surface was not pitted with only slight cracking; medium weathering - the compact cortical surface was pitted, lightly eroded, and cracked; heavy weathering - there was major destruction of the cortical surface so that the cancellous bone was extensively exposed, or the bone was heavily cracked).

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[14] Greenfield 1986, 1991; Payne 1985.

[15] Payne 1972; Lyman 1994.

In contrast to expectations, preservation was very good at the site (Tab. 4). Most of the bones had light weathering (81.8%). This did not change between periods, with the degree of preservation being relatively equal.

Changes in frequency between the different horizons are another situation (Tab. 5). The percentage of lightly weathered increases with depth as one moves downward from Horizon I to IV, from 82, to 81, to 87, to 94%, respectively. The small quantities in horizons V and VI are not included because they skew the results. This is largely a byproduct of proximity to the surface and the effects of erosion and exposure to freeze and thaw processes. The bones from the upper two horizons (I-II) were in poorer condition than those from the middle horizons (III-IV).

D. Gnawing

The percentage of canid (dog) or rodent gnawed bone is relatively low (Tab. 6). Overall, only 3.7% of the assemblage had any evidence of chewing. This varied dramatically between the EIA (3.5%) and the Eneolithic (7.7%). A few showed evidence of having been digested and defacated (n=9). Gnawing by rodents is extremely limited, but is more pervasive with dogs. Dogs are obviously an important taphonomic agent at the site.

E. Burning

A large percentage of the assemblage was burned (NISP: 1899; 9.5%). Most assemblages in the region indicate a much lower percentage of burned bone.[16] It could be construed that this is due to the fact that the settlement was burned down during its destruction. However, there were palimpsests of ash deposit throughout the domestic area. These appeared to be the dumping of domestic food production debris beneath the houses, which were slightly raised on the sloping terrain within the walls. The best evidence for the raising of houses was the numerous stone cassettes that encircled the post holes of the houses (Fig.8).

F. Tool making

A very small percentage (83 definite tools and 44 possible tools; for a total of 0.64% of NISP – Tab. 7) of remains showed any evidence of having been made into tools or ornaments. Based on preliminary descriptions of the tools, since none were extensively analyzed prior to the advent of the war, none were clearly ornaments. It is quite interesting that the

[16] Usually in the range of 3-7% - Greenfield 1986, 1991, n.d.

Fig. 8. *Photograph of stone cassettes to hold wooden posts for raised floors of houses on sloping terrain. Sector Ib, 1 cultural horizon* (kulturni sloj), *3rd excavation level* (otkopni sloj), *base of baked earth* (dno pečene zemlje), *viewed from north.*

frequency of tools is so low in comparison to earlier periods.[17] The advent of iron metallurgy had a significant effect upon the use of bone for tools. In essence, tool making cannot be considered a significant source of bone attrition at the site.

Another way of tracking the frequency of tool or ornaments is by examining the amount of use wear polish on bones. Even very fragmentary remains of tools or ornaments can be identified, even when the other clearer indications are not present. As with the more definite or possible bone tools, the category of polished remains is also very small (n=105; 0.53% of NISP – Tab. 8). Of these, only 10 were not also identified as definite tools or possible tools. It is interesting to observe that not all tools were polished.

G. Butchering

Very few remains show any evidence of butchering. Only 339 NISP for the entire assemblage (1.7% - Tab. 9) or 198 from the pure EIA deposits (1.76%) showed any evidence of butchering. Most of these were slicing

[17] Greenfield 1986, 1994, 1996; Greenfield and Fowler 2003, n.d.

marks (n=274; 80.83% - Tab.10), or slice and break (n=39; 11.50%). Very few were recognizable as chop marks (n=24; 7.08%). One of the characteristic changes that occurred with the transition from a stone to a metal economy is that the frequency of butchering marks on bones dramatically declines.[18]

H. Bone Fragmentation

To assess the state of preservation of the sample, the remains were analyzed according to the size of fragments recovered. In the first place, there is little likelihood that fragmentation could have been affected by transport of material from the site. All of the analyses (except for the 1980 sample) took place at the field lab constructed next to the site. Bones were also separated from ceramics and other heavy artifacts in the trench and placed in separate bags.

When the assemblage is considered in general terms, most of the remains were very fragmented - less than a quarter of their original whole bone size (76.73% - Tab.11). Surprisingly, the next largest group was whole bones (10.31%). It is very unusual to have such high frequencies of whole bones. The third largest group is between one quarter and less than a half in size (8.64%). The fourth group is one quarter to less than a half (3.29%), followed by three quarters to less than whole (1.03%). Very few were broken during recovery (n=13). In most cases, the smallest group is those that were found whole. For example, at Megalo Nisi Galanis, they were only 2.48% of the NISP. This is a remarkably large number of whole bones for Neolithic and Bronze Age sites.[19]

VI. Period by period analysis

A. Overall sample frequency

A total of 19,990 NISP (Number of identified specimens) were counted at the site, with slightly higher number of fragments (20,122 – Tab. 1 and 2). Most of the bones derive from the pure EIA horizons (III-IV – 11, 277 or 56%), with the Mixed Iron Age levels representing the second most common category (42.85% of NISP). The Eneolithic is represented by very small quantities of remains (n=13).

The level of taxonomic identification is an important indicator of the quality of the recovery during sampling, as well as preservation. The percentage of bones that were identified to a high (genus or species level) is

[18] Greenfield 1999b, 2000.

[19] See discussions in Greenfield 1986, 1991.

relatively low for the assemblage as a whole (36%) and similar for the EIA material (37.8% - Tab. 12). This is similar to sieved assemblages, but is much lower than hand-collected assemblages.[20] For example, Bukovačka Česma, a hand-collected assemblage, had a fine level of identification rate that stood at 57.7%. The rate of the medium level of identification (i.e. size-class) is relatively constant between the assemblage as a whole and the EIA level, and is similar to other sites (36.7%). It was 36.6% at Bukovačka Česma.

Many of the fragments relegated to these categories were ribs, vertebrae, and sundry other fragmentary remains that are normally difficult to identify to a higher taxonomic level. The percentage of cranial, rib, and vertebral fragments was greater among these than among the finer levels of taxonomic identification (Tab. 13). The percentage of ribs is dramatically higher in the medium and large sized mammals than among the fine taxonomic levels of identification. They are almost absent among the unknown mammals, which are relegated to very fragmentary remains.

The difference between sieved and unsieved assemblages is typically in the higher frequency of unidentifiable fragments, which were 27.3% at Kadića Brdo. At Bukovačka Česma, very few bones were completely unidentifiable (5.6%). The high rate of unidentifiable and lower rate of identifiable fragments from Kadića Brdo is a strong indication of the high rate of recovery, even though most of the assemblage was hand-collected.

B. Domestic vs. wild

In general, the frequency of domestic remains is extremely high. For the entire site, 91% of the fauna is composed of domestic taxa. This changes only slightly for the EIA (92.7% - Tab. 14). It drops slightly again, for the Mixed Iron Age (89.5%), and continues to drop for the Eneolithic (84.6%) and the Mixed Eneolithic-EIA deposits (80.7). But the validity of the percentages of the last two sets of deposits may be biased by their very small sample sizes.

The percentages do not change very much when broken down by horizon (Tab. 15). Horizons I and II are very similar (89.8 and 90%, respectively). Horizon III has a slightly higher frequency (93%). This is similar to the other EIA horizon, IV (92.7%). The Eneolithic horizons, V and VI have lower frequencies of wild remains (75 and 84.6%, respectively), although the numbers are too small have much statistical validity. The point of this exercise is to demonstrate that the economy of Kadića Brdo was extremely heavily weighted toward domestic livestock. Hunting was an insignificant activity, in terms of the quantity of material that it pro-

[20] Greenfield 1986, 1994, 1996; Greenfield and Fowler 2003, n.d.

vided. It may have remained important in terms of providing tools, skins, and other items.

C. Temporal analysis of EIA remains by taxon

The combined EIA material, from Horizon III and IV, will be summarized in the next section (Tab. 9). Each taxon will be separately described. The differences between Horizons III-IV and the more indeterminate Mixed Iron Age material from Horizons I-II are insignificant. The percentages in Tab. 16 include only those that could be considered domestic or wild. They exclude the not applicable (humans and rodents) and those of an unknown state of domestication. This is to provide some sense of the relative importance of these taxa to the economy.

The Eneolithic (Horizons V and VI) are not discussed here because of their insignificant numbers, but the data are available in the tables. It is expected that the frequencies of small taxa, such as rodents, birds, and fish would have been much higher if the water-sieved material had been included in the analysis.

1. Domestic taxa

Caprines - The most common taxon (genus and species level of identification) was the category identified above as Caprines. These include both sheep (*Ovis aries*) and goats (*Capra hircus*), as well as the more indeterminate Ovis/Capra specimens.

Sheep (n=356; 8.8%) were than twice as common as goats (n=147; 3.6%), suggesting that they were more important in the local economy than goats.

The vast majority of Caprine remains fell into the indeterminate Ovis/Capra category (n=1638). Ovis/Capra represented a total of 40.8% of all bone fragments identified to a potential food taxon.

When the sheep, goat, and Ovis/Capra remains are combined into the "Caprines combined" category, they clearly dominate the entire assemblage (53.3%). This quantity declines in the mixed Iron Age to a total of 43.2%.

Bos taurus – The next most common group is domestic cattle. A total of 915 NISP of domestic cattle were identified, representing 22.8% of the identified taxa. A similar fraction is present in the Mixed Iron Age deposits (29.2%). They dominate the Eneolithic levels (76.9%) because of the nature of collection strategy during the 1980 campaign (see discussion above) and the statistic cannot be used as a measure of subsistence importance.

Sus scrofa dom. – The third most common taxon is that of domestic pigs. They are represented by a NISP of 614 (15.3%). Similar frequencies of pig remains are found in the Mixed Iron Age deposits (16.2%)

Canis familiaris – Domestic dogs are the fourth most common domestic taxon (n=49; 1.22%), but were ranked sixth in the overall assemblage. They are clearly small to medium sized dogs, similar to those found in the region today (see measurement appendix). There is no evidence of wolf (*Canis lupus*) in the assemblage.

Equus caballus – Domestic horse is poorly represented at Kadića Brdo. There are only 5 NISP (0.12%). It is the lowest ranked among domestic taxa, and is tied for twelfth place with brown bear. This was unexpected given the supposed importance of the horse in warfare and control of the region during this period.

2. Wild taxa

Cervus elaphus – Red deer is the most common wild taxon (n=155; 3.86%), but is ranked fourth overall in frequency.

Capreolus capreolus – Roe deer is the second most common wild taxon (n=60; 1.49%) and is ranked fifth overall.

Castor fiber – Beaver are present in small but significant numbers (n=17; 0.42%). They are ranked third among wild and seventh in overall importance.

Sus scrofa fer. – Wild boar is the ranked fourth among wild and eighth overall (n=16; 0.4%).

The remainder of taxa, include in ranked order birds (Aves sp.), freshwater bivalves (*Unio* sp.), hare (*Lepus europaeus*), brown bear (*Ursus arctos*), aurochs (*Bos primigenius*), and fish (Pisces sp.). These contain less than 10 NISP, respectively.

3. Comparison with other contemporary assemblages

The only comparable results come from the excavations at the EIA settlement of Pod in western Bosnia[21] and Gradina.[22] However, due to the differences in recovery techniques, there are profound differences between the samples. There are so few remains from Boessneck and Stork's study and so little information on recovery techniques that it is difficult to judge their overall statistical validity. This study was conducted in the days before taphonomy or assemblage attrition was appreciated.

In the more recent study of the bone remains from Pod[23], the frequencies of remains are also very different than found at Kadića Brdo. Cattle (46%) and pigs are more common (18%), while Caprines are present in far lower frequencies (30%). Rather than simply assuming that this difference is a result of subsistence differences between the two sites, it is more likely due to the use of traditional use of hand-collection techniques. This type of recovery strategy results in a selective bias in assemblages

[21] Sachenbacher-Palavestra 1986.
[22] Boessneck and Stork 1972.
[23] Sachenbacher-Palavestra 1986.

in favor of larger animals and the larger bones of smaller animals.[24] Personal communication with the excavator of the site (Borivoj Čović) confirmed that animal bone collection was not a priority and was conducted on a haphazard basis. This problem clearly plagues Sachenbacher-Palavestra's study.

VII. Production and exploitation strategies at Kadića Brdo

(Authors: Haskel Greenfield and Elizabeth Arnold)

The best data for determining production strategies comes from mandibular and loose tooth eruption and wear information. The data below are summarized from analyses conducted with Elizabeth Arnold. The analysis includes only the data from the pure Early Iron Age levels. The method of analysis and data are described in detail in Arnold (2001), Arnold and Greenfield (2004) and Greenfield and Arnold (n.d.). They include both the uncorrected and corrected counts for calculation of mandibular tooth eruption and wear analysis, as well as suggested ages. Suggested ages are based on data from Grant (1975, 1982), Hambleton (1999), and Halstead 1985 (Tab.17).

A. Mandibular data

Seventy-two *Sus scrofa dom.* mandibles and loose teeth were recovered from Early Iron Age levels at Kadića Brdo (65 mandibles and 7 loose teeth). Twenty-three mandibles were unidentifiable to age, leaving forty-two mandibles and seven loose teeth in the final analysis (n = 49). Table 18 summarizes the age stage distributions of *Sus scrofa* remains from the Early Iron Age levels.

Fifty-seven *Ovis aries* mandibles (n=49) and loose teeth (n=8) were recovered from Early Iron Age deposits at Kadića Brdo. Ten mandibles were unidentifiable to age, leaving thirty-nine mandibles and eight loose teeth in the final analysis (n=47). Table 19 summarizes the age stage distributions of *Ovis aries* remains from the Early Iron Age.

Eleven *Capra hircus* mandibles (n=10) and loose teeth (n=1) were recovered from Early Iron Age deposits at Kadića Brdo. Three mandibles were unidentifiable to age, leaving seven mandibles and one loose tooth in the final analysis (n=8 – Table 20). Since these data were too small to be used on their own in the analysis, this sample was combined with the *Ovis/Capra* remains for the analysis (below).

[24] Lyman 1994.

There were a total of 254 mandibles (n=153) and loose teeth (n=101) of *Ovis/Capra* recovered from Early Iron Age levels at Kadića Brdo. Forty-two mandibles and four loose teeth were undeterminable to age, leaving 111 mandibles and 97 loose teeth in the final analysis (n=208). Tab. 21 summarizes the age stage distributions of *Ovis/Capra* remains from the Early Iron Age.

Sixty-six *Bos taurus* mandibles (n=36) and loose teeth (n=30) were recovered from Early Iron Age levels at Kadića Brdo. Eighteen mandibles and one loose tooth were undeterminable to age, leaving eighteen mandibles and twenty-nine loose teeth in the final analysis (n=47). Table 22 summarizes the age stage distributions of *Bos taurus* remains from the Early Iron Age.

B. Exploitation strategies

It is best to begin with domestic pigs since they are used for only their primary products and can be used as a control on the exploitation pattern of the other species. Domestic pig exploitation at Kadića Brdo (Fig. 9) yields a pattern broadly similar to those of the other sites. The highest mortality rate is between 2-7 months and 21-27 months. In addition, there are both very old and very young individuals at the site. The presence of the 0-2 month age class would indicate that animals are being birth at or near the site. The sex ratio was fairly well-balanced, but more weighted toward females (female: male - 55.3:44.7% - Tab. 23). Most of the males were culled as infants and juveniles (all except 1), while females were largely adults. This profile clearly indicates that the exploitation of pigs was for their primary products. The profile also indicates the lack of seasonal transhumant movement of pigs at the site. The presence of the earliest age groups (0-2 through to 7-14 months) indicates that herds were present in some proximity to the site during all seasons.

There were sufficient remains of *Ovis aries* recovered from Kadića Brdo to construct a harvest profile solely for sheep (n=47). This harvest profile (Fig. 10) shows a low mortality of the earliest age groups (0-6 months) followed by an extreme mortality of the 6-12 month age class. There is a slowing of mortality through the 1-2 year and 2-3 year age groups. There is a very low rate of oldest age groups (4-6 years, 6-8 and 8-10 years) in comparison to the earlier groups. However, this is due mainly to the complete absence of any *Ovis aries* remains from the 3-4 year, 6-8 and 8-10 year age groups. This harvest profile is visually very different from the combine Caprine profile (discussed below). The extreme mortality of the youngest age groups (0-1 year) is most similar to a strategy of milk production.[25] However, the balanced sex ratio of sheep remains (female:male – 52.5:47.5%) would argue against use of the herd for this

[25] Payne 1973.

single management strategy. As a result, the *Ovis aries* harvest pattern is seen to more fully conforms to Greenfield's (1988) expectations for a herd based on long-term stability and animal exploitation with a heavy emphasis on secondary products. The sample of remains identifiable to *Capra hircus* (n=8) was insufficient to construct representative harvest profiles. As a result, this sample was combined with the *Ovis/Capra* remains for the analysis (below).

The domestic Caprine harvest profile (Fig. 11) shows a very low mortality in the youngest age groups (0-6 months), followed by rapid mortality of age groups 6-12 months and 1-2 year, followed by a slowing in the 2-3 year, and a final very rapid mortality rate between 3-4 and 4-6 years. There is a very low rate of older age groups (6-8 and 8-10 years) in comparison to the earlier groups. There are no gaps in the youngest age groups (0 to 1-2 years). The sex ratio is different than with sheep. Sheep were fairly well-balanced (female:male – 52.5:47.5%), while the ratios become increasingly unbalanced in favor of adult females with goats (60.6:39.4%) and Ovis/Capra (76.5:23:5% - Table 23). The combined Caprine harvest pattern does not fit any of Payne's (1973) proposed models for exploitation strategies, but conforms to Greenfield's (1988) expectations for a herd based on long-term stability and animal exploitation with a heavy emphasis on secondary products.

The Caprine remains are not indicative of transhumance. The harvest profile shows the presence of all age classes, including the youngest, that implies a year round availability of the herds. This, in turn, suggests a non-transhumant movement and continuous culling of the animals, and residential stability throughout the year. It may be that at this later period, highland areas have developed enough to support year round residence of domestic herds through the production and storage of winter fodder and appropriate shelter available for the animals. This does not preclude the possibility that the bulk of the herd may have been moved in a transhumant fashion, while a part may have been kept year-round in proximity to the settlement.

The domestic cattle harvest profile (Fig. 12) indicates a very low mortality for the youngest age group (0-1 months), and complete absence of the 1-8 month age group. This is followed by a low mortality rate of the 8-18 and rapid mortality of the 18-30 month groups. The 30-36 month group is missing from the profile. There is a rapid mortality rate of the young adult group through to senile, although at a reduced rate from the previous age groups. The vast majority of adults were females (83.33% - Tab. 23). The majority of males were culled at younger ages (infant and juveniles). This harvest pattern does not fit any of Payne's (1973) proposed models for exploitation strategies. But, it conforms to Greenfield's (1988) expectations for a herd based on long-term stability and animal exploitation with an

emphasis on both primary and secondary products. Males were exploited for the primary products, while females for their secondary products.

The cattle remains from Kadića Brdo are extremely problematic in terms of investigating transhumant pastoralism. In a comparative

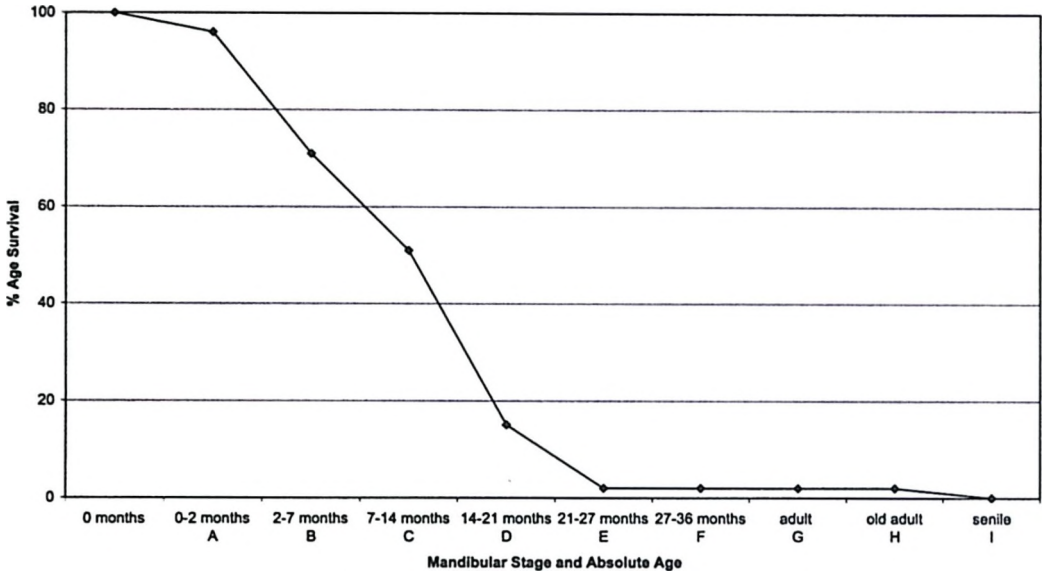

Fig. 9. *Harvest profile of* Sus scrofa dom. (domestic pigs).

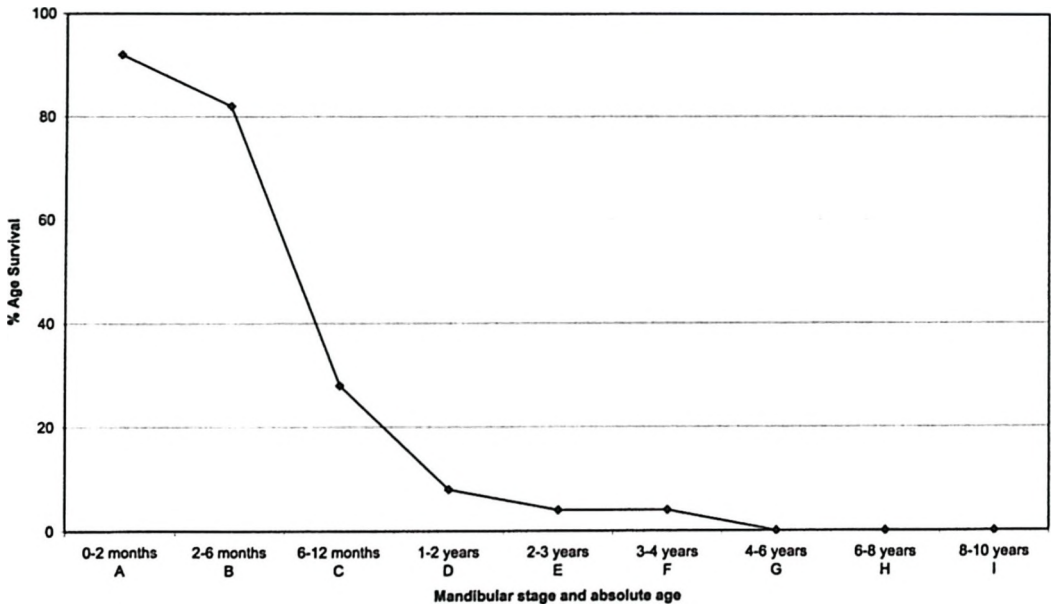

Fig. 10. *Harvest profile of* Ovis aries (domestic sheep)

study,[26] it is one of the largest sample sizes in this study, yet there is a significant gap in the age group distribution (1-8 months). This is exactly the age group that is expected to be present if there were indications of transhumance. Its absence is startling, to the say least, and difficult to

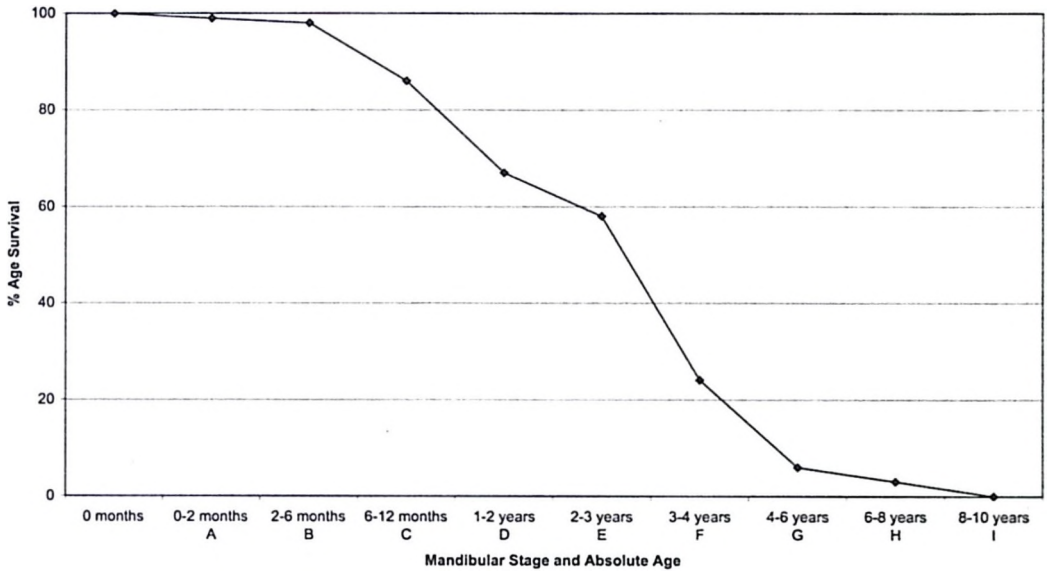

Fig. 11. *Harvest profile of domestic Caprines combined*

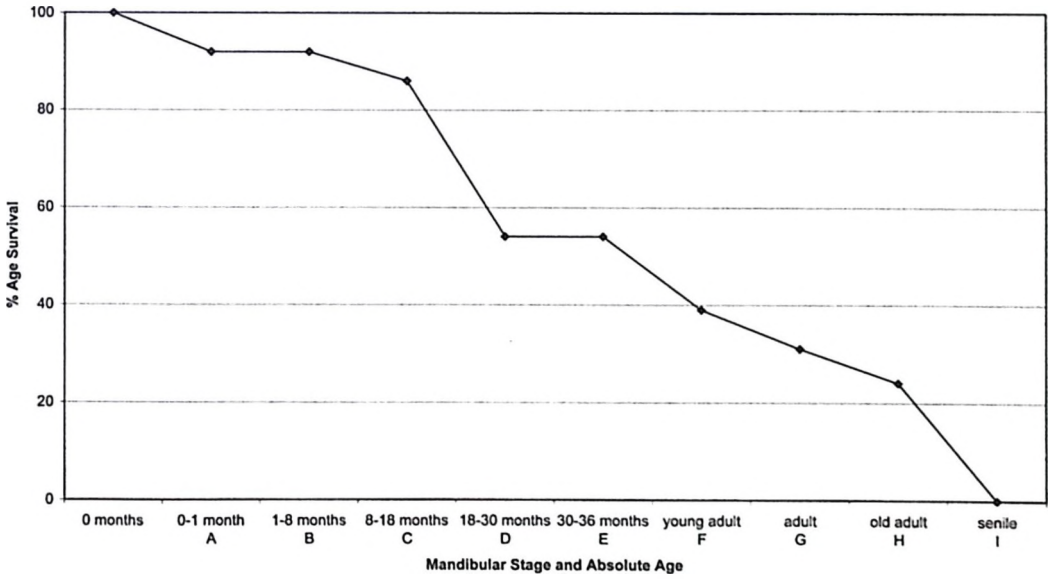

Fig. 12. *Harvest profile of* Bos taurus (domestic cattle)

[26] Arnold and Greenfield 2004; Greenfield and Arnold n.d.

explain in terms of simply transhumance. Such a pattern is found in very unpredictable climates and marginal environments, such as existed in the high mountains of eastern Bosnia (where Kadića Brdo is located). In such environments, herds often tend to pursue a herd management style that minimizes risk. Part of this strategy is to keep as many animals alive as possible. The consequence would be minimal harvesting of veal.[27] This is supported by the absence or near absence of individuals in most of the immature age groups and the high rate of mortality among adults. This is probably the best way to interpret the harvest profile.

C. Transhumant pastoralism and incremental tooth structures

While the tooth eruption and wear data were equivocal in terms of indicating transhumant pastoralism,[28] other techniques provide clearer indications. In this case, it is possible to more clearly identify the season of culling for domestic animals by examining incremental structures such as dental cementum in teeth.[29]

The archaeological thin sectioning sample consisted of ten teeth. Of these, the slides of four teeth were unreadable. Of the six remaining teeth the number of increments counted (by both readers) agrees with the age estimates obtained from tooth wear and eruption. The nature of the final increment was only determinable on four of the readable slides (Kadića Brdo Samples #2, 4, 6 and 10 - Fig.13,a- d). Each of the animals was slaughtered during what is determined to be a growth zone. Kadića Brdo Sample #4 (Fig. 13,b.) provided the best reading with the highest degree of confidence from both readers and indicates the final zone is a growth zone. This would indicate that it and the rest were slaughtered during the warm months. None of the readable samples indicated a cold season slaughter.

All the readable slides from the highland site of Kadića Brdo show a growth zone as the final increment. If involved in the transhumant movement of herds, the Kadića Brdo sample would be expected to show only a summer occupation, which it does. As such, while the sample from Kadića Brdo appears to conform to the hypotheses put forth in this investigation, it is severely limited by the lack of complementary lowland sites from the same or earlier post-Neolithic periods. Additionally, since Kadića Brdo is an EIA site (and the highlands had been colonized beginning with the Eneolithic), it is possible that colonization of the highlands has increased sufficiently for year-round settlement and herd management in

[27] As represented by the immature age groups –Arnold and Greenfield 2004; Greenfield 1988; Redding 1984

[28] Greenfield 1999a, 2001.

[29] Arnold and Greenfield 2004; Greenfield and Arnold n.d.

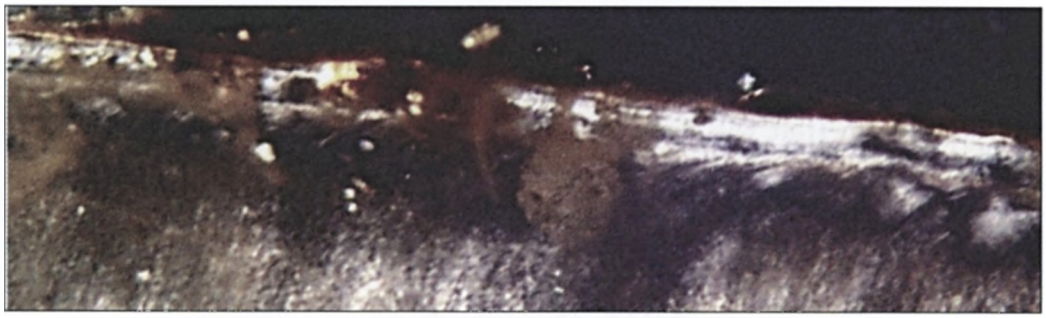

Figure 13a. *Archaeological thin sectioning sample* (Kadića Brdo sample #2)

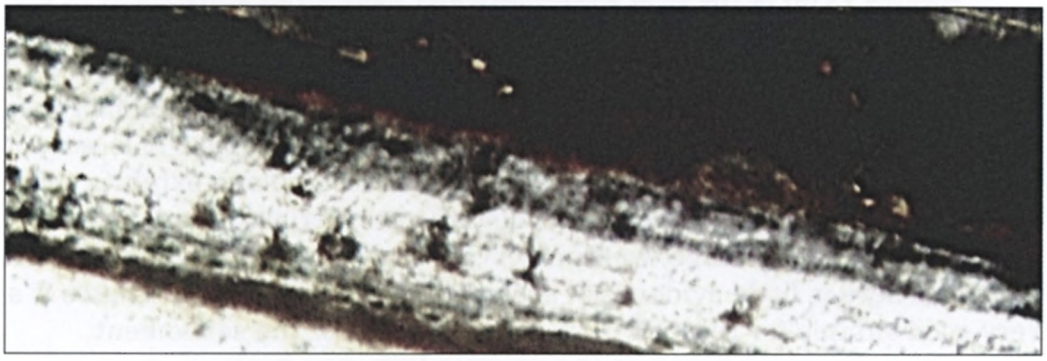

Figure 13b. *Archaeological thin sectioning sample* (Kadića Brdo sample #4)

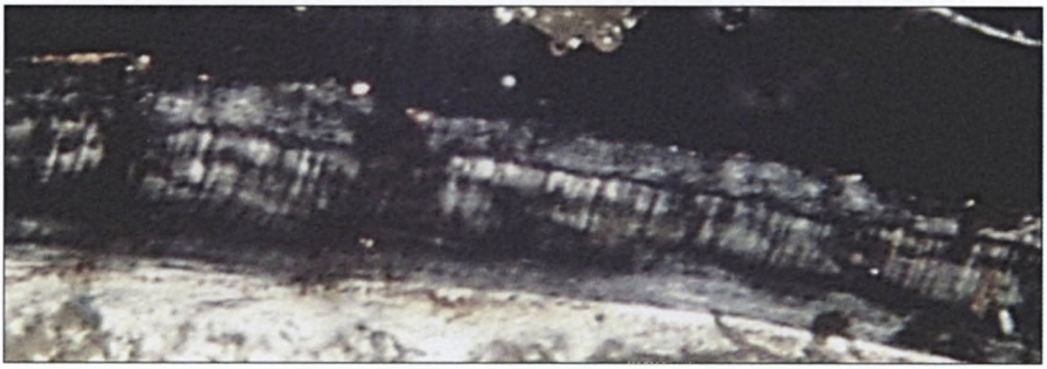

Figure 13c. *Archaeological thin sectioning sample* (Kadića Brdo sample #6)

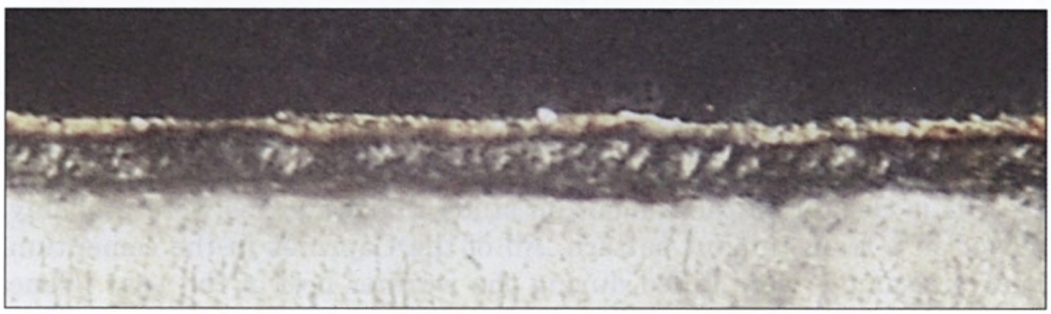

Figure 13d. *Archaeological thin sectioning sample* (Kadića Brdo sample #10)

these areas by this time. However, if this was indeed the case, one must query as to the lack of any teeth showing a winter occupation. Overall, it would seem that the data from Kadića Brdo indicates the absence of Caprine herds from the site during the cold half of the year, implying the presence of transhumance.

VIII. Conclusions

Kadića Brdo is the first systematically excavated settlement of the Glasinac culture. As a result, there is little comparative material with which to evaluate the results. Nonetheless, some results are clear.

Even thoug zooarchaeological assemblages such as this can increase our understanding of Early Iron Age subsistence strategies, it is not an easy leap from bones to human behavior. The assemblage exhibits some evidence for attrition, which may distort reconstructions of behavior. This is an extremely large, well-preserved, and reasonably well-collected sample. There is little evidence of assemblage attrition, which makes it a very good sample for reconstructing the economy of the settlement.

The differences between the various Iron Age horizons were minimal indicating little change over time during the Iron Age. The remains from Horizons I-IV are similar in terms of types and quantities of species represented. The major differences have more to do with proximity to surface and differential destruction due to weathering than to any changes in the settlements economy. The Eneolithic remains were too few to make any substantive statements.

The contribution of wild species is negligible in terms of percentages. Yet, they were probably important as occasional special foods for special occasions, for fur, tools, ornaments, etc. It was surprising to come across such strong evidence for fishing in a highland settlement, however.

Domestic animal production strategies varied according to the species. Pigs were used for their primary products (meat, hide and bone). Cattle and Caprines were used for both their primary and secondary products (milk, wool, and traction). The importance of wool and milk production at the site is corroborated by the presence of a great number of spindle whorls (of a variety of different shapes) found at the site. Their existence points undoubtedly to spinning and weaving of wool. Some of the ceramic types (such as sieves) were also probably used in the preparation of milk products.

It is clear from the cementum study that Caprines were probably moved in a transhumant pattern. All of the Caprines in the cementum analysis sample were killed during the warmer half of the year. None were either present and/or killed during the colder part of the year. This

would indicate that the animals were probably moved out of the region during the winter in order to take advantage of pastures in the lowland and to protect them from the severe weather patterns in the highlands.

In conclusion, Kadića Brdo is an important site for understanding the economy of the highland region, known as the Glasinac Plateau. It provides a baseline against which future research may be judged.

Acknowledgements

This article is dedicated to the memory of the people of the village around the site of Kadića Brdo, and especially Fatima, Mušan, Hamid and their families. They welcomed us into their homes and lives with gracious hospitality, which made our project a success. Their community was unfortunately destroyed by the war and their houses are now occupied by others. It is with great sadness that I recall the good times that we shared on the mountain top.

This research could not have successfully carried without with the help of my daughter, Rachael, who accompanied me throughout my research in the mountains of eastern Bosnia, where she learned the beauty of living close to the land, and the horrors of war. I would like to thank Dr. Blagoje Govedarica and the late Vladimir Leković (†), both of who made my research in Bosnia a real possibility. Any errors are the sole responsibility of the author.

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Rezime

Zooarheološki nalazi iz ranog željeznog doba sa utvrđenog naselja Klisura u Kadića Brdu, istočna Bosna: tafonomičko istraživanje

Ovaj rad predstavlja analizu arheozooloških nalaza prikupljenih tokom iskopavanja na Klisuri - Kadića Brdu, ranoželjeznodobnoj gradini na Glasinačkom platou u istočnoj Bosni. Tafonomičkom procjenom ostataka životinjskih kostiju utvrđeno je postojanje veoma malih oštećenja. Zbog toga se ovi životinjski ostaci mogu iskoristiti za rekonstrukciju prethistorijske ekonomike ovog naselja.

Kadića Brdo je prvo sistematski istraživano naselje Glasinačke kulture, te ne postoji dovoljno materijala za uporedne analize. Ovdje se ipak radi o dosta velikoj i dobro očuvanoj arheozoološkoj zbirci, bez nekih većih oštećenja, koja prema tome predstavlja dobar uzorak za rekonstrukciju ekonomike ovog naselja.

Razlike između željeznodobnih slojeva su minimalne, što ukazuje na veoma male promjene tokom ovog cjelokupnog perioda. Ostaci iz stratuma I-IV su slični po tipu i količini zastupljenih vrsta. Glavne razlike su više vezane za blizinu površinskom sloju i klimatskim utjecajima, nego za promjene u ekonomici naselja.

Procentualno gledajući udio divljači je zanemarljiv. Ipak, vjerovatno je da je divljač bila važna za ishranu u posebnim prilikama, te zbog krzna, alatki, ukrasa itd. Međutim, iznenađujući su nalazi koji ukazuju na postojanje ribolova u ovom visinskom naselju.

Svrha uzgoja domaćih životinja razlikovala su od vrste do vrste. Svinje su se uzgajane zbog primarnih proizvoda (meso, koža i kosti). Krupna i sitna stoka je uzgajana zbog njihovih primarnih i sekundarnih proizvoda (mlijeko, vuna i za vuču). Važnost proizvodnje vune i mlijeka potvrđuje veliki broj pršljenova za tkanje (različitih veličina i oblika) pronađenih na lokalitetu. Njihova prisutnost bez sumnje ukazuje na proces predenja i tkanja vune. Neki od keramičkih oblika (kao što su sita – cjediljke) su vjerovatno korišteni u proizvodnji mliječnih proizvoda.

Analize jasno pokazuje da je sitna stoka uzgajana nomadski. Kako se vidi iz dentalne analize primjeraka, sitna stoka je ubijana tokom toplijeg dijela godine. Nema podataka o prisustvu ili ubijanju ovih životinja tokom hladnijeg perioda godine. Iz toga proizilazi da su ove životinje tokom zime preseljavane u mjesta nizinskih ispaša koja su bila zaštićena od oštrih vremenskih uvjeta ovog visinskog kraja.

Kadića Brdo, je veoma značajan lokalitet za razumijevanje ekonomije planinskog regiona, poznatog kao Glasinački plato. Ovaj lokalitet pruža dobru osnovu za buduća uporedna istraživanja.

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Table 1: Bone frequency by period of occupation (NISP and # of fragments).

Period	Sum of NISP		Sum of # fragments	
	No.	%	No.	%
EIA	11278	56,42%	11350	56,41%
EIA?	28	0,14%	29	0,14%
Eneolithic	13	0,07%	13	0,06%
Eneolithic-EIA	105	0,53%	105	0,52%
Mixed Iron Age	8566	42,85%	8625	42,86%
Total	19990	100,00%	20122	100,00%

Table 2: Frequency of bone remains by cultural horizon (NISP).

Horizon #	No.	%
I	758	3,79%
II	6038	30,21%
II?	747	3,74%
III	7986	39,95%
I-II	1147	5,74%
III?	2193	10,97%
I-III	43	0,22%
I-III?	5	0,03%
II-III	298	1,49%
II-III?	5	0,03%
III-IV	44	0,22%
III-V	4	0,02%
III-V?	14	0,07%
IV	597	2,99%
IV-V	33	0,17%
V	60	0,30%
VI	13	0,07%
V-VI	5	0,03%
Grand Total	19990	100,00%

Table 3: Frequency of articulated specimens (number of fragments)

Articulation category		No.	%
Not articulated	Sum of NISP for articulations	19893	98,94%
	Sum of # fragments	19893	98,86%
Articulated/fused with following bone	Sum of NISP for articulations	97	0,48%
	Sum of # fragments	97	0,48%
Fused with preceding bone	Sum of NISP for articulations	70	0,35%
	Sum of # fragments	71	0,35%
Articulated with preceding bone	Sum of NISP for articulations	41	0,20%
	Sum of # fragments	55	0,27%
Possibly part of preceding bone	Sum of NISP for articulations	2	0,01%
	Sum of # fragments	2	0,01%
Possibly articulated with preceding	Sum of NISP for articulations	4	0,02%
	Sum of # fragments	4	0,02%
Total Sum of NISP for articulations		20107	
Total Sum of # fragments		20122	

Table 4: Frequency of weathered bones by period (NISP)

		Weathering					
Period		0. Very light	1. Light	2. Medium	3. Heavy	4. Water smoohted	Grand Total
EIA	NISP	3	9382	1831	52	10	11278
	%	0,03%	83,19%	16,24%	0,46%	0,09%	100,00%
EIA?	NISP	0	26	2	0	0	28
Eneolithic	NISP	0	11	2	0	0	13
Eneolithic-EIA	NISP	0	94	11	0	0	105
Mixed Iron Age	NISP	3	6853	1693	17	0	8566
	%	0,04%	80,00%	19,76%	0,20%	0,00%	100,00%
Grand Total	NISP	6	16366	3539	69	10	19990
	%	0,03%	81,87%	17,70%	0,35%	0,05%	100,00%

Table 5: Frequency of weathered bone by cultural horizon (NISP).

	Weathering						
	0. Very light	1. Light		2. Medium	3. Heavy	4. Water smoohted	Grand Total
Horizon #	No.	No.	%	No.	No.	No.	No.
I	1	627	82,72%	129	1	0	758
II	2	4908	81,29%	1117	11	0	6038
II?	0	556	74,43%	190	1	0	747
III	2	6961	87,17%	980	34	9	7986
I-II	0	855	74,54%	288	4	0	1147
III?	0	1410	64,30%	765	17	1	2193
I-III	0	41	95,35%	2	0	0	43
I-III?	0	4	80,00%	1	0	0	5
II-III	1	278	93,29%	18	1	0	298
II-III?	0	5	100,00%	0	0	0	5
III-IV	0	43	97,73%	1	0	0	44
III-V	0	4	100,00%	0	0	0	4
III-V?	0	14	100,00%	0	0	0	14
IV	0	563	**94,30%**	34	0	0	597
IV-V	0	31	**93,94%**	2	0	0	33
V	0	50	83,33%	10	0	0	60
VI	0	11	84,62%	2	0	0	13
V-VI	0	5	100,00%	0	0	0	5
Grand Total	6	16366	81,87%	3539	69	10	19990

Table 6: Frequency of gnawed bones by period (NISP).

		Period					
Gnawing agent	Gnawing Intensity	EIA	EIA?	Eneolithic	Eneolithic-EIA	Mixed Iron Age	Grand Total
Canid	Heavy	4	0	0	0	3	7
	Light	382	1	1	5	327	716
	Stomach acid	9	0	0	0	3	12
Canid Total		395	1	1	5	333	735
Rodent	Light	1	0	0	0	1	2
Sum of gnawed NISP	No.	396	1	1	5	334	737
	%	3,51%	3,57%	7,69%	4,76%	3,90%	3,69%
Total NISP	No.	11278	28	13	105	8566	19990

Table 7: Frequency of bones modified into tools (NISP).

Modification	No.	%
Possibly modified	44	0,22%
Tool	83	0,42%
Unmodified	19863	99,36%
Grand Total	19990	100,00%

Table 8: Frequency of bones with use wear polish (NISP).

	No.	%
Polished	105	0,53%
Unpolished	19885	99,47%
Grand Total	19990	100,00%

Table 9: Frequency of butchered bones (NISP).

Butchering	EIA		EIA?	Eneolithic	Eneolithic-EIA	Mixed Iron Age	Grand Total	
	No.	%	No.	No.	No.	No.	No.	%
Unbutchered	11080	98,24%	28	10	100	8433	19651	98,30%
Butchering marks present	198	1,76%	0	3	5	133	339	1,70%
Grand Total	11278	100,00%	28	13	105	8566	19990	100,00%

Table 10: Frequency of taxa by period (NISP).

Note: % of Is food taxa									
Taxon	**EIA**		**EIA?**	**Mixed Iron Age**		**Eneolithic**		**Eneolithic-EIA**	**Grand Total**
	No.	%	No.	No.	%	No.	%	No.	No.
Domestic									
Bos taurus	915	22,79%	4	766	29,23%	10	76,92%	23	1718
Canis familiaris	49	1,22%	0	16	0,61%	0	0,00%	1	66
Equus caballus	5	0,12%	0	9	0,34%	0	0,00%	0	14
Capra hircus	147	3,66%	1	77	2,94%	0	0,00%	1	226
Ovis aries	356	8,87%	0	171	6,52%	1	7,69%	1	529
Ovis/Capra	1638	40,80%	4	884	33,73%	0	0,00%	12	2538
Caprines combined	2141	**53,33%**	5	1132	**43,19%**	1	**7,69%**	14	3293
Sus scrofa dom.	614	15,29%	3	424	16,18%	0	0,00%	8	1049
Domestic Total	3724	**92,75%**	12	2347	**89,55%**	11	**84,62%**	46	6140
Wild									
Aves sp.	12	0,30%	0	5	0,19%	0	0,00%	0	17
Bos primigenius	4	0,10%	0	2	0,08%	0	0,00%	0	6
Canis lupus	0	0,00%	0	1	0,04%	0	0,00%	0	1
Capreolus capreolus	60	1,49%	0	29	1,11%	0	0,00%	0	89
Carnivore - small	1	0,02%	0	0	0,00%	0	0,00%	0	1
Castor fiber	17	0,42%	0	14	0,53%	0	0,00%	3	34
Cervus elaphus	155	3,86%	2	201	7,67%	2	15,38%	7	367
Felis sylvestri	0	0,00%	0	1	0,04%	0	0,00%	0	1
Lepus europaeus	8	0,20%	0	0	0,00%	0	0,00%	0	8
Meles meles	0	0,00%	0	2	0,08%	0	0,00%	0	2
Pisces sp.	4	0,10%	0	1	0,04%	0	0,00%	0	5
Sus scrofa fer.	16	0,40%	0	4	0,15%	0	0,00%	1	21
Unio sp.	10	0,25%	0	2	0,08%	0	0,00%	0	12
Ursus arctos	5	0,12%	0	12	0,46%	0	0,00%	0	17
Wild Total	292	**7,27%**	2	274	**10,45%**	2	**15,38%**	11	581
Not applicable									
Homo sapiens	3		0	0		0		0	3
Rodentia sp.	2		0	1		0		0	3
Not applicable Total	5		0	1		0		0	6
Unknown									
Bos sp.	1		0	6		0		0	7
Bos/Cervus	53		0	52		0		1	106
Bos/Equus/Cervus	104		0	128		0		8	240
Canis familiaris/lupus	2		0	0		0		0	2
Caprine/Capreolus	69		0	30		0		0	99
Ovis/Capra	12		0	6		0		0	18
Sus scrofa	0		0	1		0		0	1
Unknown Total	241		0	223		0		9	473
Size class									
Mammal - large sized	1763		6	1708		0		16	3493
Mammal - medium sized	2350		7	1449		0		10	3816
Mammal - small sized	23		0	4		0		0	27
Unknown mammal	2880		1	2560		0		13	5454
Size Class Total	7016		14	5721		0		39	12790
Grand Total	11278		28	8566		13		105	19990

Table 11: Frequency of fragment size (NISP).

Fragment size	EIA	EIA?	Eneolithic	Eneolithic-EIA	Mixed Iron Age	Grand Total	
	No.	No.	No.	No.	No.	No.	%
1. Whole	1016	1	5	18	821	1861	10,31%
2. 3/4 to less than whole	126	0	0	1	59	186	1,03%
3. 1/2 to less than 3/4	402	2	1	11	177	593	3,29%
4. 1/4 to less than 1/2	977	4	1	6	571	1559	8,64%
5. Less than 1/4	7543	18	4	53	6226	13844	76,73%
6. Modern break, fragment size >1/2	0	0	0	0	1	1	
7. Modern break, fragment size <1/2	1	0	0	0	11	12	
Cranial or mandible - not recorded	1210	3	2	16	691	1922	
Indeterminate	3	0	0	0	1	4	
Not recorded	0	0	0	0	8	8	
Grand Total	11278	28	13	105	8566	19990	
Total of categories 1-5	10064	25	11	89	7854	18043	100,00%

Table 12: Frequency of bones identified to various taxonomic levels (NISP).

(Species/genus level includes those not identified to a domestic or wild level, but identified to the genus.)

		Period									
		EIA		EIA?	Mixed Iron Age		Eneolithic	Eneolithic-EIA		Grand Total	
Taxonomic level		No.	%	No.	No.	%	No.	No.	%	No.	%
High	Species/ genus level	4021		14	2622		13	57		6727	
	Unknown domestication	241		0	223		0	9		473	
	Subtotal	4262	100,00%	14	2845	100,00%	13	66	83,54%	7200	100,00%
Medium	Size class	0	0,00%	37	0	0,00%	0	0	0,00%	0	0,00%
Low	Unknown	0	0,00%	223	0	0,00%	0	13	16,46%	0	0,00%
	Total	4262	100,00%	274	2845	100,00%	13	79	100,00%	7200	100,00%

Table 13: Frequency of cranial, rib, and vertebral elements among size classes and unknown (NISP).

Element	Grand total of all taxa		Unknown mammal		Mammal - large sized		Mammal - medium sized		Mammal - small sized		All fine taxonomic levels combined	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Cranium	1155	34,42%	247	95,74%	192	19,88%	63	7,08%	0	0,00%	653	53,22%
Rib	1486	44,28%	10	3,88%	541	56,00%	680	76,40%	14	93,33%	241	19,64%
Vertebra	715	21,31%	1	0,39%	233	24,12%	147	16,52%	1	6,67%	333	27,14%
Total	3356	100,00%	258	100,00%	966	100,00%	890	100,00%	15	100,00%	1227	100,00%

Table 14: Distribution of domestic and wild remains by major period (NISP and TNF).

		Domestic		Wild		Not applicable	Unknown	Grand Total
Period	Data	No.	%	No.	%	No.	No.	No.
EIA	Sum of # fragments	3791		294		5	7260	11350
	Sum of NISP	3724	92,73%	292	7,27%	5	7257	11278
EIA?	Sum of # fragments	13		2		0	14	29
	Sum of NISP	12	85,71%	2	14,29%	0	14	28
Eneolithic	Sum of # fragments	11		2		0	0	13
	Sum of NISP	11	84,62%	2	15,38%	0	0	13
Eneolithic-EIA	Sum of # fragments	46		11		0	48	105
	Sum of NISP	46	80,70%	11	19,30%	0	48	105
Mixed Iron Age	Sum of # fragments	2401		277		1	5946	8625
	Sum of NISP	2347	89,55%	274	10,45%	1	5944	8566
Total Sum of # fragments		6262		586		6	586	20122
Total Sum of NISP		6140	91,36%	581	8,64%	6	581	19990

Table 15: Distribution of domestic and wild remains by cultural horizon (NISP).

	Domestic		Wild		Not applicable	Unknown	Grand Total
Horizon #	No.	%	No.	%	No.	No.	No.
I	264	89,80%	30	10,20%	0	464	758
II	1446	90,15%	158	9,85%	1	4433	6038
II?	287	90,54%	30	9,46%	0	430	747
III	2856	93,09%	212	6,91%	4	4914	7986
I-II	345	88,92%	43	11,08%	0	759	1147
III?	474	89,10%	58	10,90%	1	1660	2193
I-III	16	84,21%	3	15,79%	0	24	43
I-III?	0	0,00%	0	0,00%	0	5	5
II-III	118	88,72%	15	11,28%	0	165	298
II-III?	2	100,00%	0	0,00%	0	3	5
III-IV	25	100,00%	0	0,00%	0	19	44
III-V	1	100,00%	0	0,00%	0	3	4
III-V?	2	66,67%	1	33,33%	0	11	14
IV	247	92,86%	19	7,14%	0	331	597
IV-V	15	100,00%	0	0,00%	0	18	33
V	30	75,00%	10	25,00%	0	20	60
VI	11	84,62%	2	15,38%	0	0	13
V-VI	1	100,00%	0	0,00%	0	4	5
Grand Total	6140	91,36%	581	8,64%	6	13263	19990

Table 16: Frequency of butchered bones by type of mark (NISP).

Butchering type	Butchering orientation	EIA	EIA?	Eneolithic	Eneolithic-EIA	Mixed Iron Age	Grand Total	
		No.	No.	No.	No.	No.	No.	%
Chop	Diagonal to main axis	3	0	0	0	1	4	
	Severed crosswise to main axis	5	0	0	0	1	6	
	Severed lengthwise of main axis	11	0	0	0	3	14	
Chop Total		19	0	0	0	5	24	7,08%
No information on type		1	0	0	0	0	1	
No information on type Total		1	0	0	0	0	1	0,29%
Slice	Crosswise to main axis	152	0	2	3	94	251	
	Lengthwise and crosswise	1	0	0	0	0	1	
	Lengthwise to main axis	11	0	0	0	11	22	
Slice Total		164	0	2	3	105	274	80,83%
Slice and break in bone		13	0	1	2	23	39	11,50%
Slice and chop		1	0	0	0	0	1	0,29%
Grand total of butchered bones							339	100,00%

Table 17: Suggested relationship between mandibular tooth eruption and wear stage and age for domestic cattle, caprines, and pigs, and frequency (NISP) for each stage based on dm4, PM4, M1, M2, and M3.

Tooth eruption and wear stage	B	C	D	E	Total
Sus scrofa dom.					
Suggested Age	2-7 months	7-14 months	14-21 months	21 months-senile	
Sus scrofa dom. frequency	12	10	18	8	48
Bos taurus					
Suggested Age	1-8 months	8-18 months	18-30 months	30 months-senile	
Bos taurus frequency	92	86	54	148	380
Caprines					
Suggested Age	2-6 months	6-12 months	1-2 years	2-10 years	
Caprines combined frequency	98	86	67	91	342

Table 18. Stage distribution of Sus scrofa dom. mandibles and loose teeth.

Stage	Suggested Age	Raw Count		Corrected Count	
		No.	%	No.	%
A	0-2 months	2	6	2	4
B	2-7 months	11	36	11.7	25
C	7-14 months	4	13	10	20
D	14-21 months	7	23	17.7	36
E	21-27 months	6	19	6.5	13
F	27-36 months	0	0	0	0
G	adult	0	0	0	0
H	old adult	0	0	0	0
I	senile	1	3	1	2
		31	100	48.9	100

Table 19. Stage distribution of Ovis aries mandibles and loose teeth.

Stage	Suggested Age	Raw Count		Corrected Count	
		No.	%	No.	%
A	0-2 months	4	11	4	8
B	2-6 months	5	14	5	10
C	6-12 months	20	55	25.6	54
D	1-2 years	5	14	9	20
E	2-3 years	1	3	1.4	4
F	3-4 years	0	0	0	0
G	4-6 years	1	3	2	4
H	6-8 years	0	0	0	0
I	8-10 years	0	0	0	0
		36	100	47	100

Table 20. Stage distribution of Capra hircus mandibles and loose teeth.

Stage	Suggested Age	Raw Count		Corrected Count	
		No.	%	No.	%
A	0-2 months	0	0	0	0
B	2-6 months	0	0	0	0
C	6-12 months	2	40	2	25
D	1-2 years	1	20	1.3	16
E	2-3 years	0	0	0	0
F	3-4 years	1	20	3.4	43
G	4-6 years	0	0	0	0
H	6-8 years	1	20	1.3	16
I	8-10 years	0	0	0	0
		5	100	8	100

Table 21. Stage distribution of Ovis/Capra mandibles and loose teeth.

Stage	Suggested Age	Raw Count		Corrected Count	
		No.	%	No.	%
A	0-2 months	1	1	1	1
B	2-6 months	1	1	1	1
C	6-12 months	15	22	25.5	12
D	1-2 years	10	14	40.5	19
E	2-3 years	5	7	19.2	9
F	3-4 years	16	23	69.8	34
G	4-6 years	17	24	39.8	18
H	6-8 years	3	4	5.6	3
I	8-10 years	3	4	5.6	3
		71	100	208	100

Table 22. Stage distribution of *Bos taurus* mandibles and loose teeth.

Stage	Suggested Age	Raw Count		Corrected Count	
		No.	%	No.	%
A	0-1 month	4	16	4	8
B	1-8 months	0	0	0	0
C	8-18 months	3	12	3	6
D	18-30 months	8	32	14.5	32
E	30-36 months	0	0	0	0
F	Young adult	2	8	7.1	15
G	Adult	1	4	3.8	8
H	old adult	1	4	3.3	7
I	Senile	6	24	11.2	24
		25	100	46.9	100

Table 23: Frequency of sexed bones (NISP).

Taxon	Female	Female?		Male	Male?		Total	Unknown	Grand Total
	No.	No.	%	No.	No.	%	No.	No.	No.
Domestic									
Bos taurus	0	15	83,33%	0	3	16,67%	18	1700	1718
Capra hircus	0	20	60,61%	1	12	39,39%	33	193	226
Ovis aries	0	21	52,50%	0	19	47,50%	40	489	529
Ovis/Capra	0	13	76,47%	0	4	23,53%	17	2521	2538
Sus scrofa dom.	7	35	55,26%	4	30	44,74%	76	973	1049
Wild									
Capreolus capreolus	0	0	0,00%	4	0	100,00%	4	85	89
Cervus elaphus	0	0	0,00%	94	0	100,00%	94	273	367