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Meat production, hunting strategies, and settlement organization of the Late Neolithic site of Chavdarova cheshma, southeast Bulgaria

Nadezhda Karastoyanova[1, 2*] and Yavor Boyadzhiev[2]

[1]National Museum of Natural History, Bulgarian Academy of Science,
n_karastoyanova@nmnhs.com

[2]National Archaeological Institute and Museum, Bulgarian Academy of Science,
yavordb@abv.bg

* Corresponding author

Abstract

This paper discusses the zooarchaeological results from the excavation project at the Late Neolithic site of Chavdarova cheshma located on a flat terrace along the ancient bed of the Maritsa River, southeast Bulgaria (Simeonovgrad, municipality of Haskovo). The site yielded a remarkably rich assemblage of faunal remains deriving from domestic refuse, with animal bones found in close association with numerous ovens situated on the slopes of an ancient gully. These concentrations indicate that butchering, processing, and cooking activities were conducted predominantly outside of the houses.

Cattle are the dominant domestic species, underscoring their key role in the subsistence economy, while sheep and goats form a substantial secondary component. Domestic pigs are present in smaller numbers, and dog remains are rare, reflecting the presence of small domestic dogs of little economic importance. Kill-off pattern analysis indicates that livestock were primarily slaughtered at ages optimal for meat yield, suggesting that animal husbandry at the site was geared mainly toward meat production rather than secondary products such as milk or wool.

*Among wild taxa, the extraordinarily high proportion of fallow deer (*Dama dama*) is particularly significant, surpassing the typically dominant red deer (*Cervus elaphus*) in Neolithic assemblages from Bulgaria. This pattern points to targeted hunting strategies and favorable local habitats for fallow deer.*

The spatial clustering of faunal remains around the spring, riverbank, and oven concentrations suggests a dedicated processing zone, possibly linked to mobility and exchange along the Maritsa River. Imported marine shells and Aegean-type painted pottery further support the interpretation of Chavdarova cheshma as a small riverine waypoint integrated into wider networks of movement and interaction during the Late Neolithic.

Keywords: *Late Neolithic – zooarchaeology – hunting – husbandry – Balkan prehistory – animal remains – fallow deer.*

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Introduction

During the Late Neolithic (ca. 5500/5450 – 4950/4900 cal. BC), notable transformations occurred in societies across the Balkan Peninsula. These changes are reflected in settlement organization, pottery production, flint technology, and subsistence strategies. Around the mid-sixth millennium BC, these developments marked the transition from the Early to the Late Neolithic according to the currently used chronology in Bulgaria. Upper Thrace and particularly the Maritsa River Valley represents a key region for tracing these cultural and economic processes (Boyadzhiev 2020, 47f).

Chronologically, the Neolithic in Upper Thrace spans the sixth millennium BC, with the transition from the Early to the Late Neolithic – defined as the Karanovo II–III period – dated to ca. 5550/5500–5450/5400 cal. BC (Nikolov 1998, 206ff and 214ff; 2004, 20; Boyadzhiev 2000, fig. 2; 2009, 25ff). Based on the stratigraphy of Tell Karanovo, this framework remains the principal reference for understanding regional developments despite certain local variations across Thrace.

Within this context, the site of Chavdarova cheshma stands out as one of the most significant Late Neolithic settlement sites in the Maritsa River Valley. The exceptionally large amount of animal remains discovered there provides valuable evidence for daily life and subsistence practices as well as for reconstructing the natural environment of the period. Notably, the faunal assemblage is dominated by fallow deer (*Dama dama*) rather than red deer (*Cervus elaphus*), which predominates at most other prehistoric sites (Manhart 1997, 716ff; Ninov & Stanev 1992, 121ff; Ninov 1999, 131ff; Gorczyk & Karastoyanova 2017, 523ff; Nobis & Ninov 2002). This pattern reflects the well-documented substantial population of fallow deer in southeast Bulgaria during the Neolithic and illustrates regional environmental particularities (Karastoyanova et al. 2020, 8ff).

The evidence from Chavdarova cheshma not only enhances our understanding of human–animal relationships and environmental conditions in Upper Thrace but also highlights the growing importance of hunting as a component of the subsistence economy during the Late Neolithic.

The site's excavations

The site of Chavdarova cheshma (5450–5200 BC) is located in the Zlati Dol quarter of the town of Simeonovgrad, near the railway station, on two non-flooded terraces – the so-called central (II) and western (I) terraces – south of an ancient channel of the Maritsa River (fig. 1). There is evidence that the settlement stretches further south of the modern railway line. However, this area is now built over and cannot be investigated.

The rescue excavation project was carried out in 2014–2015. Earlier research includes three test trenches excavated in 1968 by D. Aladzhov of the Haskovo Historical Museum as well as excavations at the Early Neolithic settlement on the Central Mound conducted by A. Raduncheva between 1979–1982 (2002). More trenches were excavated in 2005 ahead of the construction of the high-speed Plovdiv–Svilengrad Railway

(Boyadzhiev et al. 2008). The 2014–2015 rescue excavations significantly expanded the investigated area to 1,400 m² along a 10–20 m wide strip crossing the settlement east–west (fig. 2; Boyadzhiev et al. 2015 and 2016).

The excavations revealed an extensive settlement of a dispersed type, with structures spaced 50–60 meters apart. The remains of nine structures were identified, most of which were heavily disturbed by later intrusions. Some of them had two levels, and specific structures – such as building 5 – show evidence of up to five construction phases. Both the stratigraphic sequence and the ceramic assemblage indicate long occupation in the first half of the Late Neolithic (Karanovo III period). A distinct zone of features developed along the slope of an ancient ravine, apparently linked to the proximity of the Maritsa River, which at that time formed a convenient bay supplied with abundant spring water (fig. 3; Boyadzhiev et al. 2016, 100).

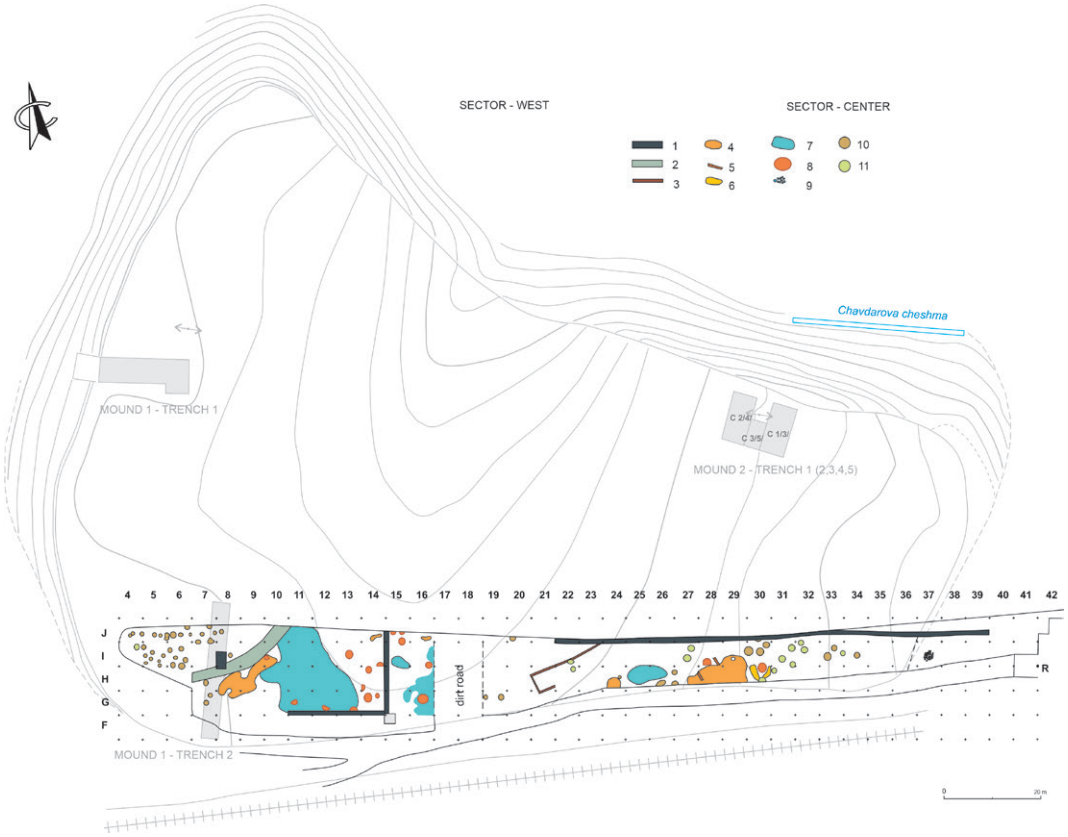


Figure 1. *Layout of the excavated area at Chavdarova cheshma in 2014–2015. Key: (1) recent disturbances; (2) Early Bronze Age ditch; (3) Neolithic trench; (4) Late Neolithic burnt structural debris; (5) remains from house walls; (6) packed house floor; (7) accumulation of stones, pottery, and animal bones; (8) thermal installation; (9) stone construction from Antiquity; (10) pit; (11) clay-plastered pit. Image Credit: Y. Boyadzhiev.*



Figure 2. *Panoramic view of the west part of the excavated area in 2014–2015. Image Credit: Y. Boyadzhiev.*

The area between the houses was used for various economic activities. More than one hundred negative features were recorded: pits of different size, depts, and fill, many of which truncated or overlapped. Along the eastern slope of the west terrace, an extensive concentration of stones, pottery, and animal bones was documented, spanning more than 250 m^2. Beneath this deposit, two occupation levels with hearths and ovens were uncovered, many of them remarkably well preserved, with several successive replastered base surfaces each.

On the slopes of the ravine separating the two terraces, a series of flattened platforms were identified that were constructed of packed yellow clay (fig. 4). Measuring ca. 5 or 6 m long and wide, they were arranged in a step-like pattern at different levels, indicating periodic terracing of the terrain. Numerous ovens – 29 in total – were constructed both on these platforms and directly on the cultural deposits (fig. 5). The earliest oven lay directly above river sand. Most of these installations had several layers of base plastering demonstrating their long use (fig. 6). More dug-in installations were found around them. In the upper part of the terraces, the remains of nine structures were uncovered.

Stratigraphic evidence suggests at least two or three settlement stages during the Karanovo III phase, while the natural was not reached on the slopes (Boyadzhiev et al. 2014 and 2016).

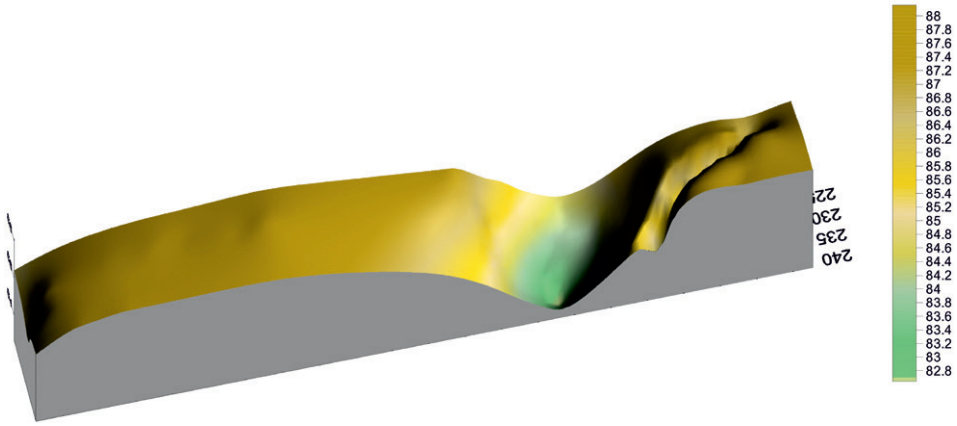


Figure 3. *Computer generated reconstruction of the ancient terrain. Image Credit: Y. Boyadzhiev.*



Figure 4. *Packed and clay-plastered working surfaces on the eastern slope of the gully. Image Credit: Y. Boyadzhiev.*

The faunal assemblage, which is the focus of this paper derives from the cultural deposits, pit fills, and associated structural remains of these occupation levels. It consists of a large number of well-preserved animal bones of both domestic and wild species, providing valuable evidence for reconstructing subsistence strategies, butchery practices, and human–animal interactions in the Late Neolithic of Upper Thrace.



Figure 5. *Remains of ovens on the west slope of the gully. Image Credit: Y. Boyadzhiev.*



Figure 6. *Repeatedly renovated oven. Image Credit: Y. Boyadzhiev.*

Materials and methods

During the rescue excavations at Chavdarova cheshma, a substantial amount of faunal material was recovered. In total, 9,074 animal remains were recorded, of which 8,954 belong to the Late Neolithic occupation, five to a Chalcolithic pit, 54 to an Early Bronze Age context, and 74 to Late Antique deposits. In this paper, we consider only the Late Neolithic assemblage. The rescue project was carried out in two field seasons (a total of five months) under the direction of Yavor Boyadzhiev and Antonia Andonova. Most of the faunal remains originate from structural features, ceramic concentrations, and pits located around houses and hearths. The Late Neolithic assemblage constitutes by far the largest portion of the faunal material, representing approximately 74% of all identified remains from the site (cf. fig. 16).

A total of 8,954 animal remains were analyzed from the Late Neolithic layers and features, of which 8,305 were identified to the species level (NISP – Number of Identified Specimens; table 1, fig. 7). The minimum number of individuals (MNI) was also calculated. Most of the bones are highly fragmented, and some show traces of low-temperature burning. The assemblage is generally well-preserved, with minimal weathering, suggesting a short exposure time before burial. Fine tools were used during feature excavation, and partial sieving was applied.

Identification was carried out using the comparative collections of the National Museum of Natural History, Bulgarian Academy of Sciences, and standard reference works (Barone 1976; Schmid 1972). Diagnostic criteria from Boessneck et al. (1964), Prummel & Frisch (1986), and Zeder & Pilaar (2010) were applied to differentiate species. Age estimation was based on epiphyseal fusion and dental eruption/wear, following the methods of Schmid (1972), Payne (1973), and Grant (1982).

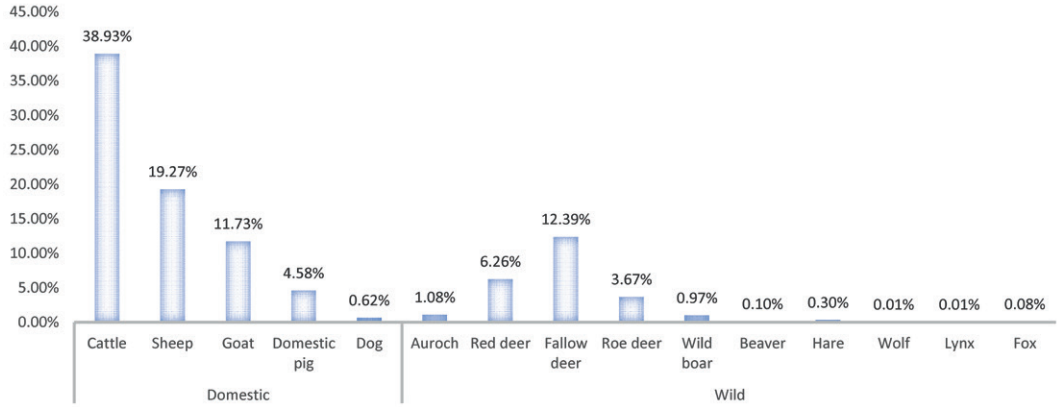


Figure 7. *Relative proportions of domestic and wild taxa in the Late Neolithic faunal assemblage from Chavdarova cheshma (percent NISP). Image Credit: N. Karastoyanova.*

	Cattle	*Sheep*	*Goat*	*Dom. pig*	*Dog*	*Aurochs*	*Red deer*	*Fallow deer*	*Roe deer*	*Wild boar*	*Fox*	*Lynx*	*Wolf*	*Hare*	*Beaver*	*Bos sp.*	*Sus sp.*	*Caprine*	*River mussel*	*Goose*	*Great bustard*	*Griff vulture*	*Golden eagle*	*total*
antler							12	30	9															51
horncore	43	10	28			2										1								84
cranium	21	31	24	3	2	1	3	14	2								5							106
maxilla	47	41	22	22	1	1	5	15	2	9					1									166
mandible	106	337	244	35	17	1	21	43	8	6	2		1	3	2			1						827
teeth	18	12	9	4	2		8	2	3	2														60
atlas	20	8	5	8		1	4	20	1	2														69
axis	22	15	4	3	1		7	15		1						1		1						70
cervical vertebra	69	12	1	8	1		17	16	2								3	14						143
scapula	102	145	66	17		2	26	64	17	6				5	2	1		30						484
humerus	217	153	99	74	2	11	35	87	13	5	1			2		1		22					1	723
radius	178	138	72	31	6	7	16	63	20	4	1	1		3		2		23						565
ulna	67	26	14	4	5	2	15	20	3	6						1	2	7						172
carpal	14	2					5	1																22
metacarpal/ carpometacarpus	159	106	82			1	21	51	14							2		16			2	1		455
metacarpal I										2														2
metacarpal II				5						4														9
metacarpal III				2						3														5
metacarpal IV				4						1	1													6
rib	315	11	2	11		4				2							4	22						371
thoracic vertebra	88	6	6	1	2		5	13									2	2						125
lumbar vertebra	58	6	2		1	1	8	15	2								3	4						100

	Cattle	*Sheep*	*Goat*	*Dom. pig*	*Dog*	*Aurochs*	*Red deer*	*Fallow deer*	*Roe deer*	*Wild boar*	*Fox*	*Lynx*	*Wolf*	*Hare*	*Beaver*	*Bos sp.*	*Sus sp.*	*Caprine*	*River mussel*	*Goose*	*Great bustard*	*Griff vulture*	*Golden eagle*	*total*
Pelvis/coracoid	158	82	36	31		3	17	57	6	3				4	2			5		1				405
sacrum	12			1		1		1									3							18
femur	62	18	9	4	1	4	37	54								2		9						200
patella	7						4	3																14
tibia	206	107	62	25	4	8	76	118	20	2				1	1	4		38						672
calcaneus	146	38	17	6		9	26	71	8							3		1						325
tarsal	25	1					6	7		1														40
talus	104	10	2	10			14	37	14	3						1								196
metatarsal	176	47	34			1	27	38	10					2		2		8						345
metatarsal II				2																				2
metatarsal III				2						1														3
metatarsal IV				1						2														3
metatarsal V																								
1st phalanx	236	32	15	14		3	12	27	31	2	1			2		2								377
2nd phalanx	93	3		2			6	5	8	2														119
3rd phalanx	67			2			14	18	3	1														105
shell																			865					865
Total	**2837**	**1397**	**850**	**332**	**45**	**63**	**447**	**905**	**203**	**70**	**6**	**1**	**1**	**22**	**7**	**23**	**22**	**204**	**865**	**1**	**2**	**1**	**1**	**8305**
Number by class	**Mammals**	7435	**Birds**	5	**Mollusks**	865																		

Table 1. *Number of identified skeletal elements by taxon and anatomical category from the Late Neolithic at Chavdarova cheshma.*

Measurements were taken according to von den Driesch (1976). The withers height of small ruminants (sheep and goats) was calculated using coefficients proposed by Tsalkin (1961) and Schramm (1967), for wild boar by Teichert (1969), and for cattle following Tsalkin (1960), Vasilev et al. (1979), and Vasilev (1985). The anatomical distribution of skeletal parts was evaluated following Uerpmann's (1973) three-zone model: (A) meaty elements (vertebrae, upper limb bones, scapulae, pelvis); (B) less meaty elements (lower limbs, cranium, jaws, ribs, sternum); and (C) elements without meat (phalanges, horns, tail bones, teeth). The relative ratio of these zones in a complete skeleton is approximately balanced.

The identification of burning stages was carried out following the criteria outlined in Nicholson (1993, 414, table 1).

Some of the skeletal outline images were adapted from materials provided by Powered by Piwigo ArchéoZoo.org (2004–2021). These illustrations are used under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

Results

Domestic mammals

Domestic animals comprise ca. 74% of the total faunal assemblage, indicating well-developed animal husbandry in the region. Cattle, sheep, and goats were the main domesticated species. The large proportion of cattle remains suggests that cattle breeding was the most significant branch of livestock management (fig. 7 and table 1). According to the mortality profiles, artiodactyls were exploited for meat, while sheep were likely also used for their wool. Dog remains are very few and belong to small-sized individuals. The proportion of bones gnawed by carnivores (dogs) is minimal.

Dog *(Canis familiaris)*

A total of forty-five dog remains were identified, representing about 0.62% of the total assemblage (fig. 7). Most of the elements belong to the mandibles and ulnae. Adult individuals over four years of age predominate, while only two fragments derive from juvenile specimens. Based on the size of mandibles, the dogs were small. The minimum number of individuals (MNI) is 11. Due to the high degree of fragmentation, most bones could not be measured; only the teeth provided measurable dimensions.

Comparison of mandibular M1 (first molar) lengths with other Late Neolithic sites shows that most sites, including Kapitan Andreevo and Sarnevo (Gorczyk & Karastoyanova 2017, 528ff), contain consistently small dogs with closely grouped measurements. In contrast, Chavdarova cheshma displays a wider range of M1 values, suggesting the presence of both very small and somewhat larger individuals. This variation likely reflects normal size diversity within a small-bodied dog population rather than distinct morphotypes (table 2).

Site	n	First molar length of mandible (in mm)
Kapitan Andreevo	7	19–22
Chavdarova cheshma	7	17–36
Koprivets B	1	17.5
Sarnevo	4	18–21

Table 2. *Measurements of the length of the M1 (first lower molar tooth) on the mandible from various Late Neolithic sites in Bulgaria (Manhart 1998; Gorczyk & Karastoyanova 2017).*

The skeletal morphology and size correspond to *Canis familiaris* forma *palustris* – the so-called Peat Dog, a small, gracile domestic form typical of Neolithic Europe. This morphotype is characterized by a narrow skull, slender long bones, and an overall body height of ca. 40–45 cm at the withers. Dogs of similar proportions are typical for the Neolithic and Eneolithic Balkans and were widespread in prehistoric Bulgaria (Spassov & Iliev 1994, 297).

Cattle (*Bos taurus*)

Cattle account for approximately 35% of all identified animal remains (2,837 fragments; MNI = 78), representing the most numerous domestic species at the site. This dominance indicates an advanced level of cattle husbandry during the Late Neolithic in the Maritsa River Valley.

The bones are highly fragmented, and long bones were deliberately broken to extract marrow. Several partially preserved horn cores and limb bones were also found. Only two complete metapodials were available for direct calculation of withers height. For the remaining specimens, withers height was estimated using the Vasilev–Atanasov–Tsonev index (1979) and Tsalkin (1960), which is based on measurements of proximal and distal breadth fragments of metapodial bones. At Chavdarova cheshma, a total of 411 metapodial fragments were included in these calculations, and the values derived from the two complete bones are incorporated into the final dataset presented in the table. Measurements suggest relatively large animals, with an estimated withers height of approximately 114–122 cm (mean around 118 cm). These values indicate that the cattle from Chavdarova cheshma were larger than modern brachyceros breeds and some contemporaneous Neolithic populations in Bulgaria (table 3).

Site	Period	Withers height (cm)	n	Mean
Chavdarova cheshma	Late Neolithic	114.20 – 121.30	413	117.75
Kapitan Andreevo	Late Neolithic	115.4 – 110.3	54	112.91
Akladi cheiri	Late Neolithic	99.5 – 140	74	121
Rhodopean shorthorn cattle	recent	♀97 – 110	–	103.5

Table 3. *Withers heights (cm) of cattle from Late Neolithic sites in Bulgaria (Spassov & Iliev 2021).*

The highest proportion of skeletal elements comes from the trunk and upper limb regions (zone A), which carry the largest muscle masses and thus the highest meat yield. Elements with less meat (zone B) are represented in similar proportions, while bones without meat (zone C) are rare. This pattern suggests that the animals were butchered and consumed on or near the settlement. The bones were fractured for marrow extraction and possibly used as blanks for tool production. The scarcity of zone C elements may indicate that the phalanges were removed together with the hides (fig. 8).

Mortality profiles show that most cattle were slaughtered during the juvenile and adult stages. According to Payne's (1973) mortality models, this pattern suggests an exploitation strategy for meat. The small difference between the proportions of young and mature individuals suggests a balanced approach to herd management (fig. 9).

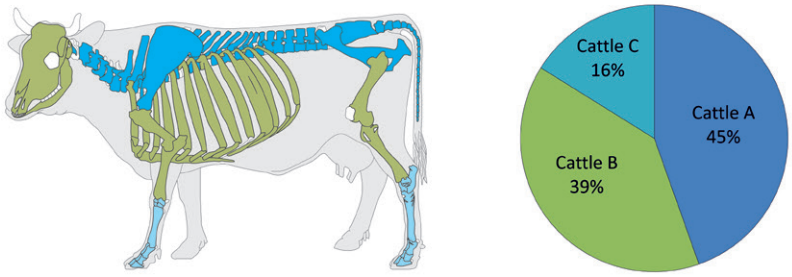


Figure 8. *Anatomical distribution of cattle skeletal elements according to Uerpmann's A–B–C grouping, showing the proportional representation of high-meat (A), low-meat (B), and meatless (C) elements at Chavdarova cheshma. Image Credit: N. Karastoyanova and © 1996 ArcheoZoo.org / Michel Coutureau (Inrap), Vianney Forest (Inrap) D'après : Barone (Robert). — Anatomie comparée des mammifères domestiques, Tome I Ostéologie – atlas. Paris : Vigot, 1976, pl. 7, p. 22.*

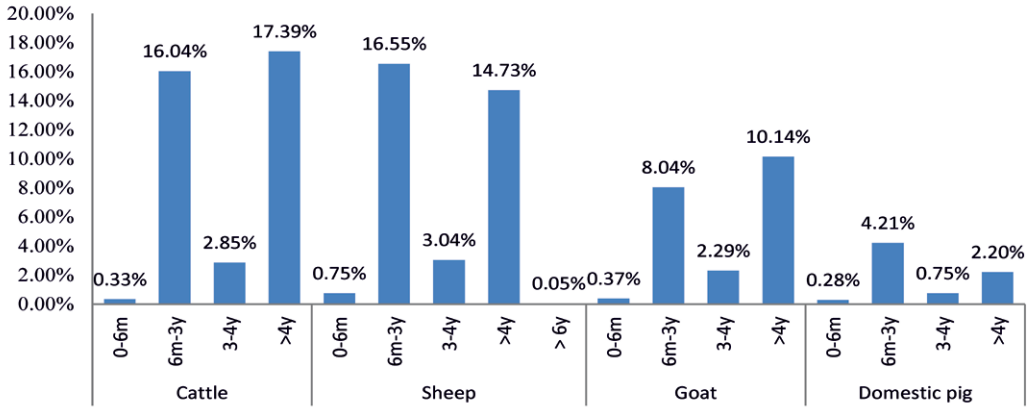


Figure 9. *Epiphyseal fusion profiles of cattle, sheep, goats, and pigs from the assemblage. Image Credit: N. Karastoyanova.*

Goat/Sheep (*Capra hircus /Ovis aries*)

A total of 2,451 remains belonging to sheep and goats were identified: 1,397 of sheep, 850 of goat, and 204 specimens too fragmentary for specific identification. Overall, sheep predominate, forming the second-largest domestic taxon at the site, after cattle (fig. 7). The ratio between sheep and goats is approximately sixty-two to thirty-eight per cent. Horn cores of both species were recorded. Most of the bones are heavily fragmented.

The estimated mean withers height of sheep is 52.45 cm, which indicates relatively small animals compared to other sites such as Yabalkovo (mean 57.6 cm: Spassov & Iliev 2015, 426) and Golyamo Delchevo (mean 57.2 cm). These values are close to those of the primitive Zackel-type sheep, a long-tailed mountain breed preserved in parts of Southeast Europe, with an average height between 55–60 cm. Two individuals with an estimated height of about 60 cm were identified and are likely males.

Goats appear considerably larger than sheep, with a mean wither's height of approximately 70 cm. Most of these remains probably belong to male individuals; however, even accounting for sexual dimorphism, the goats from Chavdarova cheshma were relatively large compared to those from other Late Neolithic sites. Their size is close to that of some modern local goat breeds (table 4).

Site	Min.	Max.	Mean	n
Chavdarova cheshma	59	76	65.78	5
Kapitan Andreevo	54	58	56.70	3
Golyamo Delchevo	50	63	57.82	17
Ovcharovo	59	64	61.10	10
Recent breeds	70	80	–	–

Table 4. *Withers height (cm) of goats from Chavdarova cheshma compared to other Late Neolithic and Chalcolithic sites in Bulgaria (Vasilev 1985; Ivanov & Vasilev 1975).*

Regarding skeletal-part representation, the highest proportions in both species correspond to zones A and B – elements bearing large and small quantities of meat – which are almost equally represented. Bones without meat, such as horns, teeth, and phalanges (zone C), are least frequent. This pattern suggests that butchery and consumption took place within or near the settlement (fig. 10).

The age-distribution pattern reconstructed from mandibular tooth wear stages shows a pronounced concentration of slaughtered animals in the 3–4 and 4–6 year age groups, accompanied by relatively low frequencies of very young (0–12 months) and early adult (1–3 years) individuals. This structure contrasts sharply to slaughter regimes targeting primarily meat (Payne's model A), which typically show a strong peak in the first year of life, and with milk-oriented systems (model B), where most surplus animals are culled before or shortly after weaning (fig. 11).

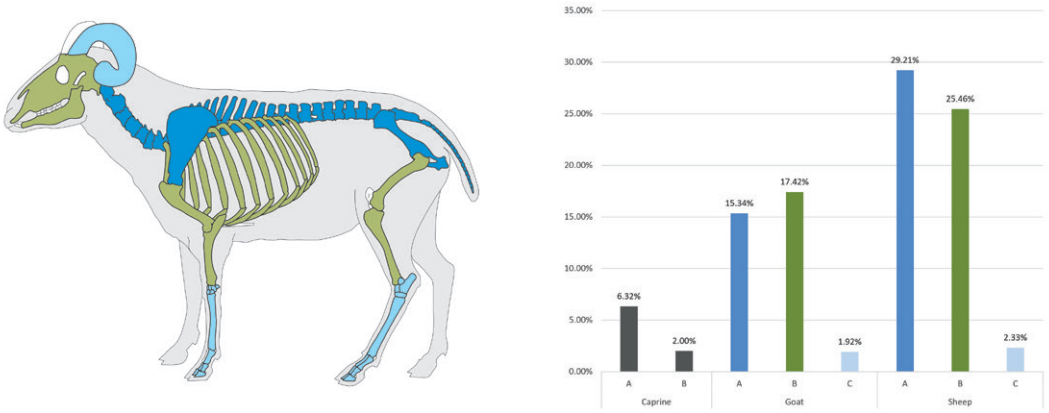


Figure 10. *Anatomical distribution of caprines skeletal elements according to Uerpmann's A–B–C grouping, showing the proportional representation of high-meat (A), low-meat (B), and meatless (C) elements at Chavdarova cheshma. Image Credit: N. Karastoyanova and © 1996 ArcheoZoo.org / Michel Coutureau (Inrap), Vianney Forest (Inrap) D'après : Barone (Robert). — Anatomie comparée des mammifères domestiques, Tome I Ostéologie – atlas. Paris : Vigot, 1976, pl. 8, p. 23.*

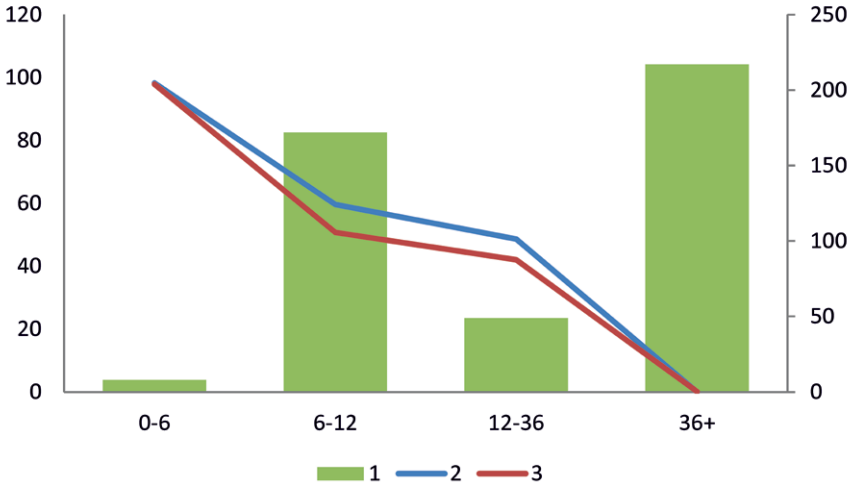


Figure 11. *Kill-off pattern by age groups based on mandibular tooth wear stages converted according to Payne (1973). Columns represent the number of individuals in each age class, with 95% Poisson confidence intervals; the line indicates the overall mortality curve. Key: (1) caprine; (2) goat; (3) sheep. Image Credit: N. Karastoyanova.*

Domestic pig *(Sus scrofa domesticus)*

Remains of domestic pig are represented by 332 specimens, accounting for about 4% of all identified faunal remains (cf. fig. 7). The minimum number of individuals (MNI) is sixteen. Most of the elements belong to zone A – bones bearing large quantities of meat, particularly forelimbs and vertebrae. Cranial and mandibular fragments are also numerous (fig. 12).

Most individuals were slaughtered between six months and three years of age, while a few remains belong to older animals (over four years). The absence of measurable adult bones, due to unfused epiphyses, prevents the precise reconstruction of body size (cf. fig. 9).

The skeletal-part distribution shows that meat-bearing elements dominate, followed by those with less flesh, while bones without meat (teeth, phalanges) are least represented. This pattern suggests that pigs were slaughtered and processed locally, and their meat formed a supplementary yet regular component of the diet during the Late Neolithic occupation of the site (cf. fig. 12).

Wild fauna

The wild fauna from Chavdarova cheshma is diverse and well-represented, reflecting a rich and varied environment during the Late Neolithic. Although domestic animals dominate the assemblage, the proportion of wild taxa is relatively high, which is typical of Late Neolithic sites in southeast Bulgaria. The species composition includes large and medium-sized game such as aurochs (*Bos primigenius*), red deer (*Cervus elaphus*), fallow

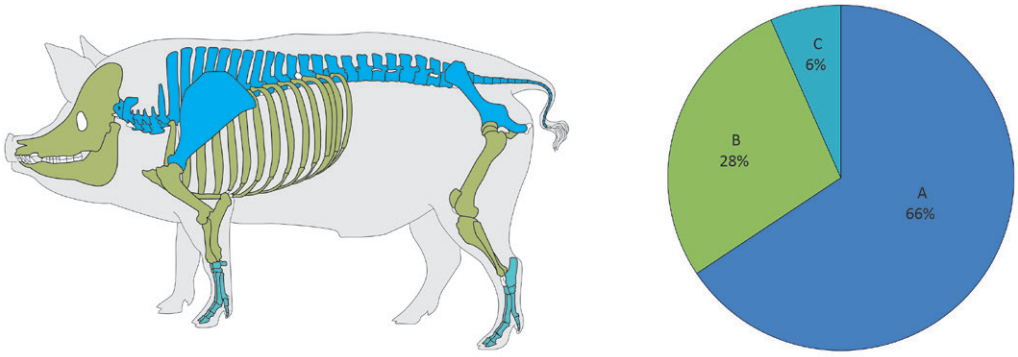


Figure 12. Anatomical distribution of domestic pig skeletal elements according to Uerpmann's A–B–C grouping, showing the proportional representation of high-meat (A), low-meat (B), and meatless (C) elements at Chavdarova cheshma. Image Credit: N. Karastoyanova and © 1996 ArcheoZoo.org / Michel Coutureau (Inrap), Vianney Forest (Inrap) D'après : Barone (Robert). — Anatomie comparée des mammifères domestiques, Tome I Ostéologie – atlas. Paris : Vigot, 1976, pl. 9, p. 24.

deer (*Dama dama*), roe deer (*Capreolus capreolus*), and wild boar (*Sus scrofa*), as well as smaller mammals including fox (*Vulpes vulpes*), wolf (*Canis lupus*), lynx *(Lynx lynx*), beaver (*Castor fiber*), badger (*Meles meles*), and hare (*Lepus europaeus*). Remains of birds, mollusks, and reptiles were also identified. The presence of such a wide range of wild species indicates the exploitation of multiple ecological zones – riverine, forested, and open landscapes – and demonstrates the important role of hunting in the local subsistence economy.

A total of 865 shells of the freshwater mussel (*Unio crassus*) were recovered. Many exhibit signs of heating, indicating their use as food, although some may also have been collected for ornamental purposes. Bird bones are rare (NISP 5), representing only a very small fraction of the assemblage. Identified species include lesser white-fronted goose (*Anser erythropus*), great bustard (*Otis tarda*), griffon vulture (*Gyps fulvus*), and a large eagle, probably golden eagle (*Aquila chrysaetos*). The presence of great bustard (*Otis tarda*) at Chavdarova cheshma likely indicates its use as a valuable game bird. These finds confirm that Thrace was among the main regions of the species' distribution in the Neolithic and Chalcolithic, documenting its formerly wide presence across Bulgaria. Remains of large diurnal raptors, such as *Gyps fulvus* and *Aquila chrysaetos*, are also common at Neolithic, Chalcolithic, and Bronze Age sites. The site's proximity (10–15 km) to the Sakar and East Rhodope Mountains provides suitable rocky habitats for these species (Boev 2017, 110f).

Among mammals, large game is dominant. Aurochs are represented by 63 bones belonging to at least three individuals. The size of the horn cores suggests that they belonged to robust, large-bodied animals (table 5). Limb bones are most common, and the individuals were mainly adults, with one juvenile specimen. Red deer constitute about five and a half per cent of all remains (447 bones, MNI = 29) and include both males and females. Most antlers are 'trophy' specimens from hunted animals rather than shed ones, and some limb bones indicate large individuals. The mortality profile, which encompasses both juvenile and adult deer, indicates year-round hunting with no discernible seasonal preference (fig. 13).

Site	Procc. corunales (diameter)	Calcaneus (GL)	Humerus (Bd)
Chavdarova cheshma	230–236	156–178	107–113
Kapitan Andreevo	–	136–180	–
Ovcharovo	205–225	146–148	95–130
Golyamo Delchevo	183–242	145–183	95–129
Koprivets B	–	160–168	–

Table 5. *Comparison of aurochs (*Bos primigenius*) bone elements (mm) with those from other sites in Bulgaria (Vasilev 1985; Ivanov & Vasilev 1975; Manhart 1998).*

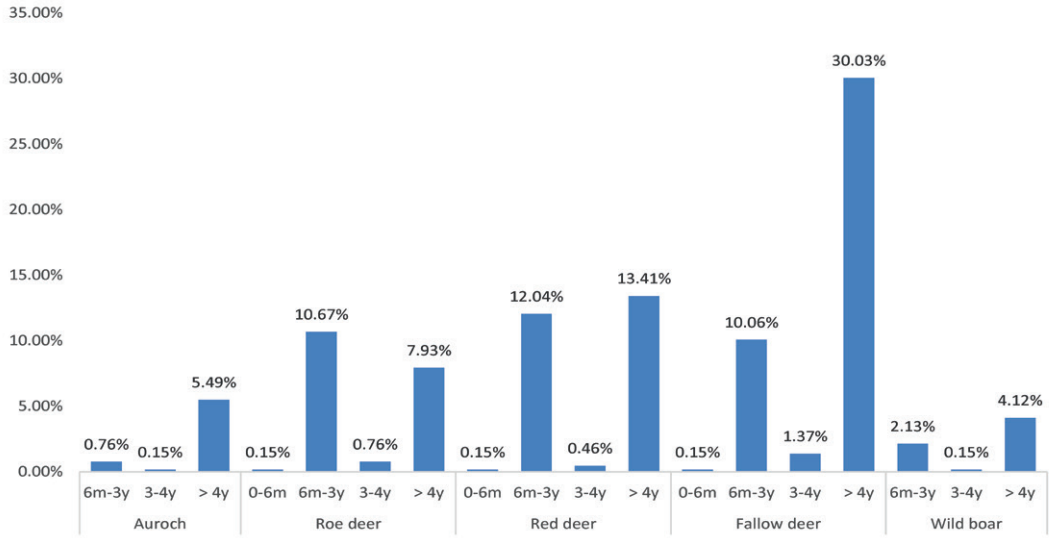


Figure 13. *Epiphyseal fusion profiles of game animals from the assemblage. Image Credit: N. Karastoyanova.*

Fallow deer is the most numerous wild species, represented by 905 remains (MNI = 51). This high proportion indicates intensive hunting in the Late Neolithic, a pattern similar to that observed at sites such as Sarnevo (Gorczyk & Karastoyanova 2017, 529ff), Kapitan Andreevo, and other Late Neolithic sites in southeast Bulgaria. The majority of remains come from tibiae, upper limbs, and antlers (cf. table 1). Adult individuals predominate (table 6), but juveniles are also present. Many antler fragments bear traces of cutting and polishing, reflecting their use as raw material for tools or ornaments. Fallow deer were predominantly distributed in and around the Sakar Mountains in southeast Thrace and the southern Black Sea coast, both areas with a mosaic of forest and open areas where a transient Mediterranean climate prevailed (Spassov & Iliev 1994, 293f; Karastoyanova et al. 2020, 8).

n	Mandibular wear stage	Age in months
1	D	5–12
3	E	13–20
1	F	20–33
7	G	33–54
2	H	44–147
4	I	61–183
10	J	118–189 +

Table 6. *Fallow deer age classes after Bowen et al. (2016).*

Roe deer are represented by 266 bones (ca. 3% of the assemblage), with all skeletal regions present. Meat-bearing elements dominate, and several antler fragments suggest trophy collection. Both young and adult individuals were hunted (fig. 13).

Wild boar is represented by seventy bones, mostly from meaty limb elements. The animals were medium to large in size, similar to those from other Neolithic and Chalcolithic sites in Bulgaria. Several large tusks, belonging to adult males, were identified. Most of the hunted individuals were mature, over four years old, while juveniles were less frequent. This suggests selective hunting focused on obtaining large game for meat and tusks. Beaver remains (seven bones, from at least two adults) include mandibles, scapulae, and pelvis fragments. Although beaver is common in Neolithic faunal assemblages across the Balkans, its low frequency here suggests opportunistic rather than targeted hunting.

Small and medium predators are also present. Hare is represented by 22 bones, mostly from adult individuals. Badger is represented by a single scapula fragment from a young individual, while six bones, including two mandibles, represent a fox. A complete right mandible of a wolf indicates a large adult male, suggesting the occasional presence of the species in the vicinity of the settlement, possibly scavenging near human activity areas. The lynx is represented by a single complete ulna, an exceptionally rare find for this region. Previously, the species had been recorded only at Late Chalcolithic sites in northeast Bulgaria such as Golyamo Delchevo, Ovcharovo, Salmanovo, and Durankulak (Vasilev 1985, 23; Manhart 1998, 178). The Chavdarova cheshma specimen represents the first evidence of lynx in southeast Bulgaria and belongs to a large adult male.

Overall, the wild fauna from Chavdarova cheshma reflects a balanced and diverse ecosystem of the Late Neolithic. The predominance of large herbivores, the presence of carnivores and aquatic species, and the evidence for antler processing all indicate a mixed economic system that combined well-developed animal husbandry with active hunting and the utilization of riverine resources. The selective targeting of mature individuals and the widespread working of antler and bone indicate that hunting was not only a subsistence activity but also a source of raw materials for tool and ornament production. This evidence suggests that the inhabitants of Chavdarova cheshma practiced a flexible, sustainable economy that effectively integrated pastoralism, hunting, and craft production within the dynamic environmental setting of the Late Neolithic Maritsa Valley.

Taphonomic analysis

The faunal assemblage from Chavdarova cheshma exhibits a wide range of taphonomic modifications reflecting both human activities and post-depositional processes. Cut marks were documented on 58 bone fragments, representing a variety of domestic and wild taxa, including aurochs, cattle, sheep, goat, red deer, roe deer, fallow deer, domestic pig, and wild boar. Although this number is modest relative to the total assemblage, it likely underestimates the true frequency of butchery traces. Many bones are covered with a thick, compact, and often organic patina that obscures fine surface modifications and

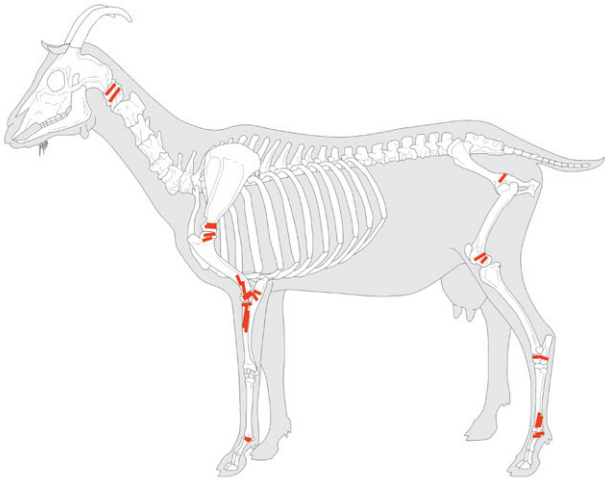


Figure 14. *Common butchery cutmark locations on the animal skeleton (schematic). Image Credit: N. Karastoyanova and © 1996 ArcheoZoo.org / Michel Coutureau (Inrap), Vianney Forest (Inrap) D'après : Barone (Robert). — Anatomie comparée des mammifères domestiques, Tome I Ostéologie – atlas. Paris : Vigot, 1976, pl. 8, p. 23.*

complicates microscopic examination. The presence of such patina suggests that numerous butchery marks may remain undetected. Where visible, the cut marks follow clear patterns associated with carcass processing: decapitation, disarticulation of major joints, and defleshing. They occur predominantly on long bones such as the humeri, femora, and tibiae, as well as on smaller elements such as phalanges. Cattle and deer bones exhibit the highest frequency of cutting traces. Additionally, several bones bear shallow, fine, and repetitive incisions characteristic of tool manufacture, indicating that selected skeletal elements were repurposed as raw material after primary butchering (fig. 14).

Only 14.29% of the bones were recovered intact, most of which are carpals, tarsals, and phalanges – elements belonging to group C that carry little or no meat. All remaining bones were intentionally fragmented during cooking and marrow extraction, as well as broken through food processing and consumption. Among the long bones, those of cattle show the highest degree of fragmentation, whereas in small ruminants, a limited number of complete forelimb elements (humerus and radius) were preserved, and in domestic pigs, mainly hind limb bones (tibia, femur, and metatarsals). The complete bones of these taxa generally belong to young individuals up to 1 year old.

Thermal alteration is another recurrent taphonomic feature, affecting approximately 70% of the assemblage. Most burnt bones exhibit dark brown coloration indicative of low-temperature heating around 300°C, typically associated with roasting rather than prolonged burning. About 13% display mixed color patterns – dark brown combined with black patches or mottled surfaces – suggesting exposure to fluctuating temperatures,

likely within domestic hearths or open fires. Only a small proportion reached higher thermal thresholds: around 1.6% of the bones are grey, corresponding to temperatures of roughly 400°C, while 0.43% are calcined white, indicating exposure to temperatures exceeding 500°C. These high-temperature alterations may reflect localized intense burning events, accidental structural fires, or secondary refuse practice. Overall, the combined evidence of cut marks, burning patterns, and bone fragmentation reveals systematic carcass processing, frequent heat exposure linked to food preparation, and taphonomic overprinting by strong patina. Together, these observations provide a nuanced understanding of the butchering practices, domestic activities, and depositional conditions that shaped the faunal remains at the site.

Description of the faunal remains by context

The distribution of faunal remains across the excavated area reveals clear spatial and contextual patterns. The highest concentration of animal bones was recorded in the west central part of the site, around houses 3 and 5, and near the ovens. Approximately 8% of all faunal remains come from this zone, which extends over squares J13–14, I12–15, H12–14, and G13–14 (fig. 15). The density of remains gradually decreases toward the periphery. This concentration, situated near the ancient bed of the Maritsa River, suggests that bones were likely discarded in or near the riverbed. The distribution pattern suggests that this area served as a butchering and meat-processing zone, where carcasses were dismembered, meat portions were distributed, and bones were subsequently broken for marrow extraction.

The largest concentration of animal remains is from the Neolithic deposits, which was recorded in a dense accumulation extending across squares G11–14, H11–14, I11–17, and J11–15 (figs. 15 and 16). This assemblage comprises 5,403 identifiable specimens. The species distribution mirrors that of the site as a whole, dominated by cattle, sheep, goat, and fallow deer. The location of this concentration – In a shallow depression between the houses and ovens – strongly suggests a specialized butchering area. Here, carcasses were processed, meat and hides removed, and bones broken for marrow extraction. The presence of numerous bone tools and preforms indicates that part of this material was subsequently reused for craft production. The body zones show a pattern in which zone A is predominant across all features and the layer. (fig. 16).

Additional faunal concentrations were identified near the ovens, within packed base deposits. A total of 207 identified elements belong to cattle, sheep, goats, fallow and red deer, roe deer, wild and domestic pigs, aurochs, and hares. The faunal composition and relative abundance of species correspond to the general pattern observed at the site, with cattle, sheep, and fallow deer predominating. The skeletal elements from all body regions are represented, with zone A elements being the most frequent.

Within the areas corresponding to houses, faunal remains are less numerous. House 3 produced 55 identifiable specimens, mostly from cattle, with smaller numbers of sheep, goat, pig, red and fallow deer, and roe deer. The bones represent all parts of the skeleton,

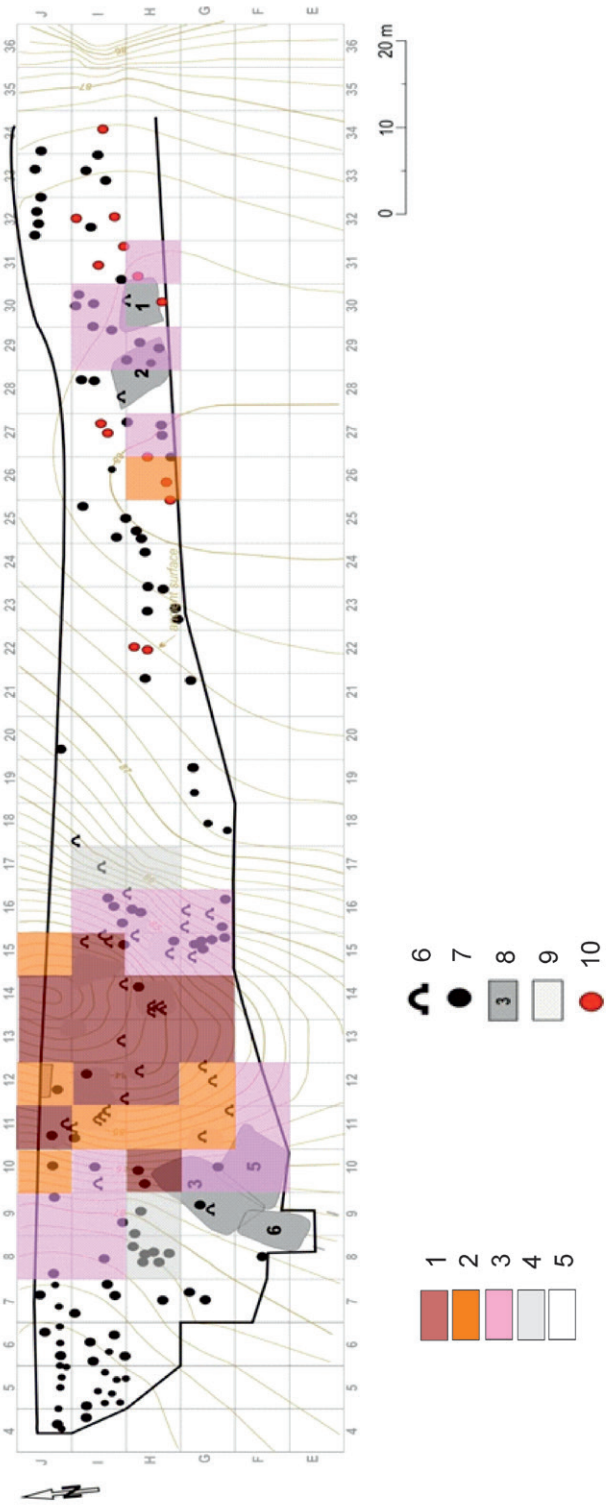


Figure 15. *Density map of animal bone concentrations (high–medium–low) overlaid on the excavation layout of Chavdarova cheshma. Key: (1) Concentration of animal remains ranging from 200 to 600 fragments per square (5x5m); (2) concentration of animal remains ranging from 200 to 100 fragments per square (5x5m); (3) concentration of animal remains ranging under 50 per square (5x5m); (4) concentration of animal remains ranging under 10 fragments per square (5x5m); (5) concentration of animal remains ranging under 5 fragments per square (5x5m); (6) fireplace; (7) Neolithic pits; (8) Neolithic structures; (9) clay platforms; (10) Chalcolithic pits. Image Credit: N. Karastoyanova.*

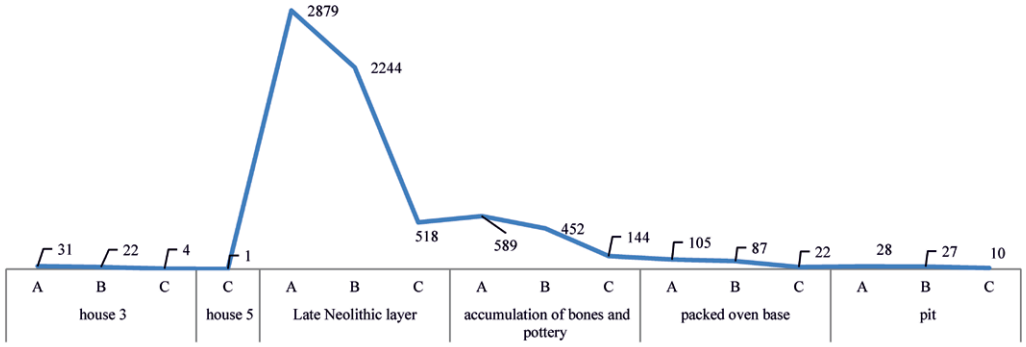


Figure 16. *Variation in faunal quantities by context and carcass part representation (Uerpmann A–C Groups) at Chavdarova cheshma. Image Credit: N. Karastoyanova.*

suggesting general domestic refuse rather than specialized activity. Most individuals were young or subadult. In contrast, house 5 yielded only a few highly fragmented bones, including a proximal phalanx of cattle.

Smaller clusters of bones were also identified in various pits across the settlement area. These contexts contained remains of both domestic and wild species. The faunal material from these pits is generally fragmentary and unevenly preserved. Some bones bear traces of low-temperature burning, around 300°C, while others show no thermal or cut marks. Several pits contained isolated, well-preserved elements, such as a complete roe deer tibia or phalanges of fallow deer, often from adult individuals. These scattered deposits probably represent secondary refuse from domestic activities or the disposal of butchering waste.

Another group of faunal remains was associated with daub pieces and structural debris. These deposits contained 22 identified bones, mainly from cattle and fallow deer, with additional remains of sheep, goat, pig, roe deer, and red deer. The assemblage consists largely of limb bones and mandibles, including a fragment of a fallow deer antler. All specimens are heavily fragmented, and a few display traces of burning.

In summary, the spatial and contextual distribution of animal remains at Chavdarova cheshma indicates intensive domestic processing and discard activities concentrated near the houses and ovens. The faunal material reflects multiple stages of carcass processing – butchering, marrow extraction, and raw material selection – suggesting that meat consumption, secondary product exploitation, and craft production were closely integrated in the daily life of the settlement's inhabitants.

Discussion

Although the sites differ not only chronologically but also in settlement type, their comparison remains valuable. Karanovo and Kapitan Dimitrievo are tell sites, Sarnevo and Kapitan Andreevo are pit sites, whereas Chavdarova cheshma is a dispersed flat site. Despite the chronological variation, all flat sites display settlement structures distinct from the tells.

In most cases, no clear above-ground buildings were identified; instead, a variety of dug-in features of different sizes and fills were recorded. Some researchers have suggested that the large cut features – often filled with burnt daub, hearth fragments, and broken vessels – represent the subterranean components of Late Neolithic houses. According to other scholars, however, such flat sites with numerous cut features were not settlements at all, but ritual complexes (pit sanctuaries), such as Lyubimets–Dana Bunar 2 (Nikolov et al. 2007), Kapitan Andreevo (Nikolov et al. 2014), and Sarnevo (Bacvarov et al. 2017, 17).

Comparison of the sites indicates a consistent tendency toward higher proportions of wild fauna in the assemblages of flat sites. This pattern contrasts to that observed at tell sites such as Karanovo (Ninov 2002, 181ff), Kapitan Dimitrievo (Ninov 1999, 134), and Yasa Tepe (Ivanov 1959, 83ff), where the percentage of wild species declines over time. In contrast, flat sites, including Chavdarova cheshma, Sarnevo, and Kapitan Andreevo show a marked increase in wild taxa, suggesting a broader shift in hunting practices and resource exploitation compared to Early Neolithic sites such as Yabalkovo (fig. 17; Spassov & Iliev 2015).

Even though Akladi cheiri is another flat site, it represents the only notable exception, with wild fauna comprising only about 11% of the total assemblage (cf. Spassov & Iliev 2021; these results are also based on an unpublished assessment of material, which was not included in the latter paper).

In terms of domestic species, the comparative evidence reveals a clear trend; the relative importance of cattle increases from the Early to the Late Neolithic, while the role of

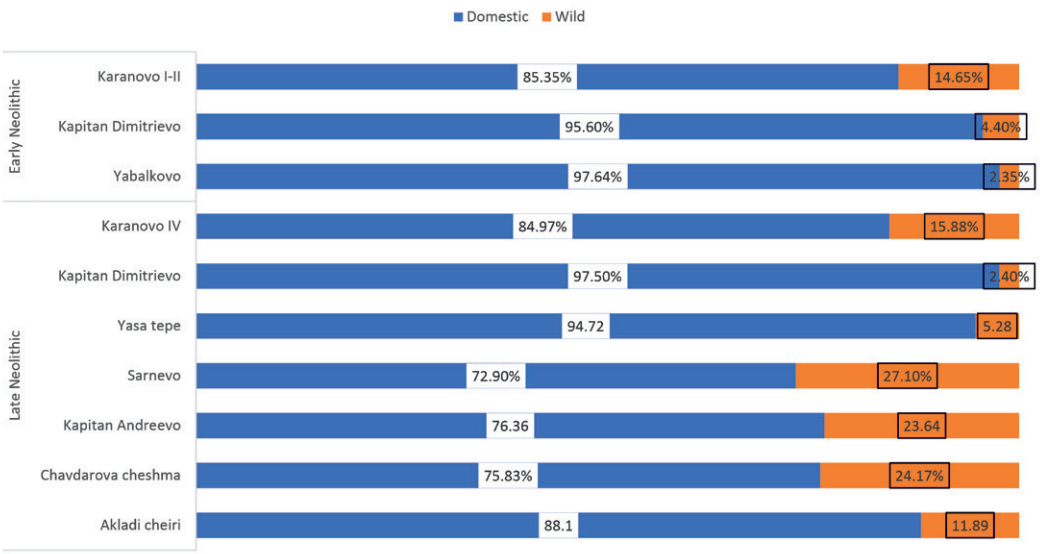


Figure 17. *Comparative proportions of domestic vs. wild faunal remains across selected Early and Late Neolithic sites in Bulgaria (Spassov & Iliev 2015; Ninov 1999 and 2002; Ivanov 1959; Spassov & Iliev 2021; Gorczyk & Karastoyanova, 2017). Image Credit: N. Karastoyanova.*

caprines diminishes (fig. 18). This shift may reflect climatic changes, evolving subsistence strategies, or broader socio-economic transformations within Neolithic communities.

The comparison of caprine kill-off patterns between Kapitan Andreevo and Chavdarova cheshma reveals two distinct herding strategies. At Chavdarova cheshma (red line), the curve declines very steeply after the 0–2 and 2–6 month age classes, indicating intensive early slaughter and a management system focused primarily on meat production. Only a small proportion of animals survive beyond one year, and very few reach older age categories. In contrast, Kapitan Andreevo (orange line) shows a much more gradual decline, with noticeably higher percentages of individuals in the 3–4, 4–6, and 6–8 year classes. This pattern reflects a husbandry system oriented toward secondary products, in which animals are kept longer for milk, wool, and reproduction. The same situation was observed in the kill-off pattern for Sarnevo (Gorczyk & Karastoyanova 2017, 525). The differences suggest that while Kapitan Andreevo and Sarnevo maintained more stable, multi-purpose herds, Chavdarova cheshma relied heavily on rapid turnover and meat-oriented exploitation, likely shaped by the site's economic and functional role within the wider Late Neolithic landscape (fig. 19).

In the Early Neolithic assemblages (Yabalkovo, Karanovo I–II, Kapitan Dimitrievo), red deer dominate, typically accounting for 20%–33% of all wild species. Roe deer

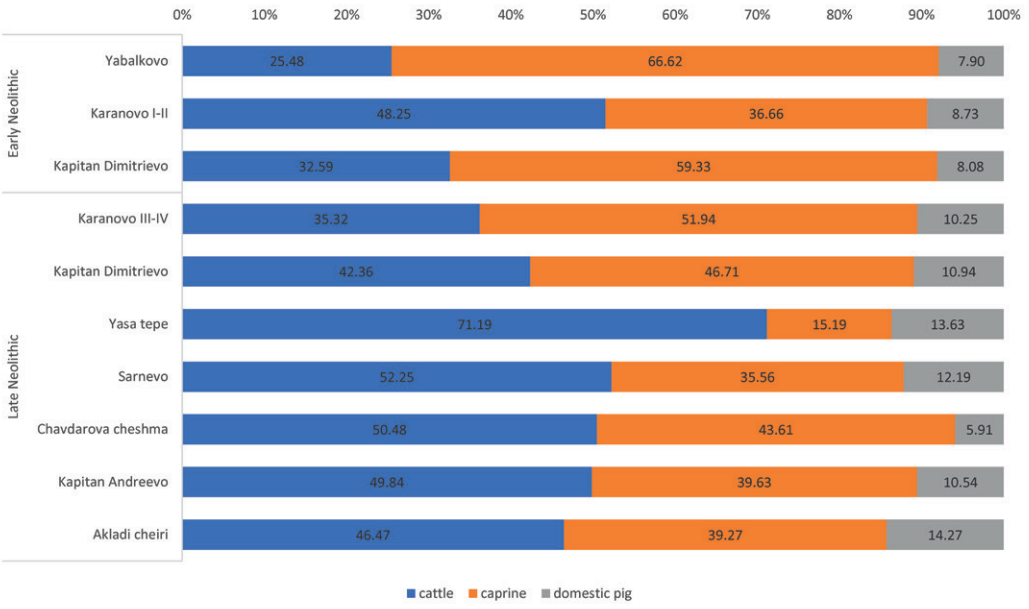


Figure 18. *Comparative distribution of major domestic taxa (cattle, caprines, domestic pig) across selected Early and Late Neolithic sites in Bulgaria (Spassov & Iliev 2015; Ninov 1999 and 2002; Ivanov 1959; Spassov & Iliev 2021; Gorczyk & Karastoyanova, 2017). Image Credit: N. Karastoyanova.*

and wild boar occur in moderate proportions, while fallow deer are either absent or minimally represented. The predominance of red deer in these sites reflects the exploitation of mixed woodland environments typical of the early Holocene landscape in Upper Thrace.

A notable shift emerges during the Late Neolithic at flat sites. Sites such as Kapitan Andreevo, Chavdarova cheshma, Akladi cheiri (Spassov & Iliev 2020), and Sarnevo show a dramatic rise in fallow deer, in some cases exceeding 50%–60% of the wild assemblage (e.g., Sarnevo). This pattern is consistent with the species' known ecological preference for mosaic 'parkland' habitats and its restricted natural distribution in southeast Bulgaria during prehistory. The strong representation of fallow deer at multiple Late Neolithic sites suggests either intensified hunting pressure, deliberate targeting of this species, or increased local population densities (fig. 20).

The Maritsa River – which was navigable until the nineteenth century – and its tributaries would have facilitated easy contact between Thrace and the neighboring regions, including the Aegean coast. The excavation at Chavdarova cheshma has revealed an unusual situation; around 80% of all faunal remains (both domestic and wild) were concentrated within a relatively small area of about 500 m² (approximately 27% of the area excavated in 2014–2015). This zone lies on the slopes of an ancient gully dividing the two river terraces on which the settlement was located, precisely where an exception-

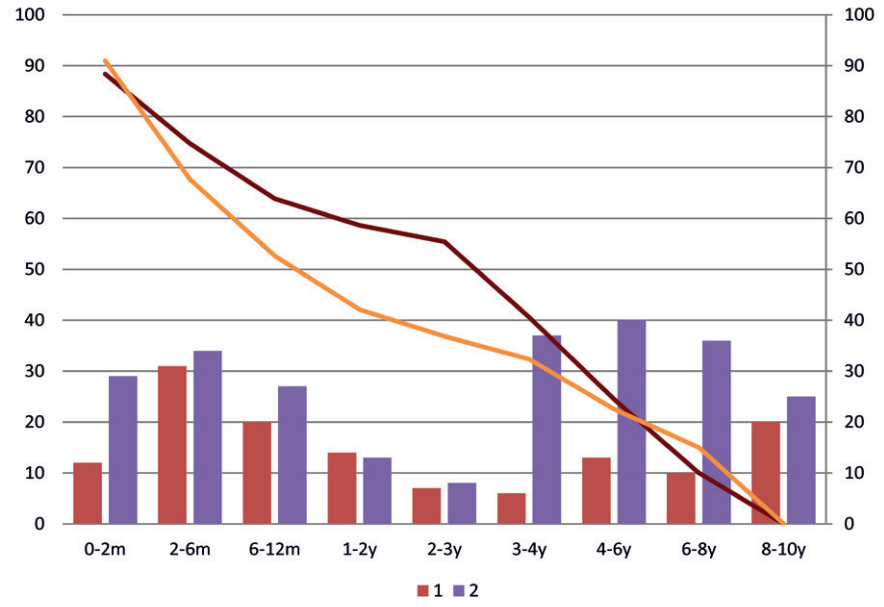


Figure 19. *Kill-off patterns of caprines at Kapitan Andreevo and Chavdarova cheshma based on Payne's (1973) method. Key: (1) Chavdarova cheshma; (2) Kapitan Andreevo. Image Credit: N. Karastoyanova.*

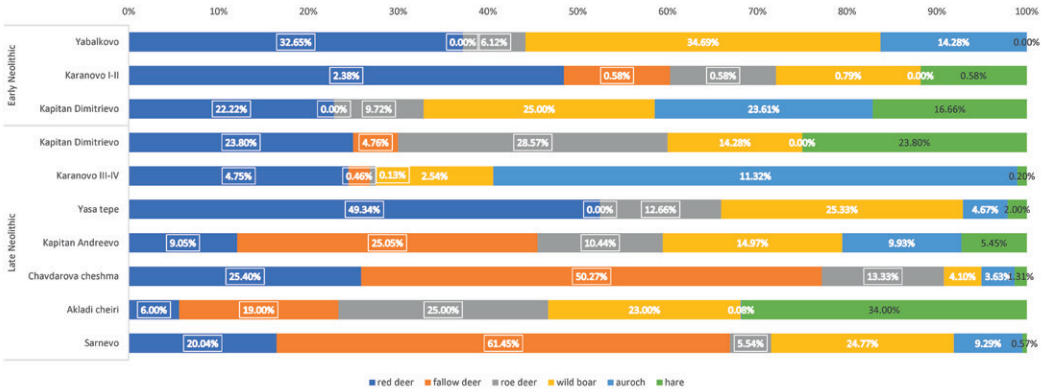


Figure 20. *Comparative distribution of wild fauna (red deer, fallow deer, roe deer, wild boar, auroch, hare) across Early and Late Neolithic sites in Bulgaria (Spassov & Iliev 2015; Ninov 1999 and 2002; Ivanov 1959; Spassov & Iliev 2021; Gorczyk & Karastoyanova, 2017). Image Credit: N. Karastoyanova.*

ally dense cluster of ovens was documented – 29 in total (cf. fig. 5). Several ovens show multiple resurfacing episodes, indicating long-term and intensive use (cf. fig. 6). Thermal alterations observed on the bones confirm food preparation activities. Although ovens were also found inside houses, cooking appears to have been concentrated outside, in this restricted and rather difficult-to-access location on the steep slopes.

Two explanations are possible. The first relates to the availability of running water. It is likely that in the Neolithic, a stream flowed through the gully into the Maritsa (cf. fig. 3). The area lies adjacent to the river, and today a large spring still issues at the base of the second terrace (cf. fig. 1). Such water sources would have been indispensable for slaughtering, butchering, and washing meat before cooking.

The second explanation concerns the unusually high number of ovens. Where the gully met the Maritsa, the erosion created a small, sheltered inlet with a gently sloping, sandy bank, unlike the steep riverbanks typical of the terrace edges. This location would have been ideal for docking vessels such as boats or rafts. Evidence for contact with the Aegean coast includes shells of marine mollusks (fig. 21), fragments of a Mediterranean Sea mollusk (Cerithium sp.), and ceramic sherds decorated in the Akropotamos style, previously unknown in the region. These finds support the hypothesis that in the Late Neolithic, the Maritsa functioned as a transport corridor linking Thrace to the Aegean.

In this context, Chavdarova cheshma may have served as a kind of river station or stopping point for travelers navigating the river. The sheltered inlet could have acted as a landing place known to boatmen and merchants. Visitors could rest, eat, and perhaps stay overnight, possibly offering goods or services in exchange. The local population evidently had the capacity to supply large quantities of meat, not only for their own needs but also for travelers.

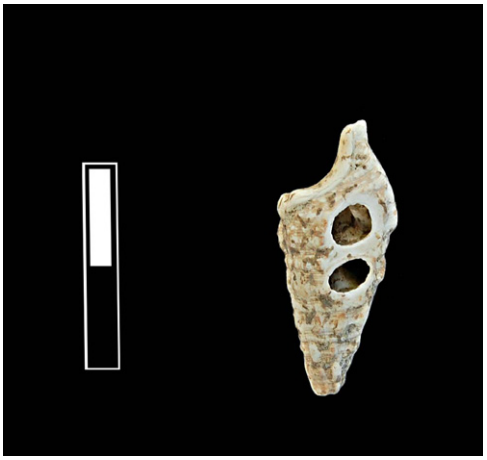


Figure 21. Shell of a marine Mediterranean mollusk (Cerithium sp.) drilled for use as an ornament. Image Credit: Y. Boyadzhiev.

Such a hypothesis may initially appear speculative, but the continually accumulating archaeological and interdisciplinary evidence increasingly suggests that life seven millennia ago was more complex and interconnected than previously believed.

Conclusion

Chavdarova cheshma is a flat Late Neolithic settlement site situated on the Maritsa River. The site yielded a large assemblage of animal remains from both domestic and wild species, most of which reflect food waste associated with butchering, processing, and cooking activities. These activities appear to have taken place outside the houses, primarily around the numerous ovens concentrated on the slopes of the ancient gully.

Among the domestic animals, cattle dominate overwhelmingly, indicating that bovine husbandry played the most important role in the subsistence economy. Sheep and goats are also well represented, while domestic pig appears in smaller quantities. Dog remains, in contrast, occur in negligible numbers and likely reflect the presence of small-sized domestic dogs rather than any substantial economic role. Kill-off pattern analysis shows that most domestic animals were slaughtered at ages optimal for meat production, indicating that livestock at Chavdarova cheshma was raised primarily for meat rather than for secondary products such as milk or wool.

The exceptionally high proportion of fallow deer (*Dama dama*) is particularly noteworthy. At Chavdarova cheshma, this species surpasses red deer (*Cervus elaphus*), which is otherwise the most characteristic wild ungulate in prehistoric assemblages from Bulgaria. This pattern suggests that fallow deer played a significant role in local hunting strategies and that the surrounding environment supported habitats favorable to this species.

The spatial distribution of faunal remains – densely clustered around the spring, riverbank, and concentrations of ovens – indicates that this area functioned as a butchering and cooking zone. Its location at the interface between the terraces and the ancient bed of the Maritsa River raises the possibility that food processing was also connected

to river-based mobility and exchange. The presence of imported marine shells and Aegean-type painted pottery further supports the interpretation that Chavdarova cheshma may have operated as a small riverine waypoint where groups traveling along the Maritsa could stop, obtain supplies, rest, and engage in local exchange.

Overall, the zooarchaeological evidence reveals a settlement with a well-developed meat-based subsistence economy, integrated into broader regional networks of movement and communication in the Late Neolithic.

References

Bacvarov & Gorczyk 2018: K. Bacvarov & J. Gorczyk. Of pits and bones: A ritual pit at the Late Neolithic site of Sarnevo in Bulgarian Thrace. – In: M. Ivanova et al. (eds.) Social Dimensions of Food in the Prehistoric Balkans. Oxford: Oxbow, 2018, 141–156.

Barone 1976: R. Barone. Anatomie comparée des mammifères domestiques. Tome I: Ostéologie – Atlas. Paris: Vigot, 1976.

Boev 2017: Z. Boev. Late Neolithic and Late Antiquity avian finds of Chavdarova cheshma. – ZooNotes 111, 2017, 1–3.

Bojadziev 2000: Y. Bojadziev. Entwicklung der frühneolitischen bemalten Keramik in Bulgarien. – In: S. Hiller & V. Nikolov (Hrsg.) Karanovo III: Beiträge zum Neolithikum in Südosteuropa. Wien: Phoibos, 2000, 327–341.

Boyadzhiev 1995: Y. Boyadzhiev. Chronology of prehistoric cultures in Bulgaria. – In: H. Todorova, S. Ivanov & G. Georgiev (eds.) Prehistoric Bulgaria. Madison: Prehistory Press, 1995, 149–191.

Boyadzhiev 2009: Y. Boyadzhiev. Early Neolithic cultures on the territory of Bulgaria. – In: I. Gatsov & Y. Boyadzhiev (eds.) The first Neolithic sites in Central/South-East European transect, Vol. I. (BAR International Series 2048) Oxford: Archaeopress, 2009, 7–44.

Boyadzhiev 2020: K. Boyadzhiev. The transition to the Late Neolithic in the Upper Thracian Plain. – Quaternary International 560–561, 2020, 45–56. https://doi.org/10.1016/j.quaint.2020.04.009.

Boyadzhiev et al. 2008: Y. Boyadzhiev, M. Gyurova, K. Boyadzhiev, D. Takorova & A. Andonova. Praistorichesko selishte "Chavdarova cheshma" – Simeonovgrad. – In: V. Nikolov, G. Nekhrizov & Y. Tsvetkova (eds.) Spasitelni arheologicheski razkopki po traseto na zhelezopytnata liniya Plovdiv–Svilengrad prez 2005 g. Veliko Tarnovo: AIM–BAN, 2008, 95–135.

Boyadzhiev et al. 2015: Y. Boyadzhiev, A. Andonova, V. Petrov, K. Boyadzhiev. Obekt "Chavdarova cheshma", Simeonovgrad. – Arheologicheski otkritiya i razkopki prez 2014 g., 2015, 70–72.

Boyadzhiev et al. 2016: Y. Boyadzhiev, A. Andonova, V. Petrov, K. Boyadzhiev. Spasitelni razkopki na obekt "Chavdarova cheshma" – Simeonovgrad. – Arheologicheski otkritiya i razkopki prez 2015 g., 2016, 98–101.

Boessneck et al. 1964: J. Boessneck, H.-H. Müller, M. Teichert. Osteologische Unterscheidungsmerkmale zwischen Schaf und Ziege. – Kühn-Archiv 78, 1964, 1–129.

Bowen et al. 2016: L. Bowen, P. Baker, R. Allen & C. Denston. Ageing fallow deer (Dama dama): Refining mandibular tooth wear stages for archaeological assemblages. – International Journal of Osteoarchaeology 26/4, 2016, 675–686. https://doi.org/10.1002/oa.2458

Driesch 1976: A. von den Driesch. A guide to the measurement of animal bones from archaeological sites. (Peabody Museum Bulletin 1) Cambridge: Harvard University Press, 1976.

Gorczyk & Karastoyanova 2017: J. Gorczyk & N. Karastoyanova. Faunal report. – In: K. Bacvarov, M. Tonkova & G. Katsarov (eds.) Sarnevo: vkopani strukturi ot kasniya neolit, rannata i kasnata zhelyazna epoha i rimskiya period. Vol. 1, Kasnoneolitnoto yamno pole. Sofia: NAIM–BAN, 2017, 511–542.

Grant 1982: A. Grant. The use of tooth wear as a guide to the age of domestic ungulates. – In: R. Wilson, C. Grigson & S. Payne (eds.) Ageing and sexing animal bones from archaeological sites. (BAR British Series 109) Oxford: BAR, 1982, 91–108.

Ivanov 1959: S. Ivanov. Domashnite i divite zhivotni v bita na naselenieto ot Yasa Tepe – Plovdiv. – Godishnik na Narodniya Arheologicheski Muzey – Plovdiv 3, 1959, 81–86.

Karastoyanova, Gorczyk & Spassov 2020: N. Karastoyanova, J. Gorczyk & N. Spassov. The natural history of the fallow deer in Bulgaria. – International Journal of Osteoarchaeology 30, 2020, 616–628. https://doi.org/10.1002/oa.2886

Manhart 1997: H. Manhart. Zur frühesten Haustierhaltung in Bulgarien. – Anthropozoologica 25–26, 1997, 715–724.

Manhart 1998: H. Manhart. Die vorgeschichtliche Tierwelt von Koprivec und Durankulak und anderen prähistorischen Fundplätzen in Bulgarien aufgrund von Knochenfunden aus archäologischen Ausgrabungen. (Documenta Naturae 116) München: Documenta Naturae, 1998.

Nicholson 1993: R. Nicholson. A morphological investigation of burnt animal bone and an evaluation of its utility in archaeology. – Journal of Archaeological Science 20, 1993, 411–428.

Nikolov 1998: V. Nikolov. Prouchvaniya varhu neolitnata keramika v Trakia. Keramichnite kompleksi Karanovo II–III, III i III–IV v konteksta na Severozapadna Anatolia i Yugoiztochna Evropa. Sofia: Agato, 1998.

Nikolov 2004: V. Nikolov. Dynamics of the cultural processes in Neolithic Thrace. – In: V. Nikolov, K. Bacvarov & P. Kalchev (eds.) Prehistoric Thrace. Sofia–Stara Zagora: NAIM-BAS, 2004, 18–25.

Nikolov 2011: V. Nikolov. A reinterpretation of Neolithic complexes with dug-out features: pit sanctuaries. – In: V. Nikolov, K. Bacvarov & M. Gurova (eds.) Festschrift for Marion Lichardus-Itten. (Studia Praehistorica 14) Sofia: NAIM–BAN, 2011, 91–119.

Nikolov et al. 2007: V. Nikolov, V. Petrova, E. Anastasova, E. Elenski, D. Andreeva, S. Ignatova, P. Leshtakov, M. Dotkova, E. Naydenova & M. Klasnakov. Arheologichesko prouchvane na kasnoneolitno yamno svetilishte Lyubimets – Dana Bunar 2. – Arheologicheski otkritiya i razkopki prez 2006 g., 2007, 44–47.

Nikolov et al. 2014: V. Nikolov, V. Petrova, T. Hristova & P. Leshtakov. Pra- i protoistoricheski obreden kompleks v m. Hauza kraj Kapitan Andreevo. – Arheologicheski otkritiya i razkopki prez 2013 g., 2014, 68–70.

Ninov 1999: L. Ninov. Arheoosteologichni izsledvaniya. – In: V. Nikolov (ed.) Selishtna mogila Kapitan Dimitrievo. Sofia/Peshtera: AIM–BAN, 1999, 131–137.

Ninov 2002: L. Ninov. Archäozoologische Untersuchungen. – In: S. Hiller & V. Nikolov (Hrsg.) Karanovo II: Die Ausgrabungen in O 19. Wien: Phoibos, 2002, 181–188.

Ninov & Stanev 1992: L. Ninov & P. Stanev. Zhivotnovadna i lovnostopanska deynost na naselenieto ot neolitnata selishtna mogila Samovodene. – Izvestiya na Istoricheski muzey Veliko Tarnovo 7, 1992, 117–126.

Nobis & Ninov 2002: G. Nobis & L. Ninov. Zur Fauna der prähistorischen Siedlung Durankulak II. – Bonner Zoologische Monographien 51, 2002, 29–59.

Payne 1973: S. Payne. Kill-off patterns in sheep and goats: the mandibles from Asvan Kale. – Anatolian Studies 23, 1973, 281–303.

Prummel & Frisch 1986: W. Prummel : H.-J. Frisch. A guide for the distinction of sheep and goat bones. – Journal of Archaeological Science 13, 1986, 567–577.

Raduncheva 2002: A. Radunčeva. Eine neolitische Siedlung am Ufer der Marica bei Simeonovgrad. – In: M. Lichardus-Itten, J. Lichardus & V. Nikolov (Hrsg.) Beiträge zu jungsteinzeitlichen Forschungen in Bulgarien. (Saarbrücker Beiträge zum Altertumskunde 74) Bonn: Habelt, 2002, 225–244.

Schmid 1972: E. Schmid. Atlas of animal bones. Amsterdam–London–New York: Elsevier, 1972.

Schramm 1967: Z. Schramm. Kości długie a wysokość w kłębie u kozy. – Roczniki Wyższej Szkoły Rolniczej w Poznaniu 36, 1967, 89–105.

Schramm & Kranz 1978: Z. Schramm & I. Kranz. Szczątki kostne dzikich przeżuwaczy (Ruminantia Scopoli, 1777) w wykopaliskach wczesnośredniowiecznego Sanoka. – Roczniki Akademii Rolniczej w Poznaniu 103 (Archeozoologia 4), 1978, 43–59.

Spassov & Iliev 1994: N. Spassov & N. Iliev. Animal remains from the submerged Late Eneolithic–Early Bronze Age settlement near Sozopol. – Thracia Pontica 6, 1994, 287–314.

Spassov & Iliev 2014: Spassov, N., Iliev, N. **Faunal remains from Early Neolithic Yabalkovo.** – In: *Yabalkovo*, Vol. 1. Sofia: Sofia University "St. Kliment Ohridski", 2014, 425–433.

Spassov & Iliev 2020: N. Spassov & N. Iliev. Analyses of bone remains from wild and domestic animals from the prehistoric site Akladi Cheiri, Chernomorets: Late Neolithic, Chalcolithic and Early Bronze Ages. – In: R. Krauss, E. Pernicka, R. Kunze, K. Dimitrov & P. Leshtakov (eds.) Prehistoric mining and metallurgy at the Southeast Bulgarian Black Sea coast. Tübingen: University Press, 2020, 161–170.

Teichert 1969: M. Teichert. Osteometrische Untersuchungen zur Berechnung der Widerristhöhe bei vor- und frühgeschichtlichen Schweinen. – Kühn-Archiv 83, 1969, 237–292.

Tsalkin 1960: V. Tsalkin. Izmenchivost' metapodii i ee znachenie dlya izucheniya krupnogo rogatogo skota drevnosti. – Byulleten' Moskovskogo obshchestva ispytateley prirody, Otdel Biologicheskiy 65/1, 1960, 109–126.

Tsalkin 1961: V. Tsalkin. Izmenchivost' metapodiy u ovets. – Byulleten' Moskovskogo obshchestva ispytateley prirody, Otdel Biologicheskiy 66/5, 1961, 114–129.

Uerpmann 1973: H.-P. Uerpmann. Animal bone finds and economic archaeology. – World Archaeology 4/3, 1973, 307–322.

Vasilev 1985: V. Vasilev. Izsledvaniya na faunata ot selishtna mogila Ovcharovo. – Interdistsiplinarni izsledvaniya 13, 1985, 148–151.

Vasilev et al. 1979: V. Vasilev, K. Atanasov & P. Tsonev. Prouchvaniya varhu korelatsionnata zavisimost mezhdu nyakoi razmeri na metapodite i visochinata pri holkata u kravi ot porodata balgarsko kafyavo govedo. – Nauchen trud, *Vissh institut po zootekhnika i veterinarna meditsina* 26/1, 1979, 149–160.

Zeder & Pilaar 2010: M.A. Zeder & S.E. Pilaar. Assessing the reliability of criteria used to identify sheep and goat mandibles. – Journal of Archaeological Science 37, 2010, 225–242.