Megaliths of the Vera Island in the Southern Urals

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Contents

Appendix 1.
Fauna from the settlements of Vera Island 7 and Vera Island 4

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The settlements of Vera Island 7 and Vera Island 4 are located on Vera Island in Lake Turgoyak (Chelyabinsk region, Miass city district, 55°09′ N, 60°01′ E). Excavation of Vera Island 7 took place in 2007, and Vera Island 4 was investigated in 2009 and 2011 (excavator S.A. Grigoriev).

The bone remains were collected from cultural layers represented by granite gruss with humified sand. A common feature of archaeozoological collections from both sites is the multiplicity of calcined and burnt (carbonated) bones and the small number of 'raw' bones, i.e. not exposed to high temperatures. Calcined bones are formed after long impact at high temperature (600° C or more), and burnt (carbonated) bones are formed after an impact at a lower temperature (300° C or less).

Mountainous soils formed on granite are widespread on the island. These are very thin and loose, well ventilated and washed, characteristics that are very unfavourable for the preservation of' 'raw' bones, and ones inherited by the cultural layer formed on these soils. 'Raw' bones quickly disappear in it too. But in these conditions burnt and calcined bones are well preserved.

Bone remains have been determined using the comparative osteological collection of the museum of the Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences[1]. Archaeozoological collections are kept in the museum of the IPAE UB RAS (SVER), Ekaterinburg: those from Vera Island 7 under the inventory no. 1966, and from Vera Island 4 under no. 2669.

Fauna from the settlement Vera Island 7

During the excavation, four layers from were distinguished from top to bottom (Table 1):

Layer 1 – turf.
Layer 2 – humified fine earth.
Layer 3 – a brown cultural layer in which two horizons are distinguished: upper (3a) and lower (3b).

Layer 4 – fill of cracks in bedrock plates and finds on them. Part of the layer (4a) is fill of the (dwelling?) pit.

Some of the bones were found in unstratified deposits, they are linked to layers 1-4.

Bone remains are highly fragmented. Almost all are calcined. Bones not exposed to fire ('raw') are rare. Burnt (carbonated) bones are absent. Due to the strong fragmentation, very few species have been identified. The composition of species is given by layer, distinguished on the basis of lithological and archaeological data.

Table 1. Taxonomic composition of bone remains from the settlement Vera Island 7, NISP.

Taxon	Layers					
	1	2	3a	3b	4	1-4
Cattle	-	1	-	-	-	-
Horse	-	-	1	-	1	-
Elk	2	3	8	10	4	1
Roe deer	4	4	13	21	6	1
Reindeer	-	-	-	1	-	-
Beaver	-	4	1	1	1	-
Mountain hare	-	-	-	1	-	
Squirrel	-	-	-	-	-	1
Mammals indeterminable	191	370	1220	1501	730	169
wood-grouse	-	-	1	-	-	-
Goose	-	-	-	1	-	-
Duck	1	3	6	14	6	-
Sandpiper	-	-	-	1	1	-
Woodpecker	-	-	1	-	-	-
Bird indeterminable	4	25	78	217	93	17
Burbot	-	-	1	1	-	-
Perch	1	2	6	11	5	-
Pike	2	4	36	48	31	-
Cyprinidae	2	4	7	15	5	-
Fish indeterminable	31	79	279	594	252	51

[1] The study was carried out within the framework of the state program of the Institute of Plant and Animal Ecology, Ural Branch of the Russian Academy of Sciences.

Species descriptions

The diagnostic material is small, so descriptions of species are made in all layers.

Cattle (*Bos taurus* L., 1758). Layer 2: a 'raw' heel-bone fragment.

Horse (*Equus caballus* L., 1758). Layer 3a: a tooth; layer 4: a tooth. All teeth are represented by calcined fragments.

Elk (*Alces alces* L., 1758). Layer 1: two teeth (one 'raw'); layer 2: three teeth; layer 3a: a fragment of an antler and seven teeth; layer 3b: ten teeth (two 'raw'); layer 4: four teeth (two 'raw'); non-stratified sediments: one tooth. Only three teeth are complete.

Roe deer (*Capreolus pygargus Pallas*, 1771). Layer 1: a tooth ('raw'), a metapodial ('raw'), talus bone and phalanx 1, of which all bones are 'raw', except for phalanx 1; layer 2: the lower jaw ('raw'), metacarpal, splint bone ('raw') and phalanx 1, an awl was made from the inner splint; layer 3a: four teeth (3 'raw'), three phalanges 1, two phalanges 2, two additional (reduced) phalanges 2 and one reduced phalanx 3; layer 3b: mandible ('raw'), two teeth (one 'raw'), radial, carpal bone, metatarsal, two splint bones, five phalanges 1, two phalanges 2, two reduced phalanges 2, four sesamoid bones; layer 4: three teeth (two 'raw') and three phalanges 1 (one 'raw'); non-stratified sediments: reduced phalanx 2. Only four teeth, the carpal bone, all additional (reduced) phalanges and sesamoid bones are complete.

Reindeer (*Rasngifer tarandus* L., 1758). Layer 3b: inner splint.

Beaver (*Castor fiber* L., 1758). Layer 2: fragments of an ulna and a radial bone, a tibia and phalanx 3; layer 3a: phalanx 3; layer 3b: ulna; layer 4: a fragment of tibia.

Mountain hare (*Lepus timidus* L., 1758). Layer 3b: a lower jaw.

The squirrel (*Sciurus vulgaris* L., 1758). Non-stratified deposits: a radial bone.

Indeterminable mammals (*Mammalia* indet.). The bones are finely fragmented (almost all less than 3 cm), all calcined. Judging from the thickness of the walls, they belong mostly to animals as big as a roe deer (or sheep), much smaller than bones of larger animals (elk, cattle, horse). The bones of animals no bigger than a wolf and smaller (beaver, hare) are rare.

Birds (*Aves*). Determinable bones are rare. Single bones of wood-grouse (*Tetrao urogallus*), goose (*Anser* sp.), woodpecker (*Dendrocopus* sp.) and sandpipers (*Scolopacidae* gen.) have been determined. The most numerous are the remains of different species of ducks (*Anatinae* gen.), which, due to their strong fragmentation, are indeterminable. For this reason, the majority belong to indeterminable remains (*Aves* indet.). Among them, there are seven bones of small birds as big as a quail and less.

Fish (*Pisces*). The bones of burbot (*Lota lota*), perch (*Perca fluviatilis*), pike (*Esox lucius*) and carp (*Cyprinidae* gen.) belong to small-sized individuals. The majority of fish remains are indeterminable (*Pisces* sp.).

Taphonomic notes

Most mammal species (horse, elk and roe deer) are represented mainly by fragments of teeth. All the other bones of mammals, except for the additional (reduced) phalanges, are also represented by fragments. On the whole, teeth, the strongest parts of the skeleton, were preserved, while the remaining (weaker) bones mostly disappeared. The large number of small indeterminable bones was caused by a long exposure to fire, which lead to their strong fragmentation.

A feature of the bone complex is the dominance of calcified bones. They form 99% of the remains of mammals and 100% of birds and fish. This composition is explained by the unfavourable physicochemical characteristics of the cultural layer. Under these conditions, 'raw' bones quickly decompose and calcined bones remain.

The accumulation of bone remains in the cultural layer of the settlement Vera Island 7 could occur in several ways. The archaeological objects are located on open sites and access was not limited, hence, in the absence of people, predatory animals could occupy these areas. The site itself is located in the forest, and predatory birds could use trees, both for building nests and resting places (perches). Naturally, people lived in this area, and they participated in the accumulation of bones. Thus, accumulation could occur as a result of several factors: the activity of predatory animals (remains of prey), predatory birds (remains of prey and pellest) and human activities.

The characteristics of bone preservation makes it possible to determine the main factor in accumulation of bone remains in the layers analysed. The bone complex is distinguished by the predominance of bones exposed to a long impact of high temperature (calcification), whereas burnt (carbonated) bones, exposed to relatively low temperatures, are absent. Exposure to high temperatures may have taken several forms: bones could have been burned in the fires on which the ancient population threw them; in the cultural layer during forest fires, which regularly occur in pine forests; in the cultural layer, on which, after the

completion of its formation, people made fires; etc. The first option is the most likely because, in a forest fire or a campfire, some of the bones are always exposed to low temperatures: those on the edge of the main burning area. In this case, they are burned (carbonated), but not calcined, and such bones are absent from those studied. Thus, all the bones were exposed to high temperature, possible only if they had a prolonged exposure to fire, i.e. were deliberately thrown into a fire. This allows us to conclude that all the calcined bones fell into the layer as a result of human activity. It is very likely that almost all the 'raw' bones were accumulated as a result of human activity. It is obvious that at some period, from the Neolithic to the Eneolithic, the population of this region had a tradition of throwing the bones of mammals, birds and fish into a fire. The role of predators or other non-human factors in the accumulation of bones is not found.

Relative dating of the bone complex

As already noted, a distinctive feature of the bone complex is the dominance of calcified bones. Study of bone remains from archaeological sites of the mountainous zone of the Middle and Southern Urals from the Mesolithic to the late Middle Ages has shown that, in mountainous soils, 'raw' bones are usually preserved only since the Early Iron Age and, exceptionally, from the Late Bronze Age. Calcined animal bones are rarely found in Late Bronze Age or later sites. However, they are common and numerous on sites of the Mesolithic, Neolithic, Eneolithic and Early Bronze Age (e.g. Kosintsev 2011). Calcined bones can be dated from the Mesolithic to the Early Bronze Age, i.e. the tradition of throwing bones into a fire existed in the Urals in the Neolithic-Eneolithic.

Almost all the determinable bones of mammals, as well as those of birds and fish, belong to wild species. This characterizes the population which left the complex of calcified bones as hunters and fishers. This type of economy existed in the south of the Middle and in the Southern Urals from the Mesolithic to the beginning of the Late Bronze Age (Kosintsev 1988). Thus, both the possibility of preserving bones in mountainous soils and species composition indicate that the complex of calcined bones accumulated during a period from the Mesolithic to the beginning of the Late Bronze Age. Taking into account the archaeological data, this period can be narrowed: from the Neolithic to the beginning of the Late Bronze Age. No 'raw' bones are earlier than the Late Bronze Age. Their very small number shows that during the period of the Late Bronze-Early Iron Age, very few 'raw' bones fell into the cultural layer. Otherwise they would be found.

Faunal analysis

The number of bones identified with species is very small and allows only the most general conclusions to be drawn. The fauna contains species that lived in the region in the Middle and Late Holocene and live there now, with the exception of reindeer and beaver, which disappeared in historical times (Kosintsev 1988). Roe deer predominate among the remains of ungulates, which is a typical picture in the region, at least from the Middle Holocene (Kosintsev 1988).

Hunting and animal husbandry

Domestic ungulates appeared in the mountainous forest zone of the Urals at the transition from the Middle to the Late Bronze Age, in the Abashevo and Sintashta period (Kosintsev 2003). The bones of domestic ungulates, cattle and horses, are rare on the settlement (Table 1). They may have populated the area since the Late Bronze Age and later. The cattle bones are 'raw', i.e. no older than the Late Bronze Age, and are probably later (see above). The equine bones are calcined, i.e. intentionally burned. They probably fell into the fire, like other calcified bones, as a result of some rite. Thus they date to the Eneolithic or earlier. Is this possible if domestic ungulates are known in the region from the Late Bronze Age? Indeed it is: wild horses lived in the Middle Urals in the Early and Middle Holocene, at least up to and including the Eneolithic (Kosintsev and Bachura 2013). The period of their existence in the Urals coincides with that of a specific tradition of burning animal bones in a fire (the Eneolithic and earlier). This means that the use of horse bones in the tradition of burning bones was quite possible before the Late Bronze Age, the time of the appearance of domestic horse in the Urals. It is likely that these are the bones of a wild horse burned in a fire.

Among determinable bones, wild animals' predominate. The mammals include roe deer, elk, beaver, reindeer, hare and squirrel. Obviously, all bird and fish bones belong to wild species. Of indeterminable remains of mammals almost all belong to large animals, probably ungulates, predominantly wild. This characterizes the population who left these bones as hunters and fishers, which conclusion is supported also by the fact that all indeterminable bones are calcified, i.e. they were used in the rite of burning in a fire and are dated to the Eneolithic or earlier (see above), thus before the appearance of domestic ungulates. Hence, almost all bone remains belong to wild species: mammals, birds and fish. Therefore, during the period of the tradition of burning bones in the fire, the population was engaged only in hunting and fishing. This corresponds to the previously obtained data on the appearance of domestic ungulates in the Urals at the transition from the Middle to the Late Bronze Age.

The number of determinable bones is very small for assessing possible changes in the structure of hunting and fishing over time, but the samples of large groups (mammals, birds and fish) are sufficient for analysis. Let us consider their proportions by layers. The number of samples in all layers, except for layer 1 and the non-stratified complex (1-4), is representative (Table 2). Differences between complexes are reliable if they are 10% or greater. On this basis, we see that the samples form two groups: 1) layers 2 and 3a; 2) layers 3b and 4. The first complex is characterized by the dominance of mammal remains. In the second complex, the proportion of mammal remains is significantly reduced and the proportion of fish remains increases. In general, from bottom to top, there is a single trend – an increase in the proportion of mammal remains and a decrease in the proportion of bird and fish remains. These changes can be considered as significant. Layer 1 is not considered, as there are insufficient samples, but this trend continues in it. If we include data from layer 1, the trend will intensify further, and the differences will be even greater. The data on the non-stratified group does not contradict this conclusion, since its characteristics occupy an average position between those of the two groupings of layers: bones got into the non-stratified group for random reasons from all layers.

Table 2. The ratio of remains of mammals, birds and fish.

Taxon	Layers					
	1	2	3a	3b	4	1-4
Mammals (%)	83	77	75	63	65	72
Birds (%)	2	7	5	10	9	7
Fish (%)	15	16	20	27	26	21
Total	238	498	1657	2436	1134	240

The selected complexes have a stratigraphic meaning and suggest two major conditional horizons: the first includes layers 1, 2 and 3a, the second layers 3b and 4. These horizons reflect a change in the structure of the thrown bone complexes. In the early period, more bones of fish and birds were thrown, and fewer mammal bones; later, the proportion of the latter increases and of the former declines. This might be connected (or not) with a change in the structure of hunting and fishing activity (there was an increase in the role of hunting for ungulates and a decrease in that for birds and fishing). These changes were relatively gradual. The chronological framework of this process is a problem. It is clear that it occurred in the period of the Neolithic-Eneolithic.

Conclusion

Almost all the bones got into the layer as a result of human activity. The taxonomic composition of the fauna allows dating of the archaeological site within a wide range: from the Early to Late Holocene. According to the archaeological data, people inhabited the area of study from the Neolithic to the Early Iron Age. The features of the bone complex (dominance of calcified bones) indicate the existence of the tradition of throwing bones (mammal, birds and fish) into the fire. This tradition existed on Vera Island at some time from the Neolithic to the Eneolithic. Over time, there was a gradual change in the tradition, which manifested itself in a change of bone remains (the ratio of bones of mammals, birds and fish) that were thrown into the fire. In the Neolithic and Eneolithic the main economic activities were hunting and fishing. Domestic ungulates appeared in the Late Bronze Age or later.

Fauna from the settlement Vera Island 4

Three areas were excavated on the site, in which up to four cultural layers were distinguished (numbered from the bottom). In Table 3, in the 'Layers' columns, the first digit indicates the number of the area; the second the layer number.

Layer 1 (1-1, 2-1, 3-1) is the earliest; archaeological material belongs to the Neolithic and Eneolithic.
Layer 2 (1-2, 2-2, 3-2) is the main. It contains materials of the Eneolithic with admixtures of Neolithic and cross-stamped ceramics.
Layer 3 (1-3, 2-3, 3-3) is the beach ridge: a mixture of layers 1 and 2.
Layers 4 (1-4) and 5 (1-5, 3-5) are the upper humified horizon of the beach ridge and later humified deposits on its surface. Accordingly, these contain admixtures from layers 1 and 2 and also small later deposits.
Layer 6 (3-6) is a dwelling pit of the Early Iron Age. It contains archaeological materials of the Early Iron Age and an admixture of all previous layers.
Layer 7 – turf.

Bone remains were found in all areas, but not in all layers (Table 3). They are fragmented. Most of them are calcified, but burnt (carbonated) and 'raw' bones are also quite numerous. Due to the strong fragmentation few bones have been identified by species (Table 3). The species composition is shown by layer (Table 4). The bones of birds and fish, with the exception of individual ones, are not identified.

Description of species

The diagnostic material is small, so descriptions of species are made in all layers.

Cattle (*Bos taurus* L., 1758). Layers 1, 2, 3, 5 and 6: 'raw' fragments of teeth; layers 1-2 and 2-3: an entire 'raw' sesamoid bone in each.

Table 3. Taxonomic composition of bone remains from the settlement Vera Island 4.

Taxon	Layers													
	1			2			3			4	5		6	7
	1-1	2-1	3-1	1-2	2-2	3-2	1-3	2-3	3-3	1-4	1-5	3-5	3-6	2-7
Cattle	-	-	1	5	-	-	-	1	-	-	2	2	2	-
Sheep/goat	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Horse	-	-	-	-	-	4	-	1	-	-	2	-	4	-
Dog	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Elk	5	-	-	-	-	2	3	-	-	-	-	1	7	-
Roe deer	9	7	2	11	1	13	6	14	1	1	-	2	17	1
Beaver	-	-	-	-	-	2	-	2	-	-	-	2	1	-
Hare	-	-	-	-	-	-	2	1	-	-	-	-	-	-
Wolf	-	-	-	1	-	-	-	-	-	-	-	-	1	-
Mole	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Water vole	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Mammals indeterminable	79/142[1]	0/16	-	54/214	9/17	60/108	0/101	84/182[1]	0/1	0/4	30/49	0/71	159/193	2/8
Bird	7	-	1	1	-	-	4	3	-	-	-	-	2	-
Pike	3	-	-	-	-	-	-	1	-	-	-	-	-	-
Fish	8	-	12	-	-	-	14	1	-	126	1	-	2	1

[1] In the numerator – number of burnt and "raw" bones, in the denominator – number of calcined bones.

Table 4. Taxonomic composition of bone remains from the settlement Vera Island 4 by layers.

Taxon	Layers					
	1	2	3	4 and 5	6	7
Cattle (*Bos taurus*)	1	5	1	4	2	0
Sheep/goat (*Ovis aries et Capra hircus*)	0	0	0	0	1	0
Horse (*Equus caballus*)	0	4	1	2	4	0
Dog (*Canis familiaris*)	1	0	0	0	0	0
Elk (*Alces alces*)	5	2	3	1	7	0
Roe deer (*Capreolus pygargus*)	18	25	21	3	17	1
Beaver (*Castor fiber*)	0	2	2	2	1	0
Hare (*Lepus timidus*)	0	0	3	0	0	0
Wolf (*Canis lupus*)	0	1	0	0	1	0
Mole (*Talpa europaea*)	1	0	0	0	0	0
Water vole (*Arvicola terrestris*)	1	0	0	0	0	0
Mammals indeterminable (*Mammalia* indet.)	79/158[1]	123/339	84/284	30/124	159/193	2//8
Bird (*Aves* indet.)	8	1	7	0	2	0
Pike (*Esox lucius*)	3	0	1	0	0	0
Fish (*Pisces* indet.)	20	0	15	127	2	1

[1] In the numerator – number of burnt and "raw" bones, in the denominator – number of calcined bones.

Horse (*Equus caballus* L., 1758). Layers 2, 3, 5 and 6: 'raw' fragments of teeth; layer 3-6: a calcined inner splint.

Sheep/goat (*Ovis aries et Capra hircus*). Layer 3-6: a 'raw' fragment of phalanx 3.

Dog (*Canis familiaris* L., 1758). Layer 1-1: a raw tooth fragment (premolar).

Elk (*Alces alces* L., 1758). Layer 1-1: five burnt teeth; layer 1-3: two teeth and a sesamoid bone; layer 3-2: two teeth; layer 3-5: a tooth; layer 3-6: six burnt teeth; non-stratified sediments: a phalanx 1. All elk remains are fragments, seven of them are 'raw' and 11 are burnt.

Roe deer (*Capreolus pygargus Pallas*, 1771). The remains of roe deer are the most numerous (Table 3). Bones of different parts of the skeleton are found. Layer 1-1: two teeth, a heel bone, a talus, a tarsal bone, a burnt phalanx 2; layer 1-2: three burnt teeth, calcined three metapodials, phalanx 1 and 'raw' lower jaw, metapodial, two phalanges 1; layer 1-3: two teeth, a scapula, three metapodials; layer 1-4: a scapula; layer 2-1: calcined a carpal bone, a talus, two sesamoids and 'raw' a tarsal bone, a talus, an splint bone and a burnt metapodial; layer 2-2: a metapodial; layer 2-3: a tooth, two carpal bones, two talus bones, a phalanx 2, a sesamoid bone and calcified tibia, and six phalanges 1; layer 2-7: an inner splint; layer 3-1: a shoulder bone and an inner splint; layer 3-2: calcined a metacarpus, phalanges 1 and 2, one burnt carpal bone and 'raw' three carpal bones, two talus bones, a tarsal bone, a phalanx 1, a sesamoid bone; layer 3-5: a tarsal bone and calcified phalanx 2; layer 3-6: calcined two metapodials, a talus bone, a heel bone, a sesamoid, two additional (reduced) phalanges 2 and 'raw' a carpal bone, two tarsal bones, a metapodial, an inner splint, a phalanx 1, two phalanx 2 and an additional phalanx 3. Non-stratified deposition: splint bone and shoulder bones. The shoulder bone from layer 1-3 belongs to an embryo. All bones, with the exception of three teeth, additional phalanges, sesamoids and carpal bones, are represented by fragments. Among them, 32 were exposed to fire and 53 are 'raw' bones.

Beaver (*Castor fiber* L., 1758). Layer 2-3: two entire 'raw' teeth; layer 3-2: two entire 'raw' teeth; layer 3-5: a calcined fragment of scapula; layer 3-6: a burned (carbonated) fragment of the lower jaw.

Mountain hare (*Lepus timidus* L., 1758). Layer 1-3: 'raw' fragments of incisor and metapodial; layer 2-3: a 'raw' fragment of metapodial.

Wolf (*Canis lupus* L., 1758). Layer 1-2: a calcined phalanx 3; layer 3-6: a 'raw' entire tooth m2.

Mole (*Talpa europaea* L., 1758). Layer 3-1: an entire 'raw' lower jaw.

Water vole (*Arvicola terrestris* L., 1758). Layer 1-1: an entire 'raw' tooth.

Indeterminable mammals (*Mammalia* indet.). The bones are finely fragmented (almost all less than 3 cm), most of them are calcined (Table 3), there are burnt and a few 'raw' bones. Judging from the thickness of the bone walls, they belong mostly to animals as big as a roe deer (and sheep), much smaller than the bones of larger animals (elk, cattle, horse). Bones of animals no bigger than a wolf and less (beaver, hare) are rare.

Birds (*Aves*). 'Raw' and slightly calcined bones predominate. The latter are highly fragmented. The bones belonged to birds of various sizes: from the size of a goose to the size of a pigeon.

Fish (*Pisces*). There are 'raw' and calcined bones. Only pike bones (*Esox lucius*) are identified, the remaining bones are indeterminable. In layer 1-4, an accumulation of 126 calcined bones was found, of which 28 can be identified; the rest are indeterminable. The vast majority of fish remains are indeterminable (*Pisces* sp.).

Taphonomic notes

Most species (cattle, horse, elk, and roe deer) are represented mainly by fragments of teeth. Among skeletal bones, only small ones (carpal, sesamoid, reduced phalanges) are complete. The remaining (weaker) bones have mostly degenerated into indeterminable fragments. Many indeterminable bones resulted from the presence of most bones in the fire, which led to strong fragmentation.

The accumulation of bone remains in the cultural layer of Vera Island 4 occurred in the same ways as on Vera Island 7. Naturally, people lived here and participated in the accumulation. In the absence of people, different predators inhabited the site. The bones of the water vole and the mole are present in the cultural layer not through human activity: hunting these species in Antiquity is unknown. Their bones might have been the remains of the food of predators or they could have died on the site. Natural death is another possible factor for the accumulation of bones. Some bird and fish bones may also be remains of the prey of predators. The majority of bones were exposed to fire, which makes it possible to consider human activity as the main factor in their accumulation. Thus, the accumulation results from the activity of predators (remains of prey and pellets), the natural death of animals and, principally, human activity.

The complex is distinguished by the dominance of bones exposed to fire. The significant number of calcified bones, i.e. exposed to high temperature for a long time, are the result of the rite of throwing bones

into a fire (see above). Another significant quantity of bones were burned to varying extent – in bonfires, in the cultural layer during forest fires, or in fires made on the cultural layer after its formation.

Relative dating of the bone complex

As shown above, all calcified bones are most likely dated to the Neolithic-Eneolithic. Burnt bones are preserved in the cultural layer as well as the calcined ones. This means that they may be dated to the Neolithic and Eneolithic too. But since they might have been formed during forest fires and from bonfires at a later time, they may have a wider date: from the Neolithic to the Early Iron Age. A feature of the complex of calcined and burnt bones is the absence of bones of domestic ungulates (excluding a horse splint bone). This shows that it was left by a population with a hunting and fishing economy, i.e. the majority of these bones, including burnt ones, were accumulated from the Neolithic to the Eneolithic. All bones of cattle and sheep/goat and almost all bones of horse are 'raw', i.e. no older than the Late Bronze Age, and probably later. The calcified horse bone might be from a wild equid (see above).

Table 5. Proportions of calcined and other mammalian bones.

Complexes	Layers				
	1	2	3	4-5	6
Calcined (%)	61	69	73	76	53
'Row' and burnt (%)	39	31	27	24	47
Total	255	501	399	166	391

The above analysis has shown that the complex of calcined bones is older than that of burnt and 'raw' bones. Since the first has a Neolithic-Eneolithic date, the burnt bones can be dated from the Neolithic to the Early Iron Age, and the 'raw' bones from the Late Bronze Age to the Early Iron Age. If this is the case, then in the lower layers (1 and 2) the proportion of the former should be higher than in the mixed layers (3 and 4) and in the dwelling pit of the Early Iron Age (layer 6). Analysis of proportions of bones by layer does not confirm this. From the lower layer 1 to the upper layer 5, the proportion of calcined bones increases (Table 5). Between the outermost layers, these differences are significant. These later layers were formed largely by the beach ridge, which consists of the displaced layers 1 and 2. During the washout of these layers, the lighter calcified bones rose with the water and accumulated on the beach, which was displaced by the beach ridge. The proportion of complexes in the Early Iron Age pit corresponds to the expected trend: the number of calcined bones in it is minimal. The results indicate a significant mixing of the cultural layer.

Faunal analysis

The number of bones linked to species is very small and allows only the most general conclusions to be drawn. The fauna includes species that lived in the region in the Middle and Late Holocene and live now, with the exception of the beaver, which disappeared in historical times. Roe deer are predominant among the bones of ungulates, which is typical of the region, at least from the Middle Holocene (Kosintsev 1988).

Hunting and animal husbandry

The bones of domestic ungulates are rare (Table 4) and almost all are 'raw'. The population of the region kept them, starting from the Late Bronze Age and probably later.

Among the determinable bones, those of wild animals dominate. Among mammals there are roe deer, elk, beaver, hare and wolf. Obviously, all the bones of birds and fish belong to wild species. Almost all the indeterminable remains of mammals belong to large animals, probably ungulates, with wild ungulates predominating. This characterizes the population that left most of these bones as hunters and fishers. To judge from the archaeological materials, a later population with domestic ungulates settled on this site, probably in the Early Iron Age. The proportions of bones in the group of 'raw' bones allow us to reconstruct the economy of this period. Among them, 24 are bones of domestic and 60 of wild ungulates. There are some 'raw' bones of wild birds and fish. All this, despite the small sample size, makes it possible to say with great confidence that in the Early Iron Age hunting and fishing were no less important than animal husbandry.

Conclusions

Almost all the bones got into the layer as a result of human activity. The taxonomic composition of the fauna allows dating of the archaeological site within a wide range from the Early to the Late Holocene. Hunters and fishers inhabited the studied area in the Neolithic and Eneolithic. Domestic ungulates appeared in the Late Bronze Age or, probably, in the Early Iron Age. During this period, hunting and fishing played a significant role in the economy too. The abundance of calcified bones indicates the existence of the tradition of throwing bones of mammals, birds and fish into the fire. This tradition existed in some period(s) from the Neolithic to the Eneolithic.

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