

# On possible arctic fox domestication in the upper Paleolithic

## Abstract

This article presents morphological and archaeological arguments in favor of the hypothesis of the domestication of the Pleistocene Arctic Fox. Such conclusions are made on the basis of the materials of the upper Paleolithic site of Byki 1 (Russia, Kursk region), which was investigated by one of the authors. The authors suggest that in the upper Paleolithic the domestication of animals was not limited to multiple domestication of the wolf in different parts of the Oikumen. People tried to domesticate predators of the canine family as well.

**Keywords:** upper paleolithic, domestication of animals, canines, arctic fox, settlement Byki 1

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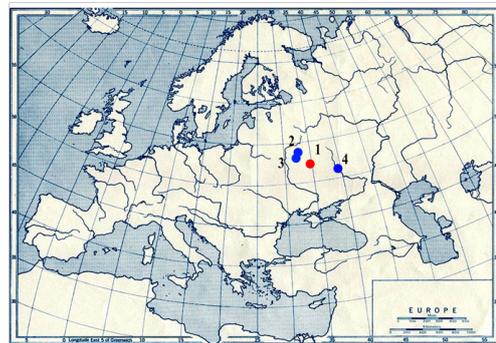
## Introduction

For decades it was claimed in archaeological literature that the Upper Paleolithic man first tamed the dog and used it for hunting. The most ancient skull, certainly belonging to a dog, and not a wolf, was found during the analysis of collections in Goyet Cave (Belgium), investigated in the middle of the XIX century. It is unclear what cultural layer the skull belongs to, but there is its AMS-date: 31,700 BP.<sup>1</sup> The remains of the ancient dogs of Europe were also found in the materials of Chauvet Cave (France, about 26,000 BP), at Mezhirich and Mezin sites in Ukraine, Eliseevichi in Russia (14,000-16,000 BP). Many researchers continually return to the idea of taming a horse at the end of the Upper Paleolithic, although the arguments given are not very convincing.<sup>2,3</sup> Still, it must be admitted that the experience of domestication as early as in the Paleolithic era was much wider than taming of the wolf. A striking example of this is the recently discovered evidence of domestication of the fox (*Vulpes vulpes* L.) in the Paleolithic of Jordan (16,500 BP).<sup>4</sup> We will consider the hypothesis about the attempts to domesticate a Pleistocene Arctic fox - another representative of the dog family.

## Methods and materials

Domestication of animals leads to significant morphological changes, including changes not only in color, shape of ears and tail, but also cranial and postcranial skeleton. Long ago paleontologists identified the signs of domestication, reflected on the morphology of the skeleton, which were confirmed by zoologists studying modern domestication processes. The most striking features are neoteric signs: shortening of the muzzle (maxillary part of the skull) and limbs, expansion of the cerebral part of the skull. In the light of these signs, bone remains of the Arctic fox *Alopex lagopus* cf. *Rossicus* (no less than 15 individuals), discovered by the author during excavations of the Upper Paleolithic site of Byki 1 in Poseimie<sup>5</sup> seem to be of serious interest. In the 1990s in the Dnieper basin on the Seim River (N51°38'54", O35°30'34") a bush of the Upper Paleolithic monuments was discovered, which was named after the nearest village Byki (Figure 1). Further discussion will touch on the materials of the settlement Byki 1 excavated by one of the authors. The cultural layer dates back to the time of completion of the formation of the ledge of the second terrace above the floodplain, when the territory of

the site was flooded with the Seim River waters during strong floods. A series of dates was obtained for Byki 1: 17540 ± 120 years (GIN-8408), 17640 ± 130 years (GIN-8409), 17200 ± 300 years (GIN-8408a) and 16600 ± 180 years (GIN-8409a),<sup>6</sup> which correspond to geostratigraphical conditions of the monument. There was found abundant stone and bone inventory in the investigated area, as well as objects identified as traces of dwellings (Figure 2). Among the numerous remains of animals the most abundant are the bones of a horse, reindeer and Pleistocene Arctic fox (Figure 3).



**Figure 1** The location of the Upper Paleolithic settlement Byki 1 on the map of Europe. The numbers indicate: 1, Settlement of Byki 1; 2, Settlement of Eliseevichi; 3, Settlement of Yudinovo; 4, Kostenkovsko-orshchevsky Paleolithic area.



**Figure 2** Excavations of Paleolithic site Byki 1.



**Figure 3** Composite skeletons of Arctic Fox from Byki I in exposition of Bryansk regional museum.

Pleistocene Arctic fox is one of the important components of the mammoth therio-complex. This small polar fox could as well live right next to human habitation, feeding on food residues among other things. The main food for the fox was vole and lemmings. The main enemies were wolves and larger predators. Its body length reached 58-70 cm, weight – 4.5-7 kg, males usually larger than females. The foxes’ exterior occupies an intermediate position between wolves and foxes. Ears are short and round. The hairline is very thick, tall and silky, with a long soft awn and very dense down. The tail is straight, fluffy.<sup>7</sup> For morphological comparison we use the data on Pleistocene Arctic foxes of the basin of the Upper Desna (Eliseevichi, Yudinovo), the upper Don (Kostenki) and modern Eurasian foxes (populations of Spitsbergen, the Commander Islands and the mainland tundra), published by Irina Kuzmina and Mikhail Sablin.<sup>8,9</sup>

**Results**

Morphometry of the osteological collection shows that the Arctic fox from Byki is, in general, smaller than the modern Arctic fox and Pleistocene fox from Eliseevichi, Yudinovo and Kostenki. The modern mainland arctic fox is 10-12% larger in the size of postcranial skeleton bones than the fox from Byki, the Pleistocene fox from Yudinovo is larger by 6-8% and the fox from Kostenki is 5-6% larger. The smaller size can be primarily explained by the fact that the fox from Byki has shorter paws (Table 1). The shortened limbs of the Pleistocene Arctic fox from Byki could actually be a sign of severe climate conditions and small thickness or even the absence of snow cover during most

of winter time. But according to the indices of predatory teeth, a fox from Byki is similar not to the Pleistocene, but to the mainland Arctic fox: it has less narrow teeth than other Pleistocene populations. MV Sablin convincingly demonstrated that arctic foxes possess the smallest width of the crown of predatory teeth, whereas foxes from the Commander Islands, where the climate is milder and more favorable, can boast the largest ones.<sup>9</sup> The proximity of the proportions of the crown of the predatory tooth to the parameters of modern mainland arctic foxes makes one assume a mildly more temperate temperature regime than in Yudinovo and Eliseevichi. Thus, we should not look for climate reasons to explain the shortness of paws of the fox from Byki. Especially considering the fact that arctic foxes are less likely to be geographically variable than many other predators.<sup>10</sup>

Measurements of the skulls (Figure 4) and the lower jaw (Table 2) show that, according to the average indices, the arctic fox from Byki is shorter than modern foxes and Pleistocene Middle Russian subspecies. Moreover, the postorbital width of the skull is somewhat larger than that of the Central Russian Pleistocene and the mainland recent populations (i.e. the forehead is slightly wider), while the remaining indices are lower. The index of the ratio of the length of the cerebral part of the skull and the main length of the skull is the highest for the Arctic fox from Byki - 42.2% (Yudinovo - 40.6%, Eliseevichi - 40.3%, modern mainland Arctic fox - 37.5%). Considerable shortening of the skull in domesticated fingerlings of modern Arctic fox in comparison with wild animals is also shown by the data of scientists from Ekaterinburg.<sup>11</sup>



**Figure 4** Byki I, The skull of the fingerling Arctic Fox.

**Table 1** Dimensions of the limbs skeleton bones of the Arctic Fox (Byki I) Comparative data on references 7,8

Bone	Measuring	Byki		Desna	Don	Recent	
	mm	n	Lim	M	M	M	
Humerus	maximum length	7	87,4-102,2	96,7	102,8	100,4	108,4
	distal epiphysis width	10	14,0-17,6	15,8	17,3	17,1	17,7
Ulna	maximum length	4	95,8-118,2	103,8	110,2	104,4	118,1
	olecranon width	10	9,2-12,5	10,3	12,3	11,9	12,1
Radius	maximum length	7	80,6-100,5	87,9	98,8	95,7	99,9
	proximal epiphysis width	8	8,4-9,9	9,2	10,3	9,9	10,3
Femur	distal epiphysis width	8	10,8-13,6	12,4	13,4	13,0	13,5
	maximum length	1	107,3	-	107,1	105,5	109,4
	distal epiphysis width	5	15,8-18,0	16,9	17,9	17,6	18,0

Table Continued

Bone	Measuring mm	Byki			Desna	Don	Recent
		n	Lim	M	M	M	M
Fibula	proximal epiphysis length	3	17,0-22,0	18,6	19,9	19,4	20,2
	proximal epiphysis width	1	18,3	-	21,3	21,0	21,2
	distal epiphysis width	1	11,3	-	13,2	13,1	13,8
Calcaneus	length	4	23,2-27,7	25,8	26,5	26,6	27,4
Astragal	length	3	14,8-18,2	16,5	16,2	15,9	16,3
Mc II	length	5	28,4-33,1	32,5	36,4	35,6	37,7
	proximal width	5	3,8-4,0	3,6	3,8	nd	4,0
	proximal length	5	4,8-5,6	5,2	5,6	nd	5,9
	длина-	6	33,2-39,7	37,5	41,2	41,0	42,9
Mc III	proximal width	6	3,9-4,4	4,2	4,7	nd	4,7
	proximal length	6	4,8-5,7	5,2	5,8	nd	5,9
	length	5	33,0-38,7	36,0	40,1	39,8	41,8
Mc IV	proximal width	5	3,4-4,2	3,7	4,3	nd	4,7
	proximal length	5	4,8-5,7	5,2	5,8	nd	5,8
	length	5	26,4-33,0	30,0	33,3	33,6	35,6
Mc V	proximal width	5	4,9-6,5	5,5	6,2	nd	6,4
	proximal length	5	4,7-5,3	5,0	5,4	nd	5,6
	length	7	40,5-47,5	43,8	47,0	46,0	48,7
Mt II	proximal width	6	3,2-3,8	3,5	3,2	nd	3,4
	proximal length	5	7,0-7,8	7,4	7,9	nd	8,1
	length	7	7,6-8,5	48,9	50,7	50,9	53,6
Mt III	proximal width	7	3,2-4,0	4,8	4,8	nd	4,9
	proximal length	7	7,0-7,5	8,1	8,3	nd	8,4
	length	5	42,8-49,0	49,7	53,3	51,9	54,8
Mt IV	proximal width	5	3,7-4,2	3,6	3,7	nd	3,6
	proximal length	5	7,0-7,5	7,2	7,7	nd	7,8
	length	5	42,8-49,0	45,8	48,5	47,7	49,9
Mt V	proximal width	5	3,7-4,2	3,8	4,3	nd	4,4
	proximal length	5	4,9-6,7	6,0	6,7	nd	7,0

Table 2 Cranium and mandibula of the Arctic Fox (Byki I), Comparative data on references 7,8

Bone	Measuring mm	Byki		Desna	Recent	
		n	lim	M	M	
Cranium	Basic length	3	121,2-123,5	122,6	124,2	127,2
	length of brain part	3	49,0-52,0	50,7	50,0	47,7
	postorbital width	5	22,0-26,9	24,4	23,7	23,6
	mastoid width	5	40,5-42,5	41,2	42,4	43,2
	width of occipital condyles	4	20,8-24,0	22,5	23,9	24,4
	height in drum cameras	5	41,0-48,0	44,1	46,2	47,4
	length of dental row C1/-M3/	8	49,2-61,0	53,5	55,2	55,6

Table Continued

Bone	Measuring mm	Byki		Desna	Recent	
		n	lim	M	M	
P 4/ dext	length	8	11,5-14,8	12,8	13,9	14,0
	width	8	5,4-6,7	6,1	6,3	6,6
Mandibula	length of dental row C/1-M/3	9	55,4-61,5	58,4	61,4	61,8
M/1	length	9	12,4-14,9	13,2	14,5	14,2
dext	width	9	4,7-5,5	5,1	5,2	5,4

## Discussion

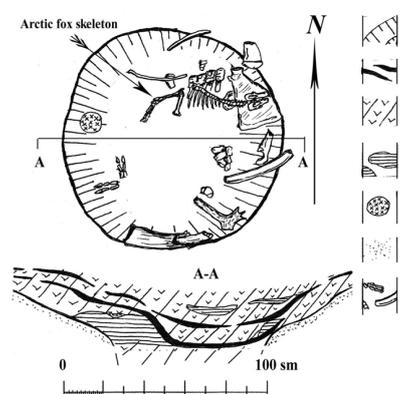
The row of teeth of the fox from Byki is shorter than that of the Middle and Pleistocene foxes. MV Sablin noted that foxes from colder climatic zones have shorter tooth rows.<sup>8</sup> However, foxes from Byki belong to a more southern (by 110-160 km, i.e. 1-1.5 degrees of latitude) and remote from the ice sheet population than that used for comparative analysis. I.G. Pidoplichko considered the shortening of the tooth row in dogs as a sign of domestication.<sup>12</sup> In fact, shortening of the muzzle can be caused, apart from direct domestication processes, by natural changes in the diet. But changing of the diet can also mean the beginning of the relationship between humans and Arctic foxes, similar to the original relationship between humans and cats. After all, biologists say that cats were not domesticated in the conventional sense; they just took advantage of the fact that people attracted mice. On the seacoast, the modern Arctic fox often accompanies polar bears, and as a result, it gets some of the meat of killed seals. Similar behavior could link part of the Pleistocene arctic fox with humans - with the local group (community) of the inhabitants of Byki site. At the very least, the shortness of the fox muzzle from Byki can be explained by the fact that it was safely fed with the waste of people's hunting activity, rather than its own prey, that is, it was well adapted to live near human habitation.

As early as the beginning of the 20th century, Russian fur farmers noted: "The Arctic Foxes are more amenable to taming than foxes. Of any ten arctic foxes contained in the log buildings, there will always be one or two who will willingly go to their hands. Strange as it may seem, what kind of affection can be felt for the person who keeps them in prison and shows himself once a day to throw a piece of carrion or fish."<sup>13</sup> It is behavior, first of all - lack of a reaction of fear to man, that distinguishes domestic from wild animals, and their behavior is built on trust, affection and devotion.<sup>14</sup> It can be assumed that the inhabitants of the site tried to tame some of the animals that were always spinning near the shelter and heaps of garbage, selecting them on this basis. This does not mean that the wild arctic fox has automatically ceased to be an object of hunting. Although in this respect the osteological collection of Byki gives interesting evidence. Thus, a fragment of the lower jaw with permanent teeth in the eruption stage was found among the bone remnants. Erection of all milk teeth ends on the 26-27th day after birth, changing teeth to permanent occurs in late summer early autumn. Puppies feed on milk up to 1.5-2 months. Then they are fed with milk food for a while. Could the baby, even in the early autumn, when the fur is of poor quality and moulting begins, become an object of hunting? After all, the fox in Byki was not used for food. A skull of an Arctic fox fingerling with completely uncombined seams was also found on the site.<sup>15</sup>

In the light of the possible domestication of the Arctic fox it seems strange that in Byki there are no pendants and necklaces from its teeth, widely represented on several earlier and synchronous monuments,

such as Avdeevo, Kostenki 1, Gagarino, Zaraysk, Khotylevo 2, (the Seim, Don, Oka, Desna basins). Absence of the remains of a wolf in the fauna of the site looks no less interesting. Potentially, there is another sign of domestication, no longer morphological, but archaeological. It is a burial: either a person with a pet (remember the above-mentioned Paleolithic burials of people with a fox in Jordan), or a separate burial of an animal (as a burial of a dog in the floor of a Paleolithic dwelling in the Ushki-1 site in Kamchatka). Next to the body of the dog, an obsidian knife, a scraper, a grindstone was laid in a cluster of red ochre.<sup>16</sup> The oldest known joint burial of a man and a dog is known in the Madeleine cultural layer of the Oberkassel cave on the left bank of the Rhine (Germany) and dates back to about 14,000 years ago.<sup>17</sup>

The presence of a partially destroyed skeleton of an animal with a separated and adjacent head buried under the hearth after a temporary break in inhabiting the dwelling (or at the beginning of this break) appears to be the deliberate cult act of sacrifice and subsequent burial. Perhaps, the domesticated animal was sacrificed during the second settling down in a round half dugout dwelling with a hearth in the center, which had been abandoned for a while. It should be noted that the bones of the Arctic fox are also found under the lower carbonaceous layer of the fireplace, which marks the first stage of the existence of the dwelling (Figure 5). Similar rites of sacrifice (fragments of carcasses of game, ochre) associated with the cult of the fireplace were fixed in the Paleolithic settlement of Podzvonkaya in Zabaikalie by VI. Tashak.<sup>18</sup> Another fact that arouses interest is that nowhere in Byki are found skulls of the arctic fox, articulated with the spine. At the same time, the fox skulls clearly occupied a special position in the real world of the inhabitants of the site. For example, one of them was buried in a pit at the foot of an anvil from the tibia of a mammoth, on which a flint was treated in a dwelling.



**Figure 5** The Paleolithic site Byki I the supposed ritual burial of the Arctic Fox under the hearth in the dwelling. Figures are marked: 1, edge of the pit; 2, carbonaceous strata; 3, cultural layer of gray ferruginous sandy loam with traces procula; 4, clay pavement; 5, cluster of ochre (mineral paint); 6, sand (mainland); 7, bones and horn.

## Conclusion

Taking the complex of facts into consideration, the hypothesis about the experience of domestication of the Middle Russian Pleistocene subspecies of *Alopex lagopus rossicus* Kuzmina et Sablin by the inhabitants of the late Paleolithic site of Byki 1, which is 17,000-18,000 years old (the beginning of the late glaciation), should be accepted as verifiable.

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## Conflict of interest

None.

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