DOI: 10.17746/1563-0110.2018.46.2.131-139

P.A. Kosintsev[1], O.P. Bachura[1], and V.S. Panov[2]
[1]Institute of Plant and Animal Ecology,
Ural Branch, Russian Academy of Sciences,
8 Marta 202, Yekaterinburg, 620144, Russia
E-mail: kpa@ipae.uran.ru; olga@ipae.uran.ru
[2]Institute of Archaeology and Ethnography,
Siberian Branch, Russian Academy of Sciences,
Pr. Akademika Lavrentieva 17, Novosibirsk, 630090, Russia
E-mail: pvs7zeitlos@gmail.com

Remains of Brown Bear (*Ursus arctos* L.) from the Kaninskaya Cave Sanctuary in the Northern Urals

Fossil remains of brown bear from Kaninskaya Cave in the Northern Urals are described. These were accumulated during the Late Bronze Age, Early Iron Age, and Late Iron Age as a result of human activity. We analyze the composition of the skeletal elements and the nature of their fragmentation. The sex and age of the individuals whose bones were apparently used in rituals are assessed, and the seasonality of these ceremonies is evaluated. The main focus of ceremonial actions during all chronological periods was a bear's head. Crania and mandibles were cracked into several parts in one and the same fashion. Other skeletal parts were used much less often. Most postcranial bones were likewise broken into several pieces. Such practices differ from modern Ob Ugrian bear rituals. In the Bronze Age, heads of adult male and female bears were used, and the ceremonies were performed mostly in winter, less often in summer and autumn, and very rarely in spring. In the Iron Age, too, heads of adult animals, mostly males, were used, and ceremonies were held throughout the year, but most often in summer and in winter. Seasonal bear rites were not practiced. Certain elements of rites, differing from those of modern Ob Ugrians, are reconstructed. Modern Ob Ugrian bear rituals were formed in the Late Iron Age.

Keywords: *Ural, brown bear, sanctuaries, ceremonies, Bronze Age, Iron Age.*

Introduction

To date, more than a hundred Holocene localities, each containing from one to several thousand bones of brown bear (*Ursus arctos* L.), have been found in the Urals (Kosintsev, Razhev, 1993). Large aggregations of Holocene brown bear remains have been discovered at archaeological sites in the caves of the Northern and Middle Urals (Kosintsev, 1995, 1996, 2000; Kuzmina, 1971). Almost all these sites have been dated to the Iron Age (Erokhin, Chairkin, 1995; Kanivets, 1964; Chairkin, Kosintsev, Borodin, 2005), when this area was populated mostly by Ugrian or Ugro-Samoyedic-speaking populations (Gening, Goldina, 1989; Oborin, 1989). The brown bear had a particular sacral and social status in the system of festive and ritual rites of the Ob Ugrians (Vasiliev, 1948; Chernetsov, 2001). This can be seen from the existence of periodic (seasonal) and sporadic (devoted to a successful hunt) "bear fests" during which a complex of rituals relating to the brown bear was performed, and the skull and bones of the animal were buried at the end of the fest (Vasiliev, 1948; Chernetsov, 2001). As the

burials were sometimes made in caves, it is possible that the rituals were also held in those caves (Lepekhin, 1780; Pallas, 1786).

Kaninskaya Cave, in the Northern Urals, is one of the sites containing the largest amount of bones of brown bear. It has been used as a sanctuary for more than two thousand years: from the Late Bronze Age to the Middle Ages (Kanivets, 1964). The archaeological finds from the cave were described by V.I. Kanivets (1964). The collection of brown bear remains from this cave includes about two thousand bones, which compose more than 60 % of all animal bone specimens found in the cave (Kuzmina, 1971). While the data on the number and the prevalence of various skeletal elements has been published (Ibid.), a thorough analysis of the brown bear bones from Kaninskaya Cave has not yet been carried out. In this study, the occupational and ritual activity of the ancient population of the Northern Urals relating to the brown bear is reconstructed via an analysis of the skeletal remains from Kaninskaya Cave.

Materials and methods

Kaninskaya Cave is located at the upper reaches of the Pechora River (Troitsko-Pechorsky District, the Komi Republic), near the estuary of the Unya River (coordinates 62°01′36″ N, 58°10′42″ E). From an archaeological point of view, Kaninskaya Cave is almost completely studied: the excavated area covered the entry pad, inlet mainsail, and the beginning of the internal passage, and disclosed all the friable sediments containing artifacts (Kanivets, 1964). The artifacts and bone remains lay in the upper three lithological layers, 0.4 to 0.7 meters thick (Ibid.). Bronze artifacts of the Seima-Turbino type, pottery from the Lebyazhinka, Glyadenovo, and Vanvizdino cultures, stone, bone, and metal arrowheads (more than 780 spec.), adornments and costume elements, and much less numerous tools (ca 100 spec.) were found in the layers (Ibid.). The finds have been dated to the Late Bronze Age, and the Early and Late Iron Ages. The lower layer was formed in the Late Bronze Age, while the two upper layers were formed in the Early Iron Age and the Middle Ages. The brown bear remains were separated into two groups according to the layer where they were found: the Late Bronze Age (hereinafter—the Bronze Age) and the Iron Age. The first group includes 261 bone from at least 16 individuals, while the second contains 1634 bones from at least 80 individuals. As the Holocene cultural layer was studied completely, the brown bear bone sample can be considered as representative of the remains found in the cave sediments. However, the sample probably does not include all the bones that fell into the cave, because some of these could have decayed on the surface, or been taken away from the cave.

In order to date the bones more precisely, an accelerator mass-spectrometry (AMS) radiocarbon dating was carried out. A standard technique for treatment of bone specimens, ABA, was applied (Brock et al., 2010). Chemical extraction of collagen was performed at the sample preparation laboratory of the Institute of Archaeology and Ethnography of the SB RAS. The collagen samples, 17 mg each, were burnt down independently in a continuous stream of helium (element analyzer Euro EA 3028, EuroVector, Milan, Italy). Carbon dioxide from the stream was isolated cryogenically, using liquid nitrogen. The carbon dioxide was then converted to graphite at an iron catalyst, and sent to a lab of the University of Arizona (Tucson) for dating.

A posterior half of a mandible from layer 2, which was cut off vertically along the corpus of the mandible, was dated. It revealed a date of 2046 ± 33 BP (NSKA-00848), which corresponds to the beginning of the Late Holocene (Subatlantic 1), i.e. the Early Iron Age, the time of the Glyadenovo culture (Vaskul, 1997). There are several more caves containing brown bear bones near Kaninskaya Cave. The bones found in Medvezhya Cave were dated to 29,527 ± 320 BP (NSKA-00846) and 12,045 ± 79 BP (NSKA-00847), those in the Figurny Mainsail to 13,085 ± 58 BP (NSKA-00849). These dates mean that the bones fell into the sediments of caves in the Late Pleistocene, and thus cannot be attributed to human activity during the Holocene.

While describing the number and composition of the brown bear's skeletal elements, the degree of fragmentation of the bones was taken into account. There were very few complete bones; thus a group of "contingently completer" bones was distinguished. This group includes fully complete bones, complete epiphyses and diaphyses, all marked as complete bones (Table 1).

As male and female brown bears are clearly distinguishable by the greatest length and width of the root of the canine (Koby, 1949; Yoneda, Abe, 1976; Baryshnikov, Mano, Masuda, 2004), we measured these dimensions in both subsamples (i.e. Bronze and Iron Ages). The sex rates were determined using scatter plots. The significance of deviations of the sex rates from equality was tested using the chi-square criterion (Lakin, 1990).

The season of death of the studied individuals was determined by examination of the annual layers in the cementum and dentine (Klevezal, 1988). Using this indicator, the times of death of bears can be determined with an accuracy of up to one season (Zavatsky, 1984; Inukai, Kadosaki, 1974; Craighead et al., 2014). Fifty-seven isolated teeth from the Bronze and Iron Age subsamples were selected for this analysis. The selection criteria included: 1) if the tooth belonged to a single individual (i.e. only one tooth from an individual was included in the sample); 2) side (left or right); 3) age at

death based on the crown's wear (or on the stage of dental development, in individuals younger than 2 years, see (Klevezal, 2007)); and 4) size. Some teeth were extracted from artificially treated mandibles, i.e. mandibles from ritual assemblages.

Results

Description of the bear bone remains. The composition of both subsamples (Bronze and Iron Ages) is similar in terms of the proportions of different skeletal elements (Table 1). Isolated teeth are prevalent, and fragments of skull and mandible are numerous, as well as complete atlases. The rest of the skeleton is represented only by very scarce fragments. Teeth marks left by large carnivores were not observed on the studied bones, while signs of gnawing by murine rodents are present on some bones. The skulls are strongly fragmented: only two of them can be considered "contingently complete". The skulls were broken in the orbital area (Fig. 1, lines 1-1' and 2-2'). In several skulls, the occipital condyles were broken off and the braincase was pierced, in some cases bilaterally (Fig. 1, *a*, line 3-3' and area 4). Such damage could only have been caused by the deliberate actions of humans.

Almost all mandibles were broken. Some were broken transversely, anterior, or posterior to the m_2, while in others

Table 1. **Composition of the sample of the brown bear remains from Kaninskaya Cave**

Skeletal element	Bronze Age		Iron Age	
	complete*	fragments	complete*	fragments
Cranium	0	41	2	468
Mandibula	0	36	7	79
Dentes	109	20	727	131
Hyoideum	8	0	3	0
Atlas	11	2	32	0
Vertebrae cervicales	0	0	2	2
Vertebrae thoracales	0	0	0	7
Vertebrae lumbales	0	0	1	0
Sacrum	0	0	0	1
Vertebrae caudalis	0	0	2	0
Sternum	2	0	3	0
Costae	1	8	6	34
Scapula	3	2	5	10
Pelvis	0	0	0	1
Humerus	0	1	0	5
Ulna	0	0	3	4
Radius	0	0	0	3
Femur	0	0	0	6
Tibia	0	0	0	5
Fibula	0	2	2	3
Calcaneus	0	0	1	0
Carpus, tarsus	2	0	21	0
Metapodium	3	2	8	5
Phalanges 1	2	2	17	2
Phalanges 2	2	0	11	0
Phalanges 3	2	0	9	0
Sesamoideum	0	0	6	0
Total, spec.	145	116	868	766

*Contingently complete bones.

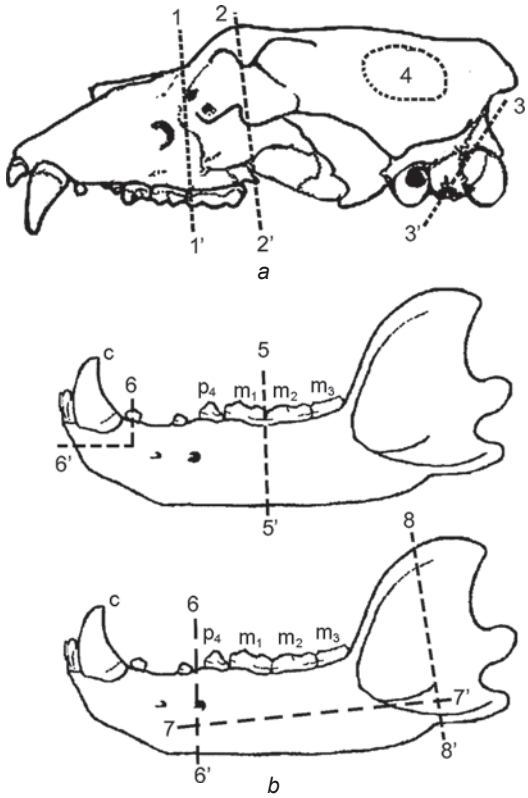

Fig. 1. Typical lesions of the skull (*a*) and mandible (*b*) of the cave bear.

the anterior part near the canine (c) (Fig. 1, *b*, line 6-6') or the lower part of the mandibular corpus (Fig. 1, *b*, line 7-7') was broken off. In some cases, the ascending ramus was separated (Fig. 1, *b*, line 8-8'). Traces made by tools can be identified on a number of the mandibles: there are deep vertical cuts on the corpus, anterior, or posterior to the m_2, along which the mandibles were crushed.

The isolated teeth are mostly complete (Table 1), though some buccal teeth were fragmented, likely during or after the burial process. Almost all the canines are complete, as these were (possibly intentionally) extracted from the mandibles by humans by breaking off a part of the canine socket (Fig. 1, *b*, line 6-6').

Almost all the atlases are complete (Table 1). Traces of tools indicating that the vertebrae were detached from the skull and brought to the cave separately were not detected. Obviously, they were cut off from the bear's carcass together with the head. Most of the other vertebrae are represented by fragments. The majority of ribs are cut or broken in the middle, their heads had been broken off.

The proximal and distal epiphyses of almost all long bones were broken off as well. In most cases, the diaphysis of the bones was split up lengthwise into several parts. Sometimes, either the ends or the middle of the diaphysis were chopped around and then the bone was crushed. Metapodia are found both completely preserved and broken up into two parts in the middle. The carpal and tarsal bones and phalanges are mostly complete. Only four broken first phalanges were found (Table 1).

The bones of a bear are notably robust—particularly the mandible, metapodia, phalanges, and long bones. Therefore, it is unlikely that the destruction described above occurred as a natural result of taphonomic processes during and after their deposition in the layer. Teeth-marks left by large carnivores are absent on the studied bones. Thus, the damage to the bones could only have been caused by human activity.

Hyoid bones are found among the remains (Table 1), and their presence, along with the atlases, suggests that whole heads with mandibles and atlases were brought to the cave. According to the number of the atlases found, at least 13 heads were brought there in the Bronze Age, and 32 in the Iron Age (Table 1).

The distribution of skeletal elements is very similar in the Bronze and Iron Age subsamples (Table 2). The skulls and mandibles (without isolated teeth) are prevalent,

Table 2. **Percentage of bones of various anatomical regions and the state of their preservation**

Region	Bronze Age			Iron Age		
	complete*	fragments	Total	complete*	fragments	Total
Head skeleton (cranium, mandible)	3	29	32	1	33	34
Isolated teeth	42	8	50	44	8	52
Axial skeleton (vertebrae, ribs)	5	4	9	3	3	6
Proximal limb elements (scapula, pelvis, humerus, ulna, radius, femur, tibia	1	2	3	1	2	3
Distal limb elements (carpus, tarsus, metapodia, phalanges 1–3)	4	2	6	4	1	5
Total, spec.	145	116	261	868	766	1634

*Legend same as in Table 1.

while elements of other parts of the skeleton are scarce: 9 % and 8 %, respectively (Table 2). The proportions of postcranial elements are 36 % and 28 %, respectively.

In the Iron Age subsample, a notable disproportion is observed between the numbers of upper and lower canines (Table 3), the former being twice as prevalent. The number of the lower canines roughly corresponds to the number of individuals, as determined by the prevalence of the atlases, upper and lower jaws; while there are more upper canines found in the cave than there are skulls. But the proportion of right to left canines does not differ from the natural, 1:1. This could be explained by isolated upper canines having been brought to the cave, while the skulls they belonged to were buried elsewhere.

Sexual composition of the sample. If it is assumed that the sexes of the animals were not taken into account when performing rituals in the cave, the sex ratio in the sample should be close to 1:1. In the scatter plots (Fig. 2), males and females are best separated by the dimensions of their lower canines. Judging from these graphs, in the

Table 3. **Sexual composition of the sample**

Canine	Side	Bronze Age		Iron Age	
		Male	Female	Male	Female
Upper	Right	2	2	31	22
	Left	1	5	46	26
	Total, spec.	3	7	77	48
Lower	Right	2	3	17	7
	Left	5	2	18	11
	Total, spec.	7	5	35	18

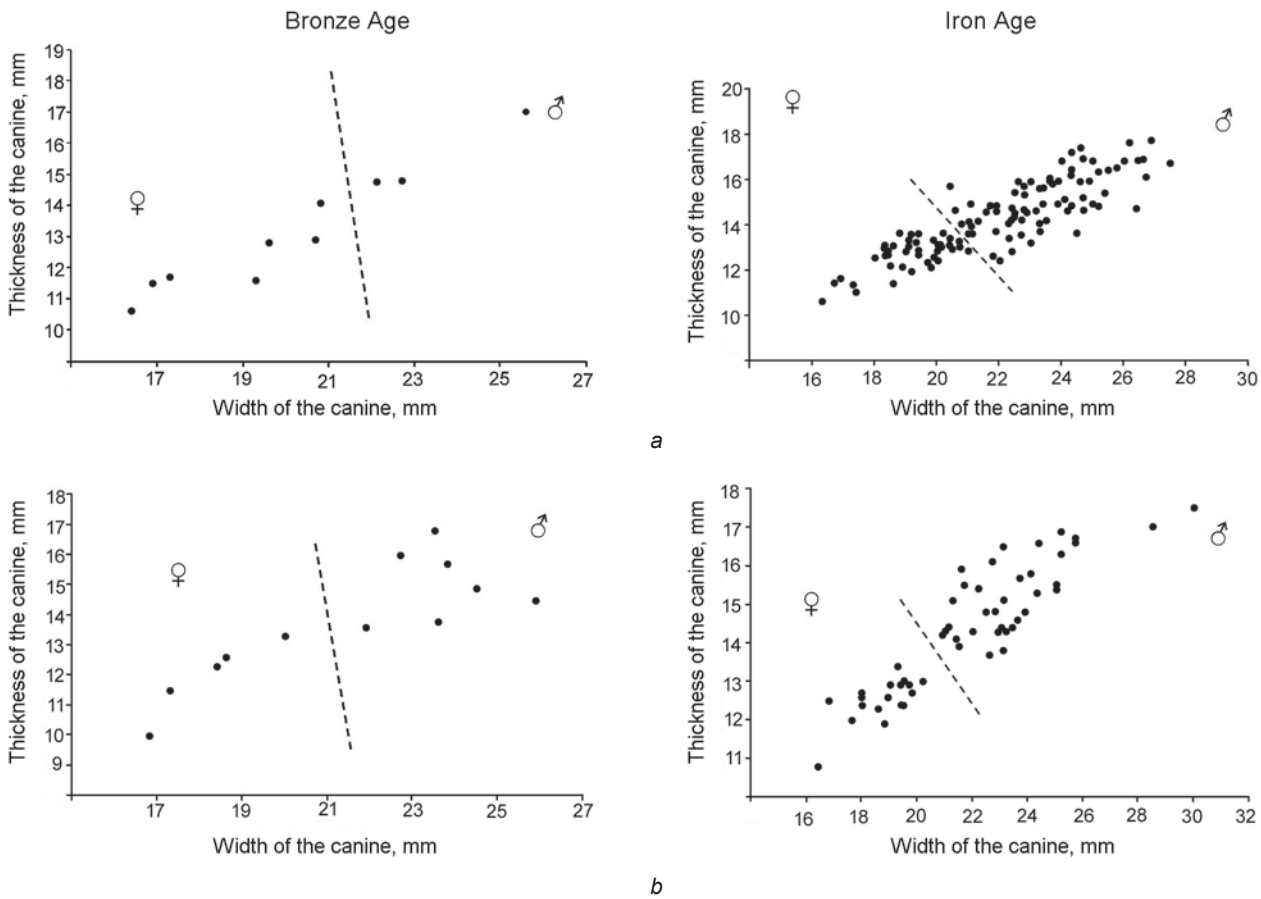

Fig. 2. Correspondence between the width and thickness of the upper (*a*) and lower (*b*) canines of the brown bears from Kaninskaya Cave.

Table 4. **Number of individuals that died during various seasons**

Season	Bronze Age			Iron Age		
	I*	M*	Total	I*	M*	Total
Winter	6	2	8	12	1	13
Spring	0	0	0	7	1	8
Summer	4	0	4	7	5	12
Autumn	3	0	3	9	0	9
Total	13	2	15	35	7	42

*I – isolated tooth; M – tooth from a mandible treated by humans.

Bronze Age sample there are the upper canines of three males and seven females, and the lower canines of seven males and five females (Table 3). As these figures are close to the 1:1 ratio, it can be concluded that males and females are equally represented in this sample. But in the Iron Age sample, a statistically significant prevalence of males is observed (Fig. 2): there are 77 male vs. 48 female upper canines, and 35 male vs. 18 female lower canines (Table 3).

Seasonality of the bear sacrifice. In the Bronze Age sample, individuals killed during summer or late winter are present, among which those who died in winter are prevalent. None of the animals in this sample was sacrificed in spring (Table 4). In the Iron Age sample, all seasons are represented, but the individuals killed during winter and summer are the most numerous (Table 4). The low sample-size of the Bronze Age group does not permit any firm conclusions regarding the difference between the two subsamples. But there is little doubt that in the Bronze Age many fewer animals were killed during spring.

Age distribution of the sample. The age at death based on the annual enamel layers and the stage of dental development (Klevezal, 1988, 2007) was determined for 16 Bronze Age individuals and 48 Iron Age individuals. As the sample size is low, only a very tentative description of the age distribution could be produced. In the Bronze Age sample, one individual is half-adult (2–3 years), four 3 to 7 year old, eight 10 to 15 year old, and three older than 15 years. In the Iron Age sample, there are eight young individuals (four younger than 1 year, and four at the age of 1–2 years), three half-adults (2–3 years), ten 3 to 7 year old, nineteen 8 to 15 year old, and eight older than 15 years. Thus, adult and old individuals are prevalent in both samples.

Discussion

The first important question to arise when exploring the data is: were all the bear bones deposited in Kaninskaya Cave the result of human activity? Brown bear use caves for winter hibernation, during which some individuals die and their bones become embedded in cave deposits (Kosintsev, Bachura, 2015; Ovodov, 1970). If the same caves were used by humans for rituals employing manipulations of parts of bear carcasses, then the bones have accumulated in the caves as a result of both natural mortality and human activity. It is hard to differentiate these two categories of bone remains, and it is particularly difficult to detect reliably the intentional destruction of bones. In other words, if an isolated complete bone is found in a cave, it is extremely difficult to determine for what reason it fell into the deposits. This problem can be solved by applying a taphonomic analysis. In the case of natural death of an animal, its full skeleton (i.e. 34 vertebrae, 28 ribs, 20 metapodia, 46 phalanges, and 22 large bones) becomes deposited in the cave. The studied sample includes 15 vertebrae (excluding the atlases), 49 ribs, 18 metapodia, and 47 phalanges (see Table 1), most of which were intentionally damaged. Complete pelvic, humeral, radial, and tibia bones are absent, as well as the talus and kneecaps. Only one calcaneus is present (see Table 1). These bones together are not enough to form even one complete skeleton. On the other hand, the number of the skull-bones, mandibles, and teeth (see Table 1) is huge: they belonged to at least 96 individuals. Thus, it is clear that the bear bones have accumulated in Kaninskaya Cave as a result of human activity (though the presence of a small amount of bones of the individuals that died for natural reasons cannot be completely excluded).

The analysis of the proportion of skeletal elements in the sample shows that skull bones, mandibles, and teeth are prevalent (see Table 2). Humans were bringing the bear heads with mandibles to the cave and performing ritual manipulations with them. There were a lot of such heads, but it is impossible to determine in what form they were brought to the cave: as complete heads, skulls, jaws, or parts thereof. The heads or parts of the heads of at least 16 individuals were deposited during the Bronze Age, and at least 80 individuals in the Iron Age. The proportion of the bones of axial skeleton, proximal and distal limb elements is small (see Table 2). In the Bronze Age sample they represent

at least four individuals, and in the Iron Age sample at least eight individuals. It is impossible to determine how these bones were brought to the cave. It could have been parts of the ribcage, limbs, paws, isolated bones, or in some cases heads and paws attached to the skin. If parts of the trunk or limbs were brought, they were butchered inside the cave. But a complete carcass has probably never been brought there.

Almost all the skulls, mandibles, and most of the postcranial bones were intentionally broken. The pattern of crushing the skull and mandible was stable: the braincase was pierced, the orbital region was broken and, in rare cases, the occipital condyles were broken off (see Fig. 1). The mandibles were most often split up into two parts; less often the posterior or incisor part of the lower border was broken off. The postcranial bones were butchered in different ways. The ribs were crushed in the middle; in the long bones, the lower and upper ends and/or the epiphyses were separated. All the bones were likely broken up inside the cave.

The manipulations with the bear bones typical of the Northern Urals populations of the Bronze and Iron Ages find analogies in the traditions of the modern aboriginal population of the Urals and Western Siberia. The Udmurt and Komi had (Konakov, 1983) and the Ob Ugrians still have (Vasiliev, 1948; Gondatti, 2000; Moldanov, 2010; Sokolova, 2002; Chernetsov, 2001) a tradition of ritual burial of the bear's skull and bones in the forest, near a lake, or in a hidden place at home. The skulls are sometimes placed at the roof of a house or outbuildings. In the 18th century, the Mansi of the Central and Northern Urals were taking the bear skulls to caves (Lepekhin, 1780; Pallas, 1786). It appears that the tradition of placing the bones of the killed bears in caves emerged no later than the Bronze Age, and has persisted until ethnographic times.

But the ways the ancient and modern hunters treated the bear bones differ substantially. As was noted, almost all the bones from Kaninskaya Cave were deliberately broken. Such treatment of the bones is not typical of the modern Ob Ugrians. Most researchers point out that the tradition of these peoples forbids breaking of the bear bones (Vasiliev, 1948; Gondatti, 2000; Moldanov, 2010; Sokolova, 2002; Chernetsov, 2001). Only N.N. Kharuzin (1899) noted, in the beliefs of the Khanty and Mansi, an idea that might provide a basis for the destruction of the bear skull: that a sinner who insulted a bear would have a long life. Also, a man had the right to break the bones of a man-eating bear killed by himself (Gondatti, 2000). But Kharuzin's opinion is not confirmed by other research on the Ob Ugrian traditions, while the situation with a man-eating bear occurs very rarely. Thus, we can suggest that in the end of the Late Iron Age or a bit later, the ritual of breaking the bear bones before burying them had been abandoned, and it became traditional to leave them complete.

The results of this study provide information regarding the season when the animals were killed, not the season the ritual was performed. It is possible that in the past these two events were separated in time. But according to ethnographic data (Ibid.; Konakov, 1983; Sokolova, 2002; Chernetsov, 2001), it is more plausible that the rituals were carried out in the same season that the bear was killed. In the Bronze Age, most animals were killed in winter, many fewer in autumn and summer; while none of them was harvested during spring (see Table 3). But owing to the low sample size, we cannot confidently conclude that there was no bear-hunting in spring. It is more likely that it occurred all year round, but less often in spring. In the Iron Age, hunting of the bear took place all year round, but mainly during winter and summer (see Table 3).

According to ethnographic data, the Ob Ugrians had both periodic (seasonal) and sporadic (on the occasion of a successful hunt) bear fests (Chernetsov, 2001; Sokolova, 2002). The seasonal fests were arranged yearly, between the end of December and the end of March (Sokolova, 2002). The Komi had only sporadic ceremonies relating to the bear-hunt (Konakov, 1983). If the ancient fests, in the Iron Age in particular, had been periodic, the remains belonging to the season of performing the ritual would have been prevalent in the cave deposits. But the studied materials do not lead to such a conclusion. It seems more rational to suggest that there were periodic rituals carried out every season; or, alternatively, sporadic fests after every successful bear-hunt. These two versions are not mutually exclusive; but if both are correct, it is difficult to explain the even seasonal distribution of the specimens in the Iron Age sample. Thus, we find the latter explanation more plausible, and suggest that the tradition of periodic bear fests emerged relatively late, during the Iron Age.

The results of the analysis of age- and sex-distributions in the sample show that during both Bronze and Iron Ages, remains of adult individuals were predominantly used for the rituals (see Table 4). But the two periods differ in terms of their sex ratios: while in the Bronze Age sample the ratio is close to 1:1 (see Table 2), in the Iron Age sample male specimens occur significantly more often (see Table 3). Notably, the modern Ob Ugrians hunt both young and adult animals, and males as well as females (Vasiliev, 1948; Gondatti, 2000; Sokolova, 2002; Chernetsov, 2001). None of the ethnographic studies points to a selective hunt of the bears (including that for the bear fests) by the modern Ob Ugrians dependant on the age or sex of the animals. This was probably the case in the Bronze Age as well. But in the Iron Age, male bear carcasses were mostly used, and this tradition was abandoned only later.

Conclusions

The results of this study show that the remains of brown bear in Kaninskaya Cave accumulated as a result of human activity during the Bronze and Iron Ages, and Medieval times. Some general details of this ritual activity can be reconstructed. The prevalence of the brown bear specimens among the bones found in the cave suggests that the bear was one of the main objects of the rituals, and the head of this animal was their most important attribute. The skulls and mandibles were broken apart according to standard schemes. The skull was broken in the orbital area, and the braincase was often pierced. The mandible was typically split into two parts; its lower border, posterior part, or the incisor area was usually broken off. During the Iron Age, separate canines extracted from the skulls were brought to the cave alongside the heads. Other parts of the body were used in the rituals much more rarely. Most postcranial elements were broken apart as well. Such treatment of the bear remains is contrary to the traditions of modern Komi and Ob Ugrians. This latter attitude, much more respectful towards bear remains, had probably emerged by the end of the Iron Age.

The heads of adult males and females were used for the cave rituals during the Bronze Age. In the Iron Age, the heads of adult individuals were used as well, but mostly male. During the Bronze Age, the rituals were held mostly in winter, less often in summer or autumn, and probably very rarely in spring. In the Iron Age, they took place all year round, but most often in summer or in winter. It seems that bear fests in the past were not confined to a particular season and were held all year round. Seasonal bear fests started being celebrated at the end of the Iron Age.

The results of the study of the osteological materials from Kaninskaya Cave suggest that, during the Late Bronze and Early Iron Ages and Medieval times, the bear was one of the main sacrificial animals of populations of the Northern Urals. But the ancient rituals do not find direct analogs in ethnographic modernity. Rather, our results lead to the conclusion that the rituals related to the bear-hunting of the present day Ob Ugrians, including seasonal bear fests, had emerged in their modern forms by the end of the Iron Age.

Acknowledgements

Description of the material was performed under public contract of the Institute of Plant and Animal Ecology (IPAE), Ural Branch of the Russian Academy of Sciences. Analysis of the data was performed by fellows of the IPAE UB RAS, supported by the Russian Foundation for Basic Research (Project No. 14-04-92104), and by fellows of the IAET SB RAS, supported by the Russian Science Foundation (Project No. 14-50-00036). The authors express their gratitude to the staff of the NSF Arizona AMS Laboratory, University of Arizona (Tucson, USA) for technical assistance.

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Received March 22, 2016.