THE BEARS OF ILLINKA CAVE NEAR ODESSA (UKRAINE)

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Abstract

The fossil remains from the Ilinka cave near Odessa, Upper Pleistocene, yielded a considerable amount of cave bear remains during the excavation campaigns between 1939 and 1945. The cave became of interest when bone and stone artifacts surfaced and consecutive works and publications focused on this topics. In the beginning of 2000, in the course of a co-operation between the university of Vienna and the Museum of Odessa, it was possible to evaluate the cave bear remains for the first time morphologically as well as metrically. This and an AMS-dating revealed the presence of the highly developed cave bear *Ursus ingressus* between 30.000 and 46.000 years BP in the so called Nordmann territory. The acknowledgment of two time layers in this cave is of importance for the age assignment of the Paleolithic tools.

Samenvatting

De laat-pleistocene fossiele overblijfselen uit de Ilianca grot bij Odessa bevatten een aanzienlijke hoeveelheid materiaal van grottenberen, opgegraven tussen 1939 en 1945. De grot werd interessant toen artefacten van bot en steen tevoorschijn kwamen en er vervolgens over gepubliceerd werd. Begin 2000, in de loop van een samenwerkingsverband tussen de universiteit van Wenen en het Museum van Odessa, werd het mogelijk om het grottenbeermateriaal voor de eerste keer zowel morfologisch als metrisch te evalueren. Dit, en een koolstofdatering, openbaarde de aanwezigheid van de sterk ontwikkelde grottenbeer *Ursus ingressus*, met een ouderdom tussen 30.000 en 46.000 BP, uit het zogenaamde Nordmann district. De erkenning van twee tijdlagen in deze grot is van betekenis voor de ouderdomsbepaling van de Paleolithische artefacten.

PREFACE

The city of Odessa was built on the so called Odessa limestone, an Upper Miocene calcareous sandstone layer, criss-crossed by numerous karst caves that contain Late Pleistocene vertebrate remains. Nordmann (1849, 1858-1860) was the first to excavate in this area. The majority of the fossil material he excavated in the so-called "Nordmann caves" is now stored at the University of Helsinki. Kurtén (1969) interpreted the fauna as of interstadial age, because "cold" elements seemed to be rare. Only a few new sites have been found since then, one of them was a small cave 26km north of Odessa on the western shore of Limen Kui-al'nyk.

In the period between 1938 and 1945 several excavations were carried out in this small cave near the Illinka village. The material includes numerous stone artifacts, some from the Mousterian and some from the basal Upper Paleolithic. Beside these artefacts a large amount of mammalian remains were found, but bones and teeth of cave bears dominated by far.

SHORT HISTORY OF EXPLORATION

The first palaeontological excavation was held in 1938. A large number of bones and three flint fragments were found, one of the flints above the bone-bearing horizon (Roshchin, 1939, 1941). Due to these spectacular findings several palaeontological excavations took place during 1939-1940 and more than 10.000 bone fragments and 38 stone artefacts were collected, but the planigraphy and stratigraphy were not reported. One of the most exciting findings was a fragment of a flint plate discovered by A.V. Dobrovolsky (1950). At that year all collected flints were stored at the Department of Material Culture and History in Leningrad and first results of this material were published by N. Zamiatnin in 1950. In 1964 the collection of 39 flint and 4 quartzite artefacts were brought to the Archaeological Museum in Odessa (Sapozhnikov & Sapozhnikova, 1989).

In 1941 A.V. Dobrovolsky led another excavation at the Illinka cave. He explored 4.5 m^2 of the cave and discovered 10 flint fragments, micro blades and points beside numerous bones. Due to this campaign it became possible to evaluate the stratigraphy of the findings. The bones were irregularly distributed within the profile, completely absent in the first 1.2 m, but beneath this depth more or less evenly distributed. Flints were found in a depth of 0.8 to 0.25 m. In the lowermost part of the section all bones were black coloured and scattered (Dobrovolsky, 1950).

Further excavations were executed in 1944-1945 by T. Grytsai, but the results are unknown. In 1945 and 1946 P.P. Efimenko visited the cave and in 1946 a special expedition of the Archaeological Institute of the Ukrainian Academy of Science was organized under I.G. Pidoplichko and further exploration of the cave was done, but although around 10 m^3 were excavated no further flints were found. Therefore the dating and interpretation of the findings can only be solved on the basis of the campaigns of 1941 and 1946 (Sapozhnikov & Sapozhnikova, 1989).

Figure 1: Geographic position of the cave bear sites "Illinka" and "Nerubajskoe" near Odesaa (Ukrania) (after Nagel et al., 2005)

Figuur 1: Geografische positive van de grottenbeersites "Illinka" en "Nerubajskoe" bij Odesaa (Oekraïne) (naar Nagel et al., 2005)

Sapozhnikov and Sapozhnikova (1989) divided all stone artefacts into three complexes, called "ancient", "late", and "modern" of which the ancient complex was identified as Mousterian (Pidoplichko 1949; Dobrovolsky 1950; Efimenko 1953, 1954) and the "late" complex was attributed to the lower Late Palaeolithic. Besides stone tools some bone polishers and drilled bear canines were found. One of the bone tools was ^{14}C dated to 27.500 ± 210 Ki-11681) (Sapozhnikov, 2005). The flints of the "modern" complex were possibly inserts of threshing board.

Some scientists hypothesized an ancient cave bear cult because one of the bear skulls was found between stone plates, one mandible leaned against four limestone plates (Pidoplichko 1956; Dobrovolsky 1950) and 10 bear skulls were assembled on the right wall of the cave and covered with a stone plate (Efimenko, 1948). Due to missing evidence of human influence other scientists strongly doubt this theory (Sapozhnikov & Sapozhnikova, 1989).

SYSTEMATIC DESCRIPTION

During several excursions by scientists of the University of Vienna, the bear remains from the Illinka cave, which are kept at the Institute of Paleontology at the University Odessa, were measured and morphologically analyzed. The results can be found in table 1.

Figure 2: Leftovers of the bear cave near the village Ilinka

Figuur 2: Overblijfselen van de berengrot bij het dorp Ilinka

Figure 3: Entrance of Illinka cave

Figuur 3: Ingang van de Illinka grot

METRIC

The majority of the bear teeth from the Illinka cave belong to a large-sized cave bear-taxon. The measurements are comparable with the faunas of *Ursus ingressus* which have been described from the Alps, the Classic Karst and the Carpathians: Gamssulzen cave (Rabeder, 1995), Nixloch in Losenstein-Ternberg (Nagel & Rabeder 1992), Drachenhöhle Mixnitz (Frischauf *et al*., 2014), Potocka zijalka (Pacher *et al*., 2004) and Krizna jama (Pacher *et al*., 2014).
In the faunas of *Ursus spelaeus* (represented with the subspecies *Ursus spelaeus eremus* in eastern Central Europe, (Rabeder *et al*., 2004)), the dimensions of the teeth are 7% smaller in average (Schwabenreith Cave, Herdengelhöhle-older layers (see Rabeder, 1999)).
The mean values (longitude and latitude) of the molars of the bears from the Illinka cave fluctuate around the mean values of *U. ingressus* from Gamssulzen cave by -2% to +4% (see Rabeder, 1995).
The metapodials of the Illinka bears are longer (by 2%) but narrower (4%) and therefore slimmer (see tab.4).

LOCOMOTION VERSUS DIETARY HABITS (LDH-DIAGRAM)

The evolutionary lines of the "Big Bears" (subgenus *Ursus s.s.*) differ in developmental contrary trends (Rabeder *et al*., 2011): brown bears and polar bears show extended limbs, while the dentition is almost unchanged or even reduced. The dentition of cave bears is augmented whilst the extremities are shorter and thicker. The relation between dentition and limb development can be seen in the so-called "locomotion

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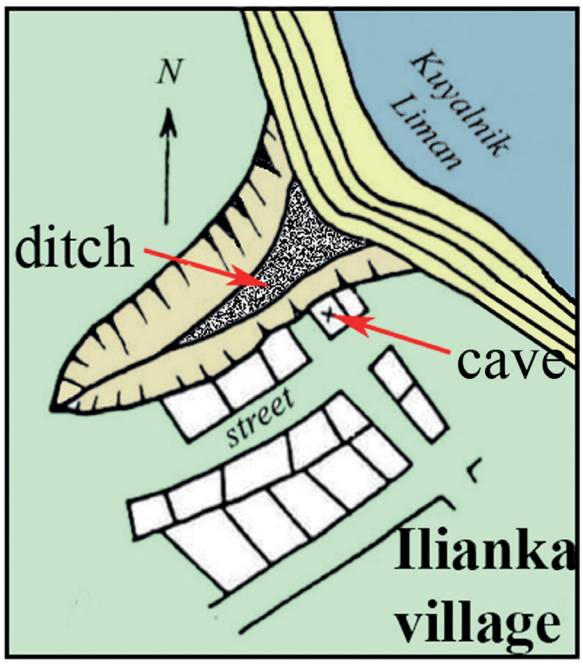

Figure 4: Cave location in the Ilinka Village (after Roschin, 1939)

Figuur 4: Locatie van de grot in het dorp Ilinka (naar Roschin, 1939)

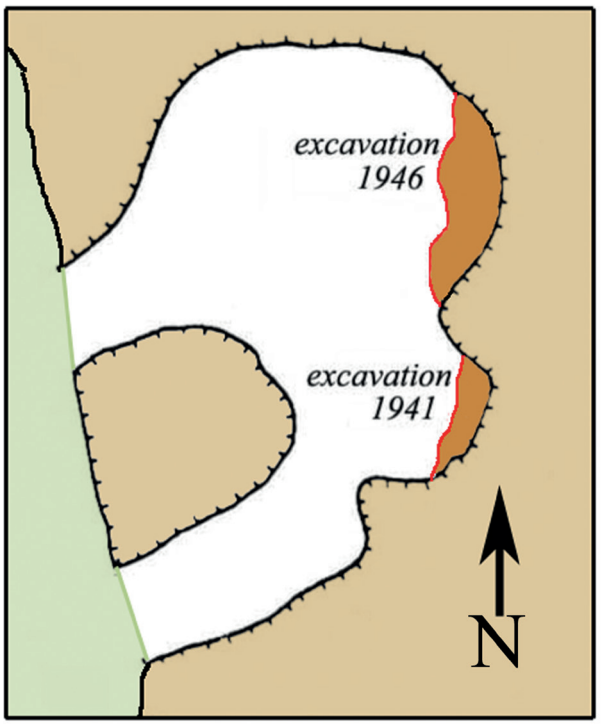

Figure 5: General plan of the cave (after A.V. Dobrovolsky, 1941)

Figuur 5: Plattegrond van de grot (naar A.V. Dobrovolsky, 1941)

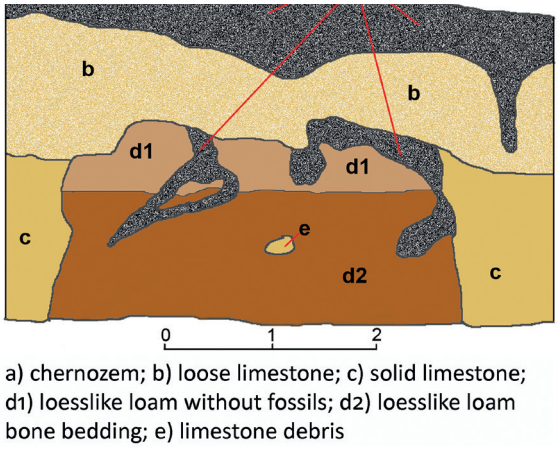

Figure 6: Plan of excavation in 1941 (after A.V. Dobrovolsky, 1941)

Figuur 6: Plattegrond van de opgraving in 1941 (naar A.V. Dobrovolsky, 1941)

versus dietary habits diagrams" (= "run-chew-diagrams" see Frischauf *et al*., 2014). All the values of a statistically relevant amount of teeth and metapodials are standardized. As a standard, the average of all standardized molar lengths and the average of all standardized metapodial lengths of *Ursus ingressus* from Gamssulzenhöhle (Rabeder, 1995) are used. This forms a pair of values for each fossil bear population or for a skeleton, which allows the comparison between fossil bear populations and modern bears.
The run-chew-diagram can be important for the classification within the cave bear group, to interrelate the degree of specialization in direction of the "spelaeoid type" (enlargement of the molars, coarsening of the extremities) or the "arctoid type" (extended and slimmer extremities, primitive dentition, see Rabeder *et al*., 2011).

MORPHODYNAMIC INDICES

The morphodynamic indices of the premolars from Illinka have much lower values than those of the typus fauna of *Ursus ingressus*, which matches the trends in alpine cave bears.

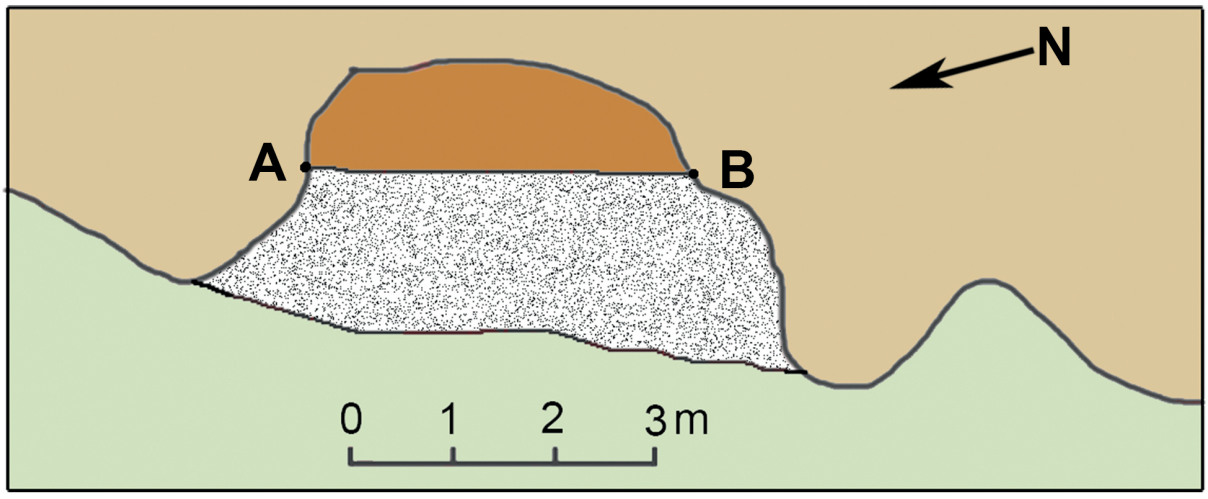

Figure 7: Section of sediments in excavation of 1941 (after A.V. Dobrovolsky, 1941)

Figuur 7: Sectie van sedimenten in de opgraving van 1941 (naar A.V. Dobrovolsky, 1941)

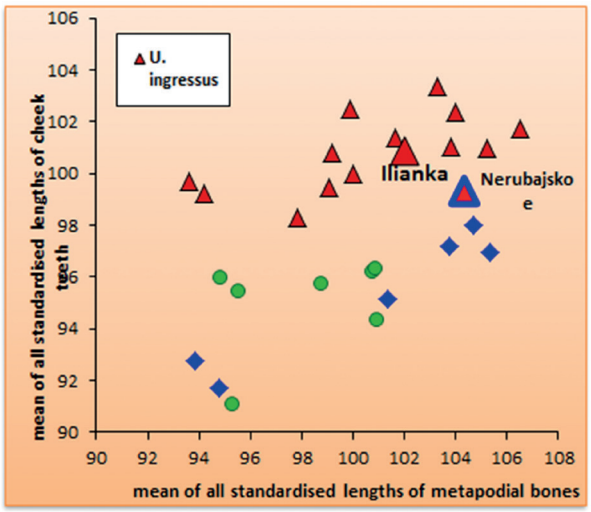

Figure 8: Locomotion vs. Dietary Habit-Diagramme of cave bear faunas of the Alps in comparison to the faunas of Illinka cave and Nerubajskoe cave

Figuur 8: LDH-diagram van grottenbeerfauna's uit de Alpen in vergelijking met de fauna's van de Illinka grot en de Nerubajskoe grot

Within the *U. ingressus* group the morphodynamic indices of the dentition (P4 sup index, p4 inf. index and P4/4 index and the m2 enthypoconid index) are closely related to the altitude of the caves (Rabeder *et al*., 2008): the higher the site is, the higher the values of the indices. The relatively low value of the P4/4 index is in accordance with the low altitude (75m) of the cave and is comparable with the value of the lowest alpine bear cave (Windener Bärenhöhle, 190m).

The trend lines in the graph (Fig.9) show that the evolutionary level of *Ursus ingressus* is correlated with the altitude of the sites. The fauna of the Illinka cave corresponds with this trend.

URSUS ARCTOS L.?

The dental material of the Illinka cave may also contain brown bear teeth. Among the mandibular premolars of Illinka bears two specimens of the morphotype b1 (Rabeder, 1983) were found: the P4 has a small lingual cusp beside the lingual edge of the main cusp (protoconid). This morphotype occurs in *Ursus arctos* relatively frequently and has been homologated as the metaconid due to its location. In primitive cave bears it is represented as morphotype B1, which has a paraconid as an accessory side cusp.
Because brown bears in the Pleistocene were a bit smaller than cave bears of the same age, some of the smaller molars from the material of the Illinka cave may originate from brown bears. However, metapodials of brown bears, which can be easily recognized by their slenderness, were not found.

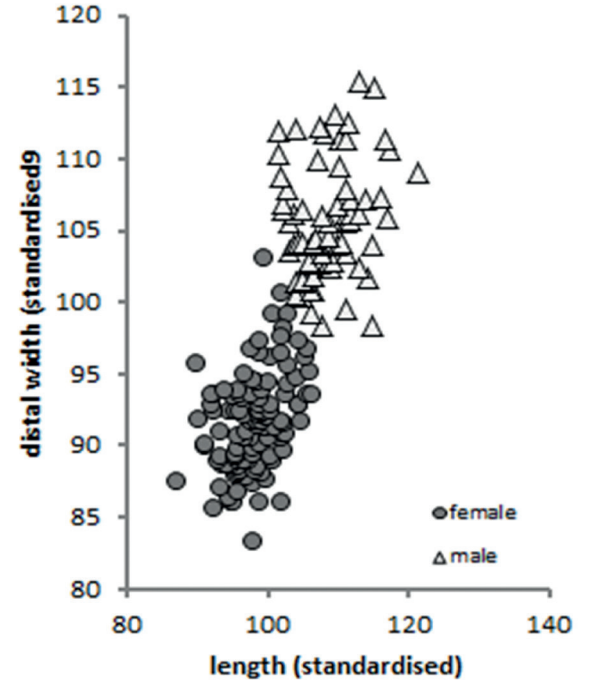

Figure 10: Scatter diagram of all standardized metapodial bones from Illinka cave

Figuur 10: Spreidingsdiagram van alle gestandaardiseerde metapoden uit de Illinka grot

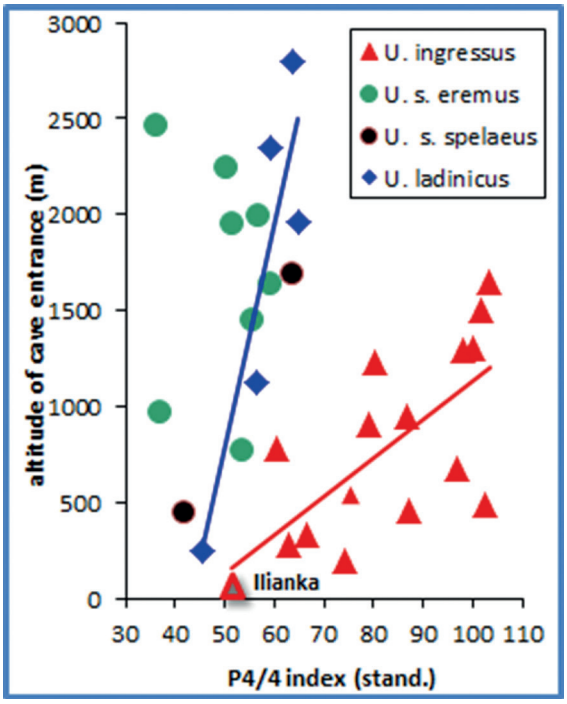

Figure 9: Morphodynamic position of premolar index (p4/4 index) and the altitude of cave entrances of Middle Wurmian cave bear fauna from Illinka cave in comparison to faunas of Alps, Carpathians, German and Greece

Figuur 9: Morfodynamische positive van de premolaarindex (p4/4 index) en de hoogte van grotopeningen van de midden-wurmiaanse grottenbeerfauna uit de Illinka grot in vergelijking met fauna's van de Alpen, Karpaten, Duitsland en Griekenland

SEX INDEX

Male and female individuals can be easily distinguished by the canines due to high sexual dimorphism in these teeth (Rabeder & Withalm, 2014). Unfortunately it was not possible to take all measurements of the canines from the Illinka cave, as the excavations in Nerubajskoe (Nagel, 2005) had to be completed in time.
The sex ratio can also be calculated by the size differences of the metapodials (Fig. 10). From the material examined, 60% of the individuals are female (see Rabeder *et al*., 2008, Figure 13).
The sexual dimorphism index for metapodials found at this site is approximately 110% for the length and 115% for the width and lies within normal distribution (Table 4.).

SYSTEMATIC POSITION

In 2003 and 2004, morphometric and morphological analysis of the cave bear remains were carried out in cooperation with the University of Odessa. From comparisons between the faunas of the Alps and the Carpathians, we can conclude that the cave bears of the Ilinka cave belong to *Ursus ingressus* (Rabeder *et al*., 2004).

metapodial	Mc1	Mc2	Mc3	Mc4	Mc5	mt1	mt2	mt3	mt4	mt5	total
n	5	68	28	33	9	2	27	9	12	5	198
cheek teeth	mand.	P4	M1	M2	p4	m1	m2	m3			total
n	15	41	34	65	37	28	50	54			324
limb bones	hum.	radius	ulna	femur	tibia	fib	scl	calc	astr		total
n	10	21	18	4	25	0	43	66	43		198

Table 1: Studied material of Ursus from Illinka cave

Tabel 1: Bestudeerd materiaal van Ursus uit de Illinka grot

element	mean (mm)	Gamssulzen standard	mean standardized	devi-ation	max (mm)	min (mm)	number
P4 sup. length	19,99	20,13	99,32	1,02	21,8	17,4	42
P4 sup. width	13,90	14,21	97,78	1,23	16,05	11,25	41
P4 sup. index	114,29	255,70	44,70	–	–	–	42
M1 sup. length	28,70	28,73	99,91	1,30	31,2	26,1	35
M1 sup. width	19,75	19,75	99,98	1,00	21,6	17,6	35
M2 length	45,11	44,40	101,59	2,48	50	37,9	66
M2 width	23,00	22,55	102,24	1,39	25,4	19,5	63
M2 metaloph index	259,46	375,00	69,19	–	–	–	74
P4/4 index	115,58	225,12	51,34				
p4 inf. length	15,84	15,24	103,91	1,15	18,1	13,45	37
p4 inf. width	12,45	10,32	103,60	0,84	12,1	8,95	37
p4 inf. index	116,89	198,20	58,98	–	–	–	37
m1 inf. length	30,04	30,22	99,39	1,42	32,8	27,3	27
m1 inf. width	14,49	14,50	99,90	1,03	17,1	12,5	28
m2 inf. length	31,04	30,63	101,33	1,41	33,80	28,30	47,00
m2 inf. width	19,17	18,25	105,02	1,23	22,10	16,40	50,00
m2 enthypoconid index	158,00	185,30	85,27	–	–	–	50
m3 inf. length	27,59	27,56	100,09	2,06	32,1	21,1	55
m3 inf. width	19,48	19,11	101,92	1,26	22,5	17	55
m3/m2 index length	88,88	89,98	98,79				
m3/m2 index width	101,62	104,71	97,05				

Table 2: Means of measurements of cheek teeth of Ursus ingressus from Illinka cave

Tabel 2: Gemiddelden van de gemeten waardes van kiezen van Ursus ingressus van de Illinka grot

	Illinka	n	GS standard	standardised
P4 sup index	114,29	42	255,7	44,70
p4 inf index	116,89	37	198,2	58,98
P4/4 index	115,58		225,12	51,34

Table 3: Morphodynamic indices of fourth premolars of Ursus ingressus from Illinka cave

Tabel 3: Morfodynamische indexen van de vierde premolaar van Ursus ingressus uit de Illinka grot

Metapodial bones	number
females	116
males	74
total	190
sex index	61,05

means	length	epiphyseal width	plumpness index
females (stand.)	97,97	91,60	93,63
males (stand.)	108,57	106,13	97,89
all (stand.)	102,08	96,40	95,07
sex dimorphism index	110,82	115,85	104,55

Table 4: Frequencies and mean values of female and male metapodials of Ursus from Illinka cave

Tabel 4: Frequenties en gemiddelde waarden van vrouwelijke en mannelijke metapoden van Ursus uit de Illinka grot

	Ilinka cave	specimens	individuals	Odessa-Nerubaj caves Kurtén (1969)
Carnivora	Ursus ingressuss	29.336	374	Ursus spelaeus
	Crocuta crocuta	12	3	Crocuta crocuta spelaea
	Canis lupus	9	4	Canis lupus
	Vulpes vulpes	5	4	Vulpes vulpes
	Vulpes corsak	3	3	Vulpes cf. corsac
	Meles meles	524	51	cf. Martes martes
	Panthera leo	6	1	Panthera leo spelaea
Rodentia	Spalax sp.	8	4	Spalax sp.
	Cricetus cricetus	1	1	Citellus cf. suslicus
	Hystrix sp.	2	2	Castor fiber
				Arvicola sp.
Lagomorpha	Lepus europaeus	2	2	Lepus sp.
	Ochotona pusilla	8	3	
Perissodactyla	Equus ferus	14	4	Equus sp.
	Coelodonta antiquitatis	1	1	Equus (asinus) sp.
				Coelodonta antiquitatis
Artiodactyla	Bison priscus	24	4	Bison priscus
	Saiga tartarica	3	3	Bos primigenius
	Capreolus capreolus	2	2	Alces alces
	Cervus elaphus	11	2	Megaceros sp.
				Dama dama
				Capreolus capreolus
				Rangifer tarandus
				Sus scrofa
Proboscidea				Mammuthus primigenius

Table 5: Faunal lists of fossil mammals of Illinka cave (after Ridush, 2009) and Odessa-Nerubajskoe caves (Kurtén, 1969)

Tabel 5: Faunalijst van fossiele zoogdieren uit de Illinka (naar Ridush, 2009) en Odessa-Nerubajskoe grotten (Kurtén, 1969)

Locality	Material	Lab nr.	Method	C14 age years BP	error +	error –	CalPal years BP	error + / -	References
Nordmann cave	cave bear bone	ST-2644	C14	26930	980	980	31618	918	Kurtén 1969
Illinka cave	bone tool	Ki-11681	AMS	27500	210	210	32102	228	Sapozhnikov, 2005
Illinka cave	cave bear bone	VERA-2195	AMS	41700	1200	1100	45286	1262	original
Nerubajskoe	rib artiodactyle	VERA-2763	AMS	13.335	45	45	16271	416	Nagel et al. 2005
Nerubajskoe	cave bear bone	VERA-2761	AMS	>52.450					Nagel et al. 2005

*Table 6: Radiometric data of fossil bones from bear caves near Odessa. *calibrated by www.calpal-online.de*
*Tabel 6: Radiometrische gegevens van fossiele botten van grottenberen bij Odessa. *gecalibreerd door www.calpal-online.de*

On the other hand, there are metric and morphological differences, which can be explained by adaptations to life in different habitats and climates.

The comparison of the evolutionary levels (Fig.9) as well as the dimensions of teeth and metapodials (Fig. 8) shows that the fauna of the Illinka cave is situated within the cluster of *Ursus ingressus*.

COMPARISON TO THE CAVE BEAR FAUNA FROM NERUBAJSKOE

The fauna of Nerubajskoe was discovered in a small cave ruin that also belongs to the "Old Nordmann Territory" and is located approximately only 16 km from the llianka cave (Nagel *et al*., 2005). Although the amount of fossil material from Nerubajskoe is not large, it is possible to assign the bear fauna to *Ursus ingressus*. The "run-chew" diagram (Fig. 8) also shows that both bear populations are closely related with each other. Based on DNA analyses, these populations are part of a cluster that contains several faunas belonging to the species *Ursus ingressus*.

ADDITIONAL FAUNA

The fauna of Illinka cave (Ridush, 2009) includes, other than cave bears, 17 different taxa (see faunal list). The horse (*Equus* sp.), bison (*Bison priscus*) and red deer (*Cervus elaphus*) are very numerous, while the typical elements of a cold steppe like woolly rhino (*Coelodonta*) or saiga (*Saiga tartarica*) are quite rare. Furthermore the porcupine (*Hystrix*), typical for a more moderate climate, is present. Kurtén (1969) speculated that among the material from the old Nordmann caves, a similar distribution can be seen: elements from two different time periods. The possible presence of a brown bear would fit into this assumption, since these two large carnivores never share the same space at the same time.

Among the carnivores, the great amount of badgers must be mentioned. The cave was probably a badger den for some time. Cave hyena and cave lion are rare but well documented. The co-occurance of *Lepus* and *Ochotona* , while seldom seen in Middle Europe, is more typical for an eastern steppe fauna.

DATINGS FROM THE NORDMANN TERRITORY

Kurtén, in cooperation with the Laboratory for Radioactive Dating in Stockholm, tried to date material from the Nordmann caves. The resulting date, 26.930 ± 980 a BP, from a conventional radiocarbone analyses, must be seen as an average. Several different fragments were used (Kurtén, 1969) but still the age is close to the result from Ilinka (27.500 years BP, bone tool, Ki-11681) (Sapozhnikov, 2005). A new dating (VERA-2195) executed on a cave bear bone brought a significantly higher age value, indicating two different layers of occupation. The age assignment of the Palaeolithic tools, found above the cave bear horizon, is more precise now.

Two different time layers were also recorded from Nerubajskoe. The *Ursus* material was outside the range of ^{14}C-method (>52.450 a BP; VERA-2761). It was dated with the accelerator method in 2003 (Nagel *et al*., 2005). A rib fragment of an artiodactyla from that site belonged to the latest Pleistocene with 13.355 ± 45 (calibrates 14.700 a BC; VERA-2763).

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