

Additional Faunal Elements from Križna jama (Slovenia)

by

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Abstract

This study is concerned with the carnivore remains from the cave site Križna jama in Slovenia. The number of faunal elements is relatively small. All bones and teeth came from old excavations. A short description of the fossil remains of wolf, wolverine and pine marten will be given.

Keywords: carnivores, Late Pleistocene, Križna jama, Slovenia

Zusammenfassung

Die Raubtierfunde aus der Höhle Križna jama in Slowenien werden vorgestellt. Die Individuenanzahl ist klein. Alle Knochen und Zähne stammen aus alten Grabungen. Die fossilen Funde von Wolf, Vielfraß und Baummarder werden kurz beschrieben.

Schlüsselwörter: Raubtiere, Oberpleistozän, Križna jama, Slowenien

Izveček

V tej študiji so obravnavani ostanki karnivorov iz nahajališča Križna jama v Sloveniji. Število živalskih elementov je sorazmerno majhno, vsi ostanki kosti in zob pa izhajajo iz prejšnjih izkopavanj. Podajamo kratek opis ostankov volka, ameriškega rosomaha in kune zlatice.

Ključne besede: karnivori, zgornji pleistocen, Križna jama, Slovenija

1. Introduction

The cave is located on the east side of the intermittent Lake Cerknica at Lož, about 20 km E of Postojna. The eight km long Križna jama is well known for its rich stalagmite decoration and its underground lakes as well as for the numerous cave bear remains. The water part was discovered in 1926. First excavations took place in 1878 and 1879 by F. von HOCHSTETTER (1881). Cave bear bones could be detected only in two areas of the cave (Medvedji rov/Bear Passage and Kittlova brezna/Kittl's Abyss). However, evidence of additional faunal elements is rare.

The fauna according to HOCHSTETTER (1881:305) consists of *Ursus spelaeus* (99%, all ages, 2000 bones, more than 100 individuals), *Canis lupus*, *Martes foina* and *Gulo gulo*.

2. Methods

A short description of the fossil remains from Križna jama will be given. Bones and teeth were measured to the nearest 0.1 mm following the definitions of VAN DEN DRIESCH (1976). The number of individuals (MNI) and bone elements (brackets) is given for each species.

3. Description of the Material

Among additional faunal elements five species are confirmed. All of them were found during the old excavations. LIEBE (1879) already mentioned an epistropheus and a third cervical vertebra of *Canis lupus*. The two vertebrae are grown together. In addition, an ulna from *Gulo gulo* and a skull from *Martes martes* (pine marten) were mentioned. Already LIEBE (1879) stated that the skull looks modern suggesting diluvial age. HOCHSTETTER (1881) gives evidence of the origin of these finds. They all were found at the terrace called "Bärenwirthshaus" in the Medvedji rov / Bear Passage approx. 400 meters from the cave entrance. In addition to the above specimens he also mentions a left mandible from *Gulo gulo*, a mandible

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	Tl	bp	bd	SD
KJ	52.8	20.0	16.3	12.3
Arrikruz	57	24	20.5	16.5
Extant male	44–49 (n=7)	—	—	—
Extant female	41–43.5 (n=3)	—	—	—

Table 1: *Panthera spelaea*; measurements (in mm) of phalanx 1 anterior, digit V from Križna jama (KJ) compared with Arrikruz (ALTUNA, 1981) and extant lions (GROSS, 1992:46). **Abbreviations:** Tl – total length, bp – proximal width, bd – distal width, SD – smallest diaphyseal width

and a right humerus from a marten (*Mustela foina*?). This material is still housed at the Natural History Museum (NHMW) in Vienna.

HOCHSTETTER (1881:305) denied explicitly any finds of the cave hyena and the cave lion, but one phalanx of *Panthera spelaea* is housed at the Institute of Paleontology (IPUW) in Vienna, which comes from a small assemblage probably collected by Janesch in 1902 (Table 1). This material contains also a pelvic bone from goat and one m2 from dog.

An additional fragment of a humerus from *Canis lupus* is housed at the depot (BTC-Lj) in Ljubljana. This find comes from the excavation by Brodar and Gospodarič in 1971.

Canis lupus LINNAEUS, 1758 – Wolf

Material: 1 tibia dex (NHMW 1879), 1 humerus fragment distal (BTC-Lj), 1 metacarpal V (NHMW), 1 metatarsal II (NHMW), 2 cervical vertebrae (NHMW), MNI 2 (6)

The dimension of the right tibia can be compared with those of the extant wolves (Table 2). The tibia and the

metapodials do not belong to the same individual. The tibia from Križna jama is small but rather broad at the proximal end and hence similar to specimens from Drachenhöhle and Salzofenhöhle. It cannot be excluded that these unstratified specimens belong to domestic dogs (Table 2) but a more detailed analysis is needed. Gnawing marks cannot be determined on the bones. The mcV and the mtII are from a very large individual, even larger than other Upper Pleistocene remains from Austria and Slovenia (Table 3). At the humerus fragment pathological bone growth can be observed (Fig. 1).

Martes martes (LINNAEUS, 1758) – Pine marten

Material: 1 cranium (NHMW A5358), 1 mandible sin. (NHMW A5358), 1 humerus dex. (NHMW A5358), MNI 2 (3)

The almost complete skull (Table 4) is only broken at the right zygomatic arch. The preserved P2, P4 and M1



Figure 1: *Canis lupus*, distal humerus fragment with pathological bone growth, anterior and posterior view (BTC-Lj, Photo: M. Pacher).

Sites	Tl (n)	bp (n)	bd	SD (n)	SDD (n)
KJ	198.30	39.80	26.20	19.70	20.80
Drachenhöhle	206	43.0	18.0	—	—
Salzofenhöhle (Vb)	216.15	38.27	24.48	—	—
Extant male	243.8 ±21.9 (11)	46.6 ±2.1 (5)	—	16.9 ±1.5 (5)	17.6 ±1.8 (5)
Extant female	235.8 ±19.5 (8)	45.8 ±1.6 (4)	—	16.1 ±1.5 (4)	18.2 ±0.9 (4)

Table 2: *Canis lupus*; measurements (in mm) of tibiae from Križna jama (KJ), Drachenhöhle near Mixnitz (Austria, SICKENBERG, 1931: 751), Salzofenhöhle (Austria, PACHER & DÖPPES, 1997: 137) and extant species (DOYLE, 2009:70). **Abbreviations:** Tl – total length, (n) – number, bp – proximal width, bd – distal width, SD – smallest diaphyseal width, SDD – smallest diaphyseal depth

(Table 5) show the typical characteristics of the pine marten, *Martes martes* (e.g. the transverse M1 has a rounded buccal edge, WOLSAN et al., 1985).

The complete left mandible with p2–m1 (Table 6) belongs to the pine marten *Martes martes*. The relatively large distance (7.3 mm) between the foramina mentalia is longer in *M. martes* than in *M. foina* (STUBBE, 1993: 372; ANDERSON, 1970).

The right humerus fragment is nearer in size to *Martes martes* than to *M. foina* (see Table 7). The small size of our comparative material prevents a clear assignment of the humerus to *Martes* sp.

Gulo gulo (LINNAEUS, 1758) – Wolverine

Material: 1 mandible sin. (NHMW 1878), 1 ulna sin. (NHMW 1878), MNI 2 (2)

The mandible is broken under the anterior root of the first molar (m1) and was glued together. Only the uppermost part of the horizontal branch is broken off. The alveoli of p1, p4 and m2 are only very well visible in X-rays (Fig. 2). The teeth (C, p2, p3 and m1, Table 8) are worn down significantly. The mandibular foraminae are the same size. The mandible was examined radiographically in order to

Sites	mc V						mt II			
	Tl	bp	dp	bd	bda	SD	L	pb	db	SD
KJ	82.50	17.40		15.60	14.0		92.40		10.20	7.9
Potočka zijalka		14.40	14.0					6.70	15.30	8.5
Mokriška jama	76.20		14.4	12.80						
Drachenhöhle	73.11			13.61			89.26		14.90	
Salzofenhöhle (Vb)							73.57		9.29	
Griffen							88.80		12.30	
Veternica	81.3–84.6						82.2–98.6		9.29	
Extant male	64.20	14.80	12.4	11.30		8.5	73.4	8.50	10.6	6.8
Extant female	64.10	14.50	11.5	11.50		7.2	74.1	8.15	10.0	6.0
							74.2	7.90	10.4	6.0
							79.5	8.20	10.3	6.0
							80.4	7.90	10.7	6.2

Table 3: *Canis lupus*; measurements (in mm) of mc V and mt II from Križna jama (KJ), different Late Pleistocene sites (DÖPPES, 2004:74; PACHER & DÖPPES, 1997:139; THENIUS, 1960:36; MALEZ, 1963:62 (n=?)) and extant species (DÖPPES, 2004:74). **Abbreviations:** Tl – total length, bp – proximal width, dp – proximal depth, bd – distal width, bda – width of distal articulation, SD – smallest diaphyseal width

Skull	Sex	Cbl (n)	Mast (n)	Ect (n)	Pob (n)
KJ		85.4	38.5	26.2	18.0
<i>M. martes</i> , Austria	m	81.08–88.64 (29)	—	24.09–29.39 (31)	17.01–22.15 (30)
	f	77.6–79.78 (4)	36.03–37.97 (4)	22.30–25.73 (4)	17.63–18.63 (4)
<i>M. martes</i> , Europe	m	79.8–88.4 (18)	—	—	—
	f	73.6–80.1 (11)	—	—	—
<i>M. foina</i> , Austria	m	77.46–87.58 (32)	35.90–42.37 (28)	23.49–32.21 (30)	17.62–22.37 (30)
	f	76.98–82.28 (7)	37.09–39.72 (7)	25.40–29.87 (7)	17.62–20.52 (6)
<i>M. foina</i> , Europe	m	78.3–85.1 (56)	36.0–42.3 (43)	—	15.7–22.0 (52)
	f	72.0–81.0 (61)	35.0–39.6 (41)	—	15.6–21.6 (57)

Table 4: *Martes foina* and *Martes martes*; measurements (in mm) of skulls from Križna jama (KJ) and extant species of Austria (SPITZENBERGER, 2001) and Europe (ANDERSON, 1970). **Abbreviations:** cbl – condylobasal length, ect – greatest frontal breadth, gmb – greatest mastoid breadth, pob – least breadth between the orbits, m – male, f – female, (n) – number

Teeth	Sex	L-P4 (n)	B-P4 (n)	L-M1 (n)	B-M1 (n)
KJ		8.4	5.2	6.3	8.2
<i>M. martes</i> , Austria	m	7.79–9.16 (25)	4.94–5.87(25)	5.25–6.63 (25)	7.85–8.88 (25)
	f	7.04–8.18 (31)	4.37–5.52 (31)	4.81–5.93 (31)	6.78–8.30 (31)
<i>M. foina</i> , Austria	m	8.26–10.00 (33)	4.76–6.09 (33)	4.81–6.86 (32)	8.04–9.36 (32)
	f	8.53–9.13 (7)	4.45–5.63 (7)	4.62–5.80 (7)	7.70–8.51 (7)
<i>M. martes</i> , Europe	m	7.8–9.3 (21)	—	—	7.8–8.9 (24)
	f	7.1–8.2 (13)	—	—	7.5–8.2 (16)
<i>M. foina</i> , Europe	m	8.4–10.0 (56)	—	—	7.9–9.5 (56)
	f	7.7–9.0 (50)	—	—	7.5–8.9 (49)

Table 5: *Martes martes* and *Martes foina*; measurements (in mm) of upper teeth from Križna jama (KJ) and extant species of Austria (SPITZENBERGER, 2001) and Central Europe (ANDERSON, 1970). **Abbreviations:** L – length, B–breadth, m – male, f – female, (n) – number

Mandible	Sex	Gl (n)	Mh (n)	L-m1 (n)	B-m1 (n)
KJ		58.1	26.0	11.4	4.2
PZ-926		53.3	24.5	9.4	—
<i>M. martes</i> , Austria	m	53.87–60.82 (30)	23.17–26.79 (30)	9.35–10.99 (31)	3.86–4.66 (31)
	f	51.29–53.95 (5)	21.93–23.45 (5)	9.29–9.76 (5)	3.91–4.30 (5)
<i>M. martes</i> , Europe	m	53.5–62.2 (32)	24.3–28.0 (29)	9.4–11 (34)	—
	f	47.9–59.2 (21)	20.5–25.3 (20)	8.4–10.5 (21)	—
<i>M. foina</i> , Austria	m	52.56–58.42 (32)	22.90–28.19 (33)	8.65–11.02 (33)	4.03–5.05 (33)
	f	51.02–55.5 (7)	22.97–25.52 (7)	8.48–9.93 (7)	3.88–4.55 (7)
<i>M. foina</i> , Europe	m	51.0–57.2 (43)	23.4–27.4 (59)	8.6–10.6 (62)	—
	f	48.0–53.6 (43)	20.6–24.9 (62)	7.8–9.8 (60)	—

Table 6: *Martes martes* and *Martes foina*; measurements (in mm) of mandibles from Križna jama (KJ), Potočka zijalka (PZ, DÖPPES, 2004) and extant species of Austria (SPITZENBERGER, 2001) and Europe (ANDERSON, 1970). **Abbreviations:** Gl – mandible length between Processus angularis and Infradentale, Mh – mandible height, L – length, B–breadth, m – male, f – female, (n) – number

Site	Sex	Tl (n)	bp (n)	dp	bd	bt	SD
KJ	—	—	10.8	11.7	—	—	4.3
<i>M. martes</i> , Veternica	—	70.4	—	12.9	15.1	10.4	—
<i>M. foina</i> , Central Europe	m	66.5–69.9 (14)	14.4–15.8 (14)	—	—	—	—
	f	60.0–65.4 (17)	12.9–14.3 (17)	—	—	—	—

Table 7: *Martes martes* and *Martes foina*; measurements (in mm) of humeri from Križna jama (KJ), Veternica (Croatia, MIRACLE & BRAJKOVIĆ, 2010) and extant species of Central Europe (STUBBE, 1993). **Abbreviations:** Tl – total length, bp – proximal width, dp –proximal depth, (n) – number, bd – distal width, bt – breadth trochlea, SD – smallest diaphysis width, n – number, m – male, f – female

		L-C	B-C	L-p2	B-p2	L-p3	B-p3	L-p4	B-p4	L-m1	B-m1
KJ		10.20	9.50	6.40	4.20	7.70	5.60			22.10	9.20
Jvp		11.00	9.20	7.00	4.70	8.80	6.10	12.00	7.50		
Jvp		11.10	8.80					12.40	7.90	22.20	10.10
Knk						8.50	5.70	12.50	8.00	23.50	11.00
Lj		10.80	11.80	6.00	5.30	9.40	6.70	13.80	9.20	23.90	11.70
Norway female	n	15	15			15	15	15	15	15	15
	min	9.25				6.90	4.50	9.30	6.30	18.00	7.30
	max	10.35				8.30	5.50	11.30	7.90	20.40	8.50
	d					7.35	4.91	10.31	7.14	19.12	8.10
Norway male	n					14	14	14	14	13	13
	min					7.20	4.70	10.60	6.90	19.55	8.30
	max					8.70	5.40	11.60	8.50	21.70	9.50
	d					8.02	5.04	11.19	7.75	20.64	8.85

Table 8: *Gulo gulo*; measurements (in mm) of lower teeth from Križna jama (KJ), other Late Pleistocene remains in Slovenia (PAVŠIČ & TURK, 1989) and extant species of Norway (DÖPPES, 2001). **Abbreviations:** KnK – Kostanjevica na krasu, Lj – Ludvikova jama, Jvp – Jama velikih pod kovnjakov, L – length, B – width, n – number, min – minimal, max – maximum, d – mean value

		Tl	bd
KJ		137.00	11.60
male	n	21	21
male	min–max	133.89–152.80	11.50–14.90
male	m	144.23	13.20
female	n	20	19
female	min–max	124.7–137.1	10.20–13.00
female	m	128.88	11.72

Table 9: *Gulo gulo*; measurements (in mm) of ulnae from Križna jama (KJ) and extant specimens (DÖPPES, 2001). **Abbreviations:** Tl – total length, bd – distal width, n – number, m – mean value

investigate the bone behind the m1. In other European findings (DÖPPES, 2001, 2005) the clear absence of m2 by X-ray images could be demonstrated. Based on the compilation of extant remains and Late Pleistocene finds, however, no correlation with geographical, biological or chronological parameters is evident. In the sites Drachenhöhle near Mixnitz (Austria) and Villereversure (France) mandibles with and without the m2 even come from the same site.

The well preserved ulna was first mentioned by LIEBE (1879). Its dimensions (Table 9) compared with the extant species are smaller than the dimensions of the mandible and therefore the ulna belongs to another individual. *Gulo gulo* remains are known in Slovenia from the Potočka zijalka (1 maxilla-fragment and a canine tooth, DÖPPES, 2004), Ludvikova jama (1 right mandible without m2, 3 maxilla, 1 maxilla-fragment (PAVŠIČ & TURK, 1989; DÖPPES, 2000), Jama velikih pod kovnjakov (2 mandible-fragments, 3 canines, 1 incisor, DÖPPES, 2001) and Kostanjevica na Krasu (an almost complete skeleton, ANELLI, 1941).

4. Conclusion

The present analysis described the carnivores from the old excavation for the first time. Wolf, cave lion, and also wolverine are typical additional faunal elements known from numerous cave bear sites. The remains from pine marten consist probably of recent (skull) and fossil material. *Canis lupus* represents a faunal element that tolerates a wide range of environmental changes. In Europe, the wolf was found in all habitats except in high-alpine areas. Today the occurrence is limited to wooded mountain ranges or contiguous forests, swamps and tundra (PETERS, 1993). Wolves are carnivores, occasionally the consumption of fruits and waste can be observed. *Martes martes* strongly depends on forest (STUBBE, 1993). It has a more northern distribution than *Martes foina* and

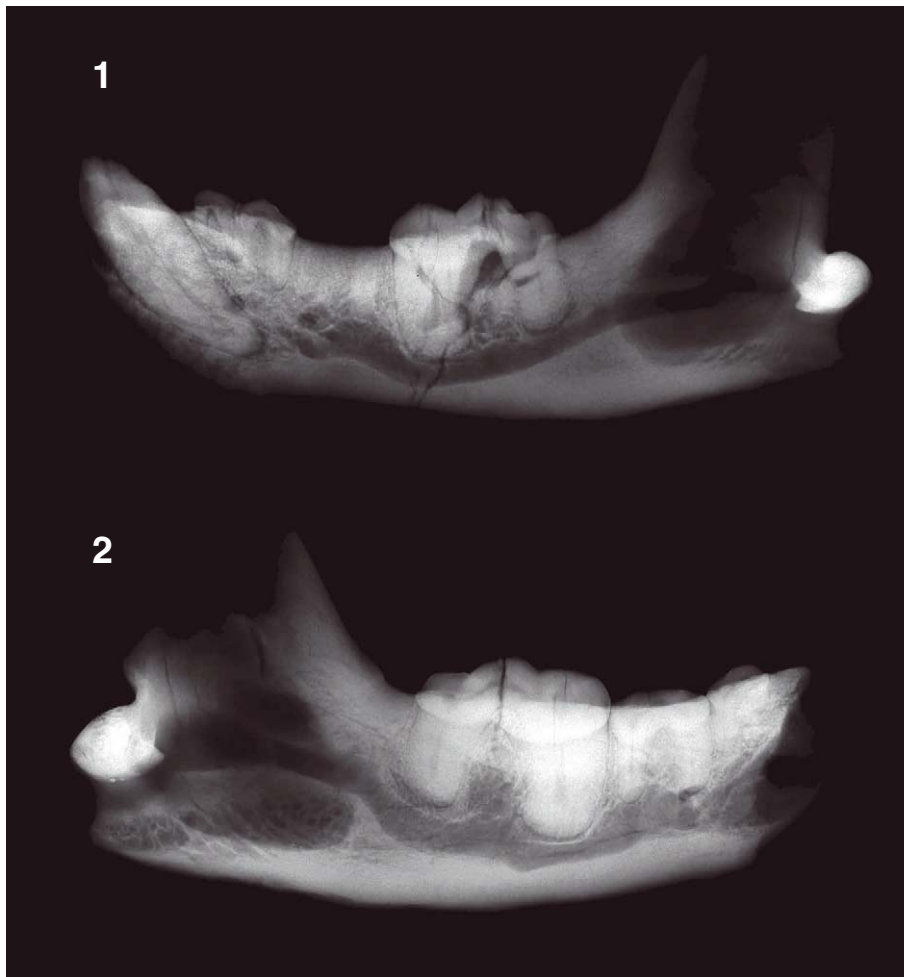


Figure 2: *Gulo gulo*; X-ray photograph of mandibles from Križna jama (1) and Drachenhöhle near Mixnitz (Austria, 2). Natural size. X-ray: Gerhard Withalm

is found from the Scandinavia, British Islands to Italy, from North-Spain eastward to Asia Minor. *Martes foina* has a similar distribution than *Martes martes*, but the pine marten avoids human neighbourhood. Since *Martes foina* was a late immigrant to Europe, probably from the Middle East, records of its presence in Würmian deposits should, as KURTÉN (1968) noted, be viewed with suspicion. Even ANDERSON (1970) and SATO et al. (2003) described *Martes foina* as a present-day species. Both martens feed on small mammals, birds, fruits and berries.

The wolverine is the biggest European mustelid and a typical animal of the North. It inhabits coniferous forests and the taiga of Scandinavia and Finland where it visits different biotopes seasonally. In summer, wolverines prefer forests, and in winter they live in the tundra. Outside of Europe, one also finds them in northern Asia and North America. This big mustelid is an omnivore that feeds, in addition to fresh meat, on carrion and on berries in late summer.

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