

The cave bears from the Grotta dell'Orso near Gabrovizza (Trieste, Italy). Fossil bear remains of the collection Ludwig Karl Moser at the Natural History Museum Vienna

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Höhlenbären | Radiokarbondatierung | DNA | Verdrängung | Koexistenz

Abstract: The fossils of the Grotta dell'Orso, recovered by Ludwig Moser (in the years 1876 to 1914), are stored in the collections of the Natural History Museum in Vienna. The cave bear remains dominating the fossil fauna were subjects to a revision. The morphological data of the dentition and the metapodials as well as the result of a DNA analysis are contradictory. The Grotta dell'Orso was possibly inhabited by two cave bear species from the *Ursus spelaeus* group (*U. s. eremus* and *U. s. ladinicus*) as well as by *U. ingressus* – similar to caves in Germany (Achtal Valley) and Austria (Herdengel cave).

Kurzfassung: Die Fossilien der Grotta dell'Orso, die von Ludwig Moser (in den Jahren 1876 bis 1914) geborgen wurden, befinden sich in den Sammlungen des Naturhistorischen Museums in Wien. Die in der Fossilfauna dominierenden Höhlenbärenreste wurden einer Revision unterzogen. Die morphologischen Daten des Gebisses und der Metapodien sowie das Ergebnis einer DNA-Analyse sind widersprüchlich. Die Grotta dell'Orso wurde möglicherweise von zwei Höhlenbärenarten aus der *Ursus spelaeus*-Gruppe (*U. s. eremus* und *U. s. ladinicus*) sowie von *U. ingressus* bewohnt, ähnlich wie Höhlen in Deutschland (Achtal) und Österreich (Herdengelhöhle).

Introduction

The Grotta dell'Orso (bear cave) near Gabrovizza is located in the municipality of Sgonico, province of Trieste (Italy), Coordinates Lat. WGS84: 45,73264162, Lon. WGS84: 13,72590614 (Fig. 1) and 211 m a.s.l., historical cadastre register number, Catasto storico Friuli Venezia Giulia: 7 VG, current regional cadastre register number, Regione Friuli Venezia Giulia: CSR33.

Research history

Ludwig Karl Moser was professor at the State German Gymnasium in Trieste and carried out numerous excavations in caves in the Austrian Littoral region, in Carniola and especially in the Trieste karst plateau from 1876 until the beginning of World War 1. The excavations in the Grotta dell'Orso (Pytina jama, so named by Moser), which began in 1879, were particularly successful. The fossils recovered were given to the Natural History Museum in Vienna. The collection from the Grotta dell'Orso includes a large number of bones and teeth of mammals, with the remains of bears predominating. A first determination was published by Anton Weithofer (see MOSER, 1888). Although the bear remains are »among the most frequently found animals«, they were only mentioned as »*Ursus spelaeus* Blumb« (MOSER, 1888).

Description of the cave

Near Gabrovizza, an Italian hamlet in the municipality of Sgonico/Zgonik, close to the easternmost border between Italy and Slovenia, a cave called Grotta dell'Orso opens up. It is one of the more than 4,000 caves that can be identified in the classic karst region, which lithological consists of limestone and dolomite and all possible combinations between these two extremes. These karstic rocks are bounded to the west and southwest by the alluvial deposits of the Soča/Isonzo Plain and the flysch of the Gulf of Trieste, and to the northeast by the flysch of the Vipava Valley. To the east the plateau extends to the Reka Valley and the Brkini area, while to the south it is bordered by the Čičarija. The karst plateau extends over a length of about 60 km and a width of 15 km on an area of about 750 km² and is oriented SE-NW (CUCCHI et al., 2015).

The cave, which opens into the Cretaceous Rudiste limestone, consists of a gallery 18 to 20 m wide and 10 to 12 m high. It extends almost horizontally for 175 m, with the first branch of the cave facing SE and the second facing SW, the depth is 39 m. The entrance, which opens at the bottom of a sinkhole (probably a roofless cave), is impressively oriented NNE. After a slight scree slope, the gallery has a floor of red clay, the result of later inflows from outside. The gallery, which seems to be oriented SE again, ends on boulders and huge fallen columns that testify to ancient collapses. The end section, rich in speleothems on the ceiling and walls, slowly fills with material from outside (Fig. 2). Most of the palaeontological finds kept in the Natural History Museum in Vienna come from the levels of this section. Numerous archaeological excavations have been carried out in front of



Fig. 1: Sketch map of the position of the Grotta dell'Orso near Gabrovizza in the province Trieste. | Abb. 1: Kartenskizze der Lage der Grotta dell'Orso bei Gabrovizza in der Provinz Triest.

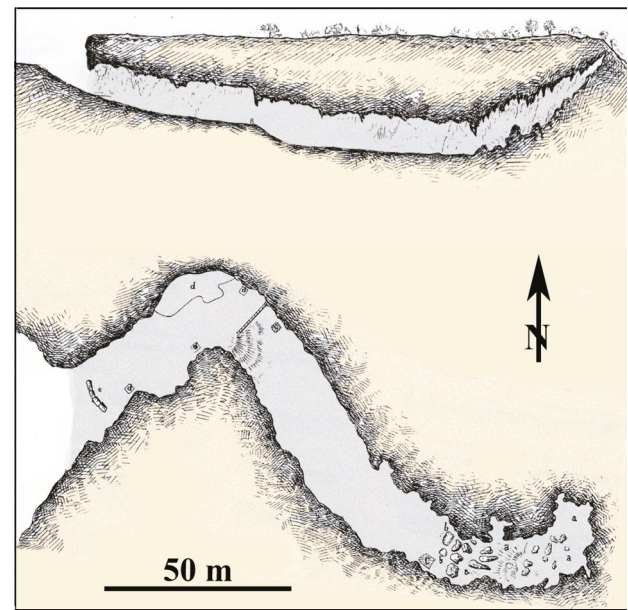


Fig. 2: Longitudinal section and ground plan of the Grotta dell'Orso near Gabrovizza drawn by Servizio geologico della Regione Autonoma Friuli Venezia Giulia. | Abb. 2: Längsschnitt und Grundriss der Grotta dell'Orso bei Gabrovizza gezeichnet vom Servizio geologico della Regione Autonoma Friuli Venezia Giulia.

the entrance, where artefacts from the Neolithic and the Metal Age have been found.

Material and methods

The fossil material investigated in this study is stored in the collections of the Natural History Museum Vienna. The teeth and metapodials were measured and morphologically evaluated (RABEDER, 1999; WITHALM, 2001). The morphodynamic indices of the 4th premolars (P4 sup and p4 inf) and the 2nd molars of the mandible (m2 inf) are the most important indicators of the evolutionary level of cave bears and the extent of their adaptation to mountain life (RABEDER, 1999; LAUGHLAN et al., 2020; DÖPPES et al., 2021). The P4/4 index and the enthyoconid index describe the number of additional cusps and incisal edges on the P4 sup and p4 inf as well as on the m2 inf. The mean values of the dimensions and the morphodynamic indices were compared with those of other caves in the province Trieste and the

Element		length	width	md index
p4 inf.	mean	13.99	9.76	128.57
	standardised	91.77	94.55	64.87
	n	8	8	8
p4/4 index	index			117.37
	stand.			52.25
P4 sup.	mean	18.92	13.76	107.14
	standardised	93.98	96.86	41.9
	n	10	10	8
m1 inf.	mean	29.18	13.82	
	standardised	96.57	95.32	
	n	24	24	
M1 sup.	mean	28.83	20.04	
	standardised	100.35	101.46	
	n	16	16	
m2 inf.	mean	29.27	17.78	193.75
	standardised	95.56	97.4	104.56
	n	37	37	37
M2 sup.	mean	45.21	23.22	200
	standardised	101.82	102.97	53.33
	n	17	17	8
m3 inf.	mean	25.84	18.74	
	standardised	93.75	98.07	
	n	28	28	
m3/m2 Index	mean	88.27	105.43	
	standardised	98.1	100.68	
all* cheek- teeth	mean stand.	96.85	98.36	
	n	136	136	
all* molars	mean stand.	97.16	98.54	
	n	120	120	

Tab. 1: Mean values of measurements and morphodynamic indices of cheek teeth of cave bears from the Grotta dell'Orso near Gabrovizza. Abbr.: all* = weighted means of all cheek teeth and molars, md = morphodynamic, n = number, stand. = standardised. Morphodynamic index of molars: m2 inf: enthyponoid index, M2 sup: metaloph index. | Tab. 1: Mittelwerte der Messungen und morphodynamischen Indices der Backenzähne von Höhlenbären aus der Grotta dell'Orso bei Gabrovizza. Abk.: all* = gewichtete Mittelwerte aller Backenzähne und Molaren, md = morphodynamisch, n = Anzahl, stand. = standardisiert. Morphodynamischer Index der Backenzähne: m2 inf: Enthyponoid-Index, M2 sup: Metaloph-Index.

Alps (Fig. 4). During this process the contradictory data became apparent.

Systematic description of bear remains

Bear remains relevant for taxonomic studies are mainly isolated molars and metapodials, while jaw remains with teeth in situ are rare. The amount of preserved teeth is relatively small, which causes some uncertainty in taxonomic assignment, see chapter »Discussion«. From the dimensions and the morphology of the teeth, it is evident that in the bear material of Grotta dell'Orso, besides a moderately large cave bear, the brown bear is also represented with some finds. Contradictory values for the taxonomic assignment result from the comparison of the cave bear remains, especially of the molars and the metapodials (Fig. 6, Tab. 1-2), and the result of a DNA analysis: the mean values rather speak for the assignment to the *Ursus spelaeus* group

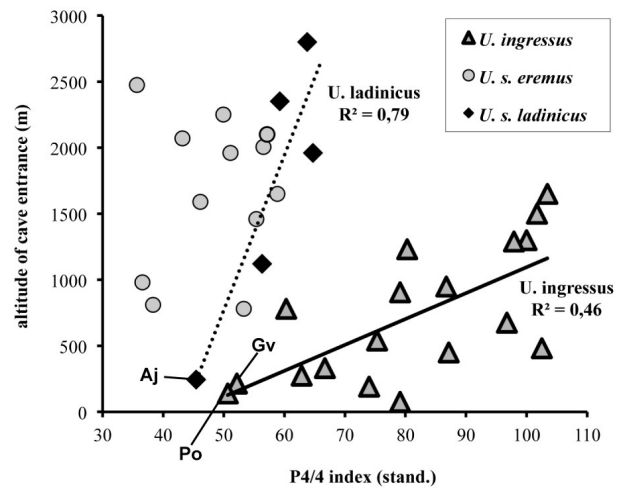


Fig. 3: Standardized values of the P4/4 index of cave bear faunas of the Alps, Eastern Europe and the Trieste karst plateau in relation to the altitude of the cave entrances. Abbreviations: Gv = Grotta dell'Orso near Gabrovizza, Po = Grotta Pocala. | Abb. 3: Standardisierte Werte des P4/4-Index der Höhlenbärenfaunen der Alpen, Osteuropas und des Triester Karsts in Abhängigkeit von der Höhe der Höhleneingänge.

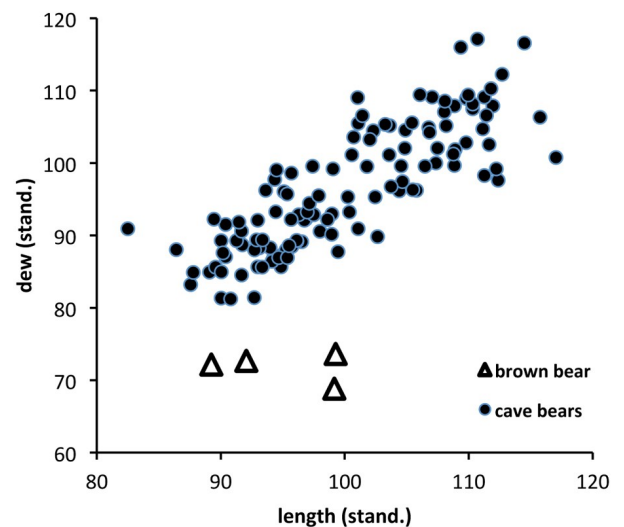


Fig. 4: Scatter diagram of standardized values of length and width of ursid metapodia from Grotta dell'Orso near Gabrovizza. The values of *Ursus ingressus* from the Gamsulzen Cave serve as standard (WITHALM, 2001). | Abb. 4: Streudiagramm der standardisierten Werte für Länge und Breite von Ursus-Metapodien aus der Grotta dell'Orso bei Gabrovizza. Die Werte von *Ursus ingressus* aus der Gamsulzenhöhle dienen als Standard (WITHALM, 2001).

(RABEDER et al., 2019), whereas the genetic analysis speaks for *Ursus ingressus*.

Dimensions

The average lengths of the molars are smaller with about 97 %, the metapodials are about the same length but much slimmer than in the reference fauna of *Ursus ingressus* from the Gamsulzen cave (RABEDER, 1995). In the LDH-diagram (Locomotion vs. Dietary Habits diagram), the average length of the metapodials (as a measure of locomotion) and the average length of the

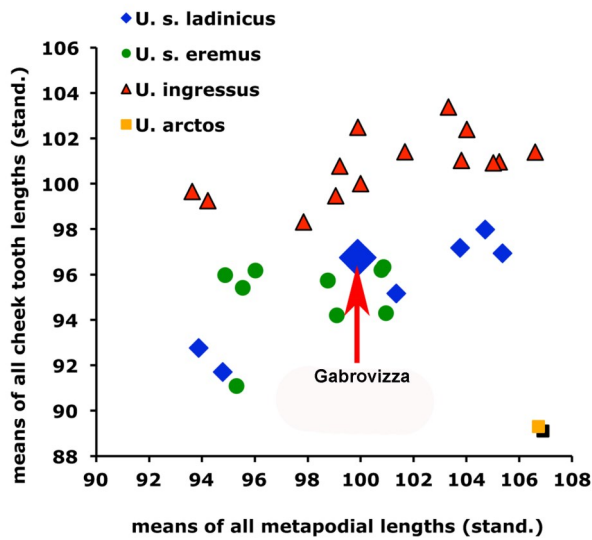


Fig. 5: LDH diagram of cave bear fauna from the Grotta dell'Orso near Gabrovizza in comparison with Alpine faunas. | Abb. 5: LDH-Diagramm der Höhlenbärenfauna aus der Grotta dell'Orso bei Gabrovizza im Vergleich mit alpinen Faunen.

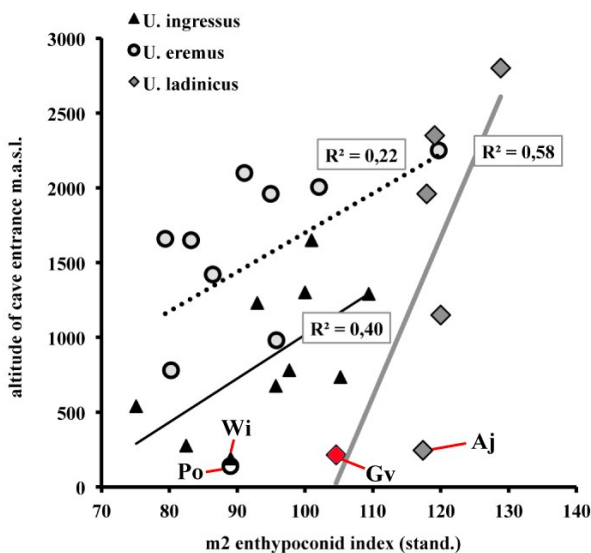


Fig. 6: Standardized values and regression lines of the m2-enthypoconid index of cave bear faunas of the Alps, Eastern Europe and the Trieste karst plateau in relation to the altitude of the cave entrances. Abbreviations: Aj = Ajdovska jama, Gv = Grotta dell'Orso near Gabrovizza, Po = Grotta Pocala, Wi = Bärenhöhle bei Winden. | Abb. 6: Standardisierte Werte und Regressionslinien des m2-Enthypokoniden-Index der Höhlenbärenfaunen der Alpen, Osteuropas und des Triester Karsts in Abhängigkeit von der Höhe der Höhleneingänge.

molars (as a measure of the chewing ability) are related (KAVCIK-GRAUMANN et al., 2016). The fauna of the Grotta dell'Orso lies in the clusters of *Ursus s. eremus* and *U. s. ladinicus* (Fig. 3) but not in the cluster of *Ursus ingressus*.

P4/4 index

This index describes the increasing molarisation of the last remaining premolars; it is the geometric mean of the p4 inf index

Element	n	length	dew	PI	length stand.	dew stand.	PI stand.
Mc1	10	67.46	17.96	26.86	106.24	93.06	88.39
Mc2	11	76.42	25.31	33.19	103.69	100.04	96.67
Mc3	14	76.05	23.94	31.42	95.30	90.32	94.63
Mc4	9	80.80	25.83	31.94	96.65	92.26	95.38
Mc5	10	82.83	28.08	33.92	100.4	96.16	95.83
mt1	14	52.64	16.76	31.87	99.13	94.71	95.62
mt2	18	67.79	20.86	30.76	100.73	97.94	97.18
mt3	17	78.08	22.49	28.86	101.00	96.13	95.35
mt4	18	83.31	23.57	28.00	98.83	96.19	96.35
mt5	11	87.73	24.13	27.55	102.37	98.88	96.77
all*	132				100.2	96.5	96.33

Tab. 2: Mean value of length, distal epiphyseal width (dew) and plumpness index (PI) of cave bears from the Grotta dell'Orso near Gabrovizza. Abbreviations: all* = weighted means of all metapodial bones, stand. = standardised (standards = mean values of Gamssulzen cave). | Tab. 2: Mittelwert von Länge, distaler Epiphysenbreite (dew) und Plumpheitsindex (PI) von Höhlenbären aus der Grotta dell'Orso bei Gabrovizza. Abkürzungen: all* = gewichtete Mittelwerte aller Metapodienknochen, stand. = standardisiert (Standards = Mittelwerte der Gamssulzenhöhle).

and the P4 sup index (RABEDER, 1999; FRISCHAUF & RABEDER, 2021) and is correlated with the altitude of the sites (Fig. 3). The faunas with *U. ingressus* show adaptations to life in high mountains much more than the faunas of the *Ursus spelaeus* group. The correlation between the values of the P4/4 index and the altitude is very different among the three cave bear taxa. While the rate of increase of the index is very high in *U. ingressus* but the coefficient of determination is small (only 0.45), in *U. s. ladinicus* the coefficient of determination is very high, almost 0.80, but the rate of increase per 100 meters is small. In the group of *U. eremus* fauna no correlation can be seen. The index value of bears from the Grotta dell'Orso is clearly smaller than in faunas from similar low altitudes (e.g. Winden, Ilinka, Merkenstein, Vindija) and is quite similar to the cave bear fauna of the Grotta Pocala (CALLIGARIS et al., 2006), which lies in the neighbourhood (Fig. 5). These faunas, both located in the Trieste karst plateau, are presumed to have a »mixed« cave bear fauna (see chapter »Discussion«)

Enthypoconid index

The two Alpine subspecies of *U. spelaeus* (*U. s. eremus* and *U. s. ladinicus*) differ most clearly in the manifestation of the enthypoconid of m2 inf. The cave bears of the Grotta dell'Orso lies in the cluster of *Ursus spelaeus ladinicus* (Fig. 5). The enthypoconid index (RABEDER, 1999) is positively correlated with the altitude of the cave entrances. The correlation to altitude also varies for this index among the different cave bear taxa. For the *U. ingressus* faunas, the average increase in the enthypoconid index grows relatively quickly per 100 m altitude. However, in caves in lower altitudes the difference between the faunas with *U. ingressus* and *U. s. ladinicus* is small. The index value of the Grotta dell'Orso is – not as expected – not in the cluster of *U. ingressus* but in the cluster of *U. s. ladinicus*.

Dimensions of metapodial bones

The scatter diagram (Fig. 6) of the lengths and width values (distal epiphyseal width) of all completely preserved metapodials shows a closed picture. A very slender »outlier« can be attributed to the taxon *Ursus arctos*.

Plumpness index of metapodials

The plumpness index (PI) is calculated from the width of the distal epiphysis (dew) and the total length of the metapodials (length): $(PI = dew/length*100)$, see WITTHALM (2001). For comparisons of cave bear characteristics, the mean of standardized PI values for all metapods is very informative for questions of body size and adaptation to mountain life. The PI mean values of *Ursus ingressus* from the Gamssulzen cave serve as standards (RABEDER, 1995).

In the faunas with *Ursus ingressus* from the Alps, Carpathians and eastern Europe, the plumpness index is positively correlated with the altitude of the sites (see Fig. 4-5, Tab. 2). The data point of the Grotta dell'Orso is not – as would be expected – in the cluster of *Ursus ingressus* but very close to the fauna of the Ajdovska jama, which morphologically and genetically belongs to the taxon *Ursus spelaeus ladinicus* (PACHER et al., 2011).

Associated fauna

The fossil material collected by Ludwig Moser in the Grotta dell'Orso near Gabrovizza and also stored in the Natural History Museum of Vienna consists of numerous mammal taxa, but not all can be considered contemporaries of the cave bears. Because the fossils were collected without a stratigraphic context (in any case, there are no records of a stratigraphic sequence) and absolute dates of the accompanying fauna is still lacking, the temporal affiliation of the various faunal elements can only be concluded by the climatic requirements of individual species. The elements of the faunal list of the »Karl Ludwig Moser collection« at the Natural History Museum Vienna (DÖPPES, 2001) can be grouped into three temporally distinct units:

Unit 1: Mammals of the Middle Wurmian period or Alpine Cave Bear Era (ca. 65–24 ka BP). This period was characterized by a warm and dry climate. The accumulation of large quantities of bone remains in caves were caused by cave bears and by cave hyenas and cave lions, which left the remains of large prey such as steppe bison and giant deer. Radiocarbon dating of a hyena remains from the nearby the Grotta Pocala (Aurisina-Nabresina) was successful (NAGEL et al., 2018), yielding an age of about 43,000 years before present (41,995–43,603 calBP). This date suggests that cave bears and hyenas inhabited the Trieste karst plateau during approximately the same period. Faunal list of unit 1: *Crocota crocuta spelaea*, *Panthera spelaea*, *Bison priscus*, *Megaloceros giganteus* and *Ursus ingressus*, ?*Ursus spelaeus ladinicus*.

Unit 2: Mammals of Late Wurmian or Alpine Glacial period (24–12 ka BP). Some taxa can be assigned to the last cold phase of the Late Pleistocene: *Lepus timidus*, *Microtus nivalis*, *Rangifer tarandus* and *Capra ibex*.

Upper jaw fragments	Lower jaw fragments	P4 inf	P4 sup	m1 inf
2	1	3	2	1

M1 sup	m2 inf	M2 sup	m3 inf	Metapodia
1	2	3	2	4

Tab. 3: List of teeth and metapodials of *Ursus arctos* from the Grotta dell'Orso near Gabrovizza. | Tab. 3: Liste der Zähne und Metapodien von *Ursus arctos* aus der Grotta dell'Orso bei Gabrovizza.

Element	length	width	morphotype
p4 inf	14.8	7.1	worn
p4 inf	13.5	7.0	A
p4 inf	12.2	7.0	worn
P4 sup	15.3	12.9	A
P4 sup	17.5	12.1	A
m1 inf	23.5	12.3	worn
M1 sup	23.4	18.4	x
m2 inf	25.1	16.3	worn
m2 inf	25.6	16.1	worn
M2 sup	35.1	20.7	worn
M2 sup	38.5	20.7	worn
M2 sup	39.0	21.0	worn
m3 inf	20.3	16.1	worn
m3 inf	22.1	15.2	x
all cheek teeth stand.	81.97	83.69	
n	14	14	

Tab. 4: Measurements of cheek teeth of *Ursus arctos* from the Grotta dell'Orso near Gabrovizza. | Tab. 4: Maße der Backenzähne von *Ursus arctos* aus der Grotta dell'Orso bei Gabrovizza.

Unit 3: Climatically indifferent elements (Middle Wurmian till Holocene): *Lepus europaeus*, *Vulpes vulpes*, *Canis lupus*, *Ursus arctos*, *Mustela erminea*, *Mustela nivalis*, *Mustela foinea*, *Meles meles*, *Martes sp.*, *Gulo gulo*, *Sus sp.*, *Cervus elaphus*, *Capreolus capreolus*, *Ovis sp.*, *Bos sp.* and *Equus sp.*

Ursus arctos L.

Among the jaw fragments as well as the isolated teeth are some elements that can be assigned to the brown bear *U. arctos* because of the small dimensions and the primitive morphology (Tab. 3-4). The metapodials of the brown bear are clearly more slender than those of cave bears (Fig. 6).

Chronology and DNA-analysis of cave bears

Because cave bear remains were stored at the Vienna Museum for over 100 years, it can be assumed that the preservation of the bone collagen is already poor, but it was possible to obtain fresh samples from the cave. The analysis of one of these samples gave an uncalibrated (BP) ^{14}C age of 46,340 years. The analysis of the mtDNA resulted in the assignment to the taxon *Ursus ingressus* RABEDER & al. 2004. The estimated molecular age of 42,460 years before today correlates surprisingly well with the ^{14}C age (s. Tab. 5). The Grotta dell'Orso was also inhabited during the so-called »Alpine Cave Bear Era« – at least during the

LabNr.	sample name	element	¹⁴ C age aBP	δ ¹³ C	cal 1-sigma calBP	cal 2-sigma calBP	C:N	C %	collagen %	molecular estimate age aBP (median)	95% HPD interval (aBP)	taxon
MAMS-40179	Gv 1	cave bear bone	46,340 ± 530	-24.1	48,050–47,349	48,051–46,652	2.4	26.9	3.7	42,460	35,403–49,057	<i>Ursus ingressus</i>

Tab. 5: Radiocarbon data and molecular age estimate of a cave bear bone from the Grotta dell'Orso near Gabrovizza. | Tab. 5. Radiokarbonaten und molekulare Altersschätzung eines Höhlenbärenknochens aus der Grotta dell'Orso bei Gabrovizza.

older part of this warm period. In this time period – which lasted approximately from 65,000 to 24,000 years before present (aBP) and was characterized by a warm and dry climate – almost all alpine and perialpine cave bear faunas are to be placed (DÖPPES et al., 2018; NAGEL et al., 2018) as well as the other cave faunas in the Trieste karst plateau such as the Grotta Pocala or the Krizna jama (CALLIGARIS et al., 2006; DÖPPES et al., 2018; NAGEL et al., 2018; PACHER et al., 2014).

DNA analysis

Genetic analysis of the bone fragment dated at about 46,340 years BP (s. Tab. 5) has resulted in an assignment to the taxon *Ursus ingressus*.

Discussion

The results of the examinations of the cave bear material from the Grotta dell'Orso near Gabrovizza are contradictory. While there is a clear assignment to the taxon *Ursus ingressus* in the DNA analysis of a cave bear bone, the data of the morphological evaluation lie outside the respective clusters of *U. ingressus*. There are similar inconsistencies in the cave bear remains from the Grotta Pocala: when evaluating the results of the new excavations (CALLIGARIS et al., 2006), it was recognized that the finds from the Grotta Pocala are metrically and morphologically closest to *Ursus ingressus*, but that there are some primitive features (e.g., the low values of the P4/4 index). That led to the following conclusion: »Eine Vermischung von geologisch älteren Bärenresten mit geologisch jüngeren Knochen und Zähnen kann auf Grund der taphonomischen Befunde nicht ausgeschlossen werden« (Based on the taphonomic findings, a mixture of geologically older bear remains with geologically younger bones and teeth cannot be excluded). In the phylogenetic tree (CALLIGARIS et al., 2006, Diagram 4), the bear remains of the Grotta Pocala were assigned to the *U. ingressus* lineage with the suggestion that they may be from older (rift-age?) strata.

ROSSI & SANTI (2015), analyzing the bear remains from the Grotta Pocala, stored at the University of Padua, concluded that these bear remains morphometrically and morphologically mediate between ancient »deningeri«-like and modern »ingressus« forms and should be placed within the *Ursus spelaeus* group. The new data from DNA analysis and radiocarbon dating for bears from the Grotta dell'Orso have now provided evidence that *Ursus ingressus* inhabited the region around Trieste during the Alpine Cave Bear Era. There is a high probability that geologically older bear remains are mixed with the cave faunas of the Grotta

dell'Orso and the Grotta Pocala, originating from *Ursus spelaeus eremus* and/or *U. s. ladinicus*. Great metrical and morphological similarities exist also to the bear fauna of the Ajdovska jama near Krsko (see Fig. 4-5). There is a similarity in the plumpness index of the metapodials and the EHyd index of m2 inf is much higher than in the typical *U. ingressus* faunas. These characteristics were the reason for the assignment of the Ajdovska cave bears to the taxon *Ursus spelaeus ladinicus*, which until then was known only from alpine sites, three DNA analyses confirmed this assignment (PACHER et al., 2011). In several characteristics, the bear fauna of the Grotta dell'Orso near Gabrovizza occupies an intermediate position between *U. ingressus* and *U. s. ladinicus*, so an attempt is made to develop a hypothesis to explain the considerable differences. Compared to other areas where Pleistocene cave bears were found, it can be assumed that a succession of two cave bear species also occurred in the area of the Trieste karst plateau.

Replacement and Coexistence

Soon after the discovery of genetic diversity in the cave bear group (HOFREITER et al., 2004; RABEDER et al., 2004), bear caves were found in which remains of two cave bear species were detected by DNA analyses. Remains of *Ursus spelaeus* and *Ursus ingressus* were found in the caves Geißenklösterle and Hohle Fels (MÜNDEL et al., 2007). Initially, it was theorised that the immigrant *U. ingressus* had displaced the resident *U. spelaeus* and that this was a »replacement«. Numerous new data have shown that both species have lived side by side for several thousands of years and therefore it would be correct to speak of coexistence. Particularly to be pointed out are the Herdengel cave near Lunz (Austria) with *U. spelaeus eremus* and *U. ingressus*, Casamène near Besançon (France) with *U. s. ladinicus* and *U. ingressus*, the Grotte de Prélétang (Presles, France) with *U. s. eremus* and *U. s. ladinicus* (see GRETZINGER et al., 2019). For both large bear caves of the Trieste karst plateau, the Grotta Pocala and the Grotta dell'Orso, it is suspected that they contain »mixed faunas« consisting of remains of an older bear form (*U. spelaeus ladinicus* and/or *U. s. eremus*) and a later immigrant species (*U. ingressus*), which explains the intermediate mean values of measures and indices.

Conclusions

The cave bear remains from the Grotta dell'Orso near Gabrovizza, stored in the Natural History Museum in Vienna, are mainly of the species *Ursus ingressus*; chronologically, these fossils be-

long to the warm phase of the Middle Worm (about 40,000 to 50,000 years before present), which corresponds to the »Alpine cave bear era«. Some of the bear remains are probably from the more primitive bear form *Ursus spelaeus ladinicus*, which has also been described from the Ajdovska jama, approx. 160 km east of the Grotta dell'Orso.

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