

The Cave Bear Incisors of Križna jama (Slovenia)

by

Christine Frischauf¹⁾

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Zusammenfassung

Dieser Artikel handelt von einer Studie an Schneidezähnen die im Laufe einer Ausgrabung im Jahr 2001, einer Kooperation der Universitäten von Laibach und Wien, geborgen worden sind. Diese Schneidezähne wurden vermessen und morphodynamisch analysiert.

Schlüsselwörter: Schneidezähne, morphodynamische Analyse, *Ursus ingressus*

Abstract

This article deals with the study of incisors that were found during the excavation from the University of Ljubljana and the University of Vienna in the year 2001. From the incisors metrical data were taken and have been morphologically analysed.

Keywords: incisors, morphodynamic analysis, *Ursus ingressus*

Element	I ^{1,2}	I ³	I ₁	I ₂	I ₃
Number	37	25	21	9	23
Not worn	20	10	10	2	7
Middle worn	1	6	4	1	3
Worn	14	7	6	5	12
Fragment	1	2	1	1	1

Table 1: Number and stage of occlusal wear of incisors found at the excavation 2001.

Izveček

Prispevek vsebuje raziskavo sekalcev (incizivov), ki so jih zbrali v času izkopavanj leta 2001. Izkopavanje so vodili sodelavci ljubljanske in dunajske Univerze. Zobe (sekalce) smo izmerili in analizirali.

Ključne besede: sekalci, morfodinamična analiza, *Ursus ingressus*

1. Material

Number and stage of occlusal wear of the incisors that were found during the excavation in 2001. The low account of i2 inf. is to be noticed, see Table 1.

About 55% of all incisors are middle worn or worn, deductively 45% of the fossil incisors belonged to young adults or pre-adults.

The abrasion and the fragmentation of the teeth reduced the number of pieces that were examined by the metrical and morphodynamic analyses. To determine the evolutionary level of the incisors the morphodynamic analysis (RABEDER, 1999) was applied. The following Table shows the number of studied incisors, see Table 2:

Element	I ^{1,2}	I ³	I ₁	I ₂	I ₃
Number	30	16	15	6	16

Table 2: Number of incisors included in the morphometrical analysis.

2. Stages of Occlusal Wear

The incisors were differentiated into three categories:

- **Not worn:** incisors without any traces of abrasion, germs
- **Middle worn:** incipient stages of abrasion, dental crown is partly polished
- **Worn:** big part of the dental crown is abraded or the crown is completely worn

¹⁾ Mag. Christine FRISCHAUF, Institute of Palaeontology, University of Vienna, Austria, e-mail: christine.frischauf@univie.ac.at

	Length	Width	Height	Fossa lunaris index	Cingulum cusp index
Mean/index	11.0	12.1	36.3	163.64	147.50
Standard deviation	1.2	0.9	3.3		
Max.	13.1	13.8	42.0	2	3
Min.	8.0	10.0	30.0	1	0
Number	31	31	17	22	20
GS standard	110.22	106.36	111.11	108.44	87.38

Table 3: Means of measurements and morphological indices of I1,2 sup. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

Figure 1 shows the abrasion of all incisors. The distribution of preadult and young adults (45%) and senile animals (41%) is almost balanced. Fourteen percent of all incisors may have been adult animals. For comparison Figure 2 shows the stages of abrasion of Loutra Almopia Cave (LAC). The amount of not worn incisors is almost the same but in LAC more middle worn teeth occur than worn ones. The occlusal wear is different in the upper and in the lower jaw. Figure 3 shows the abrasion stages of the superior incisors. Within the upper incisors preadult teeth dominate. While in Figure 4 it is more balanced but the senile teeth are most frequent.

3. Deficiency of Findings

Deficiency of findings terms the fact that several skeleton elements are found in a varying number of pieces. This number of pieces is dependent on different factors, see RABEDER (2001):

- **Size:** Selection by shifting caused by running water
- **Corrosion:** small and tenuous teeth and bones are more affected by corrosion
- **Selective choosing by the excavators:** not in this case, the sediments were carefully searched through

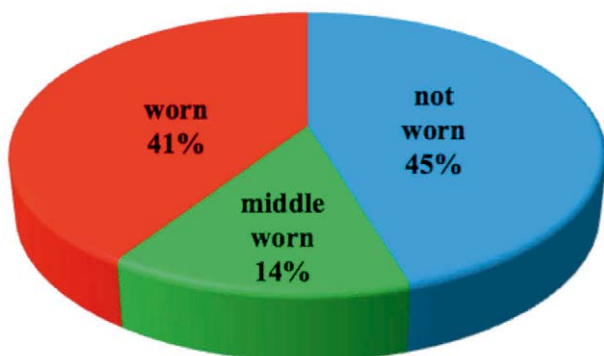


Figure 1: Stages of abrasion of all KJ incisors.

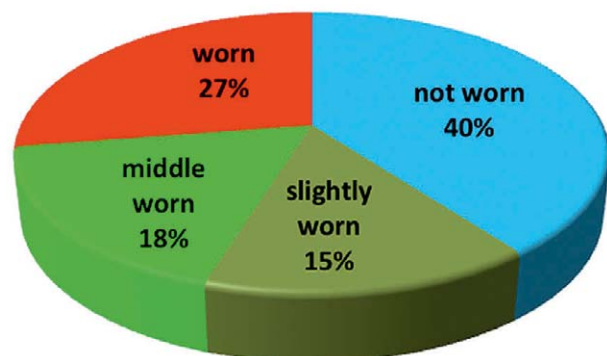


Figure 2: Stages of abrasion of all LAC incisors.

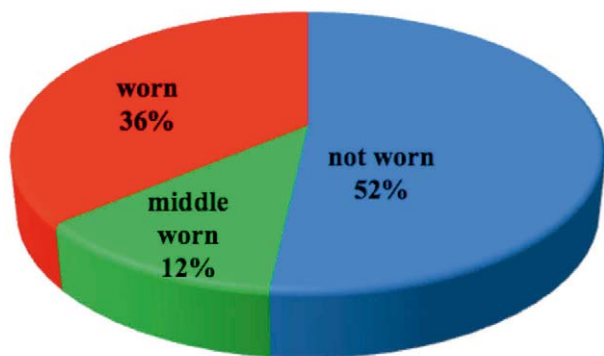


Figure 3: Stages of abrasion of upper jaw incisors from Križna jama.



Figure 4: Stages of abrasion of lower jaw incisors from Križna jama.

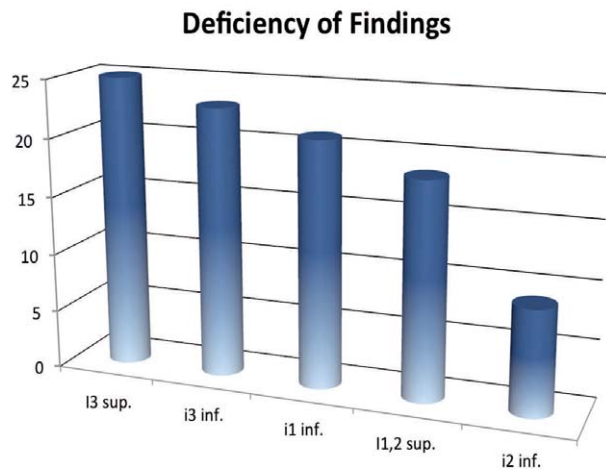


Figure 5: Deficiency of incisor findings from Križna jama.

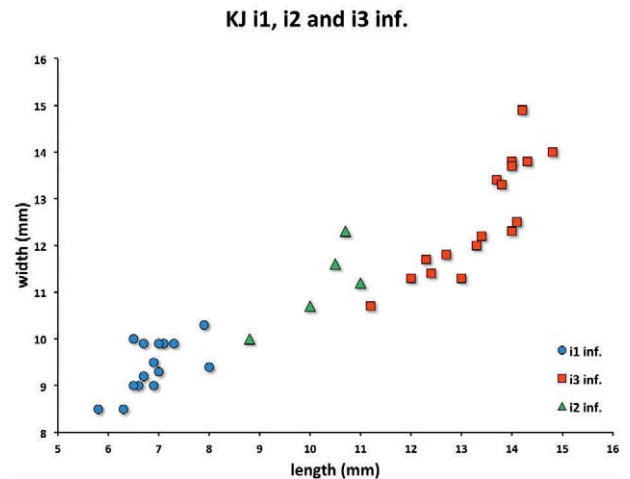


Figure 6: Scatter plot of length to width of i1, i2 and i3 inf.

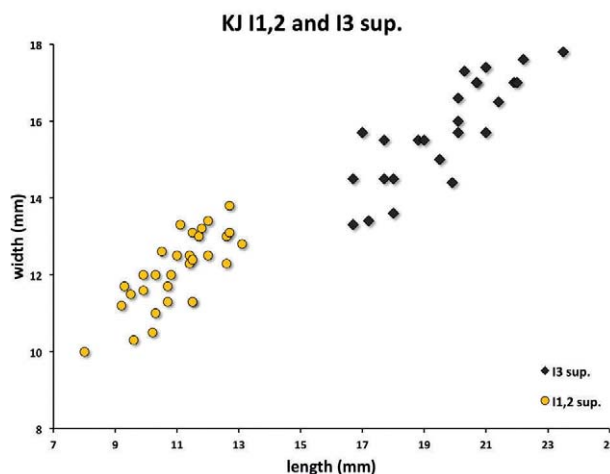


Figure 7: Scatter plot of length to width of I1,2 and I3 sup.

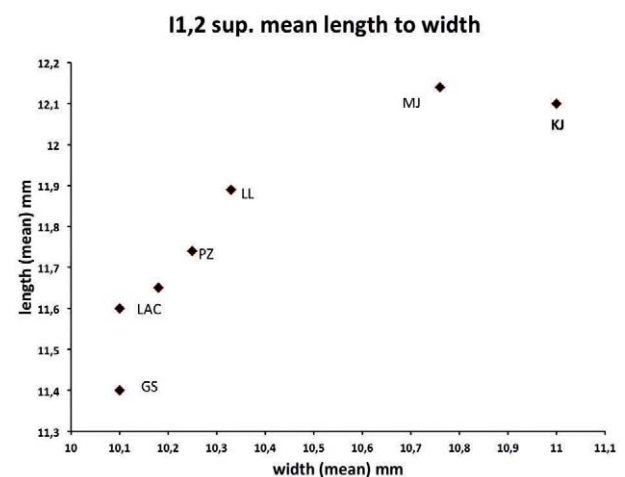


Figure 8: Scatter plot of I1,2 sup. mean length to width of *Ursus ingressus* faunas. Abbreviations: GS – Gamssulzen, KJ – Križna jama, LAC – Loutra Almopias cave, LL – Lieglloch, Mj – Medvedia jaskyňa, PZ – Potočka zijalka

Dimensions:

The Diagrams of Fig. 6 and 7 show the dimensions of all measured incisors of the cave bear remains of Križna jama. Compared to other European cave bear faunas the incisors of upper jaw and lower jaw are conspicuously big. The allocation of length and width values in this scatter diagram is like it is expected for a cave bear fauna. Once more it is not possible to differentiate the upper I1 and I2 by means of length and width.

4. Description

4.1. I1,2 sup.

Dimensions:

The upper I1,2 of Križna jama bear belong to the biggest found yet. Compared to other *Ursus ingressus* faunas the mean value of length is actually the biggest, see Table 3.

The mean width is only surpassing by the I1,2 sup. of Medvedia jaskyňa (Slovakia) see Fig. 8.

Figures 9 and 10 show the dispersion of upper I1,2 of Križna jama, Gamssulzen cave and Medvedia cave. The KJ teeth are in the blue ellipse the one of Gamssulzen cave in the red ellipse. It demonstrates the bigger dimensions of the Križna jama. The most I1,2 sup. overlap, but in Križna jama are a few teeth bigger whereas Gamssulzen cave contains smaller teeth. Exception is the shortest of all teeth that belong to Križna jama.

Compared to the Medvedia jaskyňa I1,2 (framed with the yellow ellipse) the bigger part overlap, but in MJ we could find more small teeth but most notably wider ones than in Križna jama.

Evolutionary Level:

The upper I1,2 of Križna jama possess a relatively high evolutionary level (see RABEDER, 1999). In Fig. 11 the two indices (fossa lunaris index and cingulum cusp index) I1,2 are compared with other cave bear faunas. Križna jama fits

	Length	Width	Height	Kalyx index
Mean/index	19.65	15.76	49.57	43.33
Standard deviation	1.86	1.32	2.94	
Max.	23.5	17.8	53.8	1
Min.	16.7	13.3	45.2	0
Number	25	25	9	15
GS standard	104.96	106.78	100.77	38.33

Table 4: Means of measurements and morphological index of I3 sup. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

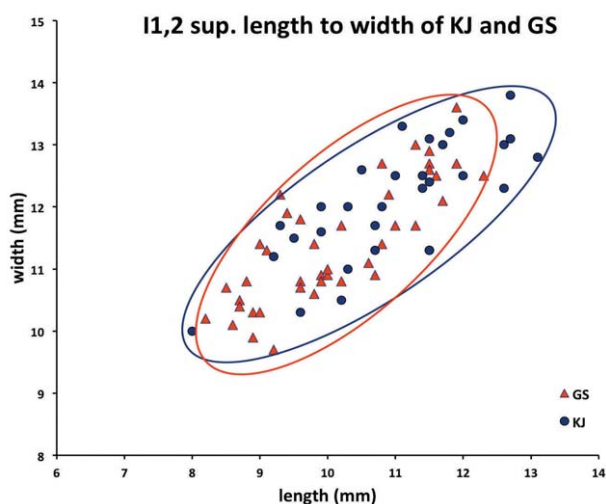


Figure 9: I1,2 sup. length to width of Križna jama and Gamsulzen cave.

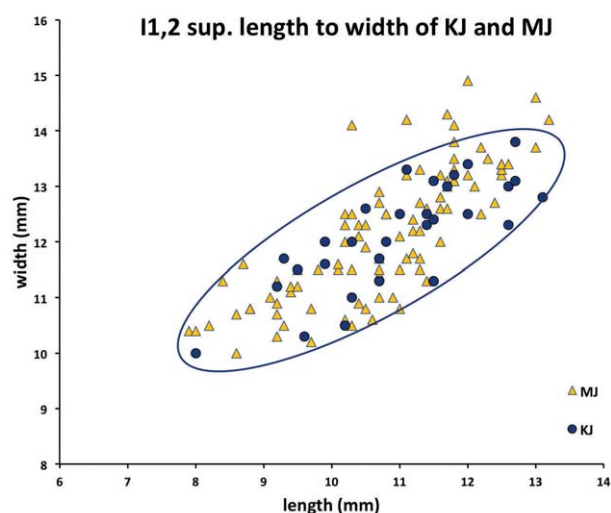


Figure 10: I1,2 length to width of KJ with GS and MJ.

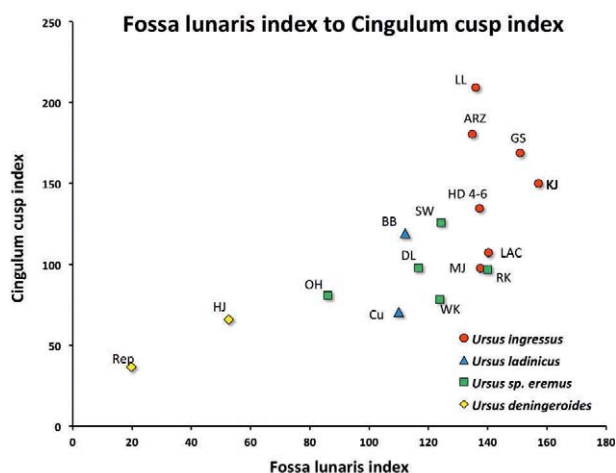


Figure 11: Fossa lunaris index to cingulum cusp index. Abbreviations: ARZ – Arzberg cave, BB – Brieglersberg, Cu – Conturines cave, DL – Drachenloch, GS – Gamsulzen cave, HD – Herdengel cave, HJ – Herkova jama, KJ – Križna jama, LAC – Loutra Almopias cave, LL – Lieglloch, Mj – Medvedia jaskýna, OH – Ochsenhalt cave, PZ – Potočka zijalka, Rep – Repolust cave, RK – Ramesch cave, SW – Schwabenreith cave

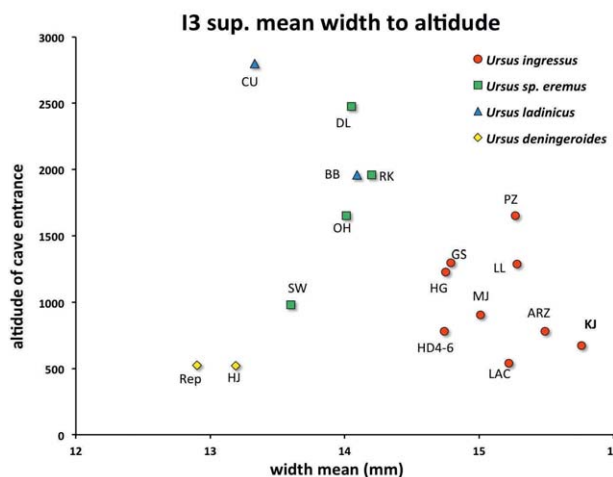


Figure 12: I3 sup. mean width to altitude of cave entrance. Abbreviations: ARZ – Arzberg cave, BB – Brieglersberg, Cu – Conturines cave, DL – Drachenloch, GS – Gamsulzen cave, HD – Herdengel cave, HJ – Herkova jama, HG – Hartelsgraben, KJ – Križna jama, LAC – Loutra Almopias cave, LL – Lieglloch, Mj – Medvedia jaskýna, OH – Ochsenhalt cave, PZ – Potočka zijalka, Rep – Repolust cave, RK – Ramesch cave, SW – Schwabenreith cave

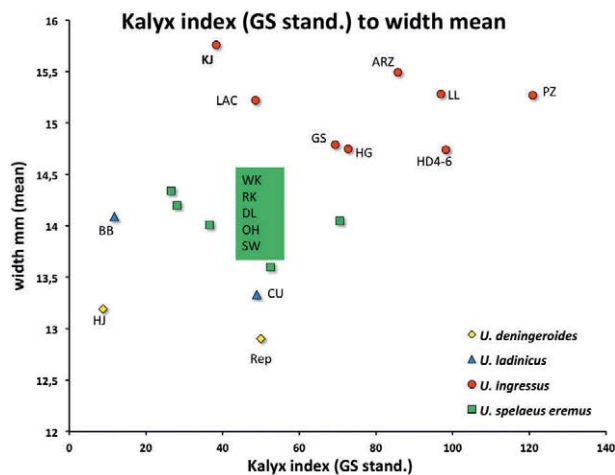


Figure 13: I3 sup. calyx index to mean width.

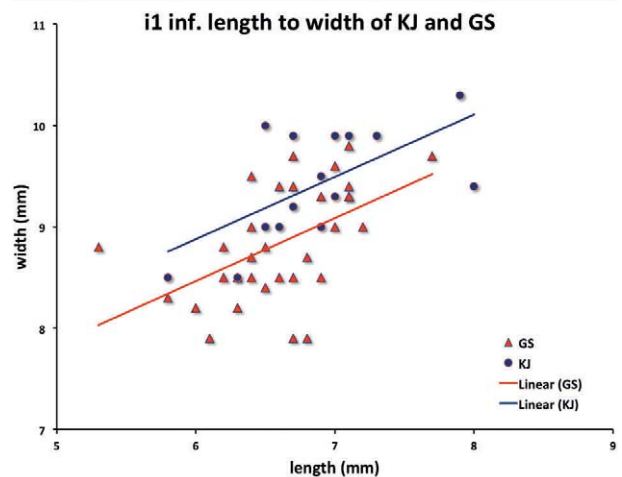


Figure 14: i1 inf. length to width of Križna jama and Gamssulzen cave.

within the *Ursus ingressus* group lying in the middle field in the development of the cingulum cusps but has the highest fossa lunaris index. Deductive there is an affinity to build a fossa lunaris and a lingual edge. 22 pieces are proper for the morphodynamic analyses. The bigger part (10 pieces) belongs to the highest fossa lunaris factor “s”. This morphotype developed a fossa lunaris and a lingual edge. Eighth exemplars belong to the “r” type (with fossa lunaris but without lingual edge). The remaining four upper I1,2 are morphotype “p” (cingulum is separated by a trench). There is no “d-type”, which is the evolutionary lowest. The number of cingulum cusps varied between zero and three.

4.2. I3 sup.

Dimensions:

Again the big dimensions of the Križna jama teeth can be shown articulately by comparing them with other cave bear faunas. In Fig. 12 the mean width is plot against the altitude of the cave entrance. With a mean width of 15.76 mm the upper I3 of Križna jama bear is the widest by being inhabitant of one of the geographical lowest caves. Similar results are within the other incisors.

Evolutionary Level:

The Evolutionary Level of the upper I3 is relatively low. Indeed the kalyx index does not separate the cave bear

species very good. So Križna jama and Loutra Almopia Cave overlap with all *Ursus spelaeus eremus*, *Ursus ladinicus* and even *Ursus deningeroides*. Within the *Ursus ingressus* line the evolutionary level of the upper I3 spreads in a large scope (Fig. 13). The small number of adequate I3 sup. (15) that could be used for the morphodynamic analyses reduces the significance.

Six of the upper I3 belong to the “0 type”. Meaning that on the distal edge there is neither a cusp nor any swelling. Another six pieces have a swelling on the distal edge therefore belonging to morphotype “0.5”. Only two teeth have a cusp and belong to the type “1”. I3 number KJ 11/2 has a swelling on the distal edge but also a cusp on the cingulum near the fossa lunaris. This is morphotype “1.5”. There are no higher evolved teeth.

4.3. i1 inf.

Dimensions:

The i1 inf. of Križna jama are of middle size. The mean length of Potočka zijalka, Lieglloch, Arzberg cave and Medvedia jaskyňa is bigger but within the width Križna jama is only beaten by the lower i1 of Lieglloch.

Figure 14 shows the comparison between the i1 inf. of Križna jama and Gamssulzen cave. It is clearly visible that the KJ teeth are longer and wider.

	Length	Width	Height	Morphotype
Mean/factor	6.88	9.42	33.71	150
Standard deviation	0.55	0.54	2.53	
Max.	8	10.30	38.40	2
Min.	5.80	8.50	30	1
Number	15	15	15	14
GS standard	104.88	107.29	110.49	185.99

Table 5: Means of measurements and morphological index of i1 inf. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

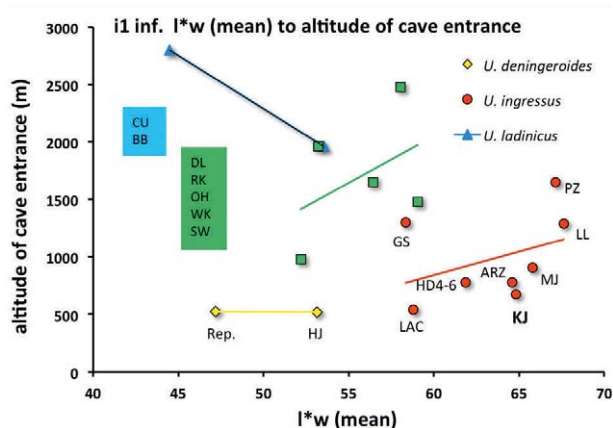


Figure 15: Mean length x width to altitude of cave entrance.

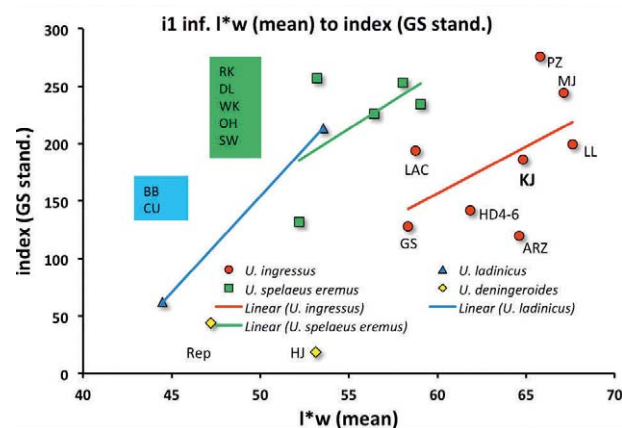


Figure 16: i1 inf. mean length x width to index (GS stand.).

In Figure 15 the mean $l \times w$ (length times width) is plotted against the altitude of cave entrance. Interesting is that only *Ursus ladinicus* shows a negative correlation between the altitude of the cave entrance and the size of the lower i1. *Ursus spelaeus eremus* otherwise shows an increase in size the higher the cave entrance is situated, but within the *Ursus ingressus* line the positive correlation is the biggest.

Morphodynamic index:

Figure 16 plots the mean of length times width ($l \times w$) against the GS standardized index of i1. Together with Loutraki Aridea cave that has the same value of morphodynamic index: 150, the Križna jama lies in the middle field. Not only other *Ursus ingressus* faunas such as Medvedia jaskyňa (with the highest evolutionary level) but also *Ursus spelaeus eremus* fauna like Ramesch-Knochenhöhle (with the 2nd highest index) and also Brieglersberg cave fauna with *Ursus ladinicus* are higher evolved. The Late Pleistocene faunas show a similar positive correlation of size and evolutionary level.

Out of the 13 lower i1 that were used for the morphodynamic analyses two teeth are associated to morphotype “A” (only protoconid and distoconid). Three lower i1 belong to the morphotype “B” (distoconid and protoconid with a partial mesial sulcus). Six teeth class with morphotype “C” (distoconid and protoconid with the mesial sulcus on the lower half of the dental crown). Morphotyp “B/C” is represented with only one tooth and is considered as in-

termediate stage between B and C. The highest evolutionary stage of the lower i1 development is the morphotype “D” occurring only with one exemplar (the mesial sulcus reached the tip tooth and splint of a small mesioconid). From the studies on the lower i1 it can be deduced that it is not possible to separate the cave bear species on the basis of the evolutionary level. They can be separated by their size only. It is to expect that further studies will bring more positive results.

4.4. i2 inf.

Because of the very low number of lower i2 it the mean values are not very serious.

	Length	Width	Height
Mean/factor	10.03	11.16	33.48
Standard deviation	0.80	0.79	11.53
Max.	11.0	12.3	41.8
Min.	8.8	10.0	36.0
Number	6	5	5
GS standard	103.33	102.86	91.33

Table 6: Means of measurements of i2 inf. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

	Length	Width	Height	Morphotype
Mean/factor	13.36	12.59	42.83	242.31
Standard deviation	0.94	1.16	2.13	—
Max.	14.8	14.9	47	—
Min.	11.2	10.7	40	—
Number	17	17	11	13
GS standard	101.25	101.16	100.91	94.43

Table 7: Means of measurements and morphological index of i3 inf. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

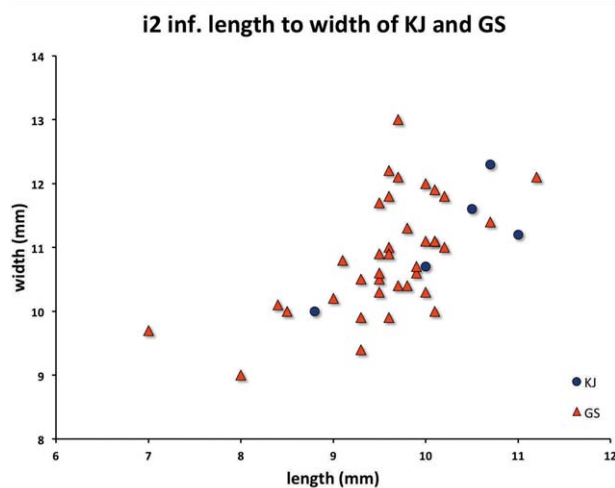


Figure 17: i2 inf. length to width of Križna jama and Gamssulzen cave.

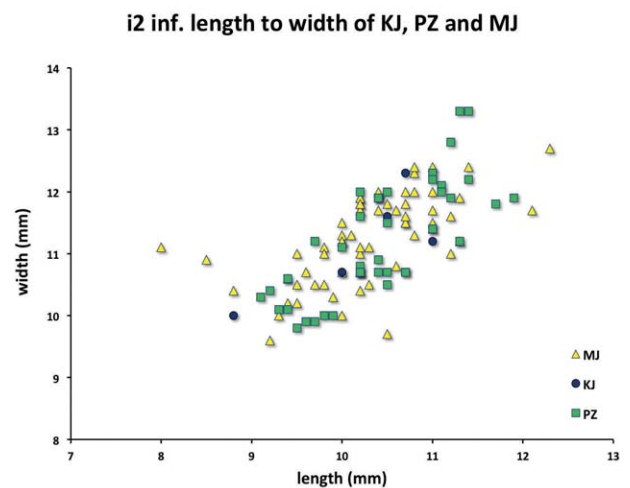


Figure 18: i2 inf. length to width of Križna jama, Medvedia jaskýna and Potočka zijalka.

Dimensions:

Figure 17 and Fig. 18: The dimensions of the lower i2 are quite big especially compared to Gamssulzen cave. Medvedia jaskýna and Potočka zijalka have bigger mean values in length and width.

Evolutionary Level:

Till now there is no morphodynamic analysis for the lower i2.

The scatter diagram of Fig. 20 compares the mean length to mean width of several cave bear faunas. The *Ursus ingressus* line separates quite clearly from the other cave bear species. While the *Ursus deningeroides* line can be distinguished from the others the *Ursus spelaeus eremus* and the *Ursus ladinicus* species are hardly to separate on basis of the dimension of the incisors.

4.5. i3 inf.

Dimensions:

Also the lower i3 of Križna jama cave bears are of big size. If you plot them in a scatter diagram (Fig. 19) against the i3 inf. of Potočka zijalka which are the biggest of all compared cave bear faunas the main part overlap but Potočka zijalka has a few exemplars that are bigger.

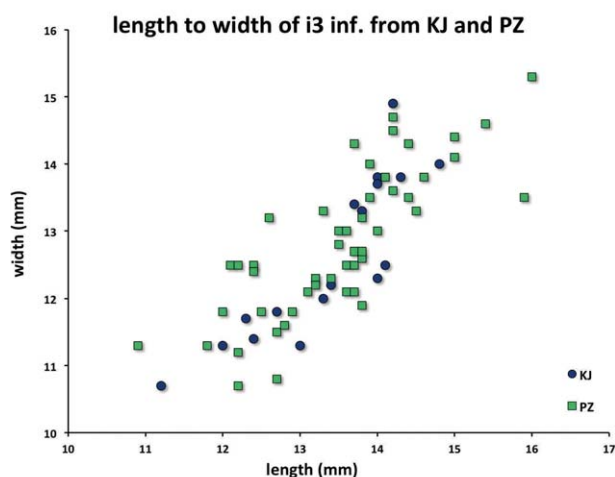


Figure 19: Length to width of Križna jama and Potočka zijalka.

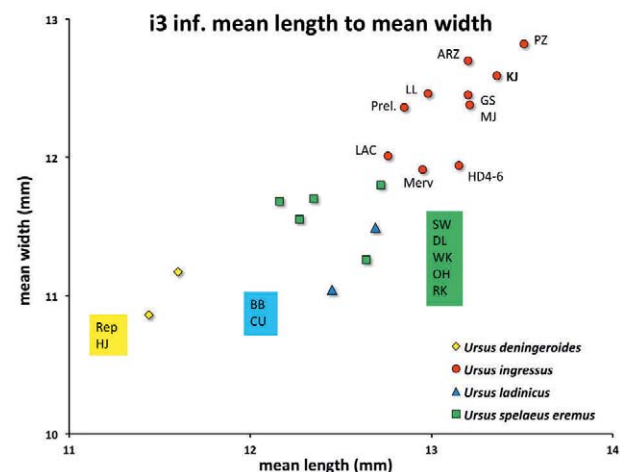


Figure 20: i3 inf. mean length to mean width of alpine and non alpine cave bear faunas.

Abbreviations: ARZ – Arzberg cave, BB – Brieglersberg, Cu – Conturines cave, DL – Drachenloch, GS – Gamssulzen cave, HD – Herdengel cave, HJ – Herkova jama, KJ – Križna jama, LAC – Loutra Almopias cave, LL – Lieglloch, Merv – Grotte Merveilleuse, Mj – Medvedia jaskýna, OH – Ochsenhalt cave, Prel – Grotte Prélétang, PZ – Potočka zijalka, Rep – Repolust cave, RK – Ramesch cave, SW – Schwabenreith cave, WK – Wildkirchli

Križna Jama: I3 sup.	Mean Length	Mean Width	n
Male	20.72	16.41	18
Female	17.38	14.38	8
Sex Dimorphism Index	119.24	114.17	—
Sex Index = 30.77			

Table 8: Means of measurements and sex indices of I3 sup. of *Ursus ingressus* RABEDER et al., 2004 from Križna jama.

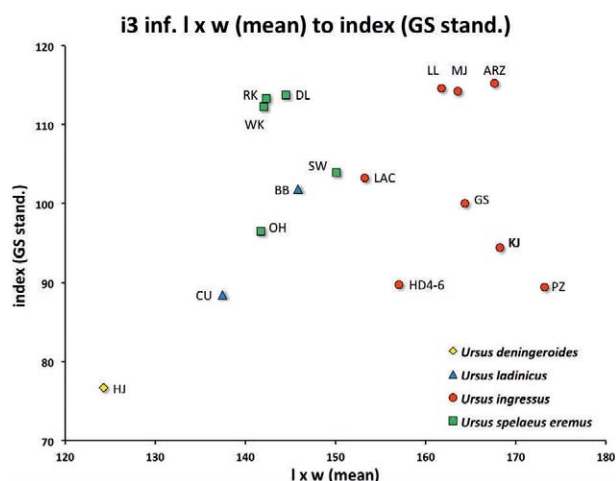


Figure 21: i3 inf. mean length x width to index GS standardized.

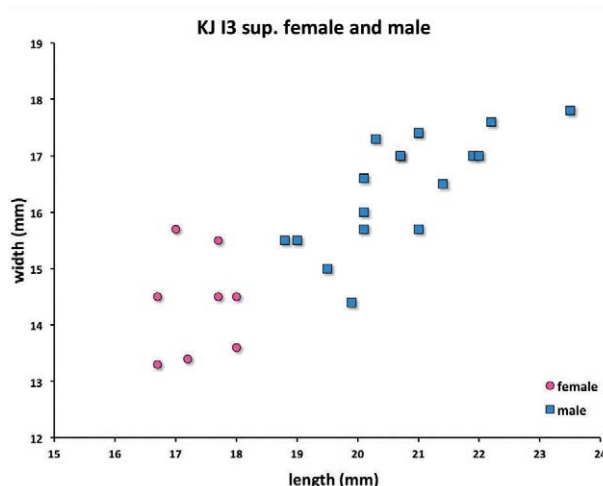


Figure 22: I3 sup. length to width of Križna jama.

Evolutionary Level:

The Evolutionary Level of the lower i3 is very low. Actually lower than most of the cave bear faunas that were compared, see Fig. 21. The lowest morphotype within the lower i3 of the Križna jama cave bear is the “C type”. The sulcus mesialis and the lingual edge range from the base of the protoconid crown to the 2nd half of the protoconid crown but stop clearly below the top. Only two pieces belong to the morphotype “D”. Here the sulcus mesialis and the lingual edge reach the top of the tooth crown. Five lower i3 class with the intermediate form “C/D” and one i3 inf. is of the intermediate form “C/E1”. E1 morphotype is defined by a small cusp on the mesial side of the Protoconid.

5. Sex Index and Sex Dimorphism Index

Figure 22 plots the length against the width of the upper I3. A fictional line separates the smaller female teeth (pink dots) on the left from the bigger male teeth (blue dots) on the right. This line would support the perceptions of the sex index of the canines. With a sex index of 30.77 the Križna jama cave has a noticeable male dominance. Also the other teeth elements tend to have more big sized teeth. The male dominance is a reason of the big dimensions of the teeth but at all the teeth elements contain bigger teeth than in other caves. There is an obvious sex dimorphism within the dimensions of the upper I3.

The Sex Dimorphism Index (119.24) of mean length is quite high. Compared to the Gamssulzen cave's I3 sup. with a sex index of 62 the SDI in length is only 114.12.

6. Conclusions

Unfortunately the amount of teeth to study was quite low. Especially the lower i2 included only five exemplars. The element with the most pieces is the upper I3. To hypothesize the size can be a factor in the deficiency of finding might be wrong considering the rare findings of upper I1,2 and the relatively frequent lower i1.

Conspicuous are the big dimensions of the teeth what is not only a result of the male dominance. All teeth elements belong to the biggest, only sometimes the fauna of Medvedia cave or Potočka zijalka is of bigger size. Within the evolutionary level the incisors of Križna jama are of low to middle development. The incisors of the Križna jama cave bear fit the values of dimension and Evolutionary Level of *Ursus ingressus*.

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