

Brigitte Hilpert

Studies of the morphology of the bears from the Steinberg-Höhlenruine near Hunas

Zusammenfassung:

Das Bärenmaterial aus der Steinberg-Höhlenruine bei Hunas wurde neu aufgearbeitet. Dabei wurden sowohl die Funde aus der Grabung Heller (1956-1964) als auch die der laufenden „neuen“ Grabung (seit 1983) eingehend biologisch, taphonomisch, metrisch und morphologisch untersucht. Die Bären aus Hunas werden zu *Ursus spelaeus* gestellt. Sie sind durch eine Merkmalskombination aus einfach gebauten Zähnen und einem typisch spelaeoiden Skelettbau gekennzeichnet, wie sie auch bei den Höhlenbären aus anderen oberpleistozänen Fundstellen der Frankenalb auftritt.

Abstract:

The bear finds from the Steinberg-Höhlenruine have been revised. The finds from the Heller excavation (1956–1964) as well as the ones from the current „new excavation“ (since 1983) have been thoroughly examined biologically, taphonomically, metrically and morphologically. The bears from Hunas belong to the *Ursus spelaeus* species and are characterised by a special combination of features: simple morphotypes of teeth and a typical spelaeoid skeleton which is to be found as well with cave bears from other Upper Pleistocene sites in the Franconian Alb.

Résumé:

Les ursidés de Steinberg-Höhlenruine (grotte effondrée de Hunas) ont été reconsidérés. Tant les pièces provenant des fouilles de Heller (1956-1964) que celles issues des fouilles actuelles en cours depuis 1983 ont été analysées du point de vue biologique, taphonomique, métrique et morphologique. Les ours de Hunas appartiennent à l'espèce *Ursus spelaeus*. Ils sont caractérisés par des dents à structure relativement simple et un squelette de type *spelaeus* clair, à l'instar des ours provenant d'autres sites du Pléistocène supérieur en Franconie.

Key words: Steinberg-Höhlenruine near Hunas, *Ursus spelaeus*, special combination of features: simple morphotypes of teeth with typical spelaeoid skeleton, Upper Pleistocene.

Introduction

The bear finds from the Steinberg-Höhlenruine near Hunas had been revised in the course of writing PhD-thesis (HILPERT 2005). The bear finds are from the Heller excavation from 1956 to 1964 and from the yearly stages of the so-called „new excavation“ which have been taking place since 1983. Apart from biological, pathological and taphonomical examinations the morphology of the remains was of particular interest in the studies. The investigation of the fauna of the Heller excavation has shown features which are normally only to be found in Middle Pleistocene sites. The U/Th-dating of dropstones from the Heller excavation seemed to confirm this. Heller assigned the bears to *Ursus spelaeus*, but noticed some primitive characteristics. However, he had only analysed the cranial finds. He did not take into account the other material. An analysis of the complete material from Heller excavation and the „new excavation“ was done. New TIMS-U/Th-datings of stalagmites from the „new excavation“ showed an age of 80,000 years, which led to many questions, especially regarding the fauna. After a comparison of the finds from Hunas with the ones from other German and Austrian sites the position of the bears in relation to the evolutionary line *Ursus deningeri* - *Ursus spelaeus* will be discussed and re-evaluated. Especially ecological factors will be taken into consideration for the analysis.

The Hunas excavation - location and stratigraphy

The Steinberg-Höhlenruine (HFA A 236) is situated in the quarry of the Sebald Zement company, Hartmannshof (Community of Pommelsbrunn, Central Franconia, Bavaria), about 40 km east of Nürnberg. The cave ruin is situated about 520 m above sea level on the eastern slope of the Steinberg. Colloquially it is known as the „Höhlenruine von Hunas“. The hamlet Hunas is to be found below the Steinberg. The cave is embedded in the dolomite of the Middle Kimmeridgian (Malm Delta) and is part of the Central Franconian Alb.

The Heller excavation and the „new excavation“ are staggered to one another. The Heller excavation has revealed a sediment complex, which is about 15 m long, 8-10 m high and 5-7 m deep which went straight through the northern part of the cave. The area of the „new excavation“ is deeper inside the cave and has, while it overlaps slightly with the Heller excavation, opened up the southern part of the cave.

In the Heller excavation layers with a thickness of 8-10 m were removed from below the roof of the cave (D-N). A detailed description of the layers is to be found in HELLER 1983. The layers below N were only opened up in an exploratory trench on the outer slope. After 10 m solid rock was discovered, presumably the bottom of the cave. The layers D and E described by Heller were not found in the „new excavation“, because it is deeper inside the cave. There the stratigraphic sequence starts with F (presumably F 2). By 2003 a sequence had been recovered which reached below the

Heller excavation. The layer that has been opened up now corresponds very well with Heller's O-layer. Below this layer part of the speleotheme with stalagmites of up to 30 cm has been opened up. From this speleotheme the sample mentioned above was taken. It belongs to the Upper Pleistocene (ROSENDAHL et al. 2004). In every layer of the whole sedimentary complex, according to Heller's analysis D to O, remains of bears were found.

Sites to compare

Up to now only few caves in the Franconian Alb which contain bear finds have been examined according to modern methods of analysis. There is no exact data on the morphology of these bears available. This is why the most important bear finds have been re-examined in order to find out more about the morphology of bears from caves in the Franconian Alb in general. The following Upper Pleistocene sites in the area around Hunas have been checked:

Gentnerhöhle bei Weidlwang (HFA A 117): Finds of *Ursus spelaeus* und *Panthera leo spelaea*; Upper Pleistocene (cf. to HILPERT & KAULICH 2005), Osterloch in Hegendorf (HFA A 2): Finds of *Ursus spelaeus* and *Crocota crocuta spelaea*; Upper Pleistocene (cf. HILPERT & KAULICH 2005), Petershöhle bei Velden (HFA A 22): extensive fauna (cf. list of fauna in Excursion-Guide, this volume) with *Ursus spelaeus*; Upper Pleistocene (cf. HILPERT & KAULICH 2005), Zoolithenhöhle bei Burggailenreuth (HFA D 109): extensive fauna (cf. list of fauna Excursion-Guide, this volume) with *Ursus spelaeus*; bears presumably Upper Pleistocene.

The bear remains - results and discussion

Bones and teeth of the bears were found in all layers. The material was first of all examined in separate layers and the data of the different layers were compared with one another. No metrical or morphological differences within the complete stratigraphic sequence could be found. Apart from ribs and vertebrae all bones were examined. Some of them (skulls, lower jaws, teeth, tibiae) will serve to exemplify the results.



Fig. 1: Skull of *Ursus spelaeus*, Hunas (above), Petershöhle near Velden (below).



Fig. 2: Lower Jaw
Ursus spelaeus,
Hunas (above),
Zoolithenhöhle near
Burggaillenreuth
(below).

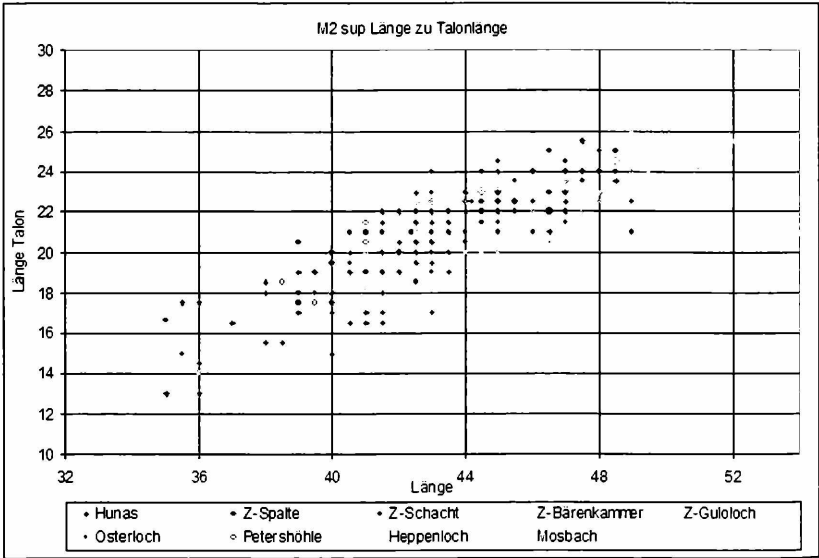
Skull and Lower Jaw

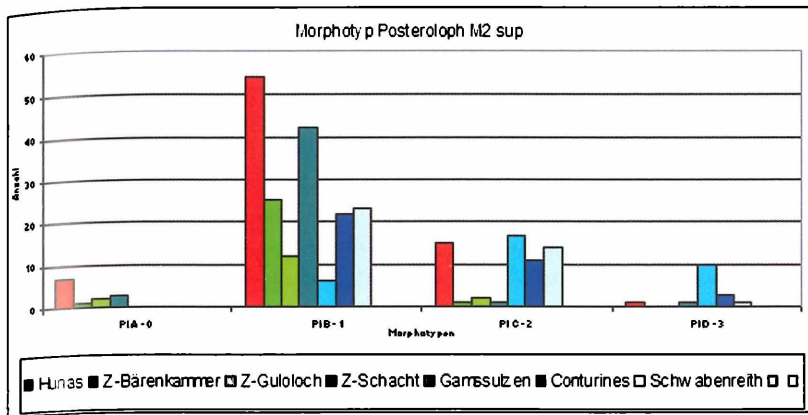
10 skulls, 19 maxillas, 15 pre-maxillas and 59 lower jaws of adult bears could be recovered. Most skulls are damaged, but some of them could be measured. The lower jaws are mostly in good condition. The skulls show the steep forehead which is typical for *Ursus spelaeus* and do not differ in this respect from the skulls from comparable sites (Fig. 1). The lower jaws are characterized by a high corpus (corpus mandibulae) and a broad ramus ascendens, which are characteristic features of *Ursus spelaeus* as well (Fig. 2).

Isolated teeth

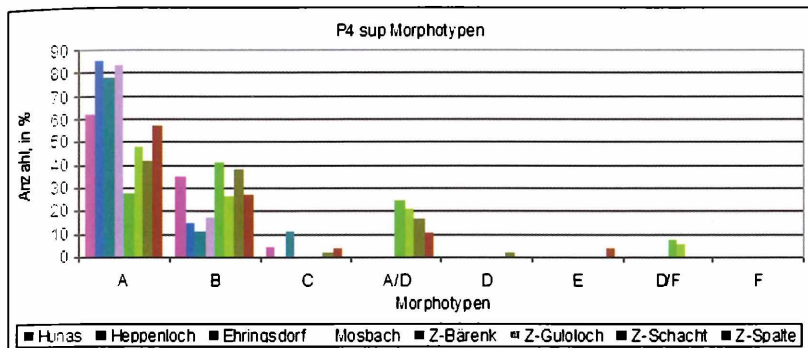
Because of their preservational properties teeth are the most common remains from Hunas. They were subjected to the most thorough examinations. 60 P⁴, 81 M¹, 95 M², 52 P₄, 103 M₁ and 82 M₃ were examined. In addition to a metrical analysis the morphology of the teeth's surface was examined. The size of the teeth gives only limited clues for the classification of the species. In the cave bear line the length of M², especially of the talon, is supposed to increase from *Ursus deningeri* to

Tab. 1: M², length of
Talon- greatest
length, Hunas,
Zoolithenhöhle:
Z-Bärenkammer,
Z-Guloloch, Z-Spalte,
Z-Schacht, Osterloch
in Hegendorf,
Petershöhle near
Velden; Heppenloch
near Gutenberg,
Mosbach (Mosbacher
Sande).

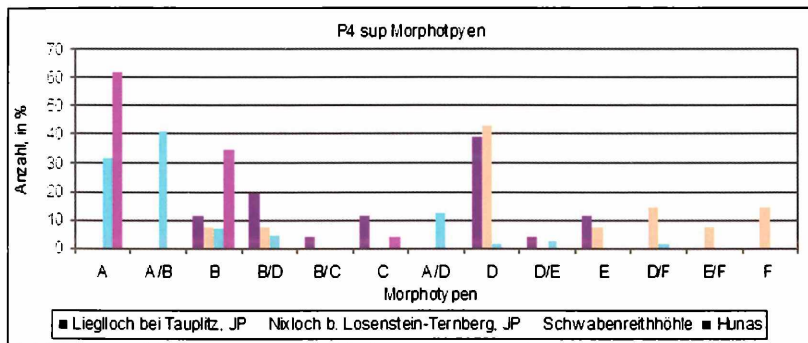




Tab. 2: Distribution of morphotype 'Posteroloph' from M², Hunas, Zoolithenhöhle: Z-Bärenkammer, Z-Guloloch, Z-Schacht, Osterloch in Hegendorf, Petershöhle near Velden; cf. RABEDER (1999): Gamssulzen-Höhle, Conturines, Schwabenreithhöhle.



Tab. 3a: Distribution of P⁴-morphotypes, Hunas, Heppenloch, Ehringsdorf, Mosbach, Zoolithenhöhle: Z-Bärenkammer, Z-Guloloch, Z-Schacht, Z-Spalte (in %).



Tab. 3b: Distribution of P⁴-morphotypes, Hunas; cf. RABEDER (1999): Liegloch bei Tauplitz, Nixloch bei Losenstein-Ternberg, Schwabenreithhöhle (in %) (JP: Upper Pleistocene).

Ursus spelaeus. The increase in chewing surface is seen as proof of the herbivorous diet of the cave bears. However, as a matter of principle the diet depends on the ecological conditions of the habitat. Depending on the flora and fauna the extent of the herbivorous eating habits tends to vary regardless of the species. A comparison of the tooth length of M² between the Middle Pleistocene finds of the Mosbacher Sande and the Heppenloch

near Gutenberg and bear finds from Upper Pleistocene sites of the Franconian Alb (Osterloch in Hegendorf, Petershöhle near Velden, Zoolithenhöhle near Burggaillenreuth) did not show any significant differences (Tab. 1). Some of the M^2 from Hunas are simply a bit shorter than some M^2 from the Zoolithenhöhle. A comparison of the other teeth from Hunas with the Middle Pleistocene and Upper Pleistocene bear teeth mentioned above did not show any differences either. Even the teeth of the holotypes of *Ursus deningeri* are of the same size as the finds from the Zoolithenhöhle, which is the type locality of *Ursus spelaeus*. A separation of the two species *Ursus deningeri* and *Ursus spelaeus* with the help of this feature is not possible. An analysis of tooth surfaces according to morphotypes (cf. RABEDER 1999) produced interesting data. The skulls and lower jaws had the distinctive features of *Ursus spelaeus*, whereas the teeth belong to *Ursus deningeri* according to Rabeder's system of morphotypes. The posteroloph of M^2 , for example, has developed into the types 0, 1 and 2 with the bears from Hunas. The same is true for the Upper Pleistocene cave bears from the Zoolithenhöhle, even though the majority of teeth are in both cases type 1 (Tab. 2). The bear teeth from the Schwabenreith-Höhle (Early Würm), the Gamssulzen-Höhle (Late Würm) and the Conturines (Early to Middle Würm) (cf. RABEDER 1999) show types 1, 2, and 3 at the posteroloph of M^2 (Tab. 2). The analysis of teeth from two more caves in the Franconian Alb (Osterloch in Hegendorf, Petershöhle near Velden) revealed simple morphotypes of teeth (Tab. 2) with types 0 and 1 at the posteroloph of M^2 and a typical spelaeoid skeleton. AMS- ^{14}C -datings have been carried out already for the Osterloch and the Petershöhle (HILPERT & KAULICH 2005). Both belong to the Upper Pleistocene. Similar features and developments are to be found with all teeth from Hunas and the other sites of the Franconian Alb. Above all the distribution of the morphotypes of P^4 shows clear differences between the sites in Germany, especially in the Franconian Alb, and the ones in Austria (Tab. 3a + b). While the teeth from Hunas and the other caves in the Franconian Alb are clearly mostly types A and B, with A being in most cases the predominant type and with only sporadic finds of P^4 in the Zoolithenhöhle, we find a different distribution in Austrian caves: The Upper Pleistocene Lieglloch and the Late Würm Nixloch show a widespread distribution of types, while Nixloch has mostly types D and F (cf. RABEDER 1999). These types have hardly been found with P^4 in the caves of the Franconian Alb. The P^4 from the Schwabenreithhöhle show a similar distribution to Hunas, at least as far as the majority of the distribution of the types is concerned. The types A/D to D/F are not to be found in Hunas.

The bears from sites in the Alps which are younger, older and about the same age have more highly-developed teeth than the ones from Hunas and other sites in the Franconian Alb. The stratigraphic application of the morphotype system can not really be used for the bears from caves in the Franconian Alb. It has become apparent that a different development can be observed with the cave bears there which show a special combination of simple morphotypes of teeth and a typical spelaeoid skeleton.

Postcranial bones

The postcranial finds are only of limited use for examinations, because there are only very few adult finds. The majority of limb bones is made up of remains from young bears. Morphological differences of limb bones which could be used to distinguish *Ursus deningeri* from *Ursus spelaeus* are hardly known thus far. Mostly there are differences in size to be found. Only the tibiae show differences. In general the tibiae of *Ursus deningeri* have less torsion than the finds of *Ursus spelaeus*. However there is a gradual transition from one to the other. The tibiae from Hunas have been measured from 48° to 52°, the results for tibiae from cave bears from other sites in the Franconian Alb vary from 50° to 62°. The bears from Hunas differ slightly from these results. The number of carpalia and tarsalia was not sufficient enough for a detailed comparison. As far as measurements were possible there have been no differences in comparison to the comparable sites. The metacarpalia and metatarsalia were metrically as well as morphologically examined, but there again the amount of finds was so small that they were not compared to other sites.

Conclusion

The bear finds from Hunas show differences in the teeth structure from the features of the „classical“ *Ursus spelaeus*. All other features are typical for the spelaeoid species. Other Upper Pleistocene sites of the Franconian Alb show the same combination of features of simple morphotype teeth, which is normally attributed to *Ursus deningeri*, and typical spelaeoid skeleton. An explanation for these results could be the different ecosystems of the respective regions. The Alps are an extremely dissected area for example: It consists of deep valleys as well as high and mountainous areas of a height of up to 4810m (LANG 1994). There you find different faunas of the mountainous and sup-alpine zones in a comparatively small area, because of the different heights (LANG 1994). This area is subject to extreme climatal fluctuations which do not only affect the flora but also the appearance of the area as such. In very cold periods with an increase in ice formations most parts of the Alps were „uninhabitable“, because many valleys were filled with glaciers. The Franconian Alb on the other hand are part of the Central European, Sub-Atlantic area (LANG 1994). Especially the Northern and Central Franconian Alb are an area of rather small differences in height (mostly about 200 to 250m). The weathering of the predominate dolomite has created a small-sized and dissected area (so-called Kuppenalb) which is divided in many different ecological zones. Because of the comparatively small differences in height within the area the effects of climatic fluctuations were not as extreme as in the Alps. Above all there were no glaciers. In general all regions in Germany and Europe have been affected to a different degree by climatic fluctuations depending on the geological structure and geographical position. Consequently there have been different effects on

the pressure of selection on flora and fauna and therefore on the combination of features of the animals. If the elongated and more noded teeth of cave bears are a sign of a herbivorous diet, then the bears from Hunas are probably more likely to have had a more omnivorous diet, because of their less noded and less elongated teeth. It has been proven that bears from the Alpine region were mostly herbivores (ROSENDAHL & GRUPE 2001). There are no results for the bears of the Franconian Alb, yet. The bears from Hunas can be assigned to *Ursus spelaeus*, but to a group which in the Northern and Central Franconian Alb is characterized by a special combination of simple morphotypes of teeth with typical spelaeoid skeleton. The bears do not help with the dating of sites. In order to find out to what extent the cave bears were a more omnivorous species further research will be necessary.

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Address of author:

Dipl.-Geol. Brigitte Hilpert, Institut für Paläontologie, Loewenichstr. 28, 91054 Erlangen;
brigitte.hilpert@pal.uni-erlangen.de

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