

Phylogenetic Problems of the Alpine Cave-Bears

Problemas filogenéticos de los Osos de las Cavernas Alpinos

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ABSTRACT

The metric and morphological characteristics of 23 alpine cave bear fauna are been studied and compared with the normal lowland form. The phylogenetic conclusions are drawn: 3 new subspecies?

Key words: Alpine cave bears, phylogeny, taxonomy

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INTRODUCTION

Large quantities of fossil teeth and bones have been found in caves throughout Europe. They belong to the so-called cave-bear. These animals probably used caves as hibernation places, which would explain the mass occurrences of skeletal remains. More than 30 cave sites are known in Austria alone and some of these caves are situated at an altitude of 2.000m or more.

The rapid evolution from the Middle Pleistocene Deninger bear, *U. deningeri*, to the more recent cave bear, *U. spelaeus*, was the central focus of many publications (e.g. EHRENBERG, MOTTTL, KURTEN, MUSIL, etc.). This evolution from an omnivorous ancestor to a herbivorous cave bear took less than 150.000 years. Radiocarbon and uranium-series dates constrain these palaeontological results. This evolutionary speed is only challenged by micromammals.

The high alpine cave bears remains are smaller in size than the comparable ones found in lowland sites. This was the reason that EHRENBERG (1926) addressed them as "high alpine small form" (Schreiberwand-Höhle: 2200m and Salzofen: 2005m), which lead to a controversially discussion.

The existence of such a small form was very much doubted by some scientists. They suspected a dominance of females over males in these caves which would give the impression of a "small form" – not a dwarf form! Cave bears had an obvious accentuated sexual dimorphism, in which females were about 15 % smaller than males, based on the comparison of canines.

The difference is even less when it comes to body mass.

METHOD AND RESULTS

The shifting of morphological features during a geological time-period is an evolutionary process. The so-called Morphodynamic method quantifies this process. On the fourth premolar, for example, the increase of cusps per tooth and the enlarging of the occlusal surfaces – suited to grinding functions – is an adaptation to a more herbivorous way of live. The comparison of the evolutionary level of the fourth upper and lower p4 results in a P4/4-Index. In diagrams, the P4/4 –Index versus the standardised dimensions of teeth - e.g. mean value of length of m1 (figure 1) or m3 (figure 2) in percent to Gamssulzen standard (RABEDER, 1999) - results in five units. They are characterised in a provisional taxonomic frame as follows (figure 3):

U. deningeri deningeroides MOTTTL, Repolusthöhle

A small form of *U. deningeri*. The fauna from the Repolust cave is presently determined as "late Middle Pleistocene" because of uncertain Uranium-Thorium data.

U. deningeri n.ssp., Conturineshöhle

A small high alpine cave bear, combining features from the Deninger bear with typical *U. spelaeus* characteristics. *U. deningeri* features are P3, length of m3, metapodials; *U. spelaeus* feature is the spelaoid P4/4-index, higher than in Early Würmian *U. spelaeus*-faunas. The separation probably occurred during the denin-

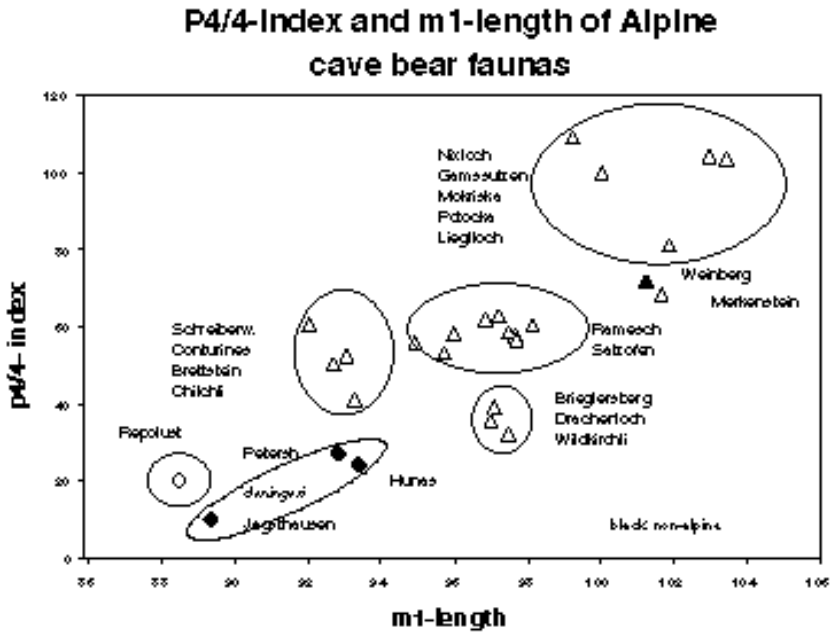


Figure 1. Scatter diagramm of m1 length (in percent to mean m1 length from Gamssulzen cave) versus p4/4 index.

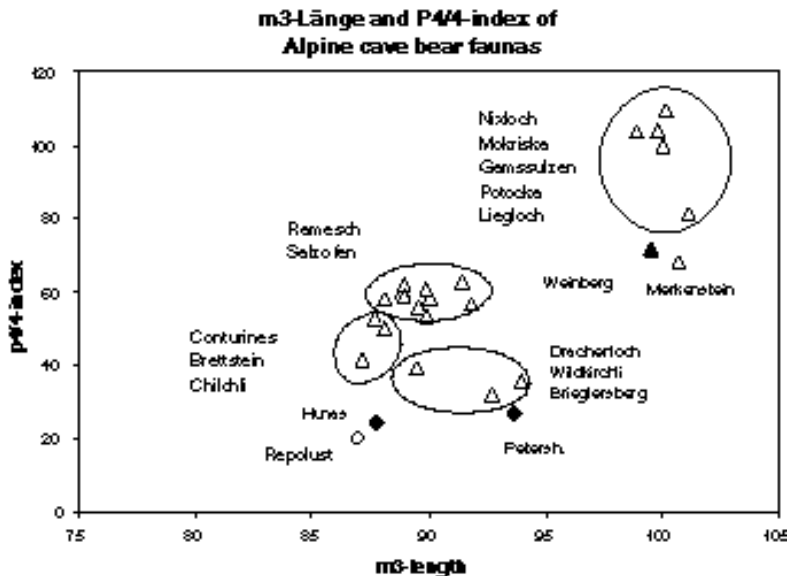


Figure 2. Scatter diagramm of m3 length (in percent to mean m3 length of Gamssulzen) versus p4/4-index.

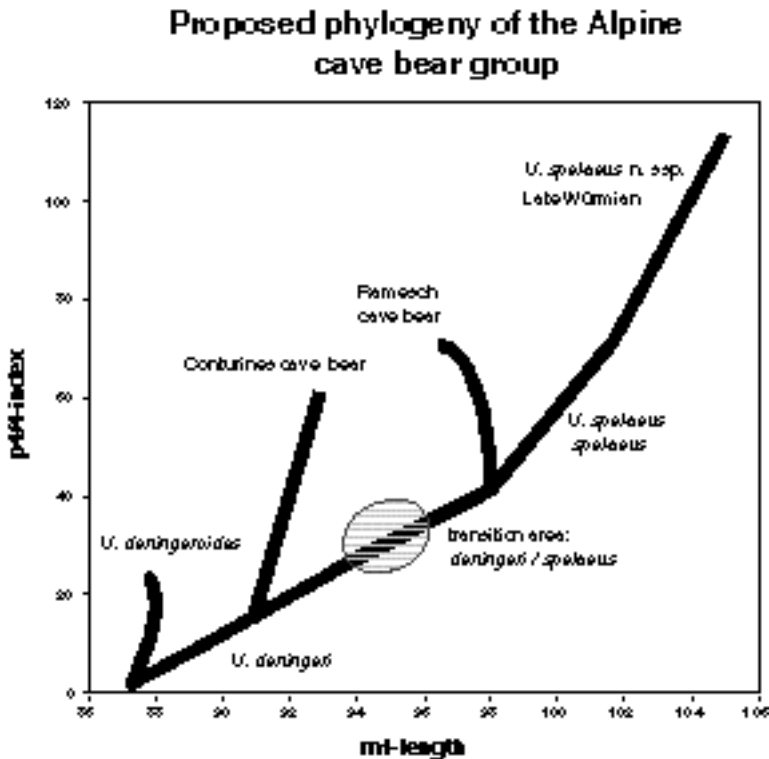


Figure 3. Proposed phylogeny of the Alpine cave bear group.

geri-level. The Conturines bears are dated into the Middle Würm. A connection with *U. d. deningeroides* is possible. If the cave bear remains from the Schreiberwandhöhle, Brettsteinhöhle and Chilchi-Höhle belong to this new species cannot be answered yet.

The "Drachenloch-bears"

Bears from high alpine caves of the western part of Switzerland (Drachenloch, Wildkirchli, Sulzfluh) show morphological results as the "normal" cave bear. They are from the Riss-Würm or Early Würm,

indicated by the present taxonomic knowledge.

U. spelaus n.ssp., Ramesch-cave

The evolutionary level of these bears is the result of a regressive evolution. This is the conclusion from many data of the two-meter high profile in the Ramesch-Knochenhöhle.

From approximately 35.000 years on, both mean size and morphodynamic indices of the premolars declined in the upper parts of the Ramesch profile. A possible reason was a change to colder climate.

U. spelaus n.ssp., Gamssulzenhöhle

Large cave bears of a high evolutionary level immigrated into the alpine region between 38.000 and 35.000 years before present. They didn't mix with the ***U. spelaeus*** n.ssp. from the Ramesch-cave living in the same area. This bear is known only from alpine caves of the East Alps (Gamssulzenhöhle, Potocka, Mokriska) and West Alps (Schnurenloch). Bears of

lower altitude with such a high evolutionary level were not described yet.

We hope to get new insights into the very complex taxonomy of the alpine cave bears by investigating the postcranial skeletons more thoroughly and by including cave bear DNA data, currently under investigation by the ancient DNA group of the Max-Planck society.

REFERENCES

- EHRENBERG, K. (1992). Die Ergebnisse der Ausgrabungen in der Schreiberwandhöhle am Dachstein. *Paläont. Z.*, **11** (3): 261-268, Berlin.
- KURTEN, B. (1958): Life and death of the Pleistocene cave bear. – *Acta Zool. Fennica*, **95**: 1-59, Helsinki.
- MOTTL, M. (1964). Bärenphylogenese in Südostösterreich. *Mitt. Mus. Bergbau, Geol. Tech.* **15**, Graz.
- MUSIL, R. (1980/81): *Ursus spelaeus*, der Höhlenbär. *Weimarer Monogr. Ur- und Frühgesch.* **2**, 1-3, Weimar.
- RABEDER, G. (1999). Die Evolution des Höhlenbärengebisses. *Mitt. Komm. Quartärforsch. Österr. Akad. Wiss.* **11**: 1-102, Wien.