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Bear assemblage from the Za Hájovnou Cave in Moravia (Czech Republic): sex ratios and age structure

Zusammenfassung:

Die Ansammlung von Bärenfunden in der Höhle Za Hájovnou in Mähren ist charakterisiert durch die Dominanz von jungen Bären (~ 74%) und durch das gelegentliche Auftreten neugeborener sowie sehr alter Bären. Die Geschlechterverteilung, welche durch Untersuchungen an adulten Canini und Langknochen aus der gesamten Höhle ermittelt wurde, beträgt 56% : 44% zu Gunsten der Männchen. In Bezug auf die Sterblichkeitsrate besteht die Ansammlung überwiegend aus Individuen, die vermutlich während ihrer Winterruhe verhungert sind. Allerdings sind auch andere Todesursachen (Krankheit, Raubtiere etc.) nicht auszuschließen.

Abstract:

The bear assemblage from the Za Hájovnou Cave in Moravia is characterized by the dominance of non-adults (~ 74%) and by the sporadic occurrence of neonates and very old specimens. The sex ratio, based on the analysis of adult canines and long bones from the whole cave, is 56% : 44% in favour of males. From mortality viewpoint, the assemblage consists of specimens, which mostly died during their hibernation, probably for reason of the starvation(?), though other reasons of their death (diseases, predators, etc.) are not excluded.

Résumé:

La collection de restes d'ours provenant de la grotte Za Hájovnou en Moravie est caractérisée par la dominance d'individus juvéniles (environ 74%) et par la présence sporadique de nouveaux-nés et d'individus très vieux. L'analyse des canines adultes et des os longs provenant de toute la grotte montre une dominance des mâles (56%) sur les femelles (44%). Du point de vue de la mortalité, l'assemblage comprend des individus décédés surtout pendant l'hibernation, probablement de faim, bien que d'autres causes (maladies, prédateurs etc.) ne puissent être exclues.

Key words: bears of the *deningeri*-group, age structure, sex ratios, Za Hájovnou Cave, Moravia

Introduction

Finds of bears from the *deningeri*-group are not as common as remains of the Late Pleistocene *Ursus spelaeus*. Thus, the poor fossil record of these bear species from the late Early Pleistocene to the Middle Pleistocene do not allow more detailed and comparative analyses in comparison with the amount of cave bear fossils. Furthermore, the taxonomical problem of bears of the *deningeri*-group is still not adequately solved so far. The designation *Ursus deningeri* probably includes the entire group of time- and morphologically differing populations, subspecies, or species respectively (MUSIL 1969).

From viewpoint of problems under study (sex ratios and age structure of bear assemblages), only some more detailed reports on bears of the *deningeri*-group are known (e.g. STINER et al. 1998). On the other hand, the standart of knowledge of demographic characteristics of the both Late Pleistocene cave bears and Recent brown bears is much higher, and so, it can be considered as a good guide for the study of some aspects of the paleobiology of bears from the *deningeri*-group (e.g. timing of tooth eruption, time of birth, or composition of individual populations).

So far, the excavations in the Za Hájovnou Cave in Javoříčko Karst in Moravia (Fig. 1) yielded a large quantity of bear fossils. They allow a preliminary conclusion on sex ratios and age structure of this bear assemblage. Thus, the paper is a contribution to the better understanding of problems under study for bears from the Middle Pleistocene.

Material and Methods

All fossil material found in the cave is stored in the Moravian Land Museum in Brno. The finds are very fragmentary - only a few long bones are entirely preserved. It is caused by the process of fossilization, when teeth and bones were frequently chaotically accumulated by secondary redeposition (probably by gravity and/or water transport?) and cemented by cave sinter.

The bear fossils have been found mainly in 5 cave parts - Narozeninová chodba (Birthday passage), Vykopaná chodba (Excavated passage), Kostnice I (Charnel-house I), Kostnice II (Charnel-house II), and Chodba naděje (Passage of Hope) (Fig. 1). Generally, 1,115 fossil remains of bears have been analysed - 395 isolated teeth or their fragments, 70 fragments of skulls and mandibles (with dentition or toothless ones), and 650 fragments of postcranial skeleton (especially vertebrae and bones of limbs). No fragments of ribs and phalanges were under study.

Each of teeth and different bone elements were used for more detailed analysis, as long as $n = 10$ and more. For age structure determination of whole bear assemblage, determined teeth were used and sex ratios were calculated from canines and preserved limb bones.

So far, some methods and systems for the determination of ontogenetic age of individuals on the basis of crown wear stages are known. System of DEBELJAK (2002) was used for analysis of determined bear canines under study. Premolars and molars have been analysed according to modified and

applied methods of KURTÉN (1958) and STINER (1994, 1998), whereas system of RABEDER (1992) was used mainly for the verification of found data.

For age determination of found incisors, an own method based on wear stage was used. The teeth were classed to 5 groups: A - unworn incisors without a root, B - unworn incisors with the root, C - incisors with slightly worn crown, D - worn incisors, E - incisors with heavily to fully worn crown. The first two groups are attributed to non-adults and the last one represents the senile animals.

From viewpoint of the ontogeny, following main age cohorts are considered: a) non-adults - neonates (one-year old bear cubs), juveniles (~ 1-2(3) years old specimens), and subadults (~ 3-4 years old bears); b) young adults - > 4 years old specimens; c) old (senile) adults - specimens with very heavily worn teeth, especially molars.

The relative abundance of young, prime adult and old specimens is plotted in a tripolar age graph (STINER 1994, 1998), where the triangle is divided to areas associated with a mortality pattern family such as the „non-violent attrition“ (NNVA) and the „living structure“ (LS) patterns. This throw a light on the origin of the taphocoenose.

Results

Incisors

From all 76 found incisors, 73 permanent ones have been used for more detailed analysis. Non-adult specimens form the dominant age group (51-52%), whereas senile animals are represented by ~ 14% only. From all wear stages, B one is dominant (48-49%).

Canines

So far, 9 deciduous and 97 permanent canines (or their fragments) have been found in sediments of the whole cave. Minimally, three of deciduous teeth belong to RABEDER 'S (1992) age stage b to c. For more detailed analysis, 52 permanent canines have been used. Against to other teeth, the young adults form the dominant group (52-57%). Old adults are represented by 10-11% only.

For determination of sex ratio, dimensions of 20 canines (including 5 teeth of juveniles) have been used. The complete analysis demonstrated a slightly dominance of females (53-55%). Total ratio between adult males and females is 9 : 11.

Premolars and molars

Premolars and molars are the most frequently found teeth in the cave. Generally, 242 cheek teeth have been determined. A ratio between juvenile to subadult specimens and adult to senile animals is, on average, 4 : 1 in favour of non-adults, teeth of which form almost 80% in the whole sample under study.

However, the age determination based on wear stages of all teeth is relatively not stable, because cheek teeth of different wear stages can be situated in

jaws of single specimen. For that reason, the analysis is standard only for this tooth type, which is most represented in the whole sample under study. In the case of material from the Za hájovnou Cave, most of all determined teeth belong to M2s (or to left M2s resp.). For verification, the same analysis was also used for m2s, which form the majority of lower cheek teeth.

From all 57 M2s (32 M2 sin.*) used for analysis, 49 was loose. Non-adult specimens are the dominant age cohort in the whole cave (Fig. 2a-b), when their M2s form, on average, 74% (78%*). The similar situation was also found by the analysis of M2s from the Narozeninová chodba. To the contrary, the percentage of juvenile and subadult bears is lower in the Chodba naděje (64%). From viewpoint of wear stages, the ones of juvenile animals are dominant.

All 44 analysed m2s from the whole cave show the dominance of juvenile to subadult bears (89%). To the contrary, the analysis of m2s from the Narozeninová chodba and the Kostnica II shows slightly different results. Whereas 25% of analysed molars from the Narozeninová chodba belong to adult and senile specimens, these age groups form only 8% in the Kostnica II! From viewpoint of wear stages, the juvenile ones dominate again. On the other hand, the youngest age cohort (neonates) and senile animals are present only rarely - approximately 2% (Fig. 2c-d).

As aforementioned, only analysis of the most represented tooth type (in this case M2 or M2 sin.* resp.) can provide verifiable data. Thus, it is possible to draw that non-adult specimens form ~ 74% (78%*) in the whole bear assemblage under study.

Skulls and mandibles

Found 16 skull fragments consists of 3 neurocranial fragments (adults) and 13 fragments of upper jaws (minimally 1 senile and 7 juveniles to subadults). Minimally 26 of all 53 mandibular fragments fall into the group of non-adults; one-year old specimens and 4-6 years old prime adults form the dominant age groups.

Postcranial bones

Humerus (67), femur (71) and tibia (71) are the most represented of all postcranial bones. Whereas only 30-35% of thighbones and shinbones belong to non-adults, 55% of humeri fall into this age group.

The limb bones were mainly used for the determination of sex ratio for adult specimens, when measurable finds of radius, McIII, and tibia have been analysed (Fig. 3). Based on the complete bone analysis, the average ratio between males and females is 58% : 42% in favour of males.

However, based on the complete analysis of canines and bones, the sex ratio of adult males and females is 56% : 44% in favour of males.

For the determination of MNI, the teeth have been used. The highest number of all found teeth belongs to left M2s. They consist of 27 loose teeth and 5 ones preserved in fragments of upper jaws. Thus, the material under study comprises fossils of minimally 32 specimens (MNI).

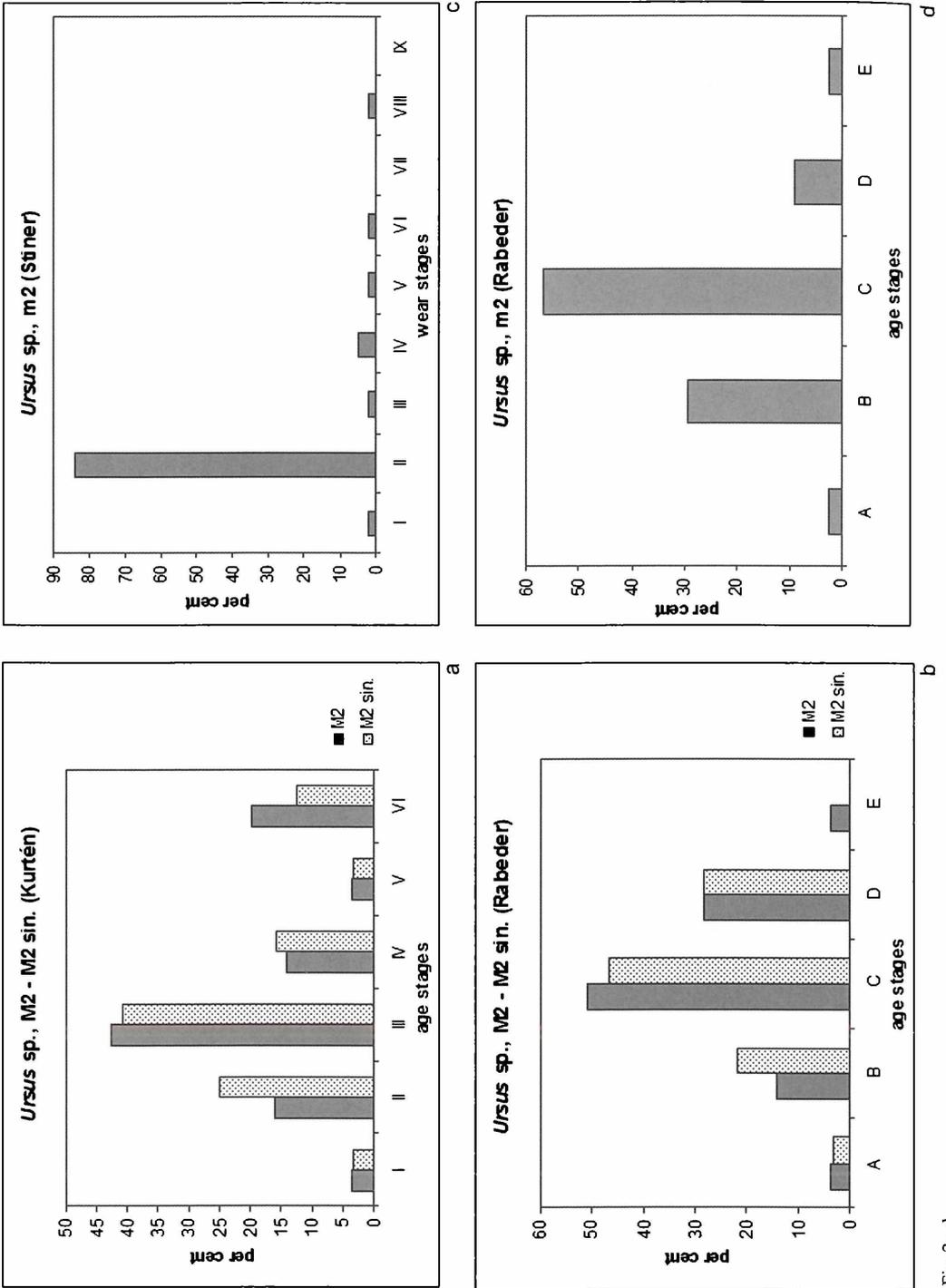
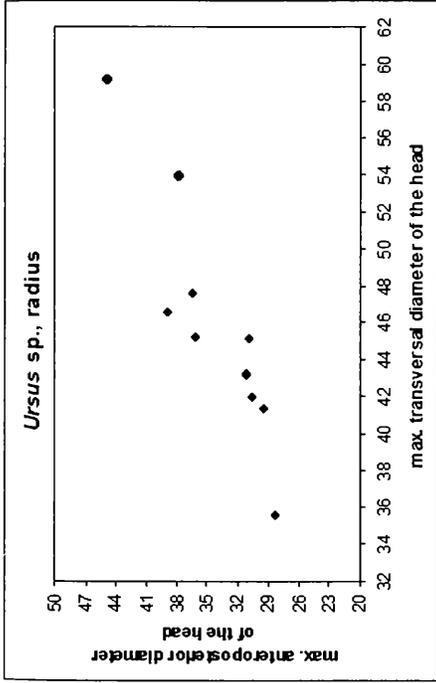
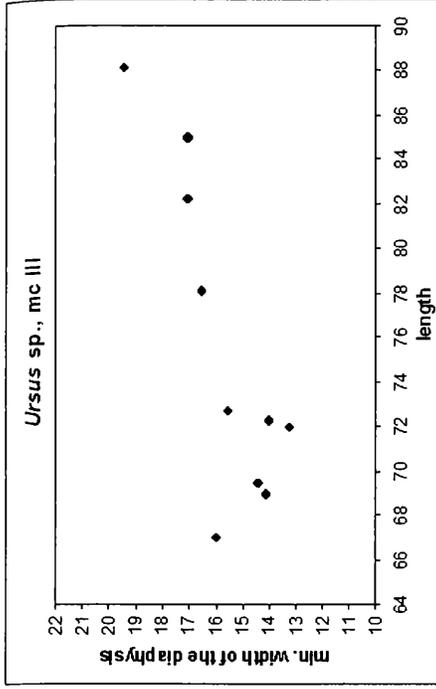


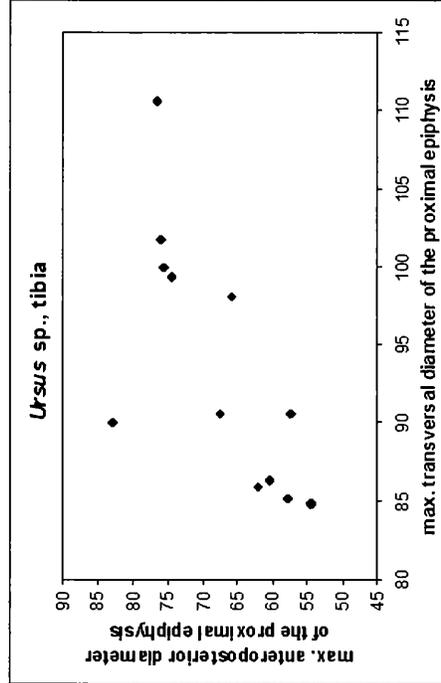
Fig. 2a-d



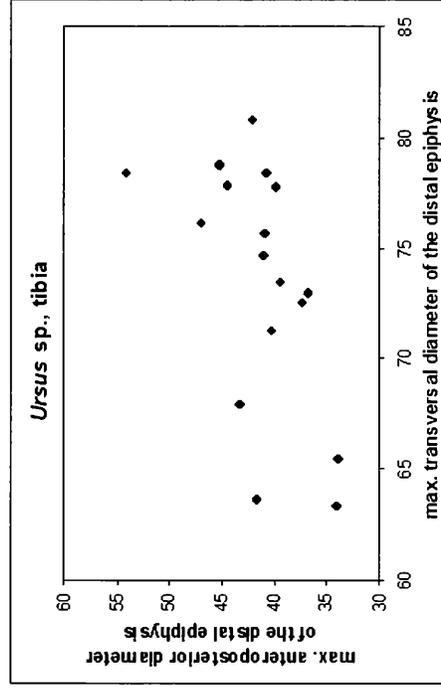
a



c



b



d

Fig. 3a-d

Discussion and conclusion

The summary of results on sex ratio of adult bear specimens from the Za hájovnou Cave shows the slightly dominance of males (56%). Thus, the bear assemblage from the cave is differing from other *Ursus deningeri* assemblages of Eurasian sites (e.g. from Sima de los huenos (GARCÍA et al. 1997), Westbury (BISHOP 1982), or Yarimburgaz (STINER 1998)), where females clearly outnumber males. To the contrary, sex ratios between males and females of Late Pleistocene cave bears are much more varying (WEINSTOCK 2000).

These variabilities in the sexual composition of individual bear taphocoenoses were/are interpreted by a change of the heredity (ABEL 1929, 1931), different mode of the seeking of suitable caves for their hibernation (KURTÉN 1958, 1976, REISINGER & HOHENEGGER 1998), or by a reflection of the diet (STINER et al. 1998).

Also, the presence (or absence) of water in caves could play an important role for the seeking of suitable den for hibernation. It appears to be a possibility that pregnant females or females with their progeny sought rather smaller, easily defendable caves (or cave parts) with the presence of water and adequate quantity of seasonal resources in the near vicinity.

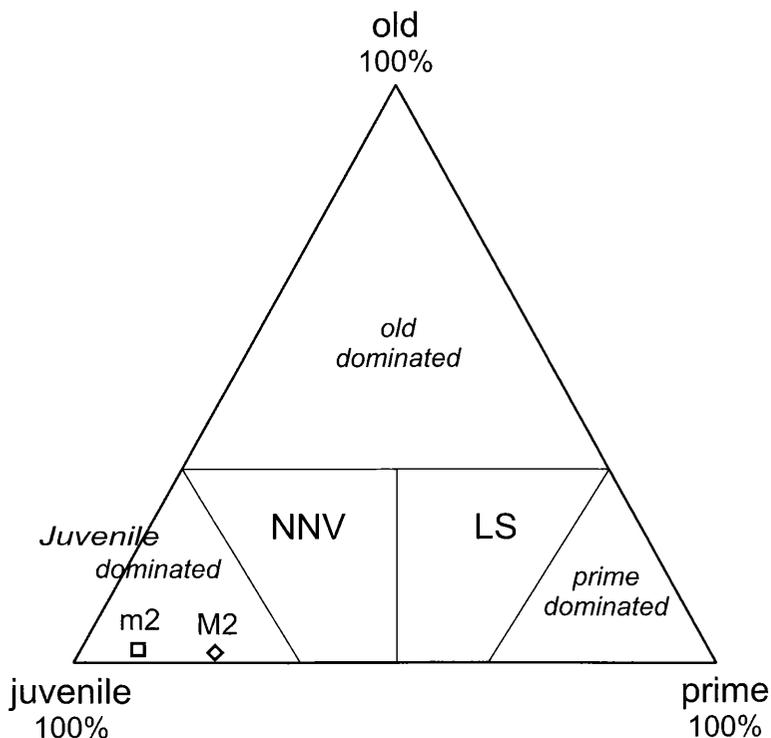


Fig. 4

The analysis of most represented teeth in the bear assemblage under study (M2s/M2 sin.*) showed the dominance of non-adults (74%/78%*), with dominant age cohort of juvenile specimens (1-3 years old animals). The similar situation was also found at many sites of *Ursus spelaeus* (e.g. Zoolithenhöhle, Hohlenstein-Barenhöhle (WEINSTOCK 2000); Pod hradem (GARGETT 1996), Divje babe I (DEBELJAK 2002)).

However, the assemblage is also characterized by the absence (or by sporadic occurrence) of neonates and very old adults. Whereas low number of neonate fossils is explainable by the difficulty of the preservation of their fragile osteological remains and by their lesser resistance to transport damage, the sporadic occurrence of senile specimens is possible to explain by the mortality of animals still before the reaching of old age. Diseases, predators, and/or starvation could cause the mortality of bears during the hibernation. But, no conspicuous and extended pathological phenomena were found at osteological remains. Since a graph of mortality patterns indicates an assemblage of the juvenile dominance within the non-violent attrition (Fig. 4), there is little probability that the bear mortality was caused by predators, though fossils of lions have been found on the site too. For these reasons, the presence (or absence) of the sufficient quantity of appropriate seasonal resources as the limiting factor for the specimen mortality of bear assemblage under study is not excluded. Also, a possibility of the influence of other factors, which are not thus far more exact known, is not excluded.

Finally, the detailed analysis of 1,115 fossil remains of minimally 32 bear specimens from the Moravian Za hájovnou Cave yields preliminary results on age structure and sex ratios of the assemblage under study. This bear assemblage is characterized by the dominance of non-adults, mainly of juvenile specimens 1-3 years old, (~ 74%) and by the absence (or sporadic occurrence respectively) of neonates and very old specimens. The sex ratio, based on the analysis of adult fossil remains (canines and long bones) from the whole cave, is 56% : 44% in favour of males.

From mortality viewpoint, the assemblage consists of specimens, which mostly died during their hibernation, probably for reason of the starvation(?), though other reasons of their death (diseases, predators, etc.) are not excluded.

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