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Dental wear and grit ingestion in extant and extinct bears from Northern Spain

Desgaste dentario e ingestión de partículas minerales en osos actuales y extintos del Norte de España

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ABSTRACT

The dental morphology of the cave bear *Ursus spelaeus* (Rosenmuller & Heinroth, 1794) indicates its specialisation as a vegetation eater. Although vegetal matter plays also an important role in the diet of most living bears, the dental wear exhibited by cave bears differs qualitatively from that seen in brown bears even on gross inspection. The diet of the extant brown bear *Ursus arctos* (Linnaeus, 1758) is well known from present-day studies involving direct observation as well as scat analysis. The ingestion of tubers and other gritty foods has repeatedly been suggested as the cause for the extreme wear observed on cave bear teeth. In this work we seek to analyse the modes and degrees of enamel-wear in brown and cave bears from Northern Spain with the objective of shedding some light on the cave bear diet as regards to grit ingestion. We examine the incidence of gross wear features and enamel micro-fractures on the bear molars, and from this it is concluded that the cave bears analysed here did not ingest gritty foods and seemed to avoid putting into their mouth any object at all soiled with gritty dirt.

Key words: ***Ursus spelaeus*, *Ursus arctos*, dental wear, diet**

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INTRODUCTION

In recent years, dental wear studies have been increasingly employed to assess different ingestion behaviours in mammals, extant as well as extinct (TEAFORD, 1988; KING *et al.* 1999). This is based on the fact that many abrasives contained or associated with the diet leave marks on the teeth, and different patterns of dental wear reflect the behaviours that produced them.

The study of dental wear yields therefore information on behaviours related to nutritional habits. Enamel is a harder substance than most food items, which nevertheless produce alterations on it. Grit is certain to contain substances harder than enamel, and the different quantities of ingested grit are bound to show in dental wear studies. Grit ingestion has been repeatedly suggested as the main cause for the extreme wear on Cave bear teeth (KOBY, 1940, 1953; STINER, 1997).

On the other hand Brown bear diet is known from several studies, and it does involve the ingestion of roots, tubers and gritty foods in varying degrees, and the ingestion and processing of hard substances is reflected in the wear of teeth as micro-fractures or enamel chipping. This degree of wear can be seen clearly at low magnification with the binocular microscope. The wear on teeth of extant brown bears of known diet is compared with that one of Holocene brown bears and cave bears from the same geographical region.

MATERIALS & METHODS

We have analysed the first lower M1 throughout our samples: Cave bears from Troskaeta Ko-kobea (Basque Country) (21 specimens), Tito Bustillo cave (Asturias) (6 specimens) and Cova Eirós (Galicia) (5 specimens); fossil brown bears from several caves in Asturias (SH5: 3 specimens, CCV: 1 specimen, LCF: 1 specimen) and extant brown bears from Asturias, from private hunters collections (12 specimens). The original teeth have been replicated employing high precision techniques (KING *et al*., 1999), and our analysis have been carried out on these replicas.

Every cusp (paraconid, protoconid, entoconid, metaconid, hipoconid and hipoconulid) of the M1 has been individually looked at throughout the light microscope, and the following macro-wear features have been recorded for each individual cusp:

a) Tip cusp loss (rough wear)

b) Discrete *ante-mortem* enamel micro-fractures

Figure 1 is a sketch of a right M1, naming the cusps and their orientation. Figure 2 gives the distribution of foodstuffs throughout the year in the diet of European *Ursus arctos* according to COUTURIER (1954).

According to COUTURIER (1954), roots and tubers account for a 13,2% of the foodstuffs ingested yearly by European brown bears. Particularly important are the tubers of *Conopodium majus*, that are the staple from mid May to mid July.

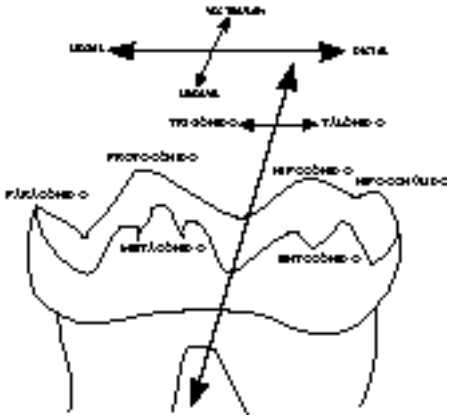

Figure 1. Right first low M1 of *Ursus*. As seen from the lingual side.

ANALYSIS

The breakage of the enamel on cusp tips produces a rough morphology due to enamel micro-chipping, and this generally happens early during the life of the brown bears. Figure 3 is a sample of these enamel micro-fractures as they appear on a present day brown bear (specimen COC-002) from Asturias. This specimen is two years old and shows a high degree of enamel fractures, both on cusp tips and also generally affecting all the oclusal surface.

Figure 4, below, is the graphic representation the data obtained for cusp-tip loss with rough topography. Greatest modification is seen on Holocene brown bears, followed by present day brown bears. Cave bears show consistently low values for this kind of tooth wear. This

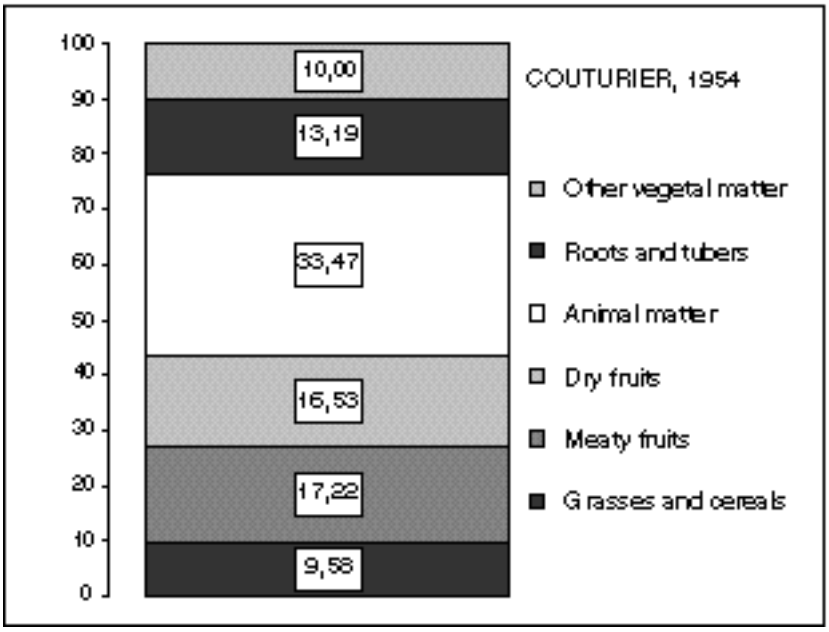

Figure 2. Extant European brown bear diet (COUTURIER, 1954).

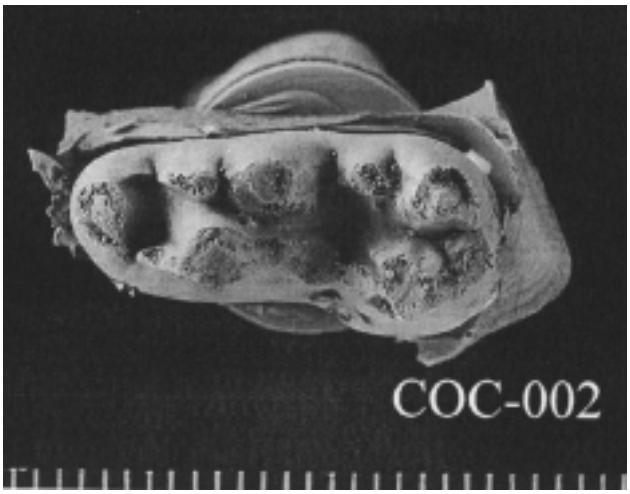

Figure 3. COC-002. Extant brown bear from Asturias, two years old. Enamel microfractures.

figure strongly suggests that this degree of damage is related to grit ingestion in brown bears, and the lack of similar damage to cave bear teeth indicates that they did not eat food encrusted with grit.

Discrete chips in the enamel may be produced by the ingestion of very hard substances, presumably grit amongst them. Figure 5 below is the graphic representation of the data obtained for these discrete *ante-mortem* enamel fractures.

Again cave bears display consistently low values. Only the mesial cusps are affected in our reduced sample of Holocene brown bears. The low M1 of extant brown bears is affected by enamel chipping in all the cusps.

SUMMARY AND DISCUSSION

It has been suggested that the extreme wear on cave bear teeth is due chiefly to the ingestion of grit associated to roots and tubers. In this paper we analyse and compare the presence and degree of enamel chipping on the oclusal surfaces of extant brown bears of known diet with that of fossil brown bears and extinct cave bears from the same geographical area.

Firstly we revise (binocular lens) separately each cusp tip in the low M1 of the bear teeth (paraconid, protoconid, entoconid, metaconid, hipoconid and hipoconulid) analysed. We record whether the tip of these cusps appear broken acquiring a rough morphology, and conclude that while a very high proportion of brown bears –fossil as well as extant- do show this alteration, the presence of enamel cusp tip loss by cause of enamel microfractures (rough topography) is almost negligible in cave bears.

Secondly we record (binocular lens again) any microfracture or enamel chip appearing elsewhere on the cusp surfaces –that is, not in cusp-tips. While all the

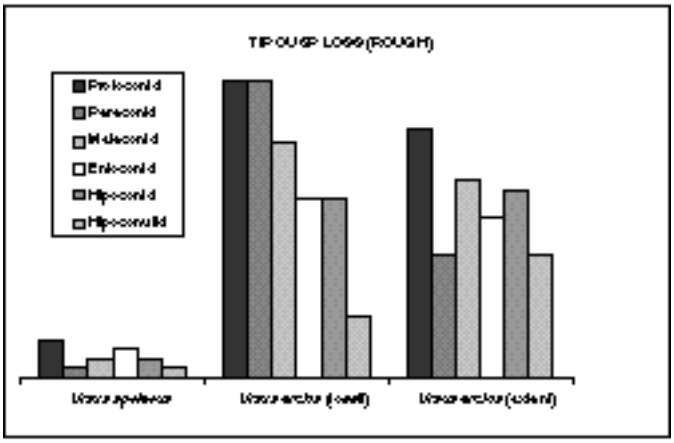

Figure 4. Lower M1 from brown and cave bears. Cusp tip loss with rough morphology.

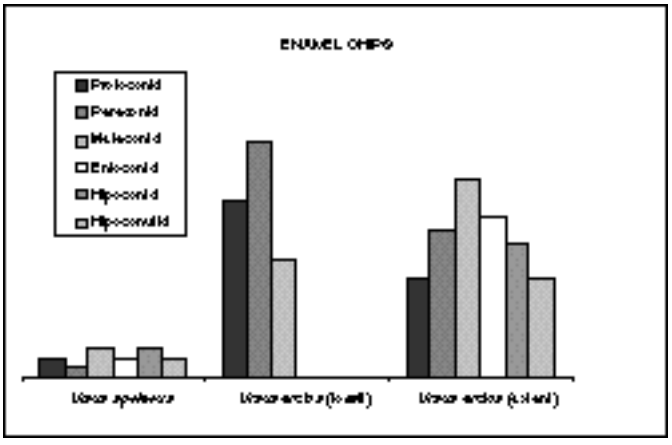

Figure 5. Enamel chips on the low M1 of *Ursus*.

cusps in extant brown bears have some enamel chipping, fossil brown bears show these chips only in the anterior cusps (trigonid). The presence of enamel chipping in cusp surfaces other than cusp tips is also negligible in the case of the cave bears *Ursus spelaeus*.

If we accept that the enamel chipping documented here for *Ursus arctos* correlates with the 13,19% tubers and roots that they are known to ingest yearly (COUTURIER, 1954), it has to be concluded that the consumption of these foods by the cave bear *Ursus spelaeus* was much lower and indeed negligible, and can not be the cause of the intense wear seen on cave bears.

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