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A palaeobiological approach to the cave bears from Liñares and Eirós (Galicia, Spain)

Una aproximación paleobiológica a los Osos de las Cavernas de Liñares y Eirós (Galicia, España)

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ABSTRACT

The sites of Liñares and Eirós are closely situated in the NW of Spain and both contains a large number of *Ursus spelaeus* remains. However, the chronology of these sites is different and correspond to different climatic conditions. Once considered the effects of the preservational bias in the deposit, the demographic particularities of each population can be explained in terms of the different climatic conditions suffered by the studied cave bear populations.

Key words: Cave bear, demography, paleobiology, Galicia

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INTRODUCTION

The Cave Bear became widely distributed throughout Europe during the Pleistocene. The findings are restricted almost exclusively to calcareous areas, and more specifically in karstic cavities which they tended to occupy during hibernation. The westernmost limit of the distribution reach Galicia, in the NW of the Iberian Peninsula, the Eirós Cave (GRANDAL d'ANGLADE, 1993), in the Serra de Rañadoiro. The second of the Galician sites considered in this paper, the Liñares Cave, is situated in the Serra do Courel (Figure 1).

The structure of the populations is different in both caves. For the interpretation of this structure, a detailed taphonomic study must be carried out previously in order to avoid the misinterpretation of the data produced by the preservational bias. The taphonomical processes implied in the formation of the deposits differ from one cave to the other, and were described extensively in previous papers (GRANDAL d'ANGLADE & VIDAL ROMANÍ, 1997; LÓPEZ GONZÁLEZ *et al.*, 1998, GRANDAL d'ANGLADE *et al.*, 2000). They can be summarized as follows:

In the deposit of Eirós the bones are

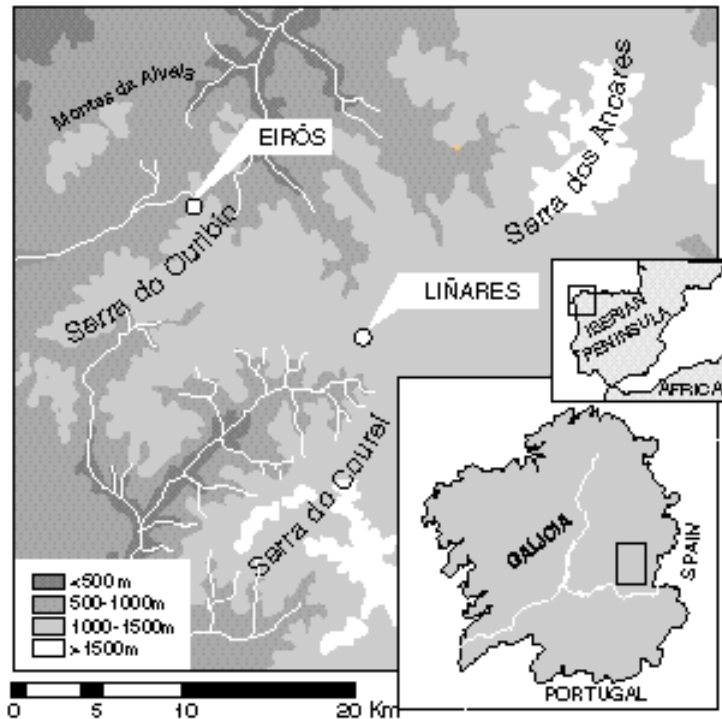


Figure 1. Geographic situation of the studied sites.

well preserved, and not rounded. In some cases anatomic connections are preserved, though in an approximated way (GRANDAL d'ANGLADE & VIDAL ROMANÍ, 1997). There are no indications of selection by size in the deposit of the bones, that can be interpreted as a zone of occupation of the bears during the dormancy period (GRANDAL d'ANGLADE, *et al.*, 2000).

In Liñares the studied area corresponds to a deposit placed in a lateral hole running downwards, progressively narrow and filled in with limestone and slate blocks, clays and bones, intercalated with thin stalagmitic floors (LÓPEZ GONZÁLEZ, 1996; LÓPEZ GONZÁLEZ *et al.*, 1997). The bones and the blocks moved down, together with the clay, along this hole by gravity and sporadic slides. A marked difference is observed on the position of the bones: the large ones, like cave bear skulls, were found at the beginning of the hole, almost closing the entrance, whilst the smaller were in lower positions, reflecting a strong selection of sizes along the slope. Most of the smallest bones (most of the juvenile remains included) seem to have been lost downwards. This fact must be taken into account when a demographic study is made.

CHRONOLOGY AND ENVIRONMENT

In order to make a paleobiological interpretation it is necessary to have accurate datings of the deposit, and to know that all the bones involved in the study correspond to more or less contemporary

individuals, and not to an acretional deposit with different levels that represent a large timespan. The chronology of the studied sites is different: Eirós corresponds to a cold phase in the Oxygen Isotopic stage 2 ($24,090 \pm 440$ years BP) whilst Liñares corresponds to a warmer phase in the stage 3 ($35,220 \pm 1,440$ years BP) (figure 2).

The cave bears are supposed to be indifferent to the environmental conditions and not conditioned by the biotope (TOEPFER, 1963). They seem to respond to climatic changes not by means of migration, such as other large herbivores, but with different periods of dormancy. For instance, in American black bears periods from 5 to 7 months in cold regions (ROGERS, 1987) to cases where there was no dormancy at all (HELLGREN & VAUGHAN, 1987) have been documented.

However, the cold glacial periods would produce a strong impoverishment of the Cave bears' biotope. The presence of large areas covered by ice and the changes in the vegetation would lead to scarcity of food or different food sources, that would have a direct influence in the survivorship of the populations.

SEX RATIO

Distribution of the populations by sex was calculated from the sexable pieces with almost complete reliability: skull, jaw, limb bones, and canines. The results are shown in table 1. The sex ratio is different in both populations. According to several groups of sexable remains (table 1) the sex ratio is balanced in Eirós and more biased towards females in Liñares.

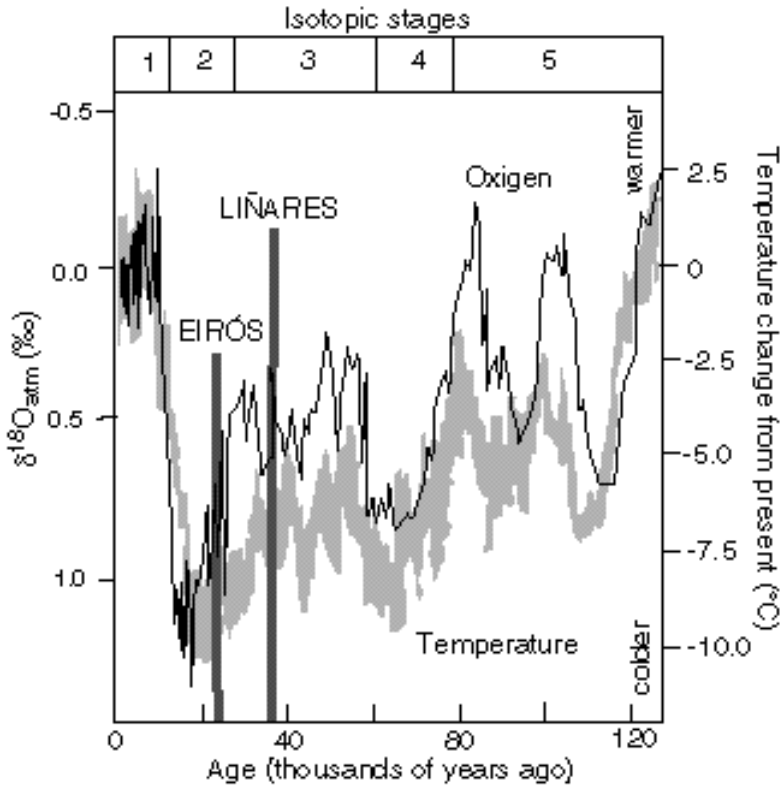


Figure 2. Climatic changes during the Upper Pleistocene and Holocene, and the chronology of the studied sites

In Eirós a slight predominance of females over males can be seen, though the difference is not significant. Only in the case of the limb bones is the difference between the sexes found to a degree greater than that expected (50% 50%). The population of Liñares shows a greater number of females than males. The skull, canines, and limb bones show a high proportion of females in the population. This is not the case of the jaws, that give a contradictory result. All but two skulls correspond to female bears, whilst the number of male jaws is slightly higher

than those of females. The sexing was carried out by the transversal diameter of the canine.

The interpretation of the sex ratio in a cave bear site is not simple. It has been suggested that the caves of smaller dimensions could be occupied preferably by females with their young, whereas those of greater development they would be lived by males (KURTÉN, 1958) However, in the cases studied here, both caves could be considered "small". Another explanation for the different sex ratios was proposed by REISINGER & HOHENEGGER (1998),

SITE	sex distribution	skull		jaw		canines		limb bones	
		a.v.	%	a.v.	%	a.v.	%	a.v.	%
EIRÓS	FEMALES	6	61.53	10	58.82	30	52.63	42	68.85
	MALES	5	38.46	7	41.17	27	47.37	19	31.14
LIÑARES	FEMALES	7	77.7	3	42.8	16	69.2	24	72.7
	MALES	2	22.3	4	57.2	6	30.8	9	27.3

Table 1. Sex distribution in the populations of Eirós and Liñares, according to various kinds of sexable remains, in absolute values (a. v.) and percents (%). Data from GRANDAL d'ANGLADE & VIDAL ROMANÍ, 1997, GRANDAL d'ANGLADE *et al.*, 2000.

according to whom the females would occupy the highest caves, whilst the males would prefer caves at lower altitudes above sea level. At first sight, this could be the explanation for the difference observed between Liñares (1,100 m.a.s.l.) and Eirós (780 m.a.s.l.). However, the comparison in this terms is not accurate, since both sites are not contemporary.

A more accurate palaeoecological interpretation can be made taking into account the chronology of both sites, and the different climatic conditions, would provide a better approximation to the phenomenon. STINER (1998), according to the ecology of present ursids, propose a model to explain the differences in sex ratio. During the tempered times with abundance of nourishing resources, the males undergo very brief periods of dormancy whereas the females have to remain more months in the cave to give birth the young and to feed them until (partial) weaning. This supposes a more a longer occupation of the cavity by the females, that therefore would have more probabilities of dying inside the cave that the males, who already would have left it before. This would be the case in Liñares.

Nevertheless, during cold global episodes, such as in Eirós, the individuals of both sexes would undergo an equally long dormancy and the probabilities of dying within the cave would be also even.

MORTALITY PROFILES

In Eirós the proportion between adults and juveniles depends on the type of bone considered (table 2). Regarding the results obtained for some of the strongest remains such as skulls and long bones, the juveniles represent a high percent of the population (60-80 %). However in some of the most fragile juvenile remains such as scapulae, pelvis or jaws, the proportion decreases considerably. In our opinion, this would be the result of a process of fragmentation that affected the more delicate bones that was not detected in previous studies. The causes of this fragmentation are not known for the moment, but could be due to trampling or as a diagenetic process.

In Liñares the percent of adult individuals is much greater than that of juveniles, as is shown in table 2. This is not common in most of the Cave Bear sites. In our

percents	EIRÓS		LIÑARES	
	Adults	Juveniles	Adults	Juveniles
skull	17.3	82.7	78.0	22.0
jaw	50.0	50.0	82.3	17.7
scapula	72.7	27.3	62.5	37.5
pelvis	54.6	45.4	81.8	18.2
limb bones	36.5	63.5	80.6	19.4

Table 2. Percent of juvenile and adult individuals in the populations of Eirós and Liñares, according to the most reliable kind of remains.

opinion, this phenomenon may be caused by two reasons: First, because of the process of washing that affected the filling (LÓPEZ GONZÁLEZ, 1996, LÓPEZ GONZÁLEZ *et al.* 1997). According to this, most of the smallest remains, including the juvenile ones, would have been lost towards the lake at the bottom of the hole. This would be the reason why only the bigger remains of the juveniles have been found, whilst the smaller bones such as phalanges or metapodials are inexistent (LÓPEZ GONZÁLEZ *et al.*, 1997, GRANDAL d'ANGLADE, *et al.*, 2000)

A more accurate method to determine the age at death of the bears can be the analysis of the degree of formation and wearing of the teeth. Only a very few studies of this type were made on cave bear populations (ANDREWS & TURNER, 1992; DEBELJAK, 1997; GRANDAL d'ANGLADE & VIDAL ROMANÍ, 1997; STINER, 1998; WEINSTOCK, 1999, 2000 and this volume), although the results can be highly significative.

Figure 3 shows the grouping into development and wear stages (percents) of

cheek teeth from Eirós and Liñares. Also the age groups calculated from these stages, according to the method proposed by ANDREWS & TURNER (1992).

FIG. 3

The mortality profile in Eirós is biased towards juveniles, whilst in Liñares there are more senile individuals. It is necessary to remark that the degree of wearing is not sinonimous of the age, but should be correlated. Also, the "age" is not necessarily equivalent in both populations.

If the bears have a mainly herbivorous diet, as was proposed by many authors (KURTÉN, 1976, BOCHERENS *et al.*, 1994; BOCHERENS *et al.*, 1997; FERNÁNDEZ MOSQUERA, 1998; NELSON *et al.*, 1998; LIDÉN & ANGERBJÖRN, 1999; VILA TABOADA *et al.*, 1999), the changes in the vegetation could become decisive for the survivorship of the populations. Studies on stable isotopes of N were made on Eirós and Liñares and show an unequivocally herbivorous diet (FERNÁNDEZ MOSQUERA, 1998; VILA TABOADA *et al.*, 1999).

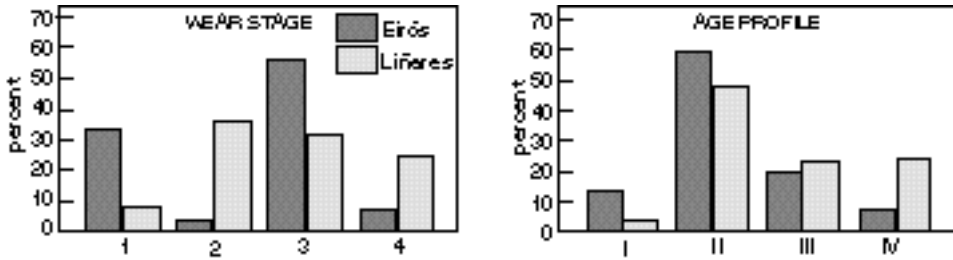


Figure 3. Wear stages and mortality profiles of the studied populations according to the cheek teeth wearing. The number of specimens is 240 in Eirós and 102 in Liñares. Data from Eirós are from GRANDAL d'ANGLADE & VIDAL ROMANÍ, 1997. Wear stages: 1, germin; 2, unworn; 3, slightly worn, 4, heavily worn. Age groups: I, neonates; II, juveniles; III, prime adults, IV, senile individuals.

The changes in the vegetation from the Liñares time to the Eirós time are known to be from open woodlands to steppe-like with predominance of grass (HUNTLEY, 1988, WATTS, 1988). Grass are more abrasive than other herbaceous plants because of their siliceous stems. Thus, a high percent of cheek teeth with heavy degree of wearing could be expected in Eirós, independently of the age at death of the bears.

However, the interpretation of these profiles indicates that, at the age of death, the bears from Liñares had more worn cheek teeth than those from Eirós. The hypothesis of the abrasive diet as a cause of death in Eirós can be rejected. The death

in Eirós has another explanation, and it was most probably due to the shortage of food supplies, combined with the inexperience of younger bears, that produces a lack of fat reserves to overcome the long winter dormancy. The milder climate conditions in Liñares would allow the bears to reach an older age.

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