

Hominid exploitation of the environment and cave bear populations. The case of *Ursus spelaeus* Rosenmüller-Heinroth in Amutxate cave (Aralar, Navarra-Spain)

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Abstract

Cave bears (*Ursus deningeri* and *U. spelaeus*) and hominids (*Homo heidelbergensis*, *H. neanderthalensis*, and *H. sapiens*) were potential competitors for environmental resources (subterranean and open air). Here, we examined the age at death of cave bear (*Ursus spelaeus* Rosenmüller-Heinroth) specimens from Amutxate cave in order to shed light on the effect of resource sharing between cave bears and hominids. After studying dental wear of the deciduous and permanent dentitions, the ontogenetic development of mandibles, and incremental layers of cement (annuli), we defined five age groups differentiated by marked development and size gaps. Our findings indicate that after hibernating, bears abandoned the den, thereby leaving the subterranean environment (caves) free for temporary hominid occupation—this would explain the subtle traces of hominid presence in many dens. However, a simple calculation based on age at death of subadult and adult cave bear specimens in Amutxate cave, extrapolated to the whole cave area, showed that the area surrounding this cave hosted bears for at least 9,000 years. This length of habitation, quite similar to the time-span derived from amino acid racemization and electron spin resonance, indicates that bear populations in the Amutxate cave constituted a serious constraint for hominid exploitation of the environment.

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Introduction

Fossilized bones and teeth of bears (*Ursus deningeri* von Reichenau and *Ursus spelaeus* Rosenmüller-Heinroth) are commonly found in caves. In some cases, caves also show weak evidence of hominid presence in the form of low numbers of herbivore bones and teeth, and stone tools. On occasion, evidence of human presence is stronger, where stone

tools and hominid remains are found in general stratigraphic association.

From Middle Pleistocene to Upper Pleistocene times, at least three species of hominids (*Homo heidelbergensis*, *H. neanderthalensis*, and *H. sapiens*) coexisted with hibernating cave bears (*U. deningeri* and *U. spelaeus*) in the Iberian Peninsula. This coexistence implies that bears and hominids competed for habitat. This competition was mostly passive—Pleistocene cave bears were vegetarian (i.e., they did not hunt hominids; Bocherens et al., 1990, 1991; Fernández-Mosquera, 1998), and hominids did not usually eat bears. In a study that attempted to differentiate between predation-mediated and hibernation-related cave bear

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(*U. deningeri*) mortality in Yarimburgaz Cave in Turkey, Stiner (1998) concluded that the non-violent (hibernation-related) attrition pattern dominated. Torres et al. (1991) reported similar patterns of bear death assemblages in many Spanish caves.

Earlier evidence of hominid predation of cave bears has recently been reinterpreted. For example, the bear skull fragment found in Sloup Cave in Moravia (Czech Republic) (see Kurtén, 1976) was previously argued to be clear proof of a single bear hunted by humans. This was proved false, however, when the flint fragment that was found near the fossil (Hitchcock, 2005) was shown not to be a spearhead as reported by Bächler (1940). In another example, the site of Erd (Hungary) was previously described (Gabori-Csánk, 1968) as an open-air camp of cave bear hunters. However, whole bear skeletons were found at the site, and it is implausible that whole bear corpses were transported to the top of the hill. In fact, a careful reading of the site description reveals that Erd Hill was a cave whose roof is now missing, suggesting that the bear death assemblage resulted from hibernation-related deaths, not predation. Similar objections are voiced by Pinto-Llona et al. (2005).

Starvation is, and probably was, the main cause of death during hibernation. According to many authors, both sexes of cave bears die during hibernation (Koby, 1949; Kurtén, 1976; Torres, 1984; Grandal d' Anglade and Vidal-Romaní, 1997), and a balanced number of males and females are usually found in caves, although not necessarily in the same caves at the same time. During hibernation, bears change their metabolism in order to reduce their energy requirements. This strategy involves switching to a “lipid diet” without protein consumption, using body fats as a source of energy. To protect the liver during hibernation, bears do not excrete but reabsorb urea from the bladder (Crombie et al., 1993).

In forced summer starvation (Nelson et al., 1975), fat and protein are used as a source of energy, and the nitrogenous

waste products of amino acids are excreted in urine and feces (Lyman et al., 1982). Thus, undernourishment during the fall due to competition, environmental stress, or disease would threaten bear survival. For comparative purposes, we have included a summary of some of the basic ecological characteristics of modern hibernating bears (Table 1).

While there were many threats to cave bear survival, cave bears also posed a great threat to Pleistocene hominid groups. Hominid activities such as sheltering, hunting, scavenging, and gathering were probably restricted by wandering cave bears in search of food (scavenging, gathering) or mating partners. The “minimal period of country occupation,” calculated by determining the age at death of subadult and adult cave bears, helps to establish this period of restricted hominid transit. In some cases, hominids moved into the uplands in pursuit of wild goat (*Capra ibex* L.) herds. They killed goat adults and kids born at the spring break-up after the thaw, as is evident from the deciduous dentitions and unfused epiphyses of the goat assemblages in the caves of El Reguerillo (Torres, 1974) and Amutxate. These findings suggest that by the beginning of the spring, shelters had been abandoned by cave bears and taken over by hominid groups.

Calculating the age at death of cave bear cubs enables us to determine when females and their offspring abandoned the cave. Subterranean shelters would have been more useful to predatory hominid groups if they had become vacant at the end of winter or beginning of spring. Extended use of caves by bears would have prevented hominid use of these shelters and a wide area around it. Thus, the age at death of cave bears provides information on the constraints on the geographical dispersion and environmental exploitation of hominid groups. With this information, it is possible to establish a theoretical calendar of intermittent cave availability for temporal hominid camps. In this study, we analyze the

Table 1
Ecological data on living species of hibernating bears

	<i>Ursus arctos</i>	<i>Ursus maritimus</i>	<i>Ursus americanus</i>
Mating	May–July (Wilson and Ruff, 1999)	April–May (Ramsay and Stirling, 1986)	June–July (Wimsatt, 1963) June–August (Stirling, 1993)
Den entrance	October–December (Camarra, 1987; Wilson and Ruff, 1999)	October–December (Amstrup, 1995)	late December to early January (Johnson, 1978)
Den leaving	March–May (Wilson and Ruff, 1999) April (Ward, 1994)	late March to mid-April (Amstrup, 1995)	late March to early April (Johnson, 1978)
Birth	January–March (Wilson and Ruff, 1999) January–February (Clevenger and Purroy, 1991)	January (Uspenski, 1977)	early January to early February (Alt, 1983)
Weaning	18–30 months (Wilson and Ruff, 1999)	27 months (Stirling, 1986)	17–18 months (Needham, 2000)
Interbirth interval	2–4 years (Wilson and Ruff, 1999) 3 years (Clevenger and Purroy, 1991). Linked to primary productivity and population density (Ferguson and McLoughlin, 2000)	3 years (Stirling, 1986)	1–2 years
Sexual maturity	4–6 years (Wilson and Ruff, 1999)	3 years (Lentfer and Miller, 1969)	1–4 years (females) and 4–5 years (males) (Stirling, 1993)
Survival rate of cubs and yearlings		44–53% (Amstrup, 1995)	75% (Kolenosky, 1990)

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