

Last Glaciation cold-adapted faunas in the Iberian Peninsula

García, N. & Arsuaga, J.L., 2003 - Last Glaciation cold-adapted faunas in the Iberian Peninsula - in: Reumer, J.W.F., De Vos, J. & Mol, D. (eds.) - *ADVANCES IN MAMMOTH RESEARCH* (Proceedings of the Second International Mammoth Conference, Rotterdam, May 16-20 1999) - DEINSEA 9: 159-169 [ISSN 0923-9308] Published 24 May 2003

The present paper presents a compilation and update of sites which contain last glaciation faunas in the Iberian peninsula. Some authors consider that, except in the Pyrenees, the Iberian glaciation was restricted to the OIS 2 and they only include this mountain range (sometimes together with the Cantabrian mountain range) in the distribution maps of cold-adapted faunas in Europe. Nevertheless, there were glaciation processes on other mountain systems placed at a more southern latitude than the northern part of the Iberian Peninsula, and cold-adapted species have been found even in the Andalusian territory. The aim of this study is to provide detailed and updated information about Iberian sites with the presence of *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Rangifer tarandus*, *Saiga tatarica*, *Ovibos moschatus*, *Gulo gulo* and *Alopex lagopus*. This association represents typical cold-resistant forms of the last glacial in Eurasia and extends also to the Far East and Beringia (Kahlke 1999) so their presence in a number of sites in the Iberian Peninsula suggests cold conditions.

Correspondence: N. García & J.L. Arsuaga, Universidad Complutense de Madrid, ISCHII, C/Sinesio Delgado 4, Pab-14, 28029 Madrid, Spain, e-mail: ngarcia@isciii.es & jlarsuga@isciii.es

Keywords: Spain, Late-Pleistocene, fauna

INTRODUCTION

For the selection of cold-adapted large mammals species, we have followed the suggestions of Kahlke (1999: 77), and only consider those inhabiting the arctic to subarctic or inner-continental regions: *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Rangifer tarandus*, *Saiga tatarica*, *Ovibos moschatus*, *Gulo gulo* and *Alopex lagopus*. Since the idea is to clearly separate the arctic faunas which provide clear data about the glaciation conditions in the Iberian Peninsula, we have not included *Ursus spelaeus*, *Bison priscus*, *Megaloceros* or other species in our study. Although these species are usually associated with typical cold-adapted faunas, they are also found in woody temperate zones without arctic faunas.

In addition to either fossilised remains of arctic fauna or artistic representations, there is other evidence to indicate that large areas of the Iberian Peninsula had very open ecosystems with few trees during the OIS 2 cold period, and perhaps in earlier cold periods as well. This evidence of periglacial conditions comes from three sources: the pollen record, glacial landforms and cave sediments.

The pollen spectra of the Cantabrian archaeological caves (Sánchez Goñi 1993) show cold and dry conditions with steppe-like vegetation during the maximum upper pleni-glacial and lateglacial (Younger Dryas) or OIS 2. These caves are all located below 400 m above sea level. In Carihuella Cave, in Southeastern Spain (and at around 1020 m above sea level), the pollen spectra show

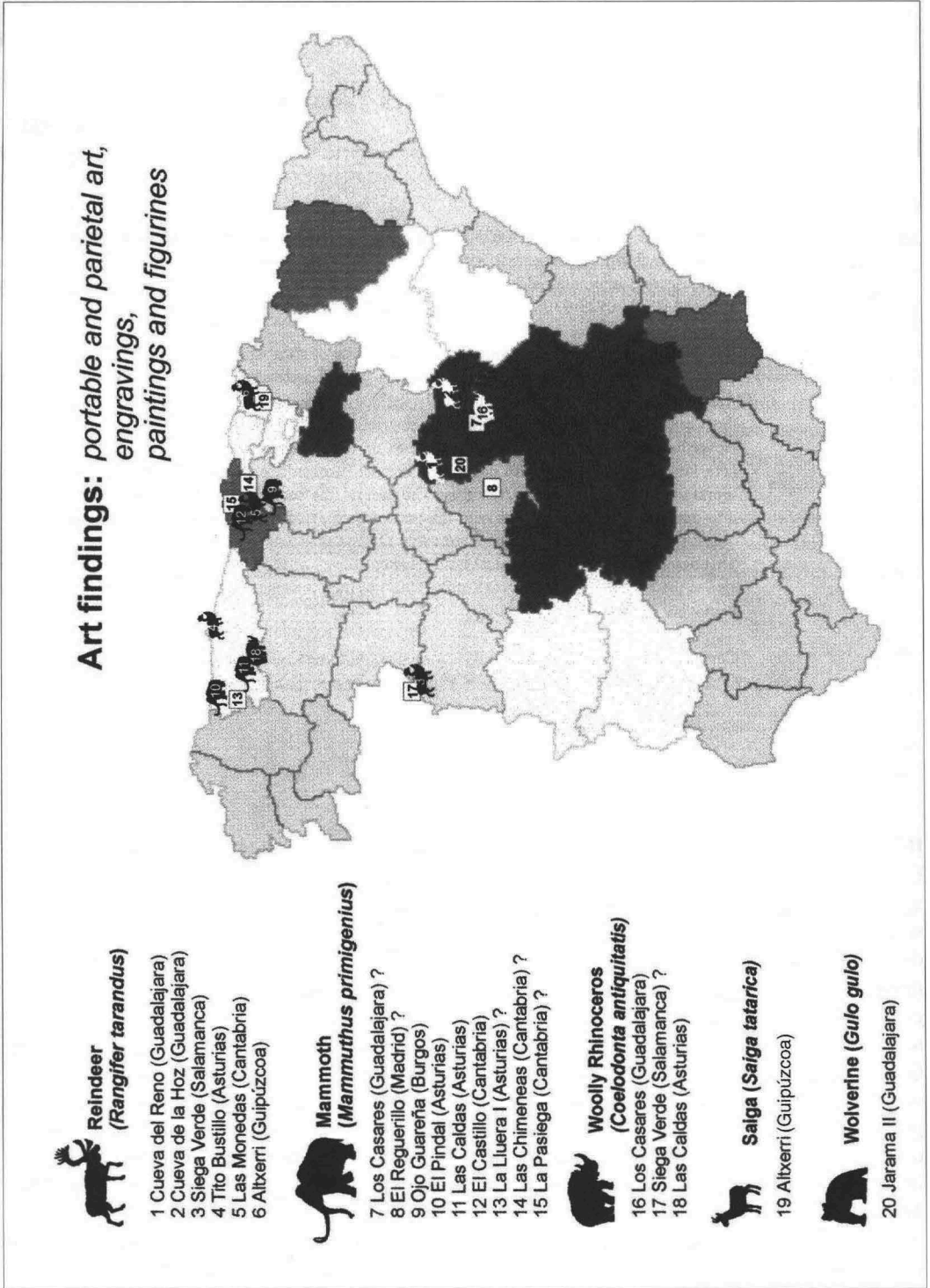


Figure 1. Art findings from caves or open air sites representing cold adapted species. We have indicated the questionable occurrences with a question mark in the legends and with a square symbol (instead of the corresponding faunal symbol) on the maps.

similar forest regressions in the same periods, in levels containing thermoclastic scree. Even in the Levant caves, where fossil remains of arctic fauna have never been found, the sediments assigned to the maximum upper pleniglacial and late glacial indicate very dry conditions with naked soils (Fumanal 1986). The pollen spectra obtained in lakes or peat bogs seem to follow a similar pattern, such as the continuous sequence from the site of Padul, south of the city of Granada and located at 1000 m above sea level. Grass steppes and open coniferous parklands would have been largely dominant during the maximum upper pleniglacial and lateglacial on the entire Iberian Peninsula. However, in coastal refuges of the Atlantic Ocean and the Cantabrian and Mediterranean seas and lowermost valleys (Costa *et al.* 1990), deciduous or Mediterranean woodlands survived and later expanded in the Holocene. The annual mean temperature was perhaps 10° C colder than that of the present day.

Before the maximum upper pleniglacial, the pollen record of the Iberian Peninsula is much poorer, although in Carihuela Cave a maximum lower pleniglacial is also recorded and there is a steppe phase recorded in the Padul sequence (Dupré 1988) of probably equivalent age. Glaciers were present in the main mountain ranges of the Iberian Peninsula during the maximum upper pleniglacial and lateglacial (Gómez & Pérez 1998). In the Pyrenees, Cantabrian Mountain Range, Galaico-Leonés System, Sierra de la Estrela and Sierra de Gredos (the last two in the Central System), and Sierra Nevada, valley glaciers developed. There were also icecaps irradiating valley glaciers in the Galaico-Leonés System. The Sierra Nevada glaciers were the Southernmost ones in Europe. In Sierra de Guadarrama and the Iberian System, the glaciers were restricted to basins, which were the focal point for their nourishment, or to deep snowy hollows. Some of the end moraines descended to a very low altitude in the Galaico-Leonés System and Cantabrian Mountain Range, in many instances

below 1000 m of altitude and descending to as low as 340 m in one exceptional case (Asón Gorge). The larger glaciers of the Iberian Peninsula developed in the Pyrenees, with some descending to 700-800 m above sea level, with lengths of dozens of kilometers (52 km in one case, the glacier of Aneu in the Noguera Pallaresa river) and with ice thicknesses of more than 500 m and in some cases more than 900 m.

Although in the past some authors recognized a Riss and a Würm glaciation, most researchers today believe that the Iberian glaciers were restricted to the maximum upper pleniglacial and lateglacial (except, of course, in the Pyrenees, where some glacial cirques and snowy hollows even survive today). Two levels of moraines corresponding to two major ice advances are usually recognized: the lowest belonging to the maximum upper pleniglacial and the highest to the late glacial. However, some authors recognize very degraded moraines in the Sierra Nevada, at a lower altitude, that could correspond to an earlier 'Riss' glaciation (Rubio *et al.* 1993). Although there is still not much information available for Portugal, it seems that there were no glacial processes nor a cold climate affecting the vegetation until the maximum upper pleniglacial (Raposo 1995).

The chronology of the Last Glacial Maximum in the Iberian Peninsula has become a matter of great interest in relation to the problem of modern human colonisation of Europe and Neandertal extinction, that took place during OIS 3 (van Andel & Tzedakis 1998). In the 1980s, some Spanish scholars established that Neandertals were replaced by modern humans in the Iberian Peninsula later than in other areas (Vega-Toscano *et al.* 1988), and climatically at the beginning of a cold period ('Würm III') that would correspond to the end of OIS 3. Since then, it has become clearer that in what is nowadays ecologically the Mediterranean Iberia (i.e. south of the Ebro River), the Neandertals lasted for perhaps more than 10.000 yrs after the first modern humans arrived in the Atlantic Iberia

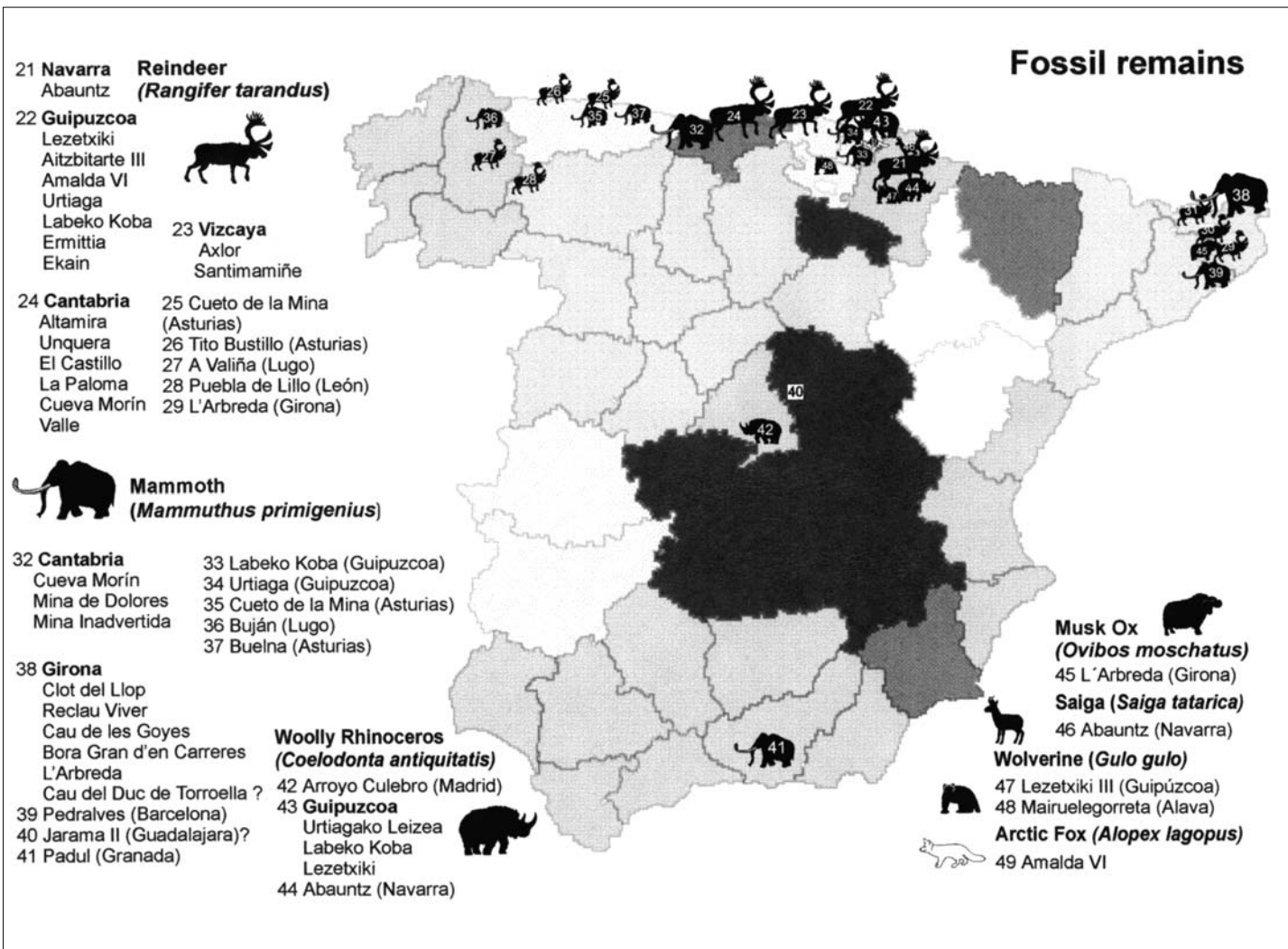


Figure 2. Fossil remains of cold adapted species from Iberian sites. Most of the fossil evidence occurs in the northern part of the Iberian Peninsula, but also in southern sites. We have indicated the questionable occurrences with a question mark in the legends and with a square symbol (instead of the corresponding faunal symbol) on the maps.

(north of the Ebro River). The 'Ebro frontier' model suggests that the basin of the Ebro represented an ecological barrier to the dispersal of the first modern humans in Iberia (Duarte *et al.* 1999). Some authors believe that a climatic deterioration around 30.000 yBP in the Mediterranean ecosystems caused the dispersal of modern humans south of the Ebro river and the subsequent extinction of the last Neandertals, which would have disappeared together with other Mediterranean endemic fauna and flora (Raposo & Cardoso 1998).

MATERIAL AND METHODS

The tables include an inventory of cold adapted faunal remains from Iberian archaeological sites and represent a compilation based on numerous published studies. The maps are elaborated by us to better show the approximate geographic location of the sites. No arctic species have been reported up to now in Portugal, and for this reason we did not include this territory in the maps. Furthermore, an approximate chronology of the sites is attempted when possible, in most cases based on the interpretation of the associated

stone tools. When the fossil remains are out of archaeological context it is noted as 'undefined cultural level'. The study includes not only the fossil remains recovered but also diverse artistic representations (portable and parietal art) depicting arctic animals. However, since in some cases the art interpretations are open to debate, we have indicated the questionable occurrences with a question mark in the tables and with a square symbol, instead of the corresponding faunal symbol, on the maps. The sites with absolute chronometric dates are also included in the text.

COLD ADAPTED TAXA IN THE IBERIAN PENINSULA

Reindeer (*Rangifer tarandus*)

art findings (Fig. 1) At Guadalajara, two caves show reindeer representations, Cueva del Reno, with one engraving (Alcolea *et al.* 1997) and Cueva de la Hoz also with one engraving (Balbín & Alcolea 1994; Balbín *et al.* 1995). In the open air site of Siega Verde (Salamanca), two engravings have been interpreted as reindeer figures (Balbín & Alcolea

Table 1 *Rangifer tarandus* remains from Navarra, Guipúzcoa and Vizcaya.

| Sites | Navarra | | Guipúzcoa | | | | Vizcaya | | | | |
|------------------|--------------------|-------------------|--------------------|-------------------|-----------|------------|-----------------|-------------------|-----------|------------|------------|
| | Middle Magdalenian | Upper Magdalenian | Middle Magdalenian | Lower Magdalenian | Solutrean | Gravettian | Chatelperronian | Upper Magdalenian | Solutrean | Gravettian | Mousterian |
| Abauntz | 4 | | | | | | | | | | |
| Lezetxiki | | | | | | 12 | | | | | |
| Aitzbitarte III | | | | | 1 | 1 | | | | | |
| Aitzbitarte IV | | | 3 | | 3 | | | | | | |
| Erralla | | 4 | | 1 | | | | | | | |
| Amalda VI | | | | | 1 | 2 | | | | | |
| Urtiaga Lelzea | | | | | 96 | | | | | | |
| Urtiaga | | 46 | 6 | 12 | | | | | | | |
| Labeko Koba | | | | | | | abundant | | | | |
| Ermittia | | | 4 | | 4 | | | | | | |
| Ekain | | 4 | | | | | | | | | |
| Torre III | | 1 | | | | | | | | | |
| Axlor | | | | | | | | | | | 1 |
| Santimamiñe VIII | | | | | | | | | 3 | 2 | 1 |
| Lumentxa | | | | | | | | 7 | | | 10 |

Table 2 Cantabrian sites with Reindeer (*Rangifer tarandus*) remains.

| Sites | Upper Magdalenian | Middle Magdalenian | Lower Magdalenian | Solutrean | Gravettian | Acheulean |
|-------------|-------------------|--------------------|-------------------|-----------|------------|-----------|
| Altamira | | | | 36.162 | | |
| El Castillo | abundant | | 1 | 1 | 1 | 4 |
| Cueva Morín | 2 | | | | | |

1994). In the Cantabrian Mountain range, the Tito Bustillo cave site (Asturias) presents seven paintings and at Las Monedas cave (Santander) there are four reindeer images (Altuna 1996a). Finally at Altxerri cave (Guipúzcoa) six engravings were found (Altuna 1996a).

fossil remains (Fig. 2, Tables 1, 2 and 3)

The first recordings of *Rangifer tarandus* in the Iberian Peninsula are those from Harlé (1908), who only included five sites: Aizbitarte IV, Solutrean-Magdalenian (Basque Country); Ojebar, Valle and Paloma, all Magdalenian (Cantabria); and Serinya, Magdalenian (Girona). In Tables 1-3 we include more recently excavated sites with reindeer remains. The five remains of reindeer antler from Bora Gran d'en Carreres (Girona, Table 3) show signs of extraction which indicates that this antler fragments were transported to the sites as a raw material perhaps over a long distance. Reclau Viver (Girona) is ascribed to the Aurignacian period and dated from $30,190 \pm 500$ yBP (level A) to $40,000 \pm 1,400$ yBP (level B) (Maroto et al. 1996). L'Arbreda (Girona) includes a very complete archaeological sequence from the Solutrean to the late Mousterian periods and the *Rangifer tarandus* remains comes from level H which is assigned to the early

Aurignacian level and dated on $37,340 \pm 1000$ yBP to $35,480 \pm 1000$ yBP (Maroto et al. 1996).

Mammoth (*Mammuthus primigenius*)

art findings (Fig. 1) In the Cantabrian Mountain Range, there are eight mammoth representations in the Pindal cave (Balbín et al. 1999), and Las Caldas cave presents three superimposed plate engravings (Corchón 1994, 1997), both sites are in Asturias. Another site from Asturias is La Lluera I with one questionable engraving (González Echegaray & González Sáinz 1994). From Cantabria, one painting from El Castillo cave and another one from Arco-B are recorded together with two questionable representations from Las Chimeneas cave and La Pasiega cave (Ripoll & Ripoll 1992, González Echegaray & González Sáinz 1994). To the north of Burgos, in the Ojo Guareña karst system, one mammoth painting is found (Ortega & Martín 1986). This is one of the very few findings with an absolute chronological age ranging between 11,540 yBP and 10,950 yBP for five samples (Corchón et al. 1996). These dates represent the last occurrence of woolly mammoth at the Iberian Peninsula. In Madrid one engraving (now lost) at El Reguerillo cave has been

* In Buelna (Asturias, loc. no. 37 in Fig. 2) a proboscidean skeleton was found in a small chamber inside the coastal 'Cueva de la Gesa'. This cave is only accessible during the low tide. It was attributed to *Mammuthus primigenius* (Balbín et al. 1999) but Mazo (1998) assigned it to *Elephas antiquus*. This second opinion was mainly based on the large dimensions of the pelvic bone and femur, but they fit well on the *Mammuthus primigenius* range (due to the high sexual dimorphism). No cranial nor humerus remains (which are the best diagnostic parts of the skeleton) have been recovered yet. The sediments where this elephant remains were found seem to correspond to sandstones of a fossil beach. This evidence is used by A. Mazo as an argument to ascribe the elephant to the last interglacial and so defend the *Elephas antiquus* interpretation. The discussion about the specific assignment will remain open until the rest of the animal be extracted from this site.

recorded. There is also one Upper Paleolithic ivory sculpture representing a head of a wol-verine carved on a proboscidean tusk at the Jarama II (Guadalajara) site. Furthermore, there is one engraving that could represent a mammoth from Los Casares cave (Guadalajara).

fossil remains (Fig. 2 *, Table 4) The first citation of *Mammuthus primigenius* in the Iberian Peninsula was that of Obermaier (1916), who only included six sites, from Cantabria (Mina Inadvertida at Pámanes; Minas de las Dolores y Angel at Udías), Oviedo (Cueto de la Mina at Posadas), Girona (Clot del Lop at Olot; Cau de les Goyes at San Juliá de Ramis), and in Barcelona (Pedralves). According to Aguirre (1968) there are '*E. primigenius* (?)' remains in a fluvial deposit of the Manzanares river (Madrid). However, in the original publication by Hernández-Pacheco (1950) only *Elephas antiquus* remains are recorded. Thus no mammoth findings are clearly represented in the Madrid province. The southernmost *Mammuthus primigenius* finds in the Iberian Peninsula are those from El Padul peat-bog at only 20 km from the city of Granada (Aguirre, 1973). A carpal bone was used for ^{14}C analyses and an age of $35,790 \pm 960$ yBP was obtained (Martín pers. comm.). Cardoso (1993) reported the presence of *Mammuthus* cf. *primigenius* at Algar Joao Ramos and Gruta Figueira Brava (both in

Portugal). The Gruta Figueira Brava (Sesimbra: Portugal) is dated by ^{14}C . However, more recent publications (Raposo & Cardoso 1998, Raposo 1995) do not include this taxon in the faunal list, so we have interpreted this as a consequence of a revision. The lowermost level is $30,050 \pm 550$ yBP and the uppermost level is $30,930 \pm 700$ yBP (Raposo & Cardoso 1998).

Woolly rhinoceros (*Coelodonta antiquitatis*)

art findings (Fig. 1) The artistic representations of the woolly rhinoceros in the Iberian Peninsula are very scarce, only two engravings are clear, one is the plate from Las Caldas cave (Asturias) mentioned above (Corchón 1994, 1997) and the other one is found on a cave wall at Los Casares (Guadalajara). Finally, at the open-air site of Siega Verde (Salamanca) one engraving is reported by Balbín & Alcolea (1994).

fossil remains (Fig. 2, Table 5) Harlé (1920) described one skull of *Coelodonta antiquitatis* from Arenys de Mar (Barcelona). The *Coelodonta antiquitatis* remains from Arroyo Culebro in Madrid province (Arsuaga & Aguirre 1979) are represented by two skulls, one rostrum and one hemimandible of a young individual (thus 3-4 individuals). The chronology is very problematic. Guerin's opinion (pers. comm. in Arsuaga & Aguirre

Table 3 *Rangifer tarandus* remains from sites other than Basques and Cantabrian.

| Sites | Upper Magdalenian | Lower Magdalenian | Solutrean | Aurignacian | Mousterian |
|----------------------------------|------------------------------|-------------------|-----------|-------------|------------|
| La Paloma (Asturias) | | 1 | | | |
| Tito Bustillo (Asturias) | 1 | | | | |
| La Riera (Asturias) | 7 | | | | |
| Cueto Mina (Asturias) | 1 | | 1 | 1 | |
| A Valiña (Lugo) | 1 (undefined cultural level) | | | | |
| Puebla de Lillo (León) | 1 (undefined cultural level) | | | | |
| L'Arbreda (Girona) | | | 1 | | 1 |
| Reclau Viver (Girona) | | | 1 | | |
| Bora Gran d'en Carreres (Girona) | 5 | | | | |

Table 4 Mammoth (*Mammuthus primigenius*) fossil remains. See Note.

| Sites | Middle Magd. | Lower Magd. | Solutrean | Gravettian | Chatelperronian | Aurignacian | Premousterian |
|----------------------------------|--------------------------|-------------|-----------|------------|-----------------|-------------|---------------|
| Labeko Koba (Guipúzcoa) | | | | | some remains | | |
| Urtaigako Leizea (Guipúzcoa) | | | | 1 | | | |
| Cueva Morín (Cantabria) | | | | 1 | | | |
| Cueto de la Mina (Asturias) | | | 1 | | | | |
| Reclau Viver (Girona) | | | | | | 1 | |
| Bora Gran d'en Carreres (Girona) | 2 | | | | | | |
| L'Arbreda (Girona) | | | | 1 | | 1 | 2 |
| Padul (Granada) | undefined cultural level | | | | | | |
| Buján (Lugo) | undefined cultural level | | | | | | |
| Buelna (Asturias) | undefined cultural level | | | | | | |

1979) was that "these remains do not seem very old, in any case, it is not the Russian form". The fossils were found in a gravel quarry in a terrace of the small river Arroyo Culebro, that was assigned 'geomorphologically' to the Early Würm, perhaps equivalent to the OIS 4, although in the absence of any geochronological dating or any taxa of biostratigraphical relevance, a later age (OIS 2) cannot be completely excluded. Among the associated lithic materials also coming from the same Arroyo Culebro gravel exploitation, there is a handaxe that would support an Early Würm age, if it was truly associated with the woolly rhinoceros remains, which is not totally certain. Arroyo Culebro is the southernmost occurrence for this species in the Iberian Peninsula (0° 3' 40" E and 40° 17' 43" N). There are two Cantabrian sites that have yielded woolly rhinoceros remains, one

is Unquera (Arsuaga & Aguirre 1979) and the other is Udías with one skull, some teeth and several more fragments. On the Catalonian coast, there are several sites that have yielded woolly rhinoceros remains: El Toll (Barcelona; Moyá in Altuna 1972), L'Arbreda, Bora Gran d'en Carreres (both in Girona). And also at Labeko Koba, Urtaigako Leizea, Lezetxiki (at Guipúzcoa) and Abautz (Navarra; Altuna 1996a).

Saiga (*Saiga tatarica*)

art findings (Fig. 1) There is only one reference to two possible saiga engravings at the site of Altxerri (Guipúzcoa; Altuna 1996a).

fossil remains (Fig. 2, Table 6) The only Iberian site that has yielded saiga evidence is Abautz (Navarra) (Altuna, 1996b) with only

Table 5 Woolly Rhinoceros (*Coelodonta antiquitatis*) fossil remains.

| Sites | Middle Magd. | Lower Magd. | Solutrean | Gravettian | Chatelperr. | Aurignacian | Premousterian |
|----------------------------------|--|-------------|-----------|------------|-------------|-------------|---------------|
| Labeko Koba (Guipúzcoa) | | | | | | 92 | |
| Urtaigako Leizea (Guipúzcoa) | | | | 1 | | | |
| Lezetxiki (Guipúzcoa) | | | | 2 | | | |
| Abautz (Navarra) | 1 | | | | | | |
| Bora Gran d'en Carreres (Girona) | 2 | | | | | | |
| L'Arbreda (Girona) | | | 1 | 1 | | 1 | 2 |
| Udías (Santander) | 1 skull and several remains (undefined cultural level) | | | | | | |
| Unquera (Santander) | several remains (undefined cultural level) | | | | | | |
| El Toll (Barcelona) | several remains | | | | | | |
| Arroyo-Culebro (Madrid) | 3 skulls and a hemimandible (undefined cultural level) | | | | | | |

six fossil remains (five phalanges and one tarsal bone). Since all the bones come from one single foot, they could have been transported as part of a saiga skin from other locality. Although the saiga antelopes were very abundant in the Aquitaine large plain (north of the Pyrenees), the hilly landscape of the region surrounding the Abauntz site would have been unsuitable for their existence.

Wolverine (*Gulo gulo*)

art findings (Fig. 1) At Jarama II (Guadalajara) the Upper Paleolithic ivory statue mentioned earlier depicts the head of a wolverine (Adán *et al.* 1995)

fossil remains (Fig. 2, Table 6) From the site of Lezetxiki level III (Guipúzcoa) there is one maxilla. This level is attributed to the Gravettian. At the Mairuelegorreta cave site (Alava) a single canine was recovered without archaeological context (Altuna 1996a).

Musk Ox (*Ovibos moschatus*)

Only a single remainder attributed to the musk ox has been recovered from the L'Arbreda (Girona) site. It comes from the Gravettian-Solutrean transitional level (Maroto *et al.* 1996). (Fig. 2, Table 6)

Arctic fox (*Alopex lagopus*)

Amalda level VI (Guipúzcoa) is the only site that has yielded arctic fox fossil remains, (Fig. 2, Table 6). This level is assigned to the Gravettian cultural level by Altuna (1996a).

CONCLUSIONS

Cold-adapted species have been found in a great part of the Iberian Peninsula. The presence of arctic faunas indicating truly periglacial conditions in the Iberian Peninsula before the last glaciation cycle is not certain. There is an occurrence of *Praeovibos* sp. in Atapuerca, in Gran Dolina upper level 7, of early Middle Pleistocene age (Van der Made 1998). *Praeovibos* also occurs in the Lower Pleistocene of Venta Micena (Moyá-Solá 1987) in Granada (South of Spain). However, it seems that *Praeovibos* is more an indicator of dry climate and steppe conditions (not necessarily very cold), whereas the Middle and Late Pleistocene musk ox is clearly cold adapted. The same can perhaps be said of *Vulpes preglacialis* (the likely ancestor of the Late Pleistocene arctic fox) that also occurs in Atapuerca / Gran Dolina Early Pleistocene level TD6, as well as in the Early Pleistocene site of Venta Micena and the Middle Pleistocene site of Huescar 1 (both in Granada). If these two taxa are not periglacial indicators, no arctic taxa are found prior to the OIS 4, thus re-inforcing the hypothesis that very cold conditions never existed in the Iberian Peninsula before the last glaciation (in the OIS 4 and still more exaggerated in the OIS 2). The exception to this rule could be the reindeer remains assigned by Obermaier (1916) to level 18 of El Castillo cave. This lower level of the El Castillo sequence was described as 'Acheulian' and could belong to the end of the Middle Pleistocene (OIS 6).

Table 6 Saiga (*Saiga tatarica*), musk ox (*Ovibos moschatus*), wolverine (*Gulo gulo*) and arctic fox (*Alopex lagopus*) fossil remains.

| Sites | <i>Saiga tatarica</i> | <i>Ovibos moschatus</i> | <i>Gulo gulo</i> | <i>Alopex lagopus</i> |
|---------------------------|------------------------|--------------------------|------------------------------|-----------------------|
| Abauntz (Navarra) | 5 (Middle Magdalenian) | | | |
| Lezetxiki III (Guipúzcoa) | | | 1 (Gravettian) | |
| Mairuelegorreta (Alava) | | | 1 (undefined cultural level) | |
| Amalda VI (Guipúzcoa) | | | | 1 (Gravettian) |
| L'Arbreda (Girona) | | 1 (Gravettian-Solutrean) | | |

ACKNOWLEDGEMENTS

This study is supported by DCYT: PB96-1026-CO3-03/96. We are very grateful to J.M. Carretero, A. Gracia, I. Martínez, C. Lorenzo, R.-D. Kahlke, and D. Mol for their valuable comments and to Rolf Quam for his help with the corrections on the English.

REFERENCES

- Adan Álvarez, G., Arribas, A. Barbadillo, J., Cervera Estrada, R., García, M.A., Jordá, J.F., Pastor, J., Sánchez, B., Sánchez, A., Sanchiz, B. & Sesé C., 1995 - Prospecciones y excavaciones arqueológicas en el alto valle del Jarama (Valdesotos, Guadalajara, Castilla-La Mancha) - in: Balbín-Behrmann R., Valiente J. & Mussat M. T. (eds.) - Arqueología en Guadalajara. Patrimonio Histórico-Arqueología, Toledo: 111-124
- Aguirre, E., 1968 - Revisión sistemática de los Elephantidae por su morfología y morfometría dentaria - Estudios Geológicos 24: 109-167
- Aguirre, E., Lhenaff, R. & Zazo, C., 1973 - Nuevos fósiles de elefantes en Andalucía - Estudios Geológicos 29: 295-306
- Alcolea, J.J., Balbín-Behrman, R. de, García Valero, M.A. & Jiménez Sanz, P.J., 1997 - Nouvelles découverts d'art paléolithique dans le centre de la Péninsule Ibérique: la grotte du Renne (Valdesotos, Guadalajara) - L'Anthropologie 101(1): 144-163
- Altuna, J., 1972 - Fauna de mamíferos de los yacimientos prehistóricos de Guipúzcoa - Munibe 24: 238-315.
- Altuna, J., 1996 a - Faunas de clima frío en la Península Ibérica durante el Pleistoceno superior - in: Ramil-Rego P., Fernández Rodríguez, C. & Rodríguez Guitián M. (eds.) - Biogeografía Pleistoceno-Holocena de la Península Ibérica - Santiago de Compostela: Xunta de Galicia: 13-39
- Altuna, J., 1996b - Primer hallazgo de restos óseos de antílope Saiga (*Saiga tatarica* L.) en la Península Ibérica - Munibe 48: 3-6
- Arsuaga, P.M. & Aguirre, E., 1979 - Rinocerontes lanudos en la provincia de Madrid (*Coelodonta antiquitatis* Blumenbach) - Boletín Real Sociedad Española Historia Natural (Geol.) 77: 23-59
- Balbín Behrman, R. de, Alcolea, J.J. & González Pereda, M.A., 1999 - Une vision nouvelle de la grotte de El Pindal, Pimiango, Ribadedeva, Asturias - L'Anthropologie 103 (1): 51-92.
- Balbín Behrman, R. de, Alcolea, J.J., Moreno, F. & Cruz, L.A., 1995 - Investigaciones arqueológicas en la Cueva de la Hoz (Santa María del Espino, Guadalajara). Una visión del conjunto actualizada - in: Balbín-Behrmann R. de, Valiente J. & Mussat M.T. (eds.) - Arqueología en Guadalajara. Patrimonio Histórico-Arqueología, Toledo: 39-53
- Balbín Behrman, R. de & Alcolea, J.J., 1994 - Arte Paleolítico de la meseta Española - in: Brunet T.C. & Menéndez M. (eds.) - Arte Paleolítico - Complutum 5: 97-138
- Barandiarán, I., 1995 - Arte mueble del Paleolítico Cantábrico: una visión de síntesis en 1994 - in: Brunet, T.C. & Menéndez Fernández, M. (eds.) - Arte Paleolítico - Complutum 5: 45-79
- Canal, J. & Carbonell, E., 1989 - Catalunya Paleolítica - Patronat Eiximensis, Girona, 443 pp.
- Cardoso, J. 1993 - Contribuição para conhecimentos dos grandes mamíferos do Pleistoceno superior de Portugal - Unpublished PhD thesis
- Carrión, J.S., Munuera, M. & Navarro, C., 1998 - The paleoenvironment of Carihuela Cave (Granada, Spain): a reconstruction on the basis of palynological investigations of cave sediments - Review of Palaeobotany and Palynology 99: 317-340
- Corchón, S., 1994 - Últimos hallazgos y nuevas interpretaciones del arte mueble paleolítico en el occidente asturiano - in: Brunet T.C. & Menéndez Fernández, M. (eds.) - Arte Paleolítico- Complutum 5: 234-264
- Corchón, S., 1997 - La corniche Cantabrique entre 15 000 et 13 000 ans BP: la perspective donnée par l'art mobilier - L'Anthropologie 101 (1): 114-143
- Corchón, S., Valladas, H., Bécarea, J., Arnold, M., Tisnerat, N. & Cachier, H., 1996 - Datación de las pinturas y revisión del arte Paleolítico de cueva Palomera (Ojo Guareña, Burgos, España) - Zephyrus 49: 37-60
- Costa Tenorio, M., García Antón, M., Morla Juaristi, C. & Sainz Ollero, H., 1990 - La evolución de los bosques de la Península Ibérica: Una interpretación basada en datos paleobiogeográficos - Ecología. ICONA, Madrid, Fuera de Serie 1: 31-58.
- Duarte Maurício, J., Pettitt, P.B., Souto, P., Trinkaus, E., Van der Plicht, H. & Zilhão, J., 1999 - The early Upper Palaeolithic human skeleton from the Abrigo do Lagar Velho (Portugal) and modern human emergence in Iberia - Proceedings National Academy

- Sciences USA 96: 7604-7609
- Dupré Ollivier, M., 1988 - Palinología y Paleoambiente. Nuevos datos españoles. Referencias - Diputación provincial de Valencia, Valencia, Vol. 84
- Fumanal García, M.P., 1986 - Sedimentología y clima en el País Valenciano. Las cuevas habitadas en el Cuaternario reciente - Diputación Provincial de Valencia, Valencia, Vol. 83
- González Echegaray, J. & González Sáinz, C., 1995 - Conjuntos ruprestres paleolíticos de la cornisa cantábrica, 1994 - in: Brunet, T.C. & Menéndez Fernández, M. (eds.) - Arte Paleolítico - Complutum 5: 21-43
- Gómez, A. & Pérez, A., 1998 - Las huellas glaciares de las montañas españolas - Universidad de Santiago de Compostela, Santiago de Compostela
- Harlé, E., 1908 - Ossements de Renne en Espagne - L'Anthropologie 19: 573-577
- Harlé, E., 1920 - Restes d'Elephant et de Rhinocéros trouvés récemment dans le Quaternaire de la Catalogne - Butlletí de la Institució Catalana d'Historia Natural, 3ª época, 20 (2): 40-43
- Hernández-Pacheco, E., 1950 - Características de las terrazas del Manzanares - in: Hoyos-Sáinz (ed.) - Homenaje a Hoyos-Sáinz 2: 239 -242
- Kahlke, R.-D., 1999 - The history of the origin, evolution and dispersal of the Late Pleistocene *Mammuthus-Coelodonta* faunal complex in Eurasia (large mammals) - Fenske Companies, Rapid City, South Dakota, 219 pp.
- Maroto, J., Soler, N. & Fullola, J.M., 1996 - Cultural change between Middle and Upper Palaeolithic in Catalonia - in: Carbonell, E. & Vaquero, M. (eds.) - The last Neandertals, the first anatomically modern humans - pp. 219-250
- Mazo, A., 1998 - El elefante fósil de Buelna (Asturias). Nota preliminar - Estudios Geológicos 54: 273-274
- Ortega, A.I. & Martín M.A., 1986 - La Arqueología del karst de Ojo Guareña-Kaite - Estudios de Espeleología Burgalesa 4-5: 331-389
- Obermayer, H., 1916 - El Hombre fósil - Comisión de Investigaciones Paleontológicas y Prehistóricas 9. Museo Nacional de Ciencias Naturales: 173-178
- Raposo, L., 1995 - Ambientes, territorios y subsistencia en el Paleolítico medio de Portugal - Complutum 6: 57-77
- Raposo, L., Cardoso, J.L., 1998 - Las industrias líticas de la Gruta Nova de Columbeira (Bomarral, Portugal) en el contexto del Musteriense final de la Península Ibérica - Trabajos de Prehistoria 55: 39-62
- Ripoll, E. & Ripoll, S., 1992 - El arte Paleolítico en la Península Ibérica - Cuadernos de arte Español, Historia 16: 31 pp.
- Rubio Campos, J.C., Delgado Pastor, J. & Molina Molina, A.L., 1993 - Contribución geomorfológica en las cabeceras de los sistemas glaciares de los ríos Maitena y Alhori (Sierra Nevada), Granada - in: El Cuaternario en España y Portugal, Asociación Española para el Estudio del Cuaternario (AEQUA), Madrid, 1: 147-156
- Sánchez Goñi, M.F., 1993 - Criterios de base tafonómica para la interpretación de análisis palinológicos en cueva: el ejemplo de la región cantábrica - Estudios sobre Cuaternario: 117-130
- Van Andel, T.H. & Tzedakis, P.C., 1998 - Priority and opportunity: reconstructing the European Middle Palaeolithic climate and landscape - in: Bayley, J. (ed.) - Science in Archaeology - An agenda for the future, English Heritage: 37-45
- Van der Made, J., 1998 - Ungulados de Gran Dolina, Atapuerca: Nuevos datos e interpretaciones - in: Aguirre, E. (ed.) - Atapuerca y la Evolución Humana, Fundación Ramón Areces, Madrid, 453 pp.
- Vega-Toscano, L.G., Hoyos, M., Ruiz-Bustos, A. & Laville, H., 1988 - La séquence de la grotte de La Carihuela (Piñar, Grenade): chronostratigraphie et paléocologie du Pléistocène supérieur au sud de la Péninsule Ibérique - L'Homme de Néandertal, 2. L'Environment, Liège: 169-180

received 23 July 1999