

# **A Late Pleistocene (MIS3) ungulate mammal assemblage (Los Rincones, Zaragoza, Spain) in the Eurosiberian-Mediterranean boundary.**

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Keywords: ungulates, Iberian Peninsula, Late Pleistocene, *Capra pyrenaica*, *Equus ferus*.

## **Abstract**

During the Upper Pleistocene the archaeo-paleontological sites in the Iberian Peninsula are located mainly on the coasts. Here we present for the first time a paleoenvironmental proxy for Upper Pleistocene locality (MIS3) that is in the interior peninsular, in the Moncayo Massif (Zaragoza). This is actually the boundary between Mediterranean and Eurosiberian climatic-regions. The present study is based in the site ungulates: *Capra pyrenaica*, which is bigger in size than current and fossil from Mediterranean area. The horses have a small size, which is similar to that of the horses from Fontainhas and Casares. Significantly lesser in the number of rests, are the roe deer, the southern chamois, and the auroch. The study and comparison of the faunal assemblage of the locality of Los Rincones, with other sites of the Iberian MIS 3 shows a cluster of sites in the southern Peninsular, though separated, due to the abundance of

*C. pyrenaica*. The association of Los Rincones is similar to the southern peninsular sites such as Nerja, Gorham Cave, Cova Beneito, Zafarraya. The ungulate assemblage of Los Rincones represents a landscape with temperate climate, presence of steppe, and patches of forest, similar to the current landscape surrounding the cavity today.

## **1 Introduction**

The Iberian Peninsula is an exceptional area for studying the faunal associations of the Late Pleistocene, because on account of its geographical configuration it displays two distinct climatic ranges, the Atlantic and the Mediterranean (Schmidt et al. 2012). Further, the Iberian Peninsula contains the southwestern limit to the cold faunas that make up what is also known as the “*Mammuthus–Coelodonta* faunal complex” (Kahlke 1999). These faunas generally occur on a sporadic basis, being most frequent during Marine Isotope Stage 3 (MIS3) (Álvarez-Lao and García 2010, 2011). Although there are many Late Pleistocene (MIS3) sites in the Iberian Peninsula, most are concentrated in coastal areas or in the Pyrenean region, and there are few references to inland sites with faunas from the period in question (d’Errico and Sánchez Goñi 2003; Stewart 2007; Schmidt et al. 2012).

The objective of the present paper is to undertake a taxonomic and biometric study of the ungulates found in the cave of Los Rincones (Zaragoza, Spain) and to carry out a faunal analysis of the association present at the site, comparing it with the bibliographical data. Through a comparative study of the fauna, the aim will be to define the landscape of the inland area of the Iberian Peninsula during the Late Pleistocene (MIS3), a landscape that was inhabited by large predators such as the leopard and *Homo neanderthalensis*.

### **2.1 Description of the study area**

The cave of Los Rincones is located in the Sierra del Moncayo, in the central part of the Iberian Range in the north of the Iberian Peninsula (Figure 1(a)). On account of the isolated relief it presents between the boundary of the Ebro Valley and the Castilian Meseta as well as its high altitude (2315m), its special orientation and its geological diversity, the Moncayo massif is endowed with special characteristics that are unique within its geographical setting. It represents a confluence of three biogeographical subregions (Uribe-Echebarría 2002). The northern slope of the Moncayo is subject to the wet, cold influence of fronts from the Atlantic, harbouring plant taxa of a northern character, such as *Quercus robur* (Gómez et al. 2003). By contrast, the surrounding land shows a marked Mediterranean character, with vegetation dominated by evergreen *Quercus* such as *Q. ilex* and *Q. coccifera*. A few kilometres to the east lies the Ebro Valley, with its notable aridity, where species characteristic of semi-arid steppes such as *Lygeum spartum* can be found (Hernández and Valle 1989; Uribe-Echebarría 2002).

The climatological data from Agramonte de Moncayo (Zaragoza), situated at an altitude of 1090 m, show a mean annual precipitation of 927 mm and a mean annual temperature of 9.4°C (Hernández and Valle 1989). The pronounced altitude gradient and the NW-SE climatic dissymmetry result in a great diversity of plant environments, with three vegetation levels at present: meso-, supra- and oro-Mediterranean, with the existence of a fourth level under discussion, the cryoro-Mediterranean, which would be the equivalent of an Alpine level. The only comparable reference as regards the predominant vegetation during the period to which the fossil remains from Los Rincones correspond (MIS3) would be Gabasa Cave. A pollen study carried out on hyena coprolites dating to between 50 ka and 40 ka reflects a mosaic glacial landscape that includes *Pinus* and *Juniperus* woodlands and steppes with Chenopodiaceae, Poaceae, *Artemisia* and Asteraceae, suggesting an arid and cold/cool climate. The

presence of mesophilous and thermophilous tree and shrub taxa (*Quercus ilex*, *Q. coccifera*) also suggests the existence of temperate Mediterranean refugia during the period in question (González-Sampériz et al. 2003, 2005).

The relief around the cave of Los Rincones is abrupt, with the site surrounded by steep cliffs (Figure 1(b)), which would foster the presence of rupicolous species such as *R. pyrenaica* and *C. pyrenaica*. On the other hand, the ravine of Los Rincones opens into a broad valley that could have hosted open-environment species such as *Equus* and *Bos primigenius* and woodland species such as *C. capreolus* and *Cervus elaphus*.

## **2.2 The site of Los Rincones: origin of the accumulation**

The cave of Los Rincones is situated at the head of the ravine of Los Rincones (with a SW orientation), in the municipality of Purujosa (Zaragoza). It opens at an altitude of 1010m (see diagram of geographical location) (Figure 1(c)). The cave is divided into a number of chambers. The remains under study in the present paper appeared at the surface of the “*Ursus* gallery” (GU) and the “Leopard Gallery” (GL), which are connected and are considered a single site (Figure 1 (d), Figure 1(e)). The sample presents a similar pattern of fragmentation, with similar tooth and cut marks, and breaking pattern due to collapse of ceiling blocks. Also the faunal composition, the skeletal survival profiles and the degree of preservation of the remains, as well as the distribution of fragments of the same anatomical element in distinct galleries of the site, indicate that the process of accumulation was similar: bones, with other clastic sediments, were carried in from the surface (allogenic transport) to the *Ursus* Gallery, until the cone blocked the mouth of the cave (Sauqué et al., 2014).. The faunal association under study in the present paper date at least to the Late Pleistocene, probably MIS3. We sent samples to a radiocarbon laboratory (Beta Analytics) but

unfortunately we could not obtain radiometric ages by the  $^{14}\text{C}$  method due to lack of collagen in the bones. Also during the early stages of cleaning the gallery, a piece of Mousterian industry was also discovered in the cave of Los Rincones. The upper part of the sedimentary cone that closes off the original entrance to the cave has been dated on the basis of a microfaunal association consisting of *Microtus*, *Iberomys* and *Pliomys lenki*. Such an association is characteristic of the Late Pleistocene. The species *Pliomys lenki* disappears between 50 ka and 40 ka from the centre of the Iberian Peninsula, where it is only found at Mousterian localities (Cuenca-Bescós et al. 2010; Sauqué and Cuenca-Bescós 2013).

Late Pleistocene faunal accumulations are generally produced by the activity of humans or carnivores (Cruz-Urbe 1991; Stiner 1991; Diedrich 2011; Enloe 2012). Noteworthy among the latter are the accumulations generated by hyenas, which are much more frequent than those generated by leopards (Yravedra 2006; Diedrich 2013; Sauqué et al. 2014). Both hyenas and humans tend to break bones in order to extract the marrow, so the presence of whole bones is very rare at such sites. The site of Los Rincones is one of the few sites where the accumulation is attributed to the activity of a leopard as the main accumulator (Sauqué and Cuenca-Bescós 2013; Sauqué et al. 2014). Nonetheless, the site also testifies to the sporadic presence of Neanderthals, who left their mark in the form of cut marks in some bones, as well as remains of lithic industry (Sauqué et al. 2014). As a result, the accumulation is composed mainly of small-sized herbivores that fall within the range of leopard consumption. The accumulation consists primarily of remains of *C. pyrenaica*, (Table 1, Figure 2) thus providing a great opportunity to carry out a biometric study of this taxonomically controversial taxon (Garrido 2008; García-González 2011).

### **3. Materials and Methods**

For taxonomic identification the following authors have been followed: Bibikova (1958), Pales and Lambert (1971), Eisenmann (1986), Gee (1993), Lister (1996) , and Fernandez (2001) . Use has also been made of the reference collections of the UZ (Universidad de Zaragoza) and the IPE (Instituto Pirenaico de Ecología). In order to assess the skeletal representation of the assemblage from Los Rincones, we have used the number of remains (NR), the number of identified specimens (NISP) and the minimum number of individuals (MNI), which have been calculated in accordance with Brain (1981) and Lyman (1994a).

In order to determine the age of death, dental replacement and the degree of dental eruption have been used (Hillson 1992; Morris 1978), as well as the degree of fusion of the epiphyses in long bones (Morris 1972). Furthermore, for each species the criteria proposed by other specialists have been followed: e.g. those from Pérez Ripoll (1988) and Vigal and Marchordom (1985) for *Capra pyrenaica*; those from Tomé and Vigne (2003) for *Capreolus capreolus*; those from Pérez-Barbería (1994) for *Rupicapra pyrenaica*; and those from Aitken (1975), Azorit et al. (2002), D'Errico and Vanhaeren (2002) and Mariezkurrena (1983) for *Cervus elaphus*. The measurements were taken with a digital calliper (Digimatic Caliper CD-8" CX) in accordance with von den Driesch (1976) and Bibikova (1958). For the remains from *Equus* the methodology proposed by Eisenmann (1986) has been followed.

All measurements are given in millimetres. The morphometric data have been compared with data collections from western Europe published by a variety of authors (see citations in Tables 2, 3, 4, 5, 6, 7), as well as with our own data gathered directly from the collections of the Museo Nacional de Ciencias Naturales in Madrid (MNCN), the Museu de Prehistòria de València (MPV), the Instituto Pirenaico Ecología (IPE), the Zoologische Staatssammlung München (ZSM), the Museo Paleontológico de Zaragoza

(MPZ), the Museo Arqueológico Provincial de Huesca (MAPH), the Instituto Alavés de la Naturaleza (IAN), Institut für Paläoanatomie, Domestikationsforschung und Geschichte der Tiermedizin (Ludwig Maximilians university München) (LMU) and the Naturhistorisches Museum Basel (NMB).

To provide a statistical comparison of the site of Los Rincones with the faunal associations of other sites, we have undertaken correspondence analyses (CA) using PAST v.2.14 (Hammer et al. 2001). CA is a way of projecting a multivariate database onto two or three dimensions in order to visualize the cluster patterns. It is thus a good method for discovering geographical groupings and patterns and for bringing to light environmental gradients (Greenacre 1984; Jongman et al. 1995; Legendre and Legendre 1998).

The algorithms used by CA present two problems. The first is the tendency to compress the end of the ordinate axis, squeezing together the samples and taxa, which is not useful. The second is the arch effect, which occurs when the environmental gradient presents “losses” in the first and second ordination axes instead of being linked only with the first axis as it should be. To avoid these problems we have used a detrended correspondence analysis (DCA) for our comparison of faunal associations. First, this rescales itself, removing the compression at the ends of the axes; afterwards, it carries out the detrending, stretching and bending the arch until it becomes straight. This type of analysis is of great value for the ordination of ecological databases (Hill and Gauch 1980).

#### **4. Taxonomy**

The ungulates from Los Rincones show a good state of preservation due to the non-anthropogenic origin of the accumulation (Sauqué et al. 2014). Thanks to the low levels of modification, it has been possible to identify taxonomically a total of 615 ungulate remains (Table 1). These remains correspond to the following taxa: *C. elaphus* (red deer), *C. capreolus* (roe deer), *C. pyrenaica* (Iberian wild goat), *R. pyrenaica* (Pyrenean chamois), *Equus hydruntinus* (European ass), *E. ferus* (horse) and *Bos primigenius* (aurochs) (Table 1, Figure 2).

The main ungulate is *C. pyrenaica*, constituting 86% of the total ungulate remains. The carnivores, which are not included in the present study, are *Ursus arctos* (brown bear), *Canis lupus* (grey wolf), *Panthera pardus spelaea* (Ice Age leopard) and *Lynx* sp.

Abundant microfaunal taxa are also present, including the insectivore *Crocidura* sp., the rodents *Microtus arvalis*, *Microtus agrestis*, *Chionomys nivalis*, *Arvicola terrestris*, *Terricola* sp., *Pliomys lenki* and *Apodemus* sp., and the lagomorph *Lagomorpha* indet., as well as Aves, squamates, the tortoise *Testudo hermanni* and fish. This small-vertebrate association is typical of the Late Pleistocene of the Iberian Peninsula (Cuenca-Bescós et al. 2010; Sauqué and Cuenca-Bescós 2013; Sauqué et al. 2014).

#### **4.1. Order Artiodactyla Owen, 1848**

##### **4.1.1. Family Cervidae Goldfuss, 1820**

Cervids are scarce at Los Rincones, representing just 6.3% of the ungulates. Although they only form a small proportion of the total, their presence is interesting as it indicates a woody environment (Table 1, Figure 2).

##### **4.1.1.2. *Cervus elaphus* Linnaeus, 1758**



Thirteen remains were recovered, representing 2.1% of the ungulates. The dental remains are scarce; only two incisors were recovered. The most abundant remains are the phalanges (six), two first phalanges, two second and two third ones, also there are one metatarsus and one tibia (Figure 3).

The metatarsus (Ri10/O-13/172) presents a clear separation between grand cuneiform facet and escafocuboides facet like in *Cervus elaphus* while in *Dama dama* they appear to meet (Lister 1996). Also Ri10/O-13/172 shows a single large foramen typical of *Cervus elaphus* while *Dama dama* presents a network of pores (Lister 1996). First phalanx (Ri10/P13/1, Ri10/O-13/81) of Los Rincones shows a posterior articular facet with a mid-groove which is typical of *Cervus elaphus* (Lister 1996). The dimensions of the postcranial material that was found correspond to a medium-sized deer, one larger than the deer from Cueva Camino and Cova Negra (MIS5), but somewhat smaller than those from the north of the Iberian Peninsula (the sites of Lumentxa, Santimamiñe, Urtiaga D, Labeko Koba, La Paloma, El Mirón, Morín and Abauntz) that correspond to the last cold stage (MIS3 and MIS2). The deer from Los Rincones is similar in size to deer from Gabasa, Parpalló and Nerja (MIS3 and MIS2), which are found in a Mediterranean climatic environment (Table 2).

The larger size of these deer from the cold stages was already pointed out by Mariezkurrena (1983). This greater size could be related to Bergmann's rule (cold climates select for the survival of large-sized animals), or it could be due to differences in the availability of food, the high quality of the vegetation during the cold periods allowing ruminants such as deer to attain big sizes (Guthrie 1990).

#### **4.1.1.3. *Capreolus capreolus* Linnaeus, 1758**

Twenty-six remains were recovered, representing 4.2% of the ungulates. Cranial and postcranial remains were found (Figure 3). The minimum number of individuals is two, one adult and one subadult of roughly 19-20 months.

Among the remains recovered, an antler (Ri10/O13/230) is particularly notable for its taxonomic value. This is composed of a central branch that presents a tip that grows forwards and upwards in its upper part. The rear tip projecting backwards situated a third of the way along the central branch is not observed, since the individual is juvenile. It presents great development of the rosettes, with pearled patterning. These characteristics are typical of *C. capreolus* (Sempéré et al. 1996; Mateos-Quesada 2011) (Figure 3).

The remains that could be measured have been compared with the measurements from the bibliography (Table 3). The remains recovered from Los Rincones are similar in size to the roe deer from Gabasa (MIS3) but smaller than those from the north of the Iberian Peninsula (the sites of Jou Puerta, Urtiaga, La Riera, Santimamiñe and Lumentxa) that correspond to the last cold stage (MIS3 and MIS2) (Table 3).

The presence of *C. capreolus* is interesting since the species does not occur frequently in the sites of the Quaternary of western Europe (Altuna 1972; Lister 1989; Álvarez-Lao 2014). In the Iberian Peninsula it has mainly been recovered in northern regions, though its presence never represents more than 20% of the NISP of the ungulates of the sites in question (see Appendix 1 %NISP).

#### **4.1.2. Family Bovidae Gray, 1821**

Bovids are predominant in the ungulate association from Los Rincones, constituting 91.2% of the NISP of ungulates. The most abundant taxon is the Iberian wild goat (*C.*

*pyrenaica*), followed by much lower percentages of the Pyrenean chamois (*R. pyrenaica*) and the aurochs (*Bos primigenius*) (Figure 2, Table 1).

#### **4.1.2.1. *Bos primigenius* Bojanus, 1827**

The remains of *Bos primigenius* are scarce, representing just 0.7% of the NISP of ungulates. Moreover, they seem to belong to a single individual, since they were collected within a very small area, are similar in size, and articulate with one another. The remains recovered belong to the postcranial skeleton: a talus bone, a metatarsus, a scaphocuboid and a third phalanx (Figure 4).

The distinction between *Bos* and *Bison* is complex, and the absence of the cranial or dental remains that are best for distinguishing them obliged us to use a variety of morphological and metric criteria. In spite of the complexity, the distinction is relevant because the taxa indicate different environments: *Bison priscus* is associated with steppe regions (Brugal 1985), whereas *Bos primigenius* is found both in open and woodland areas (Ekström 1993).

Only the proximal part of the metatarsus is preserved, where the proximal articular facets corresponding to the great cuneiform and the scaphocuboid can be seen to be slightly separated, which is a trait characteristic of *Bos*, whereas in *Bison* they are joined (Brugal 1985; Gee 1993). Moreover, these facets are asymmetrical, which differentiates them from *Bison* (Álvarez-Lao and García-García 2006). Another criterion that supports an ascription of the fragment to *Bos* is the lack of the medial tubercle (Gee 1993).

With the talus bone we have followed morphological and metric criteria. In the case of *Bos*, the morphology of the plantar groove separating the articular surfaces of the

calcaneus and the scaphocuboid displays an angle of 90° both in the plantar and medial area of the bone and on the lateral margin, whereas in *Bison* it follows a gently arching course that ends in an open angle (Altuna 1972; Buitrago-Villaplana 1992; Gee 1993; Sala et al. 2010). Specimen Ri10/N10/14 clearly presents straight angles; furthermore, it does not display an articular facet for the scaphocuboid, which is a character typical of *Bison* (Bibikova 1958; Altuna 1972; Buitrago 1992; Gee 1993; Sala et al. 2010). The metric criteria applied to the talus are the index of the lateral articular facet and that of the distal trochlea (Bibikova 1958). Table 4 presents the values for these indices, as given by various authors. It can be seen that there is an overlap between the two species in these values (Sala et al. 2010), though values above 56.6 for the articular facet index have only been published for *Bos* (Stampfli 1963). For the distal trochlea index the overlap is substantial, but values below 81.2 correspond to *Bison* (Altuna 1972), whereas values above 100 correspond to *Bos* (Stampfli, 1963). The value of the lateral articular facet index for specimen Ri10/N10/14 is 60, and the distal trochlea index has a value of 110. Both these values place it clearly within the range of variability of *Bos* and exclude it from that of *Bison*. In short, metric and morphological characteristics enable us to assign the large-sized bovid remains from Los Rincones to the species *B. primigenius*, which inhabited Europe until historical times (Degerbøl and Fredskild 1970).

#### **4.1.2.2. *Capra pyrenaica* (Schinz, 1838)**

The Iberian wild goat is the predominant taxon at the site of Los Rincones; 528 remains were recovered, which represent 85.9% of the total NISP of ungulates (Table 1). The age of death reveals the presence of 20 individuals at the site. Grouped by age, these are

one neonate individual, three juvenile individuals, seven subadults, five adults and four old individuals.

The sample includes almost all the anatomical elements, especially bones of the extremities, but also cranial remains, mainly isolated teeth, axial elements, scapulae and pelvis (Figure 5, Figure 6, Figure 7).

The taxonomy of the genus *Capra* is based principally on the morphological characteristics of the horns. In the absence of these elements, M<sup>3</sup> has been one of the most-used elements, in particular the presence or absence of the metastylar wing and the width of the interstylar surface (Crégut-Bonnoure 1992). On the basis of these characters, Crégut-Bonnoure (1992, 2006) proposed that *C. pyrenaica* is derived from a common ancestor with the Caucasian goat (*C. caucasica praepyrenaica*), which would have arrived at the Massif Central in France in the course of the Eemian. Once there, it would have evolved into *C. pyrenaica*, moving towards the south of France and reaching the Pyrenees in the Magdalenian. On this theory, from the Pyrenees it would have subsequently colonized the Iberian Peninsula. Currently, in the light of the presence of *Capra* in Iberia for more than 100kyr, the high variability of the distinguishing morphological characters proposed by Crégut-Bonnoure (Magniez 2009) and the results of molecular studies showing the kinship of *C. ibex* and *C. pyrenaica* (Pidancier et al. 2006; Ureña et al. 2011), the hypothesis of the Caucasian origin of *C. pyrenaica* has rather lost plausibility (García-González 2011). Although the exact taxonomic classification of Iberian goats is far from being resolved, however, it does seem very likely that *C. pyrenaica* was already present and differentiated in the Late Pleistocene. Accordingly, it would make sense to ascribe the remains from Los Rincones to this taxon, irrespective of possible hybridizations with *C. ibex* that might

have taken place in the northeast of the Iberian Peninsula and south of France during this period (García-González 2012).

The comparative data for *C. pyrenaica* presented in Table 5 suggest the existence of two groups (clades?) in the Late Pleistocene of the Iberian Peninsula, separable by their dimensions: one northern group, characterized by their large size, and another southern group that is smaller in size (Table 5, Figure 8). The *C. pyrenaica* remains from Los Rincones would fall within the range of variation of the first group. This size gradient would have been reproduced in the Holocene (Castaños 2004) and at present, for this and other characteristics have been recognized in the present-day subspecies (Cabrera 1911). Do the differences in size among Iberian goats in the Late Pleistocene correspond to phylogenetic differences? The current subspecific differentiation of *C. pyrenaica* is a matter of controversy (Acevedo and Cassinello 2010), and the systematics should probably be revised in the near future, even at the specific level (García-González 2011). The north-south size gradient of the Iberian goats does not seem to be a temporary case of Bergmann's rule, but seems rather to be due to the possible abundance of trophic resources in two contrasting environments: the Eurosiberian (temperate and fertile) and the Mediterranean (arid and poor). The increase in size that took place in *C. pyrenaica* in the interglacial period (MIS5) at Cova Negra (Pérez-Ripoll 1990; Table 5, Figure 8) or during the Holocene (García-González 2012) would support the hypothesis of the abundance of resources.

#### **4.1.2.3. *Rupicapra pyrenaica* Linnaeus, 1858**

As regards the Pyrenean chamois, 29 remains were recovered, representing 4.7% of the NISP of the ungulates at the site (Table 1, Figure 2). Both appendicular and cranial elements were found. Among the cranial material, three  $m_3$ , one  $m_2$ , one  $M^2$  and one  $M^3$  were recovered (Figure 3).

The  $m_3$  present an external wall with a metastyle and parastyle and an oval talonid with a practically polygonal section. The distal edge is straight and not convex (Prat 1966).

The talus bones, with four elements recovered, and the phalanges, with six elements recovered, are the most numerous elements of *R. pyrenaica* at the site, and their measurements have been compared with a sample of *R. pyrenaica* from the Pleistocene of the Iberian Peninsula (Table 6). The chamois from Los Rincones is similar in size to that from Cueva Millán and smaller than those from the sites in the north of the Iberian Peninsula (Santimamiñe, Abauntz, Bolinkoba, Lumentxa, Ekain, Naranco, Aitzbitatze, Lezetxiki, Urtiaga, Amalda, La Paloma, Valdegoba) that correspond to the last cold stage (MIS3, MIS2). Furthermore, it is smaller than those from the Ebro Valley sites of Gabasa and Chaves (MIS3 and MIS2, respectively) (Table 6).

The genus *Rupicapra* (chamois) is a small-sized mountain goat-antelope that inhabits Europe and western Asia. The genus comprises two different species: *Rupicapra rupicapra*, present in the Alps, the Balkans and the Caucasus; and *R. pyrenaica*, present in the Iberian Peninsula and Italy (Lovari and Scala 1980; Nascetti et al. 1985; Pérez et al. 2002).

The time of divergence between *R. rupicapra* and *R. pyrenaica* has been estimated on the basis of their genetic distance, but different methods yield different ages. Molecular clocks show a separation that took place 1.7 Ma (Rodríguez et al. 2010), whereas phylogenetic analysis based on Y chromosomes has given a more recent age of 655 ka (Pérez et al. 2011). These genetic studies imply that the chamois recovered from the Late Pleistocene of the Iberian Peninsula belong to the species *R. pyrenaica* (Álvarez-Lao 2014).

#### **4.2. Order Perissodactyla Owen, 1848**

#### **4.2.1. Family Equidae Gray, 1821**

The systematics of horses is under revision. To underline the difference between domestic and wild species, the International Commission on Zoological Nomenclature in 2003 proposed that the name of a wild species – in the case of the horse *E. ferus* Boddaert, 1785 – should take precedence over the name of the domesticated species. However, the name of the domesticated species, *Equus caballus* Linnaeus, 1758, continues to be valid (Gentry et al. 2004; Conti et al. 2010). Accordingly, we here use the designation *E. ferus* to refer to the horses of the Pleistocene even though they may previously have been classified as *E. caballus*.

It is difficult to distinguish between the different species of equids on the basis of morphological characters alone (Eisenmann 1986; Dive and Eisenmann 1991; Orlando et al. 2009). In the present case, this is particularly difficult due to the lack of preserved cranial remains, which are those that provide most systematic information. For this reason the remains have been classified by means of a biometric study.

##### **4.2.1.1. *Equus ferus* Linnaeus, 1758**

A fragment of metapod and phalanges were recovered from the site: four first phalanges, three of which are posterior, six second phalanges, and a third phalanx (Figure 4). The phalanges were distinguished as posterior or anterior in accordance with the criteria proposed by Prat (1957), Eisenmann and De Giuli (1974) and Dive and Eisenmann (1991) (Figure 9, Figure 10).



As a whole, the horse from Los Rincones is small in size compared with the other horses of the Late Pleistocene of the Iberian Peninsula, and especially compared with the horses of the Upper Palaeolithic of the Basque Country from sites such as Atxuri, Santimamiñe and Lumentxa (Castaños 1984) (Table 7, Figure 11). Its size is similar to that of the horse from Fontainhas, which forms part of the subspecies *E. ferus antunesi*, characterized by its small dimensions (Cardoso and Eisenmann 1989), and it is also close in size to the subspecies *E. ferus casarensis* described at Los Casares (Altuna 1973). The measurements of the horse from Los Rincones are very similar to the current population of *E. ferus przewalskii* (Table 7). The third phalanx from Los Rincones presents a small maximum width, which may be related to the type of land over which the animals moved; large ungual phalanges are associated with soft ground, whereas narrow ones indicate an adaptation for movement over craggy reliefs (Eisenmann 1984).

Despite its small size, the horse from Los Rincones does not fall within the range of variation for the measurements of *E. hydruntinus*; as can be seen in Figure. 7 it lies within the range of variation for *E. f. przewalskii* as well as for the *E. ferus* of the Late Pleistocene.

#### **4.2.1.2. *Equus hydruntinus* Regalia, 1907**

Two remains of *E. hydruntinus* were recovered, which correspond to two third phalanges (Figure 4). This taxon is an indicator for conditions of aridity and open spaces (Burke et al. 2003; Orlando et al. 2006; Feranec et al. 2010).

*E. hydruntinus* was described by Regalia (1907) in the Grotta Romanelli. As it showed characteristics similar to the onager, he designated as *Equus (Asinus) hydruntinus* (Conti et al. 2010). Subsequent studies of the systematic position of this taxon classified

it as an ass (Stehlin and Graziosi 1935; Gromova 1949), a zebra (Davis 1980) and a stononian form (Forsten 1999). In recent years, however, the study of material from Crimea has brought to light the phylogenetic affinity between *E. hydruntinus* and *E. hemionus* (Burke et al. 2003), confirmed by DNA studies on remains from Crimea and Iran (Orlando et al. 2006). *E. hydruntinus* was the last species of the Pleistocene megafauna to go extinct in the Iberian Peninsula, as there is evidence of its presence as late as the 16th century (Quesada and von Lettow-Vorbeck 1992).

As there are no available biometric data for the third phalanges of *E. hydruntinus* and these display similarly proportioned bones of the extremities to onagers (Eisenmann and Baryshnikov 1995; Forsten 1999; Burke et al. 2003; Orlando et al. 2006), we have used the measurements from modern-day onagers taken from Eisenmann's collection (online data at <http://www.vera-eisenmann.com>) for the purpose of biometric comparison.

The bones of the extremities of *E. hydruntinus* are slender, and the third phalanges are pointed (Davis 2002). The third phalanges from Los Rincones with a size similar to *Equus hemionus* (Figure 10) and a sharp-pointed end belong to *E. hydruntinus*.

## **5. Faunal composition**

### **5.1. Analysis of the faunal composition in the European context of MIS3-MIS2**

The faunal composition, expressed as the percentage of each herbivore species at the site of Los Rincones, was compared with that from 89 European sites, with a total of 127 levels with different chronologies, but all of them belonging to the isotope stages MIS3 and MIS2. Of these sites, 56 are located in the Iberian Peninsula, and 33 in the rest of Europe, both in western and central parts (France, United Kingdom, Germany, the Czech Republic, Switzerland; see Appendix 1). To compare the faunal associations

present at each site, the NISP was calculated for the herbivores in each case. This parameter is considered the most reliable (Lyman 1994b), as there is no taphonomic bias towards any of the species in the assemblages (Álvarez-Lao 2014). In order to minimize the taphonomic biases that might be produced by the accumulators of the remains, the present study has taken account both of sites where the accumulators are hunter gatherers (Chaves, Grotte de la Vache, Gabasa, Abric Romaní, Santimamiñe, Nerja) and of those where they are carnivores (Zafarraya, Los Rincones, Zarzamora, Las Caldas). It has only used assemblages with an NISP greater than 100, in accordance with the methodology proposed by Álvarez-Lao (2014). Moreover, certain taxa have been grouped together, as in the case of *Capra pyrenaica* and *Capra ibex* (C.p/i) and *Rupicapra pyrenaica* and *Rupicapra rupicapra* (R.r/p). We follow Deng et al. (2011) in the taxonomic nomenclature of *Stephanorhinus hemitoechus*.

The CA has allowed us to place the sites with a similar taxonomic composition close to one another. At the same time, the taxa with a similar distribution throughout the sample should also be placed close to one another.

The DCA shows a clear separation of the sites of central and Western Europe in relation to those of the Iberian Peninsula. The sites of central and western Europe (black dots) are situated on the right of the graph and are characterized by the presence of the faunas of the “*Mammuthus-Coelodonta* faunal complex,” comprising *Mammuthus primigenius*, *Coelodonta antiquitatis*, *Megaloceros giganteus*, *Rangifer tarandus*, *Saiga tartarica*, *Equus ferus* and bovids (*Bison priscus/Bos primigenius*) (Guthrie 1990; Khalke 1999; West 2000). The mammoth and the woolly rhinoceros have been recovered in the Iberian Peninsula at 25 and 23 sites, respectively (Álvarez-Lao and García 2011, 2012). However, none of the Iberian sites presents this fauna at percentages that place it within the area of sites with the typical faunal association of the *Mammuthus-Coelodonta*

complex. An exception among the sites in the west is La Grotte de la Vache in the French Pyrenees. Its position on the left of the graph is due to the abundance of *Capra pyrenaica*, which represents 88% of the NISP of the ungulates (Pailhaugue 1998). (Figure 12)

The sites of the Iberian Peninsula (grey dots) are located on the left of the graph, with the exception of Urtiaga Leizea. This site is situated on the right due to its high numbers of reindeer, *Rangifer tarandus* (Altuna 1984), which bring it closer to the French sites of the Massif Central, where the reindeer is very abundant (Delpech 1983, 1990). The sites of the Iberian Peninsula are characterized by the presence of taxa associated with more temperate environments than the cold European faunas. Such taxa are *Capra pyrenaica*, *Cervus elaphus*, *Capreolus capreolus*, *Rupicapra pyrenaica*, *Sus scrofa* and *Stephanorhinus hemitoechus* (steppe rhinoceros). (Figure 12)

The DCA shows an oblique general gradient of increasing latitude and decreasing temperature, running from the upper right to the lower left corner. In the upper right corner are the sites of Lynford (UK) and Geissenklösterle, Hohle Stein, Vogelherd and Perick Cave (Germany), sites characterized by the presence of larger-sized taxa of the *Mammuthus-Coelodonta* complex, such as *Mammuthus primigenius*, *Coelodonta antiquitatis* and *Megaloceros giganteus*. In the lower right corner of the graph we find the sites located in the Massif Central in France, such as Abri Pataud, Roc de Combe, Laugerie Haute-Ouest and Abri Facteur among others, which are characterized by a predominance of *Rangifer tarandus* and *Saiga tatarica*. On the far right of the horizontal ordination of the graph we find both French sites (Morancourt, Duruthy, Hortus) and Middle European sites (Srbsko Chulum-Komin Cave, Czech Republic), characterized by the presence of *E. ferus* and large bovids. Close to these sites are Iberian sites such as l'Arbreda, Abric Romaní and Cova del Gegant (Catalonia), and

Cueva Morín, Labeko Koba and Lezika (Basque-Cantabrian region). Both the northern part of Catalonia and the Basque Country functioned as faunal corridors in the Pleistocene (Álvarez Lao and García 2011), so it is hardly surprising that these areas are the most similar to European ones. Despite their similarity to European sites, these sites exhibit a greater proportion of *E. hydruntinus*, associated with arid environments (Burke et al. 2003; Feranec et al. 2010). The sites of the Iberian Peninsula hardly show any variation with respect to axis 2 (horizontal alignment), whereas their distribution in relation to axis 1 marks a transition from the Mediterranean conditions of the sites in the south (Nerja, Zafarraya, Gorham's Cave, Vanguard Cave) on the left of the graph, with a high proportion of *Capra pyrenaica*, towards more Atlantic, mid-European conditions, exemplified by the sites of the Basque Country and Catalonia on the far right of the graph (with the exception of La Grotte de la Vache). In spite of being located in an area that is climatically at the boundary between Atlantic and Mediterranean environments, the site of Los Rincones is closer to the sites of the south in faunal terms. (Figure 12)

## **5.2 The site of Los Rincones in the Iberian context of MIS3**

The herbivore association present at the site of Los Rincones was compared with those at 37 sites in the Iberian Peninsula with a chronology close to MIS3 (Figure 13). The correspondence analysis shows that the sites with taxa associated with open environments such as *E. hydruntinus*, *E. ferus*, *S. hemitoechus* and the large bovids (Brugal 1985; Burke et al. 2003; Sala et al. 2011; Feranec et al. 2010) are situated in the left part of the graph. These sites are Cueva de la Zarzamora, Cueva Morín, Cova del Gegant, Labeko Koba and Figueira Brava. On the right, by contrast, are the sites of the south of the Iberian Peninsula such as Zafarraya, Nerja, Vanguard Cave and Cova

Beneito, which are characterized by a great abundance of *C. pyrenaica* associated with rocky areas. Furthermore, it should be borne in mind that this graph shows a comparison of sites from MIS3, at which time human hunter-gatherers had not yet specialized in hunting *Capra*. This phenomenon appeared in the Upper Palaeolithic (MIS2) (Freeman 1973; Straus 1987; Gamble 1995). As such, the high percentages of *Capra* in the Mediterranean sites cannot be attributed to the presence of specialized hunters, but rather to the abundance of these taxa in the area of the accumulation. In the central part of the graph we find mainly Basque-Cantabrian sites under Atlantic influence. Axis 2 separates sites with woodland taxa such as *C. elaphus*, *C. capreolus* and *S. scrofa* (Covalejos, Liñares, Lumentxa, Aitbiarte) in the lower part from sites in the upper central part (Amalda, Valdegoba, Hornos de la Peña) characterized by the presence of taxa associated with rocky environments such as the chamois, but with a more Atlantic climatic affinity than *C. pyrenaica* (Feranec et al. 2010).

Despite currently being located in a geographical situation close to the boundary between the Mediterranean and Atlantic climatic regions, in MIS3 the site of Los Rincones was close to sites such as Zafarraya, Nerja, Cova Beneito and Vanguard Cave situated in the Mediterranean climatic region in the south of the Iberian Peninsula and characterized by a strong presence of *C. pyrenaica*, a species with a high drought-tolerance (Feranec et al. 2010).

The faunal association from los Rincones is similar to southern Iberian sites (Zafarraya, Nerja, Vanguard). This fact may reflect similar environmental conditions, but it can also be due to a bias produced by the main accumulator agent. In Los Rincones, most of the ungulates recovered were transported there by Ice Age leopards, which used the cave as a refuge for protecting their kills (Sauqué et al. 2014). This predator, as his relative the *Panthera uncia* (snow leopard), shows a predilection by preys of small-medium size,

especially goats (see references in Diedrich 2013). This phenomenon, added to the placement of the cave in a rocky wall, may produce an overrepresentation of *Capra pyrenaica*. Anyway, although leopards focus mainly on prey ranging from 20-80 kg in weight (Mills and Harvey 2001), they are not selective hunters and have the broadest diet of the larger predators with 92 prey species recorded in sub-Saharan Africa (Mills and Harvey 200; Hayward et al. 2006], which may indicate that a high percentage of *Capra pyrenaica* is related to its great abundance in the landscape which surrounds the cave. On the other hand, the low percentage of equids, rhinoceros and bovids (*Bos primigenius* and *Bison*) found in Los Rincones could not be related to a low abundance of these taxa in the environment, but to the impossibility of leopards to drag these preys to their dens because they weight more than the range leopard could hunt. Therefore, the abundance of these might not reflect the “real” situation surrounding the cave and subsequently the faunal association would be more similar to the Iberian sites placed in the inland like Zarzamora, Cueva del Buho, Los Casares.

To sum up, the analysis of faunal associations is a great tool to analyse the environmental patterns, though we have to take these results carefully, especially when the accumulator may generate bias in the association.

## **6. Palaeoenvironmental context**

The herbivores at Los Rincones represent various types of landscape. The horses (*E. ferus* and *E. hydruntinus*) indicate open environments (Nowak 1999; Blasco et al. 2011), and *E. hydruntinus* is also indicative of conditions of semi-aridity (Burke et al. 2003; Feranec et al. 2010) (Figure 14). On the other hand, *C. elaphus* and *C. capreolus* suggest woodland habitats (Delpech and Prat 1980; Carranza et al. 1991; Mateos-

Quesada 2000, 2011; Carranza 2011), whereas *Bos primigenius* can inhabit both woody environments and plains (Ekström 1993). However, the best-represented herbivores both in terms of NISP and MNI are those associated with high or medium mountain areas with abrupt reliefs, such as *C. pyrenaica* and *R. pyrenaica* (Alados and Escós 1996; Granados et al. 2001; Pérez-Barbería et al. 2010) (Figure 15). In this context it is interesting to bear in mind that the site has also yielded a peripheral bone from the shell of a Hermann's tortoise (*Testudo hermanni*), which is a good indicator of Mediterranean conditions (Morales Pérez and Serra 2009).

The great abundance of *C. pyrenaica* and the presence of *R. pyrenaica* indicate that in the vicinity of the site there were rocky mountain. This landscape would be similar to what we currently find in the area around the cave, the mouth of which opens at an altitude of some 1010m in a ravine with rocky walls, ideal for both species (Figure 1).

## **7. Conclusions**

The ungulate association from Los Rincones provides us with palaeoenvironmental information about the region around the Moncayo during MIS3. In spite of its current importance as a boundary between Mediterranean and Eurosiberian climatic regions, until now there were no data available for a reconstruction of its landscape during the Late Pleistocene.

The great diversity of ungulates present at the site of Los Rincones, with seven species – *C. elaphus*, *C. capreolus*, *R. pyrenaica*, *C. pyrenaica*, *B. primigenius*, *E. ferus* and *E. hydruntinus* – associated with different environments, indicates a high taxonomic and environmental diversity corresponding both to the situation of the massif as an ecotone



and to the particular location of the site, not very different from present-day conditions. Moreover, both *E. hydruntinus* and *B. primigenius* are species that are now extinct but that survived into historical times in Europe.

The ungulate association from Los Rincones is dominated by *C. pyrenaica*. Further, this taxon is similar in size to the goats from the sites in the north of the Iberian Peninsula, which are larger than present-day goats and the fossil goats of the south of the Iberian Peninsula. The horses present at Los Rincones are smaller in size than those recovered from the Basque-Cantabrian region.

The faunal associations of the Iberian Peninsula during MIS3 and MIS2 are clearly distinct from those present at the sites of western and central Europe. The statistical ordination analysis shows a latitudinal/climatic gradient from sites with a greater presence of faunas of the *Mammuthus-Coelodonta* complex towards sites with a predominance of species with a Mediterranean affinity (*C. pyrenaica*, *S. scrofa*, *C. elaphus*, *S. hemitoechus*). At a midpoint are the sites characterized by the presence of *Equus* and large bovids associated with steppe environments.

Our study of faunal associations in the context of the Iberian Peninsula during MIS3 indicates a cluster of sites in the south of the peninsula that are separate from the other sites in the peninsula due to their high presence of *C. pyrenaica*. These sites are Nerja, Gorham's Cave, Cueva Beneito and Zafarraya, as well as the site of Los Rincones, which is included within this group.

The ungulate association of Los Rincones indicates a landscape with a temperate climate characterized by the presence of steppes, woodland and rocky areas in the vicinity of the cave. This landscape would be similar to the present-day landscape of the ravine of Los Rincones, where the cave of the same name is located.

## **8. Acknowledgments**

We thank the Centro Espeleológico de Aragón (Speleological Centre of Aragón), in particular Mario Gisbert, for the discovery and topography of the cave. The Government of Aragón, the CEA (Centro de Espeleología de Aragón) and the University of Zaragoza have partially subsidized the palaeontological activities at Los Rincones. The present study forms part of the projects “Grupos Consolidados H54” of the Government of Aragón and IUCA (Instituto Universitario de Ciencias Ambientales) and CGL2012-38434-C03-01.

The first author (VS) also thanks Alfred Sanchis (MPV), Josefina Barreiro and Patricia Pérez (MNCN), Julio Ramón (MAPH), Mario Laurino (IAN) José Ignacio Canudo (MPZ), Henriette Obermaier (LMU) and Caroline Lang (ZSM) for allowing him to study the material for comparison, as well as Lourdes Montes, Pillar Utrilla and M<sup>a</sup> Fernanda Blasco for granting access to unpublished data on Gabasa as well as their valuable comments. He also thanks Raquel Rabal and Cristina Sola for their comments and discussion on taphonomy; Véra Eisenmann for her discussions and clarifications on horses; Jorge Colmenar for his help with the photographs, and Francisco Gutierrez and Ira Sasowsky for their valuable comments about karst and geology. Rupert Glasgow revised the English grammar. Finally, many thanks go to all the members of the excavation team of the 2009 and 2010 field campaigns at Los Rincones.

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## **Table and figure captions.**

Table 1. Composition of the Los Rincones ungulate assemblage.

Table 2. Selected comparative measurements on *Cervus elaphus* postcranial elements.

Tib.: tibia; Mtt.: metatarsus; 1<sup>st</sup> Pha.: first phalanx; 2<sup>nd</sup> Pha.: second phalanx; L: maximum length; DW: distal width; PW: proximal width. Mag: Magdalenian; Sol: Solutrean; Aur: Aurignacian. <sup>a</sup> This study; <sup>b</sup> Blasco-Sancho 1995; <sup>c</sup> Pérez Ripoll 1977; <sup>d</sup> Álvarez-Lao et al. 2013; <sup>e</sup> Castaños 1986; <sup>f</sup> Altuna 1972; <sup>g</sup> Altuna and Mariezkurrena 2000; <sup>h</sup> Mariezkurrena and Altuna 1983; <sup>i</sup> Marín Arroyo 2010; <sup>j</sup> Morales and Martín 1995; <sup>k</sup> Davidson 1989; <sup>l</sup> Altuna, 1971; <sup>m</sup> Altuna et al. 2002.

Table 3. Selected comparative measurements on *Capreolus capreolus* cranial and postcranial elements. m3.: lower third molar; Hum. humerus; Ra.: radius; Mtcp.: metacarpus; Tib.: tibia; L: maximum length; DW: distal width; PW: proximal width. <sup>a</sup> This study; <sup>b</sup> Blasco-Sancho 1995; <sup>c</sup> Álvarez-Lao 2014; <sup>d</sup> Altuna 1972; <sup>e</sup> Castaños 1984; <sup>f</sup> Altuna 1986; <sup>g</sup> Castaños 1986.

Table 4. Values of the index of lateral articular facet and distal trochlea astragalus according to different authors.

Table 5. Selected comparative measurements on *Capra pyrenaica* cranial and postcranial elements. P2-P4: upper premolar series; M1–M1: upper molar series; m3.: lower third molar; Hum. humerus; Ra.: radius; Mtcp.: metacarpus; Tib.: tibia; Ast.: astragalus; Mtt.: metatarsus; L: maximum length; W: maximum width; DW: distal width; PW: proximal width. Mag: Magdalenian; Sol: Solutrean; Gra: Gravettian; Aur: Aurignacian; UPa: Upper Paleolithic. <sup>a</sup> This study; <sup>b</sup> Álvarez-Lao 2014; <sup>c</sup> Altuna 1976; <sup>d</sup> Altuna 1986; <sup>e</sup> Altuna 1972; <sup>f</sup> Castaños 1993; <sup>g</sup> Blasco-Sancho 1995; <sup>h</sup> Castaños 1984; <sup>i</sup> Castaños 1986; <sup>j</sup> Altuna and Mariezkurrena 1985; <sup>k</sup> Altuna 1973; <sup>l</sup> Pérez Ripoll 1990; <sup>m</sup> Davidson 1989; <sup>n</sup> Sauqué (unpublished data); <sup>o</sup> Morales and Martín 1995.

Table 6. Selected comparative measurements on *Rupicapra pyrenaica* cranial and postcranial elements. m3.: lower third molar; Hum. humerus; Ra.: radius; Tib.: tibia; Ast.: astragalus; 1<sup>st</sup> Pha.: first phalanx; 2<sup>nd</sup> Pha.: second phalanx; L: maximum length; W: maximum width; DW: distal width; PW: proximal width. Mag: Magdalenian; Sol: Solutrean; Gra: Gravettian. <sup>a</sup> This study; <sup>b</sup> Altuna et al. 2002; <sup>c</sup> Castaños 1984; <sup>d</sup> Blasco-Sancho 1995; <sup>e</sup> Pérez Ripoll 1977; <sup>f</sup> Castaños 1993; <sup>g</sup> Castaños 1986; <sup>h</sup> Pérez Legido and Cerdeño 1992; <sup>i</sup> Altuna and Mariezkurrena 1984; <sup>j</sup> Álvarez-Lao 2014; <sup>k</sup> Altuna 1972; <sup>l</sup> Altuna 1990; <sup>m</sup> Castaños 1980; <sup>n</sup> Arceredillo et al. 2011.

Table 7. Selected comparative measurements on *Equus* postcranial elements. 1<sup>st</sup> Pha.: first phalanx; 2<sup>nd</sup> Pha.: second phalanx; 3<sup>rd</sup> Pha.: third phalanx; L: maximum length; W:

maximum width; DW: distal width; PW: proximal width. <sup>a</sup> This study; <sup>b</sup> Castaños 1982; <sup>c</sup> Castaños 1986; <sup>d</sup> Sánchez 1990; <sup>e</sup> Altuna 1973; <sup>f</sup> Altuna 1972; <sup>g</sup> Cardoso and Eisenmann 1989; <sup>h</sup> Davidson 1989; <sup>i</sup> Pérez-Ripoll 1977; <sup>j</sup> Blasco-Sancho 1995; <sup>k</sup> Altuna et al. 2002; <sup>l</sup> Yravedra 2010; <sup>m</sup> Altuna 1976; <sup>n</sup> Eisenmann online data.

Figure 1. (a) Geographical location of Los Rincones cave. (b) Panoramic view of the Los Rincones ravine. (c) Panoramic view of the main entrance of the cave. (d) Plan view of the cave. (e) Elevation view of the cave.

Figure 2. Pie chart of ungulates from Los Rincones.

Figure 3. (a) Right tibia *Cervus elaphus* (Ri10/O-13/14). (b) Right metatarsus *Cervus elaphus* (Ri10/O-13/172). (c) Left radius *Capreolus capreolus* (Ri10/O-13/235). (d) Metacarpus *Capreolus capreolus* (Ri10/O-14/87). (e) Left antler *Capreolus capreolus* (Ri10/O-13/4; Ri10/O-14/45). (f) Right antler *Capreolus capreolus* (Ri10/O-13/230). (g) Right tibia *Capreolus capreolus* (Ri10/O-13/75). (h) Left mandible m2-m3 *Capreolus capreolus* (Ri10/O-13/73). (i) Right humerus *Rupicapra pyrenaica* (Ri10/N10/34). (j) Left tibia *Rupicapra pyrenaica* (Ri10/N10/188). (k) Left lower third molar *Rupicapra pyrenaica* (Ri10/N10/72). (l) Right lower third molar *Rupicapra pyrenaica* (Ri10/N10/71).

Figure 4. (a)(b) Right metatarsus *Bos primigenius* (Ri10/O-13/147). (c) Right astragalus *Bos primigenius* (Ri10/N10/14). (d) First phalanx *Equus ferus* (Ri10/N10/31). (e) First phalanx *Equus ferus* (Ri10/N11/1) (f) First phalanx *Equus ferus* (Ri10/O-13/71). (g) Third phalanx *Equus ferus* (Ri10/N10/64). (h) Second phalanx *Equus ferus* (Ri10/O-14/53). (i) Second phalanx *Equus ferus* (Ri10/N10/98). (j) Second phalanx *Equus ferus* (Ri10/N10/150). (k) Third phalanx *Equus hydruntinus* (Ri10/M10/10). (l) Third phalanx *Equus hydruntinus* (Ri10/N10/57).

Figure 5. Remains of *Capra pyrenaica*. (a) Left maxilla P2-M3 (Ri10/N10/41). (b) Right mandible of a juvenile p2-p4 (Ri10/O-13/92). (c) Left mandible p3-m3 (Ri10/N10/117). (d) Left M3 (Ri10/O-13/126). (e) Right M3 (Ri10/N10/83). (f) Right M3 (Ri10/GL9/9). (g) Right M3

(Ri10/O-13/201). (h) Right M3 (Ri10/O-13/203). (i) Right mandible p3-m3 (Ri10/O-13/27). (j) atlas (Ri10/O-13/118). (k) atlas (Ri10/N11/2). (l) atlas (Ri10/O-13/82).

Figure 6. Remains of *Capra pyrenaica*. (a) Right humerus (Ri10/N11/41). (b) Right humerus (Ri10/O-14/12). (c) Right humerus (Ri10/J10/1). (d) Left humerus (Ri10/O-13/179). (e) Left radius (Ri10/O-13/165). (f) Left radius (Ri10/N10/208). (g) Right metacarpus (Ri10/N10/195). (h) Right metacarpus (Ri10/O-13/199). (i) Left metacarpus (Ri10/N19/151). (j) Left metacarpus (Ri10/M9/17). (k) Left metacarpus (Ri10/GL7/19; Ri10/GL7/2; Ri10/GL7/5). (l) Right metacarpus (Ri10/O-13/184).

Figure 7. Remains of *Capra pyrenaica*. (a) lumbar vertebrae and sacrum (Ri10/O-13/90, Ri10/O-13/93). (b) Left scapula (Ri10/GL8/5). (c) Left scapula (Ri10/O-13/219). (d) Left tibia (Ri10/GL9/12). (e) Left tibia (Ri10/M9/19). (f) Right tibia (Ri10/O-13/102). (g) Right tibia (Ri10/M10/3). (h) Right tibia (Ri10/P13/5). (i) Right femur (Ri10/O-13/218; Ri10/O-13/234; Ri10/O-14/15).

Figure 8. Graph representing the maximum value, minimum and the mean of *Capra pyrenaica* from different Pleistocene sites and extant animals. Mtcp.: metacarpus; Mtt.: metatarsus; Tib.: tibia; Hum.: humerus; L: maximum length; DW: distal width.

Figure 9 Graph representing greatest length versus the proximal width of the first phalanx. Species data points and corresponding regression lines are plotted together.

Figure 10 Graph representing greatest length versus the greatest width of the third phalanx. Species data points and corresponding regression lines are plotted together.

Figure 11. Graph representing maximum value, minimum and the mean of *Equus* from different Upper Pleistocene sites and extant animals. 1st Pha.: first phalanx; 2nd Pha.: second phalanx; L: maximum length; PW: proximal width.

Figure 12. Ordination of palaeontological sites and species along the first two axes of the DCA on the basis of their ungulate composition. Grey: Iberian Peninsula sites;

Black: Western and Middle European sites, Star: Los Rincones. Taxa abbreviations: R.t.—*Rangifer tarandus*; C.e.—*Cervus elaphus*; M.g.—*Megaloceros giganteus*; C.c.—*Capreolus capreolus*; C.i./p.—*Capra ibex/pyrenaica*; R.r./p.—*Rupicapra rupicapra/pyrenaica*; S.t.—*Saiga tatarica*; Bov.—Bovinae indet.; S.s.—*Sus scrofa*; E.f.—*Equus ferus*; E.h.—*Equus hydruntinus*; C.a.—*Coelodonta antiquitatis*; S.h.—*Stephanorhinus hemitoechus*; M.p.—*Mammuthus primigenius*. Site abbreviations: Zf—Zafarraya; Ne—Nerja; Vg—Vanguard Cave; Go—Gorham's Cave; G.V—Grotte de la Vache; Ab R—Abric Romaní; Ge—Cova del Gegant; Mo—Cueva Morín; La—Labeko Koba; Lez—Lezika; Ar—Arbreda; Zar—Zarzamora; Du—L'abri Duruthy; Mor—Morancourt; Srb—Srbsko Chulum-Komin Cave; H.S—Hohle Stein; Pe—Perick Cave; Vo—Vogelherd (IV–V); Ly—Lynford; Gei—Geissenklösterle; Hor—L'Hortu; U.L—Urtiagako Leizea; Fac—Abri du Facteur; Com—Roc de Combe; Lau—Laugerie Haute Ouest.

Figure 13. Ordination of palaeontological sites and species of the Iberian Peninsula along the first two axes of the DCA on the basis of their ungulate composition. White: Iberian Peninsula sites; Star: Los Rincones. Taxa abbreviations: C.e.—*Cervus elaphus*; C.c.—*Capreolus capreolus*; C.p.—*Capra pyrenaica*; R.p.—*Rupicapra pyrenaica*; Bov.—Bovinae; S.s.—*Sus scrofa*; E.f.—*Equus ferus*; E.h.—*Equus hydruntinus*; S.h.—*Stephanorhinus hemitoechus*. Site abbreviations: Zar—Zarzamora; Bu—Cueva del Búho; Mo—Cueva Morín; Ge—Cova del Gegant; La—Labeko Koba; Fi—Figueira Brava (2-3); Ar—Arbreda; Es—Escoural; Ab R—Abric Romaní; Pe—Cueva del Pendo; Mi—Cueva Millán; Le—Lezetxiki (IIIa); HP—Hornos de la Peña; Ax—Axlor; Am—Amalda; Va—Valdegoba; Ai—Aizbiarte IV; Ab—Abauntz; Er—Cueva Ermita; JP—JouPuerta; Arr—Arrillor; PD—Pego do Diablo; GC—Grotta Nova da Columbeira; Co—Covalejos, At—Atxagakoa; Li—Liñares; Sa—Santimamiñe; Lu—Lumentxa n

VII; Ca—Los Casares; Mie—Peña Miel; Ga—Gabasa 1; Be—Cova Beneito; Vg—Vanguard Cave; Ne—Nerja; Zf—Zafarraya.

Figure. 14. In the forefront, a herd of horses (*Equus ferus*). Behind, to the right, three *Equus hydruntinus* might be seen in a steppe surrounding Los Rincones cave. In the background, the Moncayo massive (2315m a.s.l) ( Illustration Gianfranco Mensi).

Figure. 15. Ice Age leopard (*Panthera pardus spelaea*) chasing a herd of Spanish wild goat (*Capra pyrenaica*) in the ravine of Los Rincones. Behind, the mouth of the cave (1000 m a.s.l) ( Illustration Gianfranco Mensi).