BOREAS An international journal of Quaternary research

New evidences of the presence of reindeer (Rangifer tarandus) on the Iberian Peninsula in the Pleistocene. An archaeopaleontological and chronological reassessment.

Journal:	*Boreas*
Manuscript ID:	BOR-044-2013.R2
Manuscript Type:	Original Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Gómez Olivencia, Asier; Muséum national d'Histoire naturelle, Équipe de Paléontologie Humaine, CNRS, UMR 7194, Département de Préhistoire Arceredillo, Diego; University of Salamanca, Department of Geology; Universidad de Burgos, Departamento de CC. Históricas y Geografía Álvarez-Lao, Diego; Universidad de Oviedo, Departamento de Geología Garate, Diego; Arkeologi Museoa – Museo Arqueológico de Bizkaia, San Pedro, Ziortza; Euskal Museoa-Museo Vasco, Castaños, Pedro; Sociedad de Ciencias Aranzadi, Geo-Q, Rios-Garaizar, Joseba; Centro Nacional de Investigación sobre la Evolución Humana (CENIEH).,
Keywords:	Pleistocene, Palaeobiogeography, Parietal art, Portable art, Taphonomy, Cantabrian region

New evidence for the presence of reindeer (*Rangifer tarandus*) on the Iberian Peninsula in the Pleistocene: an archaeopalaeontological and chronological reassessment

ASIER GÓMEZ-OLIVENCIA

DIEGO ARCEREDILLO

DIEGO J. ÁLVAREZ-LAO

DIEGO GARATE

ZIORTZA SAN PEDRO

PEDRO CASTAÑOS

JOSEBA RIOS-GARAIZAR

GÓMEZ-OLIVENCIA, A., ARCEREDILLO, D., ÁLVAREZ-LAO, D.J., GARATE, D., SAN PEDRO, Z., CASTAÑOS, P., RIOS-GARAIZAR, J. New evidence for the presence of reindeer (*Rangifer tarandus*) on the Iberian Peninsula in the Pleistocene: an archaeopalaeontological and chronological reassessment

Reindeer (*Rangifer tarandus*) populations reached the Iberian Peninsula during the end of the Middle Pleistocene and there are numerous examples of this species from Late Pleistocene Mousterian and Upper Paleolithic sites. In this paper, new evidence of reindeer in the east Cantabrian region is presented which further supports the timing of this species' first appearance, and previous assessments are updated. To date, the presence of this species has been identified at 55 sites in the Iberian Peninsula, nearly as many as those of mammoth (*Mammuthus primigenius*) and woolly rhinoceros (*Coelodonta antiquitatis*) combined. Most of the sites with presence of reindeer

(50) are located in the Cantabrian region with a clear increase in the density of sites and remains towards the Pyrenees. The remaining five sites with evidence of reindeer are located on the other side of the Pyrenees in the north-west corner of Catalonia. In contrast, archaeological evidence of reindeer in the form of art (both parietal and portable) is more scarce and scattered. Evidence for the representation of these animals has been found outside the northern fringe of the Iberian Peninsula, which could reflect either long-distance cultural communication or the movement of human groups.

Key-words: Pleistocene; Palaeobiogeography; Parietal art; Portable art; Taphonomy; Cantabrian region

Asier Gómez-Olivencia (asiergo@gmail.com; agomezolivencia@mnhn.fr),
Équipe de Paléontologie Humaine, CNRS, UMR 7194, Département de Préhistoire du Muséum national d'Histoire naturelle,
43 rue Buffon (Batiment 140) 75005 Paris, France and
PAVE Research Group, Division of Biological Anthropology, Department of Archaeology and Anthropology, University of Cambridge.
Pembroke Street, Cambridge CB2 3DZ, UK and
Centro UCM-ISCIII de Investigación sobre Evolución y Comportamiento Humanos,
Avda. Monforte de Lemos 5 (Pabellón 14), 28029 Madrid, Spain;

Diego Arceredillo,
Department of Geology, Faculty of Science, University of Salamanca,
37008 Salamanca, Spain and

Área de Prehistoria, Departamento de CC. Históricas y Geografía,

Edificio I+D+i, Universidad de Burgos. 09001 Burgos, Spain;

Diego J. Álvarez-Lao,

Área de Paleontología. Departamento de Geología, Universidad de Oviedo,

C/Jesús Arias de Velasco s/n, 33005 Oviedo, Spain;

Diego Garate,

CREAP Cartailhac-TRACES-UMR 5608, Université de Toulouse-Le Mirail,

31058 Toulouse, France;

Ziortza San Pedro,

Euskal Museoa-Museo Vasco,

Plaza Unamuno, 4. 48005 Bilbao, Spain;

Pedro Castaños,

Sociedad de Ciencias Aranzadi, Geo-Q,

Santimami auzoa 41, 48940 Leioa, Spain;

Joseba Rios-Garaizar,

Centro Nacional de Investigación sobre la Evolución Humana (CENIEH),

Paseo Sierra de Atapuerca, s/n, 09002 Burgos, Spain.

The Iberian Peninsula is the largest peninsula in southern Europe. During the coldest episodes of the Late Pleistocene, populations of cold-adapted large mammals moved southwards in Europe, Asia and North America, paralleling the distribution of suitable tundra-steppe-like environments, reaching even the southern European peninsulas. The presence of reindeer, woolly mammoth and woolly rhinoceros in a number of archaeo-palaeontological sites from the Iberian Peninsula has been linked with extreme cold and dry events. This subject has been a matter of great interest among Quaternary palaeontologists (e.g. Harlé 1908, 1912; Altuna 1971) and has been thoroughly discussed from different points of view in the recent scientific literature (García & Arsuaga 2003; Álvarez-Lao & García 2010, 2011a, 2011b, 2012; Álvarez-Lao *et al.* 2009).

The reindeer is known in the Iberian Peninsula from 55 sites (see below), nearly double the number of sites that have yielded remains of other cold-adapted taxa (Álvarez-Lao & García 2011a). The current distribution area of fossil reindeer is restricted to the northern Cantabrian fringe and to northeast Catalonia, close to the Pyrenees. In contrast the woolly rhinoceros (*Coelodonta antiquitatis*) has been found in central Spain at around 100 ka BP (Arsuaga & Aguirre 1979; Sesé & Soto 2002; Álvarez-Lao & García 2011b) while the southernmost presence of the woolly mammoth is documented in Padul (Granada) (see Álvarez-Lao *et al.* 2009 and references therein). Additionally, the chronological occurrence of the reindeer in the Iberian peninsula is more extended than that of other cold-adapted faunas, being the only cold adapted taxon present between the Heinrich 1 (H1) and the Younger Dryas (Álvarez-Lao & García 2011a).

In this study, new examples of the presence of reindeer in the Cantabrian fringe of the Iberian peninsula are presented, all from the province of Biscay. The aim of this paper is to describe these new fossils, provide direct dates, and update current information on the presence and

chronology of the reindeer in the Iberian Peninsula. An updated record of the presence of reindeer in the parietal and portable art in the Iberian Peninsula is also provided. The palaeobiogeography and chronology of this species will be discussed in light of the new information.

Material and methods

The Iberian record of *R. tarandus* derives from 55 archaeological or palaeontological sites that are located in two well differentiated areas: the Cantabrian fringe, west of the Pyrenees; and the north-east part of Catalonia, close to the eastern end of the Pyrenees (see below). All the *R.tarandus* remains have been found in karstic systems, since the preservation of skeletal remains outside cave contexts is very rare this region.

The dates of Iberian reindeer sites were compiled from the literature and have been calibrated using Oxcal program (Bronk Ramsey 2001) using the INTCAL09 curve (Reimer *et al.* 2009) to 2 σ (95% of the range), in order to obtain dates that can be correlated with the palaeoclimatic record from the Greenland Ice Core Project (GRIP). Two new direct dates of reindeer remains are also provided, adding to the only known direct date on Iberian reindeer from the site of Santa Catalina (Berganza *et al.* 2012).

The new fossil material was measured using standard osteometric techniques. Measurements follow von den Driesch (1976), except for those of the teeth which follow van der Made (1989, 1996) (see Supplementary Information: part 2). These measurements are compared to other remains

from the Cantabrian fringe for descriptive purposes only. A more complete characterization of the Iberian reindeer compared to that of the rest of Europe will be the subject of a separate study (Álvarez-Lao, unpublished data).

Age-at-death based on dental attrition of the most complete mandibular remains was calculated using Bouchud (1966). A taphonomic analysis of all the new remains was performed using visual osteoscopic observations of the non-dental remains with a binocular lens (TVM) in order to look for anthropogenic modification, following Cáceres (2002) and San Pedro & Cáceres (2011).

The Iberian reindeer record

New and revised fossil remains

We provide new evidence of reindeer from five sites in the province of Biscay (Basque Country, northern Spain) (Table 1 and Supplementary Information: Table S1). These new fossils come from both the excavation of new sites (e.g. Arlanpe) as well as from the revision of faunal material from sites in which the presence of the reindeer was previously both unknown (e.g. Bolinkoba) or known (Axlor, Lumentxa, Atxuri) (Figure 1). We also discuss some sites listed in Table 1 for which vague references to reindeer remains can be found in the literature. The description of material proceeds geographically based on the distance from the Pyrenees. From the taphonomic analysis of the remains found at these sites (see below) we can certify that there was human processing of reindeer carcasses at Lumentxa, Atxuri, Axlor and likely also at Arlanpe. From

an osteometric point of view, the new remains fit well within the variation among reindeer from the northern fringe of the Iberian Peninsula (Supplementary Information: part 2; Álvarez-Lao, 2007).

Lumentxa. According to the first faunal studies performed by Castaños (1986 and personal communication) the reindeer assemblage from Lumentxa consisted of 23 bones: seven from level IV (four antler fragments, a metatarsal and a phalanx), seven from level V (a metacarpal, a metatarsal and five phalanges), and 10 from level VII (three metacarpals, three metatarsals and four phalanges). The MNI of individuals represented was four (one for level IV, one for level V and two for level VII).

At the beginning of this study, we revised the reindeer remains from this site curated at the Arkeologi Museoa (Bilbao) and were only able to find one complete metacarpal, two distal metacarpals and five antler fragments, two of which could be refitted together (in fact they had the same label). The revision of faunal remains from the J.M. Barandiarán collection has yielded 19 new fossils: mostly dental remains and phalanges. It is possible that some of these new remains are those studied by Castaños (Castaños 1986) but the fact that many of them belong to different archaeological levels and that they do not overlap anatomically makes this highly unlikely. In summary, from 42 potential reindeer remains, the current collection of Lumentxa preserves 26 remains (Table 1, Figs 2-5). Some of the reindeer remains from Lumentxa display traces of human processing as fresh fractures, cut marks or scraping (Supplementary Information: part 3.1).

Bolinkoba. The reindeer material from Bolinkoba was identified by P. Castaños during the course of a complete re-evaluation of the palaeontological remains from this site. It was the first time that reindeer remains were identified at this site and they comprise four fossils (three teeth and a distal phalanx) from three different levels attributed to the Upper Paleolithic (Fig. 6). No evidence of

human processing was found on the distal phalanx but given the small number of remains their taphonomic origin is still elusive.

Atxuri. Castaños (1986) noted the presence of a reindeer among the faunal remains from Atxuri. Álvarez-Lao (2007) noted the presence of two lower right premolars and a second phalanx. In this study we have identified 11 additional elements, most of which are dental remains, giving a total of 14 reindeer remains from Atxuri, most of which are teeth (Fig. 7). All the craniodental remains except for Atxi.23B.110 likely belong to the same individual based on the compatible wear of the teeth and the lack of repetition of the anatomical elements. One element attributed to this individual has been directly dated (see below). Atxi.23B.110 would represent a second, older individual. We have not attributed the only postcranial element, a second phalanx, to either of these individuals. There is clear evidence of anthropic processing on two bones (Supplementary Information: part 3.2).

Axlor. Altuna (1980) quotes the presence of ten reindeer remains found at this site from levels III and IV of the excavations performed by J.M. Barandiaran. P. Castaños performed a complete re-evaluation of the faunal remains from this site and found three additional fossil remains. Álvarez-Lao (2007) studied these 13 elements, half of which were dental remains. These remains were used in Álvarez-Lao's (2007) dissertation but have not been fully published. We have identified those elements studied by Álvarez-Lao and expanded the collection to include eight new elements. All these bones come from the excavations performed by J.M. Barandiarán between 1967 and 1974 (Barandiarán, 1980). New excavations have been performed at this site between 2001 and 2008 (González-Urquijo *et al.* 2006) but only a fraction of the palaeontological material from the new excavations has been published by Castaños (2005), who does not quote the presence of additional

reindeer remains.

The reindeer remains found at the site of Axlor include both cranial and postcranial elements from archaeological levels attributed to either the Mousterian (levels III-V) or the Early Upper Paleolithic (levels I-II) (Figs 8-10). Some of the reindeer remains found in this site display traces of human processing (Supplementary Information: part 3.3).

Arlanpe. The excavations carried out at this site between 2006 and 2011 (Rios *et al.* 2008, 2011; in press; Gómez-Olivencia *et al.* in press) have yielded 12 reindeer remains derived from all the three excavation sectors, and dating to both the Upper Paleolithic and Early Middle Paleolithic. This site could therefore be one of only two sites with a reindeer presence in the Middle Pleistocene (see below). We also provide a direct date from a nearly complete hemi-mandible found in mixed sediments (see below). Apart from the mandible, four teeth, a 2nd lateral phalanx, five lateral phalanges and an antler fragment have been found (Fig. 11). Only the mandible displays evidence of potential anthropic processing (Supplementary Information: part 3.4).

Additional sites not included in the most recent reviews. Ten new sites with the presence of reindeer that were not included in the most recent reviews by Álvarez-Lao & García (2010) or Mariezkurrena (2011) are also included in this work. Three of these sites are located close to Deba in the province of Gipuzkoa: Praileaitz I (Castaños 2010; Mujika Alustiza & Peñalver 2012), Ermittia V (Altuna *et al.* 1995) and Aitz-Gaizto II (Antxieta Arkeologi Taldea & Iriarte-Chiapusso 2012). Antoliñako Koba in Bizkaia has yielded a reindeer specimen in the Upper Solutrean levels (P. Castaños, unpublished data). The Magdalenian levels of Arrillor have yielded an additional reindeer fossil (P. Castaños, unpublished data), which makes this the third site south of the

watershed with reindeer remains (see below). Two sites have yielded reindeer remains in the area of Alfoz de Lloredo: Las Aguas and El Linar (Castaños, unpublished data). P. Arias mentioned the presence of reindeer in the site of La Garma A (Omoño, Cantabria) at the 2011 "Gravetiense Cantábrico" congress held in Altamira. Three additional sites with reindeer remains (El Otero, Santián and El Ruso I) have been recently reported (Yravedra & Gómez Castanedo 2010; Yravedra *et al.* 2010).

Finally, there is an additional reference to the presence of reindeer in Bizkaia, close to the site of Arlanpe: in the lost site of Atxubita (formerly known as Aitzobieta) in Lemoa (Nolte 1971). This cave was explored by Juan Uriarte y Eizaga during the summer of 1900 who found human and faunal remains together with some archaeological artefacts. The faunal remains include several teeth of *Bos* (probably *Bos primigenius*), teeth of a cervid (likely a reindeer), and some teeth similar to the cave hyena (see Puig & Larraz 1900). Unfortunately, these remains that were once curated at the Escuela de Ingenieros de Caminos have been lost, as that building was used during the Spanish civil war as a garrison (Nolte 1971).

Sites not included in this study. A few sites that were included in the two most recent reviews have been excluded from our study. These include Armiña (Obermaier 1925), La Parte (Álvarez-Lao & García 2006), Puebla de Lillo (J. Truyols, pers. comm. in Altuna 1972) and El Bufón (Menéndez 1923). In the case of Armiña, we believe that Obermaier quoted Harlé's works on the reindeer remains of the Iberian Peninsula but mistakenly included Armiña in the list attributed to this author (Supplementary Information: part 4).

Álvarez-Lao (unpublished) has performed a reanalysis of the reindeer remains found at La Parte and there is no current evidence to support the presence of reindeer in this site. Álvarez-Lao (2007) also revised the cranial remains found in Puebla de Lillo (León) attributed to *R. tarandus* by J. Truyols (Altuna 1972). These remains are more consistent with the morphology and size of *Cervus elaphus* rather than *R. tarandus*. Menéndez (1923) cites the presence of reindeer in the cave of El Bufón (Llanes, Asturias). This site has yielded evidence of Eneolithic occupations but the reindeer specimen, an antler fragment, was found outside the main stratigraphic context of the site preserved inside a stalagmitic crust. This speciment was not depicted nor properly described in the publication and is currently lost. In fact, Martínez Santa-Olalla (1930) cites red deer as the only ungulate present at this site. Thus, we consider the presence of reindeer in this site to be very unlikely.

Estévez (1979) proposed the probable presence of reindeer remains in the cave of Muricecs (Lleida). De la Vega (1981) on the contrary, based on Castellví (1979) provides a different faunal list for this site in which reindeer are not present. Thus we have excluded this site until these remains can be confirmed as reindeer. If confirmed (which should be done in the near future), this would extend the presence of reindeer into the north-west part of Catalonia.

Altuna (1981) did not report the presence of reindeer in Rascaño. Yravedra (2002) suggested the possibility of its presence in the Magdalenian levels, but this is actually a typographical error (J. Yravedra, pers. comm. 2013).

New and revised chronology

Information is provided on the chronology of the archaeological levels from which reindeer remains described above are derived. Two direct dates of bones from the sites of Arlanpe and Atxuri are provided that add to the direct date from a tooth from Level I of Santa Catalina (Table 2). Finally, the stratigraphy of Santimamiñe is discussed based on the new studies by López Quintana & Guenaga Lizasu (2011), correcting previous works.

In the case of Lumentxa, reindeer remains have been found in all cultural levels (Supplementary information: Table S2). This site, excavated by J.M. Barandiarán in two different phases (1926-29 and 1963-64), has a complex stratigraphy that was poorly described and interpreted (e.g., in the first excavation depth was measured from surface and in the later ones a datum was used). The core of Paleolithic levels can be attributed to the Magdalenian and Azilian age, but level VII (F) was attributed to the Aurignacian (Barandiarán 1967) due to the presence of characteristic lithic tools (nosed end-scrapers). This possibility was discussed by Utrilla (1976) who found that the stratigraphic position of level VII (F) was unclear and that the archaeological assemblage is more consistent with a Lower Magdalenian attribution. Therefore the presence of reindeer remains of Aurignacian date at this site (P. Castaños, pers. comm. in Álvarez-Lao 2007 and in Álvarez-Lao & García 2010) must be rejected.

Bolinkoba has yielded four reindeer specimens from the excavations performed by J.M. Barandiarán in 1932 and 1941: one in level III (C) attributed to the Magdalenian, two in level IV (D) attributed to the Solutrean and one in level V (E) possibly attributed to the Gravettian. Thus we

can only be certain of the presence of reindeer in this cave during the Upper Paleolithic.

The site of Atxuri, now lost due to quarrying activity, has serious stratigraphic problems. J.M. Barandiarán himself recognized that part of the site was mixed. The recent re-organization of the archaeological material found in this cave suggests that the entire sequence is mixed as there are elements attributed to Gravettian, Solutrean, Magdalenian and Bronze Age levels. That was probably because Barandiaran failed to recognize Bronze Age funerary pits during his excavations. There was a previous direct date from a decorated bone tool (Euskal Arkeologia Etnografia eta Kondaira Museoa 1995; Supplementary Information: Table S2) but we do not know how this artefact relates to the reindeer remains. One of the reindeer specimens has been directly dated to 13030±60 uncal. BP (Beta-28266) (Table 2).

The reindeer remains from Axlor come mainly from level IV (Quina Mousterian) although there is also evidence for the presence of reindeer in other Quina Mousterian levels (III and V) and in the Upper Paleolithic level I-II. The Upper Paleolithic level is not well characterized and its precise chronology is unknown due to the very small quantity of archaeological material that it has yielded. Most of the reindeer remains from the Quina Mousterian level have a minimum age of 43 ka (Supplementary Information: Table S2).

Arlanpe has yielded 12 reindeer specimens that come from all three excavation sectors and belong to different archaeological levels. Reindeer were present in both the Early Middle Paleolithic and Upper Paleolithic levels, the latter belonging to both the Gravettian and Middle Magdalenian. Thus, this site is potentially one of the oldest yielding reindeer remains, together with El Castillo. The mixed levels of Arlanpe have also yielded reindeer remains, one of which has been dated

directly to 30 250±180 uncal. BP (Beta-272220) (see Table 2).

Santimamiñe was first thought to have an Upper Paleolithic sequence starting in the Aurignacian, and continuing through the Solutrean to the Magdalenian (Barandiaran 1976). The new excavations from 2004-2006 show that the Paleolithic human occupations were restricted to the Magdalenian, during which reindeer has been found. Additional reindeer evidence from this cave comes from the Arg-o palaeontological level dated to 20 530 uncal. BP (Castaños & Castaños 2011; López Quintana & Guenaga Lizasu 2011).

A review of all the currently available stratigraphic and chronological information for the presence reindeer in the Iberian Peninsula can be found in the Supplementary Information (Table S2).

Summary of current evidence for the presence of reindeer in the Iberian Peninsula

The archaeological and palaeontological evidence for the presence of reindeer in the Iberian Peninsula has been critically analyzed as part of the present study. The integrity of sites, the stratigraphies, cultural attribution of the levels and chronology have been submitted to a detailed bibliographic review which is summarized in Table S1. We have classified the fossil evidence of reindeer into four main categories (Table 3) according to the quality of the archaeological record. A total of 52 dated and non-problematic levels yielded reindeer remains, with chronologies ranging from the Early Middle Paleolithic (Arlanpe D), to the Middle Paleolithic (Abauntz h, Axlor B, D, F; Lezetxiki IIIb, Covalejos J), Initial Upper Paleolithic (Aitzbitarte III, IV, Va; Amalda VI, Labeko

Koba IX inf, Lezetxiki IIIa, Arlanpe 2, La Garma E-F, Castillo 14, Cueto de la Mina VII) and Late Upper Paleolithic (Abauntz 2r, e; Aitzbitarte IV IV, Erralla III, V, Amalda IV, Urtiaga D, Finf, Fsup, Praileaitz nivel de cantos (Pebble level), Ermittia III, V, Kiputz D, F; Santa Catalina I, II, III; Arlanpe I; El Ruso I IV a, IV b; El Castillo 8, 6; Altamira 7, 6, 3; Cueto de la Mina V; La Riera 24; Tito Bustillo 1b and Las Caldas III-IV, IX).

Geographical framework of the presence of reindeer in the Iberian Peninsula. The present study increases the number of known localities with reindeer remains by more than 25% from 41 (Álvarez-Lao & García 2011a) to 55. There are two distinct areas within the distribution of reindeer in the Iberian Peninsula: the northeast part of Catalonia and the northern Cantabrian fringe of the Iberian Peninsula. These two areas are located at either end of the Pyrenees (Fig. 12). The evidence from the northern Cantabrian region will be discussed in detail as the record here is more extensive. In the northern Iberian Peninsula there is a clear W-E gradient in both the number of sites and the number of reindeer remains. The number of sites with the presence of reindeer increases towards the east, as one gets closer to the Pyrenees (Álvarez-Lao & García 2011a). The two sites that yielded the largest quantity of reindeer remains, Santa Catalina and Kiputx IX, are located close to the present coastline.

Except for the two sites located in the province of Navarre and the site located in the province of Araba, the remaining sites are located in the Cantabrian watershed. The site of Abauntz is close (less than 10 km) to the Cantabrian watershed which is accessed from the site by a mountain pass that reaches an altitude of 847 metres above seal level (m a.s.l.) (Belate), although the lowest mountain pass that crosses the watershed is Azpiroz (618 m a.s.l.), situated ~ 25 km to the west. The site of Zatoya is located at a higher altitude (900 m a.s.l.) in a steeper landscape with

far more complex passages towards the other side of the Pyrenees or Cantabrian valleys (mountain passes > 1000 m.). The northern Ebro Valley is easily accessible by several mountain passes situated ca. 600 m a.s.l. (Arlaban, Dima, Barazar, Altube). The site of Arrillor is at 710 m a.s.l., and is also close to the watershed and to mountain passes that connect its two sides. The absence of reindeer south of the Cantabrian range could be partly explained by the scarcity of Pleistocene sites with preserved faunal remains, although there are well known sites in the area like Koskobilo (Ruiz de Gaona 1958). The small number of reindeer remains south of the watershed, the fact that some of these remains are shed antlers with traces of human modification, and the closeness of these sites to mountain passes that connect to the northern part of the watershed do not rule out the possibility that reindeer did not cross the watershed and that these remains could have been transported and accumulated by human action.

Chronological framework of the presence of reindeer in the Iberian Peninsula. The absolute dates and relative chronology of each of the levels in which reindeer remains have been found are given in the Supplementary Information (Table S2) and synthesized in Fig. 13. Based on current data, the oldest appearance of reindeer in the Iberian Peninsula dates to the end of the Middle Pleistocene (Arlanpe levels D and 4; Castillo level 26). Previous references of Middle Pleistocene reindeer remains from La Parte and Mollet I (Álvarez-Lao & García 2010) must be discarded. In the first case, the taxonomic attribution remains unclear (Álvarez-Lao, unpublished data). The case of Mollet I is more complex. During the 1947-48 excavation a reindeer molar was recovered by J. M. Cornominas (Mir & Salas 1976). However, a review of the site published in 1987 (Maroto *et al.* 1987) suggested that the main part of the faunal assemblage recovered in the 1940's corresponded to levels 3, 4 and 5 (following the stratigraphic interpretation of Ripoll & de Lumley 1964-65), all of which date to the same period (levels 3 and 4 were the result of disturbance to level 5). This

supported the attribution of this reindeer specimen to levels 3-5, associated with a date of around 200 ka BP (J. Maroto, pers.com. in Álvarez-Lao 2007 and in Álvarez-Lao & García 2010). Recently the site has been re-excavated and the stratigraphic interpretation has been reassessed (Maroto *et al.* 2012). Level 3 is now considered Upper Pleistocene Mousterian and no reindeer remains have been attributed to Middle Pleistocene level 5. The director of this most recent archaeological excavation has confirmed that the reindeer molar found in Mollet I probably corresponds to level 3 (J. Maroto, pers. comm. 2013).

The presence of reindeer in Middle Paleolithic (MIS 4-3) sites has been demonstrated in three Cantabrian sites: Abauntz, Covalejos and Axlor. In the latter, relatively numerous reindeer remains have been found in Quina Mousterian levels dated to c. 50-40 cal. ka BP (levels 4-5; see above). Reindeer is also present in the Chatelperronian, late Aurignacian and early Gravettian (between c. 40-30 cal. ka BP). The distribution of dates show that the presence of reindeer was limited to between the H3 and H2 events (corresponding to the Gravettian) (see Álvarez-Lao & García 2010), although Aitzbitarte III levels III and IV, Arlanpe level 2 or Cueto de la Mina V have yielded specimens of this species. This is probably influenced by the small number of excavated and studied Middle and Recent Gravettian sites. It is noteworthy that in many levels with Gravettian chronology (Aitzbitarte III- III, IV, Va- Amalda VI; Bolinkoba V, Arlanpe 2, probably Axlor I-II, Santimamiñe Arg-o, Cueto de la Mina VII) reindeer remains have been recognized. In this context the study of other important Gravettian assemblages such as Aldatxarren, Altamira or La Viña will clarify this question.

Reindeer are also present in some Solutrean levels but the greatest presence occurs during Magdalenian. Reindeer appear in many Lower, Middle, Upper and Late Magdalenian sites (ca. 18-

12.5 cal. ka BP). Finally, the presence of reindeer close to the very beginning of the Holocene has been demonstrated in some sites as Santa Catalina level I, where a directly dated reindeer remain yielded a 2 sigma calibrated date of 11314-10824 cal. BP (Ua-24651) (Berganza *et al.* 2012).

Presence of reindeer in the prehistoric art of the Iberian Peninsula. The presence of reindeer is also observable in some artistic representations found on cave walls and in portable art. The complete list of sites on the Iberian Peninsula with reindeer depicted in prehistoric art can be found in Table 4 (see also Supplementary Information: Table S3) and is shown in Fig. 14. Only a few scholars have considered this question (Barandiarán 1969; García Morales 1984/85; see also reviews by Altuna 1971 and García & Arsuaga 2003) but in recent years new examples have been found (see below).

Although the reindeer is not a common animal in Iberian Palaeolithic art, it is more abundant in cave art than in portable art. In the Cantabrian region, depictions are concentrated in caves such as Altxerri, Las Monedas and Tito Bustillo, where representations can be identified in the main cave panels. In the remaining locations, the presence of reindeer is limited to only one representation per site (see Supplementary Information: Table S3). This group includes an engraving of a reindeer antler in Pindal cave (G. Tosello, pers. comm. in González-Pumariega 2011).

Out of the Cantabrian region, there is an engraved reindeer in the pre-Pyrenean mountains at Fuente del Trucho. This cave is near the transition between the south and north slopes, and we can show a close iconographic relationship between Fuente del Trucho on one side and Gargas/Tibiran (Barrière 1976) on the other. For the rest of the Peninsula there are only two examples, located in

the caves of El Reno and La Hoz in the central Meseta. Apart from the sites that we have included in this study, other scholars have proposed the presence of reindeer in the parietal art of other sites, particularly two examples at Siega Verde (Balbín & Alcolea 1994). In our view, these representations are not diagnostic and it is not possible to identify them as *R. tarandus*. In the caves of Covalanas and La Haza, two figures have been proposed to be representations of reindeer (Moure *et al.* 1991) contradicting the original interpretation (Alcalde del Río *et al.* 1911), but there is no reason to consider these animals to be reindeer.

Pieces of portable art with clear reindeer representations have been found in stratified contexts from the Upper Magdalenian at Urtiaga D (González Sainz 1984) and in the Middle Magdalenian of La Viña IV (Fortea 1990) and Las Caldas IX (Corchón 1990). Based on the anatomy represented, it is likely that the deer from Abauntz cave (Utrilla *et al.* 2008) is actually a reindeer (A. Ruiz-Redondo, pers. comm. 2012) . Another portable piece representing a reindeer from Aitzbitarte IV has been mentioned (Breuil 1924), but this attribution is controversial.

It should also be noted that reindeer bones, antlers and teeth have been used as raw material for different archaeological artefacts (e.g., pendants). A possible set of serrated reindeer teeth that were used as ornaments was also recovered during the last field season at Las Caldas IX (Corchón *et al.* 2012), and there are also examples from levels II and III of Santa Catalina cave (Berganza & Arribas 2010).

The geographic distribution of sites with artistic depictions of reindeer differs from that of sites with palaeontological evidence of reindeer. First, it is not possible to ascertain a W-E gradient of increased abundance in artistic depictions and second, these kinds of sites are not limited to the

Cantabrian region or to the northwest part of Catalonia. In fact, it seems that the reindeer has a very low but continuous presence in art throughout the Cantabrian region. The role of this animal changes drastically on the continental side of the Pyrenees: in the French Pyrenees and in the Dordogne, reindeer have a more prominent place in cave art panels and also in portable pieces, especially in Magdalenian period. For example, at Isturitz (Pyrenées-Atlantiques, France) located at the edge of the Cantabrian coast, the reindeer is the main engraved figure and is also one of the most important animals in the rich portable art record of the cave.

From a chronological point of view, most of the depictions belong to the late Upper Palaeolithic. Cave art from Altxerri, Tito Bustillo and Las Monedas relates to the recent Magdalenian, as does portable art from Las Caldas and La Viña. Only a small part of the collection seems to be older, such as the red reindeer painted in La Pasiega cave which date to the Gravettian/Solutrean.

Discussion

Distribution patterns of reindeer on the northern fringe of the Iberian Peninsula

From an archaeological point of view, the presence of reindeer remains in the Iberian Peninsula sites can be interpreted in various ways. The existence of sites with abundant reindeer remains that derive from multiple individuals and represent different anatomical parts, indicates the "natural" presence of reindeer in the ecosystem and explains their introduction to these sites as hunted prey. Also, the existence of purely palaeontological sites such as Kiputz IX, with naturally deceased (fallen in a natural trap) reindeer remains, strengthens this idea. Despite this, we cannot

completely rule out the possibility that some of these remains, specially antler fragments and modified bones or teeth but also meat/bones, were transported from distant localities. Such long distance transport has been demonstrated between the northern Pyrenees and the Cantabrian region. For example, flint from the Aquitaine region (Tercis, Chalosse, Salies de Bearn) is present in eastern Cantabrian sites over 100 km away, at least in Mousterian times (Tarriño 2003). Flint from the Upper Ebro Valley (Treviño) has been found in the Aurignacian of Brassempouy (Bon 2002) and in the Magdalenian of Asturias (Corchón *et al.* 2012). Steatite from the Northern Pyrenees has been documented in Perigord sites during the Aurignacian (White 2007) and flint from Bergerac region was transported more than 250 km, reaching sites such as Isturitz (Fernandes *et al.* 2012).

Assuming that the pattern of presence of palaeontological reindeer remains is generally a good proxy for the density of its presence in the ecosystem, one can hypothesize the existence of a double gradient in the distribution of reindeer in the Cantabrian region of the Iberian Peninsula. First, the number of reindeer would have decreased towards the west, as the animals moved further from the most important entrance into the Iberian Peninsula, at the end of the Bidasoa River on the western limit of the Pyrenees. A second gradient followed an approximate north-south axis following the rivers: numbers would have decreased as they moved south and up into the valleys. The latter gradient would be supported by the location of the two sites with the larger amount of reindeer remains on the current coast. They are both chronologically located in the final part of the Late Pleistocene with the earliest presence of reindeer at Santa Catalina dating to around 15 cal. ka BP and the most recent estimate for the Kiputz IX assemblage dating to around 17 cal. ka BP (although level C has yielded also reindeer remains and could potentially smaller the gap between these two sites). Santa Catalina is an important Upper Paleolithic site, in which the reindeer remains are the result of hunting by human groups (Berganza *et al.* 2012). Kiputz IX is a palaeontological

site and no evidence of human intervention has been found (Castaños *et al* 2006, 2012, in press). This distribution could actually reflect the ecological preferences (or limitations) of this species. It can be hypothesized that the reindeer could either have preferred open habitats and/or could have avoided sloped terrain. This could prevent this species from crossing the Pyrenees and the Cantabrian mountain range. This would also explain the distribution pattern of reindeer in the Cantabrian fringe, with more sites and remains near the modern coastal plains, and some sites in the upper part of major valleys. These valleys would be the marginal area of the reindeer distribution, and crossing the mountain passes (which are quite low at ~ 600 m a.s.l.) did not happen often, but was possible. Thus the probability of finding reindeer remains in Upper Ebro Valley sites is quite low, due to both the potential ecological preferences and the lack of sites. Note however that the presence of this species has not been noted in sites like Peña Miel or Koskobilo. The only three exceptions are the cases of Abauntz, Zatoya and Arrillor, located at south of the watershed. In these three sites the number of remains is low, suggesting the occasional presence of isolated individuals or human transport of partial carcasses from the northern part of the watershed, especially since some of these remains are shed antler specimens with traces of human modification. From these three sites it is easy to cross to the north side of the Cantabrian/Pyrenees mountain range.

Another important factor that could have affected the numbers of reindeer entering the Iberian Peninsula through the western Pyrenees is the palaeogeography of south-west France. The south-western corner of France has traditionally been regarded as a glacial refugium. A more recent reanalysis of the archaeological and geological evidence proposes that the area of Landes would actually have been a periglacial desert, at least during MIS 3 and MIS 2, with a low biomass availablity that would have made it unattractive to Upper Palaeolithic hunter-gatherers and likely acted as a cultural barrier (Bertran *et al.* in press). So if one focuses on the most immediate area of

southwestern France to the Iberian Peninsula, the potential area of distribution of animals and hunter-gatherer groups would be similar to a corridor. The Adour river basin would constitute the main part of this corridor. It should also be noted that, based on random finds in Landes from the and Holocene, suitable habitats were concentrated close to riverine areas (Merlet & Bost 2011). Bertran *et al.*'s (in press) work is based on a corpus where the access to the immediate vicinity of streams was limited due to environment protection compared to other habitats (M. Dachary, pers. Comm. 2013). It would be interesting to know whether Landes was inhospitable to hunter-gatherers all-year round, or may have attracted herds (and humans) seasonally. Finally, reindeer from sites in south-west France and the Dordogne were similar in size (Kuntz 2011) which may reflect the fact that these populations were in contact with one another, and which would weaken the hypothesis that Landes was a barrier.

Letourneux (2007) groups those sites in the French Basque Country (i.e., at the end of the corridor, south of Landes) with those from the Cantabrian region (Letourneux 2007). In this case, the view of the Pyrenees as a barrier by authors like Costamagno & Mateos Cachorro (2007) should be completed and clarified. It can be hypothesized that in the case of the reindeer (among other species), the Cantabrian mountain range could have acted as an ecological barrier, that would have been a continuation of the Pyrenees (see also Álvarez-Lao & García 2011a). In summary, Bertran *et al.*'s (in press) proposal opens up new questions concerning the palaeobiogeography of the reindeer and further comparative studies of the presence of the reindeer in this region (e.g., Gatzarria, Duruthy, Isturitz, Brassempouy) controlling for geography (i.e., location within the Adour corridor), orography (i.e., altitude and steepness of the terrain), climate and chronology are warranted in order to better understand the dynamics of this species in the adjacent Cantabrian region.

It also should be noted that there are differences in the distribution of the reindeer remains in

the Iberian Peninsula compared with other cold-adapted taxa such as the woolly rhinoceros (*Coelodonta antiquitatis*) or the woolly mammoth (*Mammuthus primigenius*). The presence of reindeer is limited to the northern Cantabrian fringe and to the northeast of Catalonia, close to the eastern end of the Pyrenees. In contrast, the woolly rhino has also been found in the centre of the Iberian Peninsula and the woolly mammoth has been found on the Portuguese coast and in Andalusia (Álvarez-Lao & García 2011a). There are differences in the potential for preservation of fossil remains between different parts of the Iberian Peninsula due to the presence/absence of karstic environments or the acidity of the soil. For example, most of the Duero basin has not preserved any fossil remain of these species. However, it seems that while the Pyrenees-Cantabrian mountain range marked the limit of the reindeer distribution, this was not the case for other species that were able to cross it.

Finally, the reindeer has only a minor presence in sites of the Iberian Peninsula, where the most abundant species are mountain goat and chamois in sites near mountainous areas (e.g., Arlanpe, Bolinkoba); red deer in lower areas (e.g., Santimamiñe) or variable if the site is close to different environments. The presence of horses and large bovids is generally low, but in some cases reaches significant percentages. In short, the typical species that are found with reindeer in the Iberian Peninsula are different from those found in central France for the same time periods, which point towards different ecological conditions (see Álvarez-Lao 2012 for a complete discussion).

Chronology of the presence of reindeer in the Iberian Peninsula and comparison with south-west France

The present work completes and amends previous assessments of the presence of reindeer in

the Iberian Peninsula but does not substantially alter the existing general picture (see Álvarez-Lao and García, 2010). Reindeer were present in the Iberian Peninsula from the end of the Middle Pleistocene, through the Mousterian to Upper Paleolithic. In the latter period, the larger number of sites has provided a clearer picture of variation in population densities. On a broader scale it is possible that there were multiple entrances of reindeer into the Iberian Peninsula, which probably acted as a population drain. Due to the potentially large migration routes, the continued presence of reindeer during a certain periods of the Upper Paleolithic based on ^{14}C could actually represent the superposition of repeated annual migrations into the region. What still remains unclear is the extent to which reindeer occupied the territory all year round or whether they entered the Iberian Peninsula temporarily as part of annual migration routes. Additional studies of the age-at-death of the reindeer remains from sites with a large number of specimens (i.e., Santa Catalina and Kiputx IX) will provide additional information on this subject. If all the ages-at-death are represented, a continuous yearlong presence would be reinforced.

Langlais *et al.* (2012) have compiled a set of direct dates of reindeer remains from sites in south-west France, and based on these results they consider it unlikely that reindeer populations persisted beyond the Bølling interstadial in the Aquitaine region. For example, in places such as Borrouilla (Arancou; Dachary *et al.* 2008) the faunal remains from the upper Magdalenian levels are mainly composed of red deer, and reindeer is very scarce. However, previous studies have showed the presence of reindeer in Azilian levels in south-west France (Costamagno 2006) and there is a a reindeer from Moulin du Roc was dated to the Alleröd (Drucker *et al.* 2011).

New research is being performed to study the taphonomy of reindeer belonging to more recent levels, and new direct dates are in the course of being obtained for this region (Dachary 2006; M. Dachary, pers. comm. 2013) in order to confirm or reject this assertion. In the Cantabrian

region there is evidence for the survival of this species after the Bølling interstadial, with remains found in Azilian levels. In fact, a reindeer tooth from Santa Catalina (see above) has yielded a direct date which is more recent than those provided by Langlais *et al.* (2012). This apparent lack of simultaneous extinction of the reindeer, if confirmed, would mean that the reindeer survived longer in the Cantabrian region than in south-west France. Future studies will confirm or reject this suggestion.

The artistic representation of reindeer in the European context

There are major differences in animals represented in the Palaeolithic art of different regions (Sauvet & Wlodarczyk 2000/01). Alternative patterns of representation are common in more restricted areas like the Iberian Peninsula (Altuna 2002) and may have both an environmental and cultural basis.

Chronologically, there are fossil remains of reindeer throughout the Upper Palaeolithic of the Iberian Peninsula, although the density of remains varies temporally. In the case of art, the situation is different. The reindeer initially does not form part of the iconography of artists in this region. Even in the rest of Europe, at the start of the Upper Palaeolithic there is a tendency to represent dangerous animals like felines, bears or rhinos, and reindeer are only represented in a few cases like Chauvet (Clottes 1996). It is during the Magdalenian that the reindeer takes a very important role in depictions on the walls of caves like Trois-Frères or in the portable pieces from others like Limeuil, both in France, within an iconography dominated by the bison and the horse. Bison and horse take over from deer in the Cantabrian region and begin to dominate the decorated

panels. After bison and horse, the goat occupies a secondary place in depictions of animals that is occasionally replaced and/or complemented by the reindeer, although the deer does not completely disappear. In sum, although an interregional art with a series of shared thematic and cultural conventions occurs in the Cantabrian, Pyrenean and Dordogne regions from the Middle Magdalenian, it is also evident that the artistic repertoire is adapted locally to the animals present in the environment of each of these regions.

Conclusions

In this paper new evidence for reindeer from five sites in the province of Biscay are presented. This new evidence was described, illustrated, characterised metrically and analyzed taphonomically. There is clear evidence of anthropogenic accummulations, butchering and fresh bone fracturing of reindeer remains from the sites of Atxuri and Axlor and probably Arlanpe. The stratigraphic position of one of the specimens from Arlanpe make this, together with the evidence from the lower levels of El Castillo, one of the oldest pieces of evidence for the presence of the reindeer in the Iberian Peninsula. There is a clear presence of reindeer in the Mousterian and throughout the Upper Paleolithic, the most recent remains being those from the site of Santa Catalina.

In the Iberian Peninsula, there is evidence of reindeer remains from 55 sites, most of which (50) are located in the Cantabrian region, with a clear increase in the density of sites and remains towards the Pyrenees. The remaining five sites with evidence of reindeer are located at the other

side of the Pyrenees in the north-west corner of Catalonia. Thus, the presence of reindeer is limited to the northern fringe of the Iberian Peninsula but is more abundant in terms of both number of sites and number of fossils than other cold-adapted faunal species. On the other hand, the presence of woolly rhinoceros and mammoth has been documented in the central and southern Iberian Peninsula respectively, which suggests differences in ecological preferences/constraints between these animals and reindeer.

In contrast with the pattern of reindeer fossil remains, the archaeological evidence of artistic depictions of reindeer (both parietal and portable) is more scarce and scattered. Representations of these animals have been found in places that lack palaeontological evidence for the presence of reindeer, such as the center of the Iberian Peninsula, which could reflect either long-distance cultural communication or the movement of human groups.

While both the presence of fossil remains and of representations of reindeer in art are drastically different in south-west of France, recent studies proposing that Landes acted as a periglacial desert present new questions that require further research to fully understand the pattern of the presence of reindeer in the Adour basin, as this would certainly have implications for understanding the presence of the reindeer in the Cantabrian region.

Acknowledgements. Thanks to the Arlanpe excavation and research team for their help in the field and fruitful discussion. Excavations at the Arlanpe site were funded by Bizkaiko Foru Aldundia, Fundación José Miguel Barandiarán and Harpea Kultur elkartea. Thanks to Lemoako Udala for all their help. The research on the faunal remains of Arlanpe has been supported by Eusko

Ikaskuntza through several research grants. Thanks to the Arkeologi Museoa (Bilbao), its director and all its staff for their help in the revision of the faunal remains. The ^{14}C dating of Atxuri was possible thanks to the permission of the Eusko Jaurlaritza. Thanks to J. Maroto, M. Dachary, P. Arias, K. Mariezkurrena, J. Altuna, S.J. Pereda, P. Alcázar, J. Estévez, F. Bernaldo de Quirós, A. Ruiz-Redondo, A.B. Marín, J. Yravedra for providing important information on sites and for discussion. Thanks to the reviewers and to the editor J. Piotrowski for their useful comments, that have improved this paper. M. Hernández and E. Pomeroy kindly revised the English and provided useful comments. Eusko ikaskuntza provided funding to study the faunal remains of Arlanpe. AGO has Marie Curie-IEF research fellowship and is supported by the Ministerio de Economía y Competitividad (project CGL2012-38434-C03-01).

References

Alcalde del Rio, H., Breuil, H. & Sierra, L. 1911: *Les cavernes de la région cantabrique*. 265 pp. Chêne, Monaco.

Alcolea, J. J., Balbín, R., Jiménez, P. J., García, M. A. & Foyo, A. 2000: La cueva de El Reno (Valdesotos, Guadalajara). Una visión de conjunto de su arte parietal paleolítico. *In* Oliveira, J. V. (ed.): *Congreso de Arqueología Peninsular. 2: Paleolítico da Península Ibérica*, 525-540. ADECAP, Porto.

Altuna, J. 1971: El reno en el Würm de la Península Ibérica. *Munibe 23*, 71-90.

Altuna, J. 1972: Fauna de mamíferos de los yacimientos prehistóricos de Guipúzcoa. *Munibe 24*, 1-492.

Altuna, J. 1980: Fauna de Axlor. Campaña de 1968, 69, 71 y 72. *In* Barandiarán, J. M. (ed.):

Excavaciones en Axlor (Campaña de 1967-74). Obras Completas, 17, 127-170. La gran Enciclopedia Vasca, Bilbao.

Altuna, J. 1981: Restos óseos del yacimiento prehistórico del Rascaño. *In* González Echegaray, J. & Barandiarán, I. (eds.): *El Paleolítico Superior de la cueva del Rascaño (Santander). Monografías del Centro de Investigación y Museo de Altamira 3*, 221-269. Centro de investigación y Museo de Altamira, Santander.

Altuna, J. 2002: Los animales representados en el arte rupestre de la Península Ibérica. Frecuencias de los mismos. *Munibe (Antropologia-Arkeologia) 54*, 21-33.

Altuna, J. & Apellániz, J. M. 1976: Las figuras rupestres paleolíticas de la cueva de Altxerri (Guipúzcoa). *Munibe 54*, 1-241.

Altuna, J., Armendariz, A., Etxeberria, F., Mariezkurrena, K., Peñalver, X. & Zumalabe, F. 1995: Carta Arqueológica de Gipuzkoa. II. Cuevas. *Munibe (Antropologia-Arkeologia) Suplemento10, 260 pp*.

Álvarez-Lao, D. & García-García, N. 2006: A new site from the Spanish Middle Pleistocene with cold-resistant faunal elements: La Parte (Asturias, Spain). *Quaternary International 142-143*, 107-118.

Álvarez-Lao, D. J. 2007: *Revisión paleontológica de los macromamíferos indicadores de clima frío en el Pleistoceno de la Península Ibérica.* 413 pp. Departamento de Geología. Universidad de Oviedo, Oviedo.

Álvarez-Lao, D. J. & García, N. 2010: Chronological distribution of Pleistocene cold-adapted large mammal faunas in the Iberian Peninsula. *Quaternary International 212*, 120-128.

Álvarez-Lao, D. J. & García, N. 2011a: Geographical distribution of Pleistocene cold-adapted large mammal faunas in the Iberian Peninsula. *Quaternary International 233*, 159-170.

Álvarez-Lao, D. J. & García, N. 2011b: Southern dispersal and Palaeoecological implications of

woolly rhinoceros (*Coelodonta antiquitatis*): review of the Iberian occurrences. *Quaternary Science Reviews 30*, 2002-2017.

Álvarez-Lao, D. J. & García, N. 2012: Comparative revision of the Iberian woolly mammoth (*Mammuthus primigenius*) record into a European context. *Quaternary Science Reviews 32*, 64-74.

Álvarez-Lao, D. J., Kahlke, R.-D., García, N. & Mol, D. 2009: The Padul mammoth finds - On the southernmost record of *Mammuthus primigenius* in Europe and its southern spread during the Late Pleistocene. *Palaeogeography, Palaeoclimatology, Palaeoecology 278*, 57-70.

Arsuaga, P. M. & Aguirre, E. 1979: Rinoceronte lanudo en la provincia de Madrid (*Coelodonta antiquitatis* Blumenbach). *Boletín de la Real Sociedad Española de Historia Natural (Geol.) 77*, 23-59.

Balbín, R. 2008: El Arte Rupestre Paleolítico al aire libre en la Península Ibérica. *In* Balbín, R. (ed.): *Arte Prehistórico al aire libre en el Sur de Europa*, 17-54. Consejería de Cultura y Turismo. Junta de Castilla y León, Valladolid.

Balbín, R. & Alcolea, J. J. 1994: Arte paleolítico de la Meseta Española. *Complutum 5*, 97-138.

Balbín, R. & González Sainz, C. 1993: Nuevas investigaciones en la cueva de La Pasiega (Puente Viesgo, Cantabria). *Boletín del Seminario de Estudios de Arte y Arqueología 59*, 9-34.

Barandiarán, I. 1967: *Paleomesolítico del Pirineo Occidental. Bases para la sistematización tipológica del instrumental óseo paleolítico. Monografías arqueológicas.* 354 pp. Universidad de Zaragoza, Zaragoza.

Barandiarán, I. 1969: Representaciones de renos en el arte paleoliitico español. *Pyrenae 5*, 1-34.

Barandiarán, J. M. 1976: *Santimamiñe. Obras Completas, IX*. 504 pp. La Gran Enciclopedia Vasca, Bilbao.

Barrière, C. 1976: *L'art pariétal de la grotte de Gargas. BAR International Series 14, Mémoire de*

l'Institut d'Art Préhistorique de Toulouse. 409 pp. British Archaeological Reports, Oxford.

Berganza, E. & Arribas, J. L. 2010: Dientes de hebívoros serrados e incisos de la cueva de Santa Catalina (Lekeitio, Bizkaia). *Munibe (Antropologia-Arkeologia) 61*, 57-70.

Berganza, E., Arribas, J. L., Castaños, P., Elorza, M., González-Urquijo, J. E., Ibáñez, J. J., Iriarte-Chiapusso, M. J., Morales Muñiz, A., Pemán, E., Rosales, T., Roselló Izquierdo, E., Ruiz Idarraga, R., Uriz, A., Uzquiano, P., Vásquez, V. & Zapata Peña, L. 2012: La transición al tardiglaciar en la costa oriental de Bizkaia: el yacimiento de Santa Catalina. Resultados preliminares. *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la Primera Mesa Redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 171-182. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Berganza, E. & Ruiz, R. 2004: *Una piedra, un mundo: un percutor magdaleniense decorado*. 6 pp. Diputación Foral de Álava, Vitoria-Gasteiz.

Bertran, P., Sitzia, L., Banks, W. E., Bateman, M. D., Demars, P.-Y., Hernandez, M., Lenoir, M., Mercier, N. & Prodeo, F. D. R. In press: The Landes de Gascogne (southwest France): periglacial desert and cultural frontier during the Palaeolithic. *Journal of Archaeological Science*.

Bon, F. 2002: Aurignacien entre Mer et Océan. Réflexion sur l'unité des phases anciennes de l'Aurignacien dans le sud de la France. *Mémoires de la Societé Préhistorique Française 29*. 253 pp. Societé Préhistorique Française, Paris.

Bouchud, J. 1966: *Essai sur le Renne et la climatologie du Paléolithique moyen et supérieur*. 300 pp. Imprimerie Magne, Périgueux.

Breuil, H. 1924: Gravure sur pierre d'Aitzbitarte a Landarbaso (Guipuzcoa). *Bulletí Associació Catalana d'Anthropologia, Etnología i Prehistoria 2*, 41-42.

Bronk Ramsey, C. 2001: Development of the radiocarbon calibration program OxCal. *Radiocarbon 43*, 355-363.

Cáceres, I. 2002: *Tafonomía de yacimientos antrópicos en Karst. Complejo Galería (Sierra de Atapuerca, Burgos), Vanguard Cave (Gibraltar) y Abric Romaní (Capellades, Barcelona).* 659 pp. Departamento de Historia y Geografía, Universitat Rovira i Virgili, Tarragona.

Cacho, R. 1999: Las representaciones animales en el arte rupestre paleolítico de la región cantábrica. Un acercamiento a su estructuración y variabilidad. 240 pp. *Departamento de Ciencias Históricas.* Universidad de Cantabria, Santander.

Castaños, J., Castaños, P. & Murelaga, X. 2006: Estudio osteométrico preliminar de los restos de ciervo (*Cervus elaphus*) del yacimiento paleontológico del Pleistoceno Superior de Kiputx IX (Mutriku, Gipuzkoa). *Geogaceta 40*, 163-166.

Castaños, J., Castaños, P., Murelaga, X. & Alonso-Olazabal, A. 2012: Kiputz IX: un conjunto singular de bisonte estepario (*Bison priscus* Bojanus, 1827) del Pleistoceno Superior de la Península Ibérica. *Ameghiniana 49*, 247-261.

Castaños, J., Castaños, P., Murelaga, X., Alonso-Olazabal, A., Ortega, L. A. & Zuluaga, M. C. In press: Osteometric analysis of scapula and humerus for *Rangifer tarandus* and *Cervus elaphus*: a contribution to cervid discrimination (Late Pleistocene, Southern Pyrenees). *Acta Palaeontologica Polonica doi: http://dx.doi.org/10.4202/app.2012.0027*.

Castaños, P. 1986: *Los Macromamíferos del Pleistoceno y Holoceno de Vizcaya. Faunas asociadas a los yacimiento arqueológicos*. 593 pp. Universidad del País Vasco-Euskal Herriko Unibertsitatea, Leioa.

Castaños, P. 2010: Nuevas cavidades con carnívoros y humanos en el Cantábrico oriental. *In* Baquedano, E. & Rosell, J. (eds.): *Zona Arqueológica 13. Actas de la 1ª Reunión de científicos sobre cubiles de hienas (y otros grandes carnívoros) en los yacimientos*

arqueológicos de la Península Ibérica, 262-268. Museo Arqueológico Regional, Alcalá de Henares.

Castaños, P. & Castaños, J. 2011: Estrategias de caza en la secuencia prehistórica de Santimamiñe. *La Cueva de Santimamiñe: revisión y actualización (2004-2006). Excavaciones arqueológicas en Bizkaia, Kobie 1*, 197-206.

Castaños, P. M. 2005: Revisión actualizada de las faunas de macromamíferos del Würm antiguo en la Región Cantábrica. *In* Lasheras, J. A. & Montes, R. (eds.): *Neandertales cantábricos, estado de la cuestión*, 201-207. Museo de Altamira, Santander.

Castellví, M. 1979: *Estudio paleocológico: cueva de "Els Ermitans" (Gerona), Cueva (B) de Olopte (Gerona), Cueva de "Els Muricecs" (Lérida).* 420 pp. Facultat de Geografia i Història. Universitat de Barcelona, Barcelona.

Clottes, J. 1996: Thematic changes in Upper Palaeolithic art: a view from the Grotte Chauvet. *Antiquity 70*, 276-288.

Corchón, M. S. 1990: *La cueva de Las Caldas. Investigaciones efectuadas entre 1980 y 1986.* Excavaciones Arqueológicas en Asturias 1983-1986, 37-53. Consejería de Educación, Cultura, Deportes y Juventud. Principado de Asturias, Oviedo.

Corchón, M. S., Álvarez-Fernández, E. & Rivero Vilá, O. 2012: Contactos extra-cantábricos en el Magdaleniense medio: nuevos datos de la Cueva de Las Caldas (Oviedo, Asturias). *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la Primera Mesa Redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 113-127. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Costamagno, S. 2006: Archéozoologie des grands mammifères des gisements de la falaise du Pastou. *In* Dachary, M. (ed.): *Les Magdaléniens à Duruthy. Qui étaient-ils? Comment vivaient-ils?*, 19-29. Centre Départamental du Patrimoine-Conseil general des Landes,

Hastingues.

Costamagno, S. & Mateos Cachorro, A. 2007: Milieu animal de part et d'autre de la chaîne pyrénéenne: Implications sur les modes de subsistance au Magdalénien. *In* Cazals, N., González Urquijo, J. & Terradas, X. (eds.): *Fronteras naturales y fronteras culturales en los Pirineos prehistóricos*, 53-73. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Dachary, M. 2006: *Les Magdaléniens à Duruthy. Qui étaient-ils? Comment vivaient-ils?* 188 pp. Centre Départamental du Patrimoine-Conseil general des Landes, La Rochelle.

Dachary, M., Chauvière, F.-X., Costamagno, S., Daulny, L., Eastham, A., Ferrier, C. & Fritz, C. 2008: La grotte Bourrouilla à Arancou (Pyrénées-Atlantiques): une séquence clef de la fin du Magdalénien pyrénéo-cantabrique. *Mémoires de la Société préhistorique française XLVII*, 355-370.

von den Driesch, A. 1976: *A Guide to the Measurements of Animal Bones from Archaeological Sites*. 148 pp. Peabody Museum, Harvard.

Drucker, D.G., Madelaine, S., Morala, S. 2011: Les derniers rennes de Dordogne. Nouvelles données chronologiques et environnementales par l'étude isotopique du collagène (13C, 14C et 15N. *Paleo 22*, 85-100.

Estévez, J. 1979: *La fauna del Pleistoceno catalán.* 522 pp. Facultat de Geografia i Història. Universitat de Barcelona, Barcelona.

Euskal Arkeologia Etnografia eta Kondaira Museoa 1995: *Txostena 1994 Memoria*. 94 pp. Bizkaiko Foru Aldundia-Bilboko Udala, Bilbao.

Fernandes, P., Morala, A., Schmidt, P., Seronie-Vivie, M.-R. & Turq, A. 2012: Le silex du Bergeracois: état de la question. *In* Bertran, P. & Lenoble, A. (eds.): *Quaternaire Continental d'Aquitaine: Un Point Sur Les Travaux Récents*, 22-44. Bordeaux, AFEQ.

Fortea, J. 1990: *Abrigo de la Viña. Informe de las Campañas 1980-1986.* Excavaciones Arqueológicas en Asturias, 1983-1986, 55-68. Consejería de Educación, Cultura, Deportes y Juventud, Principado de Asturias, Oviedo.

García Morales, M. 1984-85: Sobre el valor cronológico de la presencia del ciervo y el reno en el arte paleolítico cantábrico. *Zephyrus 37-38*, 125-135.

García, N. & Arsuaga, J. L. 2003: Last Glaciation cold-adapted faunas in the Iberian Península. *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)*, 159-169. DEINSEA, Rotterdam.

Gómez-Olivencia, A., Arceredillo, D., Rios-Garaizar, J., Garate, D., Iriarte, E. & San Pedro, Z. in press: Dental anomalies in the mandible of Capra pyrenaica: presence of two permanent fourth premolars in a Pleistocene wild goat from Arlanpe cave (Bizkaia, Northern Spain). *Journal of Osteoarchaeology http://onlinelibrary.wiley.com/doi/10.1002/oa.1295/abstract*.

González Sainz, C. 1984: Sobre la plaqueta grabada magdaleniense de la cueva de Urtiaga (Guipúzcoa). *Munibe (Antropologia-Arkeologia) 36*, 11-17.

González Sainz, C., Montes, R. & Muñoz, E. 1993: La cueva de Sovilla (San Felices de Buelna, Cantabria). *Zephyrus 46*, 7-35.

González Urquijo, J. E., Ibáñez, J. J., Rios-Garaizar, J. & Bourguignon, L. 2006: Aportes de las nuevas excavaciones en Axlor sobre el final del Paleolítico Medio. *In* Cabrera Valdés, V., Bernaldo de Quirós, F. & Maíllo, J. M. (eds.): *Ante el centenario de la cueva de El Castillo: el ocaso de los neandertales*, 269-291. UNED, Santander.

González-Pumariega, M. 2011: *La cueva de El Pindal 1911-2011. Estudio de su arte rupestre cien años después de Les cavernes de la région cantabrique.* 212 pp. Ménsula Ediciones, Oviedo.

Harlé, E. 1908: Ossements de renne en Espagne. *L'Anthropologie 19*, 573-577.

Harlé, E. 1912: Ensayo de una lista de mamíferos y aves del cuaternario conocidos hasta ahora en la Península Ibérica. *Boletín del Instituto Geológico de España T. XII, 2ª serie. T. XXXII*, 135-162.

Iriarte, M. J. 2012: Cueva Aitz Gaizto II (Lastur). *Arkeoikuska: investigación arqueológica 2011*, 335-336.

Langlais, M., Costamagno, S., Laroulandie, V., Pétillon, J.-M., Discamps, E., Mallye, J.-B., Cochard, D. & Kuntz, D. 2012: The evolution of Magdalenian societies in South-West France between 18,000 and 14,000 cal BP: Changing environments, changing tool kits. *Quaternary International 272-273*, 138-149.

Letourneux, C. 2007: Devinez qui est venu dîner à Brassempouy? Approche archéozoologique des comportements de subsistance à l'Aurignacien ancien. *In* Cazals, N., González Urquijo, J. & Terradas, X. (eds.): *Fronteras naturales y fronteras culturales en los Pirineos prehistóricos*, 39-52. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

López Quintana, J. C. & Guenaga Lizasu, A. 2011: Cueva de Santimamiñe: VIII campaña. *Arkeoikuska: investigación arqueológica 2011*, 263-264.

van der Made, J. 1989: The bovid *Pseudotragus seegrabensis* nov. gen., nov. sp. from the Aragonian (Miocene) of Seegraben near Leoben (Austria). *Proceedings of the Royal Society B 92*, 215-240.

van der Made, J. 1996: Listriodontinae (Suidae, Mammalia), their evolution, systematic and distribution in time and space. *Contributions to Tertiary and Quaternary Geology 33*, 3-254.

Mariezkurrena, K. 2011: Hallazgos de macromamíferos poco frecuentes en yacimientos arqueológicos y paleontológicos del Pleistoceno de la región Cantábrica. *Kobie 30*, 83-110.

Marín, A. B. 2008: Patrones de movilidad y control del territorio en el cantábrico oriental durante el

tardiglaciar. *Trabajos de Prehistoria 65*, 29-45.

Maroto, J., Julià, R., López-García, J. M. & Blain, H.-A. 2012: Chronological and environmental context of the Middle Pleistocene human tooth from Mollet Cave (Serinyà, NE Iberian Peninsula). *Journal of Human Evolution 62*, 655-663.

Maroto, J., Soler, N. & Mir, A. 1987: La cueva de Mollet I (Serinyà, Gerona). *Cypsela: revista de prehistòria i protohistòria VI*, 101-110.

Martínez Santa-Olalla, J. 1930: Cerámica incisa y cerámica de la cultura del vaso campaniforme en Castilla la Vieja y Asturias. *Anuario de Prehistoria Madrileña 1*, 97-129.

Menéndez, J. F. 1923: De la prehistoria en Asturias, la cueva de "El Bufón" en Vidiago. *Ibérica XIX, 481*, 361-364.

Mir, A. & Salas, R. 1976: Tres nuevos carnívoros del yacimiento cuaternario de la Cov d'en Mollet I, Serinyà (prov. de Girona). *Instituto de Investigaciones Geológicas XXXI*, 97-124.

Moure, A. 1992: *La cueva de Tito Bustillo. El arte y los cazadores del Paleolítico*. 144 pp. Trea, Gijón.

Moure, A., González Morales, M. & González-Sainz, C. 1991: *Las cuevas de Ramales de la Victoria (Cantabria)*. 86 pp. Universidad de Cantabria, Santander.

Mujika Alustiza, J. A. & Peñalver, X. 2012: La ocupación de la cuenca del Deba (Gipuzkoa) durante el Magdaleniense Inferior. *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la primera mesa redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 97-112. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Nolte, E. 1971: Nota sobre nuevos yacimientos prehistóricos en cuevas de las provincias de Vizcaya y norte de Burgos. *Munibe 23*, 355-373.

Obermaier, H. 1925: El Hombre fósil. 397 pp. *Comisión de investigaciones Paleontológicas y*

Prehistóricas, Memorias 9. Madrid.

Puig y Larraz, G. 1900: Hallazgo de una cueva con restos humanos y de mamíferos en Lemona (Vizcaya) por el Sr. Uriarte y Eizaga. *Actas de la Sociedad Española de Historia Natural 11 (1º de la 2ª serie)*, 268-269.

Rasines, P. & Serna, M. A. 2009: El arte rupestre paleolítico de la cueva de Cobrante. *Sautuola 15*, 215-220.

Reimer, P. J., Baillie, M. G. L., Bard, E., Bayliss, A., Beck, J. W., Blackwell, P. G., Bronk Ramsey, C., Buck, C. E., Burr, G. S., Edwards, R. L., Friedrich, M., Grootes, P. M., Guilderson, T. P., Hajdas, I., Heaton, T. J., Hogg, A. G., Hughen, K. A., Kaiser, K. F., Kromer, B., Mc Cormac, F. G., Manning, S. W., Reimer, R. W., Richards, D. A., Southon, J. R., Talamo, S., Turney, C. S. M., van der Plicht, J. & Weyhenmeyer, C. E. 2009: IntCal09 and Marine 09 radiocarbon age calibration curves 0-50,000 years BP. *Radiocarbon 51*, 1111-1150.

Ríos, J., Iriarte, E., Gárate, D., Gómez-Olivencia, A. & San Pedro, Z. 2008: Nuevos datos sobre la transición entre el Solutrense superior y el Magdaleniense inferior en la región cantábrica: la cueva de Arlanpe (Lemoa, Vizcaya). *Sautuola XIV*, 95-104.

Rios-Garaizar, J., Garate, D., Gómez-Olivencia, A., Arceredillo, D., Iriarte, E., García, A. & San Pedro, Z. In press: El final del Solutrense en el oriente cantábrico a través de las ocupaciones de la cueva de Arlanpe (Lemoa, Bizkaia). *Zephyrus*.

Rios-Garaizar, J., Garate, D., Gómez-Olivencia, A., Iriarte-Avilés, E., Aramburu-Artano, A., Arceredillo Alonso, D., García, A., Iriarte-Chiapusso, M. J., Moreno, J., Murelaga, X., Ortiz, J. E., Torres, T., San Pedro-Calleja, Z. & Zapata-Peña, L. 2011: The Lower to Middle Palaeolithic transition in northern Iberia: new data from Arlanpe Cave. *Antiquity 85*, http://antiquity.ac.uk/projgall/rios-garaizar329/.

Ripoll, E. 1972: La Cueva de Las Monedas en Puente Viesgo. *Monografías de Arte Rupestre, 11*, 67

pp. Diputación Provincial de Barcelona, Barcelona.

Ripoll, E. & de Lumley, H. 1964-65: El Paleolítico Medio en Cataluña. *Ampurias XXVI-XXVII*, 1-70.

Ruiz de Gaona, M. 1958: Todavía algo sobre el yacimiento de Coscobilo. *Príncipe de Viana 19*, 279-287.

San Pedro, Z. & Cáceres, I. 2011: Tafonomía del registro fósil de macromamíferos del Magdaleniense Inferior Tardío de la Cueva de Santimamiñe (Kortezubi, Bizkaia). *Kobie. Bizkaiko Arkeologi Indusketak 1, 207-238.*

Sauvet, G. & Wlodarczyk, A. 2000/01: L'art pariétal, miroir des sociétés paléolithiques. *Zephyrus 53-54*, 215-220.

Sesé, C. & Soto, E. 2002: Vertebrados del Pleistoceno del Jarama y Manzanares. *Zona Arqueológica 1*, 318-337.

Tarriño, A. 2003: La piedra como materia prima en la Prehistoria. *Manos a La Piedra.* In: Euskal Arkeologia, Etnografia eta Kondaira Museoa (ed.): *Las Herramientas De La Prehistoria*, 17-30. Museo Vasco, Bilbao.

Utrilla, P., Mazo, C., Sopena, M. C., Martínez-Bea, M. & Domingo, R. 2009: A palaeolithic map from 13,660 calBP: engraved stone blocks from the Late Magdalenian in Abauntz Cave (Navarra, Spain). *Journal of Human Evolution 57*, 99-111.

de la Vega, J. 1981: Cova dels Muricecs (Limiana de la Serra). *Butlletí Mediterrania 12-13*, 205-211.

White, R. 2007: Systems of Personal Ornamentation in the Early Upper Palaeolithic: Methodological Challenges and New Observations. *In* Mellars, P., Boyle, K., Bar-Yosef, O. & Stringer, C. (eds.): *Rethinking the Human Revolution: New Beahavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans*, 287-302. McDonald Institute

for Archaeological Research, Cambridge.

Yravedra, J. 2002: Especialización o diversificación. Una nueva propuesta para el solutrense y el magdaleniense cantábrico. *Munibe (Antropologia-Arkeologia) 54*, 3-20.

Yravedra, J. & Gómez Castanedo, A. 2010: Estudio zooarqueológico y tafonómico del yacimiento del Otero (Secadura, Voto, Cantabria). *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología 3*, 21-38.

Yravedra, J., Gómez Castanedo, A. & Muñoz Fernández, E. 2010: Estrategias de subsistencia en el yacimiento paleolítico del Ruso (Igollo de Camargo, Cantabria, España). *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología 3*, 39-58.

FIGURE LEGENDS

Figure 1. Map of the eastern Cantabrian region showing the sites in the provinces of Biscay, Gipuzkoa and Nafarroa, and other sites discussed in the text. Note that Urtiaga also represents Urtiagako Leizea and that Ermittia also represents Ermittia V.

Figure 2. Reindeer tooth and maxillary remains from Lumentxa. A-E) Upper dentition. Labial (A1)

and occlusal (A2) views of the right P^4 L.6C.205. Labial (B1) and occlusal (B2) views of the left P^3 L.7F.155. Labial (C1) and occlusal (C2) views of the right M^2 L.6C.205. Labial (D1) and occlusal (D2) views of the left M^3 L.6C.205. Labial (E1) and occlusal (E2) views of the right M^3 L.9I.125. F-I) Lower dentition. Occlusal (F1) and labial (F2) views of the left P_4 L.5D.150. Occlusal (G1) and labial (G2) views of the left M_1 L. Occlusal (H1) and labial (H2) views of the right M_2 L.13E.80. Occlusal (I1) and labial (I2) views of the left M_3 L.5E.200. Left maxilla with D^2-M^1 (not labelled) in labial (J1) and occlusal (J2) views.

Figure 3. Antler remains from Lumentxa: L.6E.195 (A); L.6E.195 (B); L.13E.80 (C); L.10F.105 (D).

Figure 4. Metacarpus remains from Lumentxa. Complete metacarpus from the right side L.6D.216 in ventral (A1) and dorsal (A2) views. Distal fragment from the right side L.9F.230 in ventral (B1) and dorsal (B2) views. Distal fragment from the left side L.1C.365 in ventral (C1) and dorsal (C2) views.

Figure 5. Additional postcranial remains from Lumentxa. Proximal fragment of the right radius L.25C.400 in cranial (A1) and ventral (A2) views. Dorsal views of phalanges: 1st foreleg phalanx L.6Y.320 (B), 1st foreleg phalanx with no physical label L.25C.410 (C), 2nd foreleg phalanx L.10D.15 (D), 2nd foreleg phalanx L.9C.10 (E), 1st foreleg phalanx L.12G.25 (F), 1st foreleg phalanx L.9D.10 (G), 3rd phalanx L.6D.216 (H), 3rd lateral phalanx L.9G.365 (I).

Figure 6. Reindeer remains from Bolinkoba. Third phalanx B.IV.490 in dorsal (A) view. P^3 B.V.21 in labial (B1) and occlusal (B2) views. I_1 L.III.91 in lingual (C1) and in buccal (C2) views. I_2

B.IV.184 in lingual (D1) and in buccal (D2) views.

Figure 7. Reindeer remains from Atxuri. Fragment of left maxilla Atxi.27C.60 in labial (A1) and occlusal (A2) views. Left M^2 Atxi.23B.110 in labial (B1) and occlusal (B2) views. Upper molar Atxi.1C.50-80 in labial (C1) and occlusal (C2) views. Fragment of right hemi-mandible with M_3 Atxi.25B.10 in occlusal (D1) and labial (D2) views. Right M_2 Atxi.25C.10 in occlusal (E1) and labial (E2) views. Right M_1 Atxi.29B.50 in occlusal (F1) and labial (F2) views. Right P_4 Atxi.25C.10 in occlusal (G1) and labial (G2) views. Right P_3 Atxi.25C.50 in occlusal (H1) and labial (H2) views. Right P_2 Atxi.21B.I.5 in occlusal (I1) and labial (I2) views. Right $M_{1?}$ Atxi.5C.40 in occlusal (J1) and labial (J2) views. Left P_3 Atxuri 1957 in occlusal (K1) and labial (K2) views. Left P_4 Atxuri 1957 in occlusal (L1) and labial (L2) views. Left M_3 Atxi.31D.40 in occlusal (M1) and labial (M2) views. 2nd phalanx of the hind leg Atxi.23C.50 in dorsal (N1) and lateral (N2) views.

Figure 8. Isolated dental remains from Axlor. Lower M1 Ax.9C.250.19 in occlusal (A1) and buccal (A2) views. Lower molar Ax7F.265.62bis in occlusal (B1) and buccal (B2) views. Lower molar Ax.7F.265.57bis in occlusal (C1) and buccal (C2) views. Right P^2 Ax.3F.265.72 in buccal (D1) and occlusal (D2) views. Left P_2 Ax.5F.266.85 in occlusal (E1) and buccal (E2) views. Left P_3 Ax.5F.266.104 in occlusal (F1) and buccal (F2) views. Left M_{1-2} Ax.9C.265.28 in occlusal (G1) and buccal (G2) views. Left M_2 1973.32 in occlusal (H1) and buccal (H2) views. Left M^{1-2} Ax.13D._.34 in buccal (I1) and occlusal (I2) views. Left M^3 Ax.7F.255.87 in buccal (J1) and occlusal (J2) views. Left M^3 Ax.11G.325.126 in buccal (K1) and occlusal (K2) views. Left M^1 Ax.7C.1 in buccal (L1) and occlusal (L2) views. Note that Ax.5F.266.85 (E)(left P_2) and Ax.5F.266.104 (F)(left P_3) could have belonged to the same individual.

Figure 9. Reindeer mandibular remains from Axlor. Left mandibular fragment preserving P_4-M_2 AX.7E.265.191 in occlusal (A1) and labial (A2) views. Left mandibular fragment preserving the M_3 AX.7E.245 in occlusal (B1) and labial (B2) views. These two fragments likely belong to the same individual.

Figure 10. Reindeer postcranial remains from Axlor. Distal fragment of humerus Ax.11G.325.113 in ventral (A1) and dorsal (A2) views. Left talus Ax.1973.34 Ax.1973.34 in tibial (B1) and calcaneal (B2) views. Right talus Ax.7D.60-130.140 in tibial (C1) and calcaneal (C2) views. Right talus Ax.7B.260.9bis in tibial (D1) and calcaneal (D2) views. 2nd phalanx Ax.11E.255.135 in side view (E). 2nd foreleg phalanx Ax.11F.290.455 in side view (F). 1st foreleg phalanx Ax.5D.276.61 in side view (G).

Figure 11. Reindeer remains from Arlanpe. A. Second lateral phalanx (ARL.J21.4.17.50). B-F. Third lateral phalanges (B: ARL.H29.3.9.6; C: ARL.J24.1.9.6; D: ARL.J25.2.2.38; E: ARL.J25.2.5.37; F: ARL.J20.2.2.21). G-J. Dental remains. Occlusal (G1) and labial (G2) views of the lower left P4 ARL.H32.2.5.8. Labial (H1) and occlusal (H2) views of the upper premolar ARL.H32.3.2.8. Labial (I1) and occlusal (I2) views of the M^3 from the left side ARL.J20.2.23.35. Labial (J1) and occlusal (J2) views of the M^3 from the left side ARL.I29.3.10.2. Antler fragment ARL.H32.2.1.7 (K). Labial view (L) of the nearly complete right hemi-mandible ARL.I30.3.2.1 with a close-up of the occlusal surface of its teeth.

Figure 12. Map of the Iberian peninsula showing sites at which reindeer remains have been found.

Figure 13. Chronological distribution of the two-sigma dates for the reindeer from the Cantabrian region compared to the GRIP palaeoclimatic oxygen curve. Blue bars represent data from actual dates while green bars are approximate chronologies based on cultural attributions. The asterisks represent the direct dates on reindeer bones from Santa Catalina, Atxuri and Arlanpe presented in Table 2. See Table S2 of Supplementary Information for a complete account of the dates.

Figure 14. Map of the Iberian Peninsula showing sites where representations of reindeer in art (parietal and/or portable) have been found.

TABLE LEGENDS

Table 1. Summary table of the reindeer remains presented in this paper. For a full description of each of the specimens, see figures and Supplementary Information: Table S1.

Table 2. Direct dates on reindeer remains from the Iberian Peninsula.

Table 3. Summary table of reindeer fossils from the Iberian Peninsula. For full details, see Supplementary Information: Table S2.

Table 4-Summary table of representations of reindeer in Paleolithic art from the Iberian Peninsula. For full details, see Supplementary Information: Table S3.

SUPPLEMENTARY INFORMATION: FIGURE LEGENDS

Figure S1. Metacarpi from Lumentxa with evidences of fresh bone breakage. L.1C.365 in dorsal (a1) and ventral (a2) views of this distal metacarpal fragment. There is evidence of scraping on the ventral surface of the bone (a2, a3). L.9F.230 in dorsal (b1) and ventral (b2) views of this distal metacarpal fragment. The evidence of an impact point is indicated with an arrow. Evidences of scraping on the dorsal surface of the bone (b1, b3).

Figure S2. Lingual view of the Atxi.25B.10 right mandible fragment that preserves the M_3 (a1) and detail of this fossil (a2) showing evidence of incision, scraping and anthropogenic fracturing with percussion, impact points, and a parasitic flake. Lingual view of the left maxilla Atxi.27C.60 (b1) and detail of this fossil (b2) in which it is possible to see multible cut marks, mainly incisions, but also evidence of scraping. All scale bars = 1 cm.

Figure S3. Posterior view of the distal epiphysis of the humerus Ax.11G.325.113 (a) in which it is possible to see the impact point. Medial view (b) of the humerus in which it is possible to see cut marks related to cutting ligaments during the disarticulation of the foreleg from the radius-ulna.

Figure S4. Cut-marks on the complete talus Ax.7D.60.130.140. These are short, deep and with a clear "V"-shaped cross-section. These marks are probably related to the disarticulation of the talar bones.

Figure S5. Lingual view of the mandible ARL.I30.3.2.1 in which it is possible to see some possible anthropogenic modifications.

SUPPLEMENTARY INFORMATION: TABLE LEGENDS

Table S1. Reindeer remains from the province of Biscay presented in this paper.

Table S2. Information on the sites that have yielded palaeontological remains of reindeer.

Table S3. Information on the sites that have yielded representations of reindeer in Paleolithic art from the Iberian Peninsula.

Table S4. Measurements (in mm) of the mandible of *Rangifer tarandus*.

Table S5. Measurements (in mm) of the incisor of *Rangifer tarandus*.

Table S6. Measurements (in mm) of the lower cheek teeth of *Rangifer tarandus*.

Table S7. Measurements (in mm) of the upper cheek teeth of *Rangifer tarandus*.

Table S8. Measurements of the humerus of *Rangifer tarandus*.

Table S9. Measurements of the radius of *Rangifer tarandus*.

Table S10. Measurements of the metacarpus of *Rangifer tarandus*.

Table S11. Measurements of the astragalus of *Rangifer tarandus.*

Table S12. Measurements of the first phalanx of *Rangifer tarandus*.

Table S13. Measurements of the second phalanx of *Rangifer tarandus.*

Table S14. Measurements of the third phalanx of *Rangifer tarandus.*

Table S15. Measurements of the second lateral phalanx of *Rangifer tarandus.*

Table S16. Measurements of the third lateral phalanx of *Rangifer tarandus.*

Table 1. Summary table of the reindeer remains presented in this paper. For a full description of each of the specimens, see figures and Supplementary Information: Table S1.

Site	Number of remains	Short description	Figure(s)
Lumentxa	26	Four antler fragments, nine dental remains, an incomplete maxilla, a complete metacarpus, two distal metacarpi, four 1st phalanges, two 2nd phalanges, one third phalanx, one third phalanx of the lateral toe, a fragment of a proximal radius	2-5
Bolinkoba Atxuri	4 14	Three dental remains and a 3rd phalanx A mandible fragment, a fragmentary maxilla, 11 dental remains, a 2nd phalanx	6 7
Axlor	21	Two mandibular fragments, 12 dental remains, a fragment of distal humerus, three tali, a 1st phalanx, two 2nd phalanges	8-10
Arlanpe	12	An antler fragment, a nearly-complete hemi-mandible, four dental remains, a 2nd lateral phalanx, five 3rd lateral phalanges	11

Table 2. Direct dates on reindeer remains from the Iberian Peninsula.

Site	Sample	Conventional radiocarbon age (BP)	Reference	95% calibrated age (BP)	References
Santa Catalina		9760±65	Ua-24651	11 314-10 824	Berganza & Ruíz (2004), Berganza *et al.* (2012)
Arlanpe	ARL.I30.3.2.1	30 250±180	Beta - 272220	35073-34546	This work
Atxuri	Atxi.27C.60	13 030±60	Beta - 289266	16363-15165	This work

Table 3. Summary table of reindeer fossils from the Iberian Peninsula. For full details, see Supplementary Information: Table S2.

Levels with confirmed presence of reindeer, precise stratigraphy and absolute chronology	Directly dated reindeer remains	Levels with confirmed presence of reindeer, and correct stratigraphy and cultural attribution	Sites and levels with confirmed presence of reindeer but unclear stratigraphy and cultural attribution	Sites and levels with doubtful reindeer presence
Abauntz (2r, e, h)	Arlanpe (A-B)	Ekain (VIa)	Abauntz (F)	Aitz Gaizto II
Zatoya IIb	Atxuri (I-VII)	Urtiaga (E)	Torre	Atxubita
Aitzbitarte III (III, IV, Va)	Santa Catalina (I)	Kiputz (C, H)	Aitzbitarte III (II)	Palomas
Aitzbitarte IV (IV)		Labeko Koba (IV, VI, IXsup)	Aitzbitarte IV (II)	
Erralla (III, V)		Lezetxiki (IVc)	Baio	
Amalda (VI, IV)		Atxurra (II)	Astigarraga	
Urtiaga (D, Finf, F sup)		Lumentxa (III, IV, V)	Praileaitz (exterior)	
Praileaitz I (Pebble level)		Bolinkoba (III, IV, V)	Urtiagako Leizea	
Ermittia (III, V) Kiputz (D, F)		Arlanpe (IV, 4) Castillo (7, 26)	Ermittia V Labeko Koba (DRS)	

Labeko Koba (IXinf)		Morín (2)	Lumentxa (I-II, VI, VII)	
Lezetxiki (IIIa, IIIb)		Cueto de la Mina (B)	Lezikako Koba	
Santa Catalina (I, II, III)		La Riera (22)	Armotxe	
Santimamiñe (VI, Almp, Csn-Camr, Arg-o)		Las Palomas (8)	Santimamiñe (IV, VII, VIII)	
Axlor (B, D, F)		Reclau Viver (Alfa Sector: B, F)	Atxuri	
Arlanpe (I, 2, D)		Reclau Viver (Alfa Sector: B, F)	Axlor (I-II)	
La Garma A (E-F)		Arrillor	Arlanpe (A-B, C)	
El Ruso I (IV a, IV b)		Antoliñako koba-Lmbc	Ojebar	
El Castillo (14, 8, 6) Altamira (7, 6, 3)		El Otero Las Aguas	Cueva del Valle (II) Santián	
Covalejos (J)		El Linar	A Valiña	
Cueto de la Mina (VII, V)			Bora Gran	
La Riera (24)			Reclau Viver (E)	
Tito Bustillo (1b)			Mollet (3)	

Las Caldas (III-IV, IX)			Can Rubau	

Table 4-Summary table of representations of reindeer in Paleolithic art from the Iberian Peninsula. For full details, see Supplementary Information: Table S3.

Site	Province	Chronology	References
Parietal art			
Altxerri	Gipuzkoa	Advanced Magdalenian	Altuna & Apellaniz (1976)
Cobrante	Cantabria	Early Magdalenian	Rasines & Serna (2009)
Hornos de la Peña	Cantabria	?	Cacho (1999)
Las Monedas	Cantabria	Upper Magdalenian	Ripoll (1972)
La Pasiega	Cantabria	Premagdalenian	Balbín & González-Sainz (1993)
Sovilla	Cantabria	Upper Magdalenian	González-Sainz *et al.* (1993)
Covarón	Asturias	Advanced Magdalenian	Cacho (1999)
Llonín	Asturias	Advanced Magdalenian	Cacho (1999)
Tito Bustillo	Asturias	Advanced Magdalenian	Moure (1992)
Pindal	Asturias	Middle Magdalenian	González-Pumariega (2011)
Peña Candamo	Asturias	?	Corchón et al., unpublished information

	La Hoz	Guadalajara	?	Balbín & Alcolea (1994)
	Reno	Guadalajara	?	Alcolea *et al.* (2000)
	Fuente del Trucho	Huesca	?	Balbín (2008)
Portable art				
	Abauntz	Nafarroa	Upper Magdalenian	Utrilla *et al.* (2009)
	Urtiaga	Gipuzkoa	Upper Magdalenian	González-Sainz (1984)
	La Viña	Asturias	Middle Magdalenian	Fortea (1990)
	Las Caldas	Asturias	Middle Magdalenian	Corchón (1990)

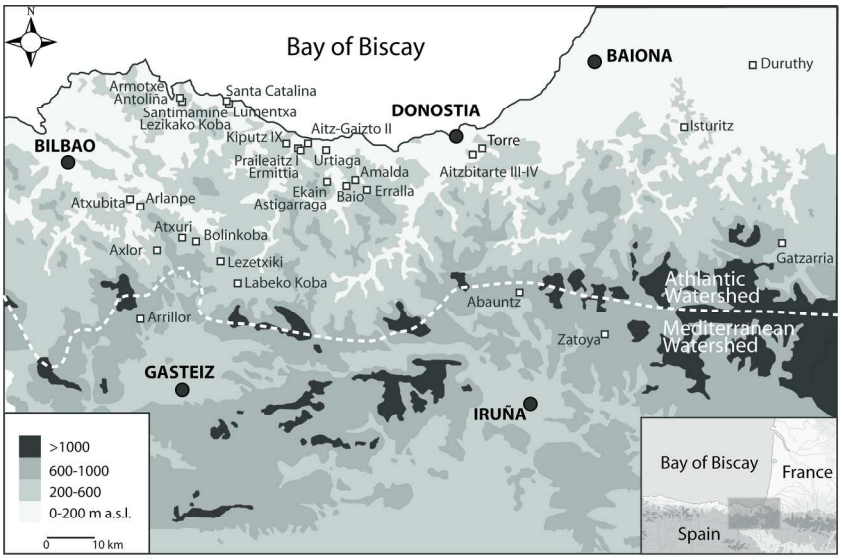

Figure 1. Map of the eastern Cantabrian region showing the sites in the provinces of Biscay, Gipuzkoa and Nafarroa, and other sites discussed in the text. Note that Urtiaga also represents Urtiagako Leizea and that Ermittia also represents Ermittia V.
188x154mm (300 x 300 DPI)

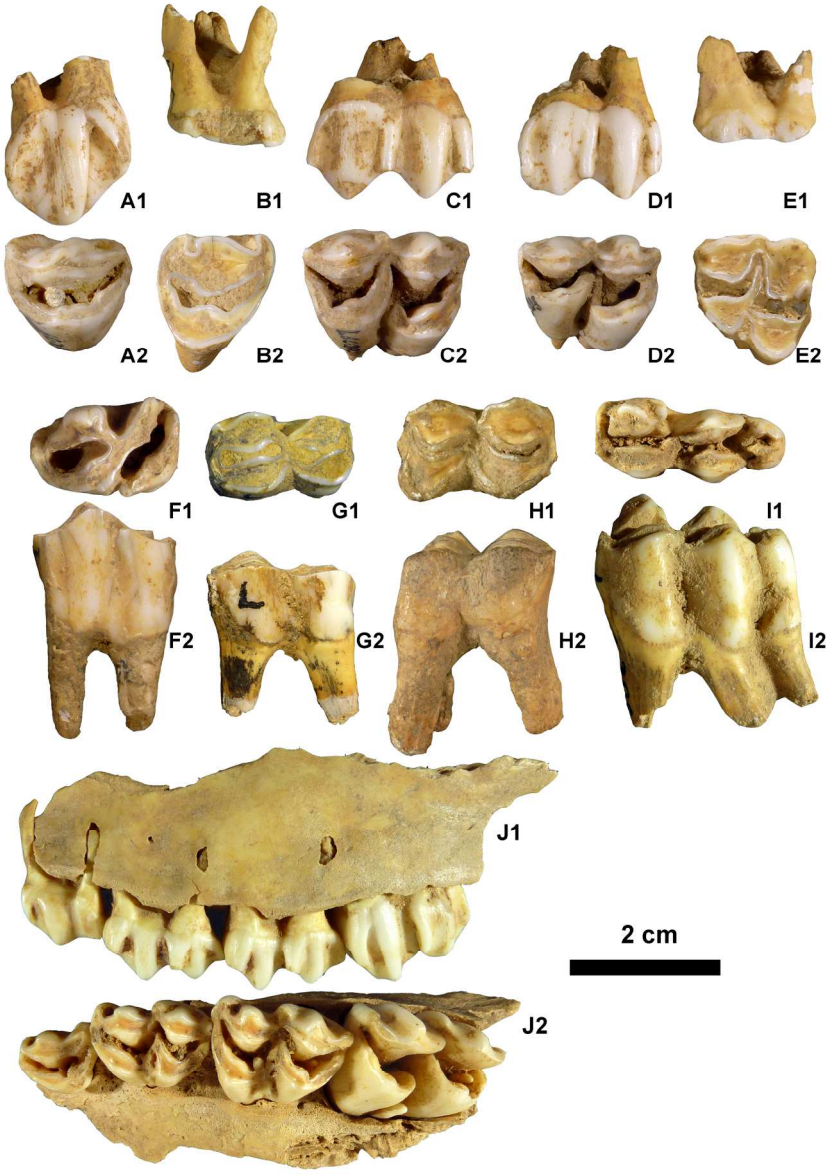

Figure 2. Reindeer tooth and maxillary remains from Lumentxa. A-E) Upper dentition. Labial (A1) and occlusal (A2) views of the right P4 L.6C.205. Labial (B1) and occlusal (B2) views of the left P3 L.7F.155. Labial (C1) and occlusal (C2) views of the right M2 L.6C.205. Labial (D1) and occlusal (D2) views of the left M3 L.6C.205. Labial (E1) and occlusal (E2) views of the right M3 L.9I.125. F-I) Lower dentition. Occlusal (F1) and labial (F2) views of the left P4 L.5D.150. Occlusal (G1) and labial (G2) views of the left M1 L. Occlusal (H1) and labial (H2) views of the right M2 L.13E.80. Occlusal (I1) and labial (I2) views of the left M3 L.5E.200. Left maxilla with D2-M1 (not labelled) in labial (J1) and occlusal (J2) views.
170x235mm (300 x 300 DPI)

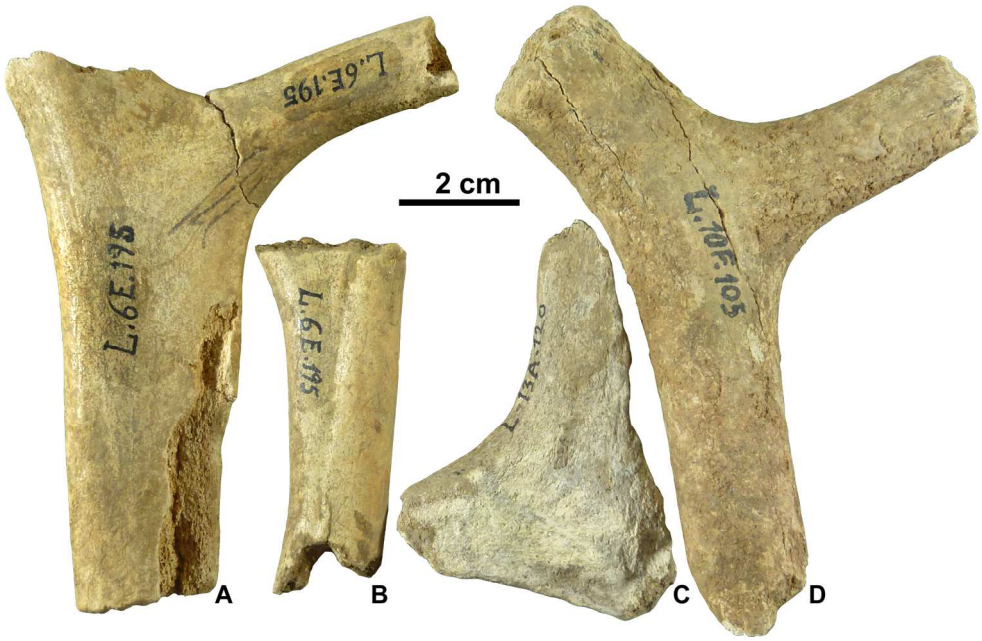

Figure 3. Antler remains from Lumentxa: L.6E.195 (A); L.6E.195 (B); L.13E.80 (C); L.10F.105 (D).
170x107mm (300 x 300 DPI)

Figure 4. Metacarpus remains from Lumentxa. Complete metacarpus from the right side L.6D.216 in ventral (A1) and dorsal (A2) views. Distal fragment from the right side L.9F.230 in ventral (B1) and dorsal (B2) views. Distal fragment from the left side L.1C.365 in ventral (C1) and dorsal (C2) views.
170x174mm (300 x 300 DPI)

Figure 5. Additional postcranial remains from Lumentxa. Proximal fragment of the right radius L.25C.400 in cranial (A1) and ventral (A2) views. Dorsal views of phalanges: 1st foreleg phalanx L.6Y.320 (B), 1st foreleg phalanx with no physical label L.25C.410 (C), 2nd foreleg phalanx L.10D.15 (D), 2nd foreleg phalanx L.9C.10 (E), 1st foreleg phalanx L.12G.25 (F), 1st foreleg phalanx L.9D.10 (G), 3rd phalanx L.6D.216 (H), 3rd lateral phalanx L.9G.365 (I).
170x188mm (300 x 300 DPI)

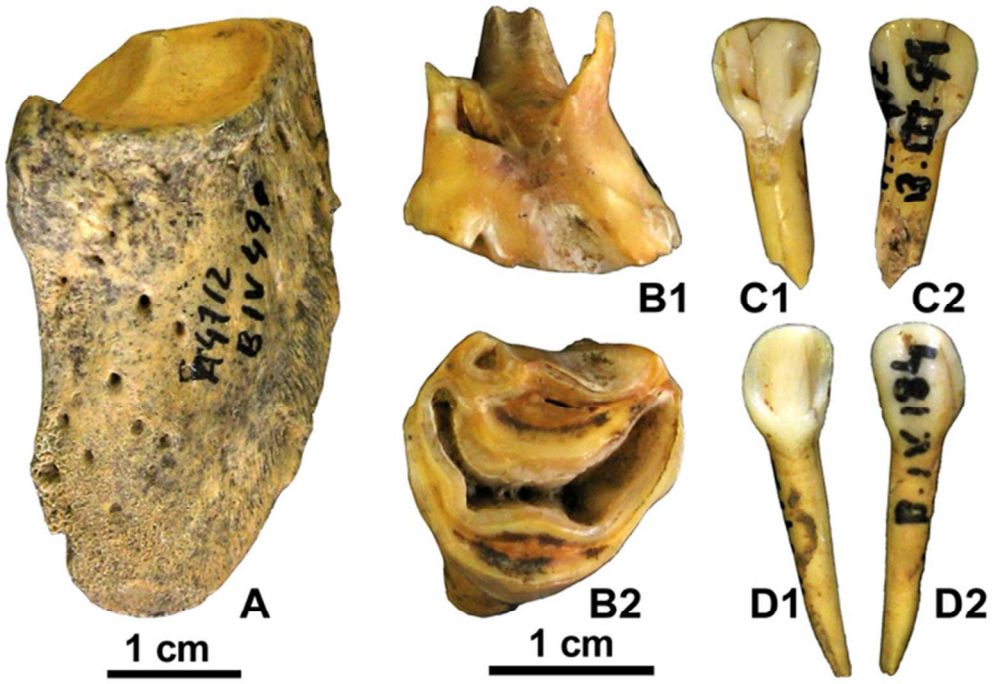

Figure 6. Reindeer remains from Bolinkoba. Third phalanx B.IV.490 in dorsal (A) view. P3 B.V.21 in labial (B1) and occlusal (B2) views. I1 L.III.91 in lingual (C1) and in buccal (C2) views. I2 B.IV.184 in lingual (D1) and in buccal (D2) views.
59x42mm (300 x 300 DPI)

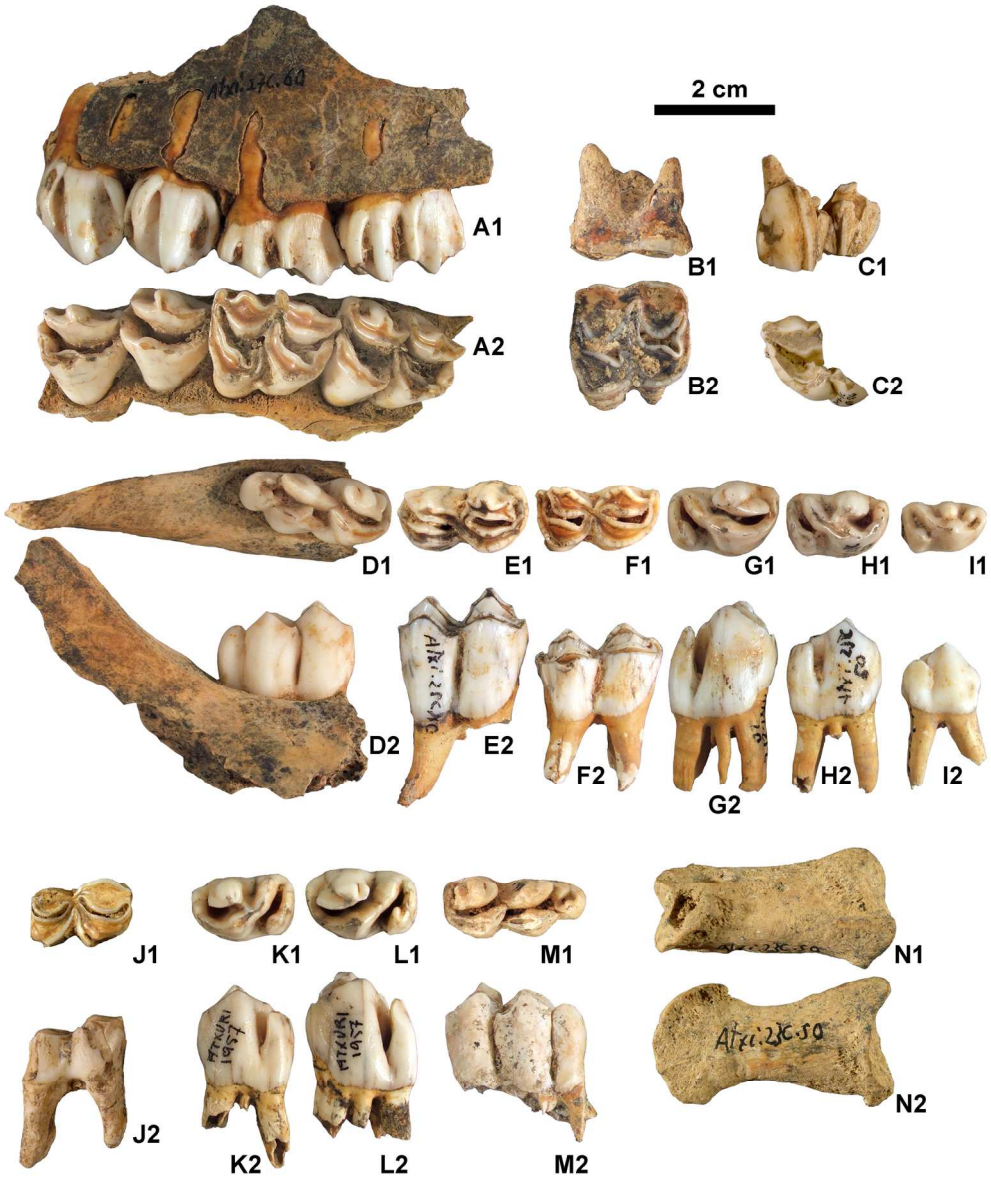

Figure 7. Reindeer remains from Atxuri. Fragment of left maxilla Atxi.27C.60 in labial (A1) and occlusal (A2) views. Left M2 Atxi.23B.110 in labial (B1) and occlusal (B2) views. Upper molar Atxi.1C.50-80 in labial (C1) and occlusal (C2) views. Fragment of right hemi-mandible with M3 Atxi.25B.10 in occlusal (D1) and labial (D2) views. Right M2 Atxi.25C.10 in occlusal (E1) and labial (E2) views. Right M1 Atxi.29B.50 in occlusal (F1) and labial (F2) views. Right P4 Atxi.25C.10 in occlusal (G1) and labial (G2) views. Right P3 Atxi.25C.50 in occlusal (H1) and labial (H2) views. Right P2 Atxi.21B.I.5 in occlusal (I1) and labial (I2) views. Right M1? Atxi.5C.40 in occlusal (J1) and labial (J2) views. Left P3 Atxuri 1957 in occlusal (K1) and labial (K2) views. Left P4 Atxuri 1957 in occlusal (L1) and labial (L2) views. Left M3 Atxi.31D.40 in occlusal (M1) and labial (M2) views. 2nd phalanx of the hind leg Atxi.23C.50 in dorsal (N1) and lateral (N2) views.

170x201mm (300 x 300 DPI)

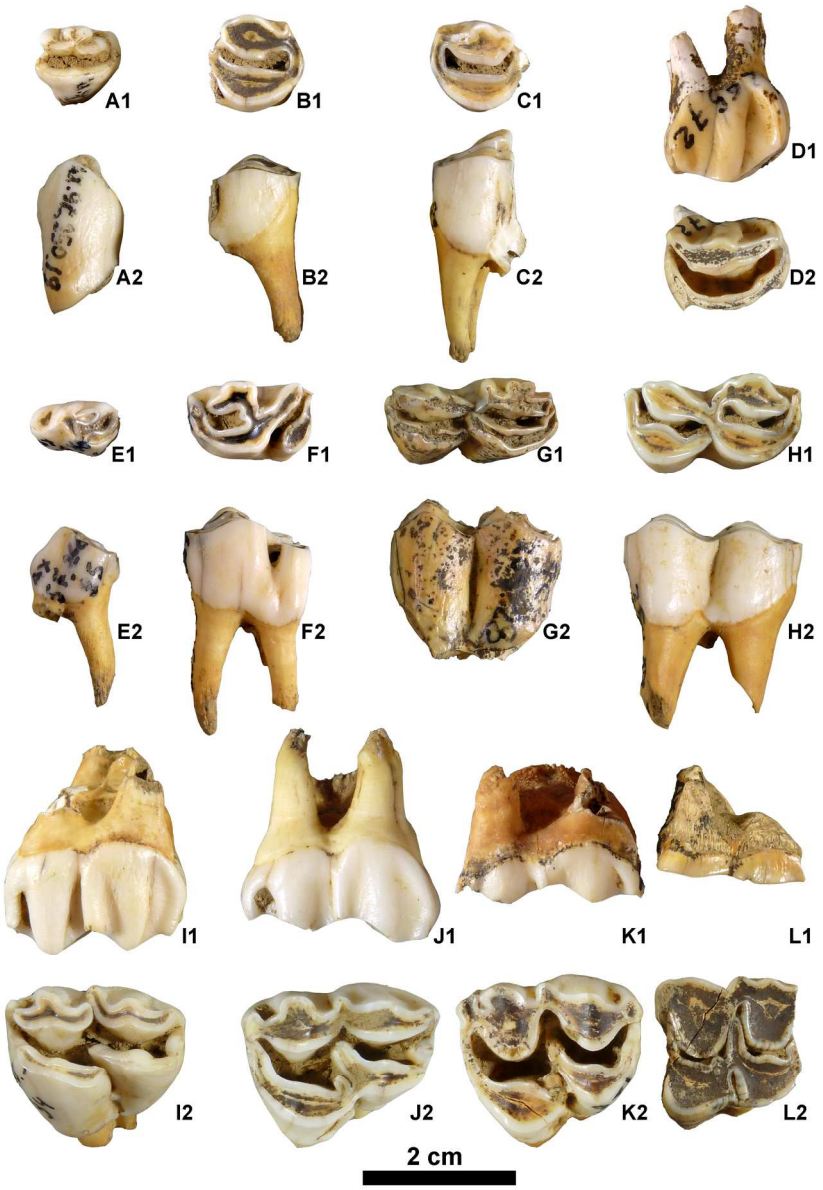

Figure 8. Isolated dental remains from Axlor. Lower M1 Ax.9C.250.19 in occlusal (A1) and buccal (A2) views. Lower molar Ax7F.265.62bis in occlusal (B1) and buccal (B2) views. Lower molar Ax.7F.265.57bis in occlusal (C1) and buccal (C2) views. Right P2 Ax.3F.265.72 in buccal (D1) and occlusal (D2) views. Left P2 Ax.5F.266.85 in occlusal (E1) and buccal (E2) views. Left P3 Ax.5F.266.104 in occlusal (F1) and buccal (F2) views. Left M1-2 Ax.9C.265.28 in occlusal (G1) and buccal (G2) views. Left M2 1973.32 in occlusal (H1) and buccal (H2) views. Left M1-2 Ax.13D._.34 in buccal (I1) and occlusal (I2) views. Left M3 Ax.7F.255.87 in buccal (J1) and occlusal (J2) views. Left M3 Ax.11G.325.126 in buccal (K1) and occlusal (K2) views. Left M1 Ax.7C.1 in buccal (L1) and occlusal (L2) views. Note that Ax.5F.266.85 (E)(left P2) and Ax.5F.266.104 (F)(left P3) could have belonged to the same individual.
170x240mm (300 x 300 DPI)

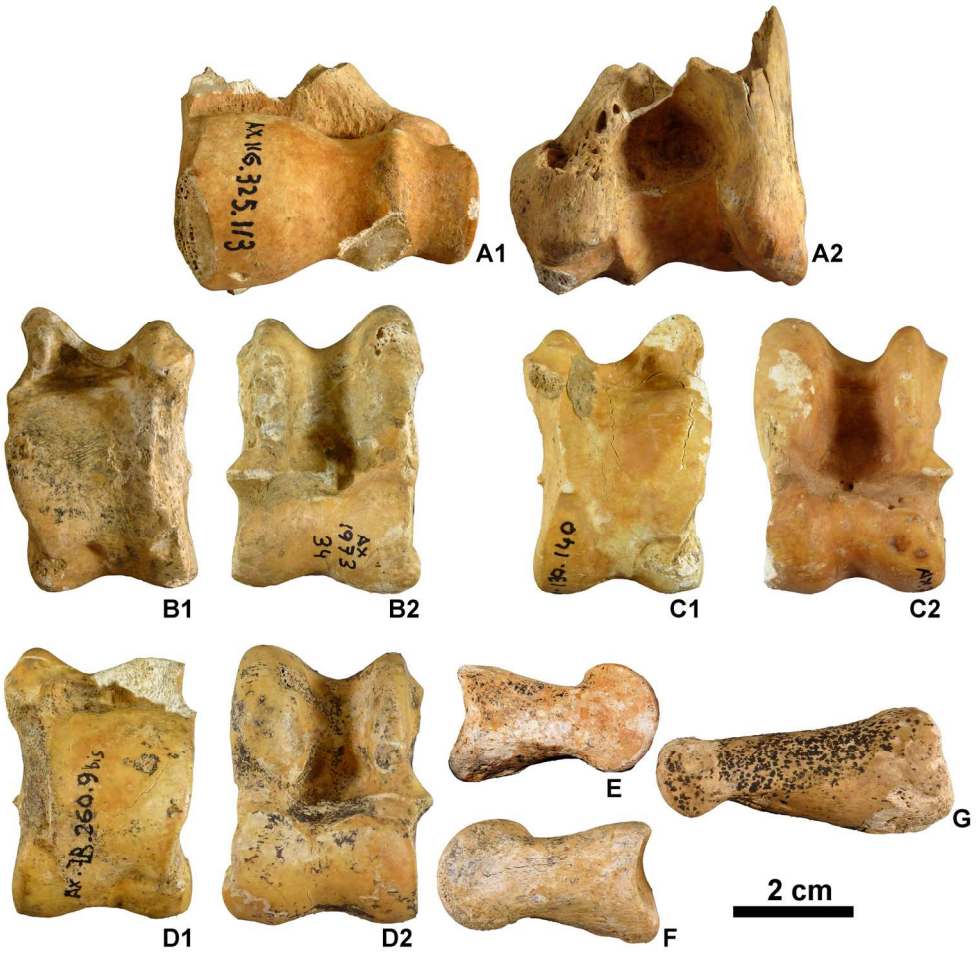

Figure 10. Reindeer postcranial remains from Axlor. Distal fragment of humerus Ax.11G.325.113 in ventral (A1) and dorsal (A2) views. Left talus Ax.1973.34 Ax.1973.34 in tibial (B1) and calcaneal (B2) views. Right talus Ax.7D.60-130.140 in tibial (C1) and calcaneal (C2) views. Right talus Ax.7B.260.9bis in tibial (D1) and calcaneal (D2) views. 2nd phalanx Ax.11E.255.135 in side view (E). 2nd foreleg phalanx Ax.11F.290.455 in side view (F). 1st foreleg phalanx Ax.5D.276.61 in side view (G).
170x163mm (300 x 300 DPI)

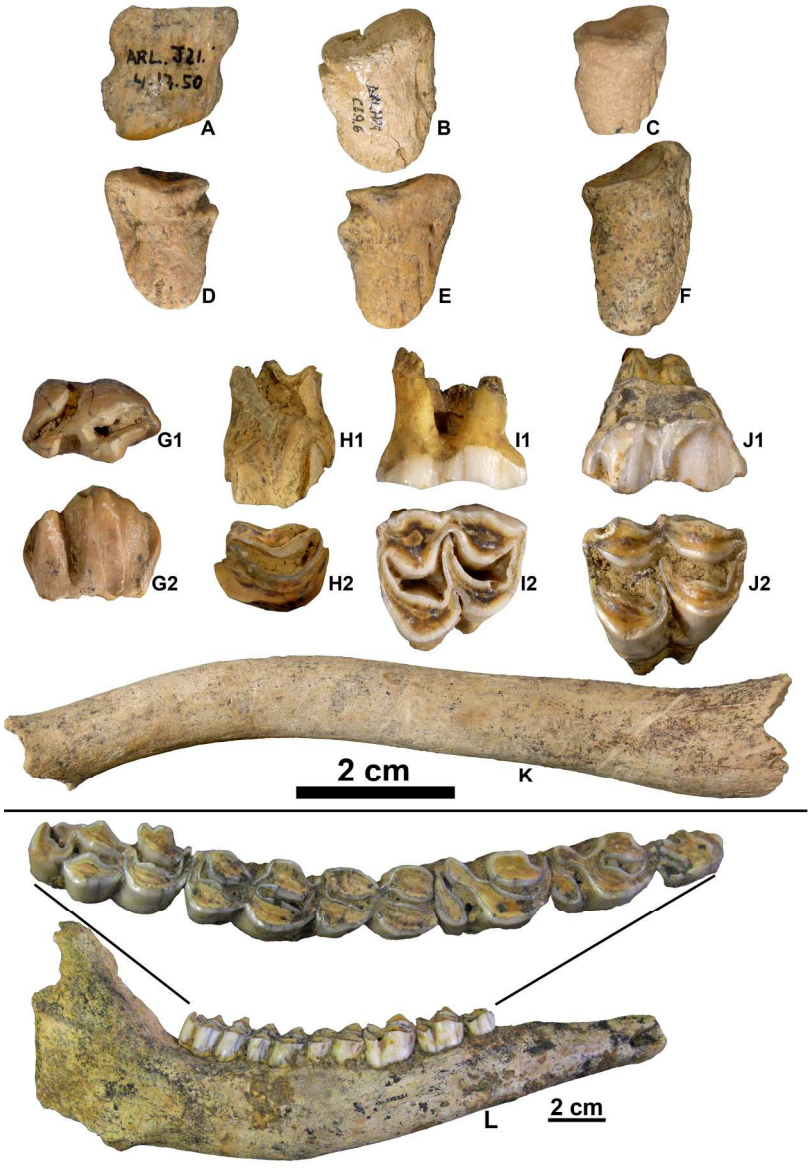

Figure 11. Reindeer remains from Arlanpe. A. Second lateral phalanx (ARL.J21.4.17.50). B-F. Third lateral phalanges (B: ARL.H29.3.9.6; C: ARL.J24.1.9.6; D: ARL.J25.2.2.38; E: ARL.J25.2.5.37; F: ARL.J20.2.2.21). G-J. Dental remains. Occlusal (G1) and labial (G2) views of the lower left P4 ARL.H32.2.5.8. Labial (H1) and occlusal (H2) views of the upper premolar ARL.H32.3.2.8. Labial (I1) and occlusal (I2) views of the M3 from the left side ARL.J20.2.23.35. Labial (J1) and occlusal (J2) views of the M3 from the left side ARL.I29.3.10.2. Antler fragment ARL.H32.2.1.7 (K). Labial view (L) of the nearly complete right hemi-mandible ARL.I30.3.2.1 with a close-up of the occlusal surface of its teeth.
170x254mm (300 x 300 DPI)

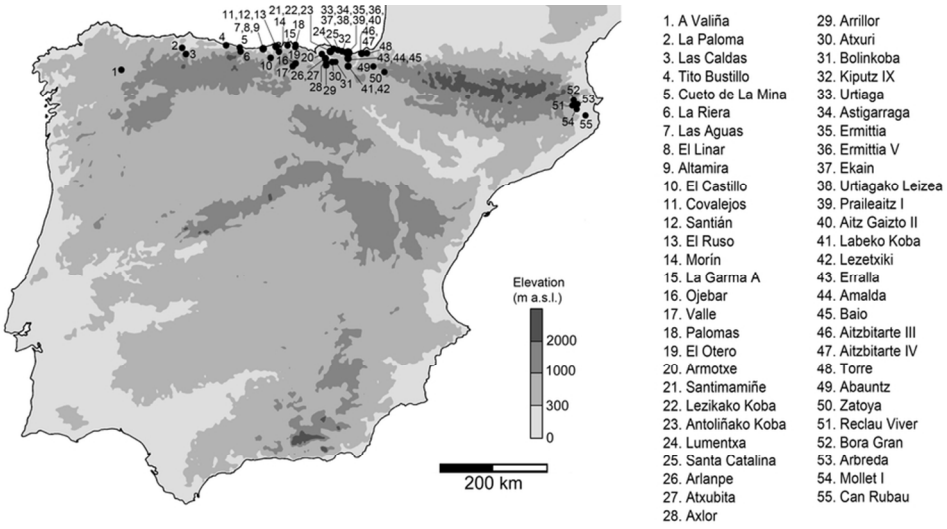

Figure 12. Map of the Iberian peninsula showing sites at which reindeer remains have been found.
83x45mm (300 x 300 DPI)

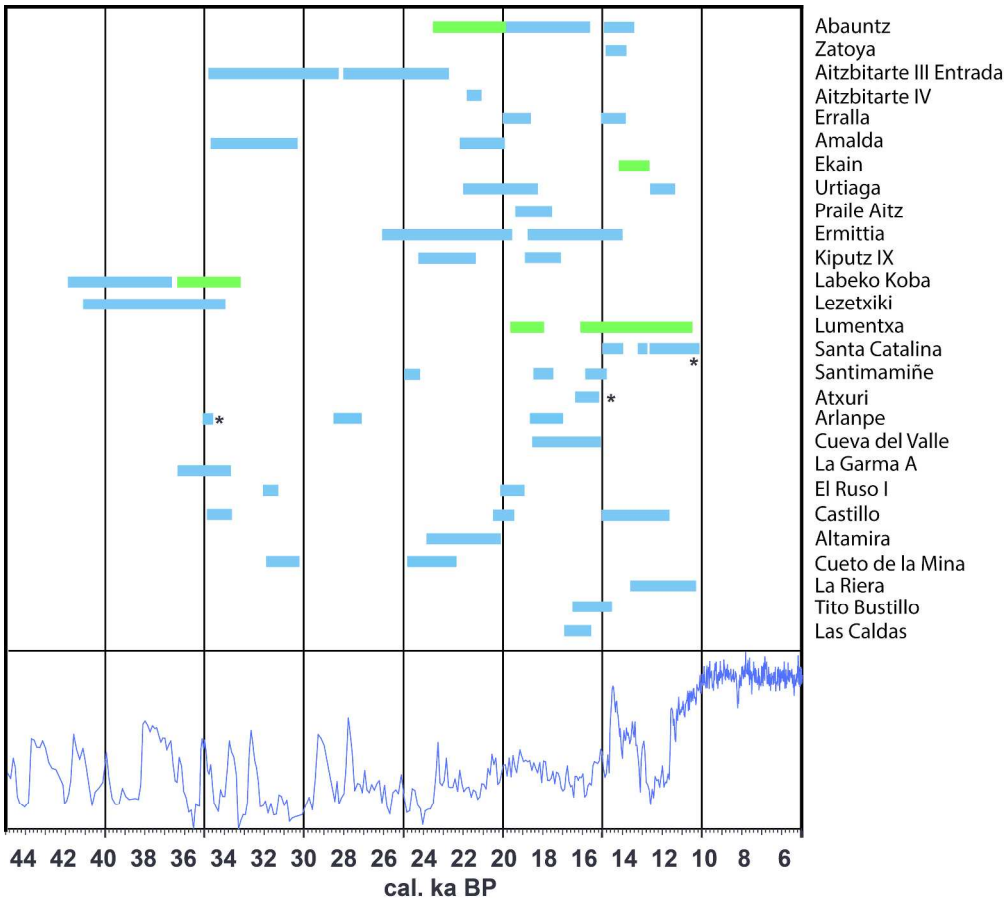

Figure 13. Chronological distribution of the two-sigma dates for the reindeer from the Cantabrian region compared to the GRIP palaeoclimatic oxygen curve. Blue bars represent data from actual dates while green bars are approximate chronologies based on cultural attributions. The asterisks represent the direct dates on reindeer bones from Santa Catalina, Atxuri and Arlanpe presented in Table 2. See Table S2 of Supplementary Information for a complete account of the dates.
152x136mm (600 x 600 DPI)

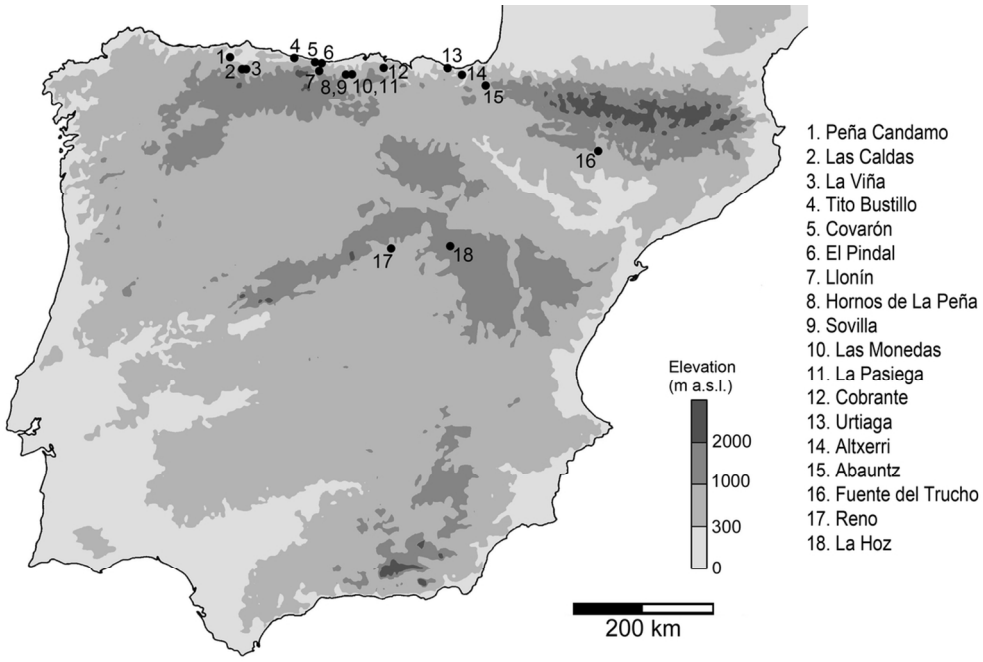

Figure 14. Map of the Iberian Peninsula showing sites where representations of reindeer in art (parietal and/or portable) have been found.
108x70mm (300 x 300 DPI)

SUPPLEMENTARY INFORMATION

1- Reindeer remains from the province of Biscay presented in this paper/List of sites that have yielded palaeontological remains of reindeer/List of sites with representations of reindeer in Paleolithic art from the Iberian Peninsula.

All these informations can be found in the file Sup. Info. 2:

Table S1. Reindeer remains from the province of Biscay presented in this paper.

Table S2. Information on the sites that have yielded palaeontological remains of reindeer.

Table S3. Information on the sites that have yielded representations of reindeer in Paleolithic art from the Iberian Peninsula.

2-Supplementary information on measurements, abbreviations and definitions in artiodactyls

2.1-Mandible

The measurements of the mandible follow von den Driesch (1976).

LC: length of the cheekteeth.
LM: length of the molar row.
LP: length of the premolar row.
HM_3: height of the mandible behind M_3.
HM_1: height of the mandible in front of M_1.
HP_2: height of the mandible in front of P_2.
BM_3: breadth of the mandible behind M_3.
BM_1: breadth of the mandible in front of M_1.
BP_2: breadth of the mandible in front of P_2.

2.2-Teeth

The measurements of the teeth follow van der Made (1989, 1996).

DAP: maximum anteroposterior diameter.
DAPb: anteroposterior diameter at the basal region.
DAPo: anteroposterior diameter at the occlusal surface.
DLL: buccolingual diameter of the incisors and canines.
DTo: transverse diameter of the occlusal surface.
DTa: transverse diameter of the anterior lobe.
DTp: tranverse diameter of the posterior lobe.
DTpp: transverse diameter of the hipoconulid of the third lower molars.
H: crown height.
Ha: height of the anterior lobe.
Hdist: crown height of the incisors at the distal end.
Hla: crown height of the incisor on the buccal side.
Hli: crown height of the incisor on the lingual side.
Hmes: crown height of the incisor on the mesial side.
Hp: height of the posterior lobe.
Ta: enamel thickness of the anterior lobe.
Tp: enamel thickness of the posterior lobe.

2.3-Postcranial remains

The measurements of the postcranial remains follow von Driech (1976) and are displayed in Figure S3.

2.3.1-Humerus
BD: maximum breadth of the distal epiphysis.
DD: maximum depth of the distal epiphysis**.**

2.3.2-Radius

BFP: breadth of the proximal articular surface.
BP: maximum breadth of the proximal epiphysis**.**
DP: maximum depth of the proximal epiphysis.
GL: maximum length of the bone.

2.3.3-Metacarpus

BD: maximum breadth of the distal epiphysis.
BP: maximum breadth of the proximal epiphysis**.**
DD: depth of the distal epiphysis.
DM: maximum depth of the medial condyle.
DL: maximum of the lateral condyle.
DP: maximum depth of the proximal epiphysis.
GL: maximum length of the bone.
SD: width of the shaft.
SDD: minimum depth of the shaft.

2.3.4-Astragalus

ATPL: height of the lateral trochlea.
BD: maximum breadth of the distal epiphysis.
BP: maximum breadth of the proximal epiphysis**.**
DM: maximum depth of the medial end.
DL: maximum of the lateral end.
GLm: maximum length of the medial end.
GLl: maximum length of the lateral end.

2.3.5-First phalanx (anterior and posterior)

BD: maximum breadth of the distal epiphysis.
BP: maximum breadth of the proximal epiphysis**.**
DD: depth of the distal epiphysis.
DPi: maximum depth of the proximal epiphysis.
DPs: depth of the proximal articular surface.
GL: axial length.
GLpe: abaxial length.
Hmax: maximum length.
SD: breadth of the shaft.
SDD: minimum depth of the shaft.

2.3.6-Second phalanx (anterior and posterior)

BD: maximum breadth of the distal epiphysis.
BP: maximum breadth of the proximal epiphysis**.**
DD: depth of the distal epiphysis.
DPi: maximum depth of the proximal epiphysis.
DPs: depth of the proximal articular surface.
GL: axial length.
GLpe: abaxial length.
Hpost: posterior length.
SD: width of the shaft.
SDD: minimum depth of the shaft.

2.3.7-Third phalanx

DLS: greatest diagonal length of the sole.
Ld: length of the dorsal surface.
MBS: middle breadth of the sole.

2.3.8-Second lateral phalanx

DAP: anteroposterior diameter.
DT: transversal diameter.
H: height.

2.3.9-Third lateral phalanx

DAP: anteroposterior diameter.
DT: transversal diameter.
H: height.

Table S4. Measurements (in mm) of the mandible of *Rangifer tarandus*.

Site	Label	r/l	BM_1	BM_3	BP_2	HM_1	HM_3	HP_2	LC	LM	LP
Arlanpe	ARL.I30.3.2.1	r	19.0	15.9	14.3	29.4	(38.5)	27.6	103.9	62.1	44.3
Urtiagako Leizea	Ur.L.L.8 B.C 16	l	16.0	15.6	13.8	34.1	34.5	(29.7)	(100.3)	(61.8)	40.4
	Ur.L.	r	18.8	17.3	15.5	30.3	40.7	32.0	91.7	(55.2)	39.5
	Ur.L (2)	l	18.5			28.6					
Urtiaga	UR.6D.200	r								63.8	
Armotxe	(No label)	l	15.5		11.7	28.2		27.9			45.7

Table S5. Measurements (in mm) of the incisor of *Rangifer tarandus*.

Site	Label	Teeth	r/l	DAP	DLL	Hdist	Hla	Hli	Hmes
Bolinkoba	B.III.91	I_1	r	6.4	4.2	6.8	7.2	6.6	6.5
	B.IV.184	I_2	r	5.2	3.9	6.9	7.7	7.8	7.6

Table S6. Measurements (in mm) of the lower cheek teeth of *Rangifer tarandus*.

Localidad	Sigla	Diente	d/i	DAPo	DAP	DAPb	DTa	DTp	DTpp	DT	DTb	H	Ha	Hp	Ta	Tp
Lumentxa	L.5D.150	P_4	l	18.4	18.6	16.0	10.7	12.7		11.6	12.7	14				
	L	M_1	l	19.6	19.2	18.6	11.2	10.9		10.5	11.2		8.3	7.6	1.1	0.9
	L.13E.80	M_2	r	19.5	18.4	17.9	12.7	12.9		12.9	12.9		9.4	9.4	1.0	1.1
	L.5E.200	M_3	l	24.8	25.5	24.8	10.9	10.3	7.2	10.3	10.9		16.7	14.6	1.3	1.3
Atxuri	Atxi 21B.I.5	P_2	r	13.2	13.7	11.7	7.4	8.1		6.4	8.1	12.8				
	ATXURI 1957	P_3	l	15.8	16.3	13.8	10.3	10.2		9.7	10.3	16.2				
	Atxi 25C.50	P_3	r	15.3	16.1	15.6	10.1	9.9		8.9	10.1	14.9				
	Atxi 25C.10	P_4	r	17.1	18.2	15.9	11.8	10.5		8.4	11.8	17.9				
	ATXURI 1957	P_4	l	17.3	17.7	15.9	11.8	10.8		9.9	11.8	16.9				
	Atxi 25C.10	M_2	r	21.1	21.1	18.2	12.2	11.4		9.7	12.2		14.8	16.1	1.0	1.0
	Atxi 5C.40	$M_{1?}$	r			17.7	12.3	11.4		11.7	12.3		7.9	7.6		0.9
	Atxi 29B.50	M_1	r	20.8	20.4	17.3	11.4	11.5		10.3	11.5		9.9	9.9	1.3	1.0
	Atxi 25B.10	M_3	r	21.8	23.6	(22.7)	11.1	9.9	6.1	8.9	11.1		16.2	14.6		
	Atxi 31D.40	M_3	l	22.9	24.7	23.6	10.4	10.1	7.1	8.8	10.4		15.6	15.1		
Axlor	Ax.5F.265.85	P_2	l	11.2	11.3	9.7	5.9	6.9		6.1	6.9	9.5				
	Ax.5F.266.109	P_3	l	15.9	16.0	13.5	9.7	10.2		9.0	10.2	12.4				
	Ax.7E.265.191	P_4	l	16.7	17.2	12.0	12.6	12.7		11.9	12.7	13.1				
	Ax.7E.265.191	M_1	l	16.2	15.6	15.2	11.7	11.7		11.5	11.7		6.0	5.1	0.9	1.0
	Ax.7E.265.191	M_2	l	19.3	19.5	18.8	12.3	11.2		11.5	12.3		8.8	7.8	0.9	0.9
	Ax.1973.32	M_2	r	21.3	21.3	19.3	11.9	11.2		11.2	11.9		10.6	11.3	1.0	0.9
	Ax.9C.265.28	M_{1-2}	r	20.5	20.6	15.9	10.4	10.9		9.2	10.9		16.7	15.5		
	Ax.7E.245	M_3	l	23.8	24.7	24.5		10.5	5.5				10.6	9.4	1.2	1.0
Arlanpe	ARL.I30.3.2.1	P_2	r	9.5	(9.9)	9.73	7.3	7.4		6.9	7.4	6.07				
	ARL.I30.3.2.1	P_3	r	15.4	(15.4)	14.66	10.7	10.1		9.4	10.5	10.6				
	ARL.I30.3.2.1	P_4	r	17.7	(17.7)	14.9	12.4	11.1		11.0	(11.8)	11.44				
	ARL.H32.2.5.8	P_4	l	18.3	18.6	15.9	9.8	10.9		8.8	10.9	14.92				
	ARL.I30.3.2.1	M_1	r	17.6	(15.7)	(16.5)	11.4	11.2		9.9	(10.9)		7.1	5.5	0.7	0.7
	ARL.I30.3.2.1	M_2	r	20.3	(18.8)	(18.5)	12.5	11.0		(9.8)	(12.3)		9.6	9.5	1.0	1.0

	ARL.I30.3.2.1	M_3	r	23.2	25.6	24.7	11.5	10.6	7.3	(9.9)	(10.9)		12.2	(10.5)	1.0	1.0
Urtiagako Leizea	Ur.L.L.8 B.C 16	P_2	l	10.3	(10.2)	9.1	6.4	7.4		7.4	7.0	8.4				
	Ur.L.L.8 B.C 16	P_3	l	(13.4)	(13.4)	(12.1)	8.7	10.4		9.5	10.5	7.2				
	Ur.L.L.8 B.C 16	P_4	l	(14.8)	(14.8)	(13.0)	12.0	11.4		11.0	11.0	8.6				
	Ur.L.	P_2	r	11.4	(11.7)	9.9	6.3	7.7		7.0	7.1	5.5				
	Ur.L. (2)	P_2	l	10.9	11.2	10.9	6.3	7.3		6.8	7.0	6.0				
	Ur.L. (4)	P_3	r	14.3	12.9	12.9	10.3	10.6		10.8	10.8	4.1				
	Ur.L.	P_3	r	(13.8)	(13.4)	13.3	10.3	9.7		10.1	(10.2)	7.9				
	Ur.L. (2)	P_3	l	15.7	15.5	14.2	10.6	10.1		9.9	10.5	10.1				
	Ur.L.	P_4	r	15.1	14.3	12.5	12.0	9.9		12.1	10.8	7.3				
	Ur.L. (2)	P_4	l	15.7	14.7	12.9	11.8	10.2		11.4	10.9	7.5				
	Ur.L. (4)	P_4	r	16.66	16.5	16.5	12.2	11.8		12.0	12.0	4.1				
	Ur.L.L.8 B.C 16	M_1	l	(16.6)	(16.5)	(16.8)	10.1	10.9		10.7	10.9		4.1	3.0	0.4	0.5
	Ur.L. (4)	M_1	r	19.2	19.2	19.2	10.5	11.5		11.6	11.6			1.2		0.7
	Ur.L.L.8 B.C 16	M_2	l	18.7	(18.0)	(17.3)	11.0	10.5		9.9	11.0		6.6	4.4	0.7	0.6
	Ur.L.	M_2	r	16.1	16.1	16.1	10.6	9.3		10.6	10.6		1.6	1.3		
	Ur.L.	M_3	r	22.0	22.5	21.5	10.1	8.5	5.4	10	10.0		5.3	4.1	0.9	0.5
	Ur.L.L.8 B.C 16	M_3	l				9.5	8.3					9.3	6.1	0.7	0.7
Aitzbitarte IV	AitIV.2L.70	M_1	l	19.4	19.9		9.4	10.2		8.1			14.2	13.5		
	AitIV.7R.70.1	M_2	l	25.1	25.1	21.52	13.1	12		11.9	12.9		12.0	17.6		
	Ait. IV. 7R. 100.R	M_2	l	23.9	24.1	21.75	11.9	11.5		10.7	11.9		14.6	13.3	0.9	1.1
	Ait. IV. 10M. 140.I	M_3	l	(24.1)	24.4	24.51	11.0	10	5.4	11.1	11.0		10.3	9.1		1.0
Armotxe	(No label)	P_2	l	12.1	12.7	11.32	7.4	8.14		6.9	8.2	10.0				
	(No label)	P_3	l	15.6	(15.8)	(13.8)	9.6	9.9		8.5	9.9	13.1				
	(No label)	P_4	l	15.7	(16.5)	(15.1)	10.8	10.3		9.5	(10.4)	14.8				
	(No label)	M_1	l	17.7	(16.8)	(16.2)	10.8	10.7		9.9	10.6		7.6	6.3	0.8	0.8
Urtiaga	"Serie P3-M1"	P_3	r	15.9	15.9	14.4	9.5	10.8		8.7	10.7	12.7				
	UR.6D.200	P_4	r	17.5	17.5	16.0	12.7	12.6		10.9	12.6	12.2				
	"Serie P3-M1"	P_4	r	15.6	(16.5)	14.4	10.6	11.3		9.7	11.0	13.61				
	UR.6D.200	M_1	r	16.9	(16.7)	(16.7)	11.3	11		10.9	11.0		7.1	5.7	0.9	0.7
	UR.9D.265	M_1	l	18.4	(18.6)	16.5	10.9	11.2		8.0	10.1		10.8	11.3	0.9	0.9
	UR.9F.415	M_1	l	20.4	(20.2)	17.8	10.6	10.5		9.5	10.3		10.2	11.0	1.1	0.9
	UR.7D.260	M_1	r	20.4	20.4		10.6			9.1			14.2		0.9	0.9
	UR.9D.300	M_1	l	20.4	21.0	18.7	10.9	11.3		8.9			13.4	13.3	1.1	1.3
	"Serie P3-M1"	M_1	r	17.9	16.8	16.6	10.5	12.2		9.8	11.2		8.4	6.5	0.8	0.7
	UR.5.D.150	M_1	r	19.8	19.9	18.4	11.1	10.3		10.2	11.1		10.9	10.5	0.9	
	UR.6D.200	M_2	r	20.3	(20.4)	17.8	11.8	10.4		11.6	(12.2)		10.1	10.4	1.0	1.0
	UR.9D.265	M_2	l	(20.5)	21.3		11.8	11.3		9.7					1.2	1.2
	UR.7D.260	M_2	r	21.8	21.7											
	UR.9D.300	M_2	l	(20.8)	(21.5)											
	"Serie M2-M3"	M_2	l	19.9	19.8	18.7	12.2	11.5		10.3	12.4		10.9	11.4	1.1	0.9
	UR.7.D.260	M_2	l	21.4	21.3	19.7	11.3	12.1		8.6	11.9		15.3	15.2		0.9
	UR.1.D.130	M_2	l	20.4	20.6	20.0	12.6	11.4		11.0	12.3		10.8	10.2	0.9	0.9
	UR.7.D.270	M_3	r	22.7	23.3	22.2	10.1	9.3	6.3	8.56	10.14		15.5	16.0		
	UR.9.F.415	M_3	l	23.3	24.8	24.4	10.5	10.1	7.1	9.5			17.0	15.7		
	"Serie M2-M3"	M_3	l	23.5	23.9	23.4	10.6	9.4	6.0	9.1	10.4		14.3	13.7		0.9
	UR.6D.200	M_3	r	24.6	23.5	22.9	10.9	9.9	5.9	10.1	11.1		12.7	12.2	1.2	1.1

Lezetxiki	Lz.6C.380	M_3	r	23.8	24.4	22.9	11.4	10.4	5.3	10.2	11.2		12.5	11.6	1.3	1.0

Table S7. Measurements (in mm) of the upper cheek teeth of *Rangifer tarandus*.

Site	Label	Teeth	r/l	DAP	DAPb	DAPo	DTa	DTp	DTo	DTp	H	Ha	Hp	Ta	Tp
Lumentxa	(No label)	D^2	l	11.8	11.2	10.7	6.4	8.8	7.8	8.8	7.8			0.8	
	(No label)	D^3	l	16.1	13.9	16.1	9.8	11.0	10.1	11.0		7.9	7.4	1.0	1.1
	(No label)	D^4	l	17.5	14.0	17.5	11.7	12.6	10.6	12.6		8.2	7.7	1.0	1.0
	L.7F.155	P^3	l	14.2	13.2	15.6	15.7	17.7	16.0	17.6	4.9			0.8	
	L.6C.205	P^4	r	16.5	13.5	16.4	16.3	16.3	11.6	16.2	15.2			0.7	
	(No label)	M^1	l	20.2	17.9	20.3	14.8	14.8	10.4	13.2					
	L.6C.205	M^2	l	21.2	18.7	21.2	17.1	17.1	13.8	16.3		11.5	12.8	1.3	0.9
	L.9I.125	M^3	r	16.6	15.9	16.6	17.2	17.2	17.0	14.0		3.0	3.9	1.0	1.2
	L.6C.205	M^3	r	20.3	17.5	20.3	17.1	17.1	12.5	14.7		12.9	13.4	1.0	1.2
Bolinkoba	B.V.21	P^3	r	14.8	12.6	15.3	14.3	15.5	14.1	15.5	4.9				
Atxuri	Atxi.27C.60	P^3	r	14.3	12.1	15.6	15.7	15.7	10.7	14.9	15.5				
	Atxi.27C.60	P^4	r	14.2	13.2	15.0	15.1	15.1	10.3	12.3	14.1				
	Atxi.1C.50-80	Upper M	l				14.9								
	Atxi.27C.60	M^1	r	19.9	17.3	21.5	16.2	16.2	16.2	15.0		9.1	13.0	0.8	0.8
	Atxi.27C.60	M^2	r	21.7	18.4	20.8	17.2	17.2	16.3	15.9		13.2	14.3	0.8	0.8
	Atxi.23B.110	M^3	l	18.6	17.7	20.1	18.2	18.2	18.8	17.8		2.0	2.0	0.8	0.8
Axlor	Ax.7F.265.72	P^2	r	13.9	9.7	14.8					11.4				
	Ax.7C.1	M^1	l	16.1	15.2	16.4	15.6	15.6	15.7	14.2		2.2	3.6	1.1	0.8
	Ax.13D._.34	M^{1-2}	l	20.2	17.2	19.7	17.6	17.6	12.2	15.5		11.8	12.4	1.2	0.9
	Ax.7F.255.87	M^3	l	21.0	17.8	21.1	18.0	18.0	15.1	15.1		8.2	10.9	1.1	1.1
Arlanpe	ARL.J20.2.23.35	M^3	l	19.5	18.0	19.7	18.2	18.2	17.5	16.2		4.2	4.9	0.9	1.1
	ARL.I29.3.10.2	M^3	l	21.2	17.5	21.2	19.1	19.1	16.4	18.2		9.6	9.1	1.2	1.6
Armotxe	(No label)	P^4	l	14.6	12.9	14.7					13.7				

Table S8. Measurements of the humerus of *Rangifer tarandus*.

Site	Label	r/l	BD	DD
Axlor	Ax.11G.325.113	l	49.3	37.6

Table S9. Measurements of the radius of *Rangifer tarandus*.

Site	Label	r/l	BPF	BP	DP
Lumentxa	L.25C.400	r	38.9	41.6	24.0

Table S10. Measurements of the metacarpus of *Rangifer tarandus*.

Site	Label	r/l	BD	BP	DD	DL	DM	DP	GL	SD	SDD
Lumentxa	L.6D.216	r	38.6	31.5	20.1	20.9	20.2	23.4	181.6	18.9	18.9
	L.1C.365	l	39.3		22.2	21.0	22.2				
	L.9F.230	r	45.2		24.3	23.2	24.3				

Armotxe		r		32.3		21.8		23.6		18.5	20.4

Table S11. Measurements of the astragalus of *Rangifer tarandus*.

Site	Label	r/l	ATLP	BD	BP	DL	DM	GLl	GLm
Axlor	Ax.1973.34	l	29.3	29.3	28.9	25.7	28.6	47.4	44.2
	Ax.7D.60-130.140	r	26.9	28.7	30.3	25.8	26.9	46.1	43.6
	Ax.7B.260.9bis	r			28.6r	26.2	27.1		44.3
Urtiagako Leizea	Ur L.	l	28.5	29.3	27.9	24.1	25.9	44.5	42.0
	Ur L.	r	22.9	28.0	28.0	22.3	23.7	42.3	40.5
	Ur L.	r	28.6	29.8	29.5	26.6	28.4	47.8	44.9
	Ur L.	l	28.7	29.7	29.1	26.6	28.8	47.7	45.2

Table S12. Measurements of the first phalanx of *Rangifer tarandus*.

Site	Label	BD	BP	DD	DPi	DPs	GL	Glpe	Hmax	SD
Lumentxa	L.25C.410 (no physically labelled)	17.1	20.8	12.5	21.1	19.2	48.4	46.0	48.6	14.3
	L.6Y.320	19.2	22.1	13.7	21.6	21.4	49.6	47.7	50.1	17.7
	L.9D.10	18.5	20.9	13.3	19.7	18.7	46.1	45.8	48.7	15.9
	L.12G.25	18.8	21.1	13.3	18.4	20.5	46.3	45.2	48.4	15.5
Atxuri	Atxi 23C.50	14.6	17.4	18.5	20.4	16.3	36.5	34.6	36.9	13.2
Axlor	Ax.5D.276.61	17.5	22.1	11.5	20.9	18.2	46.4	46.1	48.3	15.1
Urtiagako Leizea	Ur L.	17.9	21.4	12.8	21.9	22.6	48.1	49.7	51.7	13.6
	Ur L.	18.2	22.3	13.2			45.0			15.2
	Ur L.	18.2	22.2	13.9	22.2	21.7	49.1	50.2	50.6	15.1
	Ur L.	18.6	23.5	13.5	21.6	21.4	45.4	46.8	49.2	15.7
	Ur L.	18.0	23.0	12.9	21.6	21.2	45.8	47.7	49.1	15.2
	Ur L.	18.6	22.2	13.9	22.3	22.3	48.9	50.2	52.0	14.8

Table S13. Measurements of the second phalanx of *Rangifer tarandus*.

Site	Label	BD	BP	DD	DPi	DPs	GL	Glpe	Hpost	SD
Lumentxa	L.9C.10	16.9	19.5	18.5	14.5	20.6	30.4	28.7	31.0	16.2
	L.10D.15	15.8	18.0	17.9	15.0	19.4	30.5	28.9	30.7	15.9
Axlor	Ax.11F.290.455	16.6	18.7	18.4	20.5	16.4	36.5	32.9	36.1	14.7
	Ax.11E.255.135	17.0		20.5	22.0		37.2			14.0
Urtiagako Leizea	Ur L.	17.3	18.9	20.5	20.2	19.2	34.7	32.6	35.4	14.6
	Ur L.	16.7	19.4	20.4	20.7	19.4	34.6	33.0	34.9	14.9
	Ur L.	17.1	19.0	20.5	20.5	20.1	34.7	33.5	34.7	15.8
	Ur L.	16.4	18.6	18.8	20.0	20.6	36.8	35.3	37.2	13.3
	Ur L.	16.2	19.0	19.3	20.5	20.9	36.7	35.2	37.3	14.3

	Ur L.	16.8	19.4	20.2	19.9	20.1	35.1	32.2	35.2	14.9
	Ur L.	16.3	18.7	19.2	21.2	21.3	36.8	35.1	37.4	14.3

Table S14. Measurements of the third phalanx of *Rangifer tarandus.*

Site	Label	DLS	Ld	MBS
Lumentxa	L.6D.216	43.5	16.4	41.6
Bolinkoba	B.IV.490	45.4	43.4	19.2
Urtiagako Leizea	Ur L.	41.1	41.1	16.3
	Ur L.	40.5	41.0	17.8
	Ur L.	44.2	42.4	18.4
	Ur L.			19.7

Table S15. Measurements of the second lateral phalanx of *Rangifer tarandus.*

Site	Label	DAP	DT	H
Arlanpe	ARL.J21.4.17.50	16.2	8.0	16.8

Table S16. Measurements of the third lateral phalanx of *Rangifer tarandus.*

Site	Label	DAP	DT	H
Lumentxa	L.9G.365	14.8	21.5	25.6
Arlanpe	ARL.H29.3.9.6	14.9	11.9	22.3
	ARL.J24.1.9.6	12.5	8.7	17.5
	ARL.J25.2.2.38	14.3	7.5	18.1
	ARL.J25.2.5.37	16.1	7.9	20.7
	ARL.J20.2.2.21	14.4	8.4	25.0

3-Supplementary information on taphonomic modifications

3.1-Lumentxa

There is evidence of human processing of some of the reindeer remains found at this site. The distal fragments of metacarpal L.1C.365 and L.9F.230 were fractured when the bone was fresh, and the latter also preserves an impact point. Both of these two fragments display shallow parallel cut-marks interpreted as scraping marks.

Figure S1. Metacarpi from Lumentxa with evidences of fresh bone breakage. L.1C.365 in dorsal (a1) and ventral (a2) views of this distal metacarpal fragment. There is evidence of scraping on the ventral surface of the bone (a2, a3). L.9F.230 in dorsal (b1) and ventral (b2) views of this distal metacarpal fragment. The evidence of an impact point is indicated with an arrow. Evidences of scraping on the dorsal surface of the bone (b1, b3).

3.2-Atxuri

The external surface of the maxilla Atxi.27C.60 displays multiple cut-marks: most are incisions, but other are scrapings. The mandibular fragment Atxi.25B.10 shows both cut-marks and anthropogenic fracturing. The fracturing of the mandible is related to the extraction of the marrow.

Figure S2. Lingual view of the Atxi.25B.10 right mandible fragment that preserves the M_3 (a1) and detail of this fossil (a2) showing evidence of incision, scraping and anthropogenic fracturing with percussion, impact points, and a parasitic flake. Lingual view of the left maxilla Atxi.27C.60 (b1) and detail of this fossil (b2) in which it is possible to see multible cut marks, mainly incisions, but also evidence of scraping. All scale bars = 1 cm.

3.3-Axlor

There are clear cut-marks on the astragalus Ax.7D.60-130.140 probably related to the disarticulation of the tarsal bones. There is also evidence of anthropogenic breakage on the humerus Ax.116.325.113 (morphology of the fracture lines, impact points (see sup. info.). Finally, the mandibular fragments Ax.7E.265 and Ax.7E.245 show evidences of having being burnt.

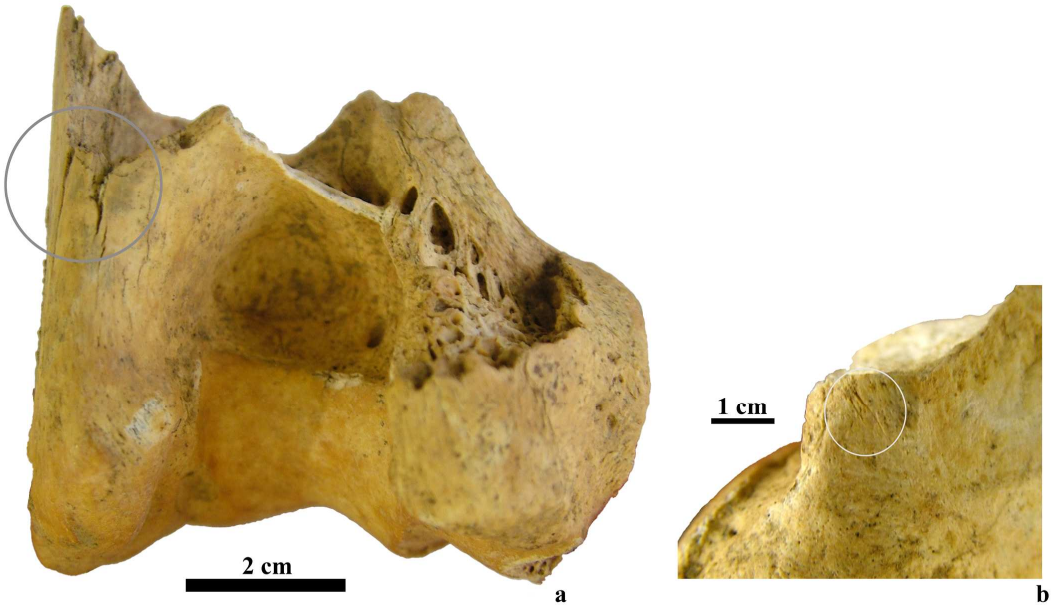

Figure S3. Posterior view of the distal epiphysis of the humerus Ax.11G.325.113 (a) in which it is possible to see the impact point. Medial view (b) of the humerus in which it is possible to see cut marks related to cutting ligaments during the disarticulation of the foreleg from the radius-ulna.

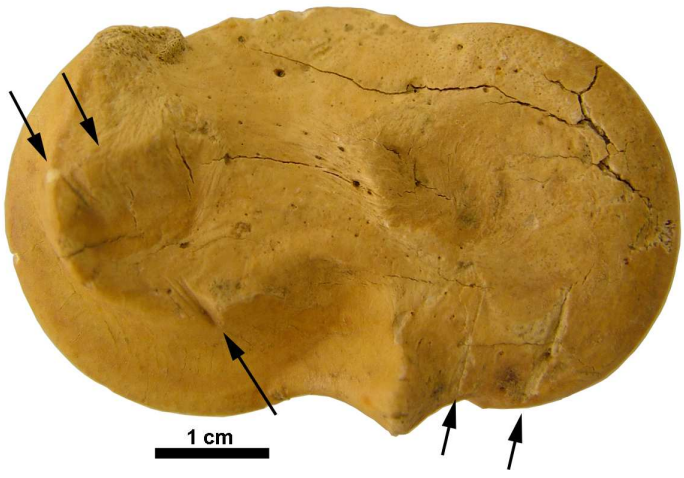

Figure S4. Cut-marks on the complete talus Ax.7D.60.130.140. These are short, deep and with a clear "V"-shaped cross-section. These marks are probably related to the disarticulation of the talar bones.

3.4-Arlanpe

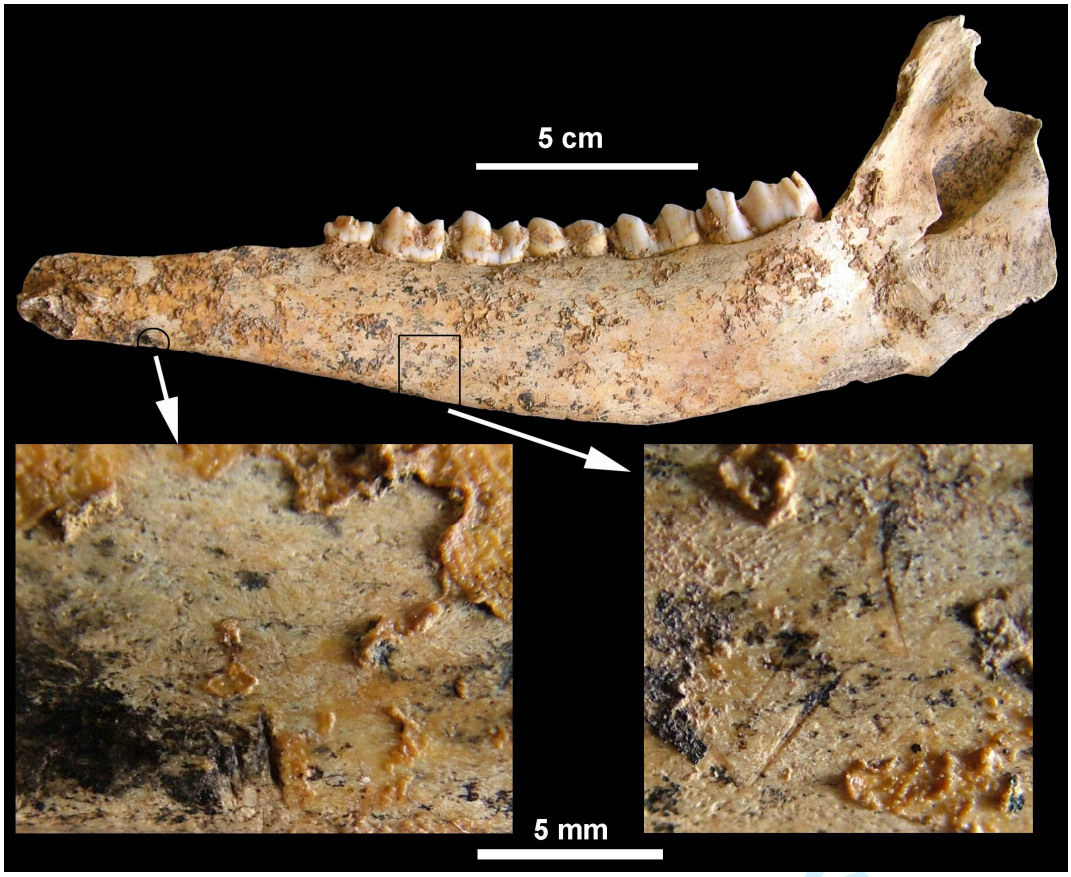

Figure S5. Lingual view of the mandible ARL.I30.3.2.1 in which it is possible to see some possible anthropogenic modifications.

4-Supplementary information on the alleged presence of reindeer in the cave of Armiña

Obermaier (1925) quotes the presence of reindeer in the cave of Armiña (also known as Errecas or Errekas, at Berriatua, province of Biscay; see Altuna, 1972) based on information provided by E. Harlé. He says that the presence of reindeer was provided for the first time by E. Harlé for the sites of Serinyá, Aitzbitarte, Armiña, Valle, Ojebar and Palomas. The cave of Armiña was found when the road between Amoroto and Berriatua was built in the mid 19th century (Adán de Yarza (1892). Gálvez-Cañero (1912) quotes the work by Adán de Yarza (1892) in which both Marqués del Socorro and Ramón Adán de Yarza found a large number of cave bear remains in Armiña (see also Puig y Larraz, 1896). Gálvez-Cañero (1912) believes that these remains were at that time curated at the Natural History Museum of Madrid. In fact, Domingo et al. (2005) have described the faunal remains from the Cantabrian region curated at the Natural History Museum of Madrid, including remains from a cave in Berriatua composed of 58 *Ursus spelaeus* fossils and a horse specimen, that in our opinion correspond to Armiña. Domingo et al. (2005) attribute these remains to either of the two caves described by Altuna (1972) in Berriatua (Atxurra and Goikolau). However, Altuna (1972) also references Armiña in this work. Thus, in the faunal remains found by Marqués del Socorro and Ramón Adán de Yarza there are no reindeer remains. Later, Altuna (1972) dug a test pit in Armiña and mostly found cave bear remains. Harlé (1908a, 1912) certifies the presence of reindeer in Serinyá, Aitzbitarte, Valle, Ojebar and Palomas, but no mention to Armiña is provided, even though at that time Armiña was already known. In our view there is no solid evidence for the presence of reindeer in Armiña, Obermaier quoted Harlé's works but wrongly introduced Armiña into the list attributed to this author.

Supplementary information- Bibliography

Adán de Yarza, R. 1892: Descripción física y geológica de la provincia de Vizcaya. *Memorias de la Comisión del Mapa Geológico de España*, 192 pp., Madrid.

Alcolea, J. J., Balbín, R., Jiménez, P. J., García, M. A. & Foyo, A. 2000: La cueva de El Reno (Valdesotos, Guadalajara). Una visión de conjunto de su arte parietal paleolítico. *In* Oliveira, J. V. (ed.): *Congreso de Arqueología Peninsular. Vol. 2: Paleolítico da Península Ibérica*, 525-540. ADECAP, Porto.

Altuna, J. 1971a: El reno en el Würm de la Península Ibérica. *Munibe 23*, 71-90.

Altuna, J. 1971b: Los mamíferos del yacimiento prehistórico de Morín (Santander). *In* González Echegaray, J. & Freeman, L. G. (eds.): *Cueva Morín. Excavaciones 1966-68*, 367-398. Publicaciones del Patronato de Cuevas Prehistóricas de Santander, Santander.

Altuna, J. 1972: Fauna de mamíferos de los yacimientos prehistóricos de Guipúzcoa. *Munibe 24*, 1-492.

Altuna, J. 1976: Los mamíferos del yacimiento prehistórico de Tito Bustillo (Asturias). *In* Moure, A. & Cano, M. (eds.): *Excavación en la Cueva de Tito Bustillo*, 149-194. Instituto de Estudios Asturianos, Oviedo.

Altuna, J. 1984: Primer hallazgo de Mamut (*Mammuthus primigenius* Blumenbach) en el País Vasco Meridional. *Munibe 36*, 27-32.

Altuna, J. 1985: Dataciones de C14. Comparación con las dataciones de otros yacimientos. *Munibe (Antropologia-Arkeologia) 37*, 25-28.

Altuna, J. 1986: The mammalian faunas from the prehistoric site of La Riera. *In* Straus, L. G. & Clark, G. (eds.): *La Riera Cave, Stone Age Hunter Gatherer adaptations in Northern Spain*, 237-274. Anthropological Papers, University of Arizona.

Altuna, J. 1989: La subsistance d'origine animal pendant le Moustérien dans la région Cantabrique (Espagne). *In* Pathou, M. & Freeman, L. G. (eds.): *L'Homme de Neandertal. La Subsistence. Actes du Colloque International de Liège. Volume 6*, 41-43. ERAUL, Liège.

Altuna, J. 1990: Caza y alimentación procedente de Macromamíferos durante el Paleolítico de Amalda. *In* Altuna, J., Baldeón, A. & Mariezkurrena, K. (eds.): *La Cueva de Amalda (Zestoa, País Vasco). Ocupaciones paleolíticas y postpaleolíticas.*, 149-192. Fundación José Miguel de Barandiarán-Sociedad de Estudios Vascos.

Altuna, J. 1992: El medio ambiente durante el Pleistoceno Superior en la región Cantábrica con referencia especial a sus faunas de mamíferos. *Munibe (Antropologia-Arkeologia) 43*, 13-29.

Altuna, J. 2004: Estudio biométrico de *Vulpes vulpes* L y *Alopex lagopus* L. Contribución a su diferenciación en los yacimientos paleolíticos cantábricos. *Munibe (Antropologia-Arkeologia) 56*, 45-59.

Altuna, J. 2011a: Aitzbitarte III situación. Descripción del valle y de la cueva. Historia de las excavaciones recientes. Descripción del relleno (zona de entrada). Dataciones de radiocarbono. *In* Altuna, J., Mariezkurrena, K. & Ríos, J. (eds.): *Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva)*, 23-38. Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Altuna, J. 2011b: Cueva de Ekain. *Arkeoikuska: investigación arqueológica 2010*, 346-348.

Altuna, J. & Apellániz, J. M. 1976: Las figuras rupestres paleolíticas de la cueva de Altxerri (Guipúzcoa). *Munibe 54*, 1-241.

Altuna, J., Armendariz, A., Etxeberria, F., Mariezkurrena, K., Peñalver, X. & Zumalabe, F. 1995: Carta Arqueológica de Gipuzkoa. II. Cuevas. *Munibe (Antropologia-Arkeologia) Suplemento 10, 260 pp*.

Altuna, J., Baldeón, A. & Mariezkurrena, K. 1985: Cazadores magdalenienses en Erralla (Cestona, País Vasco). Munibe (Antropologia-Arkeologia) 37. 206 pp. Aranzadi Zientzia Elkartea, Donostia-San Sebastian.

Altuna, J., Baldeón, A. & Mariezkurrena, K. 1990: La Cueva de Amalda (Zestoa, País Vasco). Ocupaciones paleolíticas y postpaleolíticas. Fundación José Miguel de Barandiarán-Sociedad de Estudios Vascos.

Altuna, J. & Mariezkurrena, K. 1982: Restos óseos del yacimiento prehistórico de Abauntz (Arraiz, Navarra). *Trabajos de Arqueología Navarra 3*, 347-354.

Altuna, J. & Mariezkurrena, K. 1984: Bases de subsistencia, de origen animal, de los pobladores de Ekain. *In* Altuna, J. & Merino, J. M. (eds.): *El yacimiento prehistórico de la cueva de Ekain (Deba, Guipúzcoa)*, 211-280. Sociedad de Estudios Vascos.

Altuna, J. & Mariezkurrena, K. 1985: Bases de subsistencia de los pobladores de Erralla: Macromamíferos. In: J.Altuna, A. Baldeón & K. Mariezkurrena (Dir.). Cazadores magdalenienses en Erralla (Cestona, País Vasco). *Munibe (Antropologia-Arkeologia) 37*, 87-117.

Altuna, J. & Mariezkurrena, K. 2000: Macromamíferos del yacimiento de Labeko Koba (Arrasate, País Vasco). *Munibe (Antropologia-Arkeologia) 52*, 107-181.

Altuna, J. & Mariezkurrena, K. 2001: Restos de macromamíferos del yacimiento de Zatoya (Navarra). *Trabajos de Arqueología Navarra 15*, 101-114.

Altuna, J. & Mariezkurrena, K. 2010: Tafocenosis en yacimientos del País Vasco con predominio de grandes carnívoros. Consideraciones sobre el yacimiento de Amalda. *In* Baquedano, E. & Rosell, J. (eds.): *Zona Arqueológica 13. Actas de la 1ª Reunión de científicos sobre cubiles de hienas (y otros grandes carnívoros) en los yacimientos arqueológicos de la Península Ibérica*, 214-228. Museo Arqueológico Regional, Alcalá de Henares.

Altuna, J., Mariezkurrena, K. & Elorza, M. 2002: Arqueozoología de los niveles paleolíticos de Abauntz (Arraiz, Navarra). *Saldvie. Estudios de Prehistoria y Arqueología 2*, 1-26.

Altuna, J., Mariezkurrena, K., Ríos, F. & Wesbuer, J. 2010: Contorno recortado de ave en el yacimiento de Ekain (Deba, País Vasco). *IFRAO Congress. Pléistocene Art of the World. Ariège - Pyrénées, France*, 230-231 & CD1299-CD-1310, Ariège.

Altuna, J., Mariezkurrena, K. & Ríos, J. 2011: Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva). Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Altuna, J. & Merino, J. M. 1984: *El yacimiento prehistórico de la Cueva de Ekain (Deba, Guipuzcoa). Colección Barandiarán.* 351 pp. Sociedad de Estudios Vascos, San Sebastián.

Altuna, J. & Straus, L. G. 1976: The Solutrean of Altamira. The Artifactual and the Faunal Evidence. *Zephyrus 26-27*, 175-182.

Álvarez-Lao, D. J. 2007: Revisión paleontológica de los macromamíferos indicadores de clima frío en el Pleistoceno de la Península Ibérica. *Departamento de Geología.* Universidad de Oviedo, Oviedo.

Álvarez-Lao, D. J. & García, N. 2010: Chronological distribution of Pleistocene cold-adapted large mammal faunas in the Iberian Peninsula. *Quaternary International 212*, 120-128.

Antxieta Arkeologi Taldea & Iriarte-Chiapusso, M. J. 2012: Cueva Aitz Gaizto II (Lastur). *Arkeoikuska: investigación arqueológica 2011*, 335-336.

Areso, P., Aranzasti, M., Olaskoaga, M. & Uriz, A. 1990: Sedimentología de la cueva de Amalda. *In* Altuna, J., Baldeón, A. & Mariezkurrena, K. (eds.): *La Cueva de Amalda (Zestoa, País Vasco). Ocupaciones paleolíticas y postpaleolíticas.*, 63-115. Fundación José Miguel de Barandiarán-Sociedad de Estudios Vascos.

Areso, P. & Uriz, A. 2011: Estudio del sedimento del yacimiento de Aitzbitarte III (zona de entrada). *In* Altuna, J., Mariezkurrena, K. & Ríos, J. (eds.): *Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva)*, 39-55. Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Arrizabalaga, Á. 1995: *La industria lítica del Paleolítico Superior Inicial en el Oriente Cantábrico*. 1050 pp. Departamento de Geografía, Prehistoria y Arqueología. Universidad del País Vasco, Vitoria-Gasteiz.

Arrizabalaga, A. 2000: El yacimiento arqueológico de Labeko Koba (Arrasate, País Vasco). Entorno. Crónica de las investigaciones. Estratigrafía y estructuras. Cronología absoluta. *Munibe (Antropologia-Arkeologia) 52*, 15-72.

Arruabarrena, J. M., Mujika Alustiza, J. A. & Sasieta Larrañaga, M. 2008: Cueva de Astigarraga. *Arkeoikuska: investigación arqueológica 2007*, 336-339.

Aura, J. E., Tiffagom, M., Jordá Pardo, J. F., Duarte, E., Fernández de la Vega, J., Santamaria, D., de la Rasilla, M., Vadillo, M. & Pérez Ripoll, M. 2012: The Solutrean-Magdalenian transition: A view from Iberia. *Quaternary International 272-273*, 75-87.

Balbín, R. 2008: El Arte Rupestre Paleolítico al aire libre en la Península Ibérica. *In* Balbín, R. (ed.): *Arte Prehistórico al aire libre en el Sur de Europa*, 17-54 pp. Consejería de Cultura y Turismo. Junta de Castilla y León, Valladolid.

Balbín, R. & Alcolea, J. J. 1994: Arte paleolítico de la Meseta Española. *Complutum 5*, 97-138.

Balbín, R. & González Sainz, C. 1993: Nuevas investigaciones en la cueva de La Pasiega (Puente Viesgo, Cantabria). *Boletín del Seminario de Estudios de Arte y Arqueología 59*, 9-34.

Baldeón, A. 1990: La industria lítica de los niveles paleolíticos. *In* Altuna, J., Baldeón, A. & Mariezkurrena, K. (eds.): *La Cueva de Amalda (Zestoa, País Vasco). Ocupaciones paleolíticas y postpaleolíticas.*, 63-115. Fundación José Miguel de Barandiarán-Sociedad de Estudios Vascos.

Baldeón, A. 1993: El yacimiento de Lezetxiki (Guipuzkoa, País Vasco): Los niveles musterienses. *Munibe (Antropologia-Arkeologia) 45*, 3-97.

Barandiarán, I. 1967: *Paleomesolítico del Pirineo Occidental. Bases para la sistematización tipológica del instrumental óseo paleolítico. Monografías arqueológicas.* pp. Universidad de Zaragoza, Zaragoza.

Barandiarán, I. 1971: Hueso con grabados paleolíticos, en Torre (Oyarzun, Guipúzkoa). *Munibe XXIII*, 37-69.

Barandiarán, I. & Cava, A. 2001: El Paleolítico superior de la cueva de Zatoya (Navarra): actualización de los datos en 1997. *Trabajos de Arqueología Navarra 15*, 5-99.

Berganza, E., Arribas, J. L., Castaños, P., Elorza, M., González-Urquijo, J. E., Ibáñez, J. J., Iriarte-Chiapusso, M. J., Morales Muñiz, A., Pemán, E., Rosales, T., Roselló Izquierdo, E., Ruiz Idarraga, R., Uriz, A., Uzquiano, P., Vásquez, V. & Zapata Peña, L. 2012: La transición al tardiglaciar en la costa oriental de Bizkaia: el yacimiento de Santa Catalina. Resultados preliminares. *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la Primera Mesa Redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 171-182. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Berganza, E. & Ruiz, R. 2004: *Una piedra, un mundo: un percutor magdaleniense decorado*. 6 pp. Diputación Foral de Álava, Vitoria-Gasteiz.

Boyer-Klein, A. 1976: Análisis polínico de la Cueva de Tito Bustillo (Asturias). *In* Moure, A. & Cano, M. (eds.): *Excavación en la Cueva de Tito Bustillo (Asturias)*, 201-207. Instituto de Estudios Asturianos, Oviedo.

Breuil, H. & Obermaier, H. 1935: *La Cueva de Altamira en Santillana del Mar*. 236 pp. Tipografía de Archivos, Madrid.

Cabrera Valdés, V. 1984: *El yacimiento de la cueva de "El Castillo" (Puente Viesgo, Santander). Bibliotheca Praehistorica Hispana*. 488 pp. Consejo Superior de Investigaciones Científicas, Instituto Español de Prehistoria, Madrid.

Cacho, R. 1999: Las representaciones animales en el arte rupestre paleolítico de la región cantábrica. Un acercamiento a su estructuración y variabilidad. *Departamento de Ciencias Históricas*. Universidad de Cantabria, Santander.

Castaños, J., Castaños, P. & Murelaga, X. 2006: Estudio osteométrico preliminar de los restos de ciervo (*Cervus elaphus*) del yacimiento paleontológico del Pleistoceno Superior de Kiputx IX (Mutriku, Gipuzkoa). *Geogaceta 40*, 163-166.

Castaños, J., Castaños, P. & Murelaga, X. 2006: Estudio osteométrico preliminar de los restos de ciervo (*Cervus elaphus*) del yacimiento paleontológico del Pleistoceno Superior de Kiputx IX (Mutriku, Gipuzkoa). *Geogaceta 40*, 163-166.

Castaños, J., Castaños, P., Murelaga, X. & Alonso-Olazabal, A. 2012: Kiputz IX: un conjunto singular de bisonte estepario (*Bison priscus* Bojanus, 1827) del Pleistoceno Superior de la Península Ibérica. *Ameghiniana 49*, 247-261.

Castaños, J., Castaños, P., Murelaga, X., Alonso-Olazabal, A., Ortega, L. A. & Zuluaga, M. C. In press: Osteometric analysis of scapula and humerus for *Rangifer tarandus* and *Cervus elaphus*: a contribution to cervid discrimination (Late Pleistocene, Southern Pyrenees). *Acta Palaeontologica Polonica doi: http://dx.doi.org/10.4202/app.2012.0027*.

Castaños, P. 1980: La Macrofauna de la Cueva de la Paloma. *In* Hoyos Gómez, M. & Martínez Navarrete, M. I. (eds.): *La Cueva de La Paloma. Soto de las Regueras (Asturias)*. 65-100. Excavaciones Arqueológicas en España, Madrid.

Castaños, P. 1982: Estudio de los Macromamíferos del yacimiento de Cueto de La Mina. *Boletín del Instituto De Estudios Asturianos 105/106*, 43-86.

Castaños, P. 1986: Los Macromamíferos del Pleistoceno y Holoceno de Vizcaya. Faunas asociadas a los yacimiento arqueológicos. Universidad del País Vasco-Euskal Herriko Unibertsitatea, Leioa.

Castaños, P. 2010: Nuevas cavidades con carnívoros y humanos en el Cantábrico oriental. *In* Baquedano, E. & Rosell, J. (eds.): *Zona Arqueológica 13. Actas de la 1ª Reunión de científicos sobre cubiles de hienas (y otros grandes carnívoros) en los yacimientos arqueológicos de la Península Ibérica*, 262-268. Museo Arqueológico Regional, Alcalá de Henares.

Castaños, P. & Castaños, J. 2011: Estrategias de caza en la secuencia prehistórica de Santimamiñe. *La Cueva de Santimamiñe: revisión y actualización (2004-2006). Excavaciones arqueológicas en Bizkaia, Kobie 1*, 197-206.

Castaños, P., Murelaga, X., Bailon, S., Castaños, J., Saez de Lafuente, X. & Suarez, O. 2009: Estudio de los vertebrados del yacimiento de Lezikako Koba (Kortezubi, Bizkaia). *Kobie (Serie Paleoantropología) XXVIII*, 25-50.

Castaños, P. M. 2005: Revisión actualizada de las faunas de macromamíferos del Würm antiguo en la Región Cantábrica. *In* Lasheras, J. A. & Montes, R. (eds.): *Neandertales cantábricos, estado de la cuestión*, 201-207. Museo de Altamira, Santander.

Castaños, P. M. 2009: Cueva de Lezika. *Arkeoikuska: investigación arqueológica 2008*, 273-275.

Corchón, M. S. 1990: La cueva de Las Caldas. Investigaciones efectuadas entre 1980 y 1986. *Excavaciones Arqueológicas en Asturias. 1983-1986*, 37-53. Consejería de Educación, Cultura, Deportes y Juventud. Principado de Asturias, Oviedo.

Corchón, M. S. 1995: Reflexiones acerca de la cronología del Magdaleniense cantábrico: las dataciones 14C de la Cueva de las Caldas (Asturias, España). *Zephyrus 48*, 3-19.

Corchón, M. S., Álvarez-Fernández, E. & Rivero Vilá, O. 2012: Contactos extra-cantábricos en el Magdaleniense medio: nuevos datos de la Cueva de Las Caldas (Oviedo, Asturias). *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la Primera Mesa Redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 113-127. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Crane, H. R. & Griffin, J. B. 1965: *University of Michigan Radiocarbon dates, X*. 123-152 pp. University of Michigan, Michigan.

de la Rasilla, M. 1990: Cueto de la Mina. Campañas 1981-1986. *Excavaciones Arqueológicas en Asturias 1*, 80-86.

Delibrias, G., Romain, O. & Le Hasif, G. 1987: Datation par la méthode du carbone 14 du remplissage de la grotte de l'Arbreda. *Cypsela: revista de prehistòria i protohistòria 6*, 133-135.

Domingo, M. S., Alberdi, M. T., Sánchez-Chillón, B. & Cerdeño, E. 2005: La fauna cuaternaria de la cornisa cantábrica en las colecciones del Museo Nacional de Ciencias Naturales. *Munibe (Antropologia-Arkeologia) 57*, 5-30.

Dupré, M. 1990: Análisis polínico de la cueva de Amalda. *In* Altuna, J., Baldeón, A. & Mariezkurrena, K. (eds.): *La Cueva de Amalda (Zestoa, País Vasco). Ocupaciones paleolíticas y postpaleolíticas.*, 49-51. Fundación José Miguel de Barandiarán-Sociedad de Estudios Vascos.

Esparza, X. & Mujika Alustiza, J. 1999: Reflexiones en torno a la estratigrafía de Ermittia (Deva, Guipúzcoa). *XXIV Congreso Nacional De Arqueología, Volumen 1*, 61-69, Murcia.

Estévez, J. 1977-78: Un percutor en asta de reno hallado en Serinyà (Girona). *Pyrenae 13-14*, 301-305.

Estévez, J. 1979: La fauna del Pleistoceno catalán. *Facultat de Geografia i Història.* 520 pp. Universitat de Barcelona, Barcelona.

Estévez, J. 1980: El aprovechamiento de los recursos faunísticos: Aproximación a la economía en el Paleolítico catalán. *Cypsela: revista de prehistòria i protohistòria 3*, 9-30.

Estévez, J. 1987: La fauna de l'Arbreda (sector Alfa) en el conjunt de faunes del Pleistocè Superior. *Cypsela: revista de prehistòria i protohistòria VI*, 73-87.

Euskal Arkeologia Etnografia eta Kondaira Museoa 1995: *Txostena 1994 Memoria*. 94 pp. Bizkaiko Foru Aldundia-Bilboko Udala, Bilbao.

Falguères, C., Yokoyama, Y. & Arrizabalaga, A. 2005-2006: La Geocronología del yacimiento pleistocénico de Lezetxiki(Arrasate, País Vasco): crítica de las dataciones existentes y algunas nuevas aportaciones. *Munibe (Antropologia-Arkeologia) 57*, 93-106.

Fernández Eraso, J. 1985: *Las culturas del tardiglaciar en Vizcaya*. 94 pp. Servicio Editorial, Universidad del País Vasco, Leioa.

Fernández Rodríguez, C. & Ramil-Rego, P. 1996: Catálogo y revisión crítica de las colecciones faunísticas del Museo Provincial de Lugo. *Boletín do Museo Provincial de Lugo 7*, 189-218.

Fortea, J. 1990: Abrigo de la Viña. Informe de las Campañas 1980-1986. *Excavaciones Arqueológicas en Asturias. 1983-1986*, 55-68. Consejería de Educación, Cultura, Deportes y Juventud. Principado de Asturias, Oviedo.

Galobart, A., Maroto, J. & Ros, X. 1996: Las faunas cuaternarias de mamíferos de la cuenca de Banyolas-Besalú (Girona). *Revista Española de Paleontología Nº Extraordinario*, 248-255.

Gálvez-Cañero, A. 1912: Nota acerca de las cavernas de Vizcaya. *Boletín del Instituto Geológico de España XXXIII. Tomo XIII. Segunda Serie*, 151-198.

Garate, D. 2008: *Neandertales y Cromañones. Los primeros pobladores de Bizkaia*. 270 pp. Diputación Foral de Bizkaia, Bizkaikoa y Arkeologi Museoa, Bilbao.

García-Gelabert, M. P. 2005: El trabajo sobre hueso en el Magdaleniense Superior Final del grupo humano de la Cueva del Valle, Rasines, Cantabria. Campañas de los años 1996, 1997, 1998. *Zephyrus 58*, 111-134.

Gil-García, M. J. & Ruiz-Zapata, M. B. 2005: Los neandertales cantábricos: su paisaje vegetal. *In* Lasheras, J. A. & Montes, R. (eds.): *Neandertales cantábricos, estado de la cuestión*, 489-504. Museo de Altamira, Santander.

Gómez-Olivencia, A., Arceredillo, D., Rios-Garaizar, J., Garate, D., Iriarte, E. & San Pedro, Z. in press: Dental anomalies in the mandible of *Capra pyrenaica*: presence of two permanent fourth premolars in a Pleistocene wild goat from Arlanpe cave (Bizkaia, Northern Spain). *Journal of Osteoarchaeology http://onlinelibrary.wiley.com/doi/10.1002/oa.1295/abstract*.

González Echegaray, J. & Freeman, L. G. 1978: *Vida y muerte en Cueva Morín*. 357 pp. Institución Cultural de Cantabria, Santander.

González Echegaray, J., García Guinez, M. A. & Beginez Ramirez, A. 1966: *Cueva del Otero. Excavaciones Arqueológicas en España 53*. 84 pp. Ministerio de Cultura, Madrid.

González Sainz, C. 1984: Sobre la plaqueta grabada magdaleniense de la cueva de Urtiaga (Guipúzcoa). *Munibe (Antropologia-Arkeologia) 36*, 11-17.

González Sainz, C., Montes, R. & Muñoz, E. 1993: La cueva de Sovilla (San Felices de Buelna, Cantabria). *Zephyrus 46*, 7-35.

González Urquijo, J. E., Ibáñez, J. J. & Rios-Garaizar, J. 2008: Axlor. *Arkeoikuska: investigación arqueológica 2007*, 218-223.

González-Pumariega, M. 2011: *La cueva de El Pindal 1911-2011. Estudio de su arte rupestre cien años después de Les cavernes de la région cantabrique.* 212 pp. Ménsula Ediciones, Oviedo.

Harlé, E. 1908a: Ossements de renne en Espagne. *L'Anthropologie 19*, 573-577.

Harlé, E. 1908b: Faune quaternaire de la province de Santander (Espagne). *Bulletin de la Société géologique de France 4e ser. t.8*, 300-302.

Harlé, E. 1912: Ensayo de una lista de mamíferos y aves del cuaternario conocidos hasta ahora en la Península Ibérica. *Boletín del Instituto Geológico de España T. XII, 2ª serie. T. XXXII*, 135-162.

Hedges, R. E. M., Housley, R. A., Law, I. A., Perry, C. & Gowlett, J. A. J. 1987: Radiocarbon dates from the Oxford AMS system: Archaeometry datelist 6. *Archaeometry 29*, 289-306.

Hoyos Gómez, M. & de la Rasilla, M. 1994: Dataciones C14 del Paleolítico Superior del Abrigo de Cueto de la Mina (Posada de Llanes, Asturias). *Trabajos de Prehistoria 51*, 143-148.

Hoyos Gómez, M., Martínez Navarrete, M. I., Chapa Brunet, T., Castaños, P. & Sanchiz, F. B. 1980: *La cueva de la Paloma. Soto de Regueras (Asturias)*. 227 pp. Ministerio de Cultura. Dirección General de Bellas Artes, Archivos y Bibliotecas, Madrid.

Hoyos, M., Saenz de Buruaga, A. & Ormazabal, A. 1999: Cronoestratigrafía y paleoclimatología de los depósitos prehistóricos de la cueva de Arrillor (Araba, País Vasco). *Munibe (Antropologia-Arkeologia) 51*, 137-151.

Hoyos, M. M. & Fumanal, M. P. 1985: La cueva de Erralla: estudio sedimentológico. *Munibe (Antropologia-Arkeologia) 37*, 29-43.

Iriarte-Chiapusso, M. J. 2011: El medio vegetal del yacimiento de Aitzbitarte III (Rentería, País Vasco), a partir de su análisis palinológico. *In* Altuna, J., Mariezkurrena, K. & Ríos, J. (eds.): *Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva)*, 57-78. Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Lasheras, J. A., Fernández Valdés, J. M., Montes, R., Rasines, P., Blasco, E., Soutullo, B., de las Heras, C. & Fatás, P. 2012: La Cueva de Altamira: nuevos datos sobre su yacimiento arqueológico (sedimentología y cronología). *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas De La Primera Mesa Redonda. San Román De Candamo (Asturias) 26-28 De Abril De 2007*, 67-75. PUbliCan - Ediciones de la Universidad de Cantabria, Santander.

López Quintana, J. C. & Guenaga Lizasu, A. 2011: Revisión estratigráfica del depósito arqueológico de la cueva de Santimamiñe (Kortezubi, Bizkaia): Campañas de 2004 a 2006. Cronoestratigrafía y paleoambiente. *Kobie (Serie BAI) 1*, 7-70.

Mariezkurrena, K. & Altuna, J. 1989: Análisis arqueozoológico de los Macromamíferos del yacimiento de Zatoya (Abaurrea Alta, Navarra),. *Trabajos de Arqueología Navarra 8*, 237-266.

Maroto, J. 1984: El pas del Paleolític Superior a Catalunya i la seva interpretació dins el context geogràfic franco-ibèric. 376 pp. *Departament de Geografia, Història i Història de l'Art.* Universitat de Girona, Girona.

Maroto, J. 1994: El pas del paleolític mitjà al paleolític superior a Catalunya i la seva interpretació dins del context geogràfic franco-ibèric. *Departament de Geografia, Història i Historia de l'Art.* Universitat de Girona, Girona.

Maroto, J., Julià, R., López-García, J. M. & Blain, H.-A. 2012: Chronological and environmental context of the Middle Pleistocene human tooth from Mollet Cave (Serinyà, NE Iberian Peninsula). *Journal of Human Evolution 62*, 655-663.

Maroto, J., Soler, N. & Mir, A. 1987: La cueva de Mollet I (Serinyà, Gerona). *Cypsela: revista de prehistòria i protohistòria VI*, 101-110.

Maroto, J., Vaquero, M., Arrizabalaga, Á., Baena, J., Baquedano, E., Jordá, J., Julià, R., Montes, R., Van Der Plicht, J., Rasines, P. & Wood, R. 2012: Current issues in late Middle Palaeolithic chronology: New assessments from Northern Iberia. *Quaternary International 247*, 15-25.

Moure, A. 1992: *La cueva de Tito Bustillo. El arte y los cazadores del Paleolítico*. pp. Trea, Gijón.

Moure, A. 1997: Dataciones AMS de la cueva de Tito Bustillo (Asturias). *Trabajos de Prehistoria 54*, 135-142.

Mujika Alustiza, J. A. & Peñalver, X. 2012: La ocupación de la cuenca del Deba (Gipuzkoa) durante el Magdaleniense Inferior. *In* Arias, P., Corchón, M. S., Menéndez, M. & Rodríguez, J. A. (eds.): *El Paleolítico Superior Cantábrico. Actas de la primera mesa redonda. San Román de Candamo (Asturias) 26-28 de abril 2007*, 97-112. PUbliCan-Ediciones de la Universidad de Cantabria, Santander.

Muñoz, E. 1991: Excavaciones arqueológicas en la Cueva del Ruso I. Avance preliminar. *Arquenas 1991*, 61-157.

Muñoz, E. & Serna, A. 1999: Los niveles solutrenses de la Cueva del Ruso I. *Sautuola VI*, 161-176.

Nadal, J., Albert, R. M. & Juan, J. 1997: Nuevas aportaciones arqueozoológicas y arqueobotánicas del yacimiento magdaleniense de la Bora Gran d'en Carreras (Serinyà, Pla de l'Estany). *In* Fullola, J. M. & Soler, N. (eds.): *El Món Mediterrani Després Del Pleniglacial (18.000-12.000 BP)*, 365-373. Museu d'Arqueologia de Catalunya, Girona, Girona.

Nolte, E. 1968: *Catálogo de simas y cuevas de la provincia de Vizcaya*. pp. Diputación de Vizcaya, Bilbao.

Nolte, E. 1971: Nota sobre nuevos yacimientos prehistóricos en cuevas de las provincias de Vizcaya y norte de Burgos. *Munibe 23*, 355-373.

Obermaier, H. 1925: El Hombre fósil. *Comisión de investigaciones Paleontológicas y Prehistóricas. Memoria Nº 9.* 397 pp. *Madrid*.

Pemán, E. 2011: Los micromamíferos del yacimiento de Aitzbitarte III (Rentería, Gipuzkoa) (Zona de entrada). *In* Altuna, J., Mariezkurrena, K. & Ríos, J. (eds.): *Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva)*, 481-492. Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Puig y Larraz, G. 1896: *Cavernas y simas de España*. Boletín de la Comisión del Mapa Geológico de España XXI, tomo I, 2ª serie, 443 pp. Madrid.

Puig y Larraz, G. 1900: Hallazgo de una cueva con restos humanos y de mamíferos en Lemona (Vizcaya) por el Sr. Uriarte y Eizaga. *Actas de la Sociedad Española de Historia Natural*, 268-269.

Rasines, P. & Serna, M. A. 2009: El arte rupestre paleolítico de la cueva de Cobrante. *Sautuola 15*, 215-220.

Ríos, J., Iriarte, E., Gárate, D., Gómez-Olivencia, A. & San Pedro, Z. 2008: Nuevos datos sobre la transición entre el Solutrense superior y el Magdaleniense inferior en la región cantábrica: la cueva de Arlanpe (Lemoa, Vizcaya). *Sautuola XIV*, 95-104.

Rios-Garaizar, J. 2010: Organización económica de las sociedades Neandertales: el caso del nivel VII de Amalda (Zestoa, Gipuzkoa). *Zephyrus LXV*, 15-37.

Rios-Garaizar, J. 2011: El nivel IXb de Ekain (Deba, Gipuzkoa): Una ocupación efímera del Auriñaciense Antiguo. *Munibe (Antropologia-Arkeologia) 62*, 87-100.

Rios-Garaizar, J. 2012: *Industria lítica y sociedad en la Transición del Paleolítico Medio al Superior en torno al Golfo de Bizkaia.* 564 pp. PUbliCan - Ediciones de la Universidad de Cantabria, Santander.

Rios-Garaizar, J., Arrizabalaga, Á. & Villaluenga, A. 2012: Haltes de chasse du Châtelperronien de la Péninsule Ibérique. Labeko Koba et Ekain (Pays Basque Péninsulaire). *L'Anthropologie 116*, 532-549.

Rios-Garaizar, J., de la Peña Alonso, P. & San Emeterio Gómez, A. 2011: Estudio de las industrias líticas y óseas de la entrada de Aitzbitarte III (zona de la entrada). *In* Altuna, J., Mariezkurrena, K. & Ríos, J. (eds.): *Ocupaciones Humanas en Aitzbitarte III (País Vasco) 33.600-18.400 BP (Zona de entrada a la cueva)*, 79-351. Eusko Jaurlaritzaren Argitalpen Zerbitzu Nagusia, Gasteiz.

Rios-Garaizar, J., Garate, D., Gómez, A. & Iriarte, E. 2010: Cueva de Arlanpe. III Campaña. *Arkeoikuska: investigación arqueológica 2009*, 282-285.

Rios-Garaizar, J., Garate, D., Gómez, A. & Iriarte, E. 2011b: Cueva de Arlanpe. IV Campaña. *Arkeoikuska: investigación arqueológica 2010*, 247-250.

Rios-Garaizar, J., Garate, D., Gómez-Olivencia, A., Arceredillo, D., Iriarte, E., García, A. & San Pedro, Z. In press: El final del Solutrense en el oriente cantábrico a través de las ocupaciones de la cueva de Arlanpe (Lemoa, Bizkaia). *Zephyrus*.

Rios-Garaizar, J., Garate, D., Gómez-Olivencia, A., Iriarte-Avilés, E., Aramburu-Artano, A., Arceredillo Alonso, D., García, A., Iriarte-Chiapusso, M. J., Moreno, J., Murelaga, X., Ortiz, J. E., Torres, T., San Pedro-Calleja, Z. & Zapata-Peña, L. 2011a: The Lower to Middle Palaeolithic transition in northern Iberia: new data from Arlanpe Cave. *Antiquity 85*, http://antiquity.ac.uk/projgall/rios-garaizar329/.

Rios-Garaizar, J., Iriarte, E., Gómez, A. & Garate, D. 2009: Cueva de Arlanpe. II Campaña de excavación. *Arkeoikuska: investigación arqueológica 2008*, 289-292.

Rios-Garaizar, J., Iriarte, E., Gómez, A., Garate, D., Marcos, Z., Regalado, E. & San Pedro, Z. 2008b: Cueva de Arlanpe. I Campaña de excavación. *Arkeoikuska: investigación arqueológica 2007*, 270-272.

Rios-Garaizar, J., Iriarte, E., Gómez, A., Garate, D. & Regalado, E. 2007: Cueva de Arlanpe. *Arkeoikuska: investigación arqueológica 2006*, 145-148.

Ripoll, E. 1972: La Cueva de Las Monedas en Puente Viesgo. *Monografías de Arte Rupestre, nº 11*, 67 pp. Diputación Provincial de Barcelona, Barcelona.

Ripoll, S. 1989: El Solutrense en la zona pirenaica oriental *Espacio, Tiempo y Forma. Serie I. Prehistoria y Arqueología 2*, 61-87.

Sanguino, J. & Montes, R. 2005: Nuevos datos para el conocimiento del Paleolítico Medio en el centro de la Región Cantábrica: la cueva de Covalejos (Pielagos, Cantabria). *In* Lasheras, J. A. & Montes, R. (eds.): *Neandertales cantábricos, estado de la cuestión*, 489-504. Museo de Altamira, Santander.

Sierra, L. 1913: Gruta de Ojebar. *Boletín de la Real Sociedad Española de Historia Natural XIII*, 271-298.

Soler, N. & Maroto, J. 1987: Els nivells d'occupaciò del Paleolític Superior a la cova de l'Arbreda (Serinyà, Girona). *Cypsela: revista de prehistòria i protohistòria VI*, 221-228.

Straus, L. G. & Clark, G. 1986: La Riera Cave. Stone Age hunter-gatherer adaptations in northern Spain. *Anthropological research papers 36*.

Straus, L. G., González Morales, M. R., Martínez, M. A. F. & García-Gelabert, M. P. 2002: Last Glacial human settlement in Eastern Cantabria (Northern Spain). *Journal of Archaeological Science 29*, 1403-1414.

Stuart, A. J., Kosintsev, P. A., Higham, T. F. G. & Lister, A. M. 2004: Pleistocene to Holocene extinction dynamics in giant deer and woolly mammoth. *Nature 431*, 684-689.

Utrilla, P. 1976: El Magdaleniense inicial en el País Vasco Peninsular. *Munibe 28*, 245-275.

Utrilla, P. 1986: La varilla "pseudoexcisa" de Aitzbitarte IV y sus paralelos franceses. *Estudios en homenaje al Dr. Antonio Beltrán Martínez*, 205-225. Universidad de Zaragoza, Zaragoza.

Utrilla, P. & Mazo, C. 1993-94: Informe preliminar sobre la actuación de urgencia de 1991 en la cueva de Abauntz. *Trabajos de Arqueología Navarra 11*, 9-30.

Utrilla, P. & Mazo, C. 1996: Arte mueble sobre soporte lítico de la cueva de Abauntz. Su aportación a los estilos del Magdaleniense tardío. *Complutum Extra 6*, 41-62.

Utrilla, P., Mazo, C., Sopena, M. C., Martínez-Bea, M. & Domingo, R. 2009: A palaeolithic map from 13,660 calBP: engraved stone blocks from the Late Magdalenian in Abauntz Cave (Navarra, Spain). *Journal of Human Evolution 57*, 99-111.

Valdiosera, C., Gómez-Olivencia, A., Rios-Garaizar, R., Garate, D., Svensson, E. M., Ureña, I., Rodríguez, R., Arceredillo, D., Iriarte, E. & Arsuaga, J. L. 2011: El ADN antiguo aplicado a contextos arqueopaleontológicos: el caso de la cueva de Arlanpe (Lemoa, Bizkaia). *Munibe (Antropologia-Arkeologia) 62*, 49-63.

van der Made, J. 1989: The bovid *Pseudotragus seegrabensis* nov. gen., nov. sp. from the Aragonian (Miocene) of Seegraben near Leoben (Austria). *Proceedings of the Royal Society B 92*, 215-240.

van der Made, J. 1996: Listriodontinae (Suidae, Mammalia), their evolution, systematic and
distribution in time and space. *Contributions to Tertiary and Quaternary Geology 33*, 3-254.

Vega del Sella, C. d. l. 1916: Paleolítico de Cueto de la Mina (Asturias). *Comisión de investigaciones Paleontológicas y Prehistóricas. Mem. Nº 13, Madrid*.

Vega del Sella, C. d. l. 1930: Las Cuevas de la Riera y Balmorí (Asturias). *Comisión de investigaciones Paleontológicas y Prehistóricas. Mem. Nº 38 (Serie Prehistórica 29), Madrid*.

Vigne, J.-D. 2005: L'humérus de chien magdalénien de Erralla (Gipuzkoa, Espagne) et la domestication tardiglaciaire du loup en Europe. *Munibe (Antropologia-Arkeologia) 57*, 279-287.

von den Driesch, A. 1976: *A Guide to the Measurements of Animal Bones from Archaeological Sites*. pp. Peabody Museum, Harvard.

Yokoyama, Y., Nguyen, H.-V., Quaegebeur, J.-P., Le Hasif, G. & Romain, O. 1987: Datation par la spectrométrie gamma non destructive et la résonance de spin électronique (ESR) du remplissage de la grotte de l'Arbreda. *Cypsela: revista de prehistòria i protohistòria VI*, 137-143.

Yravedra, J. 2007: Nuevas contribuciones en el comportamiento cinegético de la Cueva de Amalda. *Munibe (Antropologia-Arkeologia) 58*, 43-88.

Yravedra, J. & Gómez Castanedo, A. 2010: Estudio zooarqueológico y tafonómico del yacimiento del Otero (Secadura, Voto, Cantabria). *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología 3*, 21-38.

Yravedra, J. & Gómez Castanedo, A. 2011: Análisis de los procesos tafonómicos de Cueva Morín. Primeros resultados de un estudio necesario. *Zephyrus LXVII*, 69-90.

Yravedra, J., Gómez Castanedo, A. & Muñoz Fernández, E. 2010: Estrategias de subsistencia en el yacimiento paleolítico del Ruso (Igollo de Camargo, Cantabria, España). *Espacio, Tiempo y Forma, Serie I, Prehistoria y Arqueología 3*, 39-58.