The silence of the layers: Archaeological site visibility in the Pleistocene-Holocene transition at the Ebro Basin

Alfonso Alday [a], Rafael Domingo [b], María Sebastián [c], Adriana Soto [d], Josu Aranbarri [e], Penélope González-Sampériz[f], María Marta Sampietro-Vattuone [g], Pilar Utrilla [b], Lourdes Montes [b], José Luis Peña-Monné [c]

[a] Universidad del País Vasco/EHU. Área Prehistoria, C/ Tomás y Valiente s/n, 01006 Vitoria, Spain a.alday@ehu.eus

[b] Universidad de Zaragoza, Área Prehistoria, C/Pedro Cerbuna 12, 50009, Zaragoza, Spain rdomingo@unizar.es, lmontes@unizar.es, utrilla@unizar.es

[c] Universidad de Zaragoza, Área Geografía Física, C/Pedro Cerbuna 12. 50009, Zaragoza, Spain msebas@unizar.es, jlpena@unizar.es

[d] Université Toulouse-Jean Jaurès. UMR TRACES, 5 allées A. Machado, 31058 Toulouse Cedex 9, France asoto.sebastian@yahoo.es

[e] Universidad del País Vasco/EHU. Área Geografía Humana, C/ Tomás y Valiente s/n, 01006 Vitoria, Spain aranbarri.josu@gmail.com

[f] Instituto Pirenaico de Ecología / CSIC. Campus de Aula Dei. Avda. Montañana 1005, CP 50159 Zaragoza, Spain pgonzal@ipe.csic.es

[g] Univ Nacional de Tucumán-CONICET, Lab. de Geoarqueología, Miguel Lillo 205, 4000 San Miguel de Tucumán, Tucumán, Argentina sampietro@tucbbs.com.ar

Abstract

The Ebro Basin constitutes one of the most representative territories in SW Europe for the study of prehistoric societies during the Pleistocene-Holocene transition. The correlation of palaeoenvironmental and geomorphological proxies obtained from sedimentary records with chronologically well-constrained reference archaeological sites has allowed defining this time frame precisely, such that three main pilot areas haven been broadly depicted: the Alavese region, the Pre-Pyrenees and the Bajo Aragón.

Overall, the human imprint in the Ebro Basin was rare during the Upper Palaeolithic, but more visible from the Upper Magdalenian (14500 to 13500 cal BP) to Neolithic times (up to 5500 cal BP). Local environmental resources were continuously managed by the prehistoric communities in the different areas of study. In fact, the Ebro Basin acted during those millennia as a whole, developing the same cultural trends, industrial techniques and settlement patterns in parallel throughout the territory.

However, some gaps exist in the ^{14}C frequency curve (SCDPD curve). This is partially related to prehistoric sites in particular lithologies and geological structures that could have partly been lost by erosional processes, especially during the Early Holocene. In addition, this gap also parallels the reconstructed climate trend for the Pre-Pyrenean and the Bajo Aragón areas, which are defined by high frequencies of xerophilous flora until ca. 9500 cal BP, suggesting that continental climate features could have hampered the presence of well-established human communities in inland regions.

The interdisciplinary research (archaeology, geomorphology and palaeoclimatology) discussed in this paper offers clues to understand the existence of fills and gaps in the archaeological record of the Ebro Basin, and can be applied in other territories with similar geographic and climate patterns.

Keywords

Pleistocene-Holocene, Western Europe, Ebro Basin, Archaeological visibility, Geomorphology, Palaeoclimate, ^{14}C dates, Magdalenian, Mesolithic, Neolithic

1. INTRODUCTION

Interest in, scientific literature and projects, and meetings related to climate-human interactions have notably increased in recent years. Reconstruction of population distributions and/or analysis of occupation patterns and cultural changes in their environmental context have emerged as a major research interest (Aura et al., 2011; Banks et al., 2013; Bar-Yosef, 2015; Binford, 1999; González-Sampériz et al., 2009; Sánchez Goñi, 1966; Starkovich and Ntinou, 2015; Van der Plicht et al., 2011). However, most of these studies minimize the absence of archaeological evidence (both layers and materials), which should be considered as important as their dated or undated presence. Only the combination of lacks and fills would allow the construction of realistic scenarios.

Mediterranean regions are recognized as sensitive environments because of their particular climatic and geomorphological features, such as macro-scale erosive processes that might have destroyed and/or hidden some prehistoric sites (Fullola et al., 1987; Peña-Monné et al., 2011, 1996). In this sense, the Ebro Basin can be proposed as a good research area (Figure 1), reproducing at a micro-scale the whole panoply of environmental varieties found in the Mediterranean realm, from the Atlantic-influenced landscapes to semi-arid territories, where the present-day environment is completely different to those of the Late glacial and the Early Holocene (González-Sampériz et al., 2008, 2004, Valero-Garcés et al., 2004, 2000) or even Roman times (Pérez-Lambán et al., 2014). Hence, the basin-scale holistic analysis allows us to compare how contemporary prehistoric human occupations responded to different climatic and geomorphologic drivers.

The Ebro Basin represents a perfect case study to test how and why the potential role and the existence of open-air sites are usually misrepresented during the end of the

Pleistocene and the onset of the Holocene. Data gathered only at caves and rockshelters shows only a partial image of the prehistoric occupation patterns.

In the last decades, systematic archaeological research focused on the transition from the Upper Pleistocene to the consolidation of the farming communities in the Ebro Basin has considerably enlarged our knowledge of those societies (Alday, 2006; Alday et al., n.d.; Montes et al., 2015; Montes and Alday, 2012; Soto et al., 2015; Utrilla et al., 2012; Utrilla and Domingo, 2014; Utrilla and Montes, 2009). The descriptions of the successive cultural units and their economic patterns (raw materials exploitation and hunting and gathering, among other practices) and the amount of data related to palaeoenvironmental issues (Aranbarri et al., 2014; González-Sampériz et al., 2008, 2017) allow the depiction of the basin as a cultural ensemble with well-defined characteristics that is constantly evolving, even if we can glimpse the existence of inner regional nuances.

Figure 1.

To provide a more detailed analysis of the Ebro Basin, this work focuses on three pilot areas where the concentration of sites related to the studied chronological frame is especially relevant and linked to particular environmental trajectories (Figure 2). The Alavese area in the NW belongs to a region dominated by an Atlantic climate influence; the Central Pre-Pyrenean ranges are characterised by Mediterranean montane climatic conditions; and the Bajo Aragón area close to the Central Depression has a marked aridity index and extreme summer temperatures. The study of all these pilot areas has been built upon a basic similar process but considering some differences through time, which can be summarized in three main stages.

Figure 2.

1. In the first stage (between the 70's and 90's), the main research goal was the holistic understanding of the excavated sites: identification and nesting of the sedimentary fillings, analytics of the collections, and faunal and palaeobotanical studies (e.g. Botiquería, Costalena, Forcas I and II, Fuente Hoz, Kanpanoste-Kanpanoste Goikoa, Peña de Marañón, Pontet, Secans).
2. Around the turn of the century, new sites (Ángel, Atxoste, Baños, Legunova, Mendandia, Peña-14) were discovered in nearby areas, allowing a new research stage focused on interrelations between the sites in order to establish the cultural sequence (Alday, 2002; Cava, 2004a; Utrilla et al., 2003, 1998).
3. The last stage of our research included recent multidisciplinary studies of new sites (Espantalobos, Esplugón, Martinarri, Plano del Pulido, Rambla de Legunova, Socuevas, Valcervera and Valmayor-XI) that have enlarged the known record both cultural and geographically. The identification of different exploitation networks at local, supra-local and regional scales has enhanced our understanding of the relationships of the human groups and at the same time, the characteristics of each industrial phase. In addition, the multidisciplinary research includes the detailed study of palaeobotanical proxies (both anthracological and carpological remains), technological and functional analyses, and genetic studies.

This information allows an acceptable reconstruction of many aspects of the prehistoric past. Nevertheless, a critical revision of the available data points out some deficiencies and repetitions mainly derived from the research process, but also related to: i) The interpretation of the absence *vs.* the presence of archaeological layers, and ii) the lack/occurrence/imprecision of radiocarbon dating as well as its recent use as a demographic indicator, despite its intrinsic incoherencies.

Our hypothesis and the ultimate motivation of this paper is that the archaeological record, no matter how wide, cannot completely express the cultural situations of the past. We face a noteworthy loss of information that hampers advancement and that perhaps should encourage us to design new actions to obtain solutions. In any case, our consciousness of this situation can be the basis for a new look at prehistoric processes, a perception that must be rather different to the current one.

Consequently, this paper proposes a more realistic valorisation of prehistoric occupation patterns by exploring a multi-proxy approach to this central research issue: the description of the processes (and their possible origin; i.e., climate, humans, natural hazards) that played a major role in the settlement and abandonment of the dwelling places and the later natural evolution that have unearthed, masked, destroyed or hidden those archaeological sites, depending on the region. For this objective, we consider the Ebro Basin and the three model areas within (Alavese, Central Pre-Pyrenees and Bajo Aragón) because they represent different biogeographical regions with a common cultural pattern within the 16000 – 5500 cal BP chronological frame.

2. REGIONAL SETTINGS

The Ebro River, which runs from the Cantabrian Ranges to the Mediterranean across the NE Iberian Peninsula, constitutes a huge basin whose surface exceeds 80,000 sq. km. It is closed off to the N by the Pyrenees, to the SW and S by the Iberian Range and to the E by the Catalonian Ranges (Figure 1). It was formed by Alpine tectonic shifts that pushed up the outlying mountain chains and formed the sedimentary foreland depression. During the Tertiary, it was gradually filled with sediments as an endorheic continental basin. After the Late Miocene-Pliocene, as it became exoreic, it gained an outflow to the Mediterranean and the sediment moved to its bottom (200-300 m a.s.l.).

This was the start of the growth of the Ebro River system and of sediments draining from the basin to the sea, which still continues today.

Several climate types can be found in this territory. The NW corner is defined by an Atlantic climate regime, while the mountain ranges are defined by high- and mid-mountain climate features. In contrast, the bottom of the depression is characterized by semi-arid Mediterranean conditions. Overall, annual rainfall values oscillate between 2,500 mm and barely 350 mm, whereas temperatures depend on the height, exposition and orientation, with the highest values measured in the central and Eastern sector of the basin. The vegetation communities are well distributed according to these climatic drivers, being defined by the typical broadleaved forests in the Atlantic region and by dry steppes in the semiarid Mediterranean realm. The main characteristics of the three pilot areas can be summarized as follows.

1. The Alavese area is placed Northwest of the Basin at approximately 600 m a.s.l. It presents a mesothermal climate, moderate in temperature and with abundant precipitation (*ca.* 1,000 mm of annual rainfall). Vegetation communities in this area are dominated by mesophytes, mainly deciduous (*Quercus robur*, *Q. petraea*) and semi-deciduous oaks (*Quercus faginea*) in the lowlands, while beech (*Fagus sylvatica*) and pine communities (*Pinus sylvestris*) spread at higher elevations.
2. The central Pre-Pyrenees are located North of the Ebro Basin. This region has an average altitude of 1,000 m a.s.l. The climate is continental, with a 760 mm mean annual rainfall, mostly occurring between October and June. The vegetation composition is essentially mixed, dominated by pines (*Pinus sylvestris*) and both evergreen and semi-deciduous oaks (*Quercus ilex ssp. rotundifolia, Q. faginea*).
3. Bajo Aragón is located Southeast of the Basin and close to the Mediterranean coast. These lowlands, at an altitude lower than 400 m, are defined by a semi-arid climate

with the highest potential evapotranspiration levels of all of Iberia. Annual rainfall barely reaches 300 mm. The natural vegetation cover is open and dominated by scattered pines (*Pinus halepensis*), junipers (*Juniperus thurifera, J. phoenicea, J. oxycedrus*) and thermophilous shrubs (*Quercus coccifera, Rhamnus alaternus, Pistacia lentiscus, Phyllirea angustifolia, Rosmarinus officinalis, Lavandula latifolia*), among others.

3. MATERIALS AND METHODS

Archaeological work carried out at 80 sites from the Ebro Basin and very close areas allows us to draw an accurate picture of the prehistoric communities that lived in the region from the Late Pleistocene to Neolithic times. Their cultural phases have been characterized by means of lithic typology, as well as their economic basis (subsistence practices and resource exploitation). In total, 425 ^{14}C dates (maximum standard deviation allowed ≤ 100) sustain this dataset (Table 1; Appendix A). Archaeological sequences and ^{14}C dates reveals the continuity and discontinuity processes in the occupation patterns. As extreme examples, Atxoste (Alday, 2014) offers a stratigraphy six meters deep that was almost continuously occupied from the Late Palaeolithic to the Neolithic, dated by 23 14C dates, and Botiquería (Barandiarán, 1978) has a sequence of fertile and sterile layers from the Mesolithic and Neolithic periods of barely 1.5 m with only 4 14C dates. Among this set, the 35 sites (30 caves/rockshelters, 5 open-air locations) from the three detailed areas (43.75% of the basin sites) are the basis for the current analysis. Most of them (approximately 80%) have been excavated by the authors of this paper so their archaeological records and materials are known in detail, which assures a homogeneous treatment of data.

Table 1.

In addition, geomorphological field projects have been carried out in the three study areas. Detailed morphological descriptions of each site have been performed in order to identify the main drivers that determined their formation and degradation. These microanalyses are completed by the characterisation of the palaeoenvironmental records and other geomorphological proxies from the surrounding areas. The aim of the geomorphological analysis of the rockshelters lies in determining the varied origins and the evolutionary processes of their deposits, as well as establishing a basic typology and the extent to which their conservation and visibility is possible. These data are important to determine the distortion that the conservation/disappearance of deposits can create in the available information.

As well as in archaeology, an important effort in the study of palaeoenvironmental sequences covering the Late glacial and the Early-Mid Holocene has been performed for the Ebro Basin and the Pyrenees during the last decades (Aranbarri et al., 2014; González-Sampériz et al., 2008, 2006; Iriarte-Chiapusso, 2009; Iriarte-Chiapusso et al., 2008; Pérez-Díaz et al., 2016, 2015; Valero-Garcés et al., 2000). Although most of the studies have been focused on archaeological sites (see the compilation for the Central Ebro Basin in González-Sampériz, 2004), lacustrine records have increased exponentially in the last years. Thus, it is possible to correlate chronologically well-constrained regional palaeoenvironmental and palaeoclimatic proxies with both patterns of human occupation and geomorphological evolution of sites. For this work, the two longest continuous lacustrine sequences from both the Northern and Southern Ebro Basin (Estanya and Villarquemado records) have been selected, together with the El Portalet record from a high altitude location in the Central Pyrenees, in order to show the climate history of the Atlantic-influenced areas. These sequences cover all the different biogeographical regions within the study area.

The chronological evaluation analysis has been performed using a reference database including 425 ^{14}C dates that span from 5000 to 13000 BP (5650 to 15750 cal BP) from 80 archaeological sites. It has been compiled by means of an exhaustive bibliographical search. The only selection criterion considers their accuracy: a standard deviation of less than a century was required. Despite the lack of anthracological determination for most of the dated samples in our database, we believe that the debate surrounding short life *vs.* long life samples is no longer relevant in this case (Barceló, 2008; Williams, 2012; Drake et al., 2016). The correlation coefficient of charcoal vs. other material samples in our database is 0.92. On this basis, and accepting the "old wood effect" for some of the samples, we cannot exclude more than 500 charcoal radiocarbon references. Traditionally, ^{14}C dates have been analysed using a wide set of methods, each of them with different possibilities and limits (Attenbrow and Hiscock, 2015; Barceló, 2008; Blaauw, 2010; Contreras and Meadows, 2014; Crombé and Robinson, 2014; Gkiasta et al., 2003; Guilderson et al., 2005; Michczynski et al., 2007; Riede et al., 2009; Riede and Edinborough, 2012; Surovell and Brantingham, 2007; Torfing, 2015; Wicks et al., 2014; Williams, 2012). A consensus is established by presenting the dates in calendar years (preferentially cal BP, as shown here) rather than in their isotopic format.

The varied software specifically designed to create chronological models from a long series of ^{14}C, if analysed in detail (i.e., when looking at the cultural transitions), can be read in very different ways. Those differences may pass unnoticed or are minimised when a large number of dates are compiled, as in this paper. Nevertheless, they should be considered when working from a historical perspective. In summary, the compilation of a long series of ^{14}C dates is always problematic because different statistical solutions are available, such as Bayesian analysis or SCDPD curves, and the results are always diverse.

In this paper, the evolutionary spectrum of the ^{14}C series has been constructed following the protocols of the Summed Calibrated radiocarbon Date Probability Distribution (SCDPD) (Balsera et al., 2015; Bernabeu et al., 2015; Bocquet-Appel et al., 2012; Drake et al., 2016; Pardo et al., 2015; Shennan et al., 2013). In addition, we have included some variations for improving resolution. First, dates have been calibrated with Oxcal V4.2 (IntCal13 curve) (Bronk Ramsey, 2009; Reimer et al., 2013). Then, their graphic representation was obtained following Evin's recommendations (Evin et al., 1995) to guarantee that the dates contribute equally regardless of their chronological span (paradoxically, in traditional systems the most imprecise samples are better represented). Next, we have considered the standardized value for every subdivision (50 years long) within the studied temporal lapse. In order to avoid overrepresentation of the most repeatedly dated contexts, we have only included the highest weighed value from each context in every section. Finally, we have summed the values of each 50-year period (see Appendix B for further explanation). The benefits of this procedure can be summarized as follows: i) all the registered values are taken into account, and ii) a previous selection of the repeated values from a context is unnecessary because the system selects the best suited for each moment. Thus, all the laboratory results are respected. We have to be conscious that the available software (OxCal, Calpal, etc.) calibrates the dates and draws the frequency graphs disregarding their origin, such that each chronologic value is related to a laboratory reference but not to its site of provenance. Consequently, for this software there is no difference if a hundred dates are obtained from only one site or from a hundred different sites; on the contrary, our procedure establishes a dialogue between the date and its archaeological context.

However, there are some previous remarks that we have to bear in mind before analysing the results. Usually, SCDPD has been employed as a demographic proxy

(Balsera et al., 2015; Pardo et al., 2015; Riede et al., 2009; Shennan et al., 2013) based on the premise that “the bigger the population, the greater the archaeological record”. This proposition equates ^{14}C date frequency and population growth. But in recent years, many studies have pointed out many factors that influence the final value of the SCDPD, highlighting: i) procedural or methodological factors (Bamforth and Grund, 2012; Contreras and Meadows, 2014; Steele, 2010; Weninger et al., 2015; Williams, 2012); ii) factors related to the reality of prehistoric societies (Naudinot et al., 2014; Torfing, 2015); and iii) factors related to the nature and entity of the archaeological data (Attenbrow and Hiscock, 2015; Crombé and Robinson, 2014; Surovell et al., 2009; Surovell and Brantingham, 2007; Torfing, 2015). In relation to the latter we emphasise that:

1. Databases composed by ^{14}C references may only partially reflect the archaeological reality found by archaeologists, distinct from the historic or cultural reality.
2. Databases are composed of very different archaeological contexts in terms of entity (i.e. major sites *vs.* temporary camp-sites), functionality (i.e. settlement *vs.* funerary), knowledge degree (i.e. whole site excavated *vs.* partial test-pit), and cultural representativeness. The only common nexus for all the considered sites is their temporal convergence. Likewise, every type of human settlement offers different conservation patterns that, logically, interfere in the database construction (for example, dating funerary contexts is usually easier than dating habitation levels).
3. Databases are not independent of several problems inherent to the archaeological discipline, such as taphonomy, post-depositional processes or history of the research.

For these reasons, we believe that dating frequency curves never can be seen as a faithful reflect of the actual peopling. In this sense, in this paper we analyse SCDPD focusing on the nature of the known archaeological record –which in our territory is heavily conditioned by the geomorphic evolution typical of soft lithological environments-, especially in the lack of information from taphonomic processes and its influence in the interpretation of prehistoric dynamics.

4. RESULTS

Within the broad context of the Ebro Basin, the three pilot areas (Alavese, Central Pre-Pyrenean and Bajo Aragón regions) have provided enough data to build a first draft of their prehistoric settlements, establishing a multi-proxy approach that includes archaeological, geomorphological and palaeoenvironmental analyses.

4.1. ARCHAEOLOGICAL RECORDS AND SCDPD

The SCDPD curve of the Ebro Basin compiled as explained in Methods has a general profile that follows the same trends observed for the entire Iberian Peninsula (Figure 3). The particular nuances should be related as much as to the regional peopling dynamics as to the record opportunities, the research rhythms and the Holocene sedimentary processes.

Figure 3.

Both the Iberian and the Ebro Basin SCDPD curves (Figure 3) show a sustained growth of dating frequency from 15000-14000 cal BP and onwards (i.e., during the Late/Upper Magdalenian). There is a short drop during the GI-1b and a general abrupt and short increase at approximately 13000 cal BP. After this rise and fall, the GS-1 episode maintains a low frequency of radiocarbon dates during the whole period, and a general stability persists until *ca.* 10000 cal BP in both curves. As the Holocene advances, it is possible to observe: i) a frequency growth around 9500 cal BP (more noticeable in the Iberian curve than in the Ebro Basin), followed by an abrupt and striking decrease; ii) an accelerated and persistent rise from *ca.* 8500 cal BP, much more intense in the Iberian curve, which reaches its maximum at approximately 7500 cal BP; iii) the incorporation of dates from open-air sites since *ca.* 8000 cal BP; and iv) the sudden fall following an erratic profile from 7300 cal BP onwards, showing in this case that the Ebro Basin curve has a higher stability than the SCDPD of the Iberian Peninsula. Punctual peaks in the SCDPD curves, also detected in other parts of the world, have been related to calibration curve perturbations for the considered timeframe, *ca.* 12600 cal BP (Michczynski et al., 2007; Williams, 2012) and *ca.* 9500 cal BP (Zahid et al., 2016). In our opinion, the abrupt decrease in dates *ca*. 6700-6600 cal BP could be explained by the same reasons: it affects all the regions despite their particular environmental features and it is extremely brief.

In archaeological terms, the beginning of the timeframe is characterised by a progressive increase in dates and sites, in parallel to the tendency documented in the classic Franco-Cantabrian Late Magdalenian and Azilian periods (see Straus et al., 2012 and papers in the same volume). The generalised scarcity of sites that follows it is also part of a wider trend. As commented, the abrupt rise and fall *ca.* 13000-12500 cal BP may be related to the calibration curve stability and not to a real archaeological event (there are only five sites and seven dates for this interval). The low frequency in the Ebro curve between 11000 and 10000 cal BP can be related to the scarce number of dates and sites. The diffuse transit between the old Mesolithic industries and the Denticulate period occurs during that low-profile moment (*ca.* 10000 cal BP). Around the noticeable peak of *ca.* 9500 cal BP, several sites with a long future lifespan were occupied for the first time (Ángel 2, Artusia, Esplugón, Kanpanoste, Mendandia and Forcas II: Figure 1, Table 1). Almost the same could be said for Martinarri, Legunova or Peña-14 (Figure 1, Table 1), given the gap between their preceding Late Pleistocene occupations and this one, and Las Orcillas (as well as other undated locations). A short time before 8500 cal BP, a notable rise in frequencies can be seen until *ca.* 7400 cal BP; in some long-time occupied sites like Peña-14 or Socuevas this is the last dwelling period. On the contrary, new locations are first inhabited (Cova del Vidre, Rambla de Legunova or Cova Fosca). The final decrease cannot be explained even if we apply the taphonomic bias formula (Surovell et al., 2009).

Figure 4.

If the Ebro Basin and the three pilot area curves are analysed in detail (Figure 4), it is possible to observe similar general trends but also interesting regional differences that could be explained by the archaeological context, as follows.

- In the Alavese Area and the neighbouring Western Pyrenees (Figure 4A), the SCDPD reproduces the Ebro Basin curve, although its first growth begins later (*ca.* 14000 cal BP). A more intense drop is recorded at the end of the GS-1 and the beginning of the Holocene, when as described there is a decline in dated sites, whereas a stability of accumulated dates is observed between 7500 and 5500 cal BP, in agreement with the frequencies of dates from open air sites (the highest of the three pilot areas).

Archaeologically, the end of the Upper Magdalenian (ca 14500 to 13500 cal BP) is well represented in various archaeological sequences (Table 1), whose development during the first part of the GI-1 shows a progressive evolution towards Azilian and Mesolithic industries. This is the case at the Atxoste, Martinarri and Socuevas sites (Figure 2, Table 1) (Barandiarán et al., 2006; Soto et al., 2015). Along the GS-1 (12900 - 11700 cal BP), this progressive transformation culminates in the Azilian ensembles (Portugain, Urratxa

III) (Barandiarán and Cava, 2008; Barandiarán et al., 2006) with others attached to Microlaminar and Sauveterrian traditions (Socuevas, Atxoste), lasting until *ca.* 10500 cal BP (Soto, 2015). However, some contexts suggest a longer timespan (*ca.* 9500) (Mendandia, Martinarri, Las Orcillas) (Soto et al., 2016). Around 10000 cal BP, a large technological transformation appears: the Denticulate Mesolithic (Atxoste, Mendandia, Kanpanoste, Kanpanoste Goikoa) (Alday and Cava, 2006). In some cases, these assemblages are the beginning of new stratigraphic sequences. These industries dominate until 8700-8500 cal BP, when the triggering of the Mesolithic Geometric tradition marks the last technological change of the hunter-gatherer societies (Atxoste, Mendandia, Kanpanoste Goikoa, Socuevas) (Alday and Cava, 2009). Triangle-shaped microliths gradually replace trapeze forms during this period (Figure 5). With regional and chronological evolution, this tradition is upset at *ca.* 7500 cal BP by the arrival of the Neolithic transformation, which includes new economic patterns, as shown by diverse biological markers (pollen, charred seeds, domestic animal bones, for example). The new forms replaced old ones in several of the ancient sites, with the appearance of new occupation typologies like villages and animal enclosures (Mendandia, Atxoste, Peña Larga, Los Cascajos). The development of Betey microlithic elements connects this territory with Aquitaine, while a common ceramic decoration mode (Boquique type: Figure 5) is related to the inner Iberian Peninsula.

Figure 5

- In the Central Pre-Pyrenean area (Figure 4B), the SCDPD curve fits well with the regional one, excepting for a long drop from the second half of the GS-1 (from 12200 to 11500 cal BP and again from 10800 to 10200 cal BP). In addition, the intense peak recorded at 9500 cal BP in the Ebro curve is not observed in the region and the general growth of the accumulation curve begins later, *ca.* 8200 cal BP instead of *ca.* 9000 cal

BP as in the Ebro Basin. It is worth mentioning that open-air sites in the Pre-Pyrenees pilot area have not been found.

In the archaeological record, a well-developed Upper-Late Magdalenian dated *ca.* 14000-13000 cal BP (Legunova, Chaves, Forcas-I) is followed by the Microlaminar, Azilian or Sauveterrian levels until *ca.* 10800 cal BP in almost the same locations (Alday et al., 2014; Aura et al., 2011; Soto et al., 2015; Utrilla et al., 2012). Later, there seems to be an archaeological gap, with some true sterile layers; i.e., in the Arba de Biel area, Legunova and Peña-14 sites (Figure 2 and Table 1) (Montes et al., 2016), or even definitive abandonment of some sites (Forcas-I: Utrilla and Mazo, 2014). After this gap, the Denticulate Mesolithic occurs between 10200 and 8800 cal BP (Montes et al., 2006). It appears in thick archaeological layers at the previously mentioned Arba de Biel area, somewhat later at Esplugón (Figure 2b, Table 1) and inaugurating the archaeological sequence at Forcas-II (Figures 2b and 5, Table 1). Immediately after 8800-8200 cal BP, the Geometric Mesolithic trapeze phase appears, with Peña-14, Rambla de Legunova, Valcervera or Esplugón and the nearby Espantalobos located in the lowlands as some examples (Figure 2b, Table 1). Later, the second phase, characterised by triangles, develops *ca.* between 8200 and 7700 cal BP (Forcas-II, Esplugón). Its main feature is the dominance or equality of triangles *vs.* trapezes (Figure 5) and the posterior incorporation of some abrupt-retouched pieces of the North Pyrenean tradition (Utrilla et al., 2009). Then, the first Neolithic-related elements appear without a break. The most prominent Pre-Pyrenean Ancient Neolithic site is Chaves, a true village inside a cave (Baldellou, 2011), where a fully agricultural human occupation took place between 7500 and 7000 cal BP (Figure 2b and Table 1). This site may have triggered the regional neolithisation process. The other site locations determine their economic basis. Most are in remote areas where traditional hunting-gathering practices coexist with pioneering husbandry, with the incorporation of material novelties such as double-bevelled lithic retouch or pottery (Figure 5). Clear examples would be the Arba de Biel ensemble, Forcas-II and Esplugón (Montes et al., 2016; Utrilla et al., 2015; Utrilla and Mazo, 2014).

- Finally, the SCDPD of the Bajo Aragón pilot area (Figure 4C) shows a different evolution because the earliest documented archaeological levels -and hence the first radiocarbon dates- begin at approximately 9200 cal BP and follow a similar trend to the Ebro Basin, although the pilot area accumulation curve almost disappears at *ca.* 6600 and 6100 cal BP.

Therefore, the first human occupation in this area belongs to the Denticulate Mesolithic (Montes et al., 2006), found in sites like Los Baños, Pontet, Costalena, Plano del Pulido and Ángel located in the nearby Maestrazgo area (Figure 2, Table 1). Between 8800-8200 cal BP, the Geometric Mesolithic is the dominant horizon, starting with the traditional trapeze phase ~~motif~~ (Figure 5) at some of the mentioned sites (Barandiarán and Cava, 2000; Utrilla et al., 2009). In some of them, an evolution of the trapezes can be observed, starting with a dominance of wide and short elements, followed by small types and ending with big long specimens. The triangle B-phase, well represented North of the Ebro River, is absent from the Bajo Aragón and is rare in the nearby Maestrazgo-Els Ports area (i.e., Ángel 2 and Vidre sites: Figure 1, Table 1). The transition to the Early Neolithic (7700-7300 cal BP) remains marked by the dominance of triangles *vs.* trapezes; to this we can add the appearance of the double-bevelled retouch and the first pottery examples -Cardial, impressed or incised- that begin to generalise (Montes and Alday, 2012; Utrilla and Domingo, 2014). Sadly, the poor conservation of biological markers in this region hampers this type of analytics and thus the characterization of economic strategies.

4.2. GEOMORPHOLOGICAL PROCESSES AND REPRESENTATIVE DATA

Geomorphological studies carried out in the three pilot areas across the Ebro Basin show a generalisation of changes in landscape features during the Late Pleistocene and the Holocene due to climate fluctuations. This dynamic acquired special relevance from the Middle Holocene onwards, when human intervention on the environment begins to be recognisable. For example, sediment records at the bottom of secondary valleys in the centre of the Ebro Depression show that the erosion triggered by human activities started in the Neolithic (ca. 6500 cal BP) and sped up from the Bronze Age, becoming even faster during Iberian and Roman times (Constante et al., 2010; 2011; Peña et al., 2004; 2014; 2005; 2011).

The influence of environmental changes on the preservation of ancient prehistoric sites has been analysed in detail in the mid-section of the Segre River, Northeast of the Ebro Basin (Figure 1). Processes involved in the destruction of rockshelters (weathering of the sandstones and erosion in the bottom clay basis) have been dated to the Bronze and Iron Ages (4000-2500 cal BP) (Peña-Monné et al., 2005). To date, there are no models explaining rockshelter evolution in the Ebro Basin prior to the Bronze Age. A first morphological classification of the sites occupied by prehistoric groups from 16000 to 5500 cal BP allows us to distinguish three typologies according to the lithological characteristics, the layout of the structure and the type of response to increased erosion (Table 2, Figures 6 and 7).

Table 2.

Figure 6.

Figure 7.

1. Rockshelters and cavities in marginal and middle mountains, in detrital and calcareous rocks (limestone, dolomite, sandstones, chalk conglomerates), formed by fluvial and/or karstic activity mainly in river canyons (Table 2, type 1.1) or shelters found in slope faces due to differential erosion and weathering (Table 2, type 1.2), or cavities in river canyons formed by fluvial and karstic erosion. In several cases the lithological factor is reinforced by the structural position, taking advantage of the shelters located in the front of the cuestas (Table 2, types 1.2 and 1.3). Only a shelter located in a big tafoni was found, which was the result of old formation processes (Table 2, type 1.3, Martinarri). The evolution of these typologies (Figure 6), mainly due to collapsing overhangs, fillings by fluvial or karstic action, or fossilisation related to slope dynamics, is slow and their archaeological deposits have the highest chance of being preserved completely or partially. Type 1 is frequent in the mountain ranges of the Northern sector of the Basin (i.e. Forcas and Martinarri: Figures 6 and 7, type 1.3), the Basque Mountains (i.e. Atxoste: Figures 6 and 7, type 1.2) and some valleys in the Iberian Range (i.e. Ángel: Figures 6 and 7, type 1.1).
2. Rockshelters formed in durable sandstone layers from the continental Neogene period, in a horizontal or sub-horizontal layout and, in most cases, containing a palaeochannel structure (Table 2, Figures 6 and 7, type 2.1). They evolve relatively fast because erosive processes dismantle soft sediments and the overhanging rock fractures and falls (Figure 6). In addition, slope movements displace both the fallen blocks and the sediments. Rock weathering sometimes helps in their destruction. The processes become even faster when the palaeochannels are totally exposed, as erosion can advance on several fronts at once (type 2.2 in Table 2 and Figures 6 and 7). Frequently, fallen blocks partially protect the ancient deposits. They are

characteristic of the SE basin (Bajo Aragón) and the central-western area (Arba de Biel River), although this type is also found in the NE sector of the basin (middle valleys of the Segre and Cinca Rivers, with more recent archaeological deposits). Eventually, ancient tafonis caused by different climatic stages in more resistant sandstone formations were occupied by prehistoric groups, like Rambla de Legunova and El Pontet (type 2.3 in Table 2, Figures 6 and 7) (Domingo and Montes, 2009; Mazo and Montes, 1992). Their degradation is slower than other sandstone sites.

3. Open-air campsites, which sometimes are an expansion of the living space next to the rockshelters (Arias et al., 2015; García-Diez and Vaquero, 2015), but also occur as isolated settlements, are totally unconnected with the presence of parietal protection. The known deposits are in flat zones, near to riverbeds, like the Cabezo de la Cruz campsite (type 3 in Table 2, Figure 7) (Rodanés and Picazo, 2013) and the Cascajos and Paternanbidea villages (García Gazolaz, 1999, 2007; Sesma, 2007). This type of deposit may have been dismantled by erosion and human activities and they are often some meters underground, covered by sediments of various origins (i.e. Samitiel, Montes et al., 2000). There is little chance of finding them except when cut by watercourses or when they are uncovered by anthropogenic activities (Cabezo de la Cruz, Cascajos). This type had to be the most common; however, it is the one we know the least about.

In summary, the preservation of most of the documented sites has been accidental: accumulations of fallen roof fragments, sedimentary fills or slope slides have protected the archaeological remains. Their current visibility is also hazardous: natural erosion and/or infrastructure projects have unearthed the archaeological sediments. This dependence on visibility leads us to conclude that we only know a small portion of the potential sites that were occupied in the Basin in prehistory.

4.3. REGIONAL PALAEOENVIRONMENTAL RECORDS

As we have mentioned before, the increased amount of both palynological and sedimentological records coming from the Ebro Basin allow decoding the environmental impact of the climate phases during the Upper Pleistocene and the Holocene time frames (Aranbarri et al., 2014, 2016; González-Sampériz et al., 2017, 2010, 2009, 2008). Overall, there is a major spatial cluster in terms of available environmental studies between the Atlantic-influenced regions and those found in the dry, Central Ebro Basin (Figures 1b and 1c).

In the Alavese region, there is no master palaeoenvironmental sequence spanning the entire Late Pleistocene/Holocene period, and those available are obtained from caves and rockshelters without high-resolution analyses. In any case, relatively close regional sequences show that the vegetation landscape during the Late glacial (prior to 12900 cal BP) was defined by the progressive substitution of conifers by *Betula*-deciduous *Quercus*-*Corylus* communities, as recorded in Eurosiberian pollen profiles both from the Pyrenees (Gil-Romera et al., 2014; González-Sampériz et al., 2006) and the Cantabrian sector (Iriarte-Chiapusso et al., 2016; Moreno et al., 2011). The GS-1 represents a clear biostratigraphic marker in this region, shaping a treeless landscape with low lake levels (Moreno et al., 2011) and glacier readvances (García-Ruiz et al., 2016). In contrast, the onset of the Holocene is defined by the maximum spread of the broadleaved woodland regionally (Pérez-Díaz et al., 2016, 2015) in response to the climate/hydrological system adjustment (Moreno et al., 2010).

For the Central Pre-Pyrenees, the Estanya multiproxy sequence (González-Sampériz et al., 2017; Morellón et al., 2009; Vegas-Vilarrúbia et al., 2013) reveals the regional hydrological and vegetation response to millennial-scale climate variability since the Last Glacial Maximum. The GI-1 or Bølling/Allerød interstadial (14500-12900 cal BP) is defined by a conifer landscape with reduced meso-thermophilous flora and thus points to continental climate features in the Mediterranean realm. Hydrological proxies suggest similar arid conditions until approximately 13500 cal BP (Morellón et al., 2009; Pellicer et al., 2016). The vegetation snapshot of the GS-1 or Younger Dryas is not usual because refuge areas show unexpected palynological spectra for this period. During the onset of the Holocene, a parkland landscape dominated by junipers and steppe herbs reflect a resilient environment. Since *ca.* 9500 cal BP, *Corylus,* and after 8000-7000 cal BP, both deciduous and evergreen oaks, spread regionally, highlighting the establishment of a milder climate in the Mediterranean setting.

Regarding the environmental history of the Central Ebro Depression and the surrounding territories, the lack of chronologically well-ascribed records continues defining this region, especially during Pleistocene times. The potential of playa-lakes to draw the environmental history of this land has been widely recognized (Luzón et al., 2007; Valero-Garcés et al., 2004, 2000), although all of them have difficulty in establishing precise radiocarbon chronologies (González-Sampériz et al., 2008). Some archaeological records have partially reconstructed the vegetation landscape (Alcolea, 2014; González-Sampériz et al., 2004; Iriarte-Chiapusso et al., 2008). However, most of them show uncompleted palaeobotanical information caused by poor preservation related to dry conditions, resulting in the oxidation and mechanical destruction of pollen grains.

With respect to the nearby Bajo Aragón pilot area, the Villarquemado palaeolake sequence (Aranbarri et al., 2014) is the best available record to decode the main phases of climate variability in the region since Late glacial times. Montane pinewoods and junipers are the landscape components during the second half of the GI-1 (13500-12900 cal BP) and the GS-1 or YD, a trend that continues during the onset of the Holocene, with the resilience of conifers against arid and cold climate spells one of the environmental distinctions of the continental Mediterranean ecosystems in the Southern (Aranbarri et al., 2014) and Northern areas of the Ebro Basin (González-Sampériz et al., 2017). The sclerophyllous forest expansion in Inner Iberia occurs once humid and thermal climate conditions takes place *ca.* 9500 cal BP and especially during the Mid Holocene (8200-4200 cal BP), in contrast with the more precocious appearance of mesophytes in Mediterranean contexts such as Estanya.

5. DISCUSSION

After establishing the cultural dynamics and a holistic understanding of every archaeological site and their typological features within the palaeoenvironmental frame, it is possible to understand the site ensemble as an evolving regional network. Contemporary occupations were interdependent and followed integral exploitation strategies. The pilot areas we propose in the present study are good examples of this pattern. Those networks controlled raw lithic materials outcrops, hunting spots or specialised activity areas (butchery, meat or hide smoking). These places were exploited on a long-term basis, mainly as the Neolithic arrived.

This archaeological record shows some particular features: a) the almost complete lack of open-air settlements, the frequent employment of rockshelters and the surprising absence of Mesolithic cave occupations, even if easily available. The enormous cave of

Chaves, densely occupied during the Magdalenian and not inhabited again until the Early Neolithic, could be the most noteworthy example; b) the site concentration in some areas and the existence of wide regions with no archaeological sites at all; and c) the contemporary and lineal development of successive cultural units in the whole Basin during the studied time frame, which suggests that the territory largely functioned as a continuum, despite the wrong modern-day image of disarticulated minor regions that is due to a combination of research and taphonomic biases.

Nevertheless, we must be aware that the conserved record is hazardous from the geomorphological point of view and unsystematic if we consider the archaeological research. For example, in the Upper Arba de Biel Basin, fieldwork began in 1999 at Peña-14 and three years later, by 2002, the five currently known archaeological sites had been located (Figure 1 and Table 1). The presence of archaeologists in the area stimulated local people to find similar rockshelters that could host fertile layers. A similar story can be told for the Atxoste-Kanpanostes ensemble and the neighbouring sites of Mendandia and Martinarri. Moreover, the development of modern archaeological schools in the Ebro Basin can be traced to forty years ago to the activity of I. Barandiarán, who formed present-day research teams at the Universities of Zaragoza and Basque Country. This circumstance has conditioned investigation interests and methods (Alday and Cava, 2008).

5.1. GEOLOGICAL AND CLIMATE CONSTRAINTS

Considering the pattern of prehistoric site locations, the frequent rockshelter and cave settlements can be related to the abundance of particular lithologies and geological structures conducive to the formation of these features suitable for human occupation in the Ebro Basin. Another factor to be considered is the local climate conditions that can be gained from appropriate orientation at not too high altitude. Obviously, natural resources for subsistence, raw materials, and especially water are required, but they are easily available throughout the Basin. Therefore, there are several essential factors that promote the presence of groups of humans in certain places such as rockshelters and open-air camps, plus mixed occupation sites.

Specifically, some rockshelters are particularly appropriate for recurrent occupation where the presence or absence of humans can be clearly identified. Geological structures associated with cave-rockshelter formation facilitate criteria for searching out and finding these types of favourable environments. Moreover, their geomorphological features and the greater resistance to erosion of their lithology enable records to last longer, so that most of the deposits analysed belong to this type of occupations.

However, we have to bear in mind that most of the Ebro Basin rockshelters would hardly have been big enough to shelter a group of more than 20-30 people. Sandstone palaeochannels, particularly, suffer a continuous geomorphological evolution that prevents large roofed areas. Dwelling solutions like the annexed open-air campsites proposed for Molí del Salt (García-Diez and Vaquero, 2015) or Atxoste (Perales et al., 2016) should have been common, although their archaeological imprint is very difficult to find. Many of the rockshelter sites have been exposed and found after being cut away by roads or gravel quarries that have destroyed the outer sedimentary zones. In the early Holocene occupation of Martinarri, up to three carefully arranged functional areas have been located, one of them under the roof and the other two outside it.

Moreover, open-air campsites would rarely be reoccupied (Cabezo de la Cruz), leaving a weaker archaeological imprint, so their records are not equally useful for analysing long stratigraphic sequences. On the other hand, well-established villages dating from the Neolithic offer recurrent occupational phases that last for some centuries (Cascajos, La Lámpara). Compared to rockshelters, it is usually more difficult to predict where campsites and villages lie. Frequently they are mere hut floors, postholes and negative pits (that may reflect a long lifespan through their use as garbage dumps), so they are more exposed to erosion or sediment covering, and their record visibility is much less. Therefore, this study contains very few examples of these sites.

The characteristics of the various types of rockshelter determine their state of preservation and ease of discovery. Type 1.1, 1.2 and 1.3 shelters (Ángel 1, Atxoste and Martinarri, respectively: Table 2, Figures 6 and 7), composed of limestone, sandstone or conglomerates, are more able to withstand changes in the rock and retain their original form better. The most important evolutionary process is rock-falls, which may seal the surface and protect the underlying archaeological record. In the case of shelters inside river canyons, records can be protected by flooding that covers the cavity (Ángel 1: type 1.1 in Table 2, Figures 6 and 7). Therefore, well-preserved archaeological records are more likely to be found at these shelters.

Types 2.1 (Plano del Pulido) and 2.2 (Valcervera), shown in Table 2 and Figures 6 and 7, evolve the most rapidly, since they consist of sandstone outcrops more susceptible to weathering, worsened by the S/SE orientation of the rock cliffs containing the shelters. This sandstone was formed by palaeochannels in several planes of stratification that led to water penetration, wet-dry sequences, and haloclastic processes giving rise to microform alterations, such as tafoni and honeycombs in the rock wall. In addition, there are fractures from decompressed rock causing the rock-falls that protect the archaeological record. Type 2.2 (Valcervera type), with a narrow palaeochannel morphology, evolved even faster, since it has two erosion faces that could cause the whole palaeochannel to disappear, hiding the original location of the settlement (Figure 7).

Sandstone shelters types 1.3 and 2.3 (Martinarri and El Pontet, respectively) evolve more slowly than the others, although their composition, structure, and age are very similar. In these cases, large tafoni were developed and covered by a duricrust, a legacy of warmer and moister climates than today. To a large extent, such hardening prevented changes (flaking, spalling) in the rock surface. Nevertheless, rock-falls are the most active process.

Finally, open-air settlements (type 3, Cabezo de la Cruz: Table 2, Figure 7) are subject to many different geomorphological processes that could lead to either partial or total erosion, or to perfect preservation under accumulations from several origins (fluvial, slopes, etc.). Likely, those processes have buried the campsites that undoubtedly should have been the basis of the human occupation system in the floodplains of the central Ebro Basin. Their current visibility depends on natural incisions or human interventions that bring them to the surface.

5.2. SITE CONCENTRATIONS *VERSUS* GAPS

All across the Ebro Basin the prehistoric cultural patterns were very similar, which means that the human groups that lived there were well connected. Demographic and social needs encouraged the relationships. However, the population cartography reveals wide documental gaps, which interferes with the previous assumption. The difficulty in concretizing the existence of those interregional links confirms the current insufficiency of archaeological records and the need for further surveying programs.

With this in mind, the study of the BP ^{14}C frequency curves offers nuanced and partial readings concerning human populations for every pilot area and for the whole Basin compared to the Iberian Peninsula, with a total of 1327 dates (Figures 3 and 4). For example, in the Alavese area, the frequency peak at approximately 9500 cal BP converges with the end of the Microlaminar episode at some sites (i.e., Atxoste, Martinarri and Mendandia: Table 1) and the early Denticulate Mesolithic (i.e., Kanpanoste: Table 1). In the same period, the curve is more stable in the Pre-Pyrenees, while in the Bajo Aragón the first human occupations appear later, near 9000 cal BP, with the poor Denticulate Mesolithic layers at Los Baños and Pontet (Table 1). A probably contemporary (but yet undated) occupation at Costalena (Figure 1) exists in the same pilot area; however, it does not contribute to the curve, as no dates are available. In the Bajo Aragón area, the almost complete lack of settlements previous to the Geometric phase (8700-7500 cal BP) should be highlighted: is this a consequence of the ancient erosive dismantlement of sandstone palaeochannels? Or was the extreme continentality the main driver hampering the existence of suitable habitats for hunter-gatherer groups at the beginning of the Holocene (Figure 8)?

If we consider the erosive processes as a hypothesis, and taking into account the current situation of most of the known rockshelter prehistoric sites, we can imagine that early Holocene (and perhaps Late Pleistocene) sites could have passed unnoticed due to the total disappearance of the palaeochannels that protected (and landmarked) the archaeological sites.

Concerning the second hypothesis, lacustrine sequences from inner Mediterranean continental environments such as the nearby Bajo Aragón areas and the sunny slopes of the Pre-Pyrenean lowlands (Figure 8) show an intense climatic seasonality and the persistence of arid features until at least 9500 cal BP, when more humid conditions expand in the whole Mediterranean region (Aranbarri et al., 2014; González-Sampériz et al., 2017). Consequently, it is suggestive to relate the onset of moister conditions recorded since *ca.* 9500 cal BP with the first remarkable Holocene peak of the Ebro Basin SCDPD curve (Figure 3). However, this peak it is not synchronous in the three pilot areas: while it is clearly observed in the Alavese one, it is less evident in the Pre-Pyrenees and does not apply to the Bajo Aragón since human occupation begins later. Similarly, it would be very suggestive to relate the decrease of the SCDPD curve from the Pre-Pyrenees with the coetaneous increase in the xerophyte component of the Estanya sequence between *ca.* 12500 and 10500. This trend of the palaeoenvironmental proxy is interpreted as increasing arid and probably cold-cool conditions during the GS-1 and the beginning of the Holocene and, perhaps, less suitable habitats for human communities. Again, we cannot observe the same trend in the other two pilot areas because available data are incomplete. Likely, only a combination of the two hypotheses may explain the archaeological record of this pilot area.

Figure 8.

Therefore, there are no certainties concerning whether the climate variability affected the prehistoric populations, as the palaeoenvironmental and archaeological records are partial, and opposite trends have been recorded in the region with respect to the potential impact of, for example, the well-known 8.2 event (González-Sampériz et al., 2009; García-Martínez de Lagrán et al., 2016; Montes et al., 2016). Similarly, we do not know how climatic features have an essential role concerning the conservation of the archaeological sites. We only know some of them. Thus, the ^{14}C frequency variability of the Ebro Basin and, probably, most of the SCDPD curves, can be related to different potential circumstances.

In the Pre-Pyrenees, there seems to be a direct relationship between the ^{14}C dates growth and the development of the second episode of the Geometric Mesolithic (8000-7500 cal BP). The rising SCDPD curve (Figure 4B) could lead us to think of population growth. But the explanation lies in the behaviour of the archaeologists. That is, following an understandable desire to refine knowledge of the Mesolithic-Neolithic transition, intensification of research has implied an increase in dating key human occupations (such as Forcas-II or Rambla levels for the Late Mesolithic and the Ancient Neolithic). This abundance of sites and radiocarbon dates for such a short period of time may offer the false image of population growth, at least in sites like the ones cited above, where the economy did not change at all from Mesolithic to Neolithic times, despite the incorporation of sparse material novelties (double-bevelled retouched microliths, pottery). From *ca.* 7500 onwards, the radiocarbon dates from the cave of Chaves Ancient Neolithic (Baldellou, 2011) nourish the Pre-Pyrenean curve for more than 500 years. In this case archaeology, not the dates, tells us that a large human group intensely occupied the huge cavity throughout that time.

From 7000 cal BP, a loss of information –both radiocarbon chronologies and sites- occurs in the Ebro Basin and the entire Iberian Peninsula (Figure 3). The coincidence with the consolidation of the Neolithic economic patterns is evident. Should we think of a population decrease linked to causes such as diseases or bad crops that are invisible to the archaeology? A partial answer can be obtained from the analysis of the three pilot areas. A new occupation system based on stable villages near the farmlands -whose archaeological imprint is weak, as previously said- is reflected in the Alavese area, mainly by the occupation persistence of Cascajos and irregularly in the Bajo Aragón, where the curves are partially sustained by only two dates from the open-air sites of Alonso Norte and Riols. On the contrary, in the mountainous Pre-Pyrenees, the current lack of those villages replicates the whole declining profile of the Ebro Basin (Table 2, Figure 4). Obviously, there should have existed many more dwelling places across the Basin in Neolithic times: such an empty panorama is economically and socially untenable. Actually, this situation continues for several millennia: there is a striking lack of human settlement during the rest of the Neolithic and Chalcolithic, even in areas where their funerary megalithic constructions are common. Again, open-air villages are almost invisible to archaeologists. Therefore, local divergences point to difficult climate-SCDPD curves relationships. We have to bear in mind the provisional character of those SCDPD curves when reading them. For example, in 2009, available radiocarbon dates suggested a lack of population in the same area of the Bajo Aragón related to the 8.2 event (González-Sampériz et al., 2009). Barely eight years later, new dates obtained from the sites of Costalena and Pontet have drawn a new curve (Figure 4C) that apparently removes that supposed gap.

Another deficit of the SCDPD curves as a direct population reflection is the absence in them of sterile layers sandwiched between archaeological levels. These layers offer us valuable information concerning the rhythms of occupation/abandon of a site. Those human presences/absences may be related to cultural decisions (the hinterland occupation system) as well as to geomorphological and climate events (collapses, floods, erosion).

In the Ebro Basin, there are territories with many known prehistoric sites, non-excavated and therefore undated, that stay mute in reviews such as this. Figure 9 shows a non-exhaustive display of undated or inaccurately dated sites from the studied periods in the Ebro Basin, coupled with some representative materials that allow us to place them in a restricted time window. If we focus the research excessively to accurately radiocarbon dated sites or levels, an enormous fraction of the available evidence is silenced; for example, some of the gaps detected in Figure 1. Also, Figure 9 reinforces the vision of the prehistoric investigation as an addition of unsystematic efforts that tend to focus in some regions for a series of reasons that go from being the homeland of the researcher to public works research projects. Although some of the empty territories in Figure 1 are not such in Figure 9, wide areas remain completely unknown.

The most extreme example of underrepresented territories can be found next to the well-known Arba de Biel area, in the neighbouring Arba de Luesia, Onsella and other small river basins (Figure 9), where the archaeological surveys described in the Ph.D. thesis of J. Cabello (Cabello, 2005) have documented at least 12 sites of Mesolithic-Neolithic chronology based on lithic and ceramic remains. The same is true for the Urbasa Range, where archaeological surveys detected more than twenty undated sites that fit industrially to the analysed period (Barandiarán and Vegas, 1990). A similar situation is the "archaeological silence" of undated or inaccurately dated levels or sites (often because they were excavated a long time ago). When rejected by our frequency curves, they completely disappear if we restrict our research strategy to the radiocarbon data. There are well-known sites that we cannot include in well-documented areas: Fuente Hoz, Peña del Castillo, Bardallo and Montico de Charratu in the Alavese area (Baldeón et al., 1983), and several sites in the Bajo Aragón. Here, in the Matarraña-Algás basin alone we can list up to thirteen Mesolithic and/or Neolithic sites (Mazo et al., 1987), but only three (Costalena, Pontet and Botiquería) fit in this work. The reason for this "no consideration" is related to methodological features: i.e., deposits excavated in the fifties such as Serdá and Sol de la Piñera; sites with no datable remains such as Secans or Cova del Llop; or unexcavated sites such as Cueva Ahumada or Era de Rayos. Thus, the Denticulate Mesolithic presence at the Bajo Aragón -archaeologically documented in Pontet, Los Baños, Plano del Pulido and Costalena but only dated in Pontet and Los Baños- almost disappears in a radiocarbon-restricted discussion.

Figure 9.

The previous sites are examples of prehistoric sites or layers excluded from the research discourse because they lack ^{14}C dates, although their archaeological materials undoubtedly fit them in the respective contexts. In this way, archaeologists mute sites, levels and materials. Despite this, it is frequent to use the radiocarbon graphics to shape an accurate image of the population evolution.

Therefore, we think that perhaps the study of the increase in sites or activities therein (not only of dates) could reflect a minimum population growth in the hunter-gatherer groups or in the pioneer farmers (Table 1). This image is the same no matter if the focus is centred in each of the pilot areas or in the whole Ebro Basin: the number of sites shows a slow and progressive yet irregular increase from the Late Magdalenian onwards, which accelerates intensely in Late Mesolithic and Early Neolithic times. Thus, it seems that the site typology and visibility matter. The only exception to this image is the Azilian/Sauveterrian/Microlaminar period, when the index of sites every 100 years (Table 1) is by far the lowest of the whole series. Some possible explanations arise: apart from being the longest period that coincides with a notable paucity of known sites, it might mark the onset of a new occupational system, mostly based on open-air settlements. The new climate conditions allowed human groups to abandon the caves, lessening their archaeological imprint.

If only the number of dates and dated levels for each cultural period were considered and treated as a mere demographic reflection without any archaeological criticism at all, it could be concluded that Neolithic innovations were brought by an important human contingent: from 8000 cal BP to 7000 cal BP the number of dates almost triples (Figure 3). If the *dates = population* equation were correct, this supposed demographic growth could not be explained only in internal terms (Bocquet-Appel et al., 2012). But if other significant data are analysed, such as the type of site and its visibility, the reading is different. In Neolithic times, large cavities unoccupied until then (or only inhabited during Palaeolithic times) are used to shelter people and livestock. This is the case of Los Husos I-II, Peña Larga, Cueva Lóbrega, Chaves, Olvena, Coro Trasito, Puyascada, Colomera and Cova Gran (Figure 1). As we have discussed before, caves and large rockshelters are very easy to find. Besides, dates from open-air sites are common for another reason. On the one hand, the number of sites is far greater now than in previous periods (Table 1). On the other hand, their features (no clear levels and negative structures like hearths and grain pits) oblige us to obtain copious dates that show prolonged occupations along several centuries. Significantly, the average quantity of dates by site remains stable until Neolithic times, when it doubles.

In this sense, we could consider that only agricultural practices demand villages to be built. But we should also consider that pottery fragments are much easier to find in archaeological surveys -highlighting the existence of a possible village- than the small lithic armatures characteristic of previous stages. Perhaps this greater visibility of the material remains can explain the location of Neolithic –but not previous- villages. Some of these villages may have started as smaller dwelling places in Mesolithic times, but if we only date short-life elements undoubtedly linked to the agricultural economy (cereal seeds, domestic fauna) we will never know if their occupation started earlier. The "old wood" effect, proposed to explain some ancient charcoal dates from the Ambrona Valley sites (Rojo et al., 2008), is questioned by several authors (Barceló, 2008; Williams, 2012; Drake et al., 2016) and can be partially denied by dendrochronological studies from La Draga (Tarrus, 2008), where most of the oak trunks that served as posts were obtained from young trees less than 35 years old. It is also hard to think that prehistoric people used on a common basis very aged fallen trunks for their fires. As a matter of fact, ethnographic evidence points to a universal preference for small branches as fuel.

Could these ancient dates, almost always obtained from the bottom of the structures and some of the associated non-significant remains belong to a previous Mesolithic occupation? Again, the archaeologists mute archaeological documents after the inaccurate premise that all open-air villages were of Neolithic foundation. If we only date the undoubtedly Neolithic materials (domestic fauna, seeds) we will only obtain Neolithic dates. It seems a tautology, but it is not.

6. FINAL REMARKS

The ideas discussed here concerning the limits of radiocarbon dates as a reflection of prehistoric populations may seem discouraging for our discipline. But on the contrary, the construction of radiochronological big data is forcing us to better understanding the significance of archaeological contexts, instead of just accepting mechanistic explanations. More than forty years of fieldwork experience at the Ebro Basin have taught us that SCDPD on its own cannot be taken as a direct reflection of the population evolution, but only as an indication of human presence in the territory. Thus, the gaps in the SCDPD curves do not imply an absence of people, but only a lack of one type of archaeological information: radiocarbon dating. If, as we have seen, we have other prehistoric information sources (scattered lithic remains, undated stratified sites), we must use them in our historic explanation as a very valuable resource. Therefore, we are obliged to think about the methods and objectives of our discipline. We must be aware that our concern as prehistorians is the understanding of a very remote human ecumene and we must accept that this comprehension cannot be restricted to a mere quantification of ciphers (whether obtained from the tool assemblage or from radiochronological statistics). Our methods imply a continuous exchange of data between all the information sources. Radiochronology is only one of them (a very important one, indeed), but its capacities are very limited if we isolate the samples from their contexts and if our thought is limited to the dated archaeological record. The understanding of archaeological gaps and fills can be envisaged only by means of interdisciplinary research.

The typology of the sites that make up the database, their geologic structures, and geomorphologic evolution since the Late Pleistocene and along the Holocene reinforces our arguments on the severe loss of archaeological information. This degradation effect can be extended to similar environments in terms of its geomorphological characteristics and Holocene environmental evolution, as for example the Eastern and central part of the Iberian Peninsula and other Mediterranean areas.

Acknowledgements

Special thanks to T. A. Surovell (University of Wyoming) for his valuable advice concerning radiocarbon curves and to A. I. Barbero and F. Vadillo (University of the Basque Country) for their help with statistic issues.

This work has partially benefitted from financial and technical support provided by the Projects CLIP (HAR2014-59042-P) and DINAMO3 (CGL2015-69160-R), provided by the Spanish Inter-Ministry Commission of Science and Technology (CICYT). Also by H07-First Dwellers of the Ebro Valley PPVE and Quaternary Paleoevironments PALEOQ (Research Groups of the Government of Aragón and European Social Fund), the Research Group of Prehistory of the Government of the Basque Country (IT622-13) and Ibercaja-CAI Program Research Stays. This paper fits within the research scope of IUCA (Environmental Sciences Institute of the University of Zaragoza). R. Domingo is a Ramón y Cajal Research Fellow (ref: RyC2013-12613, Spanish Ministry of Economy and Innovation). A. Soto was funded by a post-doctoral research fellowship of the Government of the Basque Country.

Authorship contributions:

Archaeological data: A. Alday, R. Domingo, L. Montes, A. Soto and P. Utrilla.

Geological and geomorphological data: J. L. Peña-Monné, M. M. Sampietro-Vattuone and M. Sebastián.

Paleoenvironmental data: J. Aranbarri and P. González-Sampériz.

Discussion and final remarks have been agreed by all authors.

Figure captions

Figure 1. Location of the archaeological sites (open air / cave or rockshelter) and paleoenvironmental records discussed in the text. 1 Urratxa-III. 2 Socuevas. 3 El Prado. 4 Araico. 5 Larrenke N. 6 Mendandia. 7 Kanpanoste and Kanpanoste Goikoa. 8 Atxoste. 9 Martinarri. 10 San Cristóbal. 11 Husos-I and Husos-II. 12 Peña Larga. 13 Alto de Rodilla. 14 Portalón. 15 Mirador. 16 Cueva Lóbrega. 17 Cascajos. 18 Orcillas. 19 Portugain. 20 Artegieta. 21 Abauntz. 22 Paternanbidea. 23 Artusia. 24 Aizpea. 25 Zatoya. 26 Padre Areso. 27 Paco Pons. 28 Peña-14. 29. Legunova and Rambla de Legunova. 30 Valcervera. 31 Samitiel. 32 Esplugón. 33 Espantalobos. 34 Chaves. 35 Pacencia. 36 Huerto Raso. 37 Drólica. 38 Forcas-I and Forcas-II. 39 Coro Trasito. 40 Puyascada. 41 Trocs. 42 Sardo. 43 Estany de la Coveta. 44 Colomera. 45 Cova Gran. 46 Parco. 47 Montanissell. 48 Camp Colomer. 49 Balma Margineda. 50 Balma Guilanyà. 51 Molí del Salt. 52 Collet Puiggrós. 53 Colls. 54 Hort de la Boquera. 55 Filador. 56 Riols. 57 Valmayor-XI. 58 Plano del Pulido. 59 Costalena. 60 Pontet. 61 Botiquería. 62 Torrazas. 63 Alonso Norte. 64 Baños. 65 Ángel-1 and Ángel-2. 66 Clot del Hospital. 67 Vidre. 68 Mas Cremat. 69 Cova Fosca. 70 Mas Nou. 71 Cingle de l'Aigua. 72 Cabezo de la Cruz. 73 Cueva del Gato-2. 74 Carlos Álvarez. 75 Lámpara. 76 Revilla. Source: Confederación Hidrográfica del Ebro (http://www.chebro.es). Below, average annual precipitation (González-Hidalgo et al., 2011) and temperature (Gonzalez-Hidalgo et al., 2015) maps.

Figure 2. Archaeological sites studied in each pilot area (PNOA Orthophotos, 2016). In grey, archaeological sites not included in the pilot areas.

Figure 3. Compared SCDPD curves from Iberia and Ebro Basin between 16000 and 5500 cal BP. Reddish area under Ebro line points out the 90 dates from the open-air sites.

Figure 4. Ebro Basin *vs.* Alavese (A), Pre-Pyrenean (B) and Bajo Aragón (C) pilot areas. Red line shows the SCDPD from the whole basin compared to each area curve. Green and blue zones under Alavese and Bajo Aragón lines reflect its open-air sites (absents in Pre-Pyrenean area).

Figure 5. Representative archaeological materials from sites within the three pilot areas of the Ebro Basin. Magdalenian: Martinarri level 103 (Alday et al., 2012); Chaves level 2b (Utrilla, 1992). Sauveterrian/Azilian/Magdalenian: Atxoste level VIb (Soto, 2015b); Legunova level m (Montes et al., 2016). Denticulate Mesolithic: Kanpanoste level Lahni (Cava, 2004b); Forcas-II level Ib (Utrilla and Mazo, 2014); Baños level 2b1 (Utrilla and Rodanés, 2004). Geometric Mesolithic: Atxoste levels IV and IIIb2 (Soto, 2015b); Esplugón levels 4 and 3inf (Utrilla et al., 2015); Botiquería levels 2 and 4 (Barandiarán, 1978). Neolithic: Mendandia level II (Alday, 2005); Chaves level 1b (Cava, 2000) (Utrilla and Baldellou, 2001) (Baldellou, 2011); Costalena level c2 (Barandiarán and Cava, 1989).

Figure 6. Archaeological sites types and rockshelter subtypes described in Table 2.

Figure 7. General views of the archaeological site types schemed in figure 6 and detailed in Table 2.

Figure 8. Selected paleoenvironmental sequences compared to SCDPD curves to illustrate main trends and particularities of each pilot area considered in this work. From top to bottom: a) Mesophtyte (in blue) and Xerophyte component (in orange) of El Portalet record (González-Sampériz et al., 2006; Gil-Romera et al., 2014) compared to the SCDPD from the Alavese pilot area (in green); b) Mesophtyte (in blue) and Xerophyte component (in orange) of Estanya Lake (González-Sampériz et al., 2017) compared to SCDPD from the Pre-Pyrenean pilot area (in brown); c) Mesophtyte (in blue) and Xerophyte component (in orange) of Villarquemado palaeolake (Aranbarri et al., 2014) compared to SCDPD from the Bajo Aragón pilot area (in purple).

Figure 9. Representative archaeological materials from undated or inaccurately dated sites within the Ebro Basin. Magdalenian/Azilian: Bolichera (Utrilla et al., 2012); Peña del Diablo (Utrilla and Domingo, 2003); Leginpea (Nuin, 1988); Holloba (Barrios and Porres, 2006); Kukuma (Baldeón and Berganza, 1997). Denticulate & Geometric Mesolithic: Urbasa 11 (Cava, 1988); Cardiel-Valmateo (Tilo, 1990); La Peña de Marañón (Cava and Beguiristáin, 1992); Secans (Rodanés et al., 1996); Artal-Domingo (Utrilla and Domingo, 2003). Neolithic: Ambrolla (Bea et al., 2011); Torrollón (photo: Museo de Huesca); Montico de Charratu (Baldeón et al., 1983); Serdá (Vallespí, 1960); Urbasa 11 (Cava, 1988).

Table 1. Synthesis of sites and available dates from the Ebro Basin and the 3 pilot areas. The whole basin dataset already includes sites and dates from the pilot areas.

Table 2. Revised archaeological sites according to lithological characteristics, the layout of the structure and the type of response to erosional processes (see location of the sites in Figure 1).

References

Alcolea, M., 2014. Mesolithic fuel use and woodland in the Middle Ebro Valley (NE Spain) through wood charcoal analysis. Quat. Int. 431, 39–45. doi:10.1016/j.quaint.2015.11.029

Alday, A., 2014. The site at Atxoste (Vírgala, Álava), in: Sala, R. (Ed.), Pleistocene and Holocene Hunter-Gatherers in Iberia and the Gibraltar Strait: The Current Archaeological Record. Fundación Atapuerca - Universidad de Burgos, Burgos, pp. 147–151.

Alday, A., 2006. El mesolítico de muescas y denticulados en la cuenca del Ebro y el litoral mediterráneo peninsular. Memorias de Yacimientos Alaveses, 11. Diputación Foral de Álava, Vitoria.

Alday, A., 2002. Las unidades industriales mesolíticas en la Alta-Media Cuenca del Ebro. Complutum 13, 19–50.

Alday, A., Cava, A., 2009. El Mesolítico geométrico en Vasconia, in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica. Monografías Arqueológicas. Prehistoria 44. Universidad de Zaragoza, pp. 93–130.

Alday, A., Cava, A., 2008. Ignacio Barandiarán Maestu: una experiencia didáctica e investigadora de la Prehistoria. Veleia 24–25, 33–71.

Alday, A., Cava, A., 2006. La unidad de muescas y denticulados del Mesolítico en el País Vasco: la formalización de un modelo cultural, in: Alday, A. (Ed.), El Mesolítico de Muescas Y Denticulados En La Cuenca Del Ebro Y El Litoral Mediterráneo Peninsular. Memorias de Yacimientos Alaveses, 11. Diputación Foral de Álava, Vitoria, pp. 223–300.

Alday, A., Domingo, R., Montes, L., Perales, U., Soto, U., Utrilla, P., Valdeyron, N., 2014. De Toulouse a Vitoria: la formación de las primeras sociedades prehistóricas del Holoceno, in: El Cuaternario En La Region Pirenaica Occidental: Investigación Multidisciplinar.

Alday, A., Montes, L., Baldellou, V., 2012. Cuenca del Ebro (El Matarraña-Algás y la transición al Neolítico), in: Rojo, M., Garrido, R., García, I. (Eds.), El Neolítico En La Península Ibérica Y Su Contexto Europeo. Cátedra, pp. 291–331.

Alday, A., Montes, L., Utrilla, P., Domingo, R., n.d. The Mesolithic in the Ebro Basin, Spain, in: Arias, P., Cueto, M. (Eds.), Gathering in the South: Proceedings of the Eighth International Conference on the Mesolithic in Europe (Santander, 2010). Oxbow.

Aranbarri, J., Bartolomé, M., Alcolea, M., Sancho, C., Celant, A., González-Sampériz, P., Arenas, C., Magri, D., Rodríguez-Lázaro, J., 2016. Palaeobotanical insights from Early-Mid Holocene fluvial tufas in the Moncayo Natural Park (Iberian Range, NE Spain): Regional correlations and biogeographic implications. Rev. Palaeobot. Palynol. 234, 31–43. doi:10.1016/j.revpalbo.2016.08.006

Aranbarri, J., González-Sampériz, P., Valero-Garcés, B., Moreno, A., Gil-Romera, G., Sevilla-Callejo, M., García-Prieto, E., Di Rita, F., Mata, M.P., Morellón, M., Magri, D., Rodríguez- Lázaro, J., Carrión, J.S., 2014. Rapid climatic changes and resilient vegetation during the Lateglacial and Holocene in a continental region of south-western Europe. Glob. Planet. Chang. 114, 50–65.

Arias, P., Cubas, M., Fano, M.Á., Jordá Pardo, J.F., Salzmann, C., Teichner, F., Teira, L.C., 2015. Where are the “Asturian” dwellings? An integrated survey programme on the Mesolithic of northern Spain. Antiquity 89, 783–799. doi:10.15184/aqy.2015.49

Attenbrow, V., Hiscock, P., 2015. Dates and demography: are radiometric dates a robust proxy for long-term prehistoric demographic change? Archaeol. Ocean. 50, 29–35. doi:10.1002/arco.5052

Aura, E., Jordá, J.F., Montes, L., Utrilla, P., 2011. Human responses to Younger Dryas in the Ebro valley and Mediterranean watershed (Eastern Spain). Quaternay Int. 242, 348–359.

Baldellou, V., 2011. La cueva de Chaves (Bastarás-Casbas, Huesca), in: Las Primeras Producciones Cerámicas. El VI Milenio Cal aC En La Península Ibérica. Saguntum Extra-11, Valencia, pp. 141–144.

Baldeón, A., Berganza, E., García, E., 1983. Estudio del yacimiento de El Montico de Charratu (Albaina, Treviño). Estud. Arqueol. Alavesa 11, 121–186.

Balsera, V., J., B., Costa-Caramé, M., Díaz-del-Río, P., García Sanjuán, L., Pardo, S., 2015. The radiocarbon chronology of southern Spain’s late prehistory (5600–1000 cal BC): a comparative review. Oxford J. Archaeol. 34, 139–156. doi:10.1111/ojoa.12053.

Bamforth, D.B., Grund, B., 2012. Radiocarbon calibration curves, summed probability distributions, and early Paleoindian population trends in North America. J. Archaeol. Sci. 39, 1768–1774. doi:10.1016/j.jas.2012.01.017

Banks, W.E., D’Errico, F., Zilhão, J., 2013. Human–climate interaction during the Early Upper Paleolithic: testing the hypothesis of an adaptive shift between the Proto-Aurignacian and the Early Aurignacian. J. Hum. Evol. 64, 39–55. doi:doi:10.1016/j.jhevol.2012.10.001

Bar-Yosef, O., 2015. Facing climatic hazards: Paleolithic foragers and Neolithic farmers. Quat. Int. doi:10.1016/j.quaint.2015.11.037

Barandiarán, I., Cava, A., 2008. Cazadores y tallistas en el abrigo de Portugain. Una ocupación de Urbasa durante el Tardiglaciar. Fundación José Miguel de Barandiarán.

Barandiarán, I., Cava, A., 2000. A propósito de unas fechas del Bajo Aragón: reflexiones sobre el Mesolítico y el Neolítico en la Cuenca del Ebro. SPAL 9, 293–326.

Barandiarán, I., Cava, A., Alday, A., 2006. Ocupaciones en altura e interior durante el Tardiglaciar. La Llanada alavesa y sus estribaciones montañosas. Zo. Arqueol. 7, 535–550.

Barandiarán, I., Vegas, J.I., 1990. Los grupos humanos en la prehistoria de Encia-Urbasa. Fundación José Miguel de Barandiarán / Eusko Ikaskuntza, San Sebastián.

Barceló, J.A., 2008. La incertesa de les cronologies absolutes en arqueologia. Probabilitat i estadística. Cypsela 23–33.

Bernabeu, J., Barton, M.C., Pardo, S., Bergin, S.M., 2015. Modelling initial Neolithic dispersal. The first agricultural groups in West Mediterranean. Ecol. Modell. 307, 22–31. doi:10.1016/j.ecolmodel.2015.03.015

Binford, L.R., 1999. As the World Warmed: Human Adaptations across the Pleistocene/Holocene Boundary. Quat. Int. 14, 369–371.

Blaauw, M., 2010. Methods and code for “classical” age-modelling of radiocarbon sequences. Quat. Geochronol. 5, 512–518. doi:10.1016/j.quageo.2010.01.002

Bocquet-Appel, J.P., Naji, S., Vander Linden, M., K., K.J., 2012. Understanding the rates of expansion of the farming system in Europe. J. Archaeol. Sci. 39, 531–546. doi:10.1016/j.jas.2011.10.010

Bronk Ramsey, C., 2009. Bayesian Analysis of Radiocarbon Dates. Radiocarbon 51, 337–360. doi:10.2458/azu_js_rc.v51i1.3494

Cabello, J., 2005. El Poblamiento Humano Prehistórico de las Altas Cinco Villas (Zaragoza). Nuevas vías de aproximación al estudio de los yacimientos líticos de superficie de la Prehistoria reciente. Saldvie 5, 9–56.

Cava, A., 2004. Los “procesos culturales” del Holoceno en la Cuenca del Ebro y su contextualización. Saldvie 4, 17–40.

Constante, A., Peña-Monné, J.L., Muñoz, A., 2010. Alluvial geoarchaeology of an ephemeral stream: Implications for Holocene landscape change in the Central part of the Ebro Depression, Northeast Spain. Geoarchaeology 25, 475–496.

Constante, A., Peña-Monné, J.L., Muñoz, A., Picazo, J., 2011. Climate and anthropogenic factors affecting alluvial fan development during the Late Holocene in the Central Ebro valley, Northeast Spain. The Holocene 21, 275–286.

Contreras, D.A., Meadows, J., 2014. Summed radiocarbon calibrations as a population proxy: a critical evaluation using a realistic simulation approach. J. Archaeol. Sci. 52, 591–608. doi:10.1016/j.jas.2014.05.030

Crombé, P., Robinson, E., 2014. 14C dates as demographic proxies in Neolithisation models of northwestern Europe: A critical assessment using Belgium and northeast France as a case-study. J. Archaeol. Sci. 52, 558–566. doi:10.1016/j.jas.2014.02.001

Domingo, R., Montes, L., 2009. Valcervera y Rambla de Legunova: dos yacimientos postpaleolíticos en Biel, Zaragoza. Saldvie 9, 295–310.

Drake, B.L., Blanco-González, A., Lillios, K.T., 2016. Regional Demographic Dynamics in the Neolithic Transition in Iberia: Results from Summed Calibrated Date Analysis. J. Archaeol. Methods Theory 1–17. doi:10.1007/s10816-016-9286-y

Evin, J., Fortin, P., Oberlin, C., 1995. Calibration et modes de représentation des datations radiocarbones concernant le Néolithique de l’est et du sud-est de la France, in: Voruz, J.L. (Ed.), Chronologies Néolithiques: De 6000 a 2000 Avant Notre Ère Dans Le Bassin Rhodanien. Documents du Département d’Anthropologie et d’Écologie de l’Université de Genève, Ambérieu-en-Bugey, Éditions Société préhistorique rhodanienne, pp. 31–39.

Fullola, J., Gallart, J., Peña Monné, J.L., García-Argüelles, P., 1987. Estudi geomorfológic i industrial del jaciment paleolític de la Bauma de la Peixera d´Alfés (Lleida). Trib. d´Arqueologia 1986–87, 15–22.

García-Diez, M., Vaquero, M., 2015. Looking at the Camp: Paleolithic Depiction of a Hunter-Gatherer Campsite. PLoS One 10. doi:10.1371/journal.pone.0143002

García-Gazolaz, J., 2007. Los enterramientos neolíticos del yacimiento de Paternanbidea (Ibero), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 59–65.

García-Gazólaz, J., 1999. Talleres de sílex versus lugares de habitación. Los Cascajos (Los Arcos, Navarra), un ejemplo de neolitización en el Alto Valle del Ebro. Saguntum, Extra, 2, 343–352.

García-Martínez de Lagrán, I., Iriarte, E., García-Gazólaz, J., Tejedor-Rodríguez, C., Gibaja-Bao, J.F., Moreno-García, M., Pérez-Jordà, G., Ruiz-Alonso, M., Sesma-Sesma, J., Garrido-Pena, R., Carrancho-Alonso, Á., Peña-Chocarro, L., Rojo-Guerra, M.A., 2016. 8.2 ka BP paleoclimatic event and the Ebro Valley Mesolithic groups: Preliminary data from Artusia rock shelter (Unzué, Navarra, Spain). Quat. Int. 403, 151–173. doi:10.1016/j.quaint.2015.06.050

García-Ruiz, J.M., Palacios, D., González-Sampériz, P., Andrés, N., Moreno, A., Valero-Garcés, B., Gómez-Villar, A., 2016. Mountain glacier evolution in the Iberian peninsula during the Younger Dryas. Quat. Sci. Rev. 138, 16–30.

Gil-Romera, G., González-Sampériz, P., Lasheras-Álvarez, L., Sevilla-Callejo, M., Moreno, A., Valero-Garcés, B., López-Merino, L., Carrión, J.S., Pérez Sanz, A., Aranbarri, J., García-Prieto Fronce, E., 2014. Biomass-modulated fire dynamics during the last glacial-interglacial transition at the central Pyrenees (Spain). Palaeogeogr. Palaeoclim. Palaeoecol. 402, 113–124.

Gkiasta, M., Russell, T., Shennan, S., Steele, J., 2003. Neolithic transition in Europe: The radiocarbon record revisited. Antiquity 77, 45–62. doi:http://dx.doi.org/10.1017/S0003598X00061330

González-Sampériz, P., 2004. Evolución paleoambiental del sector central de la cuenca del Ebro durante el Pleistoceno Superior y Holoceno. Instituto Pirenaico de Ecología-CSIC, Zaragoza.

González-Sampériz, P., Aranbarri, J., Pérez-Sanz, A., Gil-Romera, G., Moreno, A., Leunda, M., Sevilla-Callejo, M., Corella, J.P., Morellón, M., Oliva, B., Valero-Garcés, B., 2017. Environmental and climate change in the southern Central Pyrenees since the Last Glacial Maximum: a view from the lake records. Catena 149.

González-Sampériz, P., Utrilla, P., Mazo, C., Valero-Garcés, B., Sopena, M., Morellón, M., Sebastián, M., Moreno, A., Martínez-Bea, M., 2009. Patterns of human occupation during the early Holocene in the Central Ebro Basin (NE Spain) in response to the 8.2 ka climatic event. Quat. Res. 71, 121–132. doi:10.1016/j.yqres.2008.10.006

González-Sampériz, P., Valero-Garcés, B.L., Carrión, J.S., 2004. Was the Ebro valley a glacial refugium for temperate trees? An. Biol. 26, 13–20.

González-Sampériz, P., Valero-Garcés, B.L., Moreno, A., Jalut, G., García-Ruiz, J.M., Martí-Bono, C., Delgado-Huertas, A., Navas, A., Otto, T., Dedoubat, J.J., 2006. Climate variability in the Spanish Pyrenees during the last 30, 000 yr revealed by the El Portalet sequence. Quat. Res. 66, 38–25.

González-Sampériz, P., Valero-Garcés, B.L., Moreno, A., Morellón, M., Navas, A., Machín, J., Delgado-Huertas, A., 2008. Vegetation changes and hydrological fluctuations in the Central Ebro Basin (NE Spain) since the Late Glacial period: Saline lake records. Palaeogeogr. Palaeoclim. Palaeoecol. 259, 157–181.

Guilderson, T.P., Reimer, P.J., Brown, T.A., 2005. The Boon and Bane of Radiocarbon Dating. Science (80-.). 307, 362–364. doi:10.1126/science.1104164

Iriarte-Chiapusso, M.J., 2009. Vegetation landscape and the anthropization of the environment in the central sector of the Northern Iberian Peninsula: Current status. Quat. Int. 200, 66–76. doi:10.1016/j.quaint.2008.10.008

Iriarte-Chiapusso, M.J., Muñoz Sobrino, C., Gómez-Orellana, L., Hernández-Beloqui, B., García-Moreiras, I., Fernández Rodríguez, C., Heiri, O., Lotter, A., Ramil-Rego, P., 2016. Reviewing the Lateglacial-Holocene transition in NW Iberia: a palaeoecological approach based on the comparison between dissimilar regions. Quat. Int. 403, 211–236.

Iriarte-Chiapusso, M.J., Pérez Diaz, S., Ruiz Alonso, M., Zapata, L., 2008. Paleobotanica del epipaleolítico y mesolítico vascos. Veleia 24–25, 629–642.

Luzón, A., Pérez, A., Mayayo, M.J., Soria, A.R., Sánchez Goñi, M.F., Roc, A.C., 2007. Holocene environmental changes in the Gallocanta lacustrine basin, Iberian Range,

NE Spain. The Holocene 17, 649–663.
Mazo, C., Montes, L., 1992. La transición Epipaleolítico-Neolítico antiguo en el abrigo de El Pontet (Maella, Zaragoza), in: Utrilla, P. (Ed.), Aragón/Litoral Mediterráneo: Intercambios Culturales Durante La Prehistoria. Homenaje a Juan Maluquer de Motes. Diputación Provincial de Zaragoza, pp. 243–254.
Mazo, C., Montes, L., Rodanés, J.M., Utrilla, P., 1987. Guía Arqueológica del Valle del Matarraña. Diputación General de Aragón, Zaragoza.
Michczynski, D.J., Michczynski, A., Pazdur, A., 2007. Frequency distribution of radiocarbon dates as a tool for reconstructing environmental changes. Radiocarbon 49, 799–806.
Montes, L., Alday, A., 2012. Enredados en la malla neolítica de la Cuenca del río Ebro. Redes, continuidades y cambios. Rubricatum, 5 51–60.
Montes, L., Cuchí, J.A., Domingo, R., 2000. Epipaleolítico y Neolítico en las sierras prepirenaicas de Aragón: prospecciones y sondeos, 1998-2001. Bolskan 17, 87–123.
Montes, L., Domingo, R., Cuchi, J.A., Alcolea, M., Sola, C., 2015. Completando el mapa de la Cuenca del Ebro: el Mesolítico del IX milenio cal BP de Espantalobos (Huesca, España). Munibe Antropol. 66, 119–133. doi:10.21630/maa.2015.66.06
Montes, L., Domingo, R., González-Sampériz, P., Sebastián, M., Aranbarri, J., Castaños, P., García-Simón, L.M., Alcolea, M., Laborda, R., 2016. Landscape, resources and people during the Mesolithic and Neolithic times in NE Iberia: The Arba de Biel Basin. Quat. Int. 403, 133–150. doi:10.1016/j.quaint.2015.05.041
Montes, L., Utrilla, P., Mazo, C., 2006. El Epipaleolítico macrolítico en Aragón en el contexto del Valle del Ebro y la Cataluña costera, in: Alday, A. (Ed.), El Mesolítico de Muescas Y Denticulados En La Cuenca Del Ebro Y El Litoral Mediterráneo Peninsular. Memorias de Yacimientos Alaveses, 11. Diputación Foral de Álava, pp. 193–217.
Morellón, M., Valero-Garcés, B., Vegas-Vilarrúbia, T., González-Sampériz, P., Romero, Ó., Delgado-Huertas, A., Mata, P., Moreno, A., Rico, M., Corella, J.P., 2009. Lateglacial and Holocene palaeohydrology in the western Mediterranean region: the Lake Estanya record (NE Spain). Quat. Sci. Rev. 28, 2582–2599.
Moreno, A., López-Merino, L., Leira, M., Marco-Barba, J., González-Sampériz, P., Valero-Garcés, B.L., López-Sáez, J.A., Santos, L., Mata, P., Ito, E., 2011. Revealing the last 13,500 years of environmental history from the multiproxy record of a mountain lake (Lago Enol, northern Iberian Peninsula). Paleolimnol. 46, 327–349 467.
Moreno, A., Stoll, H., Jiménez-Sánchez, M., Cacho, I., Valero-Garcés, B., Ito, E., Edwards, R.L., 2010. A speleothem record of glacial (25–11.6 kyr BP) rapid climatic changes from northern Iberian Peninsula. Chang. Glob. Planet. 71, 218–231.
Naudinot, N., Tomasso, A., Tozzic, C., Peresani, M., 2014. Changes in mobility patterns as a factor of 14C date density variation in the Late Epigravettian of Northern Italy and Southeastern France. J. Archaeol. Sci. 52, 578–590. doi:10.1016/j.jas.2014.05.021
Pardo, P., Bernabeu, J., García, O., Barton, M., Bergin, S.M., 2015. The origins of agriculture in Iberia: a computational model. Doc. Praehist. 42, 117–131. doi:10.4312/dp.42.7
Pellicer, X.M., Corella, J.P., Gutiérrez, F., Roqué, C., Linares, R., Carbonel, D., Zarroca, M., Guerrero, J., Comas, X., 2016. Sedimentological and palaeohydrological characterization of Late Pleistocene and Holocene tufa mound

palaeolakes using trenching methods in the Spanish Pyrenees. Sedimentology 63, 1789–1819. doi:10.1111/sed.12290

Peña-Monné, J.L., González, J.R., Rodríguez, J.I., 1996. Paleoambientes y evolución geomorfológica en yacimientos arqueológicos del sector oriental de la depresión del Ebro durante el Holoceno superior, in: Dinámica Y Evolución de Medios Cuaternarios. Xunta de Galicia, Santiago de Compostela, pp. 63–80.

Peña-Monné, J.L., Julián, A., Chueca, J., Echeverría, M.T., Angeles, G., 2004. Etapas de evolución holocena en el valle del río Huerva: Geomorfología y Geoarqueología, in: Peña-Monné, J.L., Longares, L.A., Sánchez, M. (Eds.), Geografía Física de Aragón. Aspectos Generales Y Temáticos. Universidad de Zaragoza / Diputación Provincial de Zaragoza, pp. 289–302.

Peña-Monné, J.L., Rubio, V., González, J.R., 2005. Aplicación de modelos geomorgológicos evolutivos al estudio de yacimientos arqueológicos en medio semiáricos (Depresión del Ebro, España), in: X Coloquio Ibérico de Geografía. A Geografía Ibérica No Contexto Europeo. Actas En CD. Evora, pp. 1–15.

Peña-Monné, J.L., Sancho, C., Muñoz, A., Constante, A., 2014. Clima y hombres en la evolución de las vales del sector cenral de la depresión del Ebro durante el Holoceno superior, in: Arnáez, J., Gonzáñez-Sampériz, P., Lasanta, T., Valero, B. (Eds.), Geoecología, Cambio Ambiental Y Paisaje: Homenaje Al Profesor José María García Ruiz. CSIC / Universidad de La Rioja, Logroño, pp. 91–102.

Peña-Monné, J.L., Sopena, M., Rubio, V., Constante, A., González, J.R., 2011. Registros geoarqueológicos residuales y reconstrucción de yacimientos en medios semiáridos del NE de España, in: Turu, V., Constante, A. (Eds.), El Cuaternario En España Y Áreas Afines. Avances En 2011. Fundació M. Chevalier / AEQUA, Andorra, pp. 257–260.

Perales, U., Soto, A., Alday, A., 2016. El análisis tecno-funcional y la gestión de la industria lítica del nivel IIIb2 de Atxoste (Álava, Epaña). Munibe Antropol. 67, 313–323. doi:10.21630/maa.2016.67.mis12

Pérez-Díaz, S., López-Sáez, J.A., Galop, D., 2015. Vegetation dynamics and human activity in the Western Pyrenean Region during the Holocene. Quat. Int. 364, 65–77. doi:10.1016/j.quaint.2014.10.019

Pérez-Díaz, S., López-Sáez, J.A., Pontevedra-Pombal, X., Souto-Souto, M., Galop, D., 2016. 8000 years of vegetation history in the northern Iberian Peninsula inferred from the palaeoenvironmental study of the Zalama ombrotrophic bog (Basque-Cantabrian Mountains, Spain). Boreas 45, 658–670. doi:10.1111/bor.12182

Pérez-Lambán, F., Peña-Monné, J.L., Fanlo-Loras, J., Picazo-Millán, J. V., Badia-Villas, D., Rubio-Fernández, V., García-Giménez, R., Sampietro-Vattuone, M.M., 2014. Paleoenvironmental and geoarchaeological reconstruction from late Holocene slope records (Lower Huerva Valley, Ebro Basin, NE Spain). Quat. Res. 81, 1–14. doi:10.1016/j.yqres.2013.10.011

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk, M., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, Hatte, C., Heaton, T.J., Hoffman, D.L., Hogg, A.G., Hughhen, K.A., Kaiser, J.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A., Turney, C.S.M., van der Plicht, J., 2013. IntCal 13 and Marine 13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55, 1869–1887.

Riede, F., Edinborough, K., 2012. Bayesian radiocarbon models for the cultural transition during the Allerod in southern Scandinavia. J. Archaeol. Sci. 39, 744–756. doi:10.1016/j.jas.2011.11.008

Riede, F., Edinborough, K., Thomas, M., 2009. Tracking Mesolithic demography in time and space and its implications for explanations of change, in: Crombé, P., Van Strydonck, M., Boudin, M., Bats, M. (Eds.), Chronology and Evolution within the Mesolithic of North-West Europe. Cambridge Scholars Publishing, pp. 177–194.

Rodanés, J.M., Picazo, J. V., 2013. El campamento mesolítico del Cabezo de la Cruz. La Muela, Zaragoza. Monografías Arqueológicas. Prehistoria 45. Universidad de Zaragoza, Zaragoza.

Rojo, M.A., Kunst, M., Garrido, R., García, Í., Morán, G., 2008. Paisajes de la Memoria: asentamientos del neolítico antiguo en el Valle de Ambrona (Soria, España). Universidad de Valladolid, Valladolid.

Sánchez Goñi, M.F., 1966. Les changements climatiques du Paléolithique supérieur. Enquête sur le rapport entre Paléoclimatologie et Préhistoire. Zephyrus 49, 3–36.

Sesma, J., 2007. Enterramientos en el poblado neolítico de Los Cascajos (Los Arcos), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Gobierno de Navarra, Pamplona, pp. 52–58.

Shennan, S., Downey, S.S., Timpson, A., Edinborough, K., Colledge, S., Kerig, T., Manning, K., Thomas, M.G., Bocquet-Appel, J.P., Bramanti, B., Pinhasi, R., Thomas, M.G., Hofreiter, M., Currat, M., Burger, J., Malmström, H., Cramon-Taubadel, N. von, Skoglund, P., Itan, Y., Powell, A., Beaumont, M.A., Ammerman, A.J., Cavalli-Sforza, L.L., Fisher, R.A., Gignoux, C.R., Henn, B.M., Mountain, J.L., Tallavaara, M., Seppä, H., Williams, A., Collard, M., Edinborough, K., Shennan, S., Scott, E.M., Reimer, P.J., Surovell, T.A., Finley, J.B., Smith, G.M., Brantingham, P.J., Kelly, R., Woodbridge, J., Stevens, C.J., Fuller, D.Q., Zimmermann, A., Meurers-Balke, J., Kalis, A.J., Hilpert, J., Wendt, K.P., Pétrequin, P., Verrill, L., Tipping, R., Stuiver, M., Pollach, H., Braziunas, T.F., Hinz, M., Feeser, I., Sjögren, K.G., Müller, J., Barry, S., Gualde, N., Bowles, S., Gamble, C., Davies, W., Pettitt, P., Hazelwood, L., Richards, M., Heaton, T.J., Blackwell, P.G., Buck, C.E., Ramsey, C.B., Vinther, B.M., McDermott, F., Mattey, D.P., Hawkesworth, C., Larocque, I., Hall, R.I., Bakke, J., Dahl, S.O., R. Paasche, L., Nesje, A., Thornalley, D.J.R., Elderfield, H., McCave, I.N., Sarnthein, M., 2013. Regional population collapse followed initial agriculture booms in mid-Holocene Europe. Nat. Commun. 4, 531–546. doi:10.1038/ncomms3486

Soto, A., 2015. Los sistemas de producción lítica en el Epimagdaleniense y el Sauveterroide del Alto Ebro: El caso del abrigo de Atxoste (Vírgala, Álava, País Vasco). Munibe Antropol. 66, 93–118. doi:10.21630/maa.2015.66.05

Soto, A., Alday, A., Mangado, X., Montes, L., 2016. Epipaleolítico y Mesolítico en la vertiente sur de los Pirineos desde la perspectiva de la industria lítica. Munibe Antropol. 67, 295–312. doi:10.21630/maa.2016.67.mis01

Soto, A., Alday, A., Montes, L., Utrilla, P., Perales, U., Domingo, R., 2015. Epipalaeolithic assemblages in the Western Ebro Basin (Spain): The difficult identification of cultural entities. Quat. Int. 364, 144–152. doi:10.1016/j.quaint.2014.05.041

Starkovich, B.M., Ntinou, M., 2015. Climate change, human population growth, or both? Upper Paleolithic subsistence shifts in southern Greece. Quat. Int. 428, 17–32. doi:10.1016/j.quaint.2015.03.044

Steele, J., 2010. Radiocarbon dates as data: Quantitative strategies for estimating colonization front speeds and event densities. J. Archaeol. Sci. 37, 2017–2030. doi:10.1016/j.jas.2010.03.007

Straus, L., Leesch, D., Terberger, T., 2012. The Magdalenian settlement of Europe: An introduction. Quat. Int. 272–273, 1–5. doi:10.1016/j.quaint.2012.05.022

Surovell, T.A., Brantingham, P.J., 2007. A note on the use of temporal frequency distributions in studies of prehistoric demography. J. Archaeol. Sci. 34, 1868–1877. doi:10.1016/j.jas.2007.01.003

Surovell, T.A., Byrd Finley, J., Smith, G.M., Brantingham, P.J., Kelly, R., 2009. Correcting temporal frequency distributions for taphonomic bias. J. Archaeol. Sci. 36, 1715–1724. doi:10.1016/j.jas.2009.03.029

Tarrus, J., 2008. La Draga (Banyoles, Catalonia), an Early Neolithic Lakeside Village in Mediterranean Europe. Catalan Hist. Rev. 1, 17–33. doi:10.2436/20.1000.01.2

Torfing, T., 2015. Neolithic population and summed probability distribution of 14C-dates. J. Archaeol. Sci. 63, 193–198. doi:10.1016/j.jas.2015.06.004

Utrilla, P., Berdejo, A., Obón, A., Laborda, R., Domingo, R., Alcolea, M., 2015. El abrigo de El Esplugón (Billobas-Sabiñánigo, Huesca). Un ejemplo de transición Mesolítico-Neolítico en el Prepirineo central, in: Del Neolític a L'edat Del Bronze En El Mediterrani Occidental. Estudis En Homenatge a Bernat Martí Oliver. Trabajos varios del SIP, Museo de Valencia, Valencia, pp. 75–96.

Utrilla, P., Cava, A., Alday, A., Baldellou, V., Mazo, C., Montes, L., 1998. Le passage du Mésolithique au Néolithique ancien dans le Bassin de l'Ebre (Espagne) d'après les datations C14. Préhistoire Eur. 12, 171–194.

Utrilla, P., Domingo, R., 2014. La transition mésolithique/néolithique dans la Vallée de l'Ebre, in: Manen, C., Perrin, T., Guilaine, J. (Eds.), La Transition Néolithique En Méditérranée. The Neolithic Transition in the Mediterranean. Errance-AEP, Toulouse, pp. 323–353.

Utrilla, P., Domingo, R., Martínez-Bea, M., 2003. La campaña del año 2002 en el Arenal de Fonseca (Ladruñán, Teruel). Saldvie 3, 301–311.

Utrilla, P., Domingo, R., Montes, L., Mazo, C., Rodanés, J.M., Blasco, M.F., Alday, A., 2012. The Ebro Basin in NE Spain: A crossroads during the Magdalenian. Quat. Int. 272–273, 88–104. doi:http://dx.doi.org/10.1016/j.quaint.2012.04.024

Utrilla, P., Mazo, C., 2014. La Peña de las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena. Monografías Arqueológicas. Prehistoria 46. Universidad de Zaragoza, Zaragoza.

Utrilla, P., Montes, L., 2009. El Mesolítico geométrico en la Península ibérica, Monografías arqueológicas. Prehistoria 44. Monografías Arqueológicas. Prehistoria 44. Universidad de Zaragoza, Zaragoza.

Utrilla, P., Montes, L., Mazo, C., Martínez Bea, M., Domingo, R., Martínez-Bea, M., 2009. El mesolítico geométrico en Aragón, in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica. Monografías Arqueológicas. Prehistoria 44. Universidad de Zaragoza, Zaragoza, pp. 131–190.

Valero-Garcés, B.L., Delgado-Huertas, A., Navas, A., Machín, J., González-Sampériz, P., Kelts, K., 2000. Quaternary palaeohydrological evolution of a playa lake: Salada Mediana, central Ebro Basin, Spain. Sedimentology 47, 1135–1156.

Valero-Garcés, B.L., González-Sampériz, P., Navas, A., Machín, J., Delgado-Huertas, A., Peña-Monné, J.L., Sancho-Marcén, C., Stevenson, T., Davis, B., 2004. Paleohydrological fluctuations and steppe vegetation during the last glacial maximum in the central Ebro valley (NE Spain). Quat. Int. 122, 43–55.

Van der Plicht, J., Akkermans, P., Nieuwenhuyse, O., Kaneda, A., Russell, A., 2011. Tell Sabi Abyad, Syria: Radiocarbon Chronology, Cultural Change, and the 8.2 ka Event. Radiocarbon 53, 229–243.

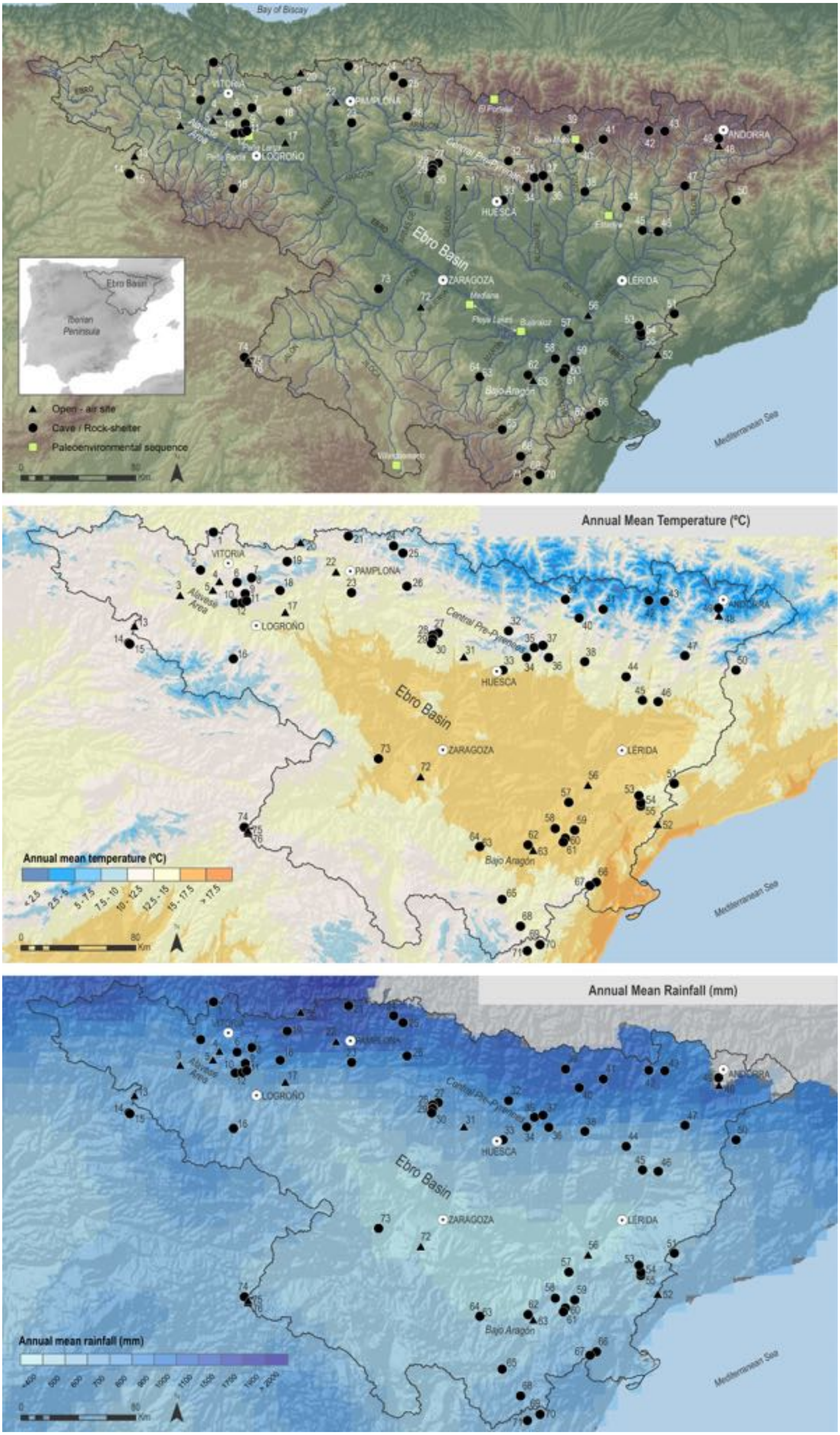
Vegas-Vilarrúbia, T., González-Sampériz, P., Morellón, M., Gil-Romera, G., Pérez-Sanz, A., Valero-Garcés, B., 2013. Diatom and vegetation responses to Late Glacial and Early Holocene climate changes at Lake Estanya (Southern Pyrenees, NE Spain). Palaeogeogr. Palaeoclim. Palaeoecol. 392, 335–349.

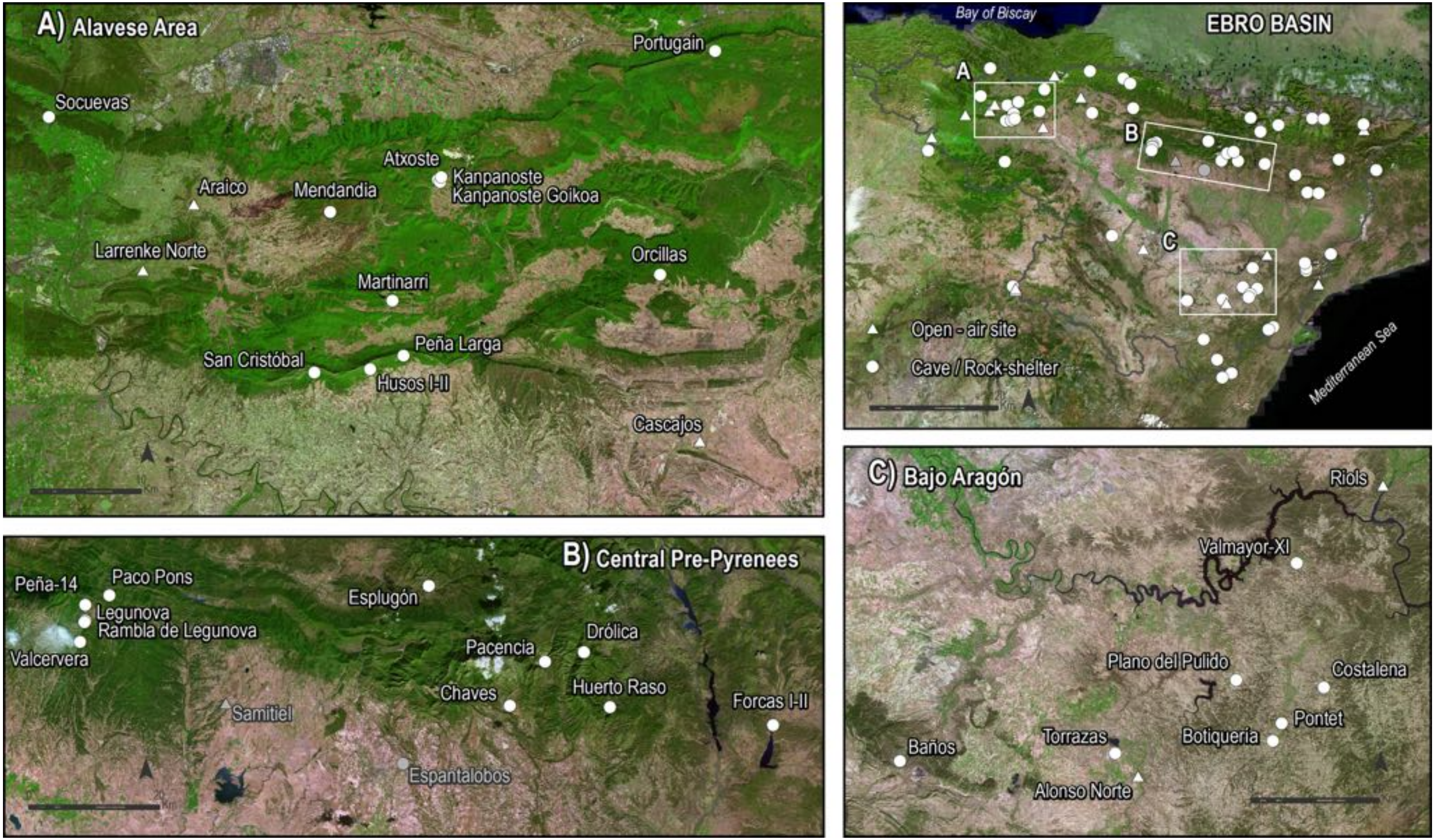
Weninger, B., Clare, L., Jöris, O., Jung, R., Edinborough, K., 2015. Quantum theory of radiocarbon calibration. World Archaeol. 47, 543–566. doi:10.1080/00438243.2015.1064022

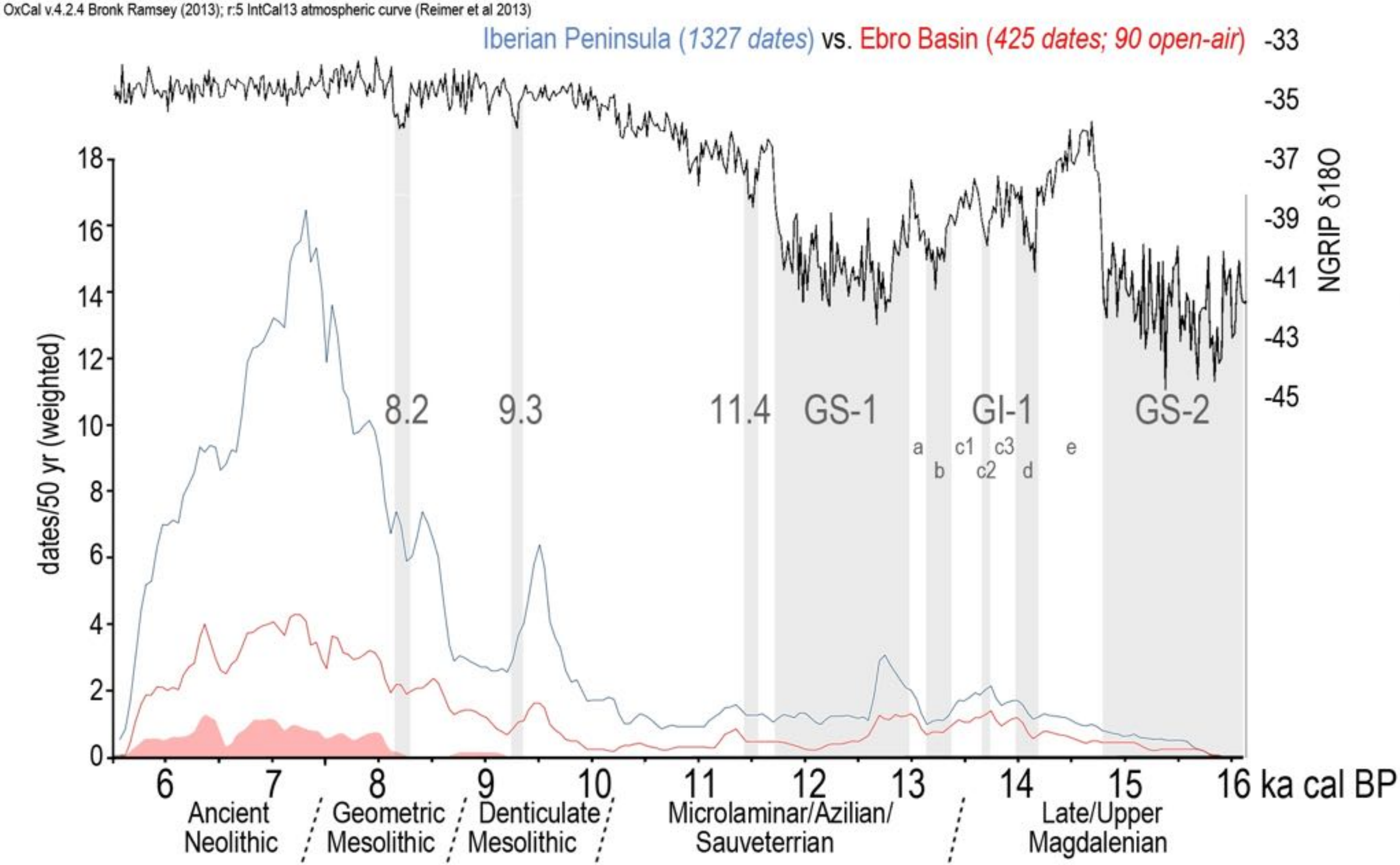
Wicks, K., Pirie, a., Mithen, S.J., 2014. Settlement patterns in the late Mesolithic of western Scotland: The implications of Bayesian analysis of radiocarbon dates and inter-site technological comparisons. J. Archaeol. Sci. 41, 406–422. doi:10.1016/j.jas.2013.07.003

Williams, A.N., 2012. The use of summed radiocarbon probability distributions in archaeology: a review of methods. J. Archaeol. Sci. 39, 578–589. doi:10.1016/j.jas.2011.07.014

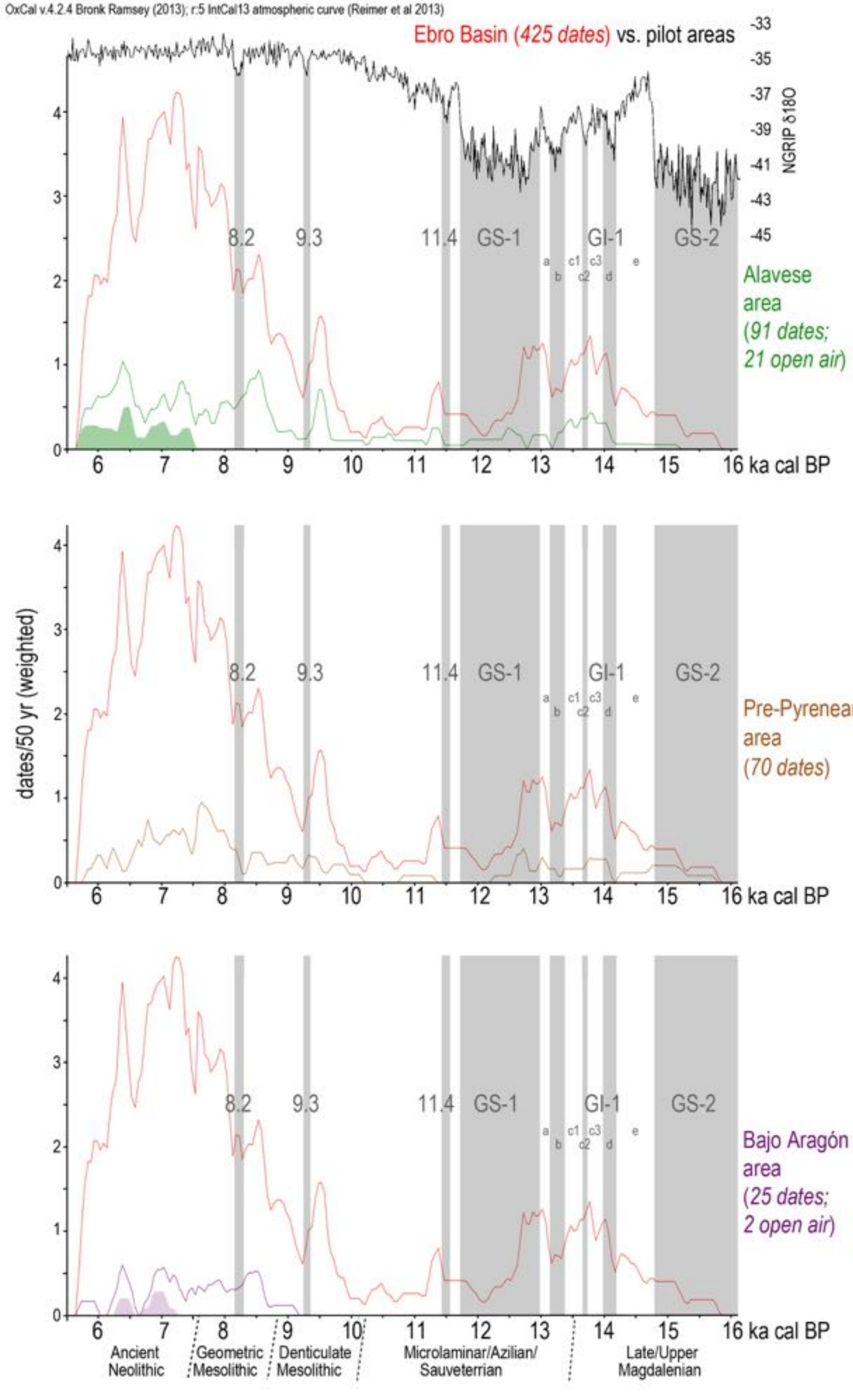
Zahid, H.J., Robinson, E., Kelly, R.L., 2016. Agriculture, population growth, and statistical analysis of the radiocarbon record. Proc. Natl. Acad. Sci. U. S. A. 113, 931–5. doi:10.1073/pnas.1517650112

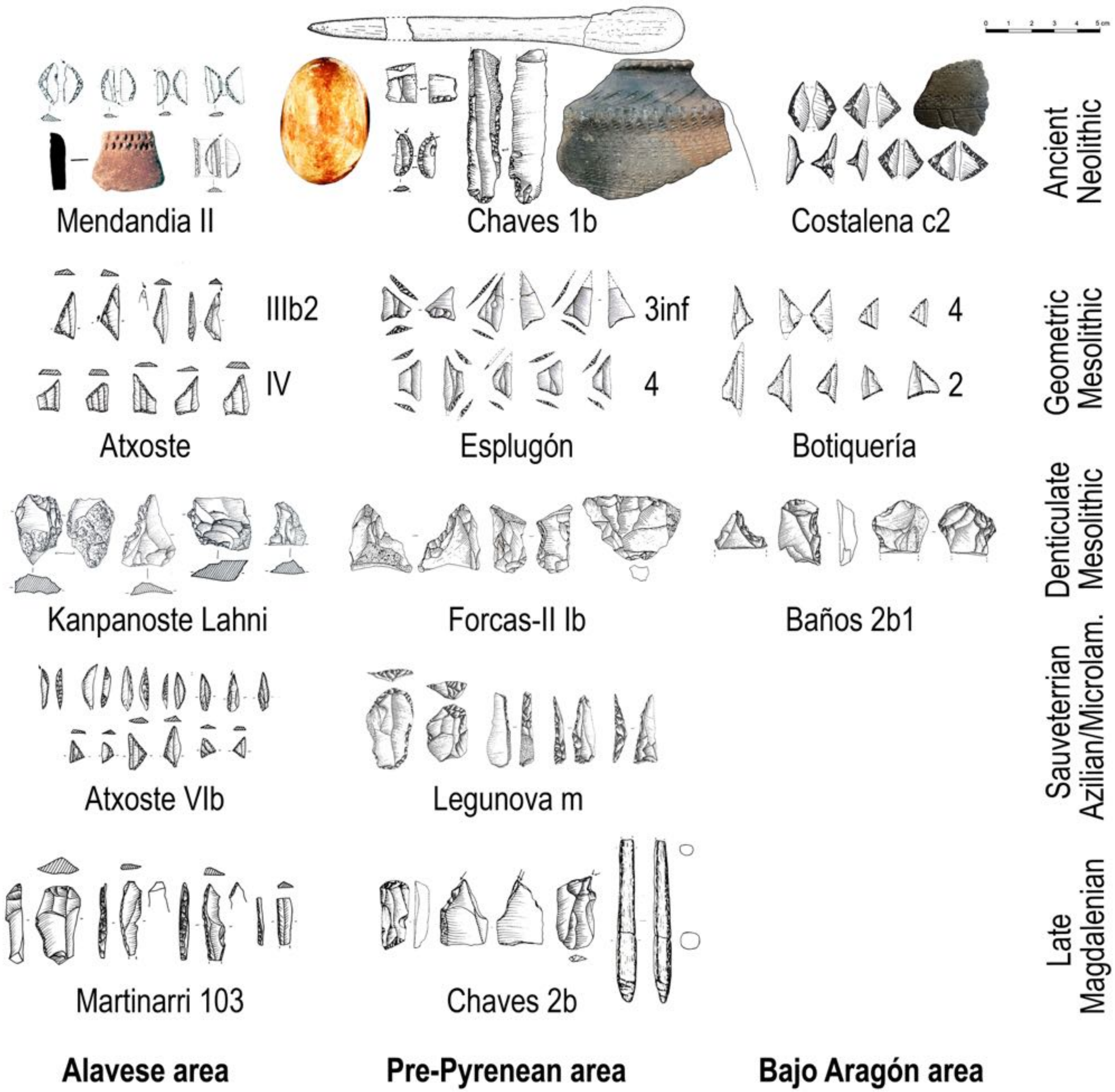

Bay of Biscay
VITORIA
PAMPLONA
LOGROÑO
Alavese Area
El Portalet
ANDORRA
Central Pre-Pyrenees
HUESCA
Ebro Basin
ZARAGOZA
LÉRIDA
Ebro Basin
Iberian Peninsula
Bajo Aragón
Mediterranean Sea
Open - air site
Cave / Rock-shelter
Paleoenvironmental sequence
Km
Annual Mean Temperature (ºC)
Annual mean temperature (ºC)
< 2.5
2.5 - 5
5 - 7.5
7.5 - 10
10 - 12.5
12.5 - 15
15 - 17.5
> 17.5
Annual Mean Rainfall (mm)
Annual mean rainfall (mm)


A) Alavese Area
Portugain
Socuevas
Atxoste
Kanpanoste
Kanpanoste Goikoa
Araico
Mendandia
Larrenke Norte
Orcillas
Martinarri
Peña Larga
San Cristóbal
Husos I-II
Cascajos
EBRO BASIN
Bay of Biscay
A
B
C
Open - air site
Cave / Rock-shelter
Mediterranean Sea
B) Central Pre-Pyrenees
Peña-14
Paco Pons
Legunova
Rambla de Legunova
Valcervera
Esplugón
Drólica
Pacencia
Chaves
Huerto Raso
Forcas I-II
Samitiel
Espantalobos
C) Bajo Aragón
Riols
Valmayor-XI
Plano del Pulido
Costalena
Pontet
Botiquería
Torrazas
Baños
Alonso Norte

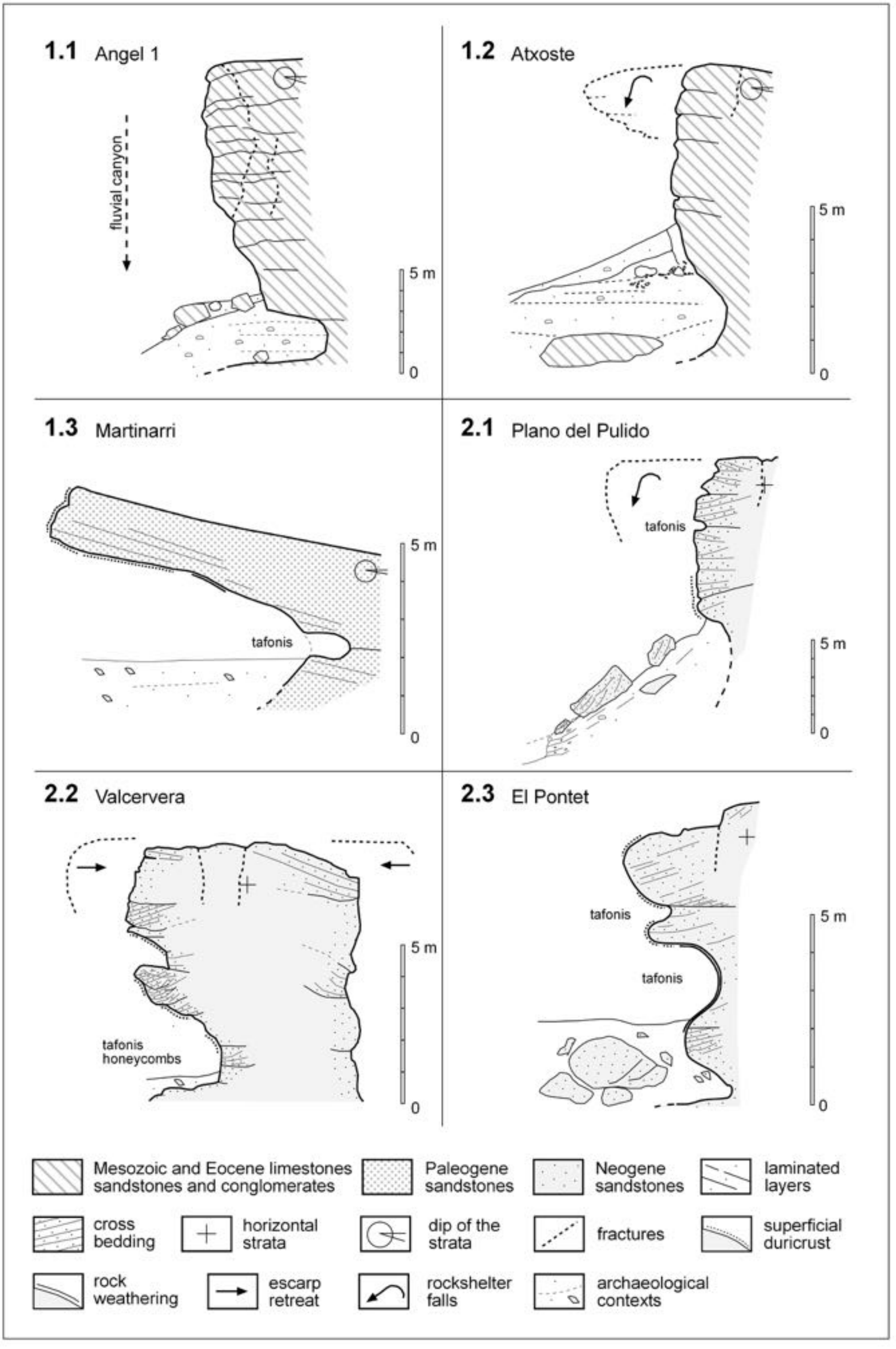


OxCal v.4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Iberian Peninsula (1327 dates) vs. Ebro Basin (425 dates; 90 open-air)
dates/50 yr (weighted)
NGRIP δ18O
8.2
9.3
11.4
GS-1
GI-1
GS-2
a
b
c1
c2
c3
d
e
ka cal BP
Ancient Neolithic
Geometric Mesolithic
Denticulate Mesolithic
Microlaminar/Azilian/ Sauveterrian
Late/Upper Magdalenian


OxCal v.4.2.4 Bronk Ramsey (2013); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Ebro Basin (425 dates) vs. pilot areas
NGRIP δ18O
8.2
9.3
11.4
GS-1
GI-1
GS-2
a b c1 c2 c3 d e
Alavese area (91 dates; 21 open air)
Pre-Pyrenean area (70 dates)
Bajo Aragón area (25 dates; 2 open air)
dates/50 yr (weighted)
ka cal BP
Ancient Neolithic
Geometric Mesolithic
Denticulate Mesolithic
Microlaminar/Azilian/ Sauveterrian
Late/Upper Magdalenian



Mendandia II
Chaves 1b
Costalena c2
Ancient Neolithic
IIIb2
IV
3inf
4
4
2
Atxoste
Esplugón
Botiquería
Geometric Mesolithic
Kanpanoste Lahni
Forcas-II Ib
Baños 2b1
Denticulate Mesolithic
Atxoste VIb
Legunova m
Sauveterrian Azilian/Microlam.
Martinarri 103
Chaves 2b
Late Magdalenian
Alavese area
Pre-Pyrenean area
Bajo Aragón area


1.1 Angel 1
fluvial canyon
5 m
0
1.2 Atxoste
5 m
0
1.3 Martinarri
tafonis
5 m
0
2.1 Plano del Pulido
tafonis
5 m
0
2.2 Valcervera
tafonis
honeycombs
5 m
0
2.3 El Pontet
tafonis
tafonis
5 m
0
Mesozoic and Eocene limestones sandstones and conglomerates
Paleogene sandstones
Neogene sandstones
laminated layers
cross bedding
horizontal strata
dip of the strata
fractures
superficial duricrust
rock weathering
escarp retreat
rockshelter falls
archaeological contexts


Ángel 1.1


Atxoste 1.2

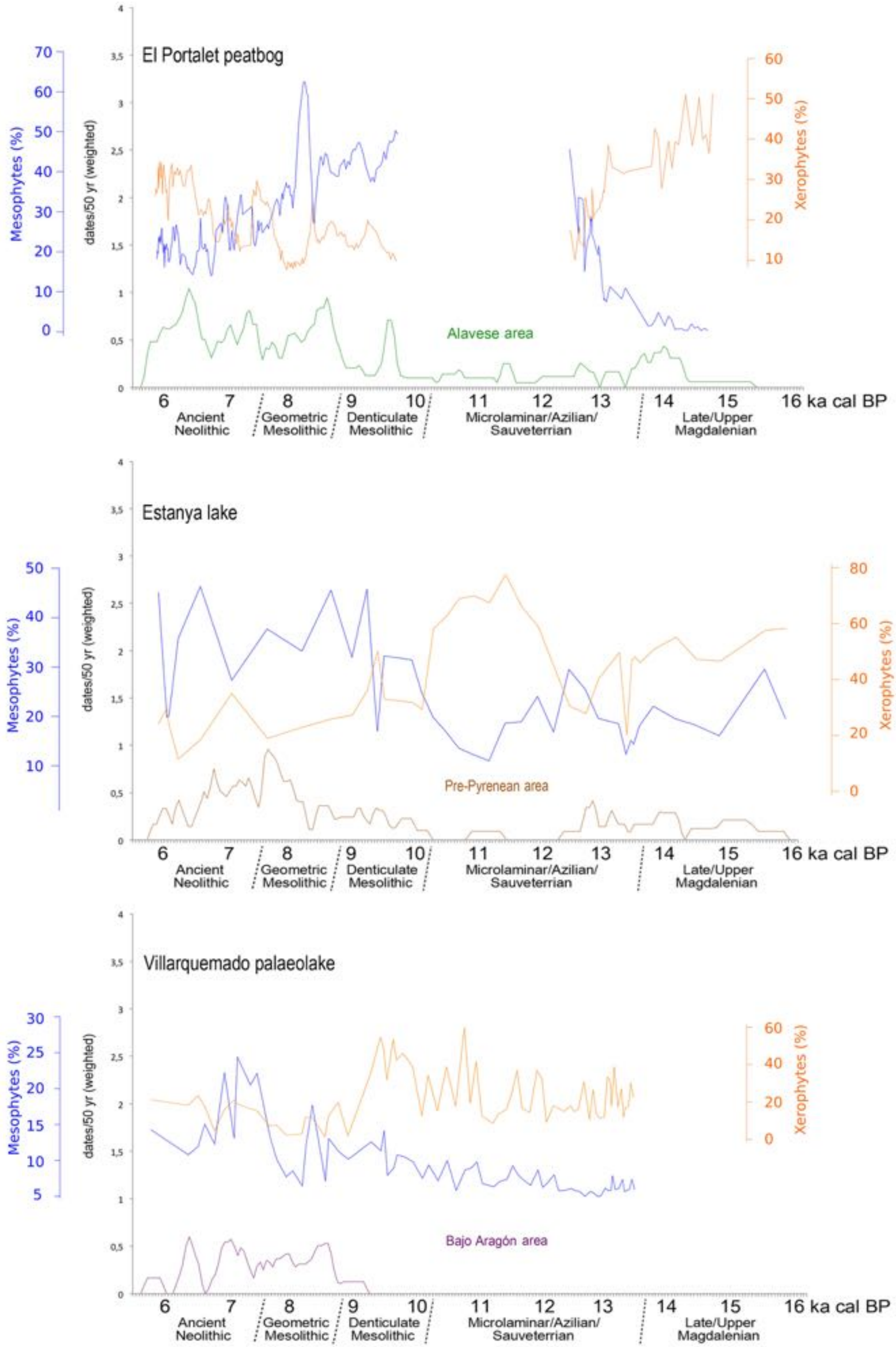

Martinarri 1.3

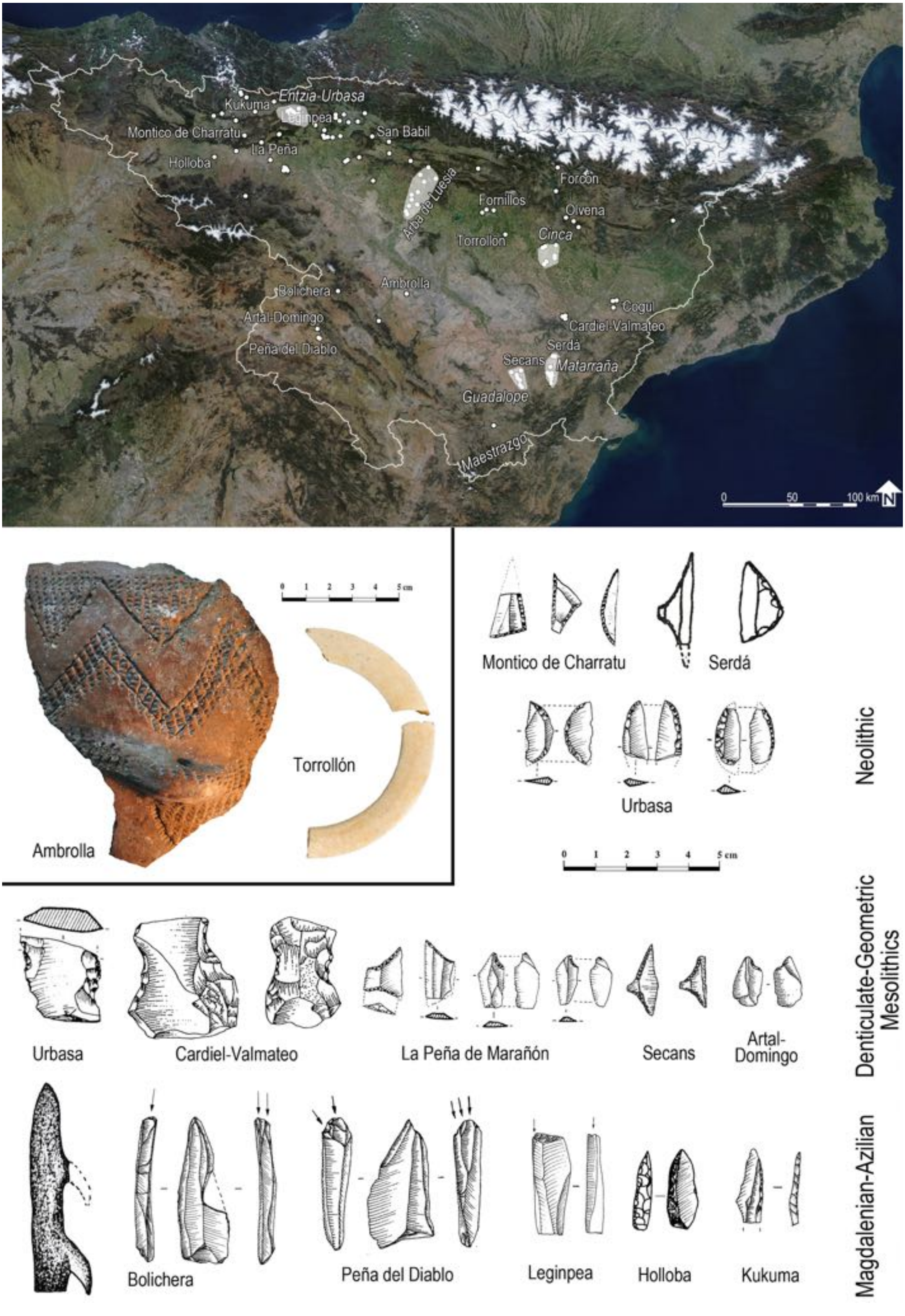

Plano del Pulido 2.1


Valcervera 2.2


Pontet 2.3


Cabezo de la Cruz 3


El Portalet peatbog
Mesophytes (%)
dates/50 yr (weighted)
Xerophytes (%)
Alavese area
Estanya lake
Pre-Pyrenean area
Villarquemado palaeolake
Bajo Aragón area
ka cal BP
Ancient Neolithic
Geometric Mesolithic
Denticulate Mesolithic
Microlaminar/Azilian/ Sauveterrian
Late/Upper Magdalenian



Entzia-Urbasa
Kukuma
Leginpea
Montico de Charratu
San Babil
La Peña
Holloba
Arba de Luesia
Forcón
Fornillos
Olvena
Cinca
Torrollón
Ambrolla
Bolichera
Cogul
Artal-Domingo
Cardiel-Valmateo
Peña del Diablo
Serdá
Secans
Matarraña
Guadalope
Maestrazgo
0 50 100 km
N
0 1 2 3 4 5 cm
Torrollón
Ambrolla
Montico de Charratu
Serdá
Urbasa
Neolithic
0 1 2 3 4 5 cm
Urbasa
Cardiel-Valmateo
La Peña de Marañón
Secans
Artal-Domingo
Denticulate-Geometric Mesolithics
Bolichera
Peña del Diablo
Leginpea
Holloba
Kukuma
Magdalenian-Azilian

Table 1. Synthesis of sites and available dates from the Ebro Basin and the 3 pilot areas.

The whole basin dataset already includes sites and dates from the pilot areas.

PERIOD (Date cal BP)	TOTAL EBRO BASIN 80 sites	SITES/ 100 YEARS	PILOT AREAS (35 sites; 186 ^{14}C)		
			ALAVESE AREA 14 sites	CENTRAL PRE-PYRENEES 12 sites	BAJO ARAGÓN 9 sites
NEOLITHIC ca. 7500-5500	54 SITES (41 caves and rockshelters 13 open-air) 254 ^{14}C	2,70	Araico Atxoste Cascajos Husos I – II Larrenke N Mendandia Peña Larga San Cristóbal (45 ^{14}C)	Chaves Drólica Esplugón Forcas II Huerto Raso Pacencia Paco Pons Rambla Legunova (33 ^{14}C)	Alonso Norte Botiquería Costalena Plano del Pulido Pontet Riols Torrazas Valmayor XI (13 ^{14}C)
GEOMETRIC MESOLITHIC ca. 8700-7500	27 SITES (26 caves and rockshelters 1 open-air) 55 ^{14}C	2,25	Atxoste Kanpanoste G Martinarri Mendandia Socuevas Urratxa III (11 ^{14}C)	Esplugón Forcas II Peña-14 Rambla Legunova Valcervera (13 ^{14}C)	Baños Botiquería Costalena Pontet (8 ^{14}C)
DENTICULATE MESOLITHIC ca. 10000-8700	17 SITES (16 caves and rockshelters 1 open-air) 32 ^{14}C	1,31	Atxoste Kanpanoste Kanpanoste G Martinarri Mendandia (11 ^{14}C)	Esplugón Forcas II Legunova Peña-14 (9 ^{14}C)	Baños Pontet (4 ^{14}C)
SAUVETERRIAN/ AZILIAN/ MICROLAMINAR ca. 13500-10000	20 SITES (20 caves and rockshelters) 46 ^{14}C	0,57	Atxoste Martinarri Mendandia Portugain Socuevas Urratxa III (11 ^{14}C)	Forcas I Legunova Peña-14 (4 ^{14}C)	
LATE MAGDALENIAN ca. 15000-13500	20 SITES (20 caves and rockshelters) 38 ^{14}C	1,33	Atxoste Martinarri Socuevas (13 ^{14}C)	Chaves Forcas I Legunova (11 ^{14}C)	-
TOTAL ^{14}C	425	0,84	91	70	25

Table 2. Revised archaeological sites according to lithological characteristics, the layout of the structure and the type of response to erosional processes (see location of the sites in Figure 1).

TYPE AND REPRESENTATIVE SITE		LITHOLOGY AND GEOMORPHOLOGY	GENESIS	ALTERATION PROCESSES
1. SHELTERS AND CAVES IN MARGINAL MIDDLE MOUNTAIN	**1.1 ÁNGEL 1** Chaves C. Drólica Huerto Raso Los Husos Mendandia C. Pacencia Peña Larga Portugain S. Cristóbal Urratxa III	Mesozoic and Eocene limestones, dolomites and conglomerates Cavity in fluvio-karstic canyon	Fluvial and/or karstic activity	Slow erosion
	1.2 ATXOSTE Los Baños Esplugón Forcas Kanpanoste Kanpanoste Goikoa Paco Pons Socuevas	Mesozoic and Eocene limestones and detrital rocks Small shelther in front of the structural cuesta	Differential erosion and rock weathering	Slow erosion
	1.3 MARTINARRI	Paleogene detrital sediments Taffoni in monocline sandstones	Ancient stages of rock weathering	Slow weathering
2. SHELTERS IN LOWLANDS EBRO BASIN	**2.1 PLANO DEL PULIDO** Botiquería Costalena Espantalobos Legunova Peña-14 Valmayor-XI	Horizontal Neogene sandstones Shelter in the cliffs of the paleochannel reliefs and mesas	Differential erosion and rock weathering	Fast weathering + rock falls
	2.2 VALCERVERA Torrazas	Horizontal Neogene sandstones Shelter in narrow and exempt paleochannel relief	Differential erosion and rock weathering	Very fast weathering + rock falls
	2.3 EL PONTET Rambla de Legunova	Horizontal Neogene sandstones Large taffoni in paleochannel relief	Ancient stages of rock weathering	Slow weathering + rock falls
3. OPEN AIR	**CABEZO DE LA CRUZ** Alonso N. Cascajos Larrenke N. Riols	Valley bottoms, fluvial terraces, alluvial cones and other flat quaternary forms	No specific	Fast accumulation + slow erosion

APPENDIX A.

EBRO BASIN DATES RANGED BY SITES (WITH MAP NUMBER) AND REFERENCES

SITE	MAP NO.	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Urratxa III	1	Ua-11434	6940	75	7626	7938	(Muñoz and Berganza, 1997)
Urratxa III	1	Ua-11435	6955	80	7657	7951	(Muñoz and Berganza, 1997)
Urratxa III	1	Ua-11433	10240	100	11411	12411	(Muñoz and Berganza, 1997)
Socuevas	2	GrA-46015	7590	45	8328	8511	Unpublished
Socuevas	2	Beta-282213	9260	50	10275	10570	Unpublished
Socuevas	2	Beta-282214	10550	50	12402	12659	Unpublished
Socuevas	2	Beta-282215	11130	50	12836	13095	Unpublished
Socuevas	2	Beta-312042	11470	50	13200	13438	Unpublished
Socuevas	2	Beta-282216	11530	50	13276	13463	Unpublished
Socuevas	2	Beta-312041	11540	50	13281	13468	Unpublished
Socuevas	2	Beta-312040	12040	50	13755	14045	Unpublished
El Prado	3	Beta-366569	5880	30	6641	6776	(Alonso and Jiménez, 2014)
Araico	4	Beta-312351	5640	40	6315	6495	(Tarriño et al., 2014)
Araico	4	Beta-312352	6050	40	6785	7005	(Tarriño et al., 2011)
Larrenke N	5	No reference	5180	100	5664	6208	(Ortiz Tudanca et al., 1983)
Larrenke N	5	No reference	5210	100	5742	6268	(Ortiz Tudanca et al., 1983)
Mendandia	6	GrN-22740	6440	40	7280	7428	(Alday, 2006)
Mendandia	6	GrN-22741	6540	70	7320	7570	(Alday, 2006)
Mendandia	6	GrN-19658	7210	80	7865	8188	(Alday, 2006)
Mendandia	6	GrN-22742	7180	45	7932	8156	(Alday, 2006)
Mendandia	6	Ua-34366	7265	70	7950	8280	(Alday et al., 2012)
Mendandia	6	GrN-22743	7620	50	8358	8539	(Alday, 2006)
Mendandia	6	GrN-22744	7810	50	8450	8750	(Alday, 2006)
Mendandia	6	GrN-22745	7780	40	8453	8630	(Alday, 2006)
Mendandia	6	GrA-6874	8500	60	9411	9556	(Alday, 2006)
Kanpanoste Goikoa	7	GrN-20214	6360	70	7165	7425	(Alday, 1998)
Kanpanoste Goikoa	7	GrN-20215	7620	80	8218	8590	(Alday, 1998)
Kanpanoste	7	GrN-22440	7620	70	8322	8583	(Cava, 2004)
Kanpanoste	7	GrN-22442	7920	100	8484	9024	(Cava, 2004)
Kanpanoste	7	GrN-22441	8200	70	9008	9400	(Cava, 2004)
Atxoste	8	GrA-9789	6220	60	6969	7265	(Alday, 2014)
Atxoste	8	GrA-13415	6940	40	7679	7915	(Alday, 2014)
Atxoste	8	GrA-13419	6970	40	7696	7927	(Alday, 2014)
Atxoste	8	GrA-13468	7140	50	7850	8041	(Alday, 2014)
Atxoste	8	GrA-13418	7340	70	8012	8326	(Alday, 2014)
Atxoste	8	GrA-13469	7480	50	8192	8383	(Alday, 2014)
Atxoste	8	GrA-13447	7810	40	8459	8699	(Alday, 2014)
Atxoste	8	GrA-13448	8030	50	8658	9031	(Alday, 2014)
Atxoste	8	GrA-15700	8510	80	9310	9670	(Alday, 2014)
Atxoste	8	GrA-15699	8760	50	9555	10115	(Alday, 2014)
Atxoste	8	GrA-13473	8840	50	9705	10159	(Alday, 2014)
Atxoste	8	GrA-35141	9450	50	10558	11067	(Alday, 2014)
Atxoste	8	GrA-35142	9510	50	10601	11086	(Alday, 2014)
Atxoste	8	GrA-15858	9550	60	10691	11133	(Alday, 2014)
Atxoste	8	GrA-23107	11690	80	13366	13730	(Alday, 2014)
Atxoste	8	GrA-19870	11730	90	13403	13756	(Alday, 2014)
Atxoste	8	GrA-22865	11720	70	13429	13730	(Alday, 2014)
Atxoste	8	GrA-22866	11760	70	13457	13741	(Alday, 2014)
Atxoste	8	GrA-22900	11800	60	13481	13750	(Alday, 2014)
Atxoste	8	GrA-19554	12070	60	13762	14088	(Alday, 2014)
Atxoste	8	GrA-19502	12200	90	13774	14503	(Alday, 2014)
Atxoste	8	GrA-19503	12540	80	14315	15140	(Alday, 2014)
Martinarri	9	Beta-410010	7350	30	8036	8294	Unpublished
Martinarri	9	Beta-410009	9870	40	11207	11385	Unpublished
Martinarri	9	GrA-46014	8455	45	9414	9537	(Alday et al., 2013)
Martinarri	9	GrA-45940	11890	50	13560	13800	(Alday et al., 2013)
San Cristóbal	10	Beta-307800	5100	30	5749	5917	(Fernández Eraso and Mujika, 2013)

San Cristóbal	10	Beta-337632	5320	30	5996	6192	(Fernández Eraso and Mujika, 2013)
San Cristóbal	10	Beta-373276	5410	30	6129	6289	(Fernández Eraso and Mujika, 2013)
San Cristóbal	10	Beta-373277	5460	30	6207	6305	(Fernández Eraso and Mujika, 2013)
San Cristóbal	10	Beta-373275	5490	30	6211	6394	(Fernández Eraso and Mujika, 2013)
San Cristóbal	10	Beta-373631	5500	30	6216	6396	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-208850	5280	40	5940	6184	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-161884	5300	40	5945	6200	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-161185	5430	60	6005	6387	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-208851	5490	40	6203	6400	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-208853	5520	40	6220	6404	(Fernández Eraso and Mujika, 2013)
Husos I	11	Beta-161179	5630	60	6296	6548	(Fernández Eraso and Mujika, 2013)
Husos I	11	Beta-161881	5810	60	6466	6748	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-221641	5790	40	6485	6712	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-221642	6040	40	6785	6996	(Fernández Eraso and Mujika, 2013)
Husos II	11	Beta-221640	6050	40	6785	7005	(Fernández Eraso and Mujika, 2013)
Husos I	11	Beta-161180	6130	60	6803	7174	(Fernández Eraso and Mujika, 2013)
Husos I	11	Beta-161182	6240	60	6979	7275	(Fernández Eraso and Mujika, 2013)
Peña Larga	12	Beta-242782	5720	49	6409	6637	(Fernández Eraso and Mujika, 2013)
Peña Larga	12	Beta-242783	6720	40	7510	7664	(Fernández Eraso and Mujika, 2013)
Alto de Rodilla	13	CSIC -1967	6171	55	6936	7245	(Alonso and Jiménez, 2014)
Portalón	14	Beta-184842	5230	40	5912	6177	(Ortega et al., 2008)
Portalón	14	Beta-222339	6100	50	6805	7159	(Ortega et al., 2008)
Portalón	14	Beta-222340	6270	40	7025	7274	(Ortega et al., 2008)
Mirador	15	Beta-220912	5090	40	5743	5918	(Vergès et al., 2008)
Mirador	15	Beta-181087	5360	50	6002	6277	(Vergès et al., 2008)
Mirador	15	Beta-208131	5470	40	6189	6391	(Vergès et al., 2008)
Mirador	15	Beta-220913	5480	40	6200	6395	(Vergès et al., 2008)
Mirador	15	Beta-181088	5700	70	6320	6658	(Vergès et al., 2008)
Mirador	15	Beta-197384	6100	50	6805	7159	(Vergès et al., 2008)
Mirador	15	Beta-182040	6130	50	6890	7165	(Vergès et al., 2008)
Mirador	15	Beta-220914	6110	40	6891	7157	(Vergès et al., 2008)
Mirador	15	Beta-208132	6120	40	6902	7158	(Vergès et al., 2008)
Mirador	15	Beta-208133	6150	40	6942	7165	(Vergès et al., 2008)
Mirador	15	Beta-208134	6320	50	7161	7415	(Vergès et al., 2008)
Mirador	15	Beta-197385	6380	40	7253	7420	(Vergès et al., 2008)
Mirador	15	Beta-197386	7060	40	7796	7965	(Vergès et al., 2008)
Cueva Lóbrega	16	GrN-16110	6220	100	6860	7414	(Barrios Gil, 2004)
Cascajos	17	GrA-16204	5100	60	5664	5988	(García Gazolaz and Sesma, 2007)
Cascajos	17	GrA-16942	5100	50	5724	5939	(García Gazolaz and Sesma, 2007)
Cascajos	17	GrA16208	5250	50	5919	6181	(García Martínez de Lagrán, 2012)
Cascajos	17	GrA-16210	5300	60	5935	6266	(García Gazolaz and Sesma, 2007)
Cascajos	17	GrA16211	5330	60	5949	6276	(García Martínez de Lagrán, 2012)
Cascajos	17	Ua16203	5450	85	6002	6405	(García Martínez de Lagrán, 2012)
Cascajos	17	Ua17793	5720	90	6312	6719	(García Martínez de Lagrán, 2012)
Cascajos	17	Ua-1625	5640	35	6318	6493	(García Gazolaz and Sesma, 2007)
Cascajos	17	GrA16209	5830	60	6490	6783	(García Martínez de Lagrán, 2012)
Cascajos	17	Ua-24423	5945	95	6507	7143	(García Gazolaz and Sesma, 2007)
Cascajos	17	UA-17995	6125	80	6795	7240	(García Gazolaz and Sesma, 2007)
Cascajos	17	Ua-16024	6185	75	6896	7260	(García Gazolaz and Sesma, 2007)
Cascajos	17	Ua24425	6145	45	6912	7166	(García Gazólaz et al., 2011)
Cascajos	17	Ua-24427	6230	50	7003	7260	(García Gazolaz and Sesma, 2007)
Cascajos	17	Ua-24426	6250	50	7007	7270	(García Gazolaz and Sesma, 2007)
Cascajos	17	Ua24424	6380	60	7176	7425	(García Gazólaz et al., 2011)
Cascajos	17	Ua-24428	6435	35	7289	7426	(García Gazólaz et al., 2011)
Orcillas	18	Beta-252434	8610	50	9501	9690	(Fernández Eraso et al., 2010)
Portugain	19	GrN-14097	10370	90	11841	12548	(Barandiarán and Cava, 2008)
Artegieta	20	GrA-28311	8055	50	8729	9121	(Mujika and Edeso, 2012)
Abauntz	21	GrN-21010	5820	40	6505	6730	(Utrilla and Mazo, 1996)
Abauntz	21	OxA-5116	11760	90	13431	13765	(Utrilla et al., 2012)
Abauntz	21	GrA-39336	12220	60	13921	14400	(Utrilla et al., 2012)
Abauntz	21	CAMS9918	12340	60	14089	14720	(Utrilla et al., 2012)
Paternanbidea	22	GrA13675	5960	40	6678	6890	(García Gazolaz, 2007)
Paternanbidea	22	GrA-13673	6090	40	6803	7156	(García Gazolaz, 2007)
Artusia	23	Beta-374431	7680	40	8402	8547	(García-Martínez de Lagrán et al., 2016)

Artusia	23	Beta-374432	7790	40	8455	8637	(García-Martínez de Lagrán et al., 2016)
Artusia	23	Beta-374433	8260	40	9093	9410	(García-Martínez de Lagrán et al., 2016)
Aizpea	24	BrN-18421	6370	70	7170	7425	(Barandiarán and Cava, 2001)
Aizpea	24	GrA-779	6600	50	7430	7570	(Barandiarán and Cava, 2001)
Aizpea	24	GrN-16222	6830	70	7571	7826	(Barandiarán and Cava, 2001)
Aizpea	24	GrN-1622	7160	70	7853	8160	(Barandiarán and Cava, 2001)
Aizpea	24	GrN-16620	7790	70	8410	8856	(Barandiarán and Cava, 2001)
Zatoya	25	GrN-23998	12205	90	13777	14526	(Barandiarán and Cava, 2001)
Padre Areso	26	(GrN-14599	5380	100	5929	6392	(García Gazólaz, 2001)
Padre Areso	26	GrN14599	5400	100	5943	6397	(García Gazólaz, 2001)
Paco Pons	27	Gra-19294	6010	45	6739	6965	(Montes et al., 2015)
Paco Pons	27	Gra-19295	6045	45	6752	7141	(Montes et al., 2015)
Peña 14	28	GrN-25094	7660	90	8224	8637	(Montes et al., 2015)
Peña 14	28	GrN-25998	8000	90	8598	9112	(Montes et al., 2015)
Peña 14	28	GrN-25999	8000	80	8605	9077	(Montes et al., 2015)
Peña 14	28	GrN-26000	10630	100	12237	12739	(Montes et al., 2015)
Rambla Legunova	29	GrA-52086	5175	40	5760	6002	(Montes et al., 2015)
Rambla Legunova	29	GrA-51860	5440	35	6190	6298	(Montes et al., 2015)
Rambla Legunova	29	GrA-52691	5670	60	6315	6628	(Montes et al., 2015)
Rambla Legunova	29	GrA-51971	6295	40	7160	7313	(Montes et al., 2015)
Rambla Legunova	29	GrA-64001	7225	40	7966	8160	(Montes et al., 2015)
Rambla Legunova	29	GrA-47886	7235	45	7970	8164	(Montes et al., 2015)
Rambla Legunova	29	GrA-61768	7260	45	7983	8174	(Montes et al., 2015)
Legunova	29	GrA-24292	8200	50	9015	9300	(Montes et al., 2015)
Legunova	29	GrA-22086	8250	60	9032	9417	(Montes et al., 2015)
Legunova	29	GrA-24294	8800	40	9666	10135	(Montes et al., 2015)
Legunova	29	GrA-24293	10760	60	12585	12749	(Montes et al., 2015)
Legunova	29	GrA-27846	11240	60	12999	13241	(Montes et al., 2015)
Legunova	29	GrA-27841	11640	60	13330	13580	(Montes et al., 2015)
Legunova	29	GrA-24295	11780	60	13472	13741	(Montes et al., 2015)
Legunova	29	GrA-22087	11980	80	13595	14049	(Montes et al., 2015)
Legunova	29	GrA-24296	12060	60	13759	14077	(Montes et al., 2015)
Legunova	29	GrA-22089	12500	90	14241	15109	(Montes et al., 2015)
Valcervera	30	GrA-27876	6815	45	7580	7727	(Montes et al., 2015)
Valcervera	30	GrA-45783	6995	40	7727	7934	(Montes et al., 2015)
Valcervera	30	GrA-45763	7035	45	7760	7960	(Montes et al., 2015)
Samitiel	31	GrN-26150	5130	20	5769	5930	(Montes et al., 2000)
Esplugón	32	Beta-338509	5970	30	6730	6892	(Utrilla et al., 2015)
Esplugón	32	Beta-283899	6120	40	6902	7158	(Utrilla et al., 2015)
Esplugón	32	Beta-313517	6730	40	7513	7667	(Utrilla et al., 2015)
Esplugón	32	Beta-306723	6950	50	7680	7925	(Utrilla et al., 2015)
Esplugón	32	GrA-59632	7620	40	8365	8518	(Utrilla et al., 2015)
Esplugón	32	GrA-59634	7715	45	8418	8584	(Utrilla et al., 2015)
Esplugón	32	Beta-306725	7860	40	8546	8933	(Utrilla et al., 2015)
Esplugón	32	GrA-59633	8015	45	8716	9020	(Utrilla et al., 2015)
Esplugón	32	Beta 306722	8380	40	9299	9485	(Utrilla et al., 2015)
Espantalobos	33	Beta-361624	7390	40	8055	8341	(Montes et al., 2015)
Espantalobos	33	Beta-361625	7900	50	8593	8978	(Montes et al., 2015)
Chaves	34	CSIC-381	6120	70	6795	7230	(Baldellou, 2011)
Chaves	34	GrN-13603	6260	100	6943	7418	(Baldellou, 2011)
Chaves	34	CSIC-379	6230	70	6948	7289	(Baldellou, 2011)
Chaves	34	GrA-26912	6230	45	7006	7257	(Baldellou, 2011)
Chaves	34	GrN-13602	6330	90	7013	7428	(Baldellou, 2011)
Chaves	34	GrN-13605	6330	70	7029	7424	(Baldellou, 2011)
Chaves	34	GrA-34256	6335	40	7167	7413	(Baldellou, 2011)
Chaves	34	GrA-28341	6380	40	7253	7420	(Baldellou, 2011)
Chaves	34	CSIC-378	6460	70	7256	7500	(Baldellou, 2011)
Chaves	34	GrA-34257	6410	40	7271	7421	(Baldellou, 2011)
Chaves	34	GrN-13604	6490	40	7316	7476	(Baldellou, 2011)
Chaves	34	UCIAMS-66317	6470	25	7324	7431	(Baldellou, 2011)
Chaves	34	GrA-34258	6530	40	7330	7558	(Baldellou, 2011)
Chaves	34	GrA-38022	6580	35	7427	7563	(Baldellou, 2011)
Chaves	34	GrN-12683	6650	80	7427	7657	(Baldellou, 2011)
Chaves	34	GrN-12658	6770	70	7500	7752	(Baldellou, 2011)

Chaves	34	GrN-14561	12660	70	14731	15285	(Utrilla, 1995)
Chaves	34	GrN-15635	12950	70	15240	15742	(Utrilla, 1995)
Cueva Pacencia	35	GrA17666	5795	45	6485	6719	(Montes et al., 2000)
Huerto Raso	36	GrA-21360	6310	60	7028	7417	(Montes et al., 2000)
Cueva Drólica	37	GrA33914	5855	40	6558	6777	(Montes and Martínez Bea, 2006)
Forcas II	38	Beta-247406	5240	40	5917	6178	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-247405	6740	40	7518	7670	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-247404	6750	40	7524	7675	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-60773	6940	90	7618	7941	(Utrilla and Mazo, 2014)
Forcas II	38	Grn-22688	6900	45	7656	7843	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-290932	7000	40	7735	7935	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-250944	7150	40	7871	8031	(Utrilla and Mazo, 2014)
Forcas II	38	GrN-22686	7240	40	7978	8163	(Utrilla and Mazo, 2014)
Forcas II	38	Beta-59997/CAMS-5354	8650	70	9520	9887	(Utrilla and Mazo, 2014)
Forcas I	38	GrN-17785	9715	75	10785	11251	(Utrilla and Mazo, 2014)
Forcas I	38	GrA-32955	11015	45	12741	13011	(Utrilla and Mazo, 2014)
Forcas I	38	GrA-33987	12010	60	13735	14045	(Utrilla and Mazo, 2014)
Forcas I	38	GrA-32957	12440	50	14217	14937	(Utrilla and Mazo, 2014)
Forcas I	38	GrA-33986	12600	60	14635	15216	(Utrilla and Mazo, 2014)
Coro Trasito	39	CNA.2520.1.1	5850	35	6561	6746	(Clemente et al., 2014)
Coro Trasito	39	Beta-358571	5990	40	6735	6941	(Clemente et al., 2014)
Coro Trasito	39	Beta -366546	6159	40	6949	7166	(Clemente et al., 2014)
Espluga de la Puyascada	40	CSIS-382	5580	70	6217	6527	(Baldellou, 1987)
Espluga de la Puyascada	40	CSIC-384	5930	60	6636	6930	(Baldellou, 1987)
Trocs	41	Mams-14856	5005	27	5655	5887	(Rojo et al., 2013)
Trocs	41	Mams-16160	5008	27	5656	5888	(Rojo et al., 2013)
Trocs	41	Mams-16165	5035	23	5716	5895	(Rojo et al., 2013)
Trocs	41	Beta-319513	5580	40	6296	6437	(Rojo et al., 2013)
Trocs	41	Beta-316511	5590	40	6299	6443	(Rojo et al., 2013)
Trocs	41	Beta-316515	5590	40	6299	6443	(Rojo et al., 2013)
Trocs	41	Beta-316514	6050	40	6785	7005	(Rojo et al., 2013)
Trocs	41	Beta-295782	6060	40	6791	7144	(Rojo et al., 2013)
Trocs	41	Beta-284150	6070	40	6793	7151	(Rojo et al., 2013)
Trocs	41	Beta-326512	6080	40	6796	7155	(Rojo et al., 2013)
Trocs	41	Mams-16161	6217	25	7015	7243	(Rojo et al., 2013)
Trocs	41	Mams-16162	6218	24	7017	7243	(Rojo et al., 2013)
Trocs	41	Mams-16166	6234	28	7024	7252	(Rojo et al., 2013)
Trocs	41	Mams-16168	6249	28	7027	7259	(Rojo et al., 2013)
Trocs	41	Mams-16164	6249	25	7029	7259	(Rojo et al., 2013)
Trocs	41	Mams-16168	6249	20	7159	7252	(Rojo et al., 2013)
Trocs	41	Mams-16159	6280	25	7167	7260	(Rojo et al., 2013)
Trocs	41	Mams-16163	6285	25	7168	7261	(Rojo et al., 2013)
Cova del Sardo	42	KIK/KIA5833/40816	5000	30	5651	5888	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA3484/26248	5060	40	5715	5912	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA4381/32340	5245	40	5920	6178	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5832/40815	5635	35	6318	6488	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5860/41134	5645	25	6324	6492	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5002/36935	5695	35	6403	6602	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5785/40878	5715	35	6412	6630	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5038/37690	5850	40	6551	6775	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5037/37689	6525	45	7325	7558	(Gassiot Ballbè et al., 2014)
Cova del Sardo	42	KIK/KIA5834/40817	6586	35	7429	7564	(Gassiot Ballbè et al., 2014)
Estany de la Coveta	43	KIA-29818	7845	45	8523	8950	(Gassiot Ballbè et al., 2014)
Cova Colomera	44	Beta248523	6020	50	6740	6994	(Oms et al., 2013)
Cova Colomera	44	Beta240551	6150	40	6942	7165	(Oms et al., 2013)
Cova Colomera	44	Beta-279478	6180	40	6951	7235	(Oms et al., 2013)
Cova Colomera	44	OxA-23634	6170	30	6980	7165	(Oms et al., 2013)
Cova Gran	45	Beta-233605	5250	40	5922	6179	(Martínez-Moreno et al., 2007)
Cova Gran	45	Beta265982	6020	50	6740	6994	(Martínez-Moreno et al., 2007)
Parco	46	CSIC403	5970	60	6668	6948	(Balsera et al., 2015)
Parco	46	GrN-20058	6120	90	6788	7246	(Mangado et al., 2014)
Parco	46	CSIC-281	6170	70	6896	7250	(Mangado et al., 2007)
Parco	46	AA-14310	10190	100	11398	12377	(Calvo et al., 2008)
Parco	46	Gif-95562	10930	100	12693	13031	(Mangado et al., 2015)

Parco	46	OxA-8657	11270	90	12945	13320	(Petit et al., 2009)
Parco	46	OxA-8656	11430	60	13135	13413	(Mangado et al., 2015)
Parco	46	OxA-10797	12460	60	14235	15006	(Mangado et al., 2006)
Parco	46	OxA-10796	12605	60	14653	15218	(Mangado et al., 2006)
Parco	46	OxA-13597	12995	50	15310	15760	(Mangado et al., 2006)
Cova de Montanissell	47	Beta213109	5680	50	6322	6631	(Armentano et al., 2007)
Camp Colomer	48	Beta325685	5300	30	5991	6185	(Martins et al., 2015)
Camp Colomer	48	Beta-325684	5350	40	6001	6272	(Martins et al., 2015)
Camp Colomer	48	Beta-325686	5630	40	6314	6487	(Martins et al., 2015)
Balma Margineda	49	Beta-325682	6410	40	7271	7421	(Martins et al., 2015)
Balma Margineda	49	Ly-5414	11510	100	13143	13547	(Guilaine and Evin, 2007)
Balma Margineda	49	Ly-4896	11690	90	13342	13735	(Guilaine and Evin, 2007)
Balma de Guilanyà	50	Beta-210730	8640	50	9527	9732	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-185046	8680	50	9536	9883	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-186168	9410	60	10439	11061	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-210728	9840	50	11182	11354	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-210729	10940	50	12707	12950	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-247706	11110	40	12838	13080	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-185066	12180	50	13864	14230	(Mora and Martínez-Moreno, 2009)
Balma de Guilanyà	50	Beta-247708	12310	40	14071	14566	(Mora and Martínez-Moreno, 2009)
Molí del Salt	51	Beta-173335	8040	40	8762	9030	(Morales et al., 2012)
Molí del Salt	51	Beta-22913	10850	70	12652	12896	(Morales et al., 2012)
Molí del Salt	51	Beta-179599	10840	50	12681	12804	(Morales et al., 2012)
Molí del Salt	51	Beta-235268	10920	60	12700	12953	(Morales et al., 2012)
Molí del Salt	51	Beta-284214	10940	50	12707	12950	(Morales et al., 2012)
Molí del Salt	51	Beta-235267	11000	60	12728	13017	(Morales et al., 2012)
Molí del Salt	51	Beta-179598	10990	50	12729	12996	(Morales et al., 2012)
Molí del Salt	51	Beta-22912	11060	70	12761	13072	(Morales et al., 2012)
Molí del Salt	51	Beta-277000	11230	50	13007	13202	(Morales et al., 2012)
Molí del Salt	51	Beta-277001	11440	60	13142	13421	(Morales et al., 2012)
Molí del Salt	51	Beta-284212	11770	50	13471	13731	(Morales et al., 2012)
Molí del Salt	51	Beta-284213	11800	50	13481	13750	(Morales et al., 2012)
Molí del Salt	51	GifA-101037	11940	100	13555	14052	(Morales et al., 2012)
Molí del Salt	51	GifA-101038	12510	100	14232	15131	(Morales et al., 2012)
Collet Puiggrós	52	UBAR891	5345	45	5996	6274	(Piera et al., 2008)
Collet Puiggrós	52	UBAR892	5480	45	6195	6396	(Piera et al., 2008)
Colls	53	AA-8646	10050	85	11267	11963	(Morales et al., 2012)
Hort de la Boquera	54	OxA-23645	11775	45	13475	13730	(Morales et al., 2012)
Hort de la Boquera	54	OxA-23646	11850	45	13565	13761	(Morales et al., 2012)
Hort de la Boquera	54	OxA-13595	12250	60	13967	14495	(Morales et al., 2012)
Filador	55	AA-13411	8150	90	8778	9405	(García-Argüelles and Fullola, 2006)
Filador	55	Oxa-8658	8515	60	9422	9594	(García-Argüelles and Fullola, 2006)
Filador	55	AA-13412	9988	97	11223	11935	(García-Argüelles and Fullola, 2006)
Filador	55	AA-8647	10020	80	11248	11930	(García-Argüelles and Fullola, 2006)
Filador	55	OXA-8650	10864	60	12678	12860	(García-Argüelles and Fullola, 2006)
Filador	55	OXA-8660	11000	50	12731	13005	(García-Argüelles and Fullola, 2006)
Riols	56	GrN-13976	6040	100	6669	7165	(Royo and Gómez, 1996)
Valmayor XI	57	Beta-341167	6090	30	6858	7153	(Rojo et al., 2015)
Valmayor XI	57	Beta-341168	6570	30	7427	7558	(Rojo et al., 2015)
Plano del Pulido	58	Beta-258559	5040	40	5663	5902	(Utrilla and Bea, 2012)
Costalena	59	GrA-13264	5480	50	6190	6398	(Barandiarán and Cava, 2000)
Costalena	59	MAMS-29828	7053	27	7838	7958	Unpublished
Pontet	60	GrN-14241	6370	70	7170	7425	(Mazo and Montes, 1992)
Pontet	60	GrN-16313	7340	70	8012	8326	(Mazo and Montes, 1992)
Pontet	60	D-AMS 020210	7341	32	8030	8283	Unpublished
Pontet	60	D-AMS 020211	7941	65	8609	8030	Unpublished
Pontet	60	D-AMS 020208	6963	32	7698	7920	Unpublished
Pontet	60	D-AMS 020209	6369	41	7180	7420	Unpublished
Pontet	60	D-AMS 020207	5644	42	6310	6504	Unpublished
Botiquería	61	GrA-13268	6040	50	6745	7143	(Barandiarán and Cava, 2000)
Botiquería	61	GrA-13270	6240	50	7005	7265	(Barandiarán and Cava, 2000)
Botiquería	61	GrA-13267	6830	50	7582	7783	(Barandiarán and Cava, 2000)
Botiquería	61	GrA-13265	7600	50	8335	8537	(Barandiarán and Cava, 2000)
Torrazas	62	GrN18320	5570	60	6280	6480	(Benavente and Andrés, 1992)

Alonso Norte	63	D-AMS 018640	6069	27	6805	7002	Unpublished
Baños	64	GrA-21550	7350	50	8028	8311	(Utrilla and Rodanés, 2004)
Baños	64	GrN-24300	7570	100	8180	8560	(Utrilla and Rodanés, 2004)
Baños	64	GrA-21551	7550	50	8206	8430	(Utrilla and Rodanés, 2004)
Baños	64	GrA-21552	7740	50	8420	8597	(Utrilla and Rodanés, 2004)
Baños	64	GrN-24299	7840	100	8445	8984	(Utrilla and Rodanés, 2004)
Baños	64	GrA-21556	8040	50	8719	9086	(Utrilla and Rodanés, 2004)
Ángel 1	65	GrA22825	5220	80	5753	6208	(Domingo et al., 2010)
Ángel 2	65	Beta-254048	6390	40	7260	7420	(Utrilla et al., 2009)
Ángel 2	65	Beta-286819	6610	40	7437	7568	Unpublished
Ángel 2	65	Beta-266112	6990	50	7705	7934	(Domingo et al., 2010)
Ángel 2	65	Beta-286820	7120	50	7846	8021	Utrilla and Mazo, 2014)
Ángel 1	65	GrA-27274	7435	45	8178	8357	(Utrilla et al., 2009)
Ángel 1	65	GrA-27278	7955	45	8647	8988	(Utrilla et al., 2009)
Ángel 2	65	GrA-22836	8310	60	9132	9466	(Utrilla et al., 2009)
Ángel 1	65	GrA-22826	8390	60	9275	9526	(Utrilla et al., 2009)
Ángel 1	65	GrA-27275	9200	50	10245	10500	Unpublished
Cova del Clot del Hospital	66	OxA-16572	10045	45	11324	11769	(Bosch et al., 2015)
Cova del Clot del Hospital	66	OxA-16421	11115	50	12830	13086	(Bosch et al., 2015)
Cova del Vidre	67	Beta-58934	6189	90	6806	7290	(Martins et al., 2015)
Cova del Vidre	67	OXA-26064	6181	35	6960	7174	(Martins et al., 2015)
Cova del Vidre	67	OXA-26005	6248	33	7025	7260	(Martins et al., 2015)
Cova del Vidre	67	UBAR-832	7290	70	7964	8301	(Morales et al., 2013)
Mas Cremat	68	Beta-232340	6020	50	6740	6994	(Vizcaíno, 2010)
Mas Cremat	68	Beta-232342	6780	50	7566	7701	(Vizcaíno, 2010)
Mas Cremat	68	Beta-232341	6800	50	7572	7725	(Vizcaíno, 2010)
Cova Fosca	69	I-9867	5715	80	6317	6673	(Olaria, 2000)
Cova Fosca	69	Beta-148996	5850	70	6489	6846	(Olaria, 2000)
Cova Fosca	69	Beta-148997	5870	80	6491	6889	(Olaria, 2000)
Cova Fosca	69	Beta-18993	5820	40	6505	6730	(Olaria, 2000)
Cova Fosca	69	Beta-148998	5820	40	6505	6730	(Olaria, 2000)
Cova Fosca	69	Beta-148999	5980	70	6661	6996	(Olaria, 2000)
Cova Fosca	69	Beta-148994	5980	70	6661	6996	(Olaria, 2000)
Cova Fosca	69	Beta-149005	6070	80	6743	7163	(Olaria, 2000)
Cova Fosca	69	Beta-149000	6080	80	6746	7165	(Olaria, 2000)
Cova Fosca	69	Beta-149001	6140	90	6797	7251	(Olaria, 2000)
Cova Fosca	69	Beta-149007	6130	60	6803	7174	(Olaria, 2000)
Cova Fosca	69	Beta-149004	6150	70	6861	7248	(Olaria, 2000)
Cova Fosca	69	Beta-149006	6250	80	6946	7412	(Olaria, 2000)
Cova Fosca	69	Beta-149009	6390	40	7260	7420	(Olaria, 2000)
Cova Fosca	69	OXA-26074	6413	33	7275	7420	(Martins et al., 2015)
Cova Fosca	69	CSIC-356	7100	70	7752	8045	(Olaria, 2000)
Cova Fosca	69	CSIC-357	7210	70	7880	8178	(Olaria, 2000)
Cova Fosca	69	OxA26073	10060	45	11340	11815	(Martins et al., 2015)
Cova Fosca	69	sin ref	12130	100	13740	14311	(Olaria, 2000)
Mas Nou	70	Beta-136676	6800	70	7516	7791	(Olaria, 2000)
Mas Nou	70	Beta-170713	6760	40	7570	7675	(Olària et al., 2005)
Mas Nou	70	Beta-136677	6900	70	7610	7924	(Olaria, 2000)
Mas Nou	70	Beta-170714	6910	40	7670	7835	(Olaria, 2000)
Mas Nou	70	Beta-170715	6920	40	7674	7839	(Olaria, 2000)
Mas Nou	70	Beta 170714	7010	40	7744	7939	(Olària et al., 2005)
Cingle de l'Aigua	71	Beta-244044	10520	60	12160	12660	(Villaverde et al., 2010)
Cabezo de la Cruz	72	GrN-29135	7150	70	7841	8160	(Rodanés and Picazo, 2009)
Cueva del Gato 2	73	GrA22525	6240	50	7005	7265	(Blasco and Rodanés, 2009)
Carlos Álvarez	74	KIA-27671	7013	38	7753	7939	(Rojo et al., 2011)
Lámpara	75	KIA-6789	6055	34	6797	6996	(Rojo et al., 2008)
Lámpara	75	KIA-6790	6144	46	6911	7166	(Rojo et al., 2008)
Lámpara	75	KIA 21348	6125	33	6914	7159	(Rojo et al., 2008)
Lámpara	75	UtC_13346	6280	50	7022	7315	(Rojo et al., 2008)
Lámpara	75	KIA 21352	6280	33	7160	7271	(Rojo et al., 2008)
Lámpara	75	KIA-4780	6390	60	7178	7428	(Rojo et al., 2008)
Lámpara	75	KIA 21347	6407	34	7272	7419	(Rojo et al., 2008)
Lámpara	75	KIA8874	6421	30	7280	7422	(Rojo et al., 2008)
Lámpara	75	KIA16567	6522	44	7325	7555	(Rojo et al., 2008)

Lámpara	75	KIA-16571	6608	35	7438	7566	(Rojo et al., 2008)
Lámpara	75	KIA-16579	6610	32	7440	7566	(Rojo et al., 2008)
Lámpara	75	KIA-16574	6729	45	7510	7671	(Rojo et al., 2008)
Lámpara	75	KIA-16575	6744	33	7580	7671	(Rojo et al., 2008)
Lámpara	75	KIA-16566	6833	34	7595	7730	(Rojo et al., 2008)
Lámpara	75	KIA 21350	6871	33	7625	7789	(Rojo et al., 2008)
Lámpara	75	KIA-16569	6920	50	7670	7921	(Rojo et al., 2008)
Lámpara	75	KIA-16577	6915	33	7677	7826	(Rojo et al., 2008)
Lámpara	75	KIA-16570	6956	39	7689	7921	(Rojo et al., 2008)
Lámpara	75	KIA-16580	6989	48	7708	7933	(Rojo et al., 2008)
Lámpara	75	KIA-16578	6975	32	7709	7926	(Rojo et al., 2008)
Lámpara	75	KIA-16568	7000	32	7752	7933	(Rojo et al., 2008)
Lámpara	75	KIA-16581	7075	44	7796	7981	(Rojo et al., 2008)
Lámpara	75	KIA-16573	7108	34	7857	8004	(Rojo et al., 2008)
Lámpara	75	KIA-16576	7136	33	7875	8015	(Rojo et al., 2008)
Revilla	76	KIA-13943	5642	96	6283	6656	(Rojo et al., 2008)
Revilla	76	UtC_13348	6120	60	6800	7169	(Rojo et al., 2008)
Revilla	76	KIA21353	6156	33	6960	7162	(Rojo et al., 2008)
Revilla	76	UtC_13350	6210	60	6960	7258	(Rojo et al., 2008)
Revilla	76	KIA21349	6158	31	6967	7163	(Rojo et al., 2008)
Revilla	76	KIA21354	6177	31	6983	7168	(Rojo et al., 2008)
Revilla	76	KIA 21346	6202	31	7001	7239	(Rojo et al., 2008)
Revilla	76	UtC_13294	6240	50	7005	7265	(Rojo et al., 2008)
Revilla	76	UtC_13295	6250	50	7007	7270	(Rojo et al., 2008)
Revilla	76	UtC_13296	6250	50	7007	7270	(Rojo et al., 2008)
Revilla	76	KIA21355	6230	30	7019	7251	(Rojo et al., 2008)
Revilla	76	KIA21359	6245	34	7024	7259	(Rojo et al., 2008)
Revilla	76	UtC_13347	6313	48	7158	7415	(Rojo et al., 2008)
Revilla	76	KIA 21357	6271	31	7160	7266	(Rojo et al., 2008)
Revilla	76	KIA21351	6289	31	7165	7269	(Rojo et al., 2008)
Revilla	76	KIA21356	6355	30	7179	7415	(Rojo et al., 2008)
Revilla	76	KIA 21358	6365	36	7182	7419	(Rojo et al., 2008)
Revilla	76	KIA-13932	6385	35	7260	7418	(Rojo et al., 2008)
Revilla	76	KIA-13937	6405	36	7270	7419	(Rojo et al., 2008)
Revilla	76	KIA-13942	6415	36	7275	7420	(Rojo et al., 2008)
Revilla	76	KIA-13945	6446	39	7287	7430	(Rojo et al., 2008)
Revilla	76	KIA-13933	6468	40	7290	7440	(Rojo et al., 2008)
Revilla	76	KIA-13938	6499	42	7317	7488	(Rojo et al., 2008)
Revilla	76	KIA-13948	6449	37	7322	7478	(Rojo et al., 2008)
Revilla	76	KIA-13940	6568	37	7425	7562	(Rojo et al., 2008)
Revilla	76	KIA-13946	6691	48	7477	7656	(Rojo et al., 2008)
Revilla	76	KIA-13939	6755	57	7509	7691	(Rojo et al., 2008)
Revilla	76	KIA-13934	6772	47	7566	7689	(Rojo et al., 2008)
Revilla	76	KIA-13947	6809	37	7585	7693	(Rojo et al., 2008)
Revilla	76	KIA-13935	6983	45	7702	7932	(Rojo et al., 2008)
Revilla	76	KIA-13944	7014	37	7757	7939	(Rojo et al., 2008)
Revilla	76	KIA-13941	7165	37	7932	8040	(Rojo et al., 2008)

REFERENCES

Alday, A., 2014. The site at Atxoste (Vírgala, Álava), in: Sala, R. (Ed.), Pleistocene and Holocene Hunter-Gatherers in Iberia and the Gibraltar Strait: The Current Archaeological Record. Burgos, pp. 147–151.

Alday, A., 2006. El legado prehistórico de Mendandia: los modos de vida de los últimos cazadores-recolectores en la prehistoria de Treviño. Arqueología de Castilla y León. Memorias 15.

Alday, A., 1998. Kanpanoste Goikoa. El depósito prehistórico de Kanpanoste Goikoa (Vírgala, Alava): memoria de las actuaciones arqueológicas 1992-1993. Memorias de Yacimientos Alaveses 5. Diputación Foral de Álava, Vitoria.

Alday, A., Carretero, J.M., Götherström, A., Anderung, C., 2012. Uros, genética, Indígenas y colonos. A propósito de la neolitización de Europa. Veleia 29, 335–358.

Alday, A., Soto, A., López de Heredia, J., Perales, U., 2013. El abrigo de Martinarri (Obécuri, Treviño): una ocupación del Tardiglaciar en la Cuenca Alta del Ebro. Trab. Prehist. 69, 257–272. doi:10.3989/tp.2012.12091

Alonso, C., Jiménez, J., 2014. Contribución al estudio del poblamiento, modos de vida y ritual funerario del Neolítico antiguo: el asentamiento al aire libre de El Prado (Pancorbo, Burgos). Zephyrus LXXIV, 41–64.

Armentano, N., Gallart, J., Jordana, X., López, J.B., Malgosa, A., Rafel, N., 2007. La cova sepulcral de Montanissell (Sallent- Coll de Nargó, Alt Urgell): pràctiques funeràries singulars durant l'edat del bronze al Prepirineu. Trib. Arqueol. 2006, 141–167.

Baldellou, V., 2011. La Cueva de Chaves (Bastarás - Casbas, Huesca). Saguntum las Prim. Prod. cerámicas, El VI Milen. cal AC en la Península Ibérica Extra 12, 141–145.

Baldellou, V., 1987. Avance al Estudio de la Espluga de la Puyascada. Bolskan 4, 3–41.

Balsera, V., Díaz-del-Río, P., Gilman, A., Uriarte, A., Vicent, J.M., 2015. Approaching the demography of late prehistoric Iberia through summed calibrated date probability distributions (7000-2000 cal BC). Quat. Int. 386, 208–211. doi:10.1016/j.quaint.2015.06.022

Barandiarán, I., Cava, A., 2008. Cazadores y tallistas en el abrigo de Portugain. Una ocupación de Urbasa durante el Tardiglaciar. Fundación José Miguel de Barandiaran Fundazioa. Colección Barandiaran 12.

Barandiarán, I., Cava, A., 2001. Cazadores-recolectores en el Pirineo Navarro: el sitio de Aizpea entre 8.000 y 6.000 años antes de ahora. Anejos de Veleia serie Maior, 10. Universidad del País Vasco Servicio Editorial.

Barandiarán, I., Cava, A., 2000. A propósito de unas fechas del Bajo Aragón: reflexiones sobre el Mesolítico y el Neolítico en la Cuenca del Ebro. SPAL 9, 293–326.

Barrios Gil, I., 2004. El yacimiento de cueva Lóbrega (Torrecilla en Cameros, La Rioja) : una visión acerca del neolítico y la Edad del Bronce en el área occidental del sistema ibérico. Historia. Arqueologia, 15, Instituto de Estudios Riojanos.

Benavente, J.A., Andrés, T., 1992. Informe sobre las excavaciones de las Torrazas (Alcañiz, Teruel), in: Arqueología Aragonesa 1990. Diputación General de Aragón, Zaragoza, pp. 57–60.

Blasco, M.F., Rodanés, J.M., 2009. Las fases de ocupación de la cueva del Gato 2 (Épila, Zaragoza) The occupation Levels of Gato 2 cave (Épila, Zaragoza). Salduie 9, 311–334.

Bosch, J., Nadal, J., Román, D., Estrada, A., 2015. Antigas excavaciones, nuevas respuestas. El yacimiento epimagdaleniense de la coval del Clto del l'Hospital (Roquetes, Baix Ebre). Saguntum 47, 9–27. doi:10.7203/SAGVNTVM.47.3780

Calvo, M., Fullola, J.M., Mangado, X., Petit, M.A., 2008. Los raspadores y el procesado de la pien en la cueva del Parco (Alòs de Balaguer, Lleida, ESpaña). Veleia 24–25, 493–530.

Cava, A., 2004. La ocupación prehistórica de Kanpanoste en el contexto de los cazadores-recolectores del Mesolítico. Memoria de Yacimientos Alaveses, 9. Diputación Foral de Álava, Vitoria.

Clemente, I., Gassiot, E., Rey Lanaspa, J., 2014. "Cort o Transito" -Coro Trasito- o corral de tránsito una cueva pastoril del Neolítico antiguo en el corazón de Sobrarbe, in: Sobrarbe Antes de Sobrarbe: Pinceladas de Historia de Los Pirineos, 2014, ISBN 978-84-

8127-265-9, Págs. 11-32. Centro de Estudios de Sobrarbe, pp. 11–32.

Domingo, R., Martínez-Bea, M., Utrilla, P., 2010. Una nueva ocupación neolítica en el río Guadalope: la campaña de 2009 en el abrigo de Ángel 2. Saldvie1 10, 225–235.

Fernández Eraso, J., García Rojas, M., Fernández Crespo, T., Castaños, P., Bailon, S., Murelaga, X., Tarriño, A., 2010. La cueva de Las Orcillas 1: una estación de los últimos cazadores-recolectores en La Berrueza (Mendaza-Acedo, Navarra). Trab. Arqueol. Navarra 22, 13–91.

Fernández Eraso, J., Mujika, J.A., 2013. La estación megalítica de la Rioja Alavesa: cronología, orígenes y ciclos de utilización. Zephyrus 71, 89–106.

García-Argüelles, P., Fullola, J.., 2006. La cueva del Parco (Alòs de Balaguer, Lleida) y el abrigo del afilador (Margalef de Montsa nt, Tarragona): dos secuencias clave para el conocimiento del Epipaleolítico en el Nordeste peninsular, in: Alday, A. (Ed.), El Mesolítico de Muescas Y Denticulados En La Cuenca Del Ebro Y El Litoral Mediterráneo Peninsular. Vitoria, pp. 121–136.

García-Martínez de Lagrán, I., Iriarte, E., García-Gazólaz, J., Tejedor-Rodríguez, C., Gibaja-Bao, J.F., Moreno-García, M., Pérez-Jordà, G., Ruiz-Alonso, M., Sesma-Sesma, J., Garrido-Pena, R., Carrancho-Alonso, Á., Peña-Chocarro, L., Rojo-Guerra, M.A., 2016. 8.2 ka BP paleoclimatic event and the Ebro Valley Mesolithic groups: Preliminary data from Artusia rock shelter (Unzué, Navarra, Spain). Quat. Int. 403, 151–173. doi:10.1016/j.quaint.2015.06.050

García Gazolaz, J., 2007. Los enterramientos neolíticos del yacimiento de Paternanbidea (Ibero), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 59–65.

García Gazólaz, J., 2001. Excavaciones arqueológicas en el abrigo del Padre Areso (Bigüézal, Navarra): Campañas de 1994, 1995,1996. Trab. Arqueol. Navarra, ISSN 0211-5174, Nº 15, 2001, págs. 307-314 15, 307–314.

García Gazolaz, J., Sesma, J., 2007. Enterramientos en el poblado neolítico de Los Cascajos (Los Arcos), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 52–58.

García Gazólaz, J., Sesma Sesma, J., Rojo Guerra, M.Á., Alday, A., Garrido Pena, R., García-Martínez de Lagrán, I., 2011. Los Cascajos (Los Arcos, Navarra). Saguntum Las Prim. Prod. cerámicas. El VI Milen. CAL AC en la península ibérica Extra, 135–140.

García Martínez de Lagrán, Í., 2012. El proceso de neolitización en el Interior Peninsular: la Submeseta Norte y el Alto Valle del Ebro: la cerámica como herramienta interpretativa. Universidad de Valladolid.

Gassiot Ballbè, E., Rodríguez Antón, D., Pèlachs Mañosa, A., Pérez Obiol, R., Julià Brugués, R., Bal-Serin, M.-C., Mazzucco, N., 2014. La alta montaña durante la Prehistoria: 10 años de investigación en el Pirineo catalán occidental. Trab. Prehist. 71, 261–281. doi:10.3989/tp.2014.12134

Guilaine, J., Evin, J., 2007. Datations istopiques des couches épipaléolithiques de la balma Margineda., in: Guilaine, J., Barbaza, M., Martzluff, M.- (Eds.), Les Excavacions a La Balma Margineda (1979–1991). Andorra. Govern. d'Andorra, pp. 62–63.

Mangado, X., Fullola, J.M., Tejero, J.-M., Petit, M.À., Sánchez, M., Bartrolí, R., 2015. Aportacions clau de la Cova del Parco (Alòs de Balaguer, la Noguera, Lleida) al Magdalenià: vint-i-cinc anys de recerca arqueològica. Trib. Afrqueologica 2012–2013, 86–99.

Mangado, X., Petit, M.., Fullola, J.., Bartolí, R., 2006. El paleolitic superior final de la cova del Parco (Alòs de Balaguer, La Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Petit, M.A., Fullola, J.M., Bartrolí, R., 2007. El paleolític superior final cova del Parco (Alòs de Balaguer, la Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Tejero, J.M., Fullola, J.M., Petit, M.A., Sánchez, M., 2014. La Cova del Parco (Alòs de Balaguer, La Noguera, Lleida). La secuencia del Magdaleniense, in: Sala, R. (Ed.), Los Cazadores Recolectores Del Pleistoceno Y Del Holoceno En Iberia Y El Estrecho de Gibaltrar. Estado Actual de El Conocimiento Del Registro Arqueológico. Universidad de Burgos, pp. 152–158.

Martínez-Moreno, J., Mora, R., Casanova, J., 2007. El contexto cronométrico y tecnotipológico durante el Tardiglaciar y Postglaciar de la vertiente sur de los Pirineos orientales. Rev. Arqueol. Ponent 16–17, 7–44.

Martins, H., Oms, F.X., Pereira, L., Pike, A.W.G., Rowsell, K., Zilhão, J., 2015. Radiocarbon dating the beginning of the Neolithic in Iberia: new results, new problems. J. Mediterr. Archaeol. 28. doi:10.1558/jmea.v28i1.27503

Mazo, C., Montes, L., 1992. La transición Epipaleolítico - Neolítico antiguo en el abrigo de El Pontet (Maella, Zaragoza), in: Utrilla, P. (Ed.), Aragón I Litoral Mediterráneo: Intercambios Culturales Durante La Prehistoria. pp. 243–254.

Montes, L., Cuchí, J.A., Domingo, R., 2000. Epipaleolítico y Neolítico en las sierras prepirenaicas de Aragón: prospecciones y sondeos, 1998-2001. Bolskan 17, 87–123.

Montes, L., Domingo, R., Cuchi, J.A., Alcolea, M., Sola, C., 2015. Completando el mapa de la Cuenca del Ebro: el Mesolítico del IX milenio cal BP de Espantalobos (Huesca, España). Munibe Antropol. 66, 119–133. doi:10.21630/maa.2015.66.06

Montes, L., Domingo, R., González-Sampériz, P., Sebastián, M., Aranbarri, J., Castaños, P., García-Simón, L.M., Alcolea, M., Laborda, R., 2015. Landscape, resources and people during the Mesolithic and Neolithic times in NE Iberia: The Arba de Biel Basin. Quat. Int. doi:10.1016/j.quaint.2015.05.041

Montes, L., Martínez Bea, M., 2006. El yacimiento campaniforme de Cueva Drólica (Sarsa de Surta, Huesca). Saldvie 6, 297–316.

Mora, R., Martínez-Moreno, J., 2009. Balma Guilanyà (Prepirineo de Lleida) y el Aziliense en el noreste de la Península Ibérica. Trab. Prehist. 66, 45–60.

Morales, J.., Cebria, A., Maestres, J., Oms, F.X., Allué, E., 2013. La cova de la Guineu. 12.000 anys de presència humana a les calçaperes del Foix, in: III Monografies Del Foix. pp. 172–183.

Morales, J.I., Burjachs, F., Allué, E., Fontanals, M., Soto, M., Expósito, I., Gassiot, E., Pèlahcs, A., Pérez-Obiol, R., Soriano, J.M., Vergès, J.M., Yll, E., 2012. Paleogeografía humana durante el Tardiglaciar y Holoceno inicial en el ámbito mediterráneo del NE Ibérico. Cuaternario y Geomorfol. 26, 11–28.

Mujika, J.A., Edeso, J.M., 2012. Lehenengo nekazari-abeltzainak Gipuzkoan Neolitikotik Burdin Arora / Los primeros agricultores y ganaderos en Gipuzkoa del Neolítico a la Edad del Hierro, 0.2. ed. San Sebastián.

Muñoz, M., Berganza, E., 1997. El yacimiento de la cueva de Urratxa III (Orozko, Bizkaia). Universidad de Deusto.

Olaria, C., 2000. Nuevas dataciones de C-14 para el neolítico mediterráneo. Quad. prehistòria i Arqueol. Castelló 21, 27–34.

Olària, C., Gusi, F., Gómez, J.L., 2005. Un enterramiento meso-neolítico en el Cingle del Mas Nou (Ares del Maestre, Castellón) del 7000 BP en territorio de arte levantino., in: Arias, P., Ontañón, R., García, C. (Eds.), III Congreso Del Neolítico. pp. 615–623.

Oms, F.X., Pedro, M., Morales, J.I., Allué, E., Frigola, J., Mendiela, S., Rodriguez, A., Sierra, J., Yubero, M., 2013. La Cova Colomera 30 anys després. Ocupacions humanes entre 6180-3280 BP al Congost de Montrebei. Campanyes de 2005-2011, in: Primeres Jornades d'Arqueologia I Paleontologia Del Pirineu I Arán. pp. 116–123.

Ortega, A.I., Juez, L., Carretero, J., Arsuaga, J.L., Pérez, A., Ortega, M.., Pérez, R., Rodríguez, A.., Santos, E., García, R., Gómez, A., Rodríguez, L., Rodríguez, Martínez de Pinillos, M., Maerínez, I., 2008. The Portalón at Cueva Mayor (Sierra de Atapuerca, Spain): a new archaeological secuence, in: Diniz, M. (Ed.), The Early Neolithic in the Iberian Peninsula. Regional and Transregional Components. BAR serie 1857, pp. 3–9.

Ortiz Tudanca, L., Ferreira, A., Gil Zubillaga, E., Tarriño, A., Tarriño, J.M., Lobo Urrutia, P.J., Vivanco, J.J., 1983. El núcleo de poblamiento postpaleolítico de Larrenke (Mijancas-Santude). Estud. Arqueol. Alavesa 11, 187–285.

Petit, M.A., Mangado, X., Fullola, J.M., Bartolí, R., Bergada, M.M., Esteve, X., 2009. Els caçadors recol.lectors de la cova del Parco (Alòs de Balaguer, la Noguera, Lleida). L´epipaleolític microlaminar: continuïtat o canvi?, in: Els Pirineus I Les Àrees Circumdants Durant El Tardiglacial. Mutacions I Filiacions Tecnoculturals, Evolució Paleoambiental (16000-10000 BP). XIV Col-Loqui Internacional D´arqueologia de Puigcerdà. Homenatge Al Professor George Laplace. Institut d´estudis ceretans, Puigcerdá, p. 579–587.

Piera, M., Pla, A., Antolín, F., Alonso, N., Camarós, E., Clop, E., Gibaja, J.F., Saña, M., Gallart, J., 2008. El Collet de Puiggròs. Un assentament a l'aire lliure de l'època neolítica, in: Fites En El Temps, (VI Trobada d'Estudiosos de Les Garrigues). pp. 23–48.

Rodanés, J.., Picazo, J., 2009. La cabaña mesolítica de Cabezo de la Cruz (La Muela, Zaragoza), in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica. Zaragoza, pp. 327–341.

Rojo, M.A., Kunst, M., Garrido, R., García, Í., Morán, G., 2008. Paisajes de la Memoria: asentamientos del neolítico antiguo en el Valle de Ambrona (Soria, España). Universidad de Valladolid, Valladolid.

Rojo, M.A., Peña-Chocarro, L., Royo, J.I., Tejedor, C., García-Martínez de Lagrán, I., Arcusa, H., Garrido, R., Moreno, M., Mazzucco, N., Gibaja, J.F., Ortega, D., Kromer, B., Alt, K.W., 2013. Pastores trashumantes del Neolítico antiguo en un entorno de Alta Montaña. Boletín del Semin. Estud. Arqueol. LXXIX, 9–55.

Rojo, M.A., Tejedor, C., Peña-Chocarro, L., Royo, J.I., García-Martínez de Lagrán, I., Arcusa, H., San Millán, M., Garrido, R., Gibaja, J.F., Mazzuco, N., Clemente, I., Mozota, M., Terradas, X., Moreno, M., Pérez, G., Álvarez, E., Jiménez, I., Gómez, F., 2015. Releyendo el fenómeno de la neolitización en el Bajo Aragón a la luz de la excavación del cingle de Valmayor XI (Mequinenza, Zaragoza). Zephyrus 75, 41–71. doi:10.14201/zephyrus2015754171

Rojo, M., Garrido, R., García-Martínez de Lagrán, I., Alda, A., García-Gazólaz, J., Sesma, J., 2011. El Valle de Ambrona y la provincia de Soria: La Lámpara, La Revilla del Campo y El Abrigo de la Dehesa/Carlos Álvarez, in: Las Primeras Producciones Cerámicas: El VI Milenio Cal AC En La Península Ibérica. Saguntum Extra 12. pp. 105–108.

Royo, J.I., Gómez, F., 1996. Hábitat y territorio durante el Neolítico Antiguo y Medio/Final en la confluencia del Segre y el Ebro (Mequinenza, Zaragoza). Rubricatum 1, I Congr, 767–780.

Tarriño, A., Elorrieta, I., García-Rojas, M., Orue, I., Sánchez, A., 2014. Neolithic Flint Mines of Treviño (Basque-Cantabrian Basin, Western Pyrenees, Spain). J. Lithic Stud. 1, 129–147. doi:10.2218/jls.v1i2.1098

Tarriño, A., Lobo, P.J., García Rojas, M., Elorrieta, I., Orue, I., Benito, A., Karampanglidis, T., 2011. Introducción al estudio de las minas neolíticas de sílex de la Sierra de Araico (Condado de Teviño): campaña de excavación del 2011. Estud. Arqueol. Alavesa 7–48.

Utrilla, P., 1995. El valle del Ebro durante el Tardiglacial y comienzos del Holoceno. Las relaciones con el Magdaleniense cantábrico, in: Moure, A., González Sainz, C. (Eds.), El Final Del Paleolítico Cantábrico. Universidad de Cantabria, pp. 281–311.

Utrilla, P., Bea, M., 2012. El asentamiento neolítico del Plano del Pulido (Caspe, Zaragoza). Congrés Int. Xarxes al Neolític. Rubricatum 5, 69–78.

Utrilla, P., Berdejo, A., Obón, A., Laborda, R., Domingo, R., Alcolea, M., 2015. El abrigo de El Esplugón (Billobas-Sabiñánigo, Huesca). Un ejemplo de transición Mesolítico-Neolítico en el Prepirineo central, in: Del Neolític a L'edat Del Bronze En El Mediterrani Occidental. Estudis En Homenatge a Bernat Martí Oliver. Trabajos varios del SIP, Museo de Valencia, Valencia, pp. 75–96.

Utrilla, P., Domingo, R., Montes, L., Mazo, C., Rodanés, J.M., Blasco, M.F., Alday, A., 2012. The Ebro Basin in NE Spain: A crossroads during the Magdalenian. Quat. Int. 272–273, 88–104. doi:http://dx.doi.org/10.1016/j.quaint.2012.04.024

Utrilla, P., Mazo, C., 2014. La Peña de Las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena. Monografías Arqueológicas, 46. Universidad de Zaragoza.

Utrilla, P., Mazo, C., 1996. Excavaciones en la cueva de Abauntz (Arraiz): campañas de 1994-1995. Trab. Arqueol. Navarra 12, 270–279.

Utrilla, P., Mazo, C., Domingo, R., 2014. Los abrigos de Forcas en la dinámica cultural del Valle del Ebro, in: Utrilla, P., Mazo, C. (Eds.), La Peña de Las Forcas (Graus, Huesca). Un Asentamiento Estratégico En La Confluencia Del Ésera Y El Isábena. Monografías Arqueológicas. Prehistoria, 46. Universidad de Zaragoza, pp. 345–405.

Utrilla, P., Montes, L., Mazo, C., Martínez Bea, M., Domingo, R.., Martínez-Bea, M., Martínez Bea, M., Domingo Martínez, R., 2009. El mesolítico geométrico en Aragón, in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica, 2009, ISBN 978-84-92522-07-1, Págs. 131-190. Universidad de Zaragoza, pp. 131–190.

Utrilla, P., Rodanés, J.M., 2004. Un asentamiento epipaleolítico en la cuenca del río Martín. El abrigo de Los Baños (Ariño, Teruel). Monografías Arqueológicas 39. Universidad de Zaragoza. Zaragoza.

Vergès, J.M., Allué, E., Angelucci, D.E., Burjachs, F., Carrancho, A., Cebrià, A., Expósito, I., Fontanals, M., Moral, S., Rodríguez, A., Vaquero, M., 2008. Los niveles neolíticos de la cueva de El Mirador (Sierra de Atapuerca, Buegos): nuevos datos sobre la implantación y el desarrollo de la economía agropecuaria en la submeseta norte, in: Hernández, M., Soler, J.., López Padilla, J.. (Eds.), IV Congreso Del Neolítico Peninsular, Vol. 1. pp. 418–427.

Villaverde, V., Román, D., Martínez, R., Badal, E., Bergada, M.M., Guillem, P.M., Pérez, M., Tormo, C., 2010. El Paleolítico superior en el País Valenciano. Novedades y perspectivas, in: El Paleolítico Superior Peninsular. Novedades Del Siglo XXII. Barcelona, pp. 85–113.

Vizcaíno, D. (coord), 2010. El Cingle del Mas Cremat (Portell de Morella, Castellón). Un asentamiento en altura con ocupaciones del Mesolítico Reciente al Neolítico Final. Generalitat de Valencia.

Alday, A., 2014. The site at Atxoste (Vírgala, Álava), in: Sala, R. (Ed.), Pleistocene and Holocene Hunter-Gatherers in Iberia and the Gibraltar Strait: The Current Archaeological Record. Burgos, pp. 147–151.

Alday, A., 2006. El legado prehistórico de Mendandia: los modos de vida de los últimos cazadores-recolectores en la prehistoria de Treviño. Arqueología de Castilla y León. Memorias 15.

Alday, A., 1998. Kanpanoste Goikoa. El depósito prehistórico de Kanpanoste Goikoa (Vírgala, Alava): memoria de las actuaciones arqueológicas 1992-1993. Memorias de Yacimientos Alaveses 5. Diputación Foral de Álava, Vitoria.

Alday, A., Carretero, J.M., Götherström, A., Anderung, C., 2012. Uros, genética, Indígenas y colonos. A propósito de la neolitización de Europa. Veleia 29, 335–358.

Alday, A., Soto, A., López de Heredia, J., Perales, U., 2013. El abrigo de Martinarri (Obécuri, Treviño): una ocupación del Tardiglaciar en la Cuenca Alta del Ebro. Trab. Prehist. 69, 257–272. doi:10.3989/tp.2012.12091

Alonso, C., Jiménez, J., 2014. Contribución al estudio del poblamiento, modos de vida y ritual funerario del Neolítico antiguo: el asentamiento al aire libre de El Prado (Pancorbo, Burgos). Zephyrus LXXIV, 41–64.

Armentano, N., Gallart, J., Jordana, X., López, J.B., Malgosa, A., Rafel, N., 2007. La cova sepulcral de Montanissell (Sallent- Coll de Nargó, Alt Urgell): pràctiques funeràries singulars durant l'edat del bronze al Prepirineu. Trib. Arqueol. 2006, 141–167.

Baldellou, V., 2011. La Cueva de Chaves (Bastarás - Casbas, Huesca). Saguntum las Prim. Prod. cerámicas, El VI Milen. cal AC en la Península Ibérica Extra 12, 141–145.

Baldellou, V., 1987. Avance al Estudio de la Espluga de la Puyascada. Bolskan 4, 3–41.

Balsera, V., Díaz-del-Río, P., Gilman, A., Uriarte, A., Vicent, J.M., 2015. Approaching the demography of late prehistoric Iberia through summed calibrated date probability distributions (7000-2000 cal BC). Quat. Int. 386, 208–211. doi:10.1016/j.quaint.2015.06.022

Barandiarán, I., Cava, A., 2008. Cazadores y tallistas en el abrigo de Portugain. Una ocupación de Urbasa durante el Tardiglaciar. Fundación José Miguel de Barandiaran Fundazioa. Colección Barandiaran 12.

Barandiarán, I., Cava, A., 2001. Cazadores-recolectores en el Pirineo Navarro: el sitio de Aizpea entre 8.000 y 6.000 años antes de ahora. Anejos de Veleia serie Maior, 10. Universidad del País Vasco Servicio Editorial.

Barandiarán, I., Cava, A., 2000. A propósito de unas fechas del Bajo Aragón: reflexiones sobre el Mesolítico y el Neolítico en la Cuenca del Ebro. SPAL 9, 293–326.

Barrios Gil, I., 2004. El yacimiento de cueva Lóbrega (Torrecilla en Cameros, La Rioja) : una visión acerca del neolítico y la Edad del Bronce en el área occidental del sistema ibérico. Historia. Arqueologia, 15, Instituto de Estudios Riojanos.

Benavente, J.A., Andrés, T., 1992. Informe sobre las excavaciones de las Torrazas (Alcañiz, Teruel), in: Arqueología Aragonesa 1990. Diputación General de Aragón, Zaragoza, pp. 57–60.

Blasco, M.F., Rodanés, J.M., 2009. Las fases de ocupación de la cueva del Gato 2 (Épila, Zaragoza) The occupation Levels of Gato 2 cave (Épila, Zaragoza). Salduie 9, 311–334.

Bosch, J., Nadal, J., Román, D., Estrada, A., 2015. Antigas excavaciones, nuevas respuestas. El yacimiento epimagdaleniense de la coval del Clto del l'Hospital (Roquetes, Baix Ebre).

Saguntum 47, 9–27. doi:10.7203/SAGVNTVM.47.3780

Calvo, M., Fullola, J.M., Mangado, X., Petit, M.A., 2008. Los raspadores y el procesado de la pien en la cueva del Parco (Alòs de Balaguer, Lleida, ESpaña). Veleia 24–25, 493–530.

Cava, A., 2004. La ocupación prehistórica de Kanpanoste en el contexto de los cazadores-recolectores del Mesolítico. Memoria de Yacimientos Alaveses, 9. Diputación Foral de Álava, Vitoria.

Clemente, I., Gassiot, E., Rey Lanaspa, J., 2014. "Cort o Transito" -Coro Trasito- o corral de tránsito una cueva pastoril del Neolítico antiguo en el corazón de Sobrarbe, in: Sobrarbe Antes de Sobrarbe: Pinceladas de Historia de Los Pirineos, 2014, ISBN 978-84-8127-265-9, Págs. 11-32. Centro de Estudios de Sobrarbe, pp. 11–32.

Domingo, R., Martínez-Bea, M., Utrilla, P., 2010. Una nueva ocupación neolítica en el río Guadalope: la campaña de 2009 en el abrigo de Ángel 2. Saldvie1 10, 225–235.

Fernández Eraso, J., García Rojas, M., Fernández Crespo, T., Castaños, P., Bailon, S., Murelaga, X., Tarriño, A., 2010. La cueva de Las Orcillas 1: una estación de los últimos cazadores-recolectores en La Berrueza (Mendaza-Acedo, Navarra). Trab. Arqueol. Navarra 22, 13–91.

Fernández Eraso, J., Mujika, J.A., 2013. La estación megalítica de la Rioja Alavesa: cronología, orígenes y ciclos de utilización. Zephyrus 71, 89–106.

García-Argüelles, P., Fullola, J.., 2006. La cueva del Parco (Alòs de Balaguer, Lleida) y el abrigo del afilador (Margalef de Montsa nt, Tarragona): dos secuencias clave para el conocimiento del Epipaleolítico en el Nordeste peninsular, in: Alday, A. (Ed.), El Mesolítico de Muescas Y Denticulados En La Cuenca Del Ebro Y El Litoral Mediterráneo Peninsular. Vitoria, pp. 121–136.

García-Martínez de Lagrán, I., Iriarte, E., García-Gazólaz, J., Tejedor-Rodríguez, C., Gibaja-Bao, J.F., Moreno-García, M., Pérez-Jordà, G., Ruiz-Alonso, M., Sesma-Sesma, J., Garrido-Pena, R., Carrancho-Alonso, Á., Peña-Chocarro, L., Rojo-Guerra, M.A., 2016. 8.2 ka BP paleoclimatic event and the Ebro Valley Mesolithic groups: Preliminary data from Artusia rock shelter (Unzué, Navarra, Spain). Quat. Int. 403, 151–173. doi:10.1016/j.quaint.2015.06.050

García Gazolaz, J., 2007. Los enterramientos neolíticos del yacimiento de Paternanbidea (Ibero), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 59–65.

García Gazólaz, J., 2001. Excavaciones arqueológicas en el abrigo del Padre Areso (Bigüézal, Navarra): Campañas de 1994, 1995,1996. Trab. Arqueol. Navarra, ISSN 0211-5174, Nº 15, 2001, págs. 307-314 15, 307–314.

García Gazolaz, J., Sesma, J., 2007. Enterramientos en el poblado neolítico de Los Cascajos (Los Arcos), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 52–58.

García Gazólaz, J., Sesma Sesma, J., Rojo Guerra, M.Á., Alday, A., Garrido Pena, R., García-Martínez de Lagrán, I., 2011. Los Cascajos (Los Arcos, Navarra). Saguntum Las Prim. Prod. cerámicas. El VI Milen. CAL AC en la península ibérica Extra, 135–140.

García Martínez de Lagrán, Í., 2012. El proceso de neolitización en el Interior Peninsular: la Submeseta Norte y el Alto Valle del Ebro: la cerámica como herramienta interpretativa. Universidad de Valladolid.

Gassiot Ballbè, E., Rodríguez Antón, D., Pèlachs Mañosa, A., Pérez Obiol, R., Julià Brugués, R., Bal-Serin, M.-C., Mazzucco, N., 2014. La alta montaña durante la Prehistoria: 10 años de investigación en el Pirineo catalán occidental. Trab. Prehist. 71, 261–281. doi:10.3989/tp.2014.12134

Guilaine, J., Evin, J., 2007. Datations istopiques des couches épipaléolithiques de la balma Margineda., in: Guilaine, J., Barbaza, M., Martzluff, M.- (Eds.), Les Excavacions a La Balma Margineda (1979–1991). Andorra. Govern. d'Andorra, pp. 62–63.

Mangado, X., Fullola, J.M., Tejero, J.-M., Petit, M.À., Sánchez, M., Bartrolí, R., 2015. Aportacions clau de la Cova del Parco (Alòs de Balaguer, la Noguera, Lleida) al Magdalenià: vint-i-cinc anys de recerca arqueològica. Trib. Afrqueologica 2012–2013, 86–99.

Mangado, X., Petit, M.., Fullola, J.., Bartolí, R., 2006. El paleolitic superior final de la cova del Parco (Alòs de Balaguer, La Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Petit, M.A., Fullola, J.M., Bartrolí, R., 2007. El paleolític superior final cova del Parco (Alòs de Balaguer, la Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Tejero, J.M., Fullola, J.M., Petit, M.A., Sánchez, M., 2014. La Cova del Parco (Alòs de Balaguer, La Noguera, Lleida). La secuencia del Magdaleniense, in: Sala, R. (Ed.), Los Cazadores Recolectores Del Pleistoceno Y Del Holoceno En Iberia Y El Estrecho de Gibaltrar. Estado Actual de El Conocimiento Del Registro Arqueológico. Universidad de Burgos, pp. 152–158.

Martínez-Moreno, J., Mora, R., Casanova, J., 2007. El contexto cronométrico y tecnotipológico durante el Tardiglaciar y Postglaciar de la vertiente sur de los Pirineos orientales. Rev. Arqueol. Ponent 16–17, 7–44.

Martins, H., Oms, F.X., Pereira, L., Pike, A.W.G., Rowsell, K., Zilhão, J., 2015. Radiocarbon dating the beginning of the Neolithic in Iberia: new results, new problems. J. Mediterr. Archaeol. 28. doi:10.1558/jmea.v28i1.27503

Mazo, C., Montes, L., 1992. La transición Epipaleolítico - Neolítico antiguo en el abrigo de El Pontet (Maella, Zaragoza), in: Utrilla, P. (Ed.), Aragón I Litoral Mediterráneo: Intercambios Culturales Durante La Prehistoria. pp. 243–254.

Montes, L., Cuchí, J.A., Domingo, R., 2000. Epipaleolítico y Neolítico en las sierras prepirenaicas de Aragón: prospecciones y sondeos, 1998-2001. Bolskan 17, 87–123.

Montes, L., Domingo, R., Cuchi, J.A., Alcolea, M., Sola, C., 2015. Completando el mapa de la Cuenca del Ebro: el Mesolítico del IX milenio cal BP de Espantalobos (Huesca, España). Munibe Antropol. 66, 119–133. doi:10.21630/maa.2015.66.06

Montes, L., Domingo, R., González-Sampériz, P., Sebastián, M., Aranbarri, J., Castaños, P., García-Simón, L.M., Alcolea, M., Laborda, R., 2015. Landscape, resources and people during the Mesolithic and Neolithic times in NE Iberia: The Arba de Biel Basin. Quat. Int. doi:10.1016/j.quaint.2015.05.041

Montes, L., Martínez Bea, M., 2006. El yacimiento campaniforme de Cueva Drólica (Sarsa de Surta, Huesca). Saldvie 6, 297–316.

Mora, R., Martínez-Moreno, J., 2009. Balma Guilanyà (Prepirineo de Lleida) y el Aziliense en el noreste de la Península Ibérica. Trab. Prehist. 66, 45–60.

Morales, J.., Cebria, A., Maestres, J., Oms, F.X., Allué, E., 2013. La cova de la Guineu. 12.000 anys de presència humana a les calçaperes del Foix, in: III Monografies Del Foix. pp. 172–183.

Morales, J.I., Burjachs, F., Allué, E., Fontanals, M., Soto, M., Expósito, I., Gassiot, E., Pèlahcs, A., Pérez-Obiol, R., Soriano, J.M., Vergès, J.M., Yll, E., 2012. Paleogeografía humana durante el Tardiglaciar y Holoceno inicial en el ámbito mediterráneo del NE Ibérico. Cuaternario y Geomorfol. 26, 11–28.

Mujika, J.A., Edeso, J.M., 2012. Lehenengo nekazari-abeltzainak Gipuzkoan Neolitikotik Burdin Arora / Los primeros agricultores y ganaderos en Gipuzkoa del Neolítico a la Edad del Hierro, 0.2. ed. San Sebastián.

Muñoz, M., Berganza, E., 1997. El yacimiento de la cueva de Urratxa III (Orozko, Bizkaia). Universidad de Deusto.

Olaria, C., 2000. Nuevas dataciones de C-14 para el neolítico mediterráneo. Quad. prehistòria i Arqueol. Castelló 21, 27–34.

Olària, C., Gusi, F., Gómez, J.L., 2005. Un enterramiento meso-neolítico en el Cingle del Mas Nou (Ares del Maestre, Castellón) del 7000 BP en territorio de arte levantino., in: Arias, P., Ontañón, R., García, C. (Eds.), III Congreso Del Neolítico. pp. 615–623.

Oms, F.X., Pedro, M., Morales, J.I., Allué, E., Frigola, J., Mendiela, S., Rodriguez, A., Sierra, J., Yubero, M., 2013. La Cova Colomera 30 anys després. Ocupacions humanes entre 6180-3280 BP al Congost de Montrebei. Campanyes de 2005-2011, in: Primeres Jornades d'Arqueologia I Paleontologia Del Pirineu I Arán. pp. 116–123.

Ortega, A.I., Juez, L., Carretero, J., Arsuaga, J.L., Pérez, A., Ortega, M.., Pérez, R., Rodríguez, A.., Santos, E., García, R., Gómez, A., Rodríguez, L., Rodríguez, Martínez de Pinillos, M., Maerínez, I., 2008. The Portalón at Cueva Mayor (Sierra de Atapuerca, Spain): a new archaeological secuence, in: Diniz, M. (Ed.), The Early Neolithic in the Iberian Peninsula. Regional and Transregional Components. BAR serie 1857, pp. 3–9.

Ortiz Tudanca, L., Ferreira, A., Gil Zubillaga, E., Tarriño, A., Tarriño, J.M., Lobo Urrutia, P.J., Vivanco, J.J., 1983. El núcleo de poblamiento postpaleolítico de Larrenke (Mijancas-Santude). Estud. Arqueol. Alavesa 11, 187–285.

Petit, M.A., Mangado, X., Fullola, J.M., Bartolí, R., Bergada, M.M., Esteve, X., 2009. Els caçadors recol.lectors de la cova del Parco (Alòs de Balaguer, la Noguera, Lleida). L´epipaleolític microlaminar: continuïtat o canvi?, in: Els Pirineus I Les Àrees Circumdants Durant El Tardiglacial. Mutacions I Filiacions Tecnoculturals, Evolució Paleoambiental (16000-10000 BP). XIV Col-Loqui Internacional D´arqueologia de Puigcerdà. Homenatge Al Professor George Laplace. Institut d´estudis ceretans, Puigcerdá, p. 579–587.

Piera, M., Pla, A., Antolín, F., Alonso, N., Camarós, E., Clop, E., Gibaja, J.F., Saña, M., Gallart, J., 2008. El Collet de Puiggròs. Un assentament a l'aire lliure de l'època neolítica, in: Fites En El Temps, (VI Trobada d'Estudiosos de Les Garrigues). pp. 23–48.

Rodanés, J.., Picazo, J., 2009. La cabaña mesolítica de Cabezo de la Cruz (La Muela, Zaragoza), in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica. Zaragoza, pp. 327–341.

Rojo, M.A., Kunst, M., Garrido, R., García, Í., Morán, G., 2008. Paisajes de la Memoria: asentamientos del neolítico antiguo en el Valle de Ambrona (Soria, España). Universidad de Valladolid, Valladolid.

Rojo, M.A., Peña-Chocarro, L., Royo, J.I., Tejedor, C., García-Martínez de Lagrán, I., Arcusa, H., Garrido, R., Moreno, M., Mazzucco, N., Gibaja, J.F., Ortega, D., Kromer, B., Alt, K.W., 2013. Pastores trashumantes del Neolítico antiguo en un entorno de Alta Montaña. Boletín del Semin. Estud. Arqueol. LXXIX, 9–55.

Rojo, M.A., Tejedor, C., Peña-Chocarro, L., Royo, J.I., García-Martínez de Lagrán, I., Arcusa, H., San Millán, M., Garrido, R., Gibaja, J.F., Mazzuco, N., Clemente, I., Mozota, M., Terradas, X., Moreno, M., Pérez, G., Álvarez, E., Jiménez, I., Gómez, F., 2015. Releyendo el fenómeno de la neolitización en el Bajo Aragón a la luz de la excavación del cingle de Valmayor XI (Mequinenza, Zaragoza). Zephyrus 75, 41–71. doi:10.14201/zephyrus2015754171

Rojo, M., Garrido, R., García-Martínez de Lagrán, I., Alda, A., García-Gazólaz, J., Sesma, J., 2011. El Valle de Ambrona y la provincia de Soria: La Lámpara, La Revilla del Campo y El Abrigo de la Dehesa/Carlos Álvarez, in: Las Primeras Producciones Cerámicas: El VI Milenio Cal AC En La Península Ibérica. Saguntum Extra 12. pp. 105–108.

Royo, J.I., Gómez, F., 1996. Hábitat y territorio durante el Neolítico Antiguo y Medio/Final en la confluencia del Segre y el Ebro (Mequinenza, Zaragoza). Rubricatum 1, I Congr, 767–780.

Tarriño, A., Elorrieta, I., García-Rojas, M., Orue, I., Sánchez, A., 2014. Neolithic Flint Mines of Treviño (Basque-Cantabrian Basin, Western Pyrenees, Spain). J. Lithic Stud. 1, 129–147. doi:10.2218/jls.v1i2.1098

Tarriño, A., Lobo, P.J., García Rojas, M., Elorrieta, I., Orue, I., Benito, A., Karampanglidis, T., 2011. Introducción al estudio de las minas neolíticas de sílex de la Sierra de Araico (Condado de Teviño): campaña de excavación del 2011. Estud. Arqueol. Alavesa 7–48.

Utrilla, P., 1995. El valle del Ebro durante el Tardiglacial y comienzos del Holoceno. Las relaciones con el Magdaleniense cantábrico, in: Moure, A., González Sainz, C. (Eds.), El Final Del Paleolítico Cantábrico. Universidad de Cantabria, pp. 281–311.

Utrilla, P., Bea, M., 2012. El asentamiento neolítico del Plano del Pulido (Caspe, Zaragoza). Congrés Int. Xarxes al Neolític. Rubricatum 5, 69–78.

Utrilla, P., Berdejo, A., Obón, A., Laborda, R., Domingo, R., Alcolea, M., 2015. El abrigo de El Esplugón (Billobas-Sabiñánigo, Huesca). Un ejemplo de transición Mesolítico-Neolítico en el Prepirineo central, in: Del Neolític a L'edat Del Bronze En El Mediterrani Occidental. Estudis En Homenatge a Bernat Martí Oliver. Trabajos varios del SIP, Museo de Valencia, Valencia, pp. 75–96.

Utrilla, P., Domingo, R., Montes, L., Mazo, C., Rodanés, J.M., Blasco, M.F., Alday, A., 2012. The Ebro Basin in NE Spain: A crossroads during the Magdalenian. Quat. Int. 272–273, 88–104. doi:http://dx.doi.org/10.1016/j.quaint.2012.04.024

Utrilla, P., Mazo, C., 2014. La Peña de Las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena. Monografías Arqueológicas, 46. Universidad de Zaragoza.

Utrilla, P., Mazo, C., 1996. Excavaciones en la cueva de Abauntz (Arraiz): campañas de 1994-1995. Trab. Arqueol. Navarra 12, 270–279.

Utrilla, P., Mazo, C., Domingo, R., 2014. Los abrigos de Forcas en la dinámica cultural del Valle del Ebro, in: Utrilla, P., Mazo, C. (Eds.), La Peña de Las Forcas (Graus, Huesca). Un Asentamiento Estratégico En La Confluencia Del Ésera Y El Isábena. Monografías Arqueológicas. Prehistoria, 46. Universidad de Zaragoza, pp. 345–405.

Utrilla, P., Montes, L., Mazo, C., Martínez Bea, M., Domingo, R.., Martínez-Bea, M., Martínez Bea, M., Domingo Martínez, R., 2009. El mesolítico geométrico en Aragón, in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica, 2009, ISBN 978-84-92522-07-1, Págs. 131-190. Universidad de Zaragoza, pp. 131–190.

Utrilla, P., Rodanés, J.M., 2004. Un asentamiento epipaleolítico en la cuenca del río Martín. El abrigo de Los Baños (Ariño, Teruel). Monografías Arqueológicas 39. Universidad de Zaragoza. Zaragoza.

Vergès, J.M., Allué, E., Angelucci, D.E., Burjachs, F., Carrancho, A., Cebrià, A., Expósito, I., Fontanals, M., Moral, S., Rodríguez, A., Vaquero, M., 2008. Los niveles neolíticos de la cueva de El Mirador (Sierra de Atapuerca, Buegos): nuevos datos sobre la implantación y el desarrollo de la economía agropecuaria en la submeseta norte, in: Hernández, M., Soler, J.., López Padilla, J.. (Eds.), IV Congreso Del Neolítico Peninsular, Vol. 1. pp. 418–427.

Villaverde, V., Román, D., Martínez, R., Badal, E., Bergada, M.M., Guillem, P.M., Pérez, M., Tormo, C., 2010. El Paleolítico superior en el País Valenciano. Novedades y perspectivas, in: El Paleolítico Superior Peninsular. Novedades Del Siglo XXII. Barcelona, pp. 85–113.

Vizcaíno, D. (coord), 2010. El Cingle del Mas Cremat (Portell de Morella, Castellón). Un asentamiento en altura con ocupaciones del Mesolítico Reciente al Neolítico Final. Generalitat de Valencia.

APPENDIX A.

EBRO BASIN DATES RANGED BY SITES (WITH MAP NUMBER) AND REFERENCES

SITE	MAP NO.	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Urratxa III	1	Ua-11434	6940	75	7626	7938	(Muñoz and Berganza, 1997)
		Ua-11435	6955	80	7657	7951	
		Ua-11433	10240	100	11411	12411	
Socuevas	2	GrA-46015	7590	45	8328	8511	Unpublished
		Beta-282213	9260	50	10275	10570	
		Beta-282214	10550	50	12402	12659	
		Beta-282215	11130	50	12836	13095	
		Beta-312042	11470	50	13200	13438	
		Beta-282216	11530	50	13276	13463	
		Beta-312041	11540	50	13281	13468	
		Beta-312040	12040	50	13755	14045	
El Prado	3	Beta-366569	5880	30	6641	6776	(Alonso and Jiménez, 2014)
Araico	4	Beta-312351	5640	40	6315	6495	(Tarriño et al., 2014)
		Beta-312352	6050	40	6785	7005	
Larrenke N	5	No reference	5180	100	5664	6208	(Ortiz Tudanca et al., 1983)
		No reference	5210	100	5742	6268	
Mendandia	6	GrN-22740	6440	40	7280	7428	(Alday, 2006)
		GrN-22741	6540	70	7320	7570	
		GrN-19658	7210	80	7865	8188	
		GrN-22742	7180	45	7932	8156	
		Ua-34366	7265	70	7950	8280	(Alday et al., 2012)
		GrN-22743	7620	50	8358	8539	(Alday, 2006)
		GrN-22744	7810	50	8450	8750	
		GrN-22745	7780	40	8453	8630	
		GrA-6874	8500	60	9411	9556	
Kanpanoste Goikoa	7	GrN-20214	6360	70	7165	7425	(Alday, 1998)
		GrN-20215	7620	80	8218	8590	
Kanpanoste		GrN-22440	7620	70	8322	8583	(Cava, 2004)
		GrN-22442	7920	100	8484	9024	
		GrN-22441	8200	70	9008	9400	
Atxoste	8	GrA-9789	6220	60	6969	7265	(Alday, 2014)
		GrA-13415	6940	40	7679	7915	
		GrA-13419	6970	40	7696	7927	
		GrA-13468	7140	50	7850	8041	
		GrA-13418	7340	70	8012	8326	
		GrA-13469	7480	50	8192	8383	
		GrA-13447	7810	40	8459	8699	
		GrA-13448	8030	50	8658	9031	
		GrA-15700	8510	80	9310	9670	
		GrA-15699	8760	50	9555	10115	
		GrA-13473	8840	50	9705	10159	
		GrA-35141	9450	50	10558	11067	
		GrA-35142	9510	50	10601	11086	
		GrA-15858	9550	60	10691	11133	
		GrA-23107	11690	80	13366	13730	
		GrA-19870	11730	90	13403	13756	
		GrA-22865	11720	70	13429	13730	
		GrA-22866	11760	70	13457	13741	
		GrA-22900	11800	60	13481	13750	
		GrA-19554	12070	60	13762	14088	
		GrA-19502	12200	90	13774	14503	
		GrA-19503	12540	80	14315	15140	
Martinarri	9	Beta-410010	7350	30	8036	8294	Unpublished
		Beta-410009	9870	40	11207	11385	
		GrA-46014	8455	45	9414	9537	(Alday et al., 2013)
		GrA-45940	11890	50	13560	13800	

SITE	CARTE N°	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
San Cristóbal	10	Beta-307800	5100	30	5749	5917	(Fernández Eraso and Mujika, 2013)
		Beta-337632	5320	30	5996	6192	
		Beta-373276	5410	30	6129	6289	
		Beta-373277	5460	30	6207	6305	
		Beta-373275	5490	30	6211	6394	
		Beta-373631	5500	30	6216	6396	
Husos II	11	Beta-208850	5280	40	5940	6184	(Fernández Eraso and Mujika, 2013)
		Beta-161884	5300	40	5945	6200	
		Beta-161185	5430	60	6005	6387	
		Beta-208851	5490	40	6203	6400	
		Beta-208853	5520	40	6220	6404	
		Beta-221641	5790	40	6485	6712	
		Beta-221642	6040	40	6785	6996	
		Beta-221640	6050	40	6785	7005	
Husos I		Beta-161179	5630	60	6296	6548	
		Beta-161881	5810	60	6466	6748	
		Beta-161180	6130	60	6803	7174	
		Beta-161182	6240	60	6979	7275	
Peña Larga	12	Beta-242782	5720	49	6409	6637	(Fernández Eraso and Mujika, 2013)
		Beta-242783	6720	40	7510	7664	
Alto de Rodilla	13	CSIC -1967	6171	55	6936	7245	(Alonso and Jiménez, 2014)
Portalón	14	Beta-184842	5230	40	5912	6177	(Ortega et al., 2008)
		Beta-222339	6100	50	6805	7159	
		Beta-222340	6270	40	7025	7274	
Mirador	15	Beta-220912	5090	40	5743	5918	(Vergès et al., 2008)
		Beta-181087	5360	50	6002	6277	
		Beta-208131	5470	40	6189	6391	
		Beta-220913	5480	40	6200	6395	
		Beta-181088	5700	70	6320	6658	
		Beta-197384	6100	50	6805	7159	
		Beta-182040	6130	50	6890	7165	
		Beta-220914	6110	40	6891	7157	
		Beta-208132	6120	40	6902	7158	
		Beta-208133	6150	40	6942	7165	
		Beta-208134	6320	50	7161	7415	
		Beta-197385	6380	40	7253	7420	
		Beta-197386	7060	40	7796	7965	
Cueva Lóbrega	16	GrN-16110	6220	100	6860	7414	(Barrios Gil, 2004)
Cascajos	17	GrA-16204	5100	60	5664	5988	(García Gazólaz and Sesma, 2007)
		GrA-16942	5100	50	5724	5939	
		GrA-16210	5300	60	5935	6266	
		Ua-1625	5640	35	6318	6493	
		GrA16208	5250	50	5919	6181	(García Martínez de Lagrán, 2012)
		GrA16211	5330	60	5949	6276	
		Ua16203	5450	85	6002	6405	
		Ua17793	5720	90	6312	6719	
		GrA16209	5830	60	6490	6783	
		Ua-24423	5945	95	6507	7143	(García Gazólaz and Sesma, 2007)
		UA-17995	6125	80	6795	7240	
		Ua-16024	6185	75	6896	7260	
		Ua-24427	6230	50	7003	7260	
		Ua-24426	6250	50	7007	7270	
		Ua24425	6145	45	6912	7166	(García Gazólaz et al., 2011)
		Ua24424	6380	60	7176	7425	
		Ua-24428	6435	35	7289	7426	
Orcillas	18	Beta-252434	8610	50	9501	9690	(Fernández Eraso et al., 2010)
Portugain	19	GrN-14097	10370	90	11841	12548	(Barandiarán and Cava, 2008)
Artegieta	20	GrA-28311	8055	50	8729	9121	(Mujika and Edeso, 2012)
Abauntz	21	GrN-21010	5820	40	6505	6730	(Utrilla and Mazo, 1996)
		OxA-5116	11760	90	13431	13765	(Utrilla et al., 2012)
		GrA-39336	12220	60	13921	14400	
		CAMS9918	12340	60	14089	14720	

SITE	CARTE N°	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Paternanbidea	22	GrA13675	5960	40	6678	6890	(García Gazólaz, 2007)
		GrA-13673	6090	40	6803	7156	
Artusia	23	Beta-374431	7680	40	8402	8547	(García-Martínez de Lagrán et al., 2016)
		Beta-374432	7790	40	8455	8637	
		Beta-374433	8260	40	9093	9410	
Aizpea	24	BrN-18421	6370	70	7170	7425	(Barandiarán and Cava, 2001)
		GrA-779	6600	50	7430	7570	
		GrN-16222	6830	70	7571	7826	
		GrN-1622	7160	70	7853	8160	
		GrN-16620	7790	70	8410	8856	
Zatoya	25	GrN-23998	12205	90	13777	14526	(Barandiarán and Cava, 2001)
Padre Areso	26	GrN-14599	5380	100	5929	6392	(García Gazólaz, 2001)
		GrN14599	5400	100	5943	6397	
Paco Pons	27	Gra-19294	6010	45	6739	6965	(Montes et al., 2015)
		Gra-19295	6045	45	6752	7141	
Peña 14	28	GrN-25094	7660	90	8224	8637	(Montes et al., 2015)
		GrN-25998	8000	90	8598	9112	
		GrN-25999	8000	80	8605	9077	
		GrN-26000	10630	100	12237	12739	
Rambla Legunova	29	GrA-52086	5175	40	5760	6002	Montes et al., 2015)
		GrA-51860	5440	35	6190	6298	
		GrA-52691	5670	60	6315	6628	
		GrA-51971	6295	40	7160	7313	
		GrA-64001	7225	40	7966	8160	
		GrA-47886	7235	45	7970	8164	
		GrA-61768	7260	45	7983	8174	
Legunova		GrA-24292	8200	50	9015	9300	(Montes et al., 2015)
		GrA-22086	8250	60	9032	9417	
		GrA-24294	8800	40	9666	10135	
		GrA-24293	10760	60	12585	12749	
		GrA-27846	11240	60	12999	13241	
		GrA-27841	11640	60	13330	13580	
		GrA-24295	11780	60	13472	13741	
		GrA-22087	11980	80	13595	14049	
		GrA-24296	12060	60	13759	14077	
		GrA-22089	12500	90	14241	15109	
Valcervera	30	GrA-27876	6815	45	7580	7727	(Montes et al., 2015)
		GrA-45783	6995	40	7727	7934	
		GrA-45763	7035	45	7760	7960	
Samitiel	31	GrN-26150	5130	20	5769	5930	(Montes et al., 2000)
Esplugón	32	Beta-338509	5970	30	6730	6892	(Utrilla et al., 2015)
		Beta-283899	6120	40	6902	7158	
		Beta-313517	6730	40	7513	7667	
		GrA-59632	7620	40	8365	8518	
		GrA-59634	7715	45	8418	8584	
		GrA-59633	8015	45	8716	9020	
		Beta-306723	6950	50	7680	7925	
		Beta-306725	7860	40	8546	8933	
		Beta 306722	8380	40	9299	9485	
Espantalobos	33	Beta-361624	7390	40	8055	8341	(Montes et al., 2015)
		Beta-361625	7900	50	8593	8978	
Chaves	34	CSIC-381	6120	70	6795	7230	(Baldellou, 2011)
		GrN-13603	6260	100	6943	7418	
		CSIC-379	6230	70	6948	7289	
		GrA-26912	6230	45	7006	7257	
		GrN-13602	6330	90	7013	7428	
		GrN-13605	6330	70	7029	7424	
		GrA-34256	6335	40	7167	7413	
		GrA-28341	6380	40	7253	7420	
		CSIC-378	6460	70	7256	7500	
		GrA-34257	6410	40	7271	7421	
		GrN-13604	6490	40	7316	7476	

SITE	CARTE N°	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Chaves	34	UCIAMS-66317	6470	25	7324	7431	(Baldellou, 2011)
		GrA-34258	6530	40	7330	7558	
		GrA-38022	6580	35	7427	7563	
		GrN-12683	6650	80	7427	7657	
		GrN-12658	6770	70	7500	7752	
		GrN-14561	12660	70	14731	15285	(Utrilla, 1995)
		GrN-15635	12950	70	15240	15742	
Cueva Pacencia	35	GrA17666	5795	45	6485	6719	(Montes et al., 2000)
Huerto Raso	36	GrA-21360	6310	60	7028	7417	(Montes et al., 2000)
Cueva Drólica	37	GrA33914	5855	40	6558	6777	(Montes and Martínez Bea, 2006)
Forcas II	38	Beta-247406	5240	40	5917	6178	(Utrilla and Mazo, 2014)
		Beta-247405	6740	40	7518	7670	
		Beta-247404	6750	40	7524	7675	
		Beta-60773	6940	90	7618	7941	
		Grn-22688	6900	45	7656	7843	
		Beta-290932	7000	40	7735	7935	
		Beta-250944	7150	40	7871	8031	
		GrN-22686	7240	40	7978	8163	
		Beta-59997/CAMS-5354	8650	70	9520	9887	
Forcas I		GrN-17785	9715	75	10785	11251	(Utrilla and Mazo, 2014)
		GrA-32955	11015	45	12741	13011	
		GrA-33987	12010	60	13735	14045	
		GrA-32957	12440	50	14217	14937	
		GrA-33986	12600	60	14635	15216	
Coro Trasito	39	CNA.2520.1.1	5850	35	6561	6746	(Clemente et al., 2014)
		Beta-358571	5990	40	6735	6941	
		Beta -366546	6159	40	6949	7166	
Espluga de la Puyascada	40	CSIS-382	5580	70	6217	6527	(Baldellou, 1987)
		CSIC-384	5930	60	6636	6930	
Trocs	41	Mams-14856	5005	27	5655	5887	(Rojo et al., 2013)
		Mams-16160	5008	27	5656	5888	
		Mams-16165	5035	23	5716	5895	
		Beta-319513	5580	40	6296	6437	
		Beta-316511	5590	40	6299	6443	
		Beta-316515	5590	40	6299	6443	
		Beta-316514	6050	40	6785	7005	
		Beta-295782	6060	40	6791	7144	
		Beta-284150	6070	40	6793	7151	
		Beta-326512	6080	40	6796	7155	
		Mams-16161	6217	25	7015	7243	
		Mams-16162	6218	24	7017	7243	
		Mams-16166	6234	28	7024	7252	
		Mams-16168	6249	28	7027	7259	
		Mams-16164	6249	25	7029	7259	
		Mams-16168	6249	20	7159	7252	
		Mams-16159	6280	25	7167	7260	
		Mams-16163	6285	25	7168	7261	
Cova del Sardo	42	KIK/KIA5833/40816	5000	30	5651	5888	(Gassiot Ballbè et al., 2014)
		KIK/KIA3484/26248	5060	40	5715	5912	
		KIK/KIA4381/32340	5245	40	5920	6178	
		KIK/KIA5832/40815	5635	35	6318	6488	
		KIK/KIA5860/41134	5645	25	6324	6492	
		KIK/KIA5002/36935	5695	35	6403	6602	
		KIK/KIA5785/40878	5715	35	6412	6630	
		KIK/KIA5038/37690	5850	40	6551	6775	
		KIK/KIA5037/37689	6525	45	7325	7558	
		KIK/KIA5834/40817	6586	35	7429	7564	
Estany de la Coveta	43	KIA-29818	7845	45	8523	8950	(Gassiot Ballbè et al., 2014)
Cova Colomera	44	Beta248523	6020	50	6740	6994	(Oms et al., 2013)
		Beta240551	6150	40	6942	7165	
		Beta-279478	6180	40	6951	7235	
		OxA-23634	6170	30	6980	7165	

SITE	CARTE N°	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Cova Gran	45	Beta-233605	5250	40	5922	6179	(Martínez-Moreno et al., 2007)
		Beta265982	6020	50	6740	6994	
Parco	46	CSIC403	5970	60	6668	6948	(Balsera et al., 2015)
		GrN-20058	6120	90	6788	7246	(Mangado et al., 2014)
		CSIC-281	6170	70	6896	7250	(Mangado et al., 2007)
		AA-14310	10190	100	11398	12377	(Calvo et al., 2008)
		Gif-95562	10930	100	12693	13031	(Mangado et al., 2015)
		OxA-8657	11270	90	12945	13320	(Petit et al., 2009)
		OxA-8656	11430	60	13135	13413	(Mangado et al., 2015)
		OxA-10797	12460	60	14235	15006	(Mangado et al., 2006)
		OxA-10796	12605	60	14653	15218	
		OxA-13597	12995	50	15310	15760	
Cova de Montanissell	47	Beta213109	5680	50	6322	6631	(Armentano et al., 2007)
Camp Colomer	48	Beta325685	5300	30	5991	6185	(Martins et al., 2015)
		Beta-325684	5350	40	6001	6272	
		Beta-325686	5630	40	6314	6487	
Balma Margineda	49	Beta-325682	6410	40	7271	7421	(Martins et al., 2015)
		Ly-5414	11510	100	13143	13547	(Guilaine and Evin, 2007)
		Ly-4896	11690	90	13342	13735	
Balma de Guilanyà	50	Beta-210730	8640	50	9527	9732	(Mora and Martínez-Moreno, 2009)
		Beta-185046	8680	50	9536	9883	
		Beta-186168	9410	60	10439	11061	
		Beta-210728	9840	50	11182	11354	
		Beta-210729	10940	50	12707	12950	
		Beta-247706	11110	40	12838	13080	
		Beta-185066	12180	50	13864	14230	
		Beta-247708	12310	40	14071	14566	
Molí del Salt	51	Beta-173335	8040	40	8762	9030	(Morales et al., 2012)
		Beta-22913	10850	70	12652	12896	
		Beta-179599	10840	50	12681	12804	
		Beta-235268	10920	60	12700	12953	
		Beta-284214	10940	50	12707	12950	
		Beta-235267	11000	60	12728	13017	
		Beta-179598	10990	50	12729	12996	
		Beta-22912	11060	70	12761	13072	
		Beta-277000	11230	50	13007	13202	
		Beta-277001	11440	60	13142	13421	
		Beta-284212	11770	50	13471	13731	
		Beta-284213	11800	50	13481	13750	
		GifA-101037	11940	100	13555	14052	
		GifA-101038	12510	100	14232	15131	
Collet Puiggrós	52	UBAR891	5345	45	5996	6274	(Piera et al., 2008)
		UBAR892	5480	45	6195	6396	
Colls	53	AA-8646	10050	85	11267	11963	(Morales et al., 2012)
Hort de la Boquera	54	OxA-23645	11775	45	13475	13730	(Morales et al., 2012)
		OxA-23646	11850	45	13565	13761	
		OxA-13595	12250	60	13967	14495	
Filador	55	AA-13411	8150	90	8778	9405	(García-Argüelles and Fullola, 2006)
		Oxa-8658	8515	60	9422	9594	
		AA-13412	9988	97	11223	11935	
		AA-8647	10020	80	11248	11930	
		OXA-8650	10864	60	12678	12860	
		OXA-8660	11000	50	12731	13005	
Riols	56	GrN-13976	6040	100	6669	7165	(Royo and Gómez, 1996)
Valmayor XI	57	Beta-341167	6090	30	6858	7153	(Rojo et al., 2015)
		Beta-341168	6570	30	7427	7558	
Plano del Pulido	58	Beta-258559	5040	40	5663	5902	(Utrilla and Bea, 2012)
Costalena	59	GrA-13264	5480	50	6190	6398	(Barandiarán and Cava, 2000)
		MAMS-29828	7053	27	7838	7958	Unpublished
Pontet	60	GrN-14241	6370	70	7170	7425	(Mazo and Montes, 1992)
		GrN-16313	7340	70	8012	8326	
		D-AMS 020210	7341	32	8030	8283	Unpublished

SITE	CARTE Nº	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Pontet	60	D-AMS 020211	7941	65	8609	8030	Unpublished
		D-AMS 020208	6963	32	7698	7920	
		D-AMS 020209	6369	41	7180	7420	
		D-AMS 020207	5644	42	6310	6504	
Botiquería	61	GrA-13268	6040	50	6745	7143	(Barandiarán and Cava, 2000)
		GrA-13270	6240	50	7005	7265	
		GrA-13267	6830	50	7582	7783	
		GrA-13265	7600	50	8335	8537	
Torrazas	62	GrN18320	5570	60	6280	6480	(Benavente and Andrés, 1992)
Alonso Norte	63	D-AMS 018640	6069	27	6805	7002	Unpublished
Baños	64	GrA-21550	7350	50	8028	8311	(Utrilla and Rodanés, 2004)
		GrN-24300	7570	100	8180	8560	
		GrA-21551	7550	50	8206	8430	
		GrA-21552	7740	50	8420	8597	
		GrN-24299	7840	100	8445	8984	
		GrA-21556	8040	50	8719	9086	
Ángel 1	65	GrA22825	5220	80	5753	6208	(Domingo et al., 2010)
		GrA-27274	7435	45	8178	8357	(Utrilla et al., 2009)
		GrA-27278	7955	45	8647	8988	
		GrA-22826	8390	60	9275	9526	
		GrA-27275	9200	50	10245	10500	Unpublished
Ángel 2		Beta-254048	6390	40	7260	7420	(Utrilla et al., 2009)
		Beta-286819	6610	40	7437	7568	Unpublished
		Beta-266112	6990	50	7705	7934	(Domingo et al., 2010)
		Beta-286820	7120	50	7846	8021	Utrilla and Mazo, 2014)
		GrA-22836	8310	60	9132	9466	(Utrilla et al., 2009)
Cova del Clot del Hospital	66	OxA-16572	10045	45	11324	11769	(Bosch et al., 2015)
		OxA-16421	11115	50	12830	13086	
Cova del Vidre	67	Beta-58934	6189	90	6806	7290	(Martins et al., 2015)
		OXA-26064	6181	35	6960	7174	
		OXA-26005	6248	33	7025	7260	
		UBAR-832	7290	70	7964	8301	(Morales et al., 2013)
Mas Cremat	68	Beta-232340	6020	50	6740	6994	(Vizcaíno, 2010)
		Beta-232342	6780	50	7566	7701	
		Beta-232341	6800	50	7572	7725	
Cova Fosca	69	I-9867	5715	80	6317	6673	(Olària, 2000)
		Beta-148996	5850	70	6489	6846	
		Beta-148997	5870	80	6491	6889	
		Beta-18993	5820	40	6505	6730	
		Beta-148998	5820	40	6505	6730	
		Beta-148999	5980	70	6661	6996	
		Beta-148994	5980	70	6661	6996	
		Beta-149005	6070	80	6743	7163	
		Beta-149000	6080	80	6746	7165	
		Beta-149001	6140	90	6797	7251	
		Beta-149007	6130	60	6803	7174	
		Beta-149004	6150	70	6861	7248	
		Beta-149006	6250	80	6946	7412	
		Beta-149009	6390	40	7260	7420	
		OXA-26074	6413	33	7275	7420	(Martins et al., 2015)
		CSIC-356	7100	70	7752	8045	(Olària, 2000)
		CSIC-357	7210	70	7880	8178	
		OxA26073	10060	45	11340	11815	(Martins et al., 2015)
		No Reference	12130	100	13740	14311	(Olària, 2000)
Mas Nou	70	Beta-136676	6800	70	7516	7791	(Olària, 2000)
		Beta-136677	6900	70	7610	7924	
		Beta-170714	6910	40	7670	7835	
		Beta-170715	6920	40	7674	7839	
		Beta-170713	6760	40	7570	7675	(Olària et al., 2005)
		Beta 170714	7010	40	7744	7939	
Cingle de l'Aigua	71	Beta-244044	10520	60	12160	12660	(Villaverde et al., 2010)
Cabezo de la Cruz	72	GrN-29135	7150	70	7841	8160	(Rodanés and Picazo, 2009)

SITE	CARTE N°	LABORATORY REFERENCE	BP ±		Cal BP 2s		AUTHORS
Cueva del Gato 2	73	GrA22525	6240	50	7005	7265	(Blasco and Rodanés, 2009)
Carlos Álvarez	74	KIA-27671	7013	38	7753	7939	(Rojo et al., 2011)
Lámpara	75	KIA-6789	6055	34	6797	6996	(Rojo et al., 2008)
		KIA-6790	6144	46	6911	7166	
		KIA 21348	6125	33	6914	7159	
		UtC_13346	6280	50	7022	7315	
		KIA 21352	6280	33	7160	7271	
		KIA-4780	6390	60	7178	7428	
		KIA 21347	6407	34	7272	7419	
		KIA8874	6421	30	7280	7422	
		KIA16567	6522	44	7325	7555	
		KIA-16571	6608	35	7438	7566	
		KIA-16579	6610	32	7440	7566	
		KIA-16574	6729	45	7510	7671	
		KIA-16575	6744	33	7580	7671	
		KIA-16566	6833	34	7595	7730	
		KIA 21350	6871	33	7625	7789	
		KIA-16569	6920	50	7670	7921	
		KIA-16577	6915	33	7677	7826	
		KIA-16570	6956	39	7689	7921	
		KIA-16580	6989	48	7708	7933	
		KIA-16578	6975	32	7709	7926	
		KIA-16568	7000	32	7752	7933	
		KIA-16581	7075	44	7796	7981	
		KIA-16573	7108	34	7857	8004	
		KIA-16576	7136	33	7875	8015	
Revilla	76	KIA-13943	5642	96	6283	6656	(Rojo et al., 2008)
		UtC_13348	6120	60	6800	7169	
		KIA21353	6156	33	6960	7162	
		UtC_13350	6210	60	6960	7258	
		KIA21349	6158	31	6967	7163	
		KIA21354	6177	31	6983	7168	
		KIA 21346	6202	31	7001	7239	
		UtC_13294	6240	50	7005	7265	
		UtC_13295	6250	50	7007	7270	
		UtC_13296	6250	50	7007	7270	
		KIA21355	6230	30	7019	7251	
		KIA21359	6245	34	7024	7259	
		UtC_13347	6313	48	7158	7415	
		KIA 21357	6271	31	7160	7266	
		KIA21351	6289	31	7165	7269	
		KIA21356	6355	30	7179	7415	
		KIA 21358	6365	36	7182	7419	
		KIA-13932	6385	35	7260	7418	
		KIA-13937	6405	36	7270	7419	
		KIA-13942	6415	36	7275	7420	
		KIA-13945	6446	39	7287	7430	
		KIA-13933	6468	40	7290	7440	
		KIA-13938	6499	42	7317	7488	
		KIA-13948	6449	37	7322	7478	
		KIA-13940	6568	37	7425	7562	
		KIA-13946	6691	48	7477	7656	
		KIA-13939	6755	57	7509	7691	
		KIA-13934	6772	47	7566	7689	
		KIA-13947	6809	37	7585	7693	
		KIA-13935	6983	45	7702	7932	
		KIA-13944	7014	37	7757	7939	
		KIA-13941	7165	37	7932	8040	

REFERENCES

Alday, A., 2014. The site at Atxoste (Vírgala, Álava), in: Sala, R. (Ed.), Pleistocene and Holocene Hunter-Gatherers in Iberia and the Gibraltar Strait: The Current Archaeological Record. Burgos, pp. 147–151.

Alday, A., 2006. El legado prehistórico de Mendandia: los modos de vida de los últimos cazadores-recolectores en la prehistoria de Treviño. Arqueología de Castilla y León. Memorias 15.

Alday, A., 1998. Kanpanoste Goikoa. El depósito prehistórico de Kanpanoste Goikoa (Vírgala, Alava): memoria de las actuaciones arqueológicas 1992-1993. Memorias de Yacimientos Alaveses 5. Diputación Foral de Álava, Vitoria.

Alday, A., Carretero, J.M., Götherström, A., Anderung, C., 2012. Uros, genética, Indígenas y colonos. A propósito de la neolitización de Europa. Veleia 29, 335–358.

Alday, A., Soto, A., López de Heredia, J., Perales, U., 2013. El abrigo de Martinarri (Obécuri, Treviño): una ocupación del Tardiglaciar en la Cuenca Alta del Ebro. Trab. Prehist. 69, 257–272. doi:10.3989/tp.2012.12091

Alonso, C., Jiménez, J., 2014. Contribución al estudio del poblamiento, modos de vida y ritual funerario del Neolítico antiguo: el asentamiento al aire libre de El Prado (Pancorbo, Burgos). Zephyrus LXXIV, 41–64.

Armentano, N., Gallart, J., Jordana, X., López, J.B., Malgosa, A., Rafel, N., 2007. La cova sepulcral de Montanissell (Sallent- Coll de Nargó, Alt Urgell): pràctiques funeràries singulars durant l'edat del bronze al Prepirineu. Trib. Arqueol. 2006, 141–167.

Baldellou, V., 2011. La Cueva de Chaves (Bastarás - Casbas, Huesca). Saguntum las Prim. Prod. cerámicas, El VI Milen. cal AC en la Península Ibérica Extra 12, 141–145.

Baldellou, V., 1987. Avance al Estudio de la Espluga de la Puyascada. Bolskan 4, 3–41.

Balsera, V., Díaz-del-Río, P., Gilman, A., Uriarte, A., Vicent, J.M., 2015. Approaching the demography of late prehistoric Iberia through summed calibrated date probability distributions (7000-2000 cal BC). Quat. Int. 386, 208–211. doi:10.1016/j.quaint.2015.06.022

Barandiarán, I., Cava, A., 2008. Cazadores y tallistas en el abrigo de Portugain. Una ocupación de Urbasa durante el Tardiglaciar. Fundación José Miguel de Barandiaran Fundazioa. Colección Barandiaran 12.

Barandiarán, I., Cava, A., 2001. Cazadores-recolectores en el Pirineo Navarro: el sitio de Aizpea entre 8.000 y 6.000 años antes de ahora. Anejos de Veleia serie Maior, 10. Universidad del País Vasco Servicio Editorial.

Barandiarán, I., Cava, A., 2000. A propósito de unas fechas del Bajo Aragón: reflexiones sobre el Mesolítico y el Neolítico en la Cuenca del Ebro. SPAL 9, 293–326.

Barrios Gil, I., 2004. El yacimiento de cueva Lóbrega (Torrecilla en Cameros, La Rioja) : una visión acerca del neolítico y la Edad del Bronce en el área occidental del sistema ibérico. Historia. Arqueologia, 15, Instituto de Estudios Riojanos.

Benavente, J.A., Andrés, T., 1992. Informe sobre las excavaciones de las Torrazas (Alcañiz, Teruel), in: Arqueología Aragonesa 1990. Diputación General de Aragón, Zaragoza, pp. 57–60.

Blasco, M.F., Rodanés, J.M., 2009. Las fases de ocupación de la cueva del Gato 2 (Épila, Zaragoza) The occupation Levels of Gato 2 cave (Épila, Zaragoza). Salduie 9, 311–334.

Bosch, J., Nadal, J., Román, D., Estrada, A., 2015. Antigas excavaciones, nuevas respuestas. El yacimiento epimagdaleniense de la coval del Clto del l'Hospital (Roquetes, Baix Ebre). Saguntum 47, 9–27. doi:10.7203/SAGVNTVM.47.3780

Calvo, M., Fullola, J.M., Mangado, X., Petit, M.A., 2008. Los raspadores y el procesado de la pien en la cueva del Parco (Alòs de Balaguer, Lleida, ESpaña). Veleia 24–25, 493–530.

Cava, A., 2004. La ocupación prehistórica de Kanpanoste en el contexto de los cazadores-recolectores del Mesolítico. Memoria de Yacimientos Alaveses, 9. Diputación Foral de Álava, Vitoria.

Clemente, I., Gassiot, E., Rey Lanaspa, J., 2014. "Cort o Transito" -Coro Trasito- o corral de tránsito una cueva pastoril del Neolítico antiguo en el corazón de Sobrarbe, in: Sobrarbe Antes de Sobrarbe: Pinceladas de Historia de Los Pirineos, 2014, ISBN 978-84-8127-265-9, Págs. 11-32. Centro de Estudios de Sobrarbe, pp. 11–32.

Domingo, R., Martínez-Bea, M., Utrilla, P., 2010. Una nueva ocupación neolítica en el río Guadalope: la campaña de 2009 en el abrigo de Ángel 2. Saldvie1 10, 225–235.

Fernández Eraso, J., García Rojas, M., Fernández Crespo, T., Castaños, P., Bailon, S., Murelaga, X., Tarriño, A., 2010. La cueva de Las Orcillas 1: una estación de los últimos cazadores-recolectores en La Berrueza (Mendaza-Acedo, Navarra). Trab. Arqueol. Navarra 22, 13–91.

Fernández Eraso, J., Mujika, J.A., 2013. La estación megalítica de la Rioja Alavesa: cronología, orígenes y ciclos de utilización. Zephyrus 71, 89–106.

García-Argüelles, P., Fullola, J.., 2006. La cueva del Parco (Alòs de Balaguer, Lleida) y el abrigo del afilador (Margalef de Montsa nt, Tarragona): dos secuencias clave para el conocimiento del Epipaleolítico en el Nordeste peninsular, in: Alday, A. (Ed.), El Mesolítico de Muescas Y Denticulados En La Cuenca Del Ebro Y El Litoral Mediterráneo Peninsular. Vitoria, pp. 121–136.

García-Martínez de Lagrán, I., Iriarte, E., García-Gazólaz, J., Tejedor-Rodríguez, C., Gibaja-Bao, J.F., Moreno-García, M., Pérez-Jordà, G., Ruiz-Alonso, M., Sesma-Sesma, J., Garrido-Pena, R., Carrancho-Alonso, Á., Peña-Chocarro, L., Rojo-Guerra, M.A., 2016. 8.2 ka BP paleoclimatic event and the Ebro Valley Mesolithic groups: Preliminary data from Artusia rock shelter (Unzué, Navarra, Spain). Quat. Int. 403, 151–173. doi:10.1016/j.quaint.2015.06.050

García Gazolaz, J., 2007. Los enterramientos neolíticos del yacimiento de Paternanbidea (Ibero), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 59–65.

García Gazólaz, J., 2001. Excavaciones arqueológicas en el abrigo del Padre Areso (Bigüézal, Navarra): Campañas de 1994, 1995,1996. Trab. Arqueol. Navarra, ISSN 0211-5174, Nº 15, 2001, págs. 307-314 15, 307–314.

García Gazolaz, J., Sesma, J., 2007. Enterramientos en el poblado neolítico de Los Cascajos (Los Arcos), in: La Tierra Te Sea Leve. Arqueología de La Muerte En Navarra. Pamplona, pp. 52–58.

García Gazólaz, J., Sesma Sesma, J., Rojo Guerra, M.Á., Alday, A., Garrido Pena, R., García-Martínez de Lagrán, I., 2011. Los Cascajos (Los Arcos, Navarra). Saguntum Las Prim. Prod. cerámicas. El VI Milen. CAL AC en la península ibérica Extra, 135–140.

García Martínez de Lagrán, Í., 2012. El proceso de neolitización en el Interior Peninsular: la Submeseta Norte y el Alto Valle del Ebro: la cerámica como herramienta interpretativa. Universidad de Valladolid.

Gassiot Ballbè, E., Rodríguez Antón, D., Pèlachs Mañosa, A., Pérez Obiol, R., Julià Brugués, R., Bal-Serin, M.-C., Mazzucco, N., 2014. La alta montaña durante la Prehistoria: 10 años de investigación en el Pirineo catalán occidental. Trab. Prehist. 71, 261–281. doi:10.3989/tp.2014.12134

Guilaine, J., Evin, J., 2007. Datations istopiques des couches épipaléolithiques de la balma Margineda., in: Guilaine, J., Barbaza, M., Martzluff, M.- (Eds.), Les Excavacions a La Balma Margineda (1979–1991). Andorra. Govern. d'Andorra, pp. 62–63.

Mangado, X., Fullola, J.M., Tejero, J.-M., Petit, M.À., Sánchez, M., Bartrolí, R., 2015. Aportacions clau de la Cova del Parco (Alòs de Balaguer, la Noguera, Lleida) al Magdalenià: vint-i-cinc anys de recerca arqueològica. Trib. Afrqueologica 2012–2013, 86–99.

Mangado, X., Petit, M.., Fullola, J.., Bartolí, R., 2006. El paleolitic superior final de la cova del Parco (Alòs de Balaguer, La Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Petit, M.A., Fullola, J.M., Bartrolí, R., 2007. El paleolític superior final cova del Parco (Alòs de Balaguer, la Noguera). Rev. d'Arqueologia Ponent 16–17, 45–62.

Mangado, X., Tejero, J.M., Fullola, J.M., Petit, M.A., Sánchez, M., 2014. La Cova del Parco (Alòs de Balaguer, La Noguera, Lleida). La secuencia del Magdaleniense, in: Sala, R. (Ed.), Los Cazadores Recolectores Del Pleistoceno Y Del Holoceno En Iberia Y El Estrecho de Gibaltrar. Estado Actual de El Conocimiento Del Registro Arqueológico. Universidad de Burgos, pp. 152–158.

Martínez-Moreno, J., Mora, R., Casanova, J., 2007. El contexto cronométrico y tecnotipológico durante el Tardiglaciar y Postglaciar de la vertiente sur de los Pirineos orientales. Rev. Arqueol. Ponent 16–17, 7–44.

Martins, H., Oms, F.X., Pereira, L., Pike, A.W.G., Rowsell, K., Zilhão, J., 2015. Radiocarbon dating the beginning of the Neolithic in Iberia: new results, new problems. J. Mediterr. Archaeol. 28. doi:10.1558/jmea.v28i1.27503

Mazo, C., Montes, L., 1992. La transición Epipaleolítico - Neolítico antiguo en el abrigo de El Pontet (Maella, Zaragoza), in: Utrilla, P. (Ed.), Aragón I Litoral Mediterráneo: Intercambios Culturales Durante La Prehistoria. pp. 243–254.

Montes, L., Cuchí, J.A., Domingo, R., 2000. Epipaleolítico y Neolítico en las sierras prepirenaicas de Aragón: prospecciones y sondeos, 1998-2001. Bolskan 17, 87–123.

Montes, L., Domingo, R., Cuchi, J.A., Alcolea, M., Sola, C., 2015. Completando el mapa de la Cuenca del Ebro: el Mesolítico del IX milenio cal BP de Espantalobos (Huesca, España). Munibe Antropol. 66, 119–133. doi:10.21630/maa.2015.66.06

Montes, L., Domingo, R., González-Sampériz, P., Sebastián, M., Aranbarri, J., Castaños, P., García-Simón, L.M., Alcolea, M., Laborda, R., 2015. Landscape, resources and people during the Mesolithic and Neolithic times in NE Iberia: The Arba de Biel Basin. Quat. Int. doi:10.1016/j.quaint.2015.05.041

Montes, L., Martínez Bea, M., 2006. El yacimiento campaniforme de Cueva Drólica (Sarsa de Surta, Huesca). Saldvie 6, 297–316.

Mora, R., Martínez-Moreno, J., 2009. Balma Guilanyà (Prepirineo de Lleida) y el Aziliense en el noreste de la Península Ibérica. Trab. Prehist. 66, 45–60.

Morales, J.., Cebria, A., Maestres, J., Oms, F.X., Allué, E., 2013. La cova de la Guineu. 12.000 anys de presència humana a les calçaperes del Foix, in: III Monografies Del Foix. pp. 172–183.

Morales, J.I., Burjachs, F., Allué, E., Fontanals, M., Soto, M., Expósito, I., Gassiot, E., Pèlahcs, A., Pérez-Obiol, R., Soriano, J.M., Vergès, J.M., Yll, E., 2012. Paleogeografía humana durante el Tardiglaciar y Holoceno inicial en el ámbito mediterráneo del NE Ibérico. Cuaternario y Geomorfol. 26, 11–28.

Mujika, J.A., Edeso, J.M., 2012. Lehenengo nekazari-abeltzainak Gipuzkoan Neolitikotik Burdin Arora / Los primeros agricultores y ganaderos en Gipuzkoa del Neolítico a la Edad del Hierro, 0.2. ed. San Sebastián.

Muñoz, M., Berganza, E., 1997. El yacimiento de la cueva de Urratxa III (Orozko, Bizkaia). Universidad de Deusto.

Olaria, C., 2000. Nuevas dataciones de C-14 para el neolítico mediterráneo. Quad. prehistòria i Arqueol. Castelló 21, 27–34.

Olària, C., Gusi, F., Gómez, J.L., 2005. Un enterramiento meso-neolítico en el Cingle del Mas Nou (Ares del Maestre, Castellón) del 7000 BP en territorio de arte levantino., in: Arias, P., Ontañón, R., García, C. (Eds.), III Congreso Del Neolítico. pp. 615–623.

Oms, F.X., Pedro, M., Morales, J.I., Allué, E., Frigola, J., Mendiela, S., Rodriguez, A., Sierra, J., Yubero, M., 2013. La Cova Colomera 30 anys després. Ocupacions humanes entre 6180-3280 BP al Congost de Montrebei. Campanyes de 2005-2011, in: Primeres Jornades d'Arqueologia I Paleontologia Del Pirineu I Arán. pp. 116–123.

Ortega, A.I., Juez, L., Carretero, J., Arsuaga, J.L., Pérez, A., Ortega, M.., Pérez, R., Rodríguez, A.., Santos, E., García, R., Gómez, A., Rodríguez, L., Rodríguez, Martínez de Pinillos, M., Maerínez, I., 2008. The Portalón at Cueva Mayor (Sierra de Atapuerca, Spain): a new archaeological secuence, in: Diniz, M. (Ed.), The Early Neolithic in the Iberian Peninsula. Regional and Transregional Components. BAR serie 1857, pp. 3–9.

Ortiz Tudanca, L., Ferreira, A., Gil Zubillaga, E., Tarriño, A., Tarriño, J.M., Lobo Urrutia, P.J., Vivanco, J.J., 1983. El núcleo de poblamiento postpaleolítico de Larrenke (Mijancas-Santude). Estud. Arqueol. Alavesa 11, 187–285.

Petit, M.A., Mangado, X., Fullola, J.M., Bartolí, R., Bergada, M.M., Esteve, X., 2009. Els caçadors recol.lectors de la cova del Parco (Alòs de Balaguer, la Noguera, Lleida). L´epipaleolític microlaminar: continuïtat o canvi?, in: Els Pirineus I Les Àrees Circumdants Durant El Tardiglacial. Mutacions I Filiacions Tecnoculturals, Evolució Paleoambiental (16000-10000 BP). XIV Col-Loqui Internacional D´arqueologia de Puigcerdà. Homenatge Al Professor George Laplace. Institut d´estudis ceretans, Puigcerdá, p. 579–587.

Piera, M., Pla, A., Antolín, F., Alonso, N., Camarós, E., Clop, E., Gibaja, J.F., Saña, M., Gallart, J., 2008. El Collet de Puiggròs. Un assentament a l'aire lliure de l'època neolítica, in: Fites En El Temps, (VI Trobada d'Estudiosos de Les Garrigues). pp. 23–48.

Rodanés, J.., Picazo, J., 2009. La cabaña mesolítica de Cabezo de la Cruz (La Muela, Zaragoza), in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica. Zaragoza, pp. 327–341.

Rojo, M.A., Kunst, M., Garrido, R., García, Í., Morán, G., 2008. Paisajes de la Memoria: asentamientos del neolítico antiguo en el Valle de Ambrona (Soria, España). Universidad de Valladolid, Valladolid.

Rojo, M.A., Peña-Chocarro, L., Royo, J.I., Tejedor, C., García-Martínez de Lagrán, I., Arcusa, H., Garrido, R., Moreno, M., Mazzucco, N., Gibaja, J.F., Ortega, D., Kromer, B., Alt, K.W., 2013. Pastores trashumantes del Neolítico antiguo en un entorno de Alta Montaña. Boletín del Semin. Estud. Arqueol. LXXIX, 9–55.

Rojo, M.A., Tejedor, C., Peña-Chocarro, L., Royo, J.I., García-Martínez de Lagrán, I., Arcusa, H., San Millán, M., Garrido, R., Gibaja, J.F., Mazzuco, N., Clemente, I., Mozota, M., Terradas, X., Moreno, M., Pérez, G., Álvarez, E., Jiménez, I., Gómez, F., 2015. Releyendo el fenómeno de la neolitización en el Bajo Aragón a la luz de la excavación del cingle de Valmayor XI (Mequinenza, Zaragoza). Zephyrus 75, 41–71. doi:10.14201/zephyrus2015754171

Rojo, M., Garrido, R., García-Martínez de Lagrán, I., Alda, A., García-Gazólaz, J., Sesma, J., 2011. El Valle de Ambrona y la provincia de Soria: La Lámpara, La Revilla del Campo y El Abrigo de la Dehesa/Carlos Álvarez, in: Las Primeras Producciones Cerámicas: El VI Milenio Cal AC En La Península Ibérica. Saguntum Extra 12. pp. 105–108.

Royo, J.I., Gómez, F., 1996. Hábitat y territorio durante el Neolítico Antiguo y Medio/Final en la confluencia del Segre y el Ebro (Mequinenza, Zaragoza). Rubricatum 1, I Congr, 767–780.

Tarriño, A., Elorrieta, I., García-Rojas, M., Orue, I., Sánchez, A., 2014. Neolithic Flint Mines of Treviño (Basque-Cantabrian Basin, Western Pyrenees, Spain). J. Lithic Stud. 1, 129–147. doi:10.2218/jls.v1i2.1098

Utrilla, P., 1995. El valle del Ebro durante el Tardiglacial y comienzos del Holoceno. Las relaciones con el Magdaleniense cantábrico, in: Moure, A., González Sainz, C. (Eds.), El Final Del Paleolítico Cantábrico. Universidad de Cantabria, pp. 281–311.

Utrilla, P., Bea, M., 2012. El asentamiento neolítico del Plano del Pulido (Caspe, Zaragoza). Congrés Int. Xarxes al Neolític. Rubricatum 5, 69–78.

Utrilla, P., Berdejo, A., Obón, A., Laborda, R., Domingo, R., Alcolea, M., 2015. El abrigo de El Esplugón (Billobas-Sabiñánigo, Huesca). Un ejemplo de transición Mesolítico-Neolítico en el Prepirineo central, in: Del Neolític a L'edat Del Bronze En El Mediterrani Occidental. Estudis En Homenatge a Bernat Martí Oliver. Trabajos varios del SIP, Museo de Valencia, Valencia, pp. 75–96.

Utrilla, P., Domingo, R., Montes, L., Mazo, C., Rodanés, J.M., Blasco, M.F., Alday, A., 2012. The Ebro Basin in NE Spain: A crossroads during the Magdalenian. Quat. Int. 272–273, 88–104. doi:http://dx.doi.org/10.1016/j.quaint.2012.04.024

Utrilla, P., Mazo, C., 2014. La Peña de Las Forcas (Graus, Huesca). Un asentamiento estratégico en la confluencia del Ésera y el Isábena. Monografías Arqueológicas, 46. Universidad de Zaragoza.

Utrilla, P., Mazo, C., 1996. Excavaciones en la cueva de Abauntz (Arraiz): campañas de 1994-1995. Trab. Arqueol. Navarra 12, 270–279.

Utrilla, P., Mazo, C., Domingo, R., 2014. Los abrigos de Forcas en la dinámica cultural del Valle del Ebro, in: Utrilla, P., Mazo, C. (Eds.), La Peña de Las Forcas (Graus, Huesca). Un Asentamiento Estratégico En La Confluencia Del Ésera Y El Isábena. Monografías Arqueológicas. Prehistoria, 46. Universidad de Zaragoza, pp. 345–405.

Utrilla, P., Montes, L., Mazo, C., Martínez Bea, M., Domingo, R.., Martínez-Bea, M., Martínez Bea, M., Domingo Martínez, R., 2009. El mesolítico geométrico en Aragón, in: Utrilla, P., Montes, L. (Eds.), El Mesolítico Geométrico En La Península Ibérica, 2009, ISBN 978-84-92522-07-1, Págs. 131-190. Universidad de Zaragoza, pp. 131–190.

Utrilla, P., Rodanés, J.M., 2004. Un asentamiento epipaleolítico en la cuenca del río Martín. El abrigo de Los Baños (Ariño, Teruel). Monografías Arqueológicas 39. Universidad de Zaragoza. Zaragoza.

Vergès, J.M., Allué, E., Angelucci, D.E., Burjachs, F., Carrancho, A., Cebrià, A., Expósito, I., Fontanals, M., Moral, S., Rodríguez, A., Vaquero, M., 2008. Los niveles neolíticos de la cueva de El Mirador (Sierra de Atapuerca, Buegos): nuevos datos sobre la implantación y el desarrollo de la economía agropecuaria en la submeseta norte, in: Hernández, M., Soler, J.., López Padilla, J.. (Eds.), IV Congreso Del Neolítico Peninsular, Vol. 1. pp. 418–427.

Villaverde, V., Román, D., Martínez, R., Badal, E., Bergada, M.M., Guillem, P.M., Pérez, M., Tormo, C., 2010. El Paleolítico superior en el País Valenciano. Novedades y perspectivas, in: El Paleolítico Superior Peninsular. Novedades Del Siglo XXII. Barcelona, pp. 85–113.

Vizcaíno, D. (coord), 2010. El Cingle del Mas Cremat (Portell de Morella, Castellón). Un asentamiento en altura con ocupaciones del Mesolítico Reciente al Neolítico Final. Generalitat de Valencia.

APPENDIX B. CHRONOLOGICAL DATABASE AND ELABORATION OF SCDPD CURVES (SUMMED CALIBRATED [RADIOCARBON] DATE PROBABILITY DISTRIBUTION)

The list of C14 dates of this article is part of a larger database, developed by A. Alday with the objective of making available an exhaustive list of dates from the end of the Pleistocene to the Middle Holocene in the Iberian Peninsula. This database -*Cronología de la Prehistoria de la Península Ibérica*- is accessible by invitation upon request at the following email a.alday@ehu.eus, and a .csv file is delivered to the researcher.

This database features 3,000 dates and soon will include 500 more. Therefore, it is an information source with an enormous potential and it is the first time it has been made public. A future on line version is being considered, which would allow better data search (by date, sites…). The final objective is the collaborative investigation in Prehistory: tables show the name of the site, sample context, dated material, laboratory reference, chronological estimation and standard deviation, site topology, a bibliographic reference and a notes section which is expected to increase in the future. Other data such as geographical area and/or geographical coordinates are available upon request.

For this article we have chosen *circa* 1,300 dates from the Iberian set. We have selected those with a maximum standard deviation of 100, which spans once calibrated between 16000 and 5500 BP. Dates have been calibrated with the program Oxcal v. 4. 2. 4 (Bronk Ramsey, 2009) following the IntCal13 curve (Reimer et al. 2013). Subsequently, and following the guidelines of Evin et al. (1995), the results have been weighted. Every sample, despite their different chronological range after the calibration, is equally represented. The 425 dates corresponding to the Ebro Basin are detailed specifically in the Appendix A.

The elaboration of the SCDPD curves from N dates is affected among other factors by an issue related to the biases of the archaeological investigation: contexts repetitively dated have a greater influence in the analytics than those dated only once, even though culturally they all have the similar roles. Therefore, previous to the calculus of the summed probability, we have implemented a routine that, in the cases of having repeated dates for the same archaeological context, only considers the most precise date per each moment, calculating and distributing per time bins (chronological sections of the curve) the representation index of each of them.

In order to explain the process, we have selected five dates from the basal level of the Atxoste site (Álava), named VII and h according to the different excavating areas. Dates are sequential and overlap before its calibration between the 11690 and the 11800 BP (table 1).

LABORATORY REFERENCE	DATE BP ±		DATE Cal BP 2 σ	
GrA-23107	11690	80	13366	13730
GrA-19870	11730	90	13403	13756
GrA-22865	11720	70	13429	13730
GrA-22866	11760	70	13457	13741
GrA-22900	11800	60	13481	13750

Table 1. Basic data from the 5 dates of Atxoste (VII/h level) selected as example.

Table 2 shows the index for each date after being calibrated, harmonized and distributed in bins of 50 years. We have chosen this range when building the curves of this article looking for the optimal trade off between the resolution quality of each bin (fit of the indexes per bin) and the visibility of the concentration/dispersion of dates per sections, taking into account the 10,500 years period studied and the 210 bins considered. Even though the precision fit increases with smaller bins (sections of 10 years, or even 1) -eliminating the residual tails in the plots-, with such small bins the dates concentration in the resulting curves become blurred, and the pattern is more difficult to interpret.

In table 2 we can see that the sum of all indexes per date is 1 (meaning that all dates have the same consideration and their indexes coincide with the dating precision). The shaded cells indicate the index selected by the algorithm in each bin: always the highest, therefore the most precise dating. Following this procedure all the dates participate (the researcher does not have to selected among the several dates of a single context), but only one, the most precise, is considered in each time bin. If we compare the optimized and not optimized probability sums we see that the latter, affected by the reiteration of dates in a same bin, can multiply per 4 the true value that corresponds to that section.

LABORATORY REFERENCE	TIME BINS Cal BP									Σ
	13351 13400	13401 13450	13451 13500	13501 13550	13551 13600	13601 13650	13651 13700	13701 13750	13751 13800	
GrA-23107	.125	.125	.125	.125	.125	.125	.125	.125	0	1
GrA-19870	0	.125	.125	.125	.125	.125	.125	.125	.125	1
GrA-22865	0	.142	.142	.142	.142	.142	.142	.142	0	1
GrA-22866	0	0	.166	.166	.166	.166	.166	.166	0	1
GrA-22900	0	0	.166	.166	.166	.166	.166	.166	0	1
Σ Not optimized	.125	.392	.726	.726	.726	.726	.726	.726	.125	-
Σ Optimized	.125	.142	.166	.166	.166	.166	.166	.166	.125	-

Table 2. Representation index of each date per each chronological section of 50 years in the SCDPD curve. The shaded cells indicate the index selected by the algorithm in each bin: always the highest one.

The process is repeated automatically in all the sites / archaeological contexts considered. From now on, the building of the SCDPD follows the procedures developed in other works (i.e. Blaauw, 2010;Michczynski et al., 2007;Surovell and Brantingham, 2007;Timpson et al., 2014; Torfing, 2015...).

REFERENCES

Blaauw, M., 2010. Methods and code for "classical" age-modelling of radiocarbon sequences. Quat. Geochronol. 5, 512–518. doi:10.1016/j.quageo.2010.01.002

Bronk Ramsey, C., 2009. Bayesian Analysis of Radiocarbon Dates. Radiocarbon 51, 337–360. doi:10.2458/azu_js_rc.v51i1.3494

Evin, J., Fortin, P., Oberlin, C., 1995. Calibration et modes de représentation des datations radiocarbones concernant le Néolithique de l'est et du sud-est de la France, in: Voruz, J.L. (Ed.), Chronologies Néolithiques: De 6000 a 2000 Avant Notre Ère Dans Le Bassin Rhodanien. Documents du Département d'Anthropologie et d'Écologie de l'Université de Genève, Ambérieu-en-Bugey, Éditions Société préhistorique rhodanienne, pp. 31–39.

Michczynski, D.J., Michczynski, A., Pazdur, A., 2007. Frequency distribution of radiocarbon dates as a tool for reconstructing environmental changes. Radiocarbon 49, 799–806.

Surovell, T.A., Brantingham, P.J., 2007. A note on the use of temporal frequency distributions in studies of prehistoric demography. J. Archaeol. Sci. 34, 1868–1877. doi:10.1016/j.jas.2007.01.003

Timpson, A., Colledge, S., Crema, E., Edinborough, K., Kerig, T., Manning, K., Thomas, M.G., Shennan, S., 2014. Reconstructing regional population fluctuations in the European Neolithic using radiocarbon dates: A new case-study using an improved method. J. Archaeol. Sci. 52, 549–557. doi:10.1016/j.jas.2014.08.011

Torfing, T., 2015. Neolithic population and summed probability distribution of 14C-dates. J. Archaeol. Sci. 63, 193–198. doi:10.1016/j.jas.2015.06.004.