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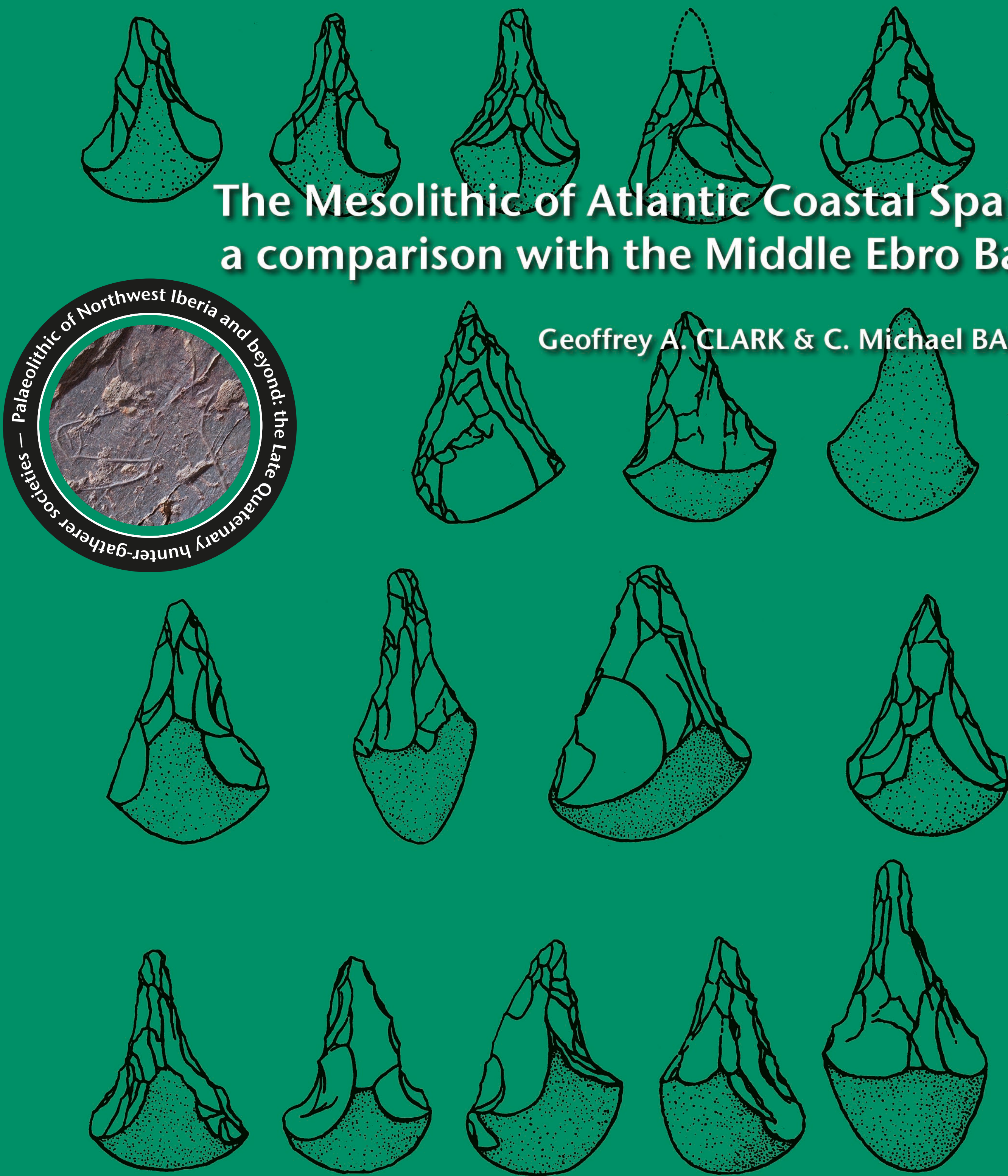

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Geoffrey A. CLARK & C. Michael BARTON

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The Mesolithic of Atlantic Coastal Spain – a comparison with the Middle Ebro Basin

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ABSTRACT
This paper compares current evidence for Mesolithic adaptations along the north Spanish coast from Galicia in the west to the Basque Country in the east. Significant questions and issues pertinent to Mesolithic research are reviewed, followed by a brief discussion of advances in method and theory over the past 25 years. Cantabria, País Vasco, and Galicia are compared with each other and *en bloc* with evidence from the middle Ebro over the 12-6 ka BP interval considered to bracket the transition between foraging and domestication economies. Marked differences in the time-space grid, geology, and the resolution of the data hinder these comparisons. A radiocarbon database totaling 610 dates is compiled, cleaned, filtered and analyzed for each region individually using summed calibrated date probability distribution (SPD) curves as a proxy for population density fluctuations over time. Regional curves are then compared with each other and with a global model.

KEY WORDS
Spain,
Mesolithic,
Atlantic *façade*,
paleodemography,
mobility,
SPD analysis.

RÉSUMÉ
Le Mésolithique de l'Espagne atlantique côtière – une comparaison avec le bassin moyen de l'Èbre.
Cet article compare les données actuelles d'adaptations mésolithiques le long de la côte nord de l'Espagne, depuis la Galice à l'ouest au Pays Basque à l'est. Les questions importantes et les problèmes liés à la recherche mésolithique sont passés en revue, suivis d'une brève discussion sur les progrès de la méthodologie et de la théorie au cours des 25 dernières années. La Cantabrie, les Asturies, le Pays basque et la Galice sont comparés entre eux, puis avec le registre provenant du bassin moyen de l'Èbre au cours de l'intervalle entre 12 à 6 ka BP, ce qui encadre la transition

entre l'économie de la chasse et la cueillette et celle de l'exploitation des plantes et des animaux domestiques. Des différences marquées dans la grille espace-temps, dans la géologie et le niveau de résolution des données entravent ces comparaisons. Une base de données de 610 datations radiocarbone est compilée, nettoyée, filtrée et analysée pour chaque région individuellement, à l'aide de courbes de distribution de probabilité de dates calibrées additionnées (SPD) en tant qu'indicateurs indirects des fluctuations de la densité de population humaine dans le temps. Les courbes régionales sont ensuite comparées entre elles ainsi qu'avec un modèle global.

MOTS CLÉS
Espagne,
Mésolithique,
façade atlantique,
paléodémographie,
mobilité,
analyse SPD.

INTRODUCTION

The Mesolithic is a concept that has a long history in archaeological research. Populated by the last hunting and gathering societies, it usually refers to the time period between the end of the Upper Paleolithic and the first appearance of plant and animal domesticates in the Neolithic. In northern Spain that interval dates from about 10.4-7.2 ka cal BP (Straus 2018a). Over much of the last century, the Mesolithic was considered the poor stepchild of the Paleolithic, a period of economic, technological, and cultural stagnation – even "devolution" (Childe 1925) – with small bands of impoverished foragers using primitive tools to eke out a living by collecting shellfish and other high-cost, low-yield resources. This was interposed in time between the glories of the late Upper Paleolithic with its spectacular cave art, robust subsistence economies, and hints of social complexity, and the Neolithic, taken as the most significant economic transformation in the human career, and the foundation for all subsequent social evolution (Clark 2009). By the late 1990s, the long accumulation of primary evidence, coupled with the rise of palaeoecological perspectives, had wrought a transformation of the conceptual framework of Mesolithic research so that the current view of the Mesolithic is one of social dynamism and innovation, radical social change, and – in some contexts – emergent social complexity rivaling that of the early Neolithic.

This article consists of five parts. First, we outline four significant questions pertinent to all Mesolithic research – questions that justify studying the Mesolithic as a separate intellectual domain (Clark 2000). Second, we present a brief summary of the methodological and theoretical advances that have taken place in Mesolithic research over the past 25-30 years. These are largely due to generational replacement and also apply to the Paleolithic because the conceptual frameworks, methods, models and often the people involved in the research tend to be the same. Third, we outline what we now know about the Mesolithic in Galicia and in historical Cantabria (the principality of Asturias; the autonomous regions of Cantabria and País Vasco) and compare them with the Mesolithic of the Middle Ebro Basin (Fig. 1). Finally, we compile a large radiocarbon database for the region and deploy summed calibrated date probability distribution (SPD) curves as a proxy for population density fluctuations over time. Regional curves are then compared with each other and with a summary curve for all of Atlantic coastal Spain.

We argue that there were broad similarities in pattern throughout western Europe and, despite differences in timing, the specifics of regional ecologies, and in the tempo and history of research, similar processes were taking place over the six millennia between 12 000 and 6000 years ago. Population-resource imbalances appear to drive most of these changes – climatic fluctuations play only a minor role. We suggest that our data fit comfortably within a general model originally developed by Andrew Christenson (1980) and Richard Redding (1988) that describes and explains four sequential stages in the economic transformations with which all foragers faced with population-resource imbalances must contend. Some lead to the transition from foraging to domestication; others do not. Because these stages have material correlates that can often be traced in an archaeological record, they constitute "middle range" theory useful for addressing process questions of central interest in all forager contexts (see papers in Soffer [1987]).

From an archaeological standpoint, the Mesolithic is an arbitrary "slice" of a temporal continuum – it only makes sense when viewed from the Tardiglacial, on the one hand, and the early Postglacial, on the other. The temporal extent of the Mesolithic varies somewhat from one region to another and, across northern Spain, from Catalunya to Galicia. It is interesting to note that those differences are slight, suggesting a broad consensus on the definition of the Mesolithic. Set against the backdrop of climate change, the salient features of the Mesolithic are: 1) vectored changes in the subsistence economy; 2) the common aspects of the lithic technologies; 3) the disappearance of parietal art; 4) the transition to domestication economies; and 5) fluctuations in population density as both causes and consequences of ecosystemic change. This paper focuses on changes in lithic technology, the subsistence economy, the appearance of domesticated plants and animals, and on demographic change as monitored by radiocarbon databases. We do not discuss the comings and goings of the art, suggesting only that the factors that selected for its expression in the LUP were no longer present in the Postglacial (Barton *et al.* 1994; Clark *et al.* 1996). These aspects are compared across Cantabria, País Vasco, and Galicia, and contrasted with those of the middle Ebro Basin. Differences and similarities are assessed, processes identified, and narratives constructed to describe the trajectory of change in each of them. In these exercises, time is regarded as a reference variable used to measure change due to other causes.

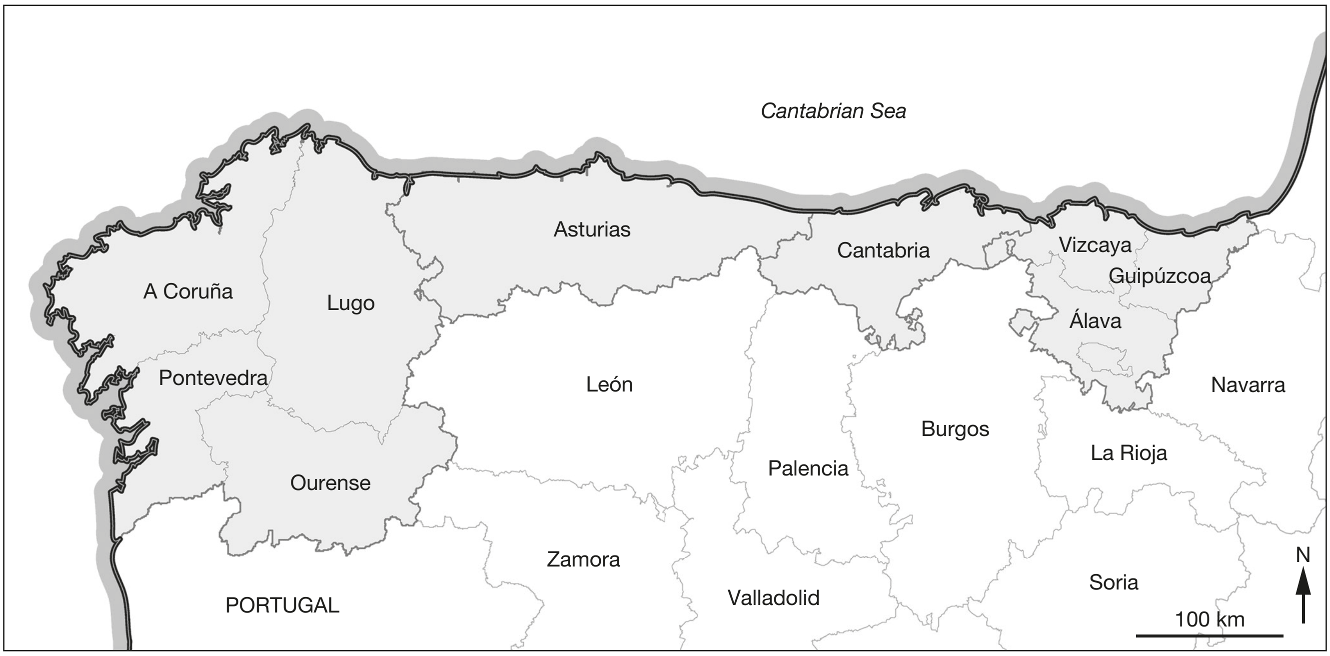

Fig. 1. — The north Spanish Atlantic façade – Galicia (A Coruña, Lugo, Pontevedra, Ourense), Asturias, Cantabria and País Vasco (Vizcaya, Guipúzcoa, Álava; western third of Navarra).

PARADIGM CHANGE AND METHODOLOGICAL INNOVATION

After a period of some 30 years of relative inactivity, the late 1970s saw a significant increase in the tempo of research in Cantabria and Asturias that resulted in a 3- or 4-fold increase in the number of known Mesolithic sites (Fano 2007a). That increase continues up to the present. Many workers adopted a loosely-defined paleoecological conceptual framework that constituted a significant departure from the typological approaches that dominated Mesolithic research in Europe from the 1950s to the 1970s. Multidisciplinary research teams appeared for the first time (e.g. González Echegaray & Freeman 1971, 1973). They included geologists, soil scientists, palynologists, lithic specialists, and faunal analysts who replaced the self-taught amateur archaeologists responsible for most Mesolithic research during the first three-quarters of the last century (e.g. Vega del Sella 1914). Refinements of chronology were important in measuring change, mainly through wider application of ever more sophisticated radiometric dating methods. The practice of identifying identity-conscious social units by the appearance of often rare and supposedly diagnostic archaeological tool types was largely abandoned (Clark & Straus 1983). There was a turning away from culture history in favor of culture ecology (Binford & Sabloff 1982; Clark 1993). Landscape-scale environmental reconstruction made its début. Efforts to link site and resource distributions over time and space led to a better understanding of how subsistence economies were organized (Freeman 1968, 1973, 1981). Horizontal exposures of occupation surfaces allowed for the detection of different kinds of activities within sites (Clark 1975; Straus & Clark 1986). The earliest models for differentiating site types within settlement systems appeared (Clark 1983a). New and powerful methods evolved (Barton 1991, 1998; Riel-Salvatore & Barton 2004; Miller & Barton 2008; Barton *et al.* 2011) and were integrated with novel, more sophisticated conceptual frameworks (Barton & Riel-Salvatore 2014; see Kuhn *et al.* [2016] for a more current appraisal). In Galicia and in the Ebro Basin, surveys became an important component of research designs. Research protocols became increasingly quantified (Clark 1982) and, with the widespread use of personal computers, there was a noticeable increase in the application of statistical methods (see, e.g. papers in Wurzer *et al.* [2015] for archaeological applications).

THE MESOLITHIC IN NORTHERN SPAIN

Except in Galicia, Mesolithic sites are found along most of the north Spanish coast and to some extent inland in Trans-Cordilleran Álava and Vizcaya (Fig. 2). The densest concentration (*c.* 150 sites) consists of the remnants of Asturian shell middens (*concheros*) found in caves and rockshelters over a 40-50 km stretch of the coast between the Río Deva (Asturias) in the east and the Río Sella in the west. Bedrock in the region is a heavily karstified Carboniferous limestone laid down in a shallow sea and later uplifted, folded, fractured, faulted and eroded creating deep N/S trending gorges that transect a narrow coastal plain some 15-45 km wide. Bounded on the north by the Cantabrian Sea (Bay of Biscay) and on the south by the Cantabrian Cordillera, the region is famous for its many painted caves (e.g. Altamira, Tito Bustillo, La Pasiega). Although there are a few exceptions, Mesolithic sites in eastern Asturias and western Cantabria are seldom found inland, whereas sites in the Basque Country exhibit a bimodal distribution. Coastal sites in Vizcaya and

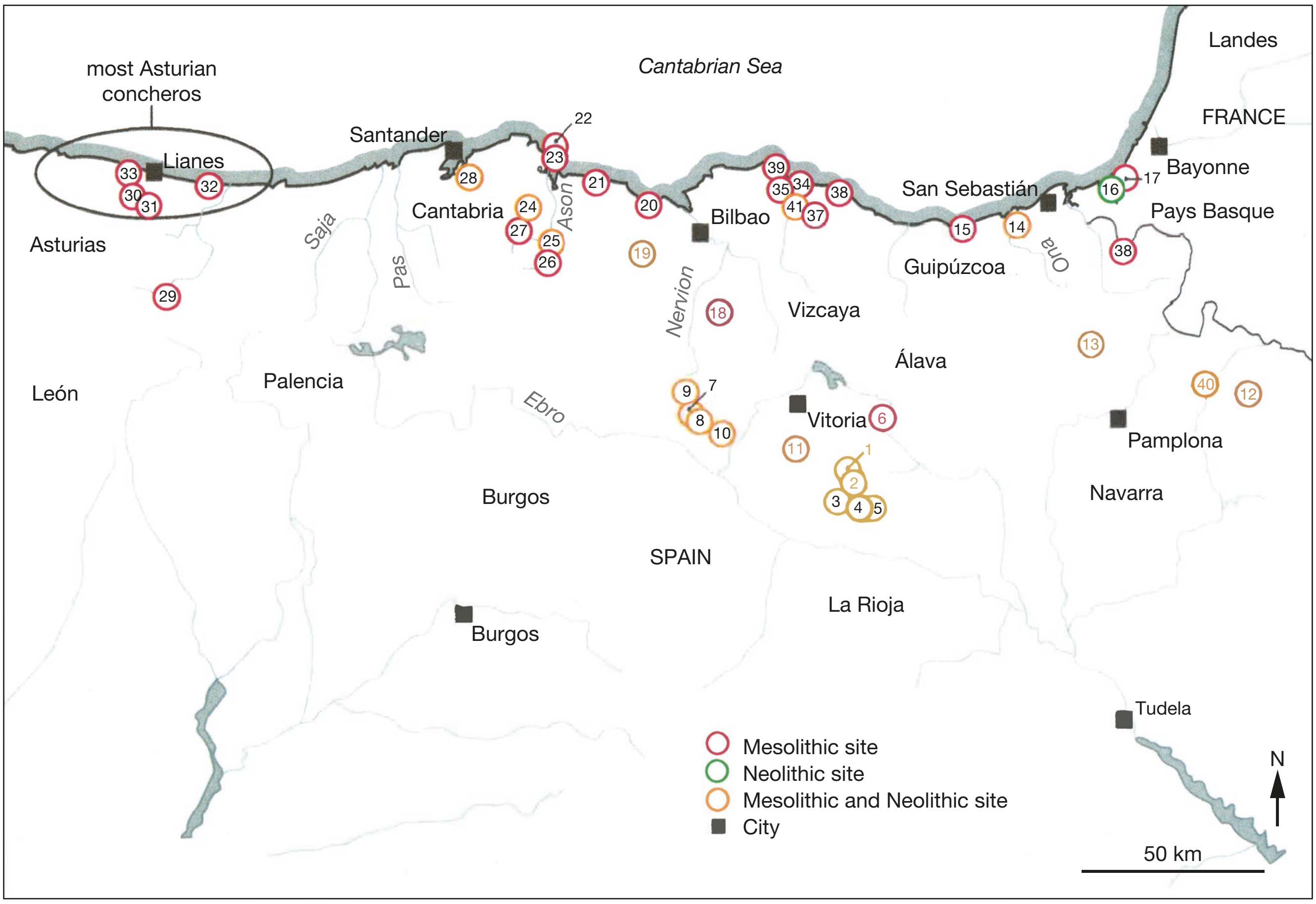

FIG. 2. — Mesolithic and Neolithic sites in Asturias, Cantabria, País Vasco and the Middle Ebro (redrawn from Straus 2008: 303). Sites (numbers): **1**, Atxoste Kanpanoste; **2**, Kanpanoste Goikoa; **3**, Montico de Charratu; **4**, Peña Larga; **5**, La Peña de Marañón; **6**, Kukuma; **7**, Socuevas; **8**, Fuente Hoz; **9**, Berniollo; **10**, La Renke; **11**, Mendandia; **12**, Zatoya; **13**, Abauntz; **14**, Marizulo; **15**, Herriko Barra; **16**, Mouligna; **17**, Moura; **18**, Urratxa; **19**, Arenaza; **20**, Pico Ramos; **21**, La Trecha; **22**, La Fragua; **23**, El Perro; **24**, La Chora; **25**, El Mirón; **26**, Tarrerón and Las Pajucas; **27**, Cubio Redondo; **28**, La Garma; **29**, La Calvera; **30**, Los Canes; **31**, Arangas; **32**, Mazaculos; **33**, La Riera; **34**, Santimamiñe; **35**, Atxeta; **36**, Lumentxa; **37**, Kobeaga; **38**, Berroberría; **39**, Pareko Landa; **40**, Aizpea; **41**, Kobaederra.

Guipúzcoa are few because a NW/SE trending anticline (the North Biscay Anticline) plunges directly into the sea resulting in a near-total absence of a coastal plain. Inland, in Álava, in the relatively flat alluvial valley of the middle Ebro drainage, both Mesolithic and Neolithic occupations occur.

THE MESOLITHIC IN VASCO-CANTABRIA

Although Mesolithic research has a respectable antiquity in all four regions, Cantabria (the principality of Asturias; the regional governments of Cantabria and the Basque Country) has the most "fine-grained" research record and the best chronological controls so it makes sense to start with it here and compare it to the Mesolithic in the Middle Ebro and in Galicia, where research and the time-space grid are not so well developed (see Straus [1986, 1992, 2012] for Cantabria; Díaz-Andreu [2014]; Díaz Andreu & Mora [1995], Díaz Andreu *et al.* [2009] for Catalonia and País Vasco; Aura *et al.* [2011], Fano *et al.* [2015] for the Ebro drainage; Llana Rodríguez [2011], Cano Pan [2012] for Galicia). In Asturias, the Mesolithic *is* the Asturian. While there are non-Asturian *concheros* (i.e., those lacking the diagnostic picks) on the coasts of Vizcaya and Guipúzcoa, there are no contemporaneous inland sites, nor do sites with bladelet-dominated industries occur, as is the case in País Vasco and the middle Ebro drainage (Fig. 3). Why this should be the case is one of the enduring mysteries of the region.

CANTABRIAN CHRONOLOGY

The Cantabrian late Upper Paleolithic and Mesolithic are relatively well-dated radiometrically, although the chronological boundaries between the phytogeographic associations first defined in Danish peat bogs (i.e., Preboreal, Boreal, Atlantic, etc.) and those in northern Spain continue to be debated (see Neulieb *et al.* 2013 for problems with pollen dating). As anyone who has tried to untangle uncal and cal dates will know, this is a source of almost endless frustration. To be consistent, we use the following equivalencies:

Bølling/Allerød:	13.8-12.7 ka cal BP	
Younger Dryas:	12.9-11.6 ka cal BP	
Pre-Boreal:	10.3-9.0 ka uncal BP	11.7-11.0 ka cal BP
Boreal:	9.0-7.5 ka uncal BP	11.0-8.3 ka cal BP
Atlantic:	7.5-5.0 ka uncal BP	8.3-5.8 ka cal BP

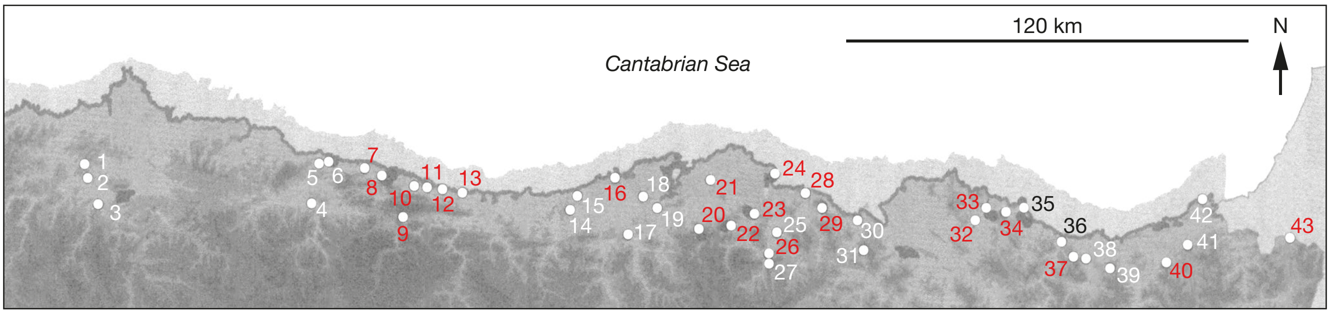

Fig. 3. — Paleolithic, Mesolithic (**red**) and Neolithic sites along the Cantabrian coast with shell deposits (redrawn from Gutiérrez-Zugasti 2009: 62, 364). Sites (numbers): **1**, La Paloma; **2**, Oscura de Ania; **3**, Las Caldas; **4**, Los Azules; **5**, Les Pedroses; **6**, La Lloseta, Tito Bustillo, San Antonio; **7**, El Penicial; **8**, Coberizas, Poza l'egua, Arnero, Bricia, Cueto de la Mina, La Riera, Lledías, Fonfría, Balmori; **9**, Arangas, Los Canes; **10**, Cuartamentero; **11**, La Llana; **12**, Vidiago; **13**, Mazaculos; **14**, El Linar; **15**, Cualventi; **16**, La Pila; **17**, El Castillo; **18**, El Pendo; **19**, Morín; **20**, El Piélago, Rascaño; **21**, La Garma; **22**, Cubío Redondo, Cofresnedo; **23**, El Otero, La Chora; **24**, La Fragua, El Perro; **25**, El Valle; **26**, El Mirón, El Horno; **27**, El Tarrerón; **28**, La Trecha, Arenillas; **29**, El Cráneo, Los Gitanos; **30**, Pico Ramos; **31**, Arenaza; **32**, Atxeta; **33**, Santimamiñe, Antoliña, Kobeaderra; **34**, Kobeaga II, Urtiaga; **35**, Santa Catalina, Lumentxa, Abbitaga, Laminak II, Goikolau, Atxurra; **36**, Ermittia; **37**, Linatzeta; **38**, Ekain; **39**, Erralla; **40**, Marizulo; **41**, Aitzbitarte; **42**, J3 (Txotxipi); **43**, Berroberria.

Table 1. — Age of localities in the north Spanish radiocarbon database for the Mesolithic and Early Neolithic: measures of central tendency and dispersion. Northern Spain by zones – Mesolithic dates (334 dates).

Analytical units	No. dates	Mean ± sd cal BP	Range cal BP	Cal cv	Mean cal BP medians	Mean ± sd uncal BP	Range uncal BP	Uncal cv
Cantabria								
Meso + Neo	168	8055 ± 225	8280-7830	0.029	7973	7223 ± 231	7454-6992	0.030
Meso Only	142	8541 ± 316	8857-8225	0.035	8423	7655 ± 262	7917-7393	0.032
Neo Only	26	5892 ± 99	5591-5793	0.011	5893	5157 ± 71	5228-5086	0.014
Pais Vasco								
Meso + Neo	55	7504 ± 63	7567-7441	0.012	7463	6605 ± 89	6694-6516	0.014
Meso Only	32	8292 ± 93	8305-8199	0.013	8331	7414 ± 90	7504-7324	0.013
Neo Only	23	6497 ± 107	6604-6390	0.016	6495	5688 ± 92	5780-5596	0.017
Middle Ebro								
Meso + Neo	362	7432 ± 60	7492-7372	0.009	7388	6526 ± 58	6584-6468	0.009
Meso Only	150	8077 ± 96	8173-7981	0.030	8281	7412 ± 64	7476-7348	0.029
Neo Only	212	6765 ± 69	6834-6696	0.011	6353	5928 ± 54	5982-5874	0.009
Galicia								
Meso + Neo	25	7439 ± 65	7504-7374	0.011	7394	6533 ± 65	6598-6468	0.010
Meso Only	10	9029 ± 101	9130-8928	0.011	8578	7680 ± 73	7753-7607	0.010
Neo Only	15	6524 ± 76	6600-6448	0.009	6546	5714 ± 58	5772-5656	0.011

We have compiled a database of almost 1000 radiocarbon determinations from north Spanish Upper and Epipaleolithic culture-stratigraphic units identified as such by the original excavators (Clark *et al.* 2019). A subset comprising 610 dates from Mesolithic and early Neolithic contexts in the four study areas is used here (Appendix 1).

The Mesolithic database for Cantabria comprises 142 uncalibrated radiocarbon dates, of which 36 dates from 18 sites pertain to the Asturian. Using a Pleistocene-Holocene boundary date of 11.7 ka cal BP, the Cantabrian sample mean ($\bar{x}$), standard deviation (1σ), coefficient of variation ($cv = \sigma/\bar{x}$) without AAR are 7655 ± 262 uncal ^{14}C years BP (1σ), a range of 7917-7393 uncal years BP, and a coefficient of variation of 0.032 (including AAR: $\bar{x}$ = 7725 ± 270 (1σ), range = 7995-7455, cv = 0.034). The calibrated median date is 8423 BP (Table 1). Regardless of filtering, the uncalibrated dates fall in the second half of the Boreal phase (9.0-7.5 ka uncal BP), whereas the calibrated median falls just before a sharp, very brief cold snap at *c.* 8.2-8.1 ka cal BP (Boreal/Atlantic boundary) that apparently had no discernible effect on Mesolithic adaptations (Straus 2018a). The Asturian thus post-dates the Pleistocene-Holocene boundary by about 3100 years and follows the microlithic Azilian (11.9-10.5 ka cal BP), well documented in caves and rockshelters both inland and along the coast, with an apparent chronological gap of *c.* 1500 years (*pace* Clark [1989, although see below], cf. González Morales *et al.* [1999]; see Gutiérrez-Zugasti [2009: 63-69] for an expanded date list). Based on the uncalibrated means, the corresponding statistics for the early Neolithic (26 dates) and the combined Mesolithic/Neolithic sample (168 dates) indicate that the Cantabrian Neolithic – on average – postdates the Mesolithic by about 2500 years (Table 1).

Cantabrian settlement patterns

We have a pretty good idea of what Asturian settlement patterns looked like – at least those that involved the use of caves – because, by about 6.8 ka cal BP, marine transgression had reached its current level (based on Gutiérrez-Zugasti

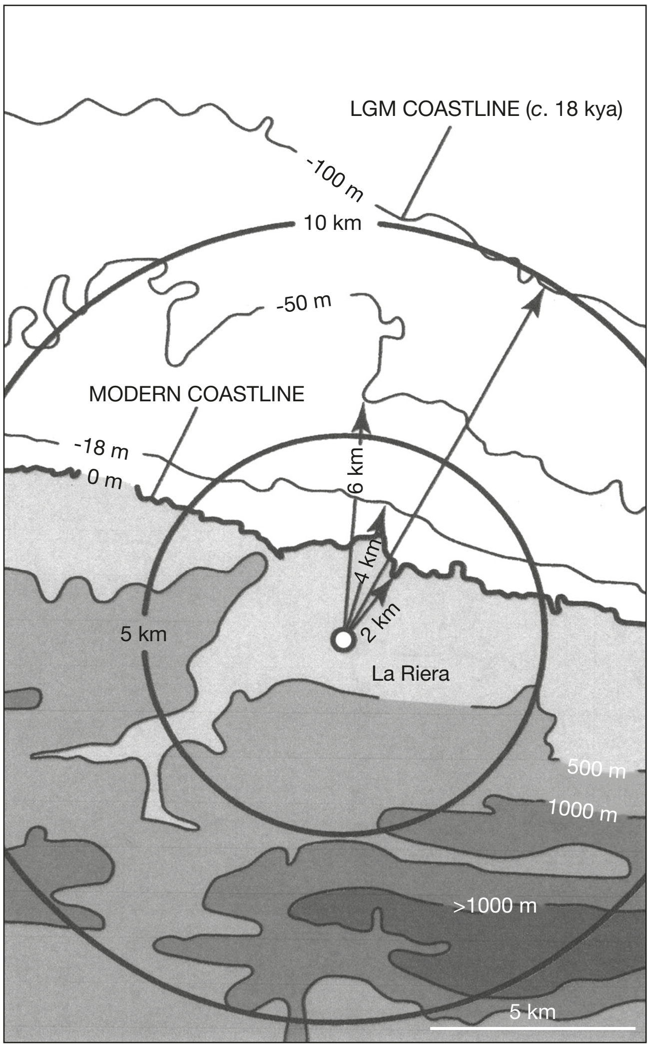

Fig. 4. — La Riera showing simplified topography, bathymetric contours and approximate distance to former coastlines. The –100 m contour approximates the position of the coast at the LGM (*c.* 18 kya) (redrawn from Bailey & Craighead 2004: 191).

[2009: 77-78]). The continental shelf off the coast of northern Spain is generally quite narrow and falls off to depths greater than –100 m within 3-10 km of the modern shoreline. Figure 4 indicates the position of the modern coast, the –100 m contour line, and La Riera cave, within 4 km of a cluster of Asturian shell midden sites near Llanes in eastern Asturias (Bailey & Craighead 2004). This means that, at least in theory, we can recover the entire settlement-subsistence system of these Mesolithic foragers whereas forager adaptations dating to earlier periods are partially lost to us because of rises in sea level. Although it seems reasonable to expect that Asturian foragers would have utilized inland resources, there is no archaeological evidence for it (Arias Cabal & Fano 2003, 2005; Arias Cabal *et al.* 2009b).

Asturian site formation processes

Although mostly unpublished, there are roughly 150 *concheros* now known, concentrated along the eastern coast of Asturias and in western Cantabria (Gutiérrez-Zugasti 2009) – many more than were known than in the early 1970s (Clark 1976) and the early 1980s (González Morales [1982]). Almost without exception they consist of the remnants of once-extensive shell middens preserved as cornices on the walls and ceilings of the caves and rockshelters that are such a prominent feature of the landscape. With little discernible stratigraphy, the *concheros* appear to have been garbage dumps consisting of marine and terrestrial shell, mammal and fish bones, microfauna, sediment; quartzite flakes, cores and large tools (picks, choppers, chopping tools) and, very rarely, human burials. Devoid for the most part of features (hearths, pits), they were associated with open air residential camps constructed of perishable materials (wood, hides, etc.) that have left no archaeological traces. Cueva de Mazaculos, where a small part of a living surface is preserved, is a noteworthy exception (González Morales *et al.* 1980; Marín Arroyo & González Morales 2009). With an exclusively coastal distribution, there are no indications of Asturian use of the piedmont nor of higher elevations in the Cordillera.

The Asturian middens mark the end of a long series of forager use and occupation of coastal Asturias extending back well into the late Pleistocene. The gradual accumulation of shell, bone and other debris eventually filled the entrances to the caves, precluding any further human use. The mountainous interior was only repopulated in the Neolithic, roughly 6000 years ago, when the earliest evidence for megalithic structures appears (Fano *et al.* 2015; Cubas *et al.* 2016). A general model for the formation and destruction of the *concheros* is shown in Figure 5 (Vega del Sella 1923). In many cases, the middens are capped with a stalagmitic crust, indicating an interval between 10-9 ka BP during which karstic processes continued uninterrupted. After about 7500 BP, there was no further use or occupation until the Middle Ages, when most of the caves were emptied of their rich, organic deposits for use as fertilizer (*abono*) and to serve as corrals for sheep and goats.

Asturian lithics and bone tools

What can we say about Mesolithic archaeology, more specifically the stone artifact assemblages? There appear to be two kinds of very different Mesolithic industries in Vasco-Cantabrian Spain. They are the Asturian, a coastal industry found in Asturias and Cantabria and also, arguably, along the coast of Portugal, and industries that resemble those of the late Upper Paleolithic in the Basque Country. The Asturian is a crude industry made almost exclusively on fine-grained metamorphic quartzite cobbles found along the beaches and estuaries in eastern Asturias, and is identified with a particular and distinctive artifact, the unifacial Asturian pick. The function of the picks has been debated for decades and, somewhat implausibly, argued to have been used to detach limpets (*Patella* spp.) from their rocky substrates (Madariaga 1967; Cuenca-Solana *et al.* 2018), an objective more easily accomplished with a toothpick, flake or blade.

The Asturian appears to indicate an abrupt technological break with the preceding Azilian. In contrast, Mesolithic sites in País Vasco, Catalunya and in the Ebro are often dominated by blades, bladelets and Upper Paleolithic tools

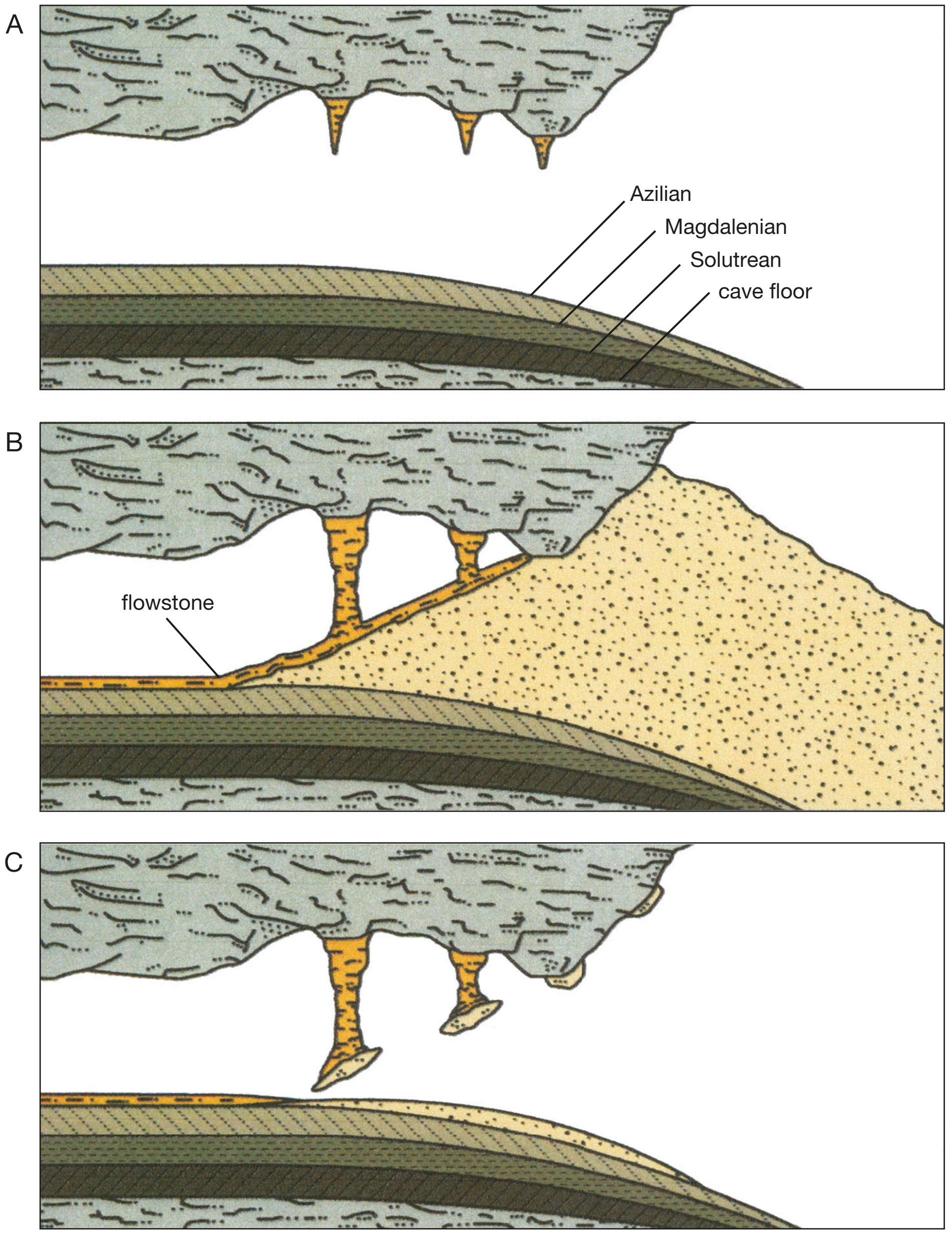

Fig. 5. — Diagram showing the formation and erosion of a typical Asturian *conchero* (based on La Riera, redrawn and modified from Vega del Sella [1923: 8]): **A**, cave at the end of the Upper Paleolithic (Azilian); **B**, bit by bit, the *conchero* fills the entrance to the cave; **C**, erosion takes place and the *conchero* disapears except where cemented to the walls and ceiling of the entrance.

like endscrapers and burins made on flint. They more closely resemble the Epi-Magdalenian Azilian. The difference is striking and might be explained – at least partly – by differences in the kinds of bedrock in the two areas. Metamorphic and igneous rocks dominate the Galician Shield and are exposed along the Cantabrian coast in beaches and estuaries. High quality flint is rare and confined to small pebbles. Sedimentary rocks with good quality flint are more common in the Basque Country and in Catalunya.

Except for the iconic picks, a few heavy duty tools (choppers, chopping tools, both of which could also have doubled as cores), and some steep sidescrapers, the Asturian is a "lithically impoverished" industry, both in general and so far as retouch frequencies are concerned (Fig. 6A, B). The rather uncommon unmodified flakes were almost certainly the primary cutting and scraping tools. A recent wear pattern study of Mesolithic flakes and blades from northern France and Belgium indicates that many were used on vegetal substrates (Guéret 2017). Rich mammal faunas are associated with many Asturian sites, but the bone and antler industry is confined to a few rudimentary points and/or awls, bone fish gorges, and a single perforated antler *bâton.* Wear and damage patterns on shell suggest that Cantabrian coastal foragers occasionally used gastropod and bivalve shells as tools, especially for making objects from plant matter (probably nets, ropes, etc.) (Cuenca-Solana *et al.* 2013). Mussel shell scrapers occur in early Neolithic levels at Santimamiñe, in Vizcaya, and in many ethnographic contexts (Cuenca *et al.* 2010, 2011; see also Gutiérrez-Zugasti 2009).

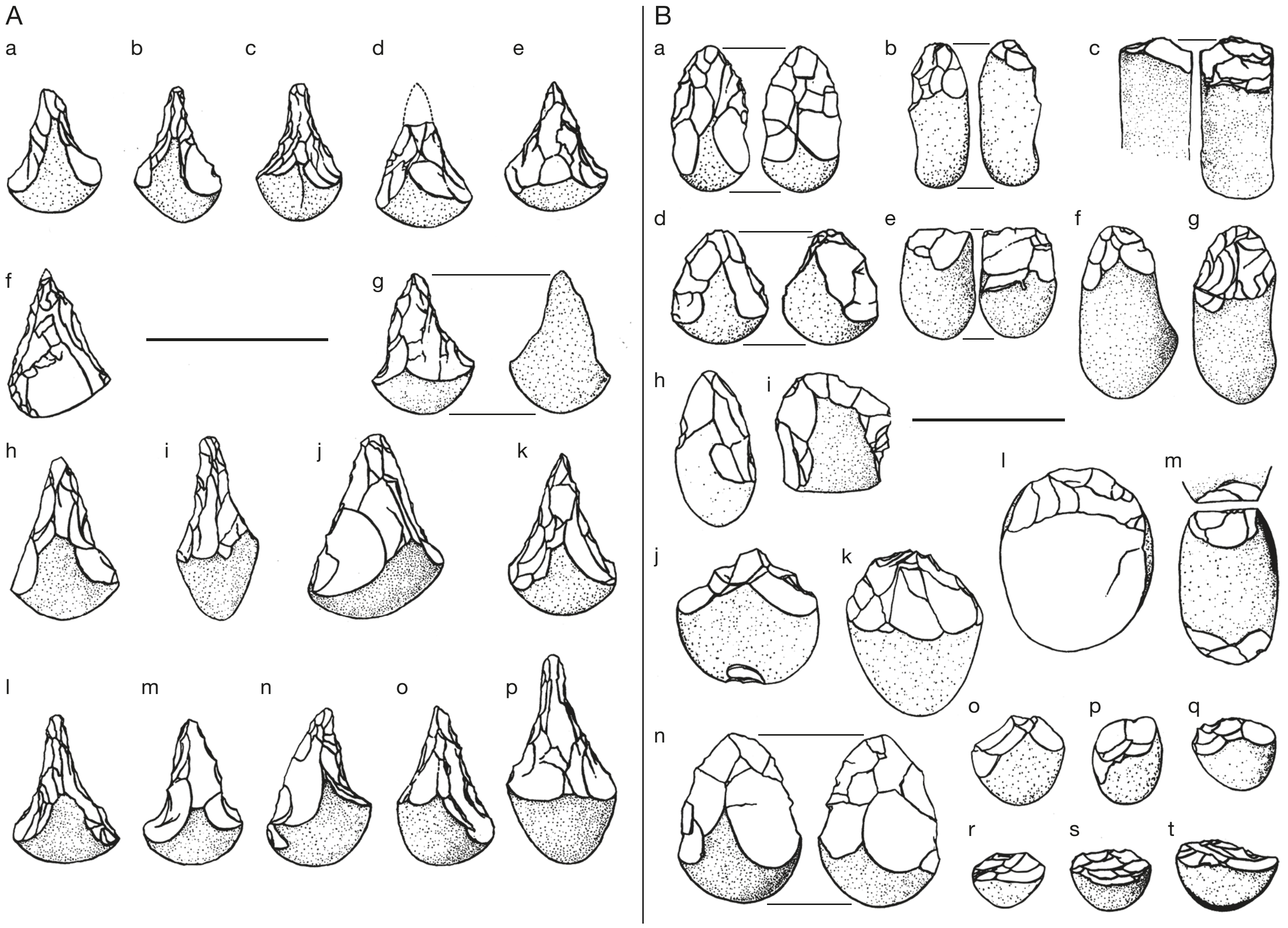

FIG. 6. — **A**, Unifacial quartzite picks, the index type for the Asturian lithic industry (from Clark 1983b: 86): **a**, Amero; **b**, Fonfria; **c**, Colombres; **d**, Cueto de la Mina; **e**, La Loja; **f**, Bricia; **g**, Coberizas; **h**, Balmori; **i**, Penicial; **j**, Liencres; **k**, Lledias; **l**, **m**, La Riera; **n**, Cuartamentero; **o**, Tres Calabres; **p**, Infierno. **B**, Asturian heavy duty tools from Cantabria made on fine to medium grained quartzite cobbles (from Clark 1983b: 90): **a**, **d**, **n**, partial bifaces; **b**, **c**, chopping tools on elongated pebbles; **e**, chopping tool; **f**, **g**, choppers on elongated pebbles; **h**, partial uniface; **i**, chopper; **j**, **k**, large choppers; **l**, large chopper made on a flake; **m**, chopper-chopping tool, battered along the right edge; **o**-**t**, small choppers or steep endscrapers. Scale bars: 10 cm.

Asturian foragers seem to have depended almost exclusively on wooden bows and arrows, bone gorges, and nets and lines for their hunting and fishing technologies. Except at the controversial open site of Liencres (Clark 1975; Papalas *et al.* 2003; cf. González Morales 1982), flint artifacts are very scarce since the raw material itself is of poor quality and occurs only as small, fractured nodules collected from river beds.

LIENCRES REVISITED

Since the mid-1970s, evidence has accumulated that raises some questions about possible relationships among different kinds of Mesolithic adaptations in Cantabria. Guided by a European tendency to juxtapose coastal shell middens and crude quartzite industries, on the one hand, with inland Mesolithic sites and more complex, flint-dominated microlithic assemblages, on the other, patterns of interassemblage variability have usually been explained by recourse to a normative paradigm that equates assemblage differences with distinct and temporally-ordered "cultures." However, some of these Mesolithic industries are apparently contemporaneous and the possibility arises that the Asturian might represent the material remains of one of two broadly-defined, yet distinct, activity sets or structural poses within a single adaptive system (Clark 1976; Straus 1979). In Cantabria itself, however, the Asturian postdates the Azilian by almost 1500 years (González Morales 1992). Is there no evidence, then, for a bladelet-dominated Mesolithic in the region? And is it really likely that the Asturian represents, or could represent, the remains of a complete settlement subsistence system?

Liencres is a small open site located in the Rostrio de Ciriego about 1 km west of the municipal cemetery for Santander, the capital of the autonomous region of Cantabria. The coastline near the site is characterized by cliffs cut into an old marine platform, the top of which is about 13 m above sea level. The platform, of limestone, has been heavily eroded; sinkholes and other karstic phenomena are common. Erosion has stripped away the vegetation surrounding the edges of the sinkholes, creating patches of bare ground leading to deflation. About 75 cm of sandy loam overlie bedrock (Butzer & Bowman 1979). In 1969 and 1972, artifacts eroding out of these sediments were piece-plotted, collected and analyzed (Clark 1975, 1979; Scheitlin & Clark 1978; Papalas *et al.* 2003) (Fig. 7).

To put Liencres in the context of the north Spanish Mesolithic, it is an "Asturian" site because of the characteristic unifacial quartzite picks although, as noted, it is somewhat unusual among Asturian sites by virtue of a large chert flake and bladelet component (Figs 8; 9). This, and an arrowhead typical of the Bronze Age, has led to the suggestion that it is a mixed site and/or that it is "Upper Paleolithic" or "Azilian" (e.g. González Morales 1982: 89, 90 – four Upper Paleolithic scatters were found in the site vicinity [Clark [1975: 10]). *While Liencres is inarguably heterogeneous and polygenic*, small tool group indices that compared Liencres (2 levels) with Azilian (12 levels) and Asturian (24 levels) cave sites indicate greater affinity with the Asturian than with the Azilian group (Clark 1989: 592, 593), but these typological comparisons were based on analyses of selected museum collections from excavations in the 1900-1930 era, published for the first time in the 1970s and 1980s (e.g. Clark 1976, 1983b; Fernández-Tresguerres 1980; Hoyos Gomez *et al.* 1980; González Morales 1982). Even the best Asturian collections are generally poor in small retouched tools, reflecting their function as bulk waste disposal areas or dumps, rather than living sites per se (although living sites were certainly nearby). It is hard to believe, though, that the Asturian, as conventionally defined, represents the entire range of stone artifacts associated with the industry, an idea that lends credence to possible complementarity between crude quartzite heavy duty tools and microlithic, blade dominated assemblages (see, e.g. Clark [1989]; Straus [1992]).

Although no evidence of structures was found, Liencres is situated along the edge of a sinkhole where its inhabitants would have been sheltered from the cold north winds coming off the Cantabrian Sea, only a few meters distant. That the site was occupied on multiple occasions by small groups of people for a short periods of time is indicated by the paucity of features and the relatively thin scatter of lithic debris. Primary manufacture of picks and choppers (including refits), and the production of quantities of chert and quartzite flakes are inferred from the scarcity of retouched pieces and the prevalence of chert and quartzite cores and debitage.

No identifiable faunal remains were recovered at Liencres, but the presence of a grinding slab, microscopic shell and bone fragments, and phosphate concentrations all suggest food processing and consumption, and the accumulation of garbage (Butzer & Bowman 1979: 287-291). Pollen analysis indicates a vegetational configuration similar to that of the present (Clark & Menéndez-Amor 1979: 292-295). The site probably dates to the warm, wet Atlantic phase, when climates like those of today prevailed in the region. Radiometric dates for the Asturian available through the early 1980s range from 9.3-6.5 uncal ka BP (mean of seven dates from five sites is 7817 ± 223 uncal BP (Clark 1989: 590, 591). This agrees astonishingly well with the sample of 36 Asturian dates from 18 sites reported here: $\bar{x}$ = 7813 ± 113 BP (Table 1).

Asturian and Azilian sites compared

An extensive comparison of 58 Asturian and Azilian sites examined chronology, paleoclimatic data, retouched tool and faunal collections, débitage and raw material characteristics;

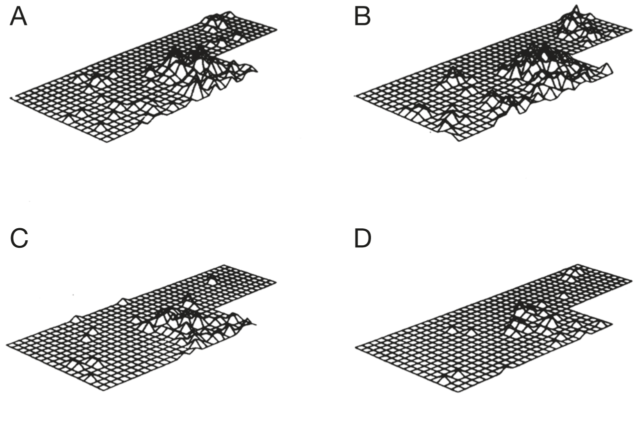

Fig. 7. — Liencres – three-dimensional SURGE 2 flint débitage frequency distribution plots (from Scheitlin & Clark 1978: 11): **A**, all flakes; **B**, primary and secondary decortication flakes; **C**, trimming flakes; **D**, bladelets. Z scale: 0.5.

site sizes, numbers, distributions, and settings (Clark 1989). Evidence was assembled that appeared at the time (the early 1980s) to indicate functional complementarity for the latest Azilian and the earliest Asturian, at least during the millennium (9.5-8.5 ka BP) when they appeared to overlap. However, with the accumulation of more dates over the past 30 years a gap of about 2.0-1.5 millennia has appeared between the two, thus undermining the case for contemporaneity (Appendix 2). That said, given the impossibility of distinguishing between the late Magdalenian and the Azilian in default of their characteristic harpoons, many dates identified by their investigators as "Azilian" could in fact be "Magdalenian" (and vice versa) (Appendix 1). Liencres is so far unique. The widespread dichotomy referred to above has been noted by many workers elsewhere along the coasts of Atlantic Europe. Whatever it might mean behaviorally, surely it must have some empirical credibility. Each assemblage type could pertain to one of two distinct generalized technologies that persisted in Cantabria between *c.* 21 ka BP and *c.* 7 ka BP, cross-cutting all the classic culture-stratigraphic subdivisions found during that time interval (Clark 1989).

Mesolithic mammal and marine faunas

There is good evidence for the kinds of animals exploited by Asturian foragers because fauna are abundant and well-preserved in the *concheros*. By extension from modern dietary preferences, we can also infer a great deal about early Holocene phytogeographic associations (Clark 1976, 1983b). The following observations are typical of the faunas from Cantabria, the Basque Country and Galicia, differing from one another only in detail (Fernández Rodríguez 2011). Although large numbers of rabbit (*Oryctolagus* spp.) and smaller numbers of hare (*Lepus* spp.) occur in some Galician sites (e.g. A Valiña, an EUP site in Lugo) and are ubiquitous in the Ebro Valley, both genera are rare in the archaeofaunas of Vasco-Cantabria. Insectivores (hedgehog, shrews, moles), rodents (squirrel, mice, rats, voles, porcupine), mustelids (weasel, skunk, martens, badger, otter), canids (fox, wolf), felids (wildcat, lynx) and a vast array of bats and birds, round out the smaller mammals.

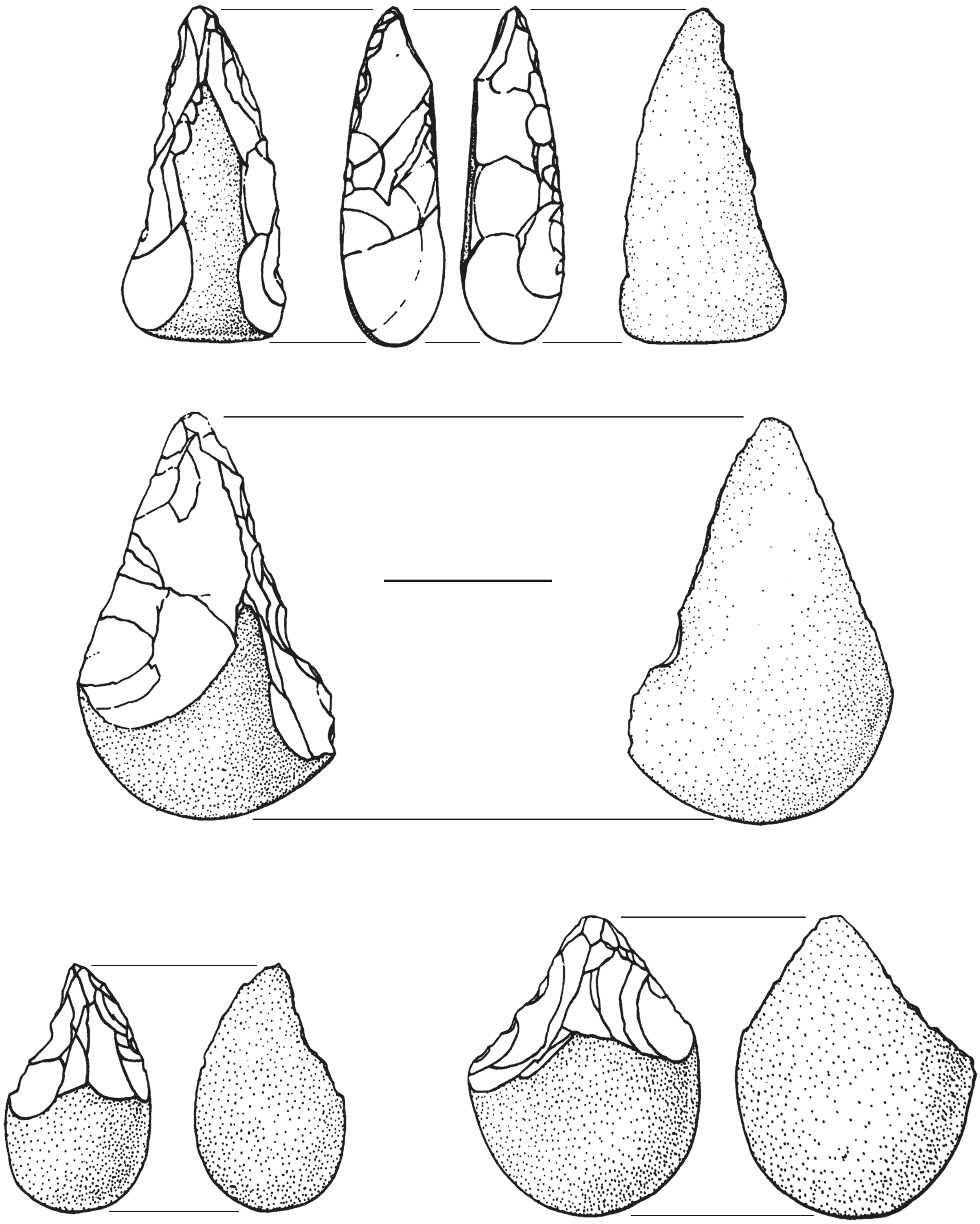

Fig. 8. — Liencres – Asturian picks made on fine-grained quartzite cobbles (from Clark 1983b: 57). Scale bar: 5 cm.

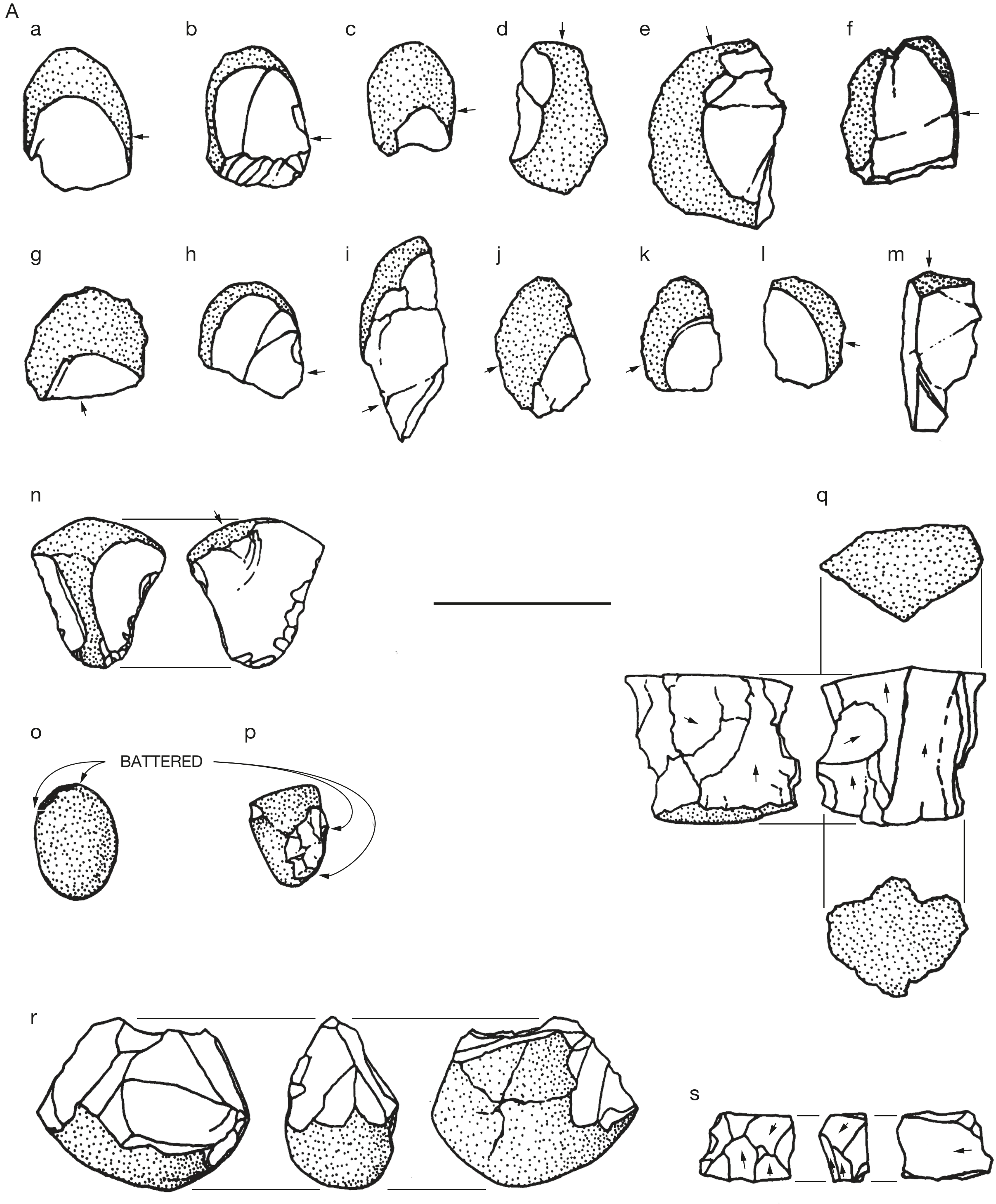

Fig. 9. — **A**, Liencres – quartzite flakes, nuclei and retouched pieces (surface): **a**-**m**, trimming flakes; **n**, sidescraper; **o**, **p**, pebble hammerstones; **q**, **s**, nuclei; **r**, chopping tool (from Clark 1983b: 58). Scale bar: 5 cm.

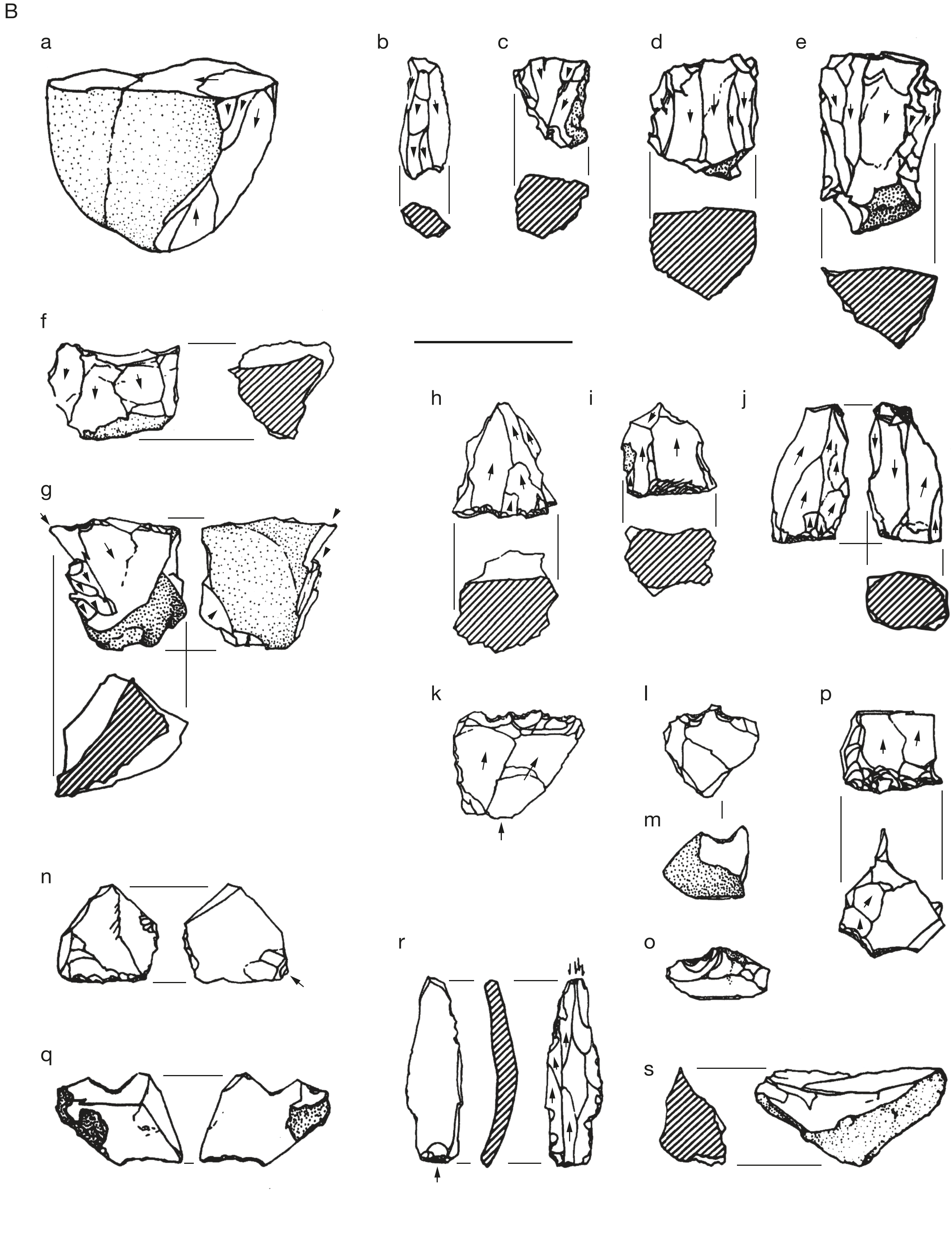

FIG. 9 continuation. — **B**, Liencres – flint and quartzite nuclei and retouched pieces (surface) (from Clark 1983b: 59): **a**, quartzite nucleus; **b**-**f**, flint nuclei; **g**, nucleiform burin or nucleus; **h**-**j**, **p**, nucleiform endscrapers and cores; **k**, denticulate; **l**, bec; **m**, **o**, **q**, notches; **n**, CRP-1; **r**, multiple burin on a blade; **s**, naturally backed knife. Scale bar: 5 cm.

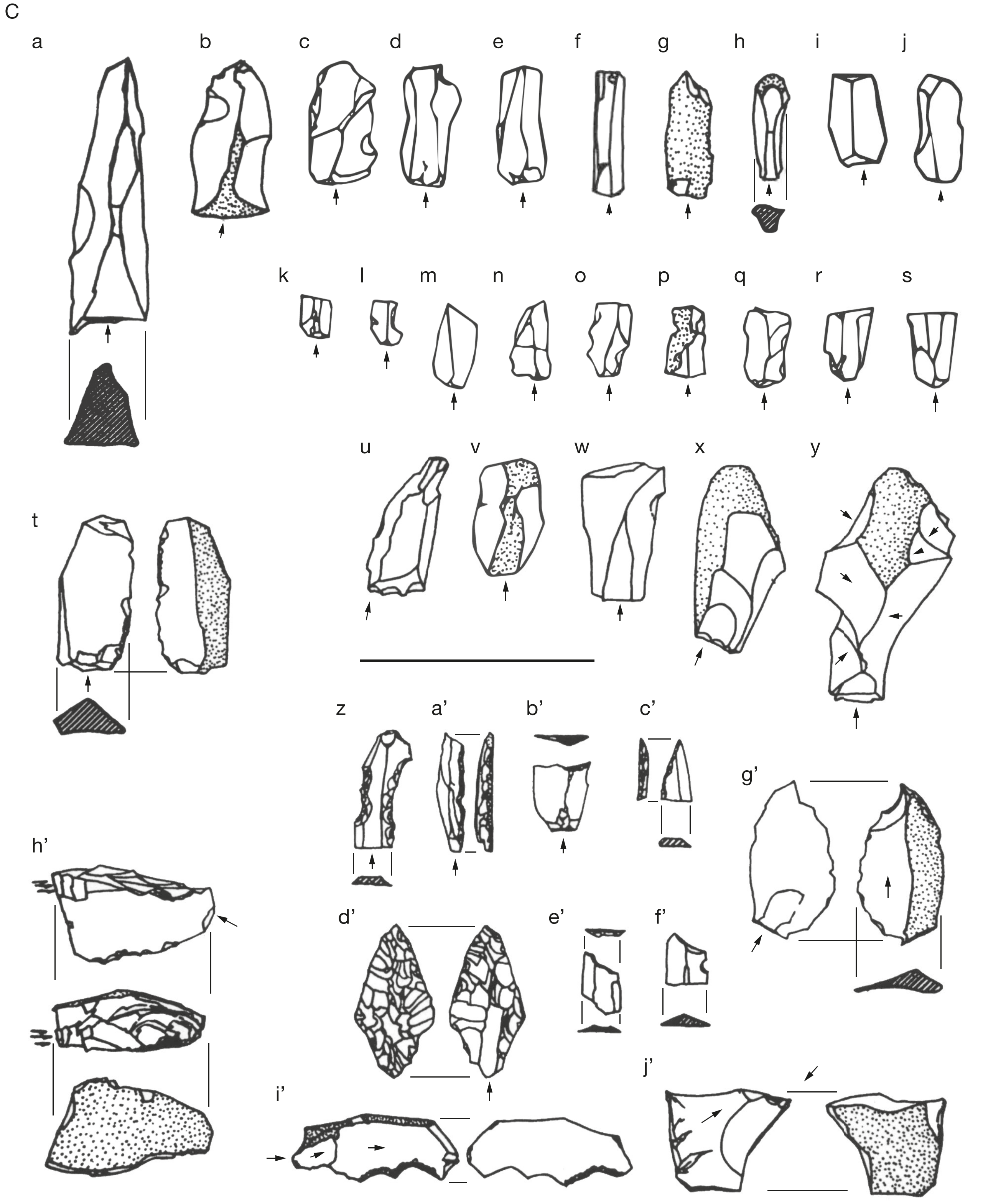

Fig. 9 continuation. — **C**, Liencres – flint blades, bladelets and retouched pieces (surface) (from Clark 1983b: 60): **a**-**s**, blades and bladelets; **t**, CRP-2 with inverse retouch; **u**-**y**, blade-like flakes; **z**, strangled bladelet; **a'**, backed bladelet; **b'**, **e'**, **f'**, truncated bladelets; **c'**, gravette point fragment?; **d'**, Bronze Age (?) bifacial point; **g'**, perforator; **h'**, sidescraper/multiple burin; **i'**, denticulate; **j'**, angle burin on a break. Scale bar: 5 cm.

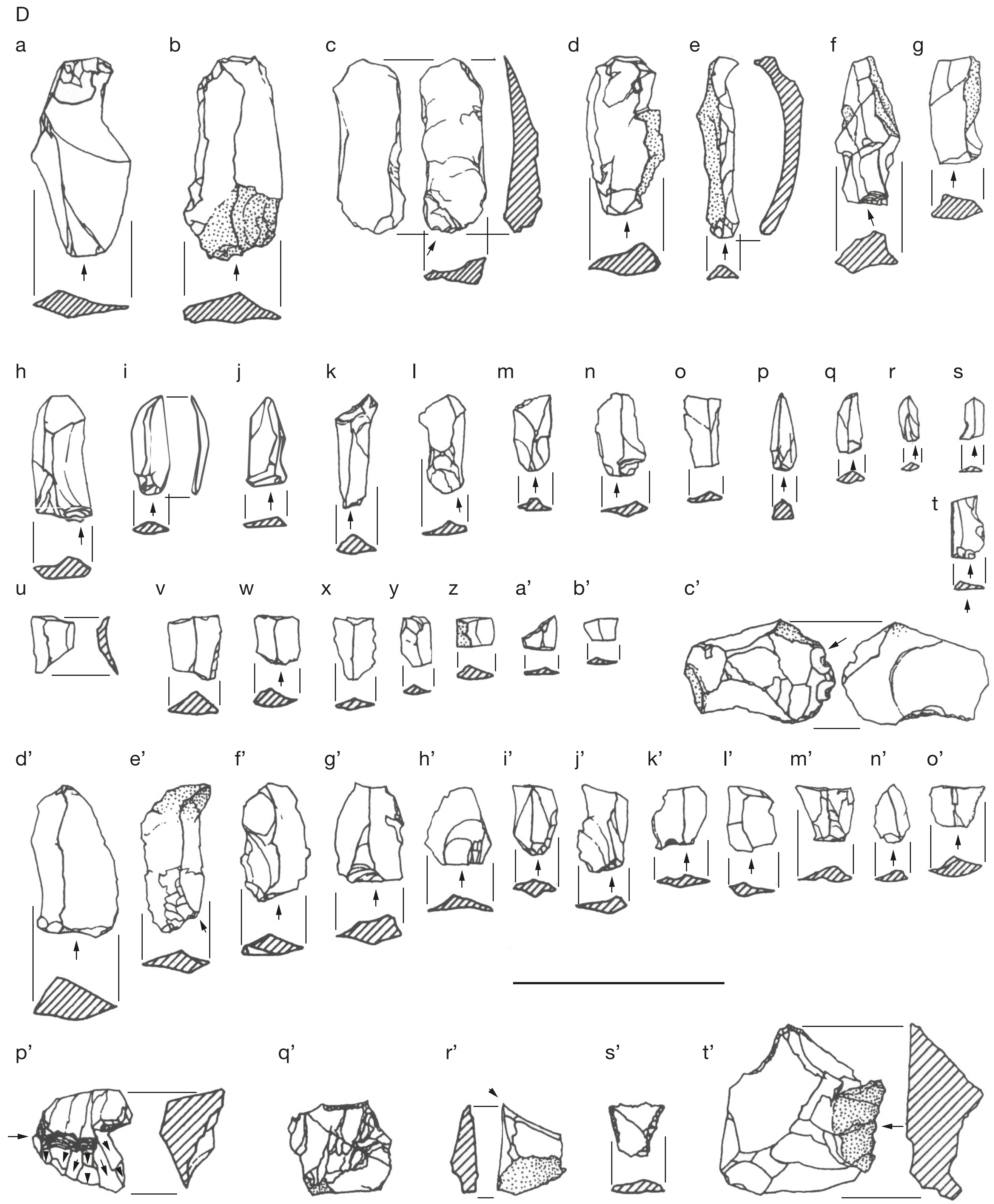

FIG. 9 continuation. — **D**, Liencres – flint blades, bladelets and retouched pieces (level 1) (from Clark 1983b: 78): **a**-**r**, blades and bladelets; **s**, notched bladelet; **t**, Dufour bladelet; **u**-**b’**, bladelet fragments; **c’**, CRP-2 with inverse retouch; **d’**-**o’**, flakes; **p’**, platform renewal flake; **q’**, perforator or bec; **r’**, burin on a break; **s’**, truncated element; **t’**, notch. Scale bar: 5 cm.

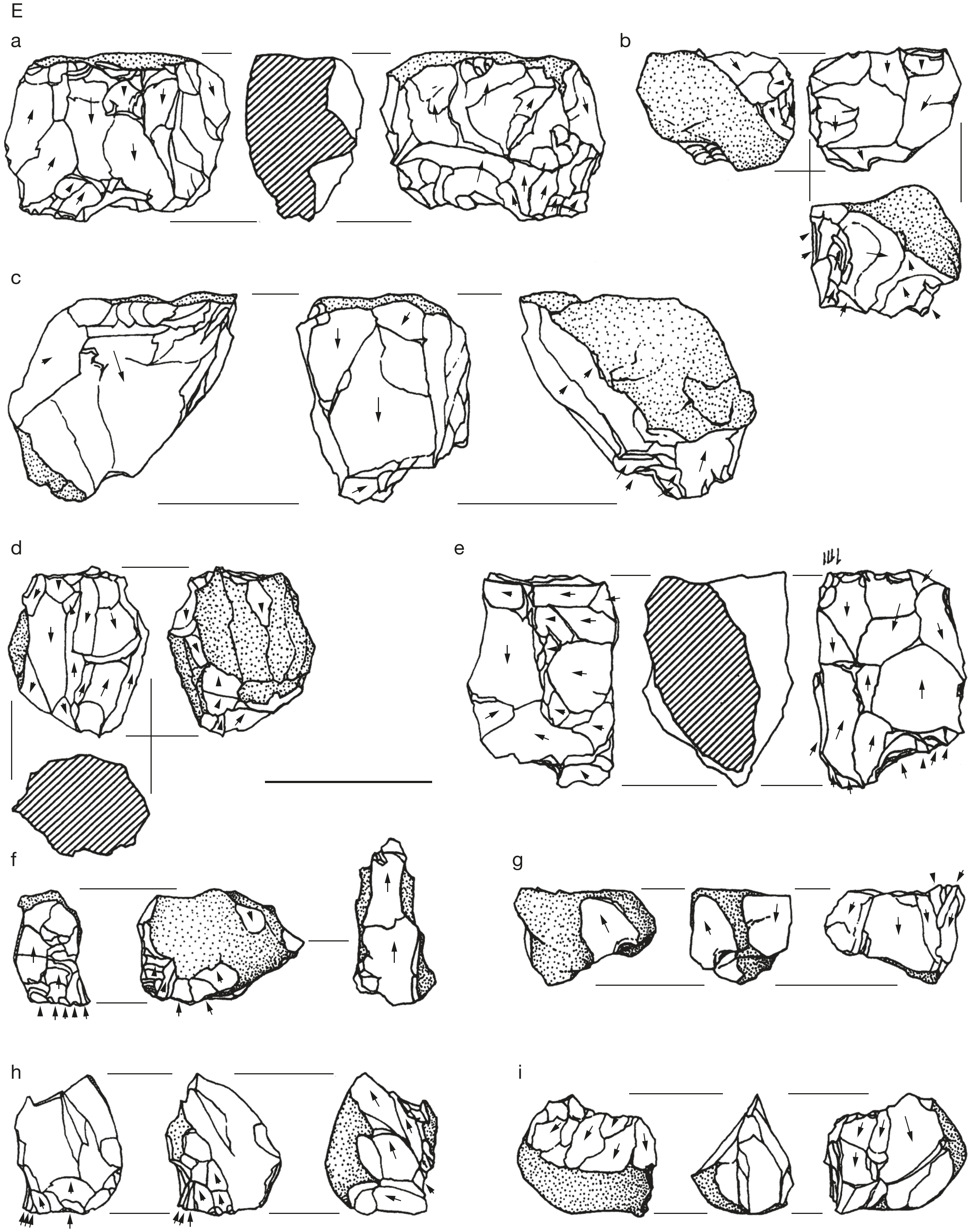

Fig. 9 continuation. — **E**, Liencres – nuclei and nucleiform endscrapers (level 1) (from Clark 1983b: 75): **a**-**e**, **g**, **i**, nuclei; **f**, **h**, nucleiform endscrapers. Scale bar: 5 cm.

Never of economic importance, some were probably hunted for their fur (the cats, some mustelids). Some of the small rodents and insectivores can shed light on the microhabitats in the immediate vicinity of caves and rockshelters. Bats and raptors (hawks, owls) are natural inhabitants of caves.

North Spanish mammal faunas

Red deer (*Cervus elaphus* Linnaeus, 1758) is the dominant dietary staple throughout the Asturian and, despite climate change, throughout the entire Upper Paleolithic. Red deer are found most commonly in open, temperate, mixed deciduous/coniferous woodlands, at low to moderate elevations (0-500 m) in areas with adequate moisture regimes (Darling 1963; Van den Brink 1967: 164, 165; Walker 1968). They occur at lower density in mixed woods where conifers predominate. Because of the maritime climate afforded by the Rennell's Current, a branch of the Gulf Stream, the lowland forests of post-Pleistocene Cantabria have always favored deciduous species.

Although catholic in their tastes, most red deer populations are sylvan browsers; deciduous foliage, twigs, and berries are the mainstays of their diets (e.g. *Populus* spp., *Salix* spp., *Betula* spp., *Alnus* spp., *Quercus* spp.). Conifers are usually spurned. During the fall, mosses and lichens are consumed in quantity. Evergreen gorse (*Ulex* spp.), heather (*Calluna* spp., *Erica* spp.), sedges (*Carex* spp.) and broom (*Genista* spp.), all locally available along the coast, are eaten during the winter months. Grasses (*Agrostis* spp.) and fungi are also consumed occasionally. The species can sometimes be found in open grasslands today (e.g. on the island of Hull [Darling 1963]) and are well-represented in the almost treeless environments of Last Glacial Cantabria. Whether a browser or a grazer, red deer was the key to the Asturian subsistence economy, much as it had been since the LGM about 20 000 years ago. Given the dramatic climate changes of the last glacial (*c.* 120-12.5 ka BP), it might seem strange that this is so but the species is highly adaptable and is found throughout the middle latitudes of Eurasia in a wide variety of environments ever since it first evolved in the Miocene of central Asia nearly 20 million years ago (Clark 1971).

Ibex (*Capra ibex* Linnaeus, 1758) is the other major prey element. For the most part, they are adapted to the steep, rocky terrain of montane regions on barren ground at, or substantially above, the tree line (variable today in the Cantabrian mountains, but usually at about 1600 m). During the winter months, they are driven from these high elevations by adverse weather conditions and by the lack of forage into the open forest transitional zone. These seasonal migrations are a characteristic of the species. Ibex from Asturian sites were probably taken during the winter months when they were most accessible to predation from the coast. There are no highland Asturian sites.

Of secondary important are chamois (*Rupicapra rupicapra* Linnaeus, 1758), roe deer (*Capreolus capreolus* Linnaeus, 1758), and boar (*Sus scrofa* Linnaeus, 1758). Unlike ibex, chamois are more confined to montane woodlands than to open ground; their range extends downslope into deciduous as well as coniferous forest (Morris 1965: 424; Van den Brink 1967: 165, 166). However, they also occur on rocky slopes at elevations above the tree line, especially during the summer months. Heather, sedge, gorse, broom, lichens, and grasses are consumed by both caprids.

Roe deer prefer young deciduous woodlands where dense undergrowth is present, tending to occupy copses near more extensive woodlands. When in fully wooded country, they favor the forest edge. Stands of birch (*Betula vulgaris* (cf. *pendula*) Roth), if present, are preferred over other deciduous species (Corbet 1966: 16). Roe deer are more tolerant than red deer of areas where no surface water is present (Prior 1968: 67), but this is not a factor in northern Spain.

Wild boar are also present, albeit less common, in Asturian faunas. Usually found in the dense vegetation along streams and rivers, they consume various roots, tubers, bulbs, acorns, fruit and beech mast (*Fagus* spp.) but are also carnivorous to a limited extent. Flesh foods include carrion, insect larvae, rodents, young rabbits (*Oryctolagus cuniculus* Linnaeus, 1758), snails (*Helix* spp.) and birds' eggs.

North Spanish marine faunas

Limpets (*Patella vulgata* Linnaeus, 1758, *P. intermedia* (cf. *depressa*) Pennant, 1777; rarely *P. aspera* Ruding, 1798, *P. lusitanica* Gmelin, 1798) and the topshell (*Trochocochlea crassa* (cf. *Monodonta lineata*) da Costa, 1778) make up the second major component in the Asturian diet. Both genera are littoral species, most prevalent in the intertidal zone. *Patella* spp. are found on rocks in tidal pools and on the walls of inlets from the high water mark of neap tides to the low water mark of spring tides. They select for areas well exposed to light, but will not tolerate rocks subjected to too much movement. Due to their extraordinary powers of adhesion, exposure to the direct impact of waves is not an important factor; exposure varies from as high as 90% to as low as 5%. Salinities as low as 3‰ can be withstood, so the species thrives in estuaries (Fretter & Graham 1962: 680). Limpets occasionally colonize other environments (e.g. consolidated sands, sheltered pebbly areas) but always in much lower densities than on fixed rocky surfaces. In Cantabria, they occur almost exclusively on the limestones into which the coastal inlets are cut. Water temperatures vary between 10°C (50°F) and 21°C (70°F). Limpets rarely occur below 5 m in depth, although they may be found high on inlet walls, up to 3 m above the low tide mark (Fretter & Graham 1962: 680; Madariaga 1967: 363, 371). They are exposed twice daily by the action of the tides and can easily be collected in great numbers with a minimal expenditure of energy. However, the average Holocene limpet yields only six calories whereas its Pleistocene predecessor, '*P. sautuola*', can yield up to three times that much. A marked decrease in size beginning in the Magdalenian is probably due to overexploitation (Straus *et al.* 1980; Ortea 1986, but cf. Bailey & Craighead 2004).

The topshell (*Trochocochlea crassa* (cf. *Monodonta lineata*) da Costa, 1778) was a secondary element in the Asturian diet; it occurs in the middens, as it does in nature, in consistently lower frequencies than the limpets. Topshells occupy similar habitats, but never extend so high as *Patella* spp. because they are less able to withstand prolonged periods without water. Exposure to direct wave action varies from 50% to 60% due to a comparative lack of adhesive power. The species will select for sunny areas on horizontal or vertical surfaces; the latter are occupied in lower frequency. Topshells occur sporadically, but when found are often locally abundant (Fretter & Graham 1962: 673).

Absent during the last glacial, the edible mussel (*Mytilus edulis* Linnaeus, 1758, cf. *provincialis*) reappears in the Boreal period and increases in size and frequency during the post-glacial optimum (*c.* 7.5-5.0 ka BP). *Mytilus edulis* is a relatively thermophile species; rapid declines in sea water temperature will destroy the beds. Mussels favor brackish water in estuarine situations but also occur attached to rocks on tidal flats and on stable, pebbly or muddy bottoms (Rogers 1920). The species is not commonly found in Asturian *concheros.* It was extensively exploited after about 5000 BP and remains a popular item in the Spanish diet today.

Studies of the oxygen isotope ratios in the growth rings of limpets and topshells indicate they were collected mainly during the winter months, a pattern first identified at La Riera (Deith & Shackleton 1986) and replicated at a few other sites. Since they must be collected in quantity to make a significant contribution to the diet, shellfish are a relatively high cost, low yield resource, usually considered to provide "insurance" in economies primarily dependent on the exploitation of red deer (British archaeologist Geoff Bailey calculated that 40 000 limpets provided the caloric equivalent of one red deer). Although eaten the year round, they were most intensively gathered when dietary staples like red deer were scarce because of overexploitation or because they were depleted of fat during the late winter months (Speth & Spielmann 1983; Speth 1987). Juvenile deer teeth indicate occupation during the spring and summer months suggesting that the middens probably accumulated year-round (Altuna 1986). In addition to the limpets, the *concheros* contain the bones of four species of salmon (*Salmo* spp.), sea trout (*S. trutta* Linnaeus, 1758), *reo or river trout* (*S. trutta trutta* Linnaeus, 1758); the carapaces of crabs (*Cancer pagurus* Linnaeus, 1758) and sea urchin shell fragments (*Paracentrotus lividus* Lamarck, 1816) (Noval 1976: 399-413). As indicated by pollen and macrobotanical remains, plant foods like roots, berries, hazelnuts and acorns were also heavily utilized as they became available in the woodland environments of the post-Pleistocene.

Late Upper Paleolithic and Mesolithic dietary trends

One other aspect of Asturian faunas is worth mentioning. From the perspective of the late glacial, it now seems clear that the Asturian represents the culmination of a long-term process of dietary intensification and diversification that extended back in time to the late Upper Paleolithic and up to the appearance of the Neolithic and beyond (Clark 1987). Although beset with fluctuations, the evidence for this is the progressive addition of more energetically "costly" species over a period of some 20 000 years (see also Marín Arroyo [2013]).

Why would foragers expend more energy to get fewer calories from the animals they hunted? There is much debate as to the cause for this. Some emphasize climate change and consequent changes in the kinds and frequencies of animals and plants present in the environment (e.g. Bailey & Craighead 2004), while others favor population-resource imbalances created by overexploitation of dietary staples (e.g. Altuna 1986; Ortea 1986; Straus & Clark 1986; Clark 1987). Whatever the case, it is important to acknowledge that the two kinds of explanation are not mutually exclusive although in general the north Spanish Mesolithic data show few significant correlations with climate change.

Absence of inland sites

Because seasonal movement up and down the N/S trending rivers in Asturias is well-documented during the late Upper Paleolithic (e.g. Clark1983a, b; Clark & Straus 1983), the near absence of inland sites contemporary with the Asturian is a curious phenomenon (Arias Cabal *et al.* 2009b). To date, however, there is almost no evidence of a human presence in the Cordilleran foothills and piedmont during the Preboreal (10.3-9.0 ka BP; 11.7-11.0 ka cal BP) and the Boreal periods (9.0-7.5 ka BP; 11.0-9.5 ka cal BP). Except for a very brief cold snap 8200 years ago (the "8.2 ka BP event" – Domínguez-Villar *et al.* 2009), these are all temperate climatic regimes. The south face of the Cordillera also shows very little evidence of Mesolithic habitation. Only six small caves and rockshelters are known (El Espertín, La Mina, La Uña, La Calavera, Los Canes, La Braña-Arintero), two of them burial caves (Los Canes in Asturias, La Braña-Arintero in León) rather than habitation sites (Vidal Encinas & Fuertes Prieto 2008; Neira Campos *et al.* 2016). Some kind of significant behavioral shift clearly took place but just exactly what it was and why it happened is open to question. Several explanations have been proposed to account for it.

Historically, the most plausible one has been that woodlands recolonized the region after the Younger Dryas (12.9-11.6 ka cal BP), perhaps affecting the kinds and quantities of animals hunted, and in consequence the technologies used to hunt them. In the increasingly dense early Holocene woodlands, where edible biomass would have been relatively low and mobility difficult, hunting became a more costly, less productive pursuit when compared to the littoral ecotone. Asturian foragers might simply have congregated in the lowlands along the coast where staple resources (red and roe deer, boar, fish, shellfish) would have been abundant on the interfluves, estuaries, and rivers that transect the coastal plain (Clark 1983a; Clark & Straus 1983). The sheer number of Asturian shell middens lends some credence to this hypothesis. However, with organic technologies, ephemeral structures, casual hearths and little accumulation of trash except for the *concheros* themselves, open air Asturian camps nearby would have left very little to have survived until the present. The near-total lack of systematic surveys in the region has also hindered recognition of surface sites (Snitker *et al.* 2018). Regarding the disappearance of Azilian-like microlithic industries, densification of the forest might have caused changes in hunting practices and the technologies required to deal with them. But this is highly speculative. It lies beyond the current resolution of the archaeological record and is consequently untestable.

A second hypothesis is that of a gradual increase in population density in Asturias and consequent resource stress led to eastward population movement along the Cantabrian coast through the low mountain passes in Cantabria and Vizcaya into the upper and middle Ebro Valley (see below). Given evidence for long-term dietary intensification in Cantabria, a possible cause for this migration could be overexploitation of dietary staples in the Asturian "heartland" by a growing population that eventually exceeded local carrying capacity and made resource exploitation so "expensive" in terms of caloric cost-benefit ratios that it was no longer sustainable. In Vizcaya and Álava there are at least a dozen sites with both Mesolithic and Neolithic levels (Rojo-Guerra *et al.* 2018). Whatever the differences in the lithic industries might mean, it is pretty clear that the Neolithic in northern Spain, as defined by the presence of pottery and/or domesticates, appeared first along the west Mediterranean coast in Catalunya and in the lower Ebro, followed the Ebro up to its headwaters in the Cordillera and, eventually, through the mountain passes to the Cantabrian coast (Fig. 10). In the Basque Country it was pretty much confined to the intermontane valleys of the Cordillera in Álava and Navarra.

Abandonment of Azilian sites

It is interesting to note that nearly all the Upper Paleolithic caves and rockshelters in Asturias and Cantabria located at moderate elevations not far from the sea were abandoned after the Azilian (e.g. El Mirón, El Horno, La Güelga, Los Azules, El Castillo, El Valle, Rascaño, Las Caldas, La Viña, Collubil) (Straus 2008, 2018a, b). The end of the Azilian coincides with the Preboreal-Boreal boundary at *c.* 10.5 cal ka BP and would suggest a region-wide phenomenon of some kind, but one unrelated to the gradual climatic upturn already underway during the latter part of the Preboreal. This contrasts sharply with the situation in the Basque country where there were fully-developed microlithic industries, perhaps indicating an influx of migrants from Mediterranean France by way of Catalunya and the Ebro valley (Arias Cabal 2007; Arias Cabal & Álvarez-Fernández 2004).

The transition to domestication economies

Compared to Mediterranean Spain, the evidence for the "Neolithization" of Vasco-Cantabria is very partial and late (*c.* 6.5 ka cal BP), and occurred along with continued exploitation of Mesolithic prey species (deer, shellfish, nuts) (Altuna 1980; Clark 1987) (Appendix 3). Domesticated animals included sheep (*O. aries* Linnaeus, 1758), goat (*C. hircus* Linnaeus, 1758), cattle (*B. taurus* Linnaeus, 1758) and pig (*S. domesticus* Erxleben, 1777) which appear separately or in various combinations in a number of sites excavated long ago and/or with equivocal dates and provenances (e.g. Arenaza, Marizulo, Los Husos, Herriko Barra, Pico Ramos, Les Pedroses, Arenillas, Los Canes) (Straus 2018a). Although the Neolithic status of these sites continues to be debated, more reliable data from recent work at Kobaederra, near the coast in Vizcaya, and at inland montane El Mirón, in Cantabria, indicate domesticated sheep, goats, pig and cattle, along with pottery, by around 6.1 ka cal BP (Zapata *et al.* 1997; Gutiérrez-Zugasti 2009; Peña-Chocarro *et al.* 2005a; Peña-Chocarro 2012). Of the domesticates, ovicaprines are numerically most common, although secondary in importance to cattle in terms of meat yield, a trend that continues into the Roman Iron Age. Because of similarities in size and morphology, Altuna (1980) once suggested that early Neolithic cattle and pigs might have been domesticated locally from *aurochsen* (*B. primigenius* Bojanus, 1827) and wild boar (*S. scrofa* Linnaeus, 1758), both present in the Mesolithic. This view has been much contested.

Despite screening and flotation, credible morphological evidence for domesticated plants, is extremely rare. A grain of emmer wheat from El Mirón dated to 5550 ± 40 uncal BP (*c.* 6.3 ka cal BP) is currently the earliest directly-dated domesticated plant from the region (Peña-Chocarro *et al.* 2005a, b; Peña-Chocarro 2012). Small numbers of hulled and free-threshing wheats (*Triticum monococcum* Linnaeus, 1758, *T. dicoccum* Schrank, 1781, *T. aestivum/durum* Linnaeus, 1758) and some nuts and fruits (*Corylus avellana* Linnaeus, 1758, *Quercus* sp., *Vitis* sp., etc.) were also recovered. The presence of free-threshing wheat at El Mirón by about 6000 years ago is noteworthy because naked wheats had been absent from the early Neolithic archaeobotanical record of coastal Cantabria. Although not found at El Mirón, barley (*Hordeum vulgare* Linnaeus, 1758) has been reported from early Neolithic contexts at Pico Ramos (*c.* 6.4 ka cal BP), Kobaederra (*c.* 6.1 ka cal BP) and Lumentxa (*c.* 6.0 ka cal BP), all in Vizcaya (Straus 2018b). Herriko Barra, a coastal site in Guipúzcoa, has yielded a trace of unidentified cereal pollen associated with a wild mammal fauna (Mariezkurrena & Altuna 1995) and dated to an unusually early 6.9 ka cal BP (Iriarte-Chiapuso *et al.* 2005). As today, agriculture is more important than pastoralism in the broad floodplain of the Ebro valley than it is in Cantabria where, because of the rugged mountainous terrain, the reverse is true (Clark 1987).

Overview – the Asturian

In sum, functional explanations of assemblage variability that view culture as a complex adaptive system that exists at a level above that of identity-consciousness "writ small" in the form of retouched stone tools appear more tenable to us than those that depend upon variety-minimizing normative typological paradigms (Binford & Sabloff 1982). The overall character of a chipped stone assemblage is determined by a small set of factors, although those factors can be related to one another in complex ways. Among them are rock mechanics (how tool stone fractures), raw material characteristics (kind, quality, "package size" and availability), and the "grain" of an assemblage (its resolution and integrity) (e.g. Andrefsky 1994, 1998, 2009; Shott 1994, 2003, 2010). In the case of chipped stone assemblages, participation in a tool-making tradition and idiosyncratic behavior might have played small roles (this is much debated) but are much more likely to be overridden by the equifinality that is such a characteristic feature of lithic

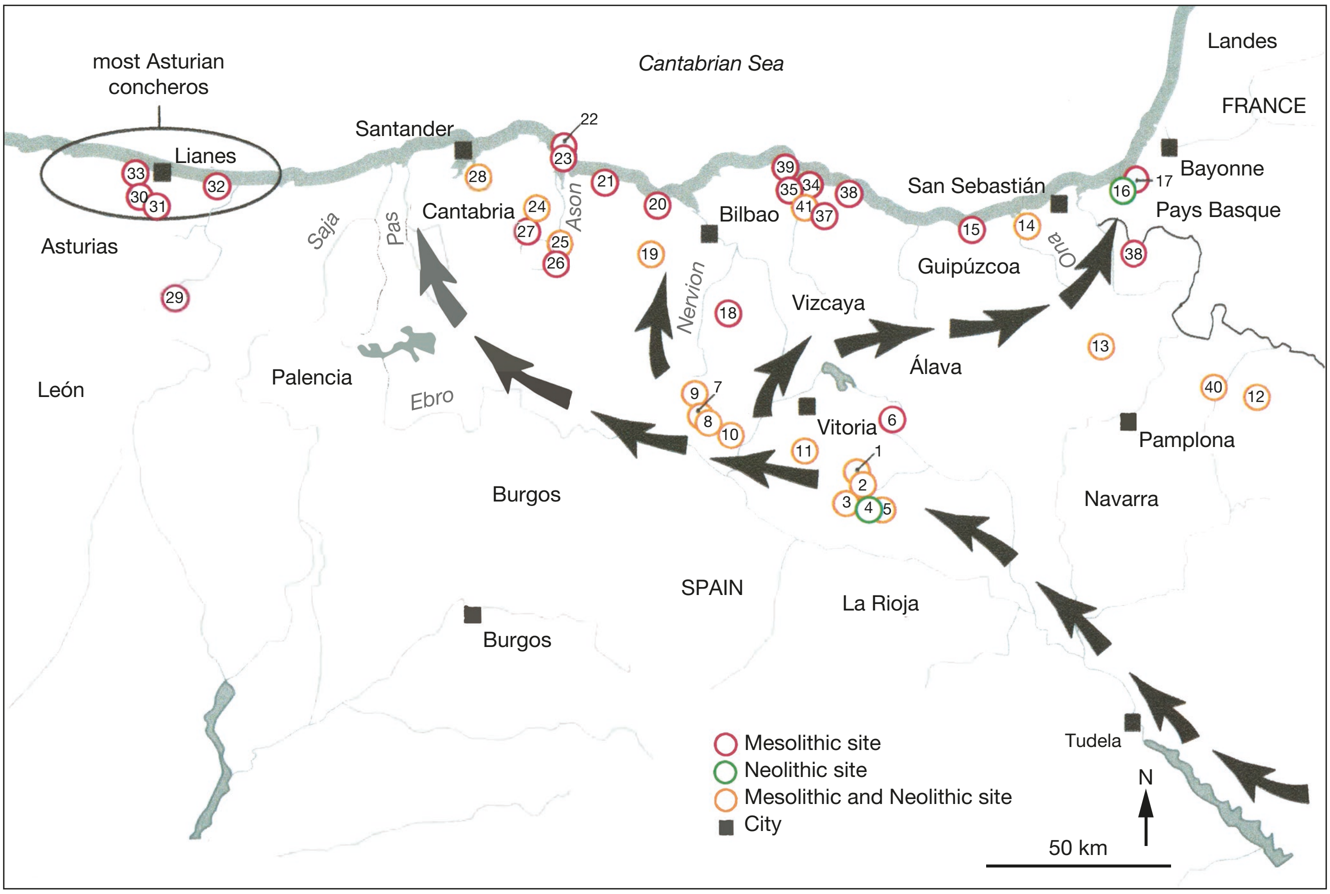

Fig. 10. — Most likely route of domesticated plants and animals originating in the Lower Ebro Valley and in Catalonia (redrawn and modified from Straus 2008: 303). Sites (numbers): **1**, Atxoste Kanpanoste; **2**, Kanpanoste Goikoa; **3**, Montico de Charratu; **4**; Peña Larga; **5**, La Peña de Marañón; **6**, Kukuma; **7**, Socuevas; **8**, Fuente Hoz; **9**, Berniollo; **10**, La Renke; **11**, Mendandia; **12**, Zatoya; **13**, Abauntz; **14**, Marizulo; **15**, Herriko Barra; **16**, Mouligna; **17**, Moura; **18**, Urratxa; **19**, Arenaza; **20**, Pico Ramos; **21**, La Trecha; **22**, La Fragua; **23**, El Perro; **24**, La Chora; **25**, El Mirón; **26**, Tarrerón & Las Pajucas; **27**, Cubio Redondo; **28**, La Garma; **29**, La Calvera; **30**, Los Canes; **31**, Arangas; **32**, Mazaculos; **33**, La Riera; **34**, Santimamiñe; **35**, Atxeta; **36**, Lumentxa; **37**, Kobeaga; **38**, Berroberría; **39**, Pareko Landa; **40**, Aizpea; **41**, Kobaederra.

technology in general (Clark 2001). Variability in raw material package size and quality is likely to be very important (whence the widely recognized dichotomy noted above), as are the general activity suites of which these artifacts were once a part (Freeman 1994; Clark & Riel-Salvatore 2006). Sampling error and a component of random variation (or "noise") in artifact form, frequency, and context can also affect assessments of assemblage differences and similarities. It is the task of the archaeologist to try to untangle these interwoven strands of causality, to partition sources of observed variation across one or more of these commonly recognized causal vectors. If successful, this partitioning can result in the identification of differences amongst assemblages that can more probably be related to one or several factors than to others. Explanations achieved in this way become more tenable with the passage of time, as successive attempts to refute them fail.

The Asturian is, admittedly, something of an enigma. However, there are good reasons for regarding it as only a part of a much wider range of subsistence technologies. As Straus (1979) pointed out long ago, the impoverished industry is so simple and incomplete that it is unlikely to represent the technological *repertoire* of an entire adaptive system. Blades and bladelets do occur in the *concheros*, albeit – except at Liencres – at very low frequencies. It is possible that the same people who were creating the garbage dumps were making, using, losing and discarding blades and bladelets somewhere else. The question is where? The long-standing seasonal transhumance documented throughout most of the Upper Paleolithic seems unlikely to have vanished without a trace with the onset of the Holocene. Keeping in mind the problem of identifying the Azilian in default of the characteristic harpoons, Azilian sites (e.g. Azules, Valle, Mirón) dated to the end of the Bølling oscillation (14.6-14.1 ka BP), persist through the short Dryas II downturn (*c.* 14.0 ka BP), all of Allerød (13.9-12.9 ka BP) and come to an end around 10.6 ka BP. The Azilian thus spans the Pleistocene/Holocene boundary (11.7 ka BP), an event of no apparent behavioral significance. The Asturian (*c.* 9.3-6.5 ka BP) spans the end of the Preboreal (10.3-9.0 ka BP), the Boreal (9.0-7.5 ka BP) period, and may extend into the early Altithermal (7.0-5.0 ka BP). Despite sharp differences in the climate of northern Spain as indicated by microfaunal and pollen diagnostics, and in contrast to the subsistence economies of the Middle and early Upper Paleolithic, there is little evidence for subsistence change over more than 15 millennia from the end of the Gravettian up until the appearance of the Neolithic. Warm or cold, wet or dry, wooded or open, the two basic staples of the regional forager economy – red deer and ibex – remained the same.

Although climate change seems to have had a minimal impact on forager economies, evidence has been accumulating for changes in population density, broadening of the human food niche, and more intensive exploitation of dietary staples. To cite several examples, an inverse relationship exists between the Azilian, when deer and ibex hunting were primary and shellfish gathering secondary, and the Asturian, when exploitation of shellfish (limpets, topshells) increased dramatically (Straus *et al.* 1980, 1981). Overexploitation of the mollusk fishery is also suggested at La Riera by a sharp decrease in the shell sizes of two limpet species in the late Magalenian, a trend that continues through the Mesolithic and beyond (Ortea 1986; Gutiérrez-Zugasti *et al.* 2011a, b). Marín Arroyo (2013) examined the ratio of ungulate to shellfish weights from the Late Magdalenian to the Asturian and showed that, as the former decreased, the latter increased. In short, overexploitation beginning in the late Magdalenian beginning to look like is a general trend driven by increasing population pressure on a limited resource base in the topographically circumscribed Cantabrian coastal strip following an influx of immigrants from Aquitaine during the LGM. Although the *conchero* remnants preserved today contain ample evidence of hunting, how big the shell mounds originally were is impossible to determine so how quantitatively important shellfish were in relation to ungulates is also impossible to determine. Perhaps they were more of a dietary staple than an "insurance resource." It is also interesting to note that "Azilian" painted pebbles have been found at Mazaculos and El Pindal, where no other indications of Azilian occupation have come to light (González Morales 1982: 248).This could mean that, despite the dates, there is more continuity (perhaps complementarity) between the Azilian and the Asturian than has so far been recognized.

THE BASQUE MESOLITHIC

The Basque Mesolithic – chronology

País Vasco can be divided into two regions: 1) the narrow coastal plain in Vizcaya and Guipúzcoa, backed up against the Cordillera Cantábrica; and 2) the interior provinces of Álava and Navarra, a series of E/W trending intermontane valleys, piedmonts and flood plains that make up part of the Río Ebro catchment. The distinction between the inland sites of the Basque provinces and those of the Middle Ebro is an arbitrary one, so that some sites and dates reported here appear in both. Although common in the Middle Ebro, there are relatively few dated Mesolithic sites in coastal Vizcaya and Guipúzcoa. Eleven sites have yielded 55 dates. The sample mean ($\bar{x}$) and standard deviation (1σ) for the coastal Basque sites is 7414 ± 90 uncal BP; *cv* = 0.01. The range is 7504-7324 kya. The corresponding figures for the calibrated dates are $\bar{x}$ = 8292 ± 93 ka, *cv* = 0.013; the range is 8305-8199 kya). The mean of the calibrated medians is 8331 cal BP (Table 1). The uncalibrated dates fall in the early Atlantic pollen phase but are about 300 years younger and much "tighter" (range = 180 years) than those of Cantabria (range = 270 years). The calibrated dates fall on the Boreal/Atlantic boundary (*c.* 8.3-5.8 ka cal BP).

Lithic industries – technology, typology and raw material

So far as lithic industries are concerned, the Basque coastal Mesolithic (Vizcaya, Guipúzcoa) exhibits both similarities and differences with that of Cantabria. On the one hand, rare shell midden sites found along estuaries and inlets in Vizcaya are "non-Asturian" only because they lack the pointed, unifacial picks that define it (e.g. Santimamiñe, Antoliña, Kobaederra). Dated to *c.* 9.3-7.0 ka cal BP, they contain very few, crude lithic artifacts – mostly unretouched flakes; a few cores, denticulates and notches (Gutiérrez-Zugasti 2009). On the other hand, microlithic industries in the Basque interior resemble those in the Ebro Basin, where there is marked technological continuity (i.e., backed bladelets, geometrics, micropoints) from the late Magdalenian through the Mesolithic (Arias Cabal & Fano 2005; Soto *et al.* 2015). Because of the regional lithology in which quartzite is relatively rare, there is a major contrast in raw material types when compared with Asturias. Usable flint tool stone derived from flysch outcrops exposed on cliff faces and valley walls is more common in the Basque country than in Cantabria and Asturias. Nodule size and quality also decrease progressively from east to west where they are replaced by quartzite, limestones and ophite (Straus 2018b). Bone and antler tools are confined to rare awls made from ungulate metapodials, the occasional rudimentary antler "point" and bone fish gorges. Perhaps the most important coastal site is J3 (Txotxipi – Altuna *et al.* 1995), a shell midden in a large rockshelter *c.* 40 m above sea level on Monte Jaizikibel overlooking the Río Bidasoa estuary in eastern Guipúzcoa about 200 m from the modern coast (Iriarte-Chiapusso *et al.* 2005, 2010; Álvarez-Fernández *et al.* 2010). Noteworthy for a rare human burial dated to *c.* 9250 cal BP, its sparse and non-descript lithic industry resembles those of other coastal Mesolithic sites and stands in contrast with those in the interior, typically explained by a dichotomy between hunting and microlithic industries, on the one hand, and marine resource exploitation, requiring only minimal technology, on the other.

In contrast with Cantabria, the Basque Mesolithic is characterized by a bewildering array of classification schemes, and there seems to be little consensus with respect to diagnostics and chronology. In Álava, Alday & Cava (2006) recognize no fewer than eight culture/stratigraphic units that can be roughly divided into: 1) a cohesive macrolithic Notch/Denticulate (N+D) facies; 2) four or five microlithic industries (Sauveterroid Mesolithic, Geometric Mesolithic, Azilian, Aziloid, Laminar Epipaleolithic, indeterminate); and 3) a Sauveterroid/N+D facies with both macro- and microlithic components. On the basis of 52 dates from 14 sites, there is both overlap and some temporal segregation.

The earliest Mesolithic industries in the Basque Country pertain to the Microlithic Mesolithic (MM) and the Sauveterrien (S), an industry first defined in southern France (Valdeyron 1994, 2008). Portugain (12.3 ka cal BP), six dates that cluster around 11.0 ka cal BP (Aizpea, Ekain, Abauntz), and an outlier (Mendandia) at 7.5 ka cal BP make up this group, defined by small backed and truncated blades and bladelets. They lack geometrics and a significant macrolithic component. The N+D industries extend in time from *c.* 10.2-8.3 ka cal BP; the S/N+D dates range from 10.2-9.4 ka cal BP, with an outlier (Pareko Landa) at 7.5 ka cal BP. Both dates fall in the last part of the Boreal (11.0-9.5 ka cal BP). The GM shows a continuous distribution of 21 dates from about 9.1-7.2 ka cal BP, mostly in the Atlantic (*c.* 8.3-5.8 ka cal BP).

Noting that the N+D dates coincide with an episode of dense oak (*Quercus ilex* Linaeus, 1758) and hazel (*Corylus avellana* Linaeus, 1758) forests, Alday & Cava (2006) make the interesting suggestion that the N+D Mesolithic might have been used primarily for woodworking whereas the very different GM reaches its full development during a period marked by a loss of tree cover. Because the raw material is largely flint, edge wear and damage studies could resolve this but, to our knowledge no edge wear studies have been done. The facies are distinguished from one another on a site-by-site basis using index types (e.g. various micropoints, geometrics), type groups, debitage, retouch modes, blank metrics and characteristics, proportional consistency or lack thereof across types and within sequences, and raw material variants. Unlike Cantabria, and in contrast with the coast, there is strong formal continuity in the microlith-dominated facies from the late Magdalenian on to the Neolithic, and an apparent consensus that the ultimate "source" of these facies was in southern France via Catalunya and the Ebro. The overall characteristics of the lithic industries tend to resemble those of the Middle Ebro.

Mesolithic subsistence along the Basque coast

Little can be added to the subsistence economy in regard to coastal Vizcaya and Guipúzcoa; the species commonly exploited are essentially the same as those found in Cantabria and Asturias (indeed, along the entire north coast). Despite much evidence for climate change over the late Pleistocene and early Holocene, the dietary staples throughout the late Paleolithic and Mesolithic do not change much. Red deer are ubiquitous and dominate in most sites, although boar are a significant dietary element in some levels at Kanpanoste (Cava *et al.* 2004) and roe deer at Mendandia (Alday 2006). Roe deer and chamois typically occur in small numbers, along with ibex, auroch (*Bos primigenius* Bojanus, 1827) and scarce remains of horse (*Equus caballus* Linnaeus, 1758). Reindeer (*Rangifer tarandus* Linnaeus, 1758), strongly dominant in Aquitaine and the Dordogne during the late Upper Paleolithic, are rare in LUP sites in northern Spain, always with very low NISP counts, and are entirely absent in Holocene contexts. Small game (rabbit, hare) were not hunted to any great extent.

So far as shellfish exploitation is concerned, the Basque sites resemble their western counterparts both in species composition and relative frequency, and in regard to the intertidal zones and substrates from which they were collected. Basque midden sites are rare compared to those in Asturias, perhaps suggesting lower population densities for the region as a whole. As in Asturias, limpets (*Patella vulgata* Linnaeus, 1758, *P. intermedia* Murray, 1857) and topshells (*Monodonta lineata* da Costa, 1778) are most common. Oysters (*Ostrea edulis* Linnaeus, 1758) are important at Kobaederra (6400-6940 cal BP), Santimamiñe (6970-7130 cal BP) and at Pico Ramos (6860-6490 cal BP), although the latter two sites are both disturbed by late Neolithic occupations (Sarasketa-Gartzia *et al.* 2018). Mussels (*Mytilus galloprovincialis* Lamarck, 1819), a marker of warming seas, are rare in Basque sites, but are common at La Llana, Mazaculos II, and Arenillas, all in Asturias (Álvarez-Fernández 2008). Regardless of location, the economic species (limpets, topshells, oysters, mussels) are collected from rocky substrates either in estuaries (common) or on the open coast (rare). There is no evidence for the consumption of marine molluscs at sites located more than 10 km inland (e.g. El Espertín, Aizpea, Peña 14, El Pontet) and most are found within 3-5 km of the modern coast. About a dozen species of small gastropods (e.g. *Nassaria lapillus* (cf. *Nucella*) Linnaeus, 1758, *Nassarius reticulatus* Linnaeus, 1758, *Littorina obtusata* Linnaeus, 1758) were collected dead from the wave-beaten coast and were used to make beads for pendants, necklaces, bracelets and anklets, an inference supported by their minimal dietary contribution, surface abrasion due to wave action, and the frequent perforation of the apex (Álvarez-Fernández 2008). They tend to occur in burial contexts (Gutiérrez-Zugasti 2009).

Overview – the Basque coastal Mesolithic

It is difficult to escape the impression that, just as Liencres could be argued to complement the Cantabrian Asturian, the flake industry at J3 and the N+D sites in the interior could complement the microlithic assemblages in Álava and in the middle Ebro drainage. There is a well-documented association between these crude flake assemblages and shell middens although they can also occur inland (e.g. the N+D). That they are rare along the coast is probably due to the topography of Guipúzcoa where the North Biscay Anticline plunges directly into the sea resulting in a near-total absence of a coastal plain. Like the Asturian, the coastal Mesolithic in the Basque provinces appears to represent only part of a regional adaptive system. It is reasonable to expect that foragers were doing a substantial amount of hunting in the Cordillera, but apparently without much use of microlith insets in compound weapons and tools. The missing component could have been replaced by organic technologies, primarily wood, which would have left no archaeological trace. However, bone and antler artifacts are also rare in the coastal sites, perhaps underscoring an emphasis on shellfish gathering, a mode of subsistence that requires little in the way of technology. Based on mid-latitude forager ethnographies (Binford 2001) and, frankly, common sense, the full range of artifacts that one might expect to find in the Mesolithic of mid-latitude Eurosiberia is present in Álava and in the middle Ebro Basin.

Table 2. — Ebro Basin Mesolithic Sites – Alava Sub-sample (extracted from Alday *et al.* 2018: 89).

Period date cal BP	Total sites Ebro Basin	Caves and rockshelters	Open air sites	No. 14C dates	Sites per 100 years	Alava Sub-region (14 sites)	Alava no. 14C dates
Neolithic *c.* 7500-5500	54	41	13	–	2.70	Araico Atxoste Cascajos Husos 1-1 Larrenke N Mendandia Peña Larga San Cristóbal	–
Geometric Mesolithic *c.* 8000-7500	27	26	1	254	2.25	Atxoste Kanpanoste G Martinarri Mendandia Socuevas Urratxa III	45
Denticulate Mesolithic *c.* 10000-8700	17	16	1	55	1.31	Atxoste Kanpanoste Kanpanoste G Martinarri Mendandia	11
Sauveterrian/ Azilian/ Microlaminar *c.* 13500-10000	20	20	0	32	0.57	Atxoste Martinarri Mendandia Portugain Socuevas Urratxa III	11
Late Magdalenian *c.* 15000-13500	20	20	0	38	1.33	Atxoste Martinarri Socuevas	13

THE MESOLITHIC IN THE MIDDLE EBRO BASIN

Chronology

Because of the likelihood of contact between the Basque coastal sites and the large Ebro catchment south of the Cordillera, we also consider some aspects of the latter here, using data from the provinces of Álava and the western part of Navarra. We do not deal with Catalunya, nor the lower reaches of the Ebro. There are more than 600 dated levels in the Ebro Basin extending in time from the late Magdalenian to the early Neolithic, of which 42% are considered Mesolithic. The Mesolithic of the middle Ebro Basin comprises 362 dates from 44 sites (Alday *et al.* 2018). The uncalibrated sample mean ($\bar{x}$) and standard deviation (1σ) are 7412 ± 64; *cv* = 0.03. The range is 7476-7348 BP. For the calibrated dates, the corresponding figures are $\bar{x}$ = 8077 ± 96 ka, *cv* = 0.01; the range is 8173-7981 BP. The cal BP median is 8281. Like the Basque coastal Mesolithic, both the calibrated and uncalibrated series date to the Atlantic/Boreal boundary.

As shown in Table 1, both the uncalibrated and calibrated dates from the Basque and Ebro samples are strikingly similar, and imply a consensus view of the time span considered "Mesolithic", whatever the very different technologies and processes involved in the appearance of domestication economies might mean. This in turn suggests a very rapid appearance of Neolithic indicators, albeit later, more partial and ephemeral along the north coast, marked by the long persistence of mixed economies (Fernández-López & Gómez Puche 2009).

It should be kept in mind that these comparisons are problematic for a number of reasons. One purely mechanical one is that dispersion in the Ebro calibrated sample is sometimes (but not always) expressed in terms of 2σ (95% confidence interval) whereas that of the uncalibrated sample is given in terms of 1σ (67% confidence interval), thus skewing comparison. Other confounding factors are a significant number of undated open sites in the Middle Ebro and over-representation of dates from a few sites, a bias problem with both the Asturian and the Ebro samples – some sites are very well dated, others not. Examples include Lámpara (18 dates) and Revilla (16 dates) in the Ebro series. In the SDPs we compensate for this kind of overrepresentation. Despite these problems, the means of the calibrated medians are very close to one another (both 8.3 ka cal BP). So far as Cantabria is concerned, the uncalibrated mid-range is 7813 uncal BP (*c.* 8.7 ka cal BP), not very different from the Basque and Ebro dates. So, no matter how you slice it, the Mesolithic in northern Spain falls into relatively narrow chronological parameters, albeit with significant differences within them.

Lithic industries

The lithic industries in the Ebro Basin region have been roughly divided into microlithic assemblages made on flints and cherts that broadly resemble the pan-Cantabrian late Magdalenian/Azilian (Rojo-Guerra *et al.* 2018) and crude, flake-dominated macrolithic industries with lots of denticulates, notches and

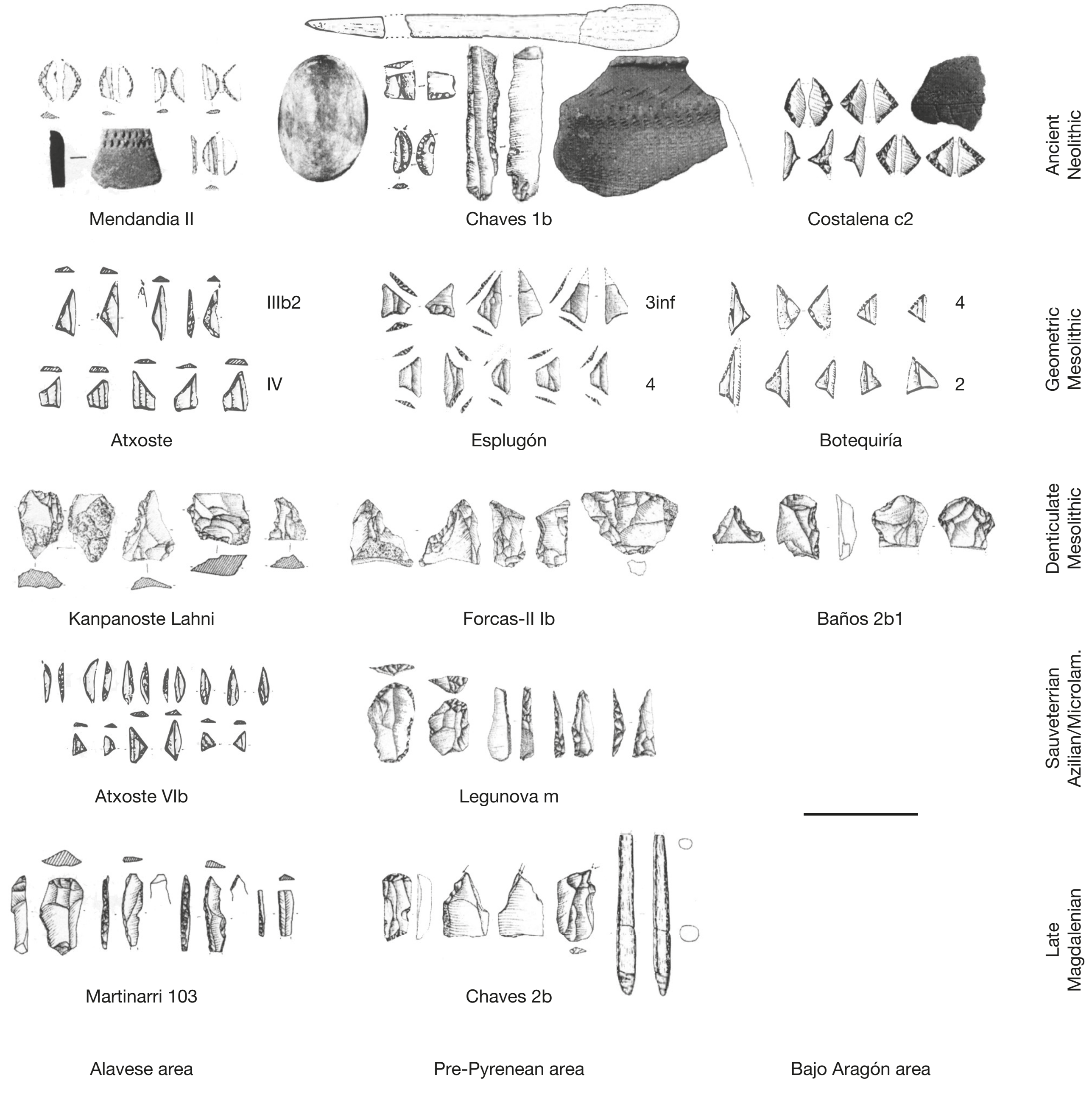

Fig. 11. — Representative archaeological material from three Mesolithic subdivisions (R) and and bracketing assemblages in sites in three pilot areas of the Ebro Basin (from Alday *et al.* 2018: 93). Scale bar: 5 cm.

sidescrapers (Alday *et al.* 2018). In addition to the ubiquitous backed and pointed bladelets, geometrics considered to be the tangible remains of compound weapons (arrows, darts) and tools (sickles, knives) slotted into organic foreshafts and hafts occur in some of these sites (Arias Cabal & Fano 2005; Alday & Cava 2006; Soto *et al.* 2015; Straus 2018a). Similar geometric industries, sometimes called "Sauvetterian" or "Sauveterroid," are also found in Catalonia and Mediterranean France (Plisson *et al.* 2008) but are absent in Asturias and very rare in País Vasco.

In a recent study, Alday and colleagues (2018) erect what appears to be an empirically sound typology comprising three Mesolithic phases bracketed by the late Magdalenian (*c.* 15-13.5 ka cal BP) and the early Neolithic (*c.* 7.5-5.5 ka cal BP), thereby introducing a degree of order in an area where several partly conflicting culture-historical chronological frameworks exist. These phases are the Microlaminar Mesolithic, the Denticulate Mesolithic, and the Geometric Mesolithic (Table 2; Fig. 11). A simplification of the Basque interior typology, a close similarity is obvious since the line between the two regions is essentially an arbitrary one.

The Microlaminar Mesolithic

The Microlaminar Mesolithic (13.5-10.0 ka cal BP) is known from 20 caves and rockshelters represented by 46 radiocarbon dates, with a site frequency index (number of sites/100 years) of 0.57. In very broad terms, the SFI suggests a decline in site frequency from the preceding late Magdalenian (1.33), also represented by 20 sites. The MM shows continuous development from an Epi-Magdalenian base, with some sites containing levels with strong Azilian affinities (e.g. Portugain, Irratxa III – Barandiarán *et al.* 2008), while others "evolve" into industries resembling the Sauvetterian of southern France (e.g. Socuevas, Atxoste VI b-c – Alday *et al.* 2018). Whatever the typological diagnostics might mean (the Azilian lacks geometrics; the Sauveterrian has variable numbers of triangular, trapezoidal and lunate microliths), there is technological continuity and a broad similarity across all the Mesolithic industries in the Middle Ebro over 3.5-4.0 millennia. Both facies span the latter half of GI-1, GS-1, and the Pre-Boreal, and show no correlation with climate change (Rasmussen *et al.* 2014).

The Denticulate Mesolithic

A dramatic technological transformation at the beginning of the Boreal marks the appearance of the Denticulate Mesolithic (10.0-8.7 ky cal BP), known from 17 sites with 55 radiocarbon dates, and with a SFI of 1.31, almost twice that of the preceding MM (0.57), perhaps signaling an increase in population. The Denticulate Mesolithic is a rather non-descript flake industry represented by notches and denticulates made on thick flakes and chunks, and a near-total absence of blades and bladelets (e.g. Kanpanoste Lahni, Forcas-II 1b) (García-Puchol *et al.* 2009; Soto *et al.* 2015). It appears to lack projectile elements, perhaps made in wood, as indicated by a use/wear study on notched pieces (Montes *et al.* 2006). Despite sharp differences in technology, there are no significant changes in raw material types. As the name implies, the DM is virtually identical to the N+D Mesolithic in the Basque interior. It is also somewhat reminiscent of the Asturian because it is so strikingly different from the industries that bracket it and because it appears to be "incomplete", only a part of a broader adaptive system in which bladelets might also have played a role. However, and again like the Asturian, there are no corresponding microlithic industries in the middle Ebro over the 1300 years allotted the DM. Just what might have caused such an extreme departure from the norm is explored below.

The geometric Mesolithic

As the name implies, the Geometric Mesolithic (8.7-7.5 ky cal BC) signals a return to the microlithic technologies that dominate in the Ebro from the Late Magdalenian up until (and into) the early Neolithic. Twenty-seven GM sites have been identified, represented by 254 radiocarbon dates. The SFI is 2.25, an apparent continuation of the trend toward increases in population density. So far as technology is concerned, the GM appears to combine a microlithic component in which triangles (e.g. Atxoste III-b2, Botiquería 4), tapezoids (e.g. Esplugón 4) and truncated bladelets ("points") are common elements, with a flake tool component consisting of notches, denticulates and scrapers reminiscent of the Denticulate Microlithic, a pattern that suggests functional differences within the technocomplex (Straus 2018a). Geometric technologies continue uninterrupted into the early Neolithic, but lunates (e.g. Mendandia II) and triangles (e.g. Costalena c2) replace trapezoids as the dominant forms. There are also sites (e.g. Chaves 1b) with a significant microblade component.

Paleoclimatic change

Much geoscience, faunal and palynological research complements the recent, intensive archaeological work in the Middle Ebro. Pollen, charcoal and microfaunal assemblages define a succession of paleoenvironmental features that correlates with regional paleoclimatic records. There is little change in subsistence throughout the Mesolithic with the major prey element, red deer, exploited well into the Neolithic, even after agropastoral economies were long established. Site function changes only in the Late Neolithic, when caves and rockshelters ceased to be used as living spaces, and began to be used as corrals and burial sites. Environmental fluctuations during the Holocene caused important landscape changes in the area, a very sensitive region due to its semiarid climate, lithology, and continuous human presence. Although severe erosion hinders palaeoenvironmental reconstruction, throughout most of the Mesolithic strong correlations between human adaptation and climate change are not evident. The late Magdalenian and most of the Microlaminar Mesolithic unfold over a long interval from about 16 to 11.7 ka cal BP encompassing the Tardiglacial, the Pleistocene/Holocene boundary, Allerød interstadial [GI-1], the sharply colder Younger Dryas [GS-1], and part of the early Preboreal); the DM is of Preboreal and Boreal age, and the GM dates to the Boreal and earliest Atlantic. The dramatic shift in technology represented by the appearance of the Denticulate Mousterian occurs around 10.2 ka cal BP, in the middle Boreal, but – again – without correlated climate change.

Settlement patterns

As noted above, the radiocarbon chronology in the Ebro is robust and generally replicates the span allotted the Mesolithic in Asturias and Cantabria. Taken at face value, there are effectively no gaps. Demographically, an SPD frequency curve documents shifts in population density. Except for a sharp but brief increase between 15-14 ka cal BP, a warm phase near the end of the Magdalenian, inferred population densities are low and stable until about 10.5 ka cal BP when an irregular trend toward increase is indicated that corresponds approximately to the time span allotted the Denticulate Mesolithic (10.0-8.7 ka cal BP) (Alday *et al.* 2018) (Fig. 12).

While temporal gaps are not apparent, there are some significant gaps in the spatial distributions of the various Mesolithic phases caused by differences in the factors acting on aspects of the landscape in Álava, the Pre-Pyrenean area, and Bajo Aragón. Alday and colleagues (2018) attribute these factors to various combinations of climate and erosion, distilling from them two hypotheses. The first focuses on sampling error (i.e., human occupation was in fact spatially continuous but appears not to be because samples are not representative of the full range of settlement recorded to date) and erosion

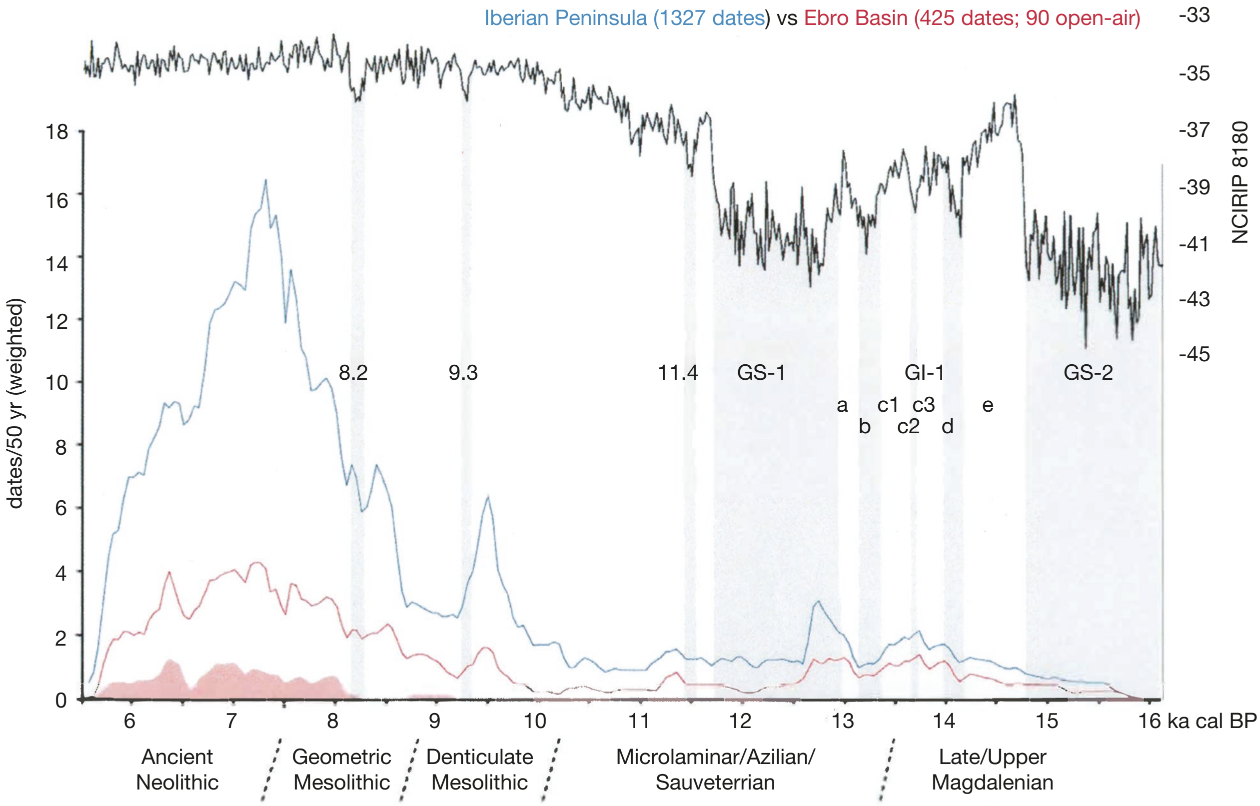

Fig. 12. — Weighted mean dates by 50-year intervals from Iberia and Ebro Basin between 16.0 and 5.5 ka cal BP. Reddish area under Ebro line based on 90 dates from the open-air sites. Note y-axis reversed compared with Figures 18-22 (from Alday *et al.* 2018: 91).

(i.e., differential erosion has created "holes" in the fabric of settlement where none previously existed). The second hypothesis emphasizes climatic factors and socio-economic changes. It proposes that there was no human settlement in parts of the Ebro sub-regions because the climate was too harsh to allow it, and/or an as yet unknown change in the economy forced a change in how humans distributed themselves over the landscape. Erosion is rejected because stratigraphies at several well-dated sites, excavated using modern techniques, evince no hiatuses. Sampling error also seems improbable because of consistency in the stratigraphies found at the 64 cave and rockshelter sites that constitute the Mesolithic sample. Cultural (i.e., behavioral) factors are favored by the authors although just what they were is not clear. Although the gap prior to the Denticulate Mesolithic occurs in all the northeastern Spanish sequences (Montes *et al.* 2006: 213), it does not coincide in time nor with episodes of climate change between regions. The three Mesolithic technocomplexes appear and disappear at around the same time in the different parts of the Basin (Alday *et al.* 2018).

The transition to the Neolithic

In contrast with Vasco-Cantabria, where the early Neolithic is poorly known and dated, defined mostly by the appearance of megalithic monuments (e.g. González Morales *et al.* 2004), there a long history of transition research in the Middle Ebro Basin and much empirical evidence for it (see Rojo-Guerra *et al.* [2018] for a historiography). Moreover, there are two competing models for the process itself: 1) Maritime Pioneer Colonization (Zilhão 2001, 2011); and 2) what is sometimes called the Dual Model (e.g. and Bernabeu Aubán *et al.* 2015, 2016; Fernández-Eraso *et al.* 2015).

Based on a critical analysis of radiocarbon dates clustering around 7400 cal BP, Zilhão (2001) argues that an extremely rapid colonization by "pioneers" originating in France and Italy is best supported empirically, and that agropastoral economies arrived more or less as a "package" including ceramic vessels (Cardial ware), polished stone axes and village dwelling, spread quickly up the Ebro occupying territory largely devoid of foragers and with whom they appear to have had little contact. The Dual Model is more complex and proceeds by stages (e.g. Bernabeu *et al.* 2014, 2016; Fernández-Eraso 2011; Fernández-Eraso *et al.* 2015; Pardo-Gordó *et al.* 2017). It emphasizes initial colonization of prime agropastoral land, only very tentative contacts with thinly-distributed hunter-gatherers and little or no acculturation, followed by a demographic pulse resulting in expansion into territory less well-suited to farming and stock raising, increased contact with foragers as colonists encroach upon their lands, segregation of forager and farming communities, accelerated acculturation and, eventually, abandonment of the hunting and gathering way of life. At present, both views have their advocates and both are supported empirically. The differences turn on whether or not, and/or to what extent acculturation plays a role in the establishment of domestication economies. Paleogenetic data are scarce but what is available points to open communities and frequent genetic exchange, a view that tends to support the Dual Model more than the MPC (one is tempted to remark that people exchange their genes much more readily than their cultures…). To our knowledge, there are no genetic analyses for the Neolithization process itself. The early Neolithic in the Ebro valley seems to be characterized by interactions among colonists and indigenes that would have blurred any "pure" Mesolithic and Neolithic lineages present at the initial stages of the process. That said, the genetic evidence definitely confirms the presence of colonists in the middle Ebro, and interaction between them and indigenous foragers (García-Martínez de Lagrán *et al.* 2018).

Overview

In contrast with Cantabria and the Basque country, and interrupted only by the Denticulate Mesolithic, there is good evidence for technotypological continuity and similarities in adaptation that cross-cut the late Magdalenian (*c.* 16-13.5 ka cal BP) and Dryas I (*c.* 16.9-14.7 ka cal BP), and the Azilian (*c.* 13.7-10.6 ka cal BP), which first occurs near the end of the Bølling oscillation (*c.* 14.8-13.6 ka cal BP), extended throughout the Dryas II cold phase (*c.* 12.9-11.7 ka cal BP), and came to a close at the end of the Allerød (*c.* 11.8-10.8 ka cal BP). The Mesolithic in the Middle Ebro dates to about 10.4-8.3 ka cal BP. It spans most of the Boreal (*c.* 11.0-9.5 ka cal BP), all of the Atlantic (*c.* 9.5-8.3 ka cal BP), ending just prior to the 8.2 ka cal BP cold event (Rohling & Pälike 2005; Thomas *et al.* 2007). There is an apparent gap of about 1500 years between the Mesolithic and the Neolithic (Table 1).

Compared to the coastal Mesolithic, microlith-dominated Mesolithic industries are most prevalent in the Ebro, perhaps underscoring an emphasis on hunting. However, it should be kept in mind that microliths in general were replaceable elements in both compound weapons and tools. Ethnographically, they were used in several different contexts (e.g. reaping cereal grasses, as elements in knives, saws), not just in hunting technology (Clarke 1978). Although there is considerable overlap, the distinctions between the MM and the GM mostly depend on differences in projective point types, thought to indicate a flexible, longstanding series of forager adaptations, one that cross-cuts all manner of climate change and topographic differences. Overall similarities with the bladelet-dominated Azilian in Cantabria are striking, nor are the non-microlithic components very different. Their prevalence in Azilian sites suggests broad similarities in technology with sites in the middle Ebro.

The extreme rarity of geometrics in Cantabria and their presence in the Ebro is interesting because of its implications for raw material differences between the two areas. Cryptocrystalline rock, often of poor quality, occurs only as small cobbles and pebbles in Cantabria, whereas better quality flints and cherts are found in larger "packages" in the Ebro Basin, perhaps allowing for better control over microlith shapes. Different methods of hafting might also have required different insets (backed bladelets in Cantabria, geometrics in the Ebro) in order to accomplish the same ends (Straus 2018a, b). Heat treatment is another variable although, so far as we know, whether or not tool stone was ever heat-treated in north Spain is unknown.

The persistence of these lithic industries across roughly eight millennia and six different phytogeographic associations, in a region where the economic faunas are essentially the same, combine to suggest that any simple relationship between macroclimatic and geographical drivers for changes in adaptation cannot be sustained empirically (Fano 2007a, b; Arias Cabal *et al.* 2007a; Straus 2018a; Clark *et al.* 2019). The principal subsistence difference is the importance of marine resources at Cantabrian coastal sites and (obviously) their complete absence inland. The continental shelf off northern Spain is very narrow and deep, with even LGM shorelines displaced no more than 5-10 km north of the present coast. Where the coastal plain is relatively wide, as in Asturias, vestiges of shell middens are common. Where the coastal plain is non-existent or extremely narrow, as in the Basque Country, shell middens are rare. Sea level transgression during the Atlantic phase (the post-glacial climatic optimum) likely destroyed many open air sites on earlier post-glacial shorelines, leaving only the biased remnants available for study today.

The major anomaly in the continuous development of microlithic technologies is the Denticulate Mesolithic, an industry in several ways analogous to the Asturian. Absent only the Asturian picks, both the DM and the Asturian are flake industries dominated by notches and denticulates with a significant "heavy duty" tool component (choppers, chopping tools) made on cobbles and big flakes, some of which were probably also cores. Like the Asturian, the DM appears "incomplete", only a part of a wider technological system that might also have included laminar technologies. It shows up at roughly the same time throughout the Ebro drainage from the coast to the highlands (Garcia-Puchol *et al.* 2009, 2018). And, like the Asturian, it is preceded by a chronological gap of several millennia. Radical change is apparent suggesting changes in adaptation but correlations with "the usual suspects" (i.e., climate change, changes in resource types and distributions, changes in raw material availability, changes in lithic "traditions", an influx of immigrants, etc.) remain elusive.

THE UPPER PALEOLITHIC AND MESOLITHIC IN GALICIA

In contrast to Vasco-Cantabria, and despite a long history of research, data relevant to the Mesolithic in Galicia are meager. The reason is its shield rock geology. Whereas Cantabria is underlain by Carboniferous substrates (limestones, dolomites, shale) upon which alkaline soils have formed that preserve fauna well, Galicia is dominated by Paleozoic (Lower Cambrian) igneous and metamorphic rock (granite, granodiorite, quartzite, gneiss) with acidic soils inimical to the preservation of organics. Caves and rock shelters are relatively common throughout Cantabria, whereas in Galicia they are confined to a narrow, N/S trending strip in the eastern part of the provinces of Lugo and Ourense constituting a tiny 0.5% of the country. It is in this northeastern corner of Galicia where practically all stratified archaeological and paleontological sites are located (Lombera-Hermida 2011).

A brief history of research

After a period of relative inactivity, the 1980s saw an expansion of interest in the geology, sedimentology, archaeology and paleontology of the region sparked by speleologists and manifest in the formation of transdisciplinary research teams that focused on contexts where Pleistocene sediments were likely to be preserved (e.g. fluvial sequences, hydromorphic soils, road cuts, karstic cavities). The main objective was to describe and date long stratigraphic sequences that could be used to organize in situ archaeological remains, should any be forthcoming. By the 1990s it became apparent that erosion had altered much of the archaeology, making it difficult to link it to the macrostratigraphy. Because of soil acidity, the archaeology consisted almost entirely of stone artifacts. No organic material was preserved, making it difficult to obtain radiometric dates. Consequently, most of what is known about the Stone Age comes mainly from the techno-typology of lithics in open-air sites (e.g. Cano Pan 1997; see Cano Pan [2012] for a historiography of Galician research during the 20th century).

The phytogeography of the karst

From the few data so far available, paleobotanical research in Galicia is consistent with the same succession of phytogeographic communities that characterized northern Spain in general (Fig. 13). The 20 000 years spanning the late glacial to the early Holocene was climatically unstable, marked by fluctuations in temperature, humidity and vegetation. The Tardiglacial (*c.* 15.0-10.0 ka BP) was generally cold and humid initially with heathlands that gradually gave way to slightly warmer, substantially drier conditions and the appearance of grasslands with stands of conifers (pine, juniper) in protected locales, along with a scattering of oaks, birches and other deciduous trees. The Bølling interstadial (14.8-13.6 ka cal BP) saw an expansion of mixed deciduous-coniferous woodlands that continued into the very humid, temperate Allerød (13.6-12.9 ka cal BP), interrupted by an episode of woodland regression during the Younger Dryas (12.9-11.7 ka cal BP), followed by recolonization and densification of mixed deciduous woodlands during the Preboreal and Boreal, culminating in the thickly forested environments of the post-glacial optimum (*c.* 7.25-6.25 ka cal BP), with temperatures *c.* 2-4° C warmer than at present (Ramil Rego *et al.* 2005; Roucoux *et al.* 2005; Vidal Romaní & Sanjurjo-Sánchez 2010; Jalut *et al.* 2010; Pérez Alberti 2011; Naughton *et al.* 2016).

In Galicia, two brief episodes of forest regression reconstructed from pollen may be synchronous with the GH-11.2 ka cal BP and GH-8.2 events (Leira & Santos 2002). At mid-elevations, two woodland expansion phases (7000-6000 cal BP, 4000-2500 cal BP) are separated by a phase of heaths and the formation of peat deposits. The 8.2 ka cal event, a very short cold snap lasting at most a couple centuries (Walker *et al.* 2012), appears to have had little effect on phytogeography, although it roughly coincides with radical technological change between the Azilian and the Asturian in Cantabria (Straus 2018a, b). It should be kept in mind that pollen sequences first defined in Scandinavia and on the north German lowland plain – like a fine wine – don't "travel well" and are strongly influenced by topography. Even during full glacial conditions, both conifers and deciduous species persisted in refugia – the deeply dissected valleys of Cantabria and other protected locales. They almost certainly did so in Galicia as well (Fig. 13).

The archaeopaleontology of the karst

Although there is scant evidence for a human presence, more than 25 caves and rockshelters have yielded paleontological remains (Grandal-d'Anglade & Romaní 1997). More recently, Lombera-Hermida (2011; Lombera-Hermida *et al.* 2014) has identified nine caves in eastern Galicia that also preserve archaeological material, thus allowing for reconstruction of the mammal communities available to Pleistocene and early Holocene foragers. Systematic study is recent but results indicate the same range of prey species known from Asturias (i.e., red and roe deer, chamois, boar, ibex; rarely horses, *aurochsen*; a single mammoth (*Elephas primigenius* Blumenbach, 1799) from a quarry in Lugo). As in Cantabria the paleontological localities are usually monospecific, dominated by cave (*Ursus spelaeus* Rosenmüller, 1794) and brown (*U. arctos* Linnaeus, 1758) bear, occasionally by hyaenas (*Crocuta crocuta spelaea* Goldfuss, 1823). Exceptions are Cova Eirós, Liñares Sur, Valdeabraira and Praducelos which have more diverse faunas (e.g. Grandal-d'Anglade & Romaní 1997). Radiometric dates from these paleontological localities are summarized in Table 3. Site locations are shown in Figures 14 and 15 (Ramil Rego *et al.* 2016). Although Metal Age archaeology occurs in some of the caves, no Pleistocene archaeology was recorded until the late 1980s with the excavation of A Valiña cave where a sparse and non-descript "Châtelperronian" industry was discovered and dated (Llana Rodríguez & Soto Barreiro 1991; Llana Rodríguez *et al.* 1992, 1996; Llana Rodríguez 2011; but cf. Fábregas Valcarce & Lombera-Hermida 2010). Whatever the character of its lithic assemblage and its equivocal dates, A Valiña was important because it was the first example of a transdisciplinary research project in Galicia. It triggered survey and testing programs at a number of caves and rock shelters, some of which yielded Pleistocene lithics, thus demonstrating an ancient human presence in the region.

The Galician Upper Paleolithic

Fifteen dates from three Upper Paleolithic sites (Cova Eirós, A Valiña, Valdavara 1) range from 35.1 to 12.0 ka uncal BP. They are distributed bimodally, with a gap of about five millennia between an "Early Upper Paleolithic" series (5 dates, 35.1-31.6 ka BP) and a "Later Upper Paleolithic" one (10 dates, 26.7-12.0 ka BP). Although they establish a range for a broadly defined Galician Upper Paleolithic, there is – with two exceptions – little to distinguish the earlier from the later series so far as their lithics are concerned.

TABLE 3. — Galicia – Radiometric dates from Paleontological sites (Fernández Rodriguez 2011; Grandal-d'Anglade *et al.* 2010).

Site	Level	Method	Material dated	Uncal date BP	Std. Dev.	Lab. no.	Comments
Cova Eirós	pasillo	OSL	sediment	*c.* 117 000		NA	natural accumulation, cave bear bone under stalagmitic crust
	galería	OSL	sediment	*c.* 97 000		NA	see above
Linares Sur	pasillo	C14/AMS	bone	8 dates >38 ka BP		NA	natural accumulation, dates beyond the limit of radiocarbon
Linares Sur	pasillo	C14/AMS	bone	37 865	2070	Ua-4808	natural accumulation, cave bear bone
Linares Sur	pasillo	C14/AMS	bone	37 690	1955	Ua-4817	see above
Linares Sur	pasillo	C14/AMS	bone	37 320	1910	Ua-4811	see above
A Ceza		C14/AMS	bone	>40 000			natural accumulation, cave bear bone, beyond limits of radiocarbon
A Ceza		C14/AMS	bone	35 230	1430		see above
Linares Sur	pasillo	C14/AMS	bone	35 220	1440	Ua-4593	natural accumulation, cave bear bone
Cova Eirós		C14/AMS	bone	31 680	900		see above
Pala do Rebolal		C14/AMS	bone	4 dates 30.5-13.5 ka BP			natural accumulation, cave bear bone
Pala do Rebolal		C14/AMS	bone	30 445	795	Ua-24940	see above, = Pala de Zorra
Cova Eirós		C14/AMS	bone	24 090	440		see above
Linares Sur	pasillo	C14/AMS	bone	17 720	185	Ua-4594	see above

The exceptions are the so-far-unique Solutrean open site of Valverde, in the Montforte de Lemos depression, which has yielded fragments of the distinctive bifacial foliates (undated, but probably in the *c.* 22-20 ka BP time range) (Lombera-Hermida *et al.* 2013) and the late Magdalenian/ Azilian (e.g. Cova Eirós, lev. B), microlithic industries that date to around 15-12 ka BP. A multicomponent UP open site, Foz do Medal Left Bank (FMLB), at the confluence of the Sabor and Medal rivers in northeast Portugal, also contains Solutrean artifacts (Gaspar *et al.* 2015, 2016). As in other regions, there is a dominant microlithic series characteristic of both the Upper and Epipaleolithic, and a smaller macrolithic one, perhaps more restricted in time to the Epipaleolithic/Mesolithic, suggesting some kind of a broad functional difference that cross-cuts the conventional division between the Epipaleolithic (= Azilian) and the Microlithic Mesolithic. In other words, it is difficult to separate the LUP from the Epipaleolithic/Mesolithic on techno-typological grounds alone, especially when the dominant raw material types (quartz, quartzite) are taken into account.

The Galician Mesolithic – chronology

Absolute dates for the Galician Mesolithic can be divided into those from limestone caves and rock shelters and those from open sites. Caution is urged in both cases because there are so few dates. Because of soil acidity and the absence of organics, the age of open sites is established more by artifact morphology and the formation processes involved in the geological contexts from which the artifacts are derived than by radiocarbon dates (Llana Rodríguez *et al.* 1992; Gallejo Lletjós 2013).

There are only eight ^{14}C dates for the Mesolithic of the caves and rockshelters, and four of them are AMS dates (Fábregas Valcarce *et al.* 2010; Vaquero Rodríguez *et al.* 2011, 2017). Only two are calibrated. There is a single date from Paradero do Reiro, an open site with some shell in an ancient paleosol. Combining them, the sample mean ($\bar{x}$) and standard deviation (1σ) are 7680 ± 73 ka uncal BP; cv = 0.01; the range is 7753-7607 ka uncal BP. For the two calibrated dates, the corresponding figures are $\bar{x}$ = 9029 ± 101 ka cal BP, cv = 0.01; the range is 9130-8928 ka cal BP). The uncalibrated dates fall toward the end of the Boreal phase (9.0-7.5 ka uncal BP) and are almost the same as those from Cantabria (7680 vs 7656 BP), whereas those from the Basque sample and the middle Ebro are practically identical (7414 vs 7412 BP). The two calibrated dates fall near the end of the Boreal period. As is usually the case with early Holocene calibrated dates, they are older by almost 900 years (Table 1).

The Mesolithic of Galicia – Lithic Industries

Recent surveys have identified about 30 open sites, although few have been extensively published (Villar Quinteiro 1997, 2007; Lombera-Hermida 2011; Ramil Rego *et al.* 2016). "Open site" is something of a misnomer because, in many cases, archaeological material that "looks LUP/Epipaleolithic" has accumulated under the overhangs of jumbles of large granite and quartzite boulders that outcrop in otherwise relatively flat terrain. These are technically rock shelters and are found almost exclusively on the Galician Shield but are considered open air sites in this paper. Lacking stratigraphy, how much compositional integrity these collections have is an open question. Given the hardness of the bedrock, the outcrops existed for tens of millennia and were used episodically, likely for the same activities, for a very long period of time. Some collections are fairly large (e.g. Férvedes II [a Lower/Middle Magdalenian site], 2319 lithics; Pena Lliboi, 3152 lithics) while the percentage of retouched pieces is usually quite small (e.g. Férvedes II, 3.4%; Pena Lliboi, 6.4%) and non-diagnostic (endscrapers, burins, denticulates, etc.) (Fig. 16). These data are summarized in Table 4.

Open sites atop *cuesta* ridges and hills are also reported in the Sierra de Xistral (Lugo), some of them attributed to the Epipaleolithic. One such site, Chan da Cruz, sheds light on how these scatters accumulated (López Cordeiro 2003). Now destroyed by the construction of a windfarm, almost 50 surface scatters and stratigraphic tests indicate that Chan da Cruz, on the top of a hill affording an unobstructed view

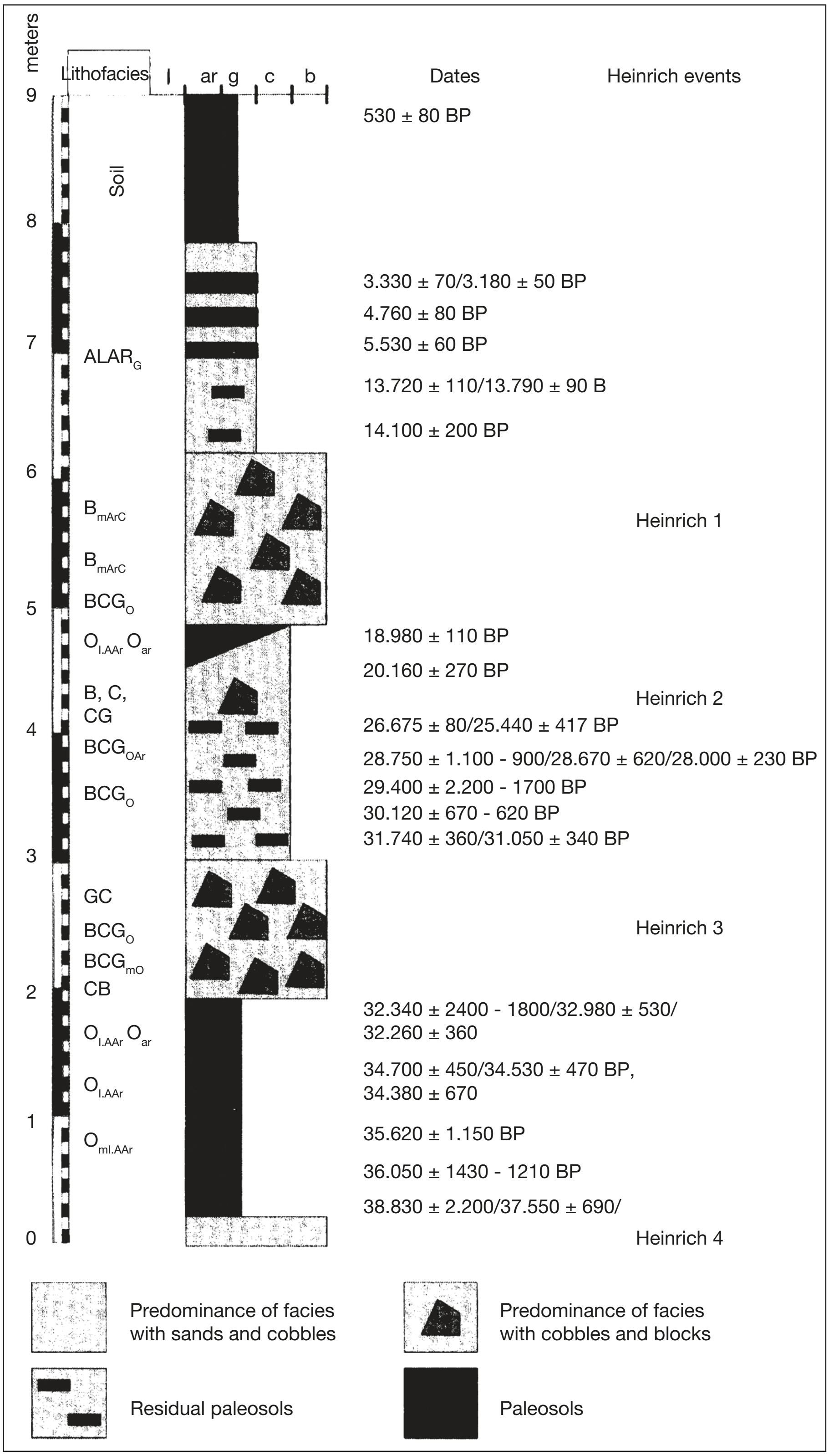

Fig. 13. — Radiometric chronology and Heinrich events for idealized depositional sequence based on Galician coastal deposits (from Pérez-Alberti 2011: 22).

of the surrounding landscape, was occupied and reoccupied for thousands of years by small groups of foragers, probably to monitor the movements of game. Lithics generated by these game lookouts were subsequently deflated and mixed, resulting in a palimpsest from a number of different time periods. While heterogeneous and polygenic, at loci where there is compositional integrity, it is possible that a somewhat restricted interval of time is represented (i.e., the attribution

TABLE 4. — Galicia – Paleolithic and Mesolithic radiometric dates.

Site/Period	Level	Method	Years BP	Std.	Range years BP
Lower Paleolithic					
Porto Maior	PM4	ESR/TT-OSL	210700	24700	235400-186000
	PM4	ESR Ti-Li	226000	10000	236000-216000
	PM3	ESR Ti-Li	266000	23000	289000-243000
	PM3	TT-OSL	242000	32000	274000-210000
	PM3	TT-OSL	225000	31000	256000-194000
Arbo	OC2	ESR Ti-Li	118000	9000	127000-109000
Middle Paleolithic					
Valdavara 3	B inf.	OSL	112837	8903	121740-103934
Valdavara 3	B inf.	OSL	103414	6956	110370-96458
Cova Eirós	3	OSL	84807	3554	88361-81253
O Regueiral	IV	OSL	69446	5472	74918-63974
As Lamas M2	IIIb	OSL	39866	3554	43420-36312
As Lamas M1	IIIb	OSL	38947	3150	42097-35797
Early Upper Paleolithic					
Cova Eirós	3	C-14/AMS	35100	700	35800-34400
A Valiña	IV	C-14	34800	1700	36500-33100
A Valiña	V	C-14	31730	2450	34180-29280
Cova Eirós	2	C-14/AMS	31690	240	31930-31450
A Valiña	IV	C-14/AMS	31600	250	31850-31350
Later Upper Paleolithic					
Budiño	base	C-14	26700	350	27050-26350
Cova Eirós		C-14	24090	440	24530-23650
A Valiña	IV base	C-14	21870	745	22615-21125
Budiño	top	C-14	18000	300	18300-17700
Cova Eirós	1	OSL	17020	1321	18341-15699
A Valiña	IV base	C-14	16420	70	16490-16350
Valdavara 1	6	C-14/AMS	15120	70	18700-17820
Valdavara 1	4	C-14/AMS	14630	70	17890-17730
Valdavara 1	4	C-14/AMS	13770	70	17080-16880
Cova Eirós	B	C-14/AMS	12040	50	12090-11990
Epipaleolithic/Mesolithic					
Valdavara 1/2	C	C-14/AMS	8920	50	10270-9830
Valdavara 1/2	C	C-14/AMS	8890	60	10250-9770
Chan do Lindeiro	burial ?	C-14/AMS	8236	51	8287-8185
Chan do Lindeiro	burial ?	C-14/AMS	7995	70	8065-7925
O Rei Cintolo	camerín	C-14	7735	60	7795-7675
O Reiro		C-14	7554	89	7643-7465
Xestido III	hearth	C-14	7310	160	7470-7150
A Braña-Arintero (Léon)	burials	C-14	6980	50	7030-6930
Fiales		C-14	6590	70	6660-6520

of the site to the Epipaleolithic). The point, though, is that the topography and the necessity for spotting game combined to identify a locale (the Cuadramón hill) that was used for millennia for short periods of time, and likely for the same purpose. There are no dates.

Raw material characteristics

Lithics from open sites are heavily dominated by quartz, quartzite and crystal quartz, with flints and cherts quite rare except in the tiny fragment of karst in the extreme northeast of the province (Lombera-Hermida & Rodríguez-Rellán 2010; Meireles 2009; Gaspar *et al.* 2016; Lombera-Hermida *et al.* 2016). As in Cantabria, the flints and cherts occur in small package sizes and are almost always of poor quality (de Lombrera-Hermida & Rodríguez-Rellán 2016). Quartz is not an ideal raw material, however, and lithic analysts often struggle to identify intentional flaking and retouch on quartz. Analyzing these assemblages is even trickier when bipolar reduction is a dominant reduction strategy, as it is here (Pargeter, pers. comm.).

Quartz as tool stone

Crystal quartz is not a "popular" tool stone when more tractable alternatives are available. However, modern experiments show that it can be knapped as well any other cryptocrystalline silicate, but the kind of elongated fracture needed to make blades and bladelets is very difficult to achieve. Longer flakes/blades tend to snap laterally, presumably along crystal boundaries and fracture lines (Rodríguez-Rellán 2016; de Lombrera-Hermida & Rodríguez-Rellán 2016). Bladelets are less problematic because the external facets on quartz crystals enable bladelet production without the need to set up ridges, as in classic platform bladelet cores (Pargeter & de la Peña 2017; Tardy *et al.* 2016).The ease with which quartz can be knapped is heavily dependent on homogeneity and package size (Flenniken 1981; Reher & Frison 1991; Pargeter & de la Peña 2017; Kannegaard 2015). Most of the lithics in Galicia are small, contain bubbles and impurities, are minimally shaped, and were probably mounted serially in organic foreshafts and hafts that have long since disappeared.

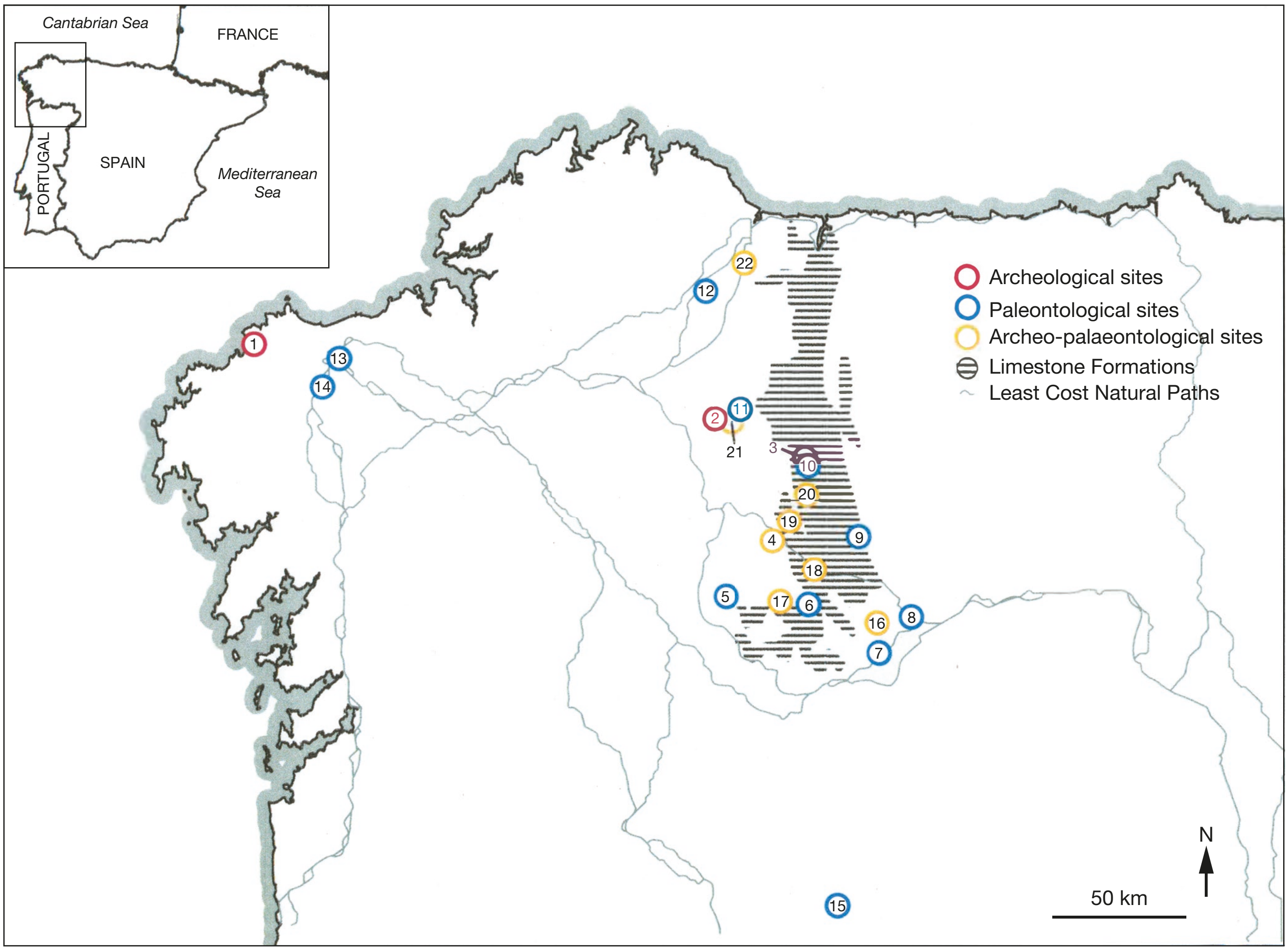

Fig. 14. — Monforte Basin and adjacent regions showing least-cost natural paths, limestone formations, and the distribution of archaeological, paleontological and archaeo-paleontological sites (composite figure redrawn from Fernández Rodríguez 2011: 46; Fábregas Valcarce 2011: 76; Lombera-Hermida 2011: 113; Lombera-Hermida *et al.* 2011: 95): **1**, O Reiro; **2**, A Valiña; **3**, Valdavara; **4**, Cova Eirós; Cancela; **5**, Buxán; **6**, Taro da Lastra, A Ceza; **7**, Pala da Vella; **8**, La Veguiña; **9**, Purruñal; Valdeabraira; **10**, Cova do Furco; **11**, Praducelos; **12**, A Furada dos Cas; **13**, Los Baños; **14**, Braña Rubia; **15**, Lorga de Dine; **16**, Serra da Encina da Lastra; **17**, Serra do Courel; Cova de Xato; **18**, Pedrafita; Liñares Sur; **19**, Cova Eirós/Cancela*; **20**, Cova da Valdavara*; **21**, Cova da Valiña* **22**, Cova do Rei Cintolo. An asterisk (*) indicates a difference between georeferenced and mapped sites.

Raw material studies have also proven useful in determining economic ranges by time and culture/stratigraphic unit. Estimating economic territories by raw material procurement suggests that the early Magdalenian in Galicia was restricted to areas close to sites because procurement was strictly local, required minimal effort and was likely embedded in other activities (Villar Quinteiro 1997). Keeping in mind that most forager gear is organic and would not be preserved, this suggests that most early Magdalenian sites functioned as base camps and fell toward the "expedient" end of the expedient/curated continuum (Clark & Barton 2017). This pattern also characterizes the late Magdalenian although there is a higher incidence of better quality exotic flints, probably derived from areas outside an economic territory. Although the mode of procurement is unknown (e.g. direct procurement, exchange, down-the-line trade), the exotic flint appears in the form of prepared cores, perhaps cached for individual use (Villar Quinteiro 1997). The Azilian/Epipaleolithic and Mesolithic see a reduction in economic territories possibly due to demographic factors (e.g. population growth, resource competition, territorial defense, and the closing of social boundaries) accompanied by technological changes. Assemblages become "miniaturized" (e.g. Pena Lliboi), there is a decline in the incidence of flakes and blades, an increase in imported flint, bladelet production, and a diversification of bladelet forms. Because these trends date to the early Holocene, territorial circumscription might also have been exacerbated by climate change and the well-documented expansion of closed woodlands.

Galicia – the Miño and Louro Terrace Sites

Crude macrolithic industries on quartzite cobbles resembling the Cantabrian Asturian occur in deflated contexts on *plateaux* above river valleys, in and on top of river terraces, and in Quaternary beach deposits and marine platforms on both banks of the Río Miño estuary and upstream on the north bank of its tributary, the Río Louro (Pontevedra) (Fig. 14). Known for more than a century, the chronological and stratigraphic implications of these discoveries have been much discussed by many investigators (see Clark [1976]; Arias Cabal [2007] for more recent ones; Cano Pan [2012] for historical references). Cano Pan (2012) provides a lucid discussion of the polygenic nature of these industries; Meireles (1996) puts them into a geomorphological context. In both areas, and in the Río Douro estuary in Portugal, "Asturian", "Pre-Asturian", "Proto-Asturian", "Asturian/Ancorian", "Pseudo-Asturian", "Mirian" and "Camposanquian" collections have been reconstituted *post hoc* from collections of mixed and rolled terrace industries by the long-standing practice of using archaeological index fossils (in this case, the iconic picks) to identify and categorize surface sites. The assertion that they are related in some way to the Cantabrian Asturian and, more generally, whether archaeological index types are adequate to identify and discriminate among specific archaeological assemblages, even when raw material consistency, surface texture, degree of rolling, and patination are taken into account, has been considered unwarranted for decades (Cano Pan & Vázquez Varela 1986). Unifacial quartzite picks morphologically identical to those of the Asturian do occur in low frequencies in many of these fossil beaches, mixed with Acheulean bifaces and other diagnostics but, when the geological contexts are taken into account, clearly indicate secondary deposition. Quartzite picks have also been found at Sarello in easternmost Galicia (Ramil Rego *et al.* 2016), and at Bañugues, Aramar, and l'Atalaya near Gijón in Asturias (Blas Cortina *et al.* 1978; Rodríguez Asensio 1978a, b), raising the possibility that at least some of the artifacts found in surficial cobble and silt deposits on top of fossil beaches might date to the Late Pleistocene or even the early Holocene. The occurrence of picks in Acheulean deposits, unquestionably in situ, has been documented at the stratified, open-air Acheulean site of Terra Amata near Nice (Lumley 1966: 41).

Regarding "historicity," it is an unexamined assumption that formal similarity "maps onto" history in some fairly direct way (Clark 2011). By itself, it implies neither contemporaneity nor historical relationship. In our view, the formal convergence that is such a marked feature of chipped stone technologies makes it much more likely that pattern similarities would express basic functional or activity differences with which all foragers had to contend, rather than historical connectivity (Clark & Riel-Salvatore 2006). In the lexicon of Binford (1981), it is an example of post-hoc accommodation, an explanation arrived at inductively after a pattern search has been completed in order to explain it. Such explanations are basically untestable and can be contested by any competent researcher who takes issue either with the patterns themselves, the causal factors assumed to underlie them, or both (Clark 2011).

Mesolithic Galicia – Atlantic coastal geomorphology

On its western (Atlantic) shores Galicia features deeply indented coastlines that are the result of gradual subsidence and marine transgression creating the *rías* – elongated, deep, steep-sided drowned valleys (Valcarlos Pagés 2000; Lorenzo *et al.* 2003). Unlike Cantabria, the continental shelf is shallow, varies between 40 and 60 km in width, and the coastline was displaced by at least that much during the LGM (González-Gómez *et al.* 2019) The *rias* are exceptionally productive in marine resources and it is a near certainty that shell middens were common along the coasts of Galicia during the Mesolithic and probably before. However, the igneous bedrock, the absence of karst, and marine transgression beginning during the Tardiglacial and continuing up to the present combine to explain the apparent absence of Mesolithic *concheros* in the province.

In the Miño drainage the presence of open-air midden sites has sometimes caused confusion in the literature. Most of them, at least, appear to be relatively recent, dating to the Bronze Age and later. Although there are few radiometric dates, one that has been dated by metal objects and pottery is located adjacent to the *castro* site of Santa Tecla (Santa Trega) and is probably contemporary with it (400-200 BC, Iron Age II). There is a *conchero* at Saá near the famed "Chellean" site that is probably also Iron Age (Domínguez Fontela 1925). There are middens associated with Roman and medieval sites. There are no indications that these *concheros* are related in any way to the terrace and beach industries just noted (González-Gómez *et al.* 2019). They only indicate a long-standing Gallegan fondness for seafood!

But just how common or rare are the middens? And, given the known rate of sea level transgression, can we use them to determine when shell middens disappeared from the archaeological record? These questions are addressed in a recent paper aimed at preserving the coastal cultural heritage of Galicia, increasingly threatened by erosion, sea level rise, urban and industrial development (González-Gómez *et al.* 2019). The authors make the interesting (although probably controversial) suggestion that midden deposits are much more common than generally appreciated, and are in fact associated with nearly every coastal town or city. While not obvious features of the landscape, they estimate there are roughly 1000 of them along the Atlantic coast and that, while most are recent, early Neolithic and Mesolithic deposits might underlie some of them. A single Galician open site, O Reiro, has been dated to 7554 ± 89 cal BP (González-Gómez *et al.* 2019).

Galicia – the Neolithization

As is Cantabria, the appearance of domestication economies in Galicia is both partial and late. There is also an apparent hiatus of about two millennia between the Mesolithic and the Neolithic, the latter a very late phase with pottery, domesticated plants (wheat, barley) and animals (ovicaprines, cattle, pigs) that might even bracket the transition to the Chalcolithic at around 5.5 ka cal BP (Lombera-Hermida 2011). Until very recently, there did not appear to *be* an early Neolithic in Galicia, at least as indicated by radiocarbon dates from cave contexts (Ramil Rego *et al.* 2016). But that might be changing. An iconic Cardial decorated jar has recently been unearthed at Cova Eirós (Triacastela, Lugo) (Fábregas Valcarce *et al.* 2019). Although not directly dated, comparisons with dated Cardial finds in southern Iberia suggest a date in the late 8th millennium BP. Unique in Galicia, and far to the north of Cardial sites in central Portugal, how it got there is an open question. Down-the-line exchange with Mesolithic foragers, possibly as a prestige item, is perhaps the most likely hypothesis (Fábregas Valcarce *et al.* 2019).

TABLE 5. — Galicia – Upper Paleolithic, Epipaleolithic and Mesolithic Open Sites – Lithic Data (Villar Quinteiro 1997; Ramil-Rego *et al.* 2016). Abbreviations: **D**, denticulate; **BU**, burin; **ES**, endscraper; **BC**, bec; **CRP**, continuously retouched piece; **BB**, backed bladelet; **N**, notch; **LDF**, lamelle Dufour. *, open sites.

							Attribution		
Major sites	**No. lithics**	**No. Ret'd.**	**% Ret'd.**	**Dominant Ret'd. types**	**Flk/Bld ratio**	**Qtz/Flt ratio**	**Villar Quinteiro (1997)**	**Ramil Rego *et al.* (2016)**	**Comments**
A Valiña	130	52	40.0	D>BU>BC	61/16	82/3	Châtelperronian	Initial Upper Paleolithic	macrolithic EUP; 3 bevel-base bone points, Chât. attribution based on dates
Dos Niñas (Os Penedos)	1336	115	8.6	BU=ES>CRP	63/7	3/93	Lower Magdalenian	Lower Magdalenian	macrolithic, >3000 lithics (RR), primary reduction, dates b/w 16-13 ka BP, eroded 11-10 ka BP, poor-quality flint, many flk/blds
Férvedes II	2319	80	3.5	BU>ES>CRP	17/28	42/58	Lower Magdalenian	Upper/Final Magdalenian	microlithic, *c.* 5000 lithics (*c.* 3% ret'd), many bladelets; mostly local flint source; LUP steatite pendant; high lithic diversity
Pena Grande	1390	220	15.8	BB>ES>BU	50/31	51/28	Azilian	Upper Magdalenian	microlithic, 41% crystal quartz, much primary reduction
Prado do Inferno	1448	144	9.9	ES>BB>BU	41/33	73/25	Azilian	Upper Magdalenian	microlithic (Azilian points), 56% crystal quartz
Pena de Lliboi	3152	203	6.4	ES>BU>N>LDF	27/37	94/4	Azilian		microlithic MESO, qtz/qtzite dominant, geometrics
Xestido III	923	145	15.7	N>BU>ES	69/30	100/0	Geometric Mesolithic	Geometric Mesolithic	microlithic MESO, rare geometrics; on corridor to Sierra Xistral; 8471 cal BP (GrN-16839), like Moita do Sebastiâo (VQ)
Minor Sites									
Férvedes I									small non-diagnostic collection, LUP/Epi (?)
Piñeiro									LUP knapping station (?), near flint outcrops; raw material types characteristic of all LUP sites
A Veiga									LUP knapping station (?), near flint outcrops; raw material types characteristic of all LUP sites
Trastoi									LUP knapping station (?), near flint outcrops; raw material types characteristic of all LUP sites
Curaceiro									small non-diagnostic collection, LUP/Epi (?)
Río Arnela (5 sites)									game lookouts (?) on terraces above passes to coast, mountains; few artifacts except Arnela III
Valdoinferno I									microlithic LUP/Epi inc. points; small non-diagnostic collection; recurring use, location suggest game lookout (?)
Valdoinferno I									microlithic LUP/Epi inc. points; small non-diagnostic collection; recurring use, location suggest game lookout (?)
Curro Vello (11 sites)	*c.* 100								microlithic MESO sites on edge of peat bog (4 open, 7 rockshelters); quartz, quartzite dominant tool stone
Curro do Oso (destroyed)									macrolithic MESO site; good pollen sequence indicating forest expansion, 10-7 ka BP; destroyed by windfarm
Chan da Cruz (destroyed)	1962								macrolithic MESO; 35 deflated scatters on cuesta ridge; pollen shows forest expansion, 10-7 ka BP; destroyed by windfarm
Sarello									macrolithic MESO coastal site with classic Asturian pick
Xestido I & II									small non-diagnostic collections, LUP/Epi (?)

As elsewhere in northern Spain, the first appearance of megaliths has sometimes has been equated with the early Neolithic (e.g. González Morales 1992; Suárez Otero 1997) but radiometric dates are few (*c.* 6.4 ka cal BP). However, work over the past 10-15 years shows that many dolmens and tombs in Galicia pertain to the late Neolithic, Chalcolithic or even the Bronze Age, in consequence of which the chronological relationship between the two remains unresolved. Evidence from Galicia itself is sparse, but a radically different (and very sophisticated) view of the Neolithization has been published recently by Fano and colleagues (2015), who argue for a mosaic pattern in neighboring Cantabria, uncoupling the appearance of ceramics, domesticated cereal grasses and fauna from one another using a Bayesian approach (see also Arias Cabal & Fano 2003; Arias Cabal 2007; Cubas *et al.* 2016 for a current overview]).

Noting that Mesolithic deposits sometimes underlie Neolithic dolmens (e.g. Peña Oviedo [Diéz Castillo 1995]), Fano and colleagues (2015) use a filtering process (radiocarbon dates ranked for reliability), archaeozoology and archaeobotany (rare evidence for morphological domesticates), and technology (ceramics, found across the whole region) to model the appearance of the Neolithic in Cantabria. They show that the transition from foraging to domestication was a complex and irregular process, pinpointing its origins in the middle Ebro Basin. At some sites (e.g. Kobaederra, in Vizcaya), domesticates existed along with traditional subsistence practices (Zapata *et al.* 2002; Altuna & Mariezkurrena 2009). Only at El Mirón, far to the east in Cantabria, do early Neolithic levels have very high percentages of domestic species from the very start (Altuna & Mariezkurrena 2012). In their view, sustained reliance on foraging and the coexistence of old and new funerary practices indicate the continued presence of indigenous foragers who, sporadically and in different ways, gradually adopted Neolithic agropastoralism after a long-protracted (*c.* 1-2 millennia) "availability" phase (Zvelebil & Rowley-Conwy 1986).

There is some precedent for a mosaic pattern in Galicia as well. O Reiro, on the coast, has pottery and cereal pollen, but is associated with a wild mammal fauna and fish (Ramil Soneira 1973). Arias Cabal (2007) identifies no less than ten "transitional" sites, most of them on or near the coast, with a probable source in central Portugal. The argument for "transitional" status is based on the presence of one or more of the traditional Neolithic indicators (i.e., pottery, domesticated plants, and/or animals). Except for O Reiro, these sites are not radiometrically dated. They include As Pereitas, Parxubeira, Barbanza, As Hozas, A Cunchosa, O Regueiriño, Porto dos Valos and A Gandara. The first four are believed to date to the eighth millennium BP.

In default of radiometric dates, there is controversy about the age of, and criteria for, identifying the transition (Meireles 2009). Suárez Otero (1997) equates the earliest Neolithic in Galicia with the appearance of impressed pottery followed shortly thereafter by megalithic tombs. A Cunchosa, O Regueiriño and Lavapés (now considered Chalcolithic) are cited as examples. Using the same criterion, Prieto Martínez (2005) argues that the early Neolithic dates to the second half of the fifth millennium cal BC (6.5-6.0 ka cal BP), as documented at Porto dos Valos and A Gándara. Both suggest a coastal route, identify central Portugal as the source, and exchange as the probable mechanism. Close proximity in time between Mesolithic structures underlying or in close association with mounds or megaliths occurs at the controversial mound of Illade O (A Coruña) where a burial pit containing two adults was radiocarbon dated to the end of the 5th millennium cal BC or the beginning of the 6th (Vaquero Lastres 1999). The relationship between the pit, the mound, and the samples dated is not clear. Other examples of superposition, unfortunately undated, include Pedra de Boi 3 (A Coruña), where a Mesolithic quarry underlies a megalithic tomb; A Gándara, also in A Coruña, where several huts were buried under another mound and Medorras de Roza das Aveas (Pontevedra), where oven-like structures dated elsewhere to the early Neolithic underlie a Chalcolithic village (Fábregas Valcarce & Vilaseco Váquez 2013). There is some consensus that the adoption of agropastoralism by local foragers dates to the first half of the 5th millennium BC (*c.* 7.0-6.5 ka cal BP), the earliest megaliths appear around 6300 BP, followed by a sharp uptick in frequency after 5900 BP. This proliferation of monuments is sometimes equated with a protracted and partial shift to domestication economies (pastoralism) by the local inhabitants but there is little hard evidence to support that. Megaliths are very diverse in form and function, suggesting that their appearance does not necessarily signify the emergence of a single, region-wide symbol system.

Overview – the Epipaleolithic and Mesolithic in Galicia

Because of acidic soil and sediments, organics directly associated with the archaeology are rare. Consequently there are few radiocarbon dates, although this deficiency is compensated for by a significant amount of geoscience and paleontological research (Table 5; Fig. 15). Generally speaking, there seem to be two kinds of Mesolithic industries in Galicia although they constitute a "fuzzy set" (Willermet & Hill 1997) without sharp boundaries in space, time or composition so far as tool forms, blanks and raw material are concerned. The more common is a microlithic bladelet industry that broadly resembles the late Magdalenian, Azilian and the Microlaminar Mesolithic in the Ebro (e.g. Pena Lliboi, Pena Grande) with strong continuity in technology and typology with the late Upper Paleolithic (Fig. 16). The other kind of industry is macrolithic, flake-based, has few formal tools (mostly endscrapers, burins), almost no laminar elements, microliths or geometrics (e.g. Valdavara 1/2) (Fig. 17). In the absence of marker types, some of which are organic, it is difficult to make a distinction between the LUP, on the one hand, and the Epipaleolithic/Mesolithic, on the other. Within the limits of measurement, however, the LUP and the Mesolithic do not appear to be contemporaneous. There seems to be a 3000 year gap (12-9 ka BP) between the youngest LUP date (Cova Eirós, lev. B) and the earliest dated Mesolithic (Valdavara 1/2, lev. C) during which populations on the Galician shield

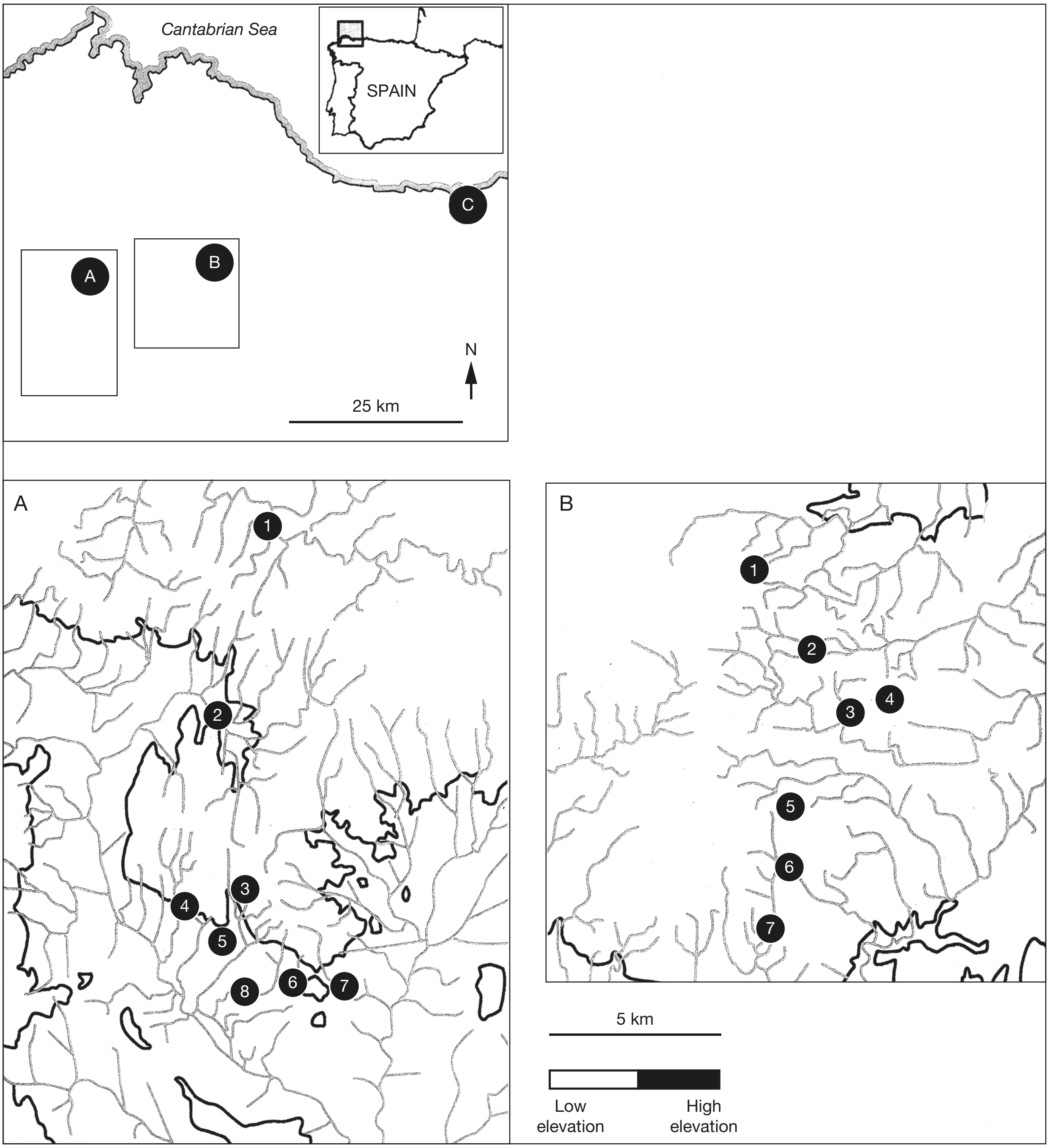

Fig. 15. — Rock shelters and open sites from three survey regions (**A**-**C**) in north-central Galicia (redrawn from Ramil Rego *et al.* 2016: 160): **A**, **1**, Prado do Inferno; **2**, Férvedes; **3**, Pena Grande; **4**, Abrigo Curaceiro; **5**, Os Penedes; **6**, Piñeiro; **7**, Trastoi; **8**, A Veiga; **B**, **1**, Chan da Cruz, Curro do Oso; **2**, área de Curro Vello; **3**-**5**, área de Xestido; **6**, **7**, área do Arnela; **C**, Sarello (a single Asturian pick).

appear to have left few traces. Whether real or apparent, the hiatus begins during the height of the Younger Dryas (12.8-11.5 ka cal BP), an abrupt, severe return to extremely cold, dry conditions (– 2-7°C) over much of the middle latitudes of the northern hemisphere (Fernández-López *et al.* 2019). It ends in the Boreal phase, at 8.9 ka cal BP. The YD could have resulted in temporary depopulation of highland Galicia and migration toward the somewhat milder, maritime coast. Repopulation would have ensued after about 11 ka BP, as foragers gradually recolonized the uplands, following the plant and animal communities upon which they subsisted. As the region warmed, the woodlands densified, and eventually the hunting of the dietary staple, red deer, became less efficient, primarily because of difficulties in locating and tracking

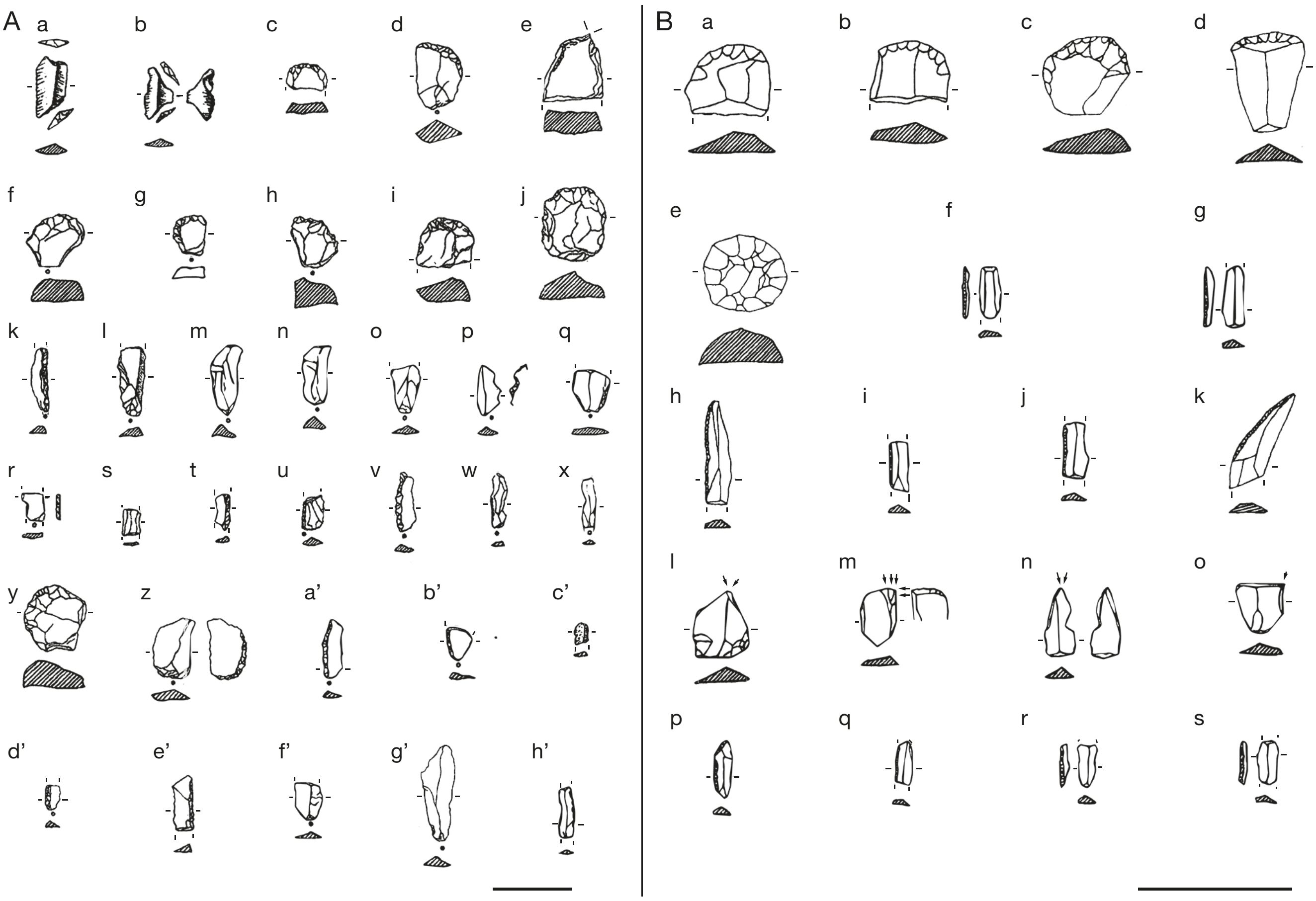

FIG. 16. — **A**, Pena Lliboi – an example of a microlithic Mesolithic industry (from Villar Quinteiro 1997: 91): **a**, **b**, trapezes; **c**, **d**, **f**-**j**, **y**, endscrapers; **e**, burin; **k**, **l**, **r**-**w**, **a'**-**e'**, backed bladelets; **m**-**o**, **q**, **f'**-**h'**, unretouched bladelets; **p**, **x**, continually retouched piece; **z**, flake with inverse backing; **B**, Pena Grande – an example of a microlithic Mesolithic industry (from Villar Quinteiro 1997: 85): **a**-**e**, endscrapers; **f**-**j**, **p**-**s**, backed bladelets; **h**, **k**, backed points; **l**-**o**, burins. Scale bars: 3 cm.

wounded animals. Although never totally abandoned, the population receded again, concentrating along the coasts, until Neolithic agropastoralists began to impact vegetation communities through deforestation and the herding of sheep and goats. This apparently occurred quite late in Galicia, which so far lacks much evidence for early domestication economies.

Genetic evidence

The past decade has seen the publication of several dozen papers about various aspects of Iberian paleogenomic research focusing on the phylogeography of the different modern populations found on the Peninsula today. At least a dozen of these are concerned with north Spanish populations, notably the Basques, a relict population in modern times but with a former extent over much of Atlantic coastal Spain, and the Galicians, because of their location in the extreme southwest corner of Europe. Research questions turn on aspects of: 1) the range extension of LGM populations packed into the Cantabrian refugium following climatic amelioration in the early Holocene; 2) modeling the genetics of the Neolithization process and possible relationships between indigenous foragers and allochthonous agropastoralists; and 3) the phylogeographical origins of modern subpopulations within Spain itself. While important in their own right, in the context of this paper these questions offer the opportunity for comparison with models developed in archaeology. That said, genomic pattern searches are relatively new and there is much controversy within the field itself about sampling issues, whether or not different molecular clocks "keep time" at the same or similar rates, what variables are important to measure, how to identify pattern, what is causing it to occur and when it occurred. The last is particularly problematic in regard to the Y chromosome. In short, there is little consensus. To try to dissect paleogenomic research is beyond our competence and is outside the remit of this paper. Nevertheless, some general observations are pertinent here.

The work can be broadly divided into: 1) research on mitochrondrial DNA (mtDNA, which tracks the matriline), specifically the H haplogroup and its subgroups, common in modern Europeans but absent in Mesolithic foragers; 2) the Y chromosome (patriline), comparing regions thought to be isolates (e.g. Galicia, the Pasiegos) or relict populations (e.g. the Basques); and 3) the Franco-Cantabrian post-Pleistocene refuge-expansion theory, created by archaeologists but tested against mtDNA and Y-chromosome data with conflicting results (cf. García *et al.* [2011] who see no evidence for it, with Valverde *et al.* [2016] who do). Behar *et al.* (2012) acknowledge a range extension but date it to *c.* 4000 BP. Iberian research also indicates only clinal geographical patterns along a N/S

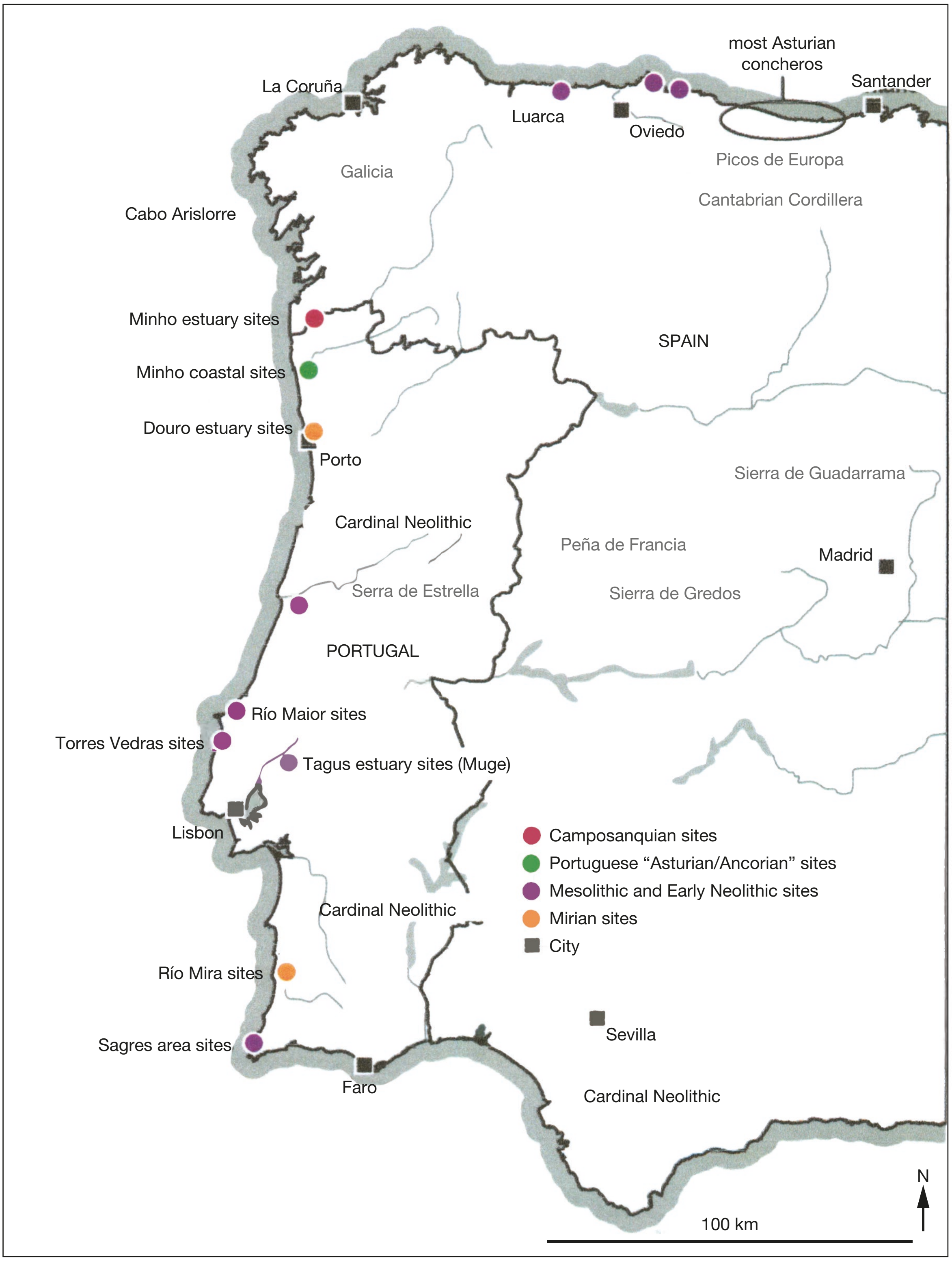

Fig. 17. — Western Iberia showing the distribution of polygenic macrolithic "sites" in river and marine terraces, and estuaries, and the distribution of Cardial Neolithic ceramics (composite figure redrawn from Clark 1983b: 45-47).

axis, a recent phenomenon attributed to the slave trade and the Arab invasion of the Peninsula by Barral-Arca *et al.* (2016), whereas Brotherton *et al.* (2013) argue that the diversity distribution seen today was established after *c.* 4000 BC during the middle Neolithic. Still other papers are concerned with N African introgression and back-crossing at points in time extending from the Lower Pleistocene up to the appearance of modern humans and beyond (e.g. Hernández *et al.* 2017).

But what of the Mesolithic itself? Sánchez-Quinto and colleagues (2012) analyzed mtDNA and shotgun genomic data from two exceptionally well-preserved 7000-year-old Mesolithic burials from La Braña-Arintero, a burial cave high in the Cordillera (*c.* 1489 m) in León (Vidal Encinas 2010). The mitochondria of both individuals were assigned to a haplotype common in previously-studied Mesolithic samples from northern and central Europe. This suggested a remarkable genetic uniformity and little phylogeographic structure over a large geographical area in populations clearly pre-dating any construal of the Neolithic. Genetic continuity from the Mesolithic to the Neolithic was poorly supported, however, leading the authors to conclude that the La Braña-Arintero individuals were not related to modern Iberians nor to any populations in southern Europe. These conclusions were subsequently confirmed by Olalde and colleagues (2014) in another study of one of the Braña-Arintero individuals that indicated the existence an ancient genomic signature common to the Upper Paleolithic and Mesolithic samples across all of western Eurasia but distinct from Neolithic populations throughout the same region. Alleles related to skin pigmentation also suggested that the light skin of modern Europeans was not yet ubiquitous in the Mesolithic and that some aspects of pathogen resistance often attributed to Neolithic agropastoralists were already present in the B-A individual's genome. A subsequent paper (Olalde *et al.* 2019) documents high genetic substructure between northwestern and southeastern Iberian foragers before the spread of agropastoralists, sporadic contact with North Africa by *c.* 4500 BP and, by *c.* 4000 BP, the replacement of *c.* 40% of Iberia's ancestry and nearly all of its Y-chromosomes by people from the Central Asian steppes. A particularly interesting finding is that present-day Basques are derived from a typical Iron Age population without evidence for admixture events that later affected the rest of the Peninsula (Olalde *et al.* 2019).

Finally, it is interesting to note that the modern female population of Galicia is extremely homogeneous so far as its mitochrondrial DNA is concerned – more homogeneous than that of males. This has been argued to be because of Galicia's geographical position at the extreme NW corner of the Iberian Peninsula, itself a cul-de-sac at the westernmost continental edge. Moreover, there is a striking similarity to the corresponding Basque sample. Several other genetic indices confirm the low variability of the Galician mtDNA when compared with data from other European and Middle Eastern samples (Salas *et al.* 1998). Many questions arise from this research, some of which have been addressed by other workers (e.g. whether or not the genetic data can be squared with the appearance of modern humans [apparently not], the early Upper Paleolithic [no, the LGM, *c.* 18 kya, as in Cantabria], the difference between the sexes [influx of males?], the genetic similarity with the Basques [relict isolates swamped genetically by LUP immigrants over most of their range?]). All these scenarios are both contested and supported, but the overall impression is that Galicia experienced a late modern human replacement that did not coincide with the IUP/EUP, and that there is discordance between the archaeology and the genetics (e.g. Cabrera Valdés & Bischoff 1989; Straus 1992).

SPD CURVES – A PROXY FOR DEMOGRAPHIC CHANGE

Grounded in statistical analyses of large radiocarbon data bases, summed probability distributions of radiocarbon dates (SPD curves) have become an increasingly popular tool with which to reconstruct prehistoric population dynamics (Williams 2012; Chaput & Gajewski 2016). Although pioneered by John Rick (1987) more than 30 years ago, SPD has "caught on" in the profession only after about 2010. New case studies from around the world are now regularly being published (e.g. Johnson & Brook 2011; Fernández-López *et al.* 2019), stimulating the development of novel techniques aimed at solving a wide range of specific methodological and interpretive problems (Crema & Bevan 2018).

SPD curves can be used both in exploratory (pattern searching) and confirmatory (hypothesis testing) modes. In place of the largely inductive regional comparisons that have dominated archaeology for decades, SPDs introduce a deductive component to research protocols that allows for more rigorous hypothesis testing (e.g. assessing the impact of climate change on past human demography [Shennan *et al.* 2013]; testing demographic models for goodness of fit using an information-theoretic approach [Fernández-López *et al.* 2019]). They can also be used, as here, to make spatially explicit inferences about geographic variation over time (Crema *et al.* 2017).

SPD analysis works by combining multiple radiocarbon age estimates, each one of which is itself a probability distribution of the likelihood that a sample is of a given age, into an aggregate probability function (for expanded discussion, see Crema *et al.* 2016; Crema & Bevan 2018). Currently, such aggregation is most often done through a Bayesian procedure that treats the individual radiocarbon estimates as prior probabilities and calculates the aggregate SPD curve as a posterior probability distribution (Parnell *et al.* 2008, 2011; Bronk Ramsey 2009). We use SPDs here as a proxy for population density to compare time/space relationships among the four regional Mesolithic data sets, and in relation to the north Spanish Mesolithic as a whole. All SPD analyses were done using the BChron package to calibrate the dates (Haslett & Parnell 2008). The Intercal 13 curve was used for terrestrial samples and the Marine 13 curve was used for shell dates (Reimer *et al.* 2013). RCarbon was used to create the SPD curves (R Core Team 2016).

Cantabrian demography

The SPD graph for the Mesolithic in Asturias and Cantabria is given in Figure 18. It is based on 144 cleaned, filtered and normalized calibrated ^{14}C dates, with repeated sampling (200 iterations) distributed in 119 100-year-long bins over a 7000 year period (12.0-5.0 ka cal BP). Binning is used here to minimize strong inter-site sampling bias where, for example, a particularly well-funded excavation has yielded an unusually large number of dates compared to other sites in the data set to which it pertains. The location in time of a particular bin is expressed by its median calibrated date in years BP.

Under the assumption of a gradual increase in population over time, the null model (grey band) is generated from the total Cantabrian regional sample. It is a hypothetical SPD expressing what we might expect to find if the number of radiocarbon samples increased at an exponential rate due to formation processes and slow population growth (0.04%/year [Bettinger 2016] – this is substantially higher than most estimates. Hassan [1981] estimates an annual growth rate for Upper Paleolithic foragers of 0.001-0.002%). The confidence interval of the null model is 95% (2σ), within which variation is not statistically significant. Positive values indicate statistically-significant increases in population growth (red bars); negative values indicate statistically-significant declines (blue bars). The null model is filtered to smooth out statistical artifacts (e.g. duplicate dates, overrepresentation from a single site, coefficients of variation >0.05) that might confound underlying patterns. The probability associated with statistical significance for Cantabria and the other regions is ≤0.005.

Preceded by approximately 2900 years of slow, irregular, exponential population increase (11.2-8.3 ka cal BP), inspection of the graph shows a single, strongly defined positive mode at 8.2-7.4 ka cal BP, with the probable maximum population density in Asturias and Cantabria at around 7.8 ka cal BP. Population densities lower than expected occur from *c.* 11.8-11.2, and 5.25-5.15 ka cal BP. The former corresponds almost exactly with the Preboreal phase (11.7-11.0 ka cal BP), while the latter corresponds to the early Neolithic. The sharp drop in population beginning around 7.7 ka cal BP is followed by an irregular but ultimately large-scale decline in the region. The mean of 26 Neolithic dates from Cantabria is 5157 ± 71 uncal BP (range = 5228-5086 uncal BP; cal BP median = 5893), whereas that of the Mesolithic is 7725 ± 270 uncal BP (range = 7995-7455. The calibrated median BP is based on the uncalibrated means and standard deviations, and the date calibration curve for each individual date. In this case, the cal BP median = 8423, suggesting a gap of approximately 2500 years between the measures of central tendency. It is perhaps significant that the ranges do not overlap at all, but the small number of early Neolithic dates urges caution.

Basque coastal demography

The SPD analysis for the Basque database is shown in Figure 19. In this case there are 42 bins; the 95% confidence interval was computed using 200 simulations calculated as above (p = 0.145). Although there is a short positive local deviation at 6.9-6.7 cal ka BP, and negative ones at >11.5 and 5.3-4.5 cal ka BP, the confidence interval for the null model is only 0.145, suggesting that these minor excursions are probably statistical artifacts attributable to the small number of dates. The last one (5.3-4.5 cal ka BP) is interesting, though, because it postdates by more than a millennium the early Neolithic in the region (median = 6.5 ka cal BP). An apparent decline in population following the introduction of domesticates might be explained by depopulation (i.e., small numbers of agropastoralists displaced indigenous foragers) and/or that early farming and herding practices imported from the Ebro basin were ill-adapted to the quite different environments of the Basque coast and hinterlands, failed as a viable subsistence regime, collapsed, and eventually resulted in a substantial amount of emigration.

Middle Ebro demography

The SPD analysis for the Middle Ebro database is shown in Figure 20. In this case there 362 dates, 229 bins; the 95% confidence interval was computed using 200 simulations calculated as above (p = 0.005). A single, statistically significant positive deviation at 8.7-6.2 ka cal BP implies a large and prolonged population increase in the Middle Ebro that peaked at *c.* 7.1 ka cal BP, a pattern that contrasts sharply with that of Cantabria, which peaks at 7.8 cal BP. There are significant negative deviations from >12.0-9.7 ka cal BP and from 5.8-4.5 ka cal BP. The former corresponds to low population densities beginning in the late Magdalenian, the region apparently being unoccupied prior to about 15 000 years ago. As in País Vasco, the latter deviation (5.8-4.5 cal ka BP) postdates by *c.* 600 years the early Neolithic in the region (median = 6.4 ka cal BP) but could well be a statistical artifact. An apparent decline in population following the introduction of domesticates might be explained by depopulation (i.e., small numbers of agropastoralists displaced more numerous indigenous foragers) by back-migration to the south or onto the Meseta del Norte or, most likely, the failure of agropastoral economies in a region to which they were poorly adapted. Contagion is another possibility. Whatever the case, declining population densities following the early phases of the Neolithic are a conspicuous feature of both graphs, and have also been noted by Shennan and colleagues (2013) elsewhere in mid-Holocene Europe. This suggests that similar processes took place in the Middle Ebro and in the Basque Country, and at about the same time. Except for the coastal sites, both are located in the greater Ebro catchment, so the distinction between the two regions is somewhat arbitrary.

The Galician Mesolithic – demography

The SPD analysis for Galicia is shown in Figure 21. In this case the sample (n = 10) was so small as to preclude even the possibility of statistical significance, so we increased the sample size to 25 by including all Mesolithic and Neolithic dates between 11.0 and 5.0 ka cal BP. There are 20 bins; the 95% confidence interval was computed as before but, even with the larger sample, there are no positive or negative deviations from the null model and all fall short of statistical significance (p = 0.363). As was true of the Basque sample, this result is almost certainly a statistical artifact attributable to the small number of dates.

SPD ANALYSES – MODEL COMPARISONS

SPD proxies for population density at regional and global scales can shed light on patterns of mobility in the small-scale societies that populated Atlantic coastal Spain and the Middle Ebro drainage south of the Cordillera.

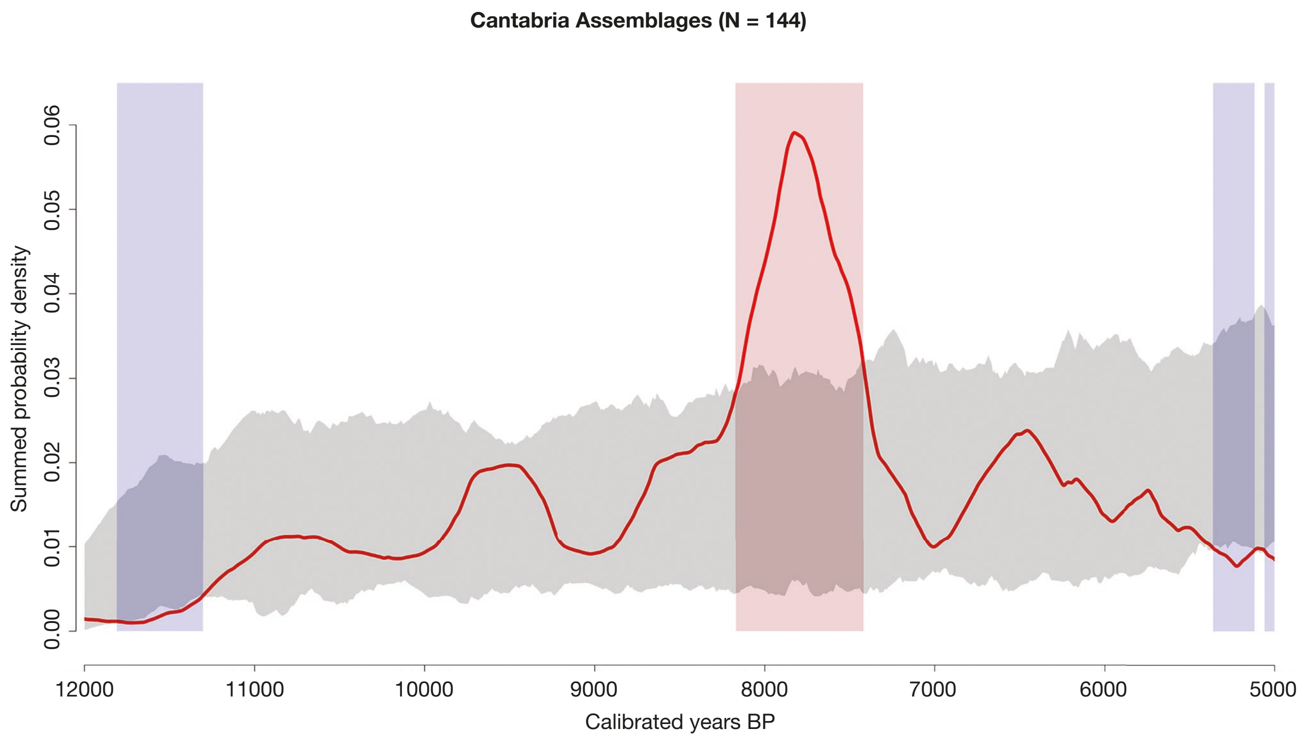

FIG. 18. — SPD graph of 144 Cantabrian Mesolithic radiocarbon dates showing a single, strongly defined positive mode at 8.3-7.4 ka cal BP (**red line**), with the probable maximum population density in Asturias and Cantabria at around 7.7-7.8 ka cal BP. Population densities lower than expected (**blue**) occur from *c.* 11.8-11.2, and 5.25-5.15 ka cal BP.

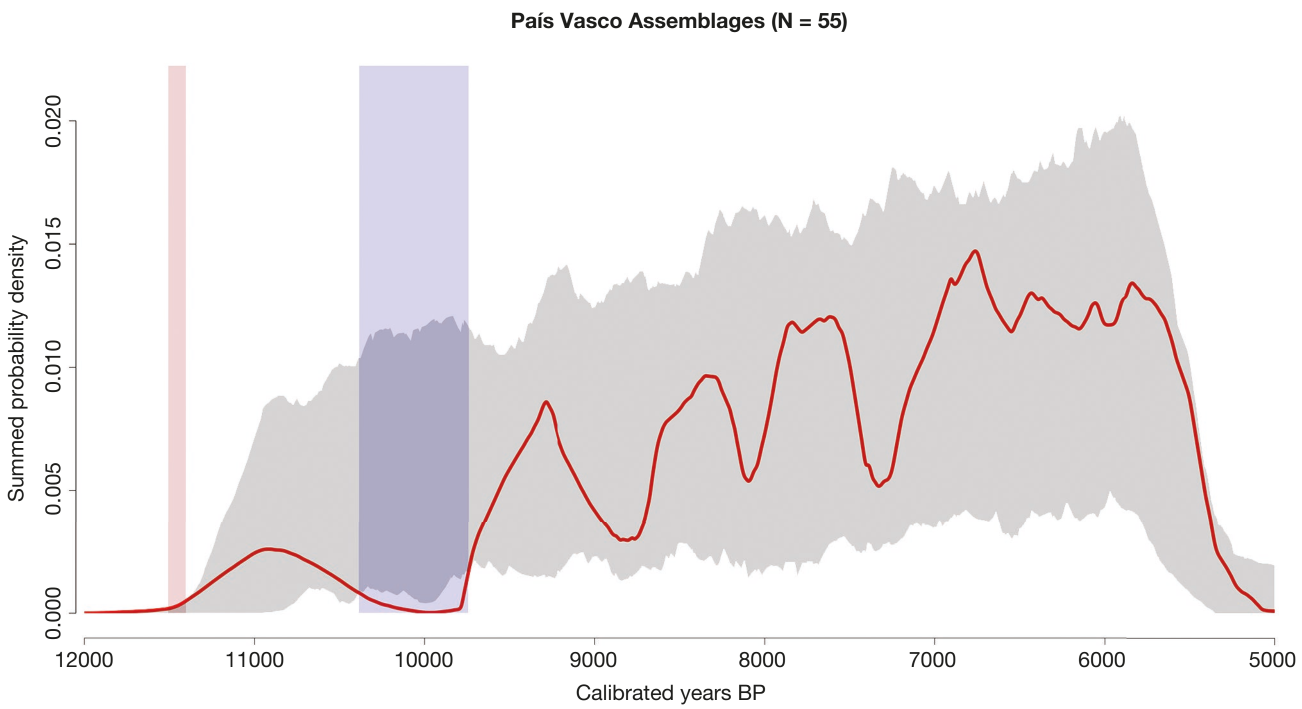

FIG. 19. — SPD graph of 55 Basque coastal Mesolithic radiocarbon dates showing a short positive local deviation at 11.5 cal ka BP, and negative ones at 11.5 cal ka BP. The confidence interval for the null model is only 0.145, suggesting that these minor excursions are probably statistical artifacts attributable to the small number of dates.

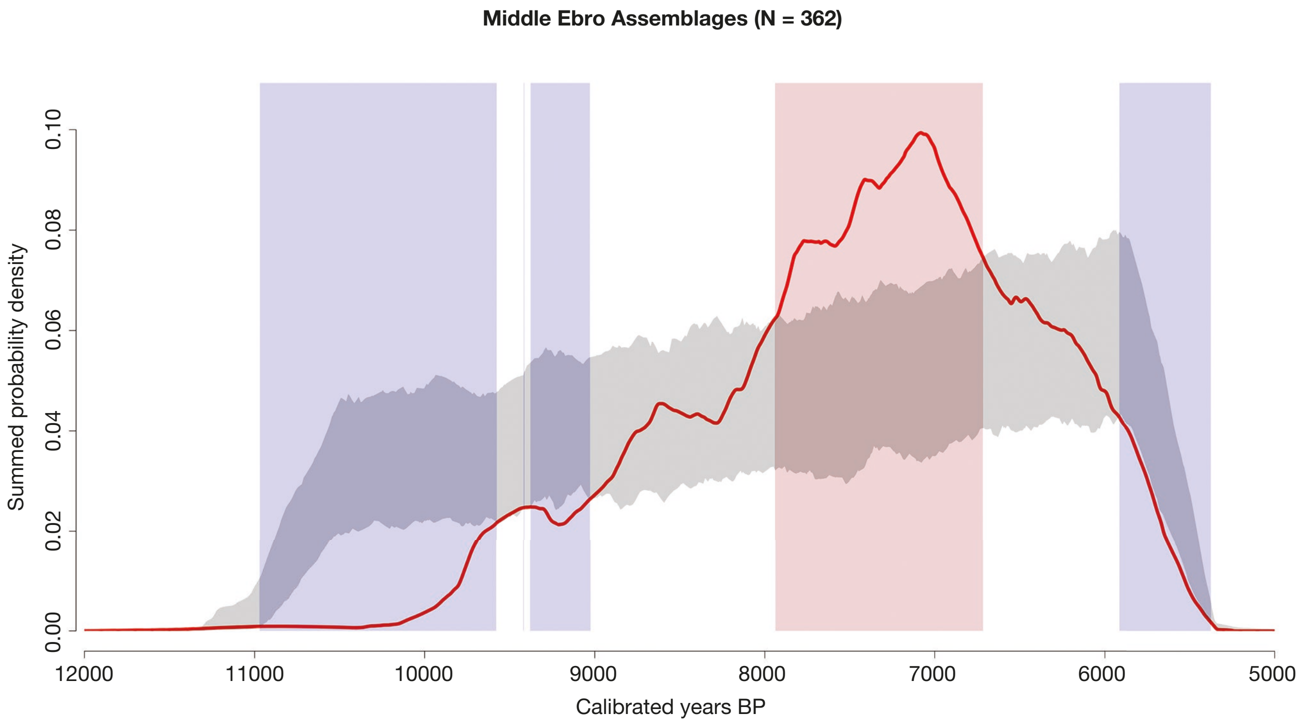

Fig. 20. — SPD graph of 362 Mesolithic dates from the Middle Ebro shows a single, statistically significant positive deviation at 8.7-6.2 ka cal BP that implies a large and prolonged population increase in the Middle Ebro that peaked at *c.* 7.1 ka cal BP, a pattern that contrasts sharply with that of Cantabria, which peaks at 7.8 cal BP. There are significant negative deviations from >12.0-9.7 ka cal BP and from 5.8-4.5 ka cal BP. The former corresponds to low population densities beginning in the late Magdalenian. The latter postdates by *c.* 600 years the early Neolithic, an apparent population decline following the introduction of domesticates noted elsewhere in western Europe (Shennan *et al.* 2013).

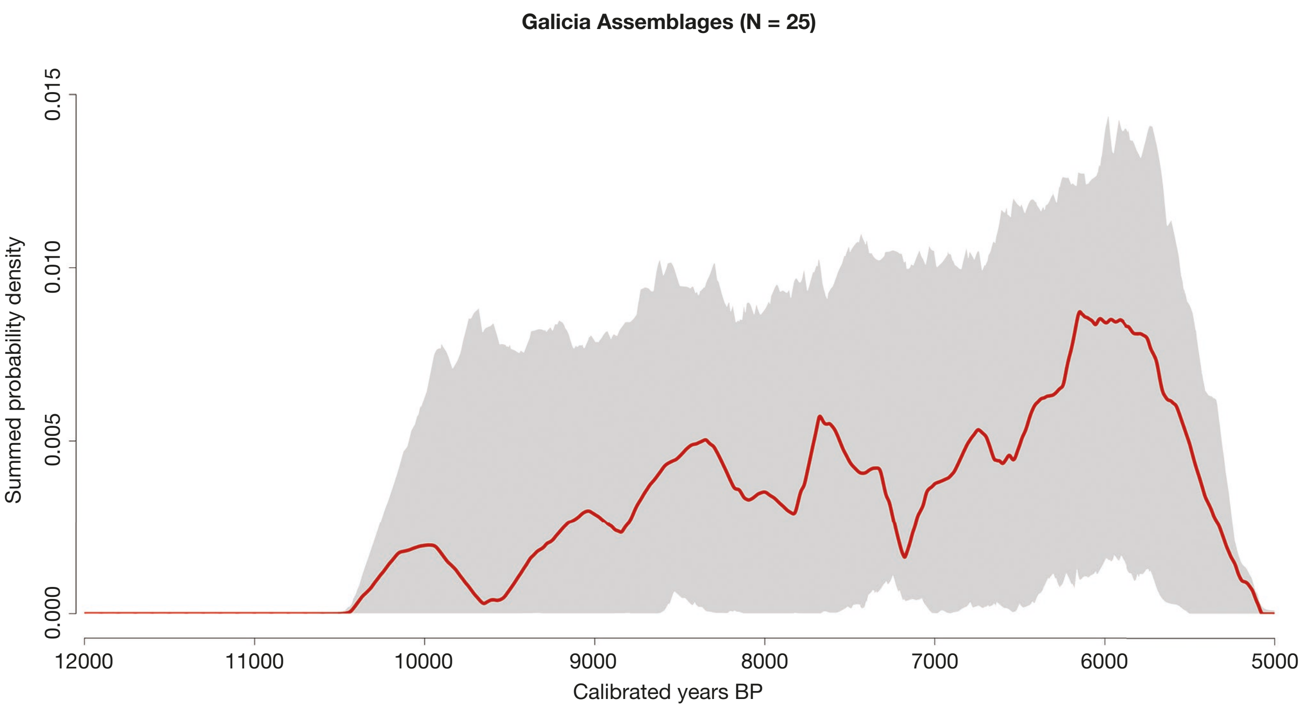

Fig. 21. — SPD graph of 25 Galician Mesolithic dates displaying a sharply irregular pattern trending upwards from 10.5 cal ka BP and marked by steep declines at about 9.65-9.5 ka cal BP and 7.2 ka cal BP, a peak *c.* 6.25-5.8 ka cal BP, followed by a precipitous decline at 5.7 ka cal BP. There are no statistically significant deviations from the null model ($p = 0.363$). As was true of the Basque sample, this result is almost certainly a statistical artifact attributable to the small number of dates.

These comparisons are made using permutation tests to make more precise regional comparisons that elucidate statistically-significant patterns that might be affected by false positives and negatives at the local scale. The permutation algorithm works by randomly shuffling all sites associated with each local SPD before applying the spatial weights according to the percentage of dates in each local sample, then computing the local growth rate within defined chronological parameters (the aggregate number of bins per test/*N*). This process is iterated *n* times (here, 200), so that for each location, there is an observed local growth rate and a vector of simulated growth rates constituting the null model. Local rates are then compared with the null model to identify intervals of positive (hot spots) and negative deviations (cold spots). Statistical significance is determined a priori by the investigator (here, $p \leq 0.005$) (see Crema *et al.* 2016, 2017 for a description of the method).

Permutation tests – local and regional models compared

In the discussion of the local models above, the Basque and Galician samples did not yield any statistically significant positive or negative deviations. Although increases and decreases in population density are indicated for both and might have empirical validity, we cannot conclude that they do because the associated probabilities are 0.145 and 0.363 respectively. In other words, the local data do not meet the criteria for statistical significance under the exponential growth model expressed in the null hypothesis. In the case of Cantabria and the Middle Ebro, both graphs show statistically significant positive and negative deviations ($p \leq 0.005$). Moreover they stand in an inverse relationship to one another, both in the Epipaleolithic (12.0-10.0 ka cal BP) and Mesolithic (Fig. 22).

The graph for Cantabria shows a weakly positive deviation over the 12.0-10.0 ka cal BP interval (Pre-Boreal, early Boreal), an increase in population that peaks at 7.7-7.8 ka cal BP (Atlantic), followed by a significant decline after 7.4 ka cal BP that continues well into the early Neolithic. Population densities lower than expected occur from *c.* 7.3 to 5.8 ka cal BP. The sharp drop in population after about 7.4 ka cal BP is followed by an irregular but ultimately large-scale decrease in population, possibly indicating near abandonment. That peak corresponds to the regional Mesolithic – the Asturian. The significant valley corresponds to the apparent near-abandonment of the region following the Asturian. There is a weak positive upturn after about 5.3 ka cal BP and an apparent gap between the Mesolithic and the Neolithic of about 2400 years, at least as indicated by measures of central tendency and dispersion. Not even the ranges overlap (Table 1). As in Figures 18-21, weak deviations are probably statistical artifacts.

The Middle Ebro SPD contrasts sharply with that of Cantabria. It shows a long but weak negative deviation between *c.* 11.4-9.8 ka cal BP that tends to support the view that the region was essentially unoccupied by humans until the late Upper Paleolithic (González-Sampériz *et al.* 2009), whereas there is much evidence for Azilian foragers in Cantabria during the same interval. This is followed by a long positive trend beginning around 10.0 ka cal BP, attaining statistical significance at *c.* 7.4 ka cal BP, with maximum population density at 7.1-7.0 ka cal BP, some 7-800 years after the Cantabrian peak, perhaps explaining the apparent depopulation of Cantabria following the Asturian. The peak at 7.1 ka cal BP is followed by about 1400 years (6.8-5.4 ka cal BP) during which population decline matches expectations under the null model. It only attains statistical significance in the late 6th millennium cal BP, when the earliest megalithic structures appear (Fano *et al.* 2015).

The permutation tests for the Basque and Galician dates are inconclusive, although the latter shows a single positive deviation at *c.* 5.8-5.5 ka cal BP, a result that squares well that the consensus view that the Neolithization in the region was both partial and late, and marked by the appearance of megaliths. The null models are very similar, differing only in detail from one another. Because of the small number of dates, the graphs themselves are essentially uninterpretable, although the coastal Basque coastal sites appear to post-date 10 ka cal BP, whereas Galicia has several early dates.

What is so striking about the demographic analyses is the consistency of pattern, regardless of scale and the shape of the null model, when the Ebro dates are compared with those of Cantabria, all north Spanish coastal dates, and those of northern Spain. *In each comparison there is an inverse relationship between Cantabria and the Middle Ebro. As Cantabria loses population, the Middle Ebro gains it.* Moreover, significant population decline in Cantabria continues for more than a millennium, whereas population increase in the Ebro is confined to about 600 years. Because there is no compelling climatic reason for this shift (Fig. 12), it suggests that Asturian foragers migrated to the middle Ebro valley where they mixed with indigenous hunter-gatherers and early agropastoral colonists from the lower Ebro. The earliest open sites in the Ebro date to around 8.0 ka cal BP (latest Geometric Mesolithic) and become relatively common in the early Neolithic, indicating that caves and rockshelters had become so filled with debris from 7000 years of human use and occupation that they were no longer suitable as living spaces. Something very similar is well-documented in Cantabria (e.g. Vega del Sella 1914; Vega del Sella *et al.* 1923, 1930).

The pan-Iberian population bottleneck

It is interesting to compare the pan-Iberian SPD model recently published by Fernández-López *et al.* (2019) with our results. Using 907 cleaned and filtered dates and a methodology similar to ours, they propose three episodes or phases of demographic change, ultimately attributed to the aftereffects of the Younger Dryas (see also Straus 2012). In Phase 1 (18-14 ka cal BP), growth rates stay within the parameters of the null model, and are positively correlated with increased precipitation, late-glacial sea level rise, and increased climatic instability during the rapidly warming Bølling/Allerød interstadial (13.8-12.7 ka cal BP). Population grew exponentially, with statistically significant upticks at 18-17.6, 14-13.4 and 13-12.8 kya. Phase 2 begins abruptly with the sharply colder (– 6° C) Younger Dryas (*c.* 12.9-11.6 kya) and extends throughout the Pre-boreal.

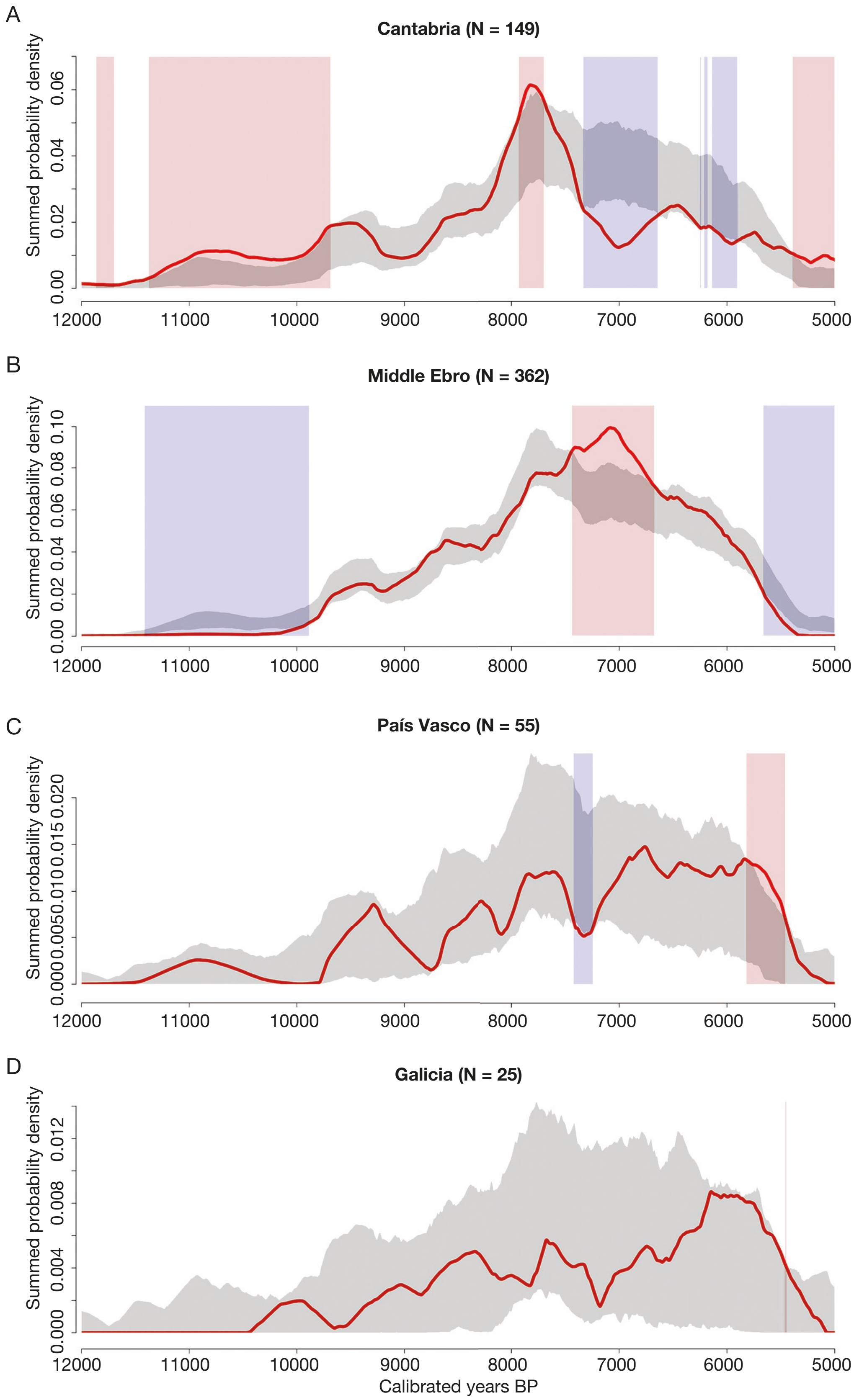

FIG. 22. — Regional SPD permutation test for the four regions comparing local population densities with the null model ($H_{0)}$ to identify intervals of positive (hot spots) and negative deviations (cold spots) with a probability of rejection of $H_o \leq 0.005$. For Cantabria (**A**) and the Middle Ebro (**B**), both graphs show statistically significant positive and negative deviations ($p \leq 0.005$), and stand in an inverse relationship to one another in the Epipaleolithic, the Mesolithic, and the early Neolithic. The Basque (**C**) and Galician (**D**) samples did not yield any statistically significant positive or negative deviations. because the associated probabilities are 0.145 and 0.363 respectively.

Significant negative deviations occur at 11.8-11.3, 11.1-10.7 and 10.5-9.9 kya, the dramatic change disrupting forager equilibria throughout the Peninsula, creating population/resource imbalances that pushed them beyond the limits of local carrying capacities, triggering a pan-Iberian contraction in population growth rates that amounted to a bottleneck. Phase 3 corresponds to the Boreal (11-9 kya) and Atlantic (9-5.8 kya), a period of logistic growth with population levels stabilizing between 9.3 and 8 kya owing to more stable temperature and precipitation regimes during the second half of the early Holocene. A short but strong uptick is dated to 7.8 kya. It is during this interval that dietary diversification increased to local maxima as foragers sought to reconcile relatively high population density with increasing resource stress. Although matches are inexact because of differences in scale (18-8 vs 12-5 ka cal BP), the Atlantic coastal and Ebro sub-samples are roughly comparable and show the same kind of inverse relationship described above. Significant population decline in north coastal Spain dates to 9.3-8.6 kya, while population increase in the Middle Ebro spikes at 8.7-8.5 kya. Data from an earlier paper (Clark *et al.* 2019) also tend to confirm this shift in population density.

MISCELLANEOUS ASPECTS OF PATTERN

In the course of this research, several other aspects of pattern became evident, suggesting future research directions. *We hasten to add that the following remarks are just that – unanalyzed, untested, subjective impressions.* Among them is the observation that we need to uncouple the first appearance of domesticates from evidence of dependence upon them. Most of the radiocarbon dates we used mark the former, rather than the latter, but dependence upon domesticates is of far greater behavioral significance than their mere appearance.

Transitional sites (i.e., those with stratified Mesolithic and Neolithic levels) were essentially confined to the middle Ebro where foragers were scarce on the landscape and where there is no evidence of a human presence prior to the late Magdalenian. They don't seem to exist elsewhere in northern Spain. The lower and middle Ebro were easily accessible to Neolithic colonists of coastal origin who encountered a broad corridor of suitable farm and pastureland land uninterrupted by the Pyrenees and the Cantabrian mountains. Early Neolithic sites are rare and later in the other three regions.

We also noticed a hiatus of approximately 1-2 millennia between what is regarded as "Mesolithic" and what is regarded as "Neolithic", probably indicating no more than consensus definitions of these two analytical units, often defined by the appearance of pottery that, in default of rare primary evidence for morphological domesticates, does not necessarily tell us anything about the subsistence economy.

In northern Spain, as in western Europe and the Middle East, there is a suggestion of population decline after the early Neolithic that could signal initially wasteful farming and herding practices that quickly exhausted soil nutrients and game, causing a population crash and a partial reversion to foraging, as happened in the Rhine and Danube (Shennan *et al.* 2013) and in the central and southern Levant (Rollefson & Köhler-Rollefson 1993). In the latter area, severe damage to the ecology surrounding large villages led to costly changes in farming and herding, greater mobility, decreases in site size and complexity, greater reliance on wild resources, impoverishment of material culture and, after *c.* 8000 BP, their abandonment, eventually followed by an increase in population – sometimes exponential, sometimes logistic – some 1500 years later (Kuijt & Goring-Morris 2002).

Despite good geoscience, archaeofaunal, archaeobotanical and radiometric data, few direct correlations between culture and climate change were apparent in our study except insofar as climate affects sea level change and changes in the extent of economic territories (cf. Fernández López *et al.* [2019] above). Although the narrow and deep continental shelf off northern Spain minimizes this problem there, the wide and shallow continental shelf off western Galicia was subject to sea level regression during the LGM and Tardiglacial, and transgression after the Holocene transition. Packing in the north Spanish coastal strip due to LGM glacial advance followed by more loss of territory as shallow continental shelves off Aquitaine and the west Galician coast were drowned by marine transgression during the early Holocene might have driven coastal foragers inland in Galicia into thinly populated areas. Consistent with the view that global climate change and local behavioral and environmental constraints are the primary determinants of demographic change, there should be a noticeable increase in Mesolithic sites in A Coruña and Pontevedra after about 8.0 ka cal BP.

Putting empirical "teeth" into these observations is hampered by a lack of data from open sites, the scarcity of faunal data, and differences in the kind, quality and package size of tool stone. Regarding material culture in general, it is logical to think that all forager adaptative systems would have required both heavy (macrolithic) and light (microlithic) tool components and that, given suitable tool stone, an apparently partial system (e.g. the Asturian, the Denticulate Mesolithic) must almost inevitably have been complemented by an as-yet-undiscovered (or unrecognized) component, perhaps an organic one. Except in Galicia, where there are few caves, and the relatively xeric, open environments of the Ebro valley, there is a massive bias against surveys in the regional research traditions of the north coast. Consequently, few open sites are known, raising the possibility that whole components of adaptive systems are "missing" simply because of a reluctance to adopt modern survey methodologies (e.g. Banning 2002; Fernández-López & Barton 2015).

CONCLUSIONS

Informed by various more or less explicit, mostly ecological, conceptual frameworks, and despite the inevitably uneven resolution of the time-space grid, recent work in northern Spain largely succeeds in shedding a long-standing adherence to culture history that has limited understanding of the foraging societies that lived within and adapted to a succession of changing landscapes in the millennia following the end of the Ice Age. In striking contrast to the pre-1980s view of cultural stagnation or "devolution" manifest mainly in the disappearance of the art and in simplified technologies, the north Spanish Mesolithic exhibits changes in mobility, inter-regional social organization, population dynamics, and changing subsistence economies that, depending on context and antecedent conditions, both resisted (Galicia, Cantabria, País Vasco) and facilitated (the middle Ebro) the adoption of agropastoralism.

Although the Mesolithic has an internal dynamic all its own, many workers feel obligated to come to grips with the nature of the transition to the Neolithic because of its transcendental importance in the economic history of our species, and because of the long-standing notion (see, e.g. papers in Zvelebil [1986]) that farming and foraging are fundamentally incompatible economic strategies that compete with one another for land, time, manpower, and other resources.

The quantitative model of the north European transition first proposed by Zvelebil & Rowley-Conwy (1986) figures prominently here. It entails an "availability" phase, where knowledge of domesticates is present, but are economically unimportant (<5% net caloric yield); "substitution", where domestication co-occurs with predation, either because of external factors (farmers colonize forager territories) or internal ones (foragers add domesticates to their range of subsistence practices; 5-50% net caloric yield), and "consolidation", where domesticates supplant predation, and foraging declines in importance (>50% net caloric yield). Although the ability to make these distinctions "on the ground" is clearly limited by factors of preservation, especially in Galicia, the adoption of farming and stock raising was clearly "patchy" and complementary in both space and time, due to proximate causes that varied from one region to the next, constrained by antecedent environmental, social, and economic conditions (see Clark [1987] for an exegesis of this view). The initial appearance of domesticates and the point at which they become economic staples are often separated by millennia, and foragers were exceptionally resistant to the adoption of domesticates, probably because of the increased labor costs involved ("domestication as a last resort" – Clark [1987]). Scattered evidence for precocious social complexity shows no correlation with an early adoption of either stock raising or agriculture (in fact, quite the contrary), suggesting that sedentism, resource intensification, and logistical collecting strategies do not necessarily pave the way for the transition, at least in northern Spain.

The "colonization wave" model of Ammerman & Cavalli-Sforza (1984) is well-supported only in the Ebro valley and along the western Mediterranean coast, where the introduction of agropastoralism appears to have been relatively rapid, and where domesticates were introduced as a "package" that quickly supplanted foraging economies (and perhaps the foragers themselves!). Even there, where there was essentially no "availability", and only a short "substitution" phase, it is clear that the transition was never an inevitable consequence of the inherent superiority of domestication economies, as Robert Braidwood argued long ago, and that understanding it simply involves plotting the distribution of early Neolithic sites in Europe and the Near East. The causes of the transition were multiple, complex and variable from region to region, with demographic factors (especially changes in population density) and, to a limited extent, climatically induced environmental changes affecting pre-existing balances between populations and resources in a mosaic pattern that we are only beginning to perceive. If a general explanation for the salient features of the Mesolithic, or for the Mesolithic-Neolithic transition, were eventually to emerge it will have to take into account many different trajectories for change. Given the lack of consensus about how to assign meaning to pattern, such a general explanation seems a long way off.

Empirical insufficiencies remain, of course, as they do in all archaeological research. Some of them that stand in the way of a better understanding of the north Spanish Mesolithic are: 1) low-resolution, poorly dated paleoenvironmental contexts; 2) inundation of early and middle Holocene shorelines by marine transgression; 3) rapid changes in latitudinally distributed floral and faunal successions along coasts with shallow continental shelves; 4) an archaeological record consisting largely of lithic surface scatters, with little or no stratigraphy, nor organic remains (e.g. Ireland, Scotland, Galicia); and 5) "banal" lithic assemblages, with few or no time-sensitive, stylistic marker types.

The transition to the Neolithic is also affected by a lack of data, and is, in addition, particularly subject to conceptual problems like: 1) strictly narrative models that lack a deductive component; 2) practical difficulties in distinguishing acculturation from immigration; 3) disagreement about how the Neolithic is to be defined (i.e., conflicting criteria, low probability of finding morphological domesticates, poor preservation of organics, etc.); 4) inapplicability of the conceptual frameworks to regions where there is little or no organic preservation; 5) contested definitions of, and test implications for, sedentism, mobility, social organization and social complexity; and 6) an inability to distinguish different "structural poses" (Binford & Sabloff 1982; Binford 2001) of a single group (or palimpsests created by multiple groups with a similar adaptation) from those of several groups with a different adaptation.

EPILOGUE

There is an equifinality to pattern in the past – different patterns can result from similar processes, and similar patterns can result from different processes. Much of the time-space grid for the north Spanish Mesolithic has been worked out to a satisfactory level of resolution, and great strides have been made over the past 25 years in identifying pattern but we are far from consensus about what is causing it to occur. Little by little, with the painstaking accumulation of more data, we should be able to arrive at better and better approximations of what actually happened in the past. Nevertheless, our conceptual reach should exceed our empirical grasp. A description of the past, no matter how detailed, is not an explanation of the past. If forced to choose, we tend to favor demographic over climatic explanations as agents for change but it's clear that an understanding of adaptation must take into account the complex adaptive links between natural and cultural systems. The challenge of future work will be to try to unravel the many tangled causal skeins that will allow us to discriminate some causes for pattern from others. How mid-latitude Holocene foragers adapted to their rapidly changing environments, to each other, and to colonizing agropastoralists – how they made the transition from predation to domestication after the end of the Ice Age – is of increasing relevance today as we face some of the unfortunate long-term consequences of that transition.

It might be thought presumptuous of us to have undertaken this survey (in fact, we were asked to do it). Neither of us are regional specialists so it is almost inevitable that we will be taken to task for shortcomings and mistakes by those who are. Nevertheless, the exercise has led to insights that we hope will stimulate discussion, if only because our results do not agree with consensus views in a particular region.

Acknowledgements
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Data archive and analysis scripts
All data and analysis scripts used to generate the summed probability distributions (SPDs) in Figures 18-22 are published and openly available on Zenodo at https://zenodo.org/record/5501599, and should be cited as Barton & Clark 2021 (see cited references section of this paper for full citation).

REFERENCES

Alday A. 2006. — El Mesolítico de muescas y denticulados en la cuenca del Ebro y el litoral Mediterráneo peninsular: síntesis de los datos, *in* Alday A. (ed.), *El Mesolítico de Muescas y Denticulados en la Cuenca del Ebro y el Litoral Mediterráneo Peninsular.* Memoria de Yacimientos Alaveses, Vol. 11, Vitoria-Gasteiz: 303-317.

Alday A. 2009. — El final del Mesolítico y los inicios del Neolítico en la Peninsula Ibérica: cronología y fases. *Munibe* 60: 157-173.

Alday A. & Cava A. 2006. — La unidad de muescas y denticulados en el Mesolítico del 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.* Memoria de Yacimientos Alaveses, Vol. 11, Vitoria-Gasteiz: 223-230.

Alday A., Domingo R., Sebastián M., Soto A., Aranbarri J., González-Sampériz P., Sampietro-Vattuone M. M., Utrilla P., Montes L. & Peña-Monné J. L. 2018. — The silence of the layers: archaeological site visibility in the Pleistocene-Holocene transition in the Ebro Basin. *Quaternary Science Reviews* 184: 85-106. https://doi.org/10.1016/j.quascirev.2017.11.006

Altuna J. 1972. — Fauna de mamíferos de los yacimientos prehistóricos de Guipúzcoa. *Munibe* 24: 1-464.

Altuna J. 1980. — Historia de la domesticación animal en el País Vasco, desde sus origenes hasta la Romanización. *Munibe* 32: 1-163.

Altuna J. 1986. — The mammalian faunas from the prehistoric site of La Riera, *in* Straus L. G. & Clark G. A. (eds), *La Riera Cave – Stone Age Hunter-Gatherer Adaptations in Northern Spain*. Arizona State University Anthropological Research Papers 36, Tempe: 237-274, 421-480.

Altuna J. & Mariezkurrena K. 2009. — Tipos de cabañas ganaderas durante el Neolítico del País Vasco y zonas próximas. *Archaeofauna* 18: 137-157.

Altuna J. & Mariezkurrena K. 2012. — Macromammalian remains from the Holocene levels of El Mirón cave, *in* Straus L. G. & González Morales R. (eds), *El Mirón Cave, Cantabrian Spain: the Site and Its Holocene Archaeological Record.* University of New Mexico Press, Albuquerque: 288-318.

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

Álvarez-Fernández E. 2008. — Food and more: marine mollusks' exploitation during the Upper Paleolithic and Mesolithic of Cantabrian Spain and the Ebro Valley. *Archaeofauna* 17: 47-61.

Álvarez-Fernández E., Ontañón-Peredo R. & Molares-Vila J. 2010. — Archaeological data on the exploitation of the goose barnacle *Pollicipes pollicipes* (Gmelin, 1790) in Europe. *Journal of Archaeological Science* 37: 402-408. https://doi.org/10.1016/j.jas.2009.10.003

Álvarez-Fernández E., Chauvin A., Cubas M., Arias Cabal P. & Ontañón-Peredo R. 2011. — Mollusc shell sizes in archaeological contexts in northern Spain (3200 to 2600 cal BC): new data from La Garma A and Los Gitanos. *Archaeometry* 53: 963-985. https://doi.org/10.1111/j.1475-4754.2011.00589.x

Ameijenda-Iglesias A., Lombera-Hermida A. de, Pérez-Alberti A., Rodríguez-Álvarez X. P. & Fábregas Valcarce R. 2010. — Geomorphological and geoarchaeological evolution of the Monforte de Lemos basin (Galicia, Spain). Erosion phases and post-depositional processes in NW Iberia. *Estudos do Quaternário* 6: 5-22. https://doi.org/10.30893/eq.v0i6.71

Ammerman A. & Cavalli-Sforza L. L. 1984. — A population model for the diffusion of early farming in Europe, *in* Renfrew C. (ed.), *The Explanation of Culture Change*. University of Pittsburgh Press, Pittsburgh: 343-358.

Andrefsky W. 1994. — Raw-material availability and the organization of technology. *American Antiquity* 59: 21-34. https://doi.org/10.2307/3085499

Andrefsky W. 1998. — *Lithics – Macroscopic Approaches to Analysis.* Cambridge University Press, Cambridge, 242 p.

Andrefsky W. 2009. — The analysis of stone tool procurement, production, and maintenance. *Journal of Archaeological Research* 17: 65-103. https://doi.org/10.1007/s10814-008-9026-2

Aranzadi T., Barandiarán J. M. & De Eguren E. 1925. — *Exploraciones en la caverna de Santimamiñe (Basondo, Cortézubi) 2. Los niveles con ceramica y el conchero.* 2ª Memoria, Bilbao, 152 p. (reprinted *in* Barandiarán J. M. 1976. *Obras Completas IX.* Imp. Grijelmo, Bilbao: 91-243).

Araújo C. 2009. — Hunter-gatherer adaptations during the Pleistocene/Holocene transition in Portugal: data and explanatory models, *in* McCartan S., Schulting R., Warren G. & Woodman P. (eds), *Mesolithic Horizons*, Vol. I. Oxbow Books, Oxford: 533-540.

ArchaeoGLOBE Project 2019. — Archaeological assessment reveals Earth's early transformation through land use. *Science* 365: 897-202. https://doi.org/10.1126/science.aax1192

Arias Cabal P. 1999. — The origins of the Neolithic along the Atlantic coast of continental Europe: a survey. *Journal of World Prehistory* 13: 403-464. https://doi.org/10.1023/A:1022370513087

Arias Cabal P. 2007. — Neighbours but diverse: social change in NW Iberia during the transition from the Mesolithic to the Neolithic (5500-4000 cal BC), *in* Whittle A. & Cummings V. (eds), Going over: the Mesolithic-Neolithic transition in north-west Europe. *Proceedings of the British Academy* 144: 53-71. https://doi.org/10.5871/BACAD/9780197264140.003.0004

Arias Cabal P. 2012. — Después de Los Azules: las prácticas funerarias en las sociedades Mesolíticas de la región Cantábrica, *in* Muñiz Álvarez J. (ed.), *Ad Orientem: del Final del Paleolítico en el norte de España a las Primeras Civilizaciones del Oriente Próximo.* Oviedo, Universidad de Oviedo: 253-274.

Arias Cabal P. & Fano M.-Á. 2003. — Shell middens and megaliths: Mesolithic funerary contexts in Cantabrian Spain and their relation to the Neolithic, *in* Burenhult G. (ed.), *Stones and Bones –Formal Disposal of the Dead in Atlantic Europe during the Mesolithic-Neolithic Interface 6000–3000 BC.* BAR Publishing (coll. International Series 1201), Oxford: 145-166.

Arias Cabal P. & Álvarez-Fernández E. 2004. — Iberian foragers and funerary ritual – a review of Paleolithic and Mesolithic evidence on the Peninsula, *in* González Morales M. & Clark G. A. (eds), *The Mesolithic of the Atlantic Façade: Proceedings of the Santander Symposium.* Arizona State University Anthropological Research Papers 55, Tempe: 225-248.

Arias Cabal P. & Fano M.-Á. 2005. — Le rôle des resources marines dans le Mésolithique de la region Cantabrique (Espagne); l'apport des isotopes stables, *in* Marchand G. & Tresset A. (eds), *Unité et diversité des processus de néolithisation sur la façade atlantique de l'Europe (6e-4e millénaires avant J.-C.).* Société Préhistorique Française, Mémoire 36, Paris: 173-188.

Arias Cabal P., Fano Martínez M. A., Armendáriz Gutiérrez A., Álvarez Fernández E., Rapado M. C., Fernández García R., Garralda Benajes M. D., Mensua Calzado C. & Teira Mayolini L. C. 2007a. — Programa de sondeos en concheros Holocenos del Oriente de Asturias, *in Excavaciones Arqueológicas en Asturias, 1999-2007.* Servicio de Publicaciones del Principado de Asturias, Oviedo: 107-116.

Arias Cabal P., Fernández-Tresguerres Velasco J. A., Álvarez Fernández E., Armendáriz Gutiérrez Á., Cueto Rapado M., Fano Martínez M. A., Fernández García R., Garralda M. D., Mensua Calzado C. & Teira Mayolini L. 2007b. — Excavación arqueológica de urgencia en la cueva de La Poza l'Egua (Lledías, Llanes), *in Excavaciones Arqueológicas en Asturias 1999–2002.* Servicio de Publicaciones del Principado de Asturias, Oviedo: 227-240.

Arias Cabal P., Armendáriz Gutiérrez Á., de Balbín R., Fano Martínez M. A., Fernández-Tresguerres Velasco J. A., González Morales M., Iriarte J. M., Ontañón R., Alcolea J., Álvarez Fernández E., Etxberría F., Garralda M. D., Jackes M. & Arrizabalaga Á. 2009a. — Burials in the cave: new evidence on mortuary practices during the Mesolithic of Cantabrian Spain, *in* McCartan S., Schulting R., Warren G. & Woodman P. (eds), *Mesolithic Horizons*, Vol. II. Oxbow Books, Oxford: 650-656.

Arias Cabal P., Cerrillo-Cuenca E., Álvarez Fernández E., Gómez Pellón E. & González Cordero A. 2009b. — A view from the edges: the Mesolithic settlement of the interior areas of the Iberian Peninsula reconsidered, *in* McCartan S., Schulting R., Warren G. & Woodman P. (eds), *Mesolithic Horizons*, Vol. I. Oxbow Books, Oxford: 301-308.

Arias Cabal P., Cubas Morera M., Fano Martínez M. A., Álvarez Fernández E., Armendáriz Gutierrez Á., Araújo, A. C., Cueto Rapado M., Duarte Simões C., Fernández Sánchez P., Iriarte Avilés E., Jordá Pardo J., López-Dóriga I. L., Marqués Menéndez A., Maximiano Castillejo A., Núñez de la Fuente S., Salmann C., Tapia Sagarna J., Teichner F., Teira Mayolini L., Uzquiano Ollero P. & Vallejo Llano J. 2018. — *Tras las huellas de los asentamientos Asturienses – intervenciones arqueolólogicas en El Alloru, la Sierra Plana de la Borbolla y otros sitios Mesolíticos del oriente de Asturias. Excavaciones Arqueológicas en Asturias (2013-2016).* Consejería de Educación y Cultura, Oviedo: 21-37.

Aura J., Jordá J., Montes L. & Utrilla P. 2011. — Human responses to Younger Dryas in the Ebro valley and the Mediterranean watershed (eastern Spain). *Quaternary International* 242: 348-359. https://doi.org/10.1016/j.quaint.2011.01.023

Bailey G. N. 1983. — Economic change in late Pleistocene Cantabria, *in* Bailey G. N. (ed.), *Hunter-Gatherer Economy in Prehistory: a European Perspective.* Cambridge University Press, Cambridge: 149-165.

Bailey G. N. & Craighead A. 2004. — Coastal paleoeconomies and paleoenvironmental trends: Asturian and Australian middens compared, *in* González Morales M. R. & Clark G. A. (eds), *The Mesolithic of the Atlantic Façade: Proceedings of the Santander Symposium.* Arizona State University Anthropological Research Papers 55, Tempe: 181-204.

Banning E. B. 2002. — *Archaeological Survey.* Kluwer Academic/Plenum, New York, 271 p.

Barandiarán I., Cava A. & Aguirre M. 2008. — *Cazadores y tallistas en el abrigo de Portugain: una ocupación de Urbasa durante el Tardiglaciar.* José Miguel de Barandiarán Fundazioa, Vitoria-Gasteiz, 312 p.

Barral-Arca R., Pischedda S., Gómez-Carballa A., Pastoriza A., Mosquera-Miguel A., López-Soto M., Martinón-Torres F., Álvarez-Iglesias V. & Salas A. 2016. — Meta-analysis of mitochondrial DNA variation in the Iberian Peninsula. *PLoS ONE* 11 (7): e0159735. https://doi.org/10.1371/journal.pone.0159735

Barton C. M. 1991. — Retouched tools – fact or fiction? Paradigms for interpreting Paleolithic chipped stone, *in* Clark G. A. (ed.), *Perspectives on the Past.* University of Pennsylvania Press, Philadelphia: 143-163.

Barton C. M. 1998. — Looking back from the world's end: paleolithic settlement and mobility at Gibraltar, *in* Sanchidrian J., Vallejo L. & Simon J. (eds), *Las Culturas del Pleistoceno Superior en Andalucía*. Patronato de la Cueva de Nerja, Nerja: 13-23.

Barton C. M. 2014. — Complexity, social complexity, and modeling. *Journal of Archaeological Method & Theory* 21: 306-324. https://doi.org/10.1007/s10816-013-9187-2

Barton C. M. & Riel-Salvatore J. 2014. — The formation of lithic assemblages. *Journal of Archaeological Science* 46: 334-352. https://doi.org/10.1016/j.jas.2014.03.031

Barton C. M. & Clark G. A. 2021. — *Supplement: Mesolithic of northern Spain – data and analysis scripts*. https://doi.org/10.5281/zenodo.5501599

Barton C. M., Clark G. A. & Cohen A. 1994. — Art as information: explaining Upper Paleolithic art in western Europe. *World Archaeology* 26: 185-207. https://doi.org/10.1080/00438243.1994.9980272

Barton C. M., Riel-Salvatore J., Anderies J. M. & Popescu G. 2011. — Modeling human ecodynamics and biocultural interactions in the Late Pleistocene of western Eurasia. *Human Ecology* 39: 705-725. https://doi.org/10.1007/s10745-011-9433-8

Barton C. M., Aura Tortosa J. E., Garcia-Puchol O., Riel-Salvatore J. L., Gauthier N., Vadillo Conesa M. & Pothier Bouchard G. 2018. — Risk and resilience in the late glacial: A case study from the western Mediterranean. *Quaternary Science Reviews* 184: 68-84. https://doi.org/10.1016/j.quascirev.2017.09.015

Behar D., Harmant C., Manry J., van Oven M., Haak W., Martinez-Cruz B., Salaberria J., Oyharçabal B., Bauduer F., Comas D. & Quintana-Murci L. 2012. — The Basque paradigm: genetic evidence of a maternal continuity in the Franco-Cantabrian region since pre-Neolithic times. *American Journal of Human Genetics* 90: 486-493. https://doi.org/10.1016/j.ajhg.2012.01.002

Bergaglio M. 2017. — The contemporary illusion: population growth and sustainability. *Environment, Development and Sustainability* 19: 2023-2038. https://doi.org/10.1007/s10668-016-9842-3

Bernabeu Aubán J., García-Puchol O., Pardo Gordó S., Barton C. M. & McClure S. B. 2014. — Socioecological dynamics at the time of the Neolithic transition in Iberia. *Environmental Archaeology* 19: 214-225. https://doi.org/10.1179/1749631414Y.0000000032

Bernabeu Aubán J. B., Barton C. M., Pardo Gordó S. & Bergin S. 2015. — Modeling initial Neolithic dispersal. The first agricultural groups in West Mediterranean. *Ecological Modelling* 307: 22-31. https://doi.org/10.1016/j.ecolmodel.2015.03.015

Bernabeu Aubán J., García-Puchol O., Barton M., McClure S. & Pardo Gordó S. 2016. — Radiocarbon dates, climatic events, and social dynamics during the Early Neolithic in Mediterranean Iberia. *Quaternary International* 403: 201-210. https://doi.org/10.1016/j.quaint.2015.09.020

Bettinger R. 2016. — Prehistoric hunter-gatherer population growth rates rival those of agriculturalists. *Proceedings of the National Academy of Sciences* 113: 812-814. https://doi.org/10.1073/pnas.1523806113

Binford L. 1980. — Willow smoke and dogs' tails: hunter-gatherer settlement systems and archaeological site formation. *American Antiquity* 45: 4-20. https://doi.org/10.2307/279653

Binford L. 1981. — *Bones – Ancient Men and Modern Myths.* Academic Press, New York, 319 p.

Binford L. 2001. — *Constructing Frames of Reference: an Analytical Method for Theory Building using Ethnographic and Environmental Data Sets.* University of California Press, Berkeley, 583 p.

Binford L. & Sabloff J. 1982. — Paradigms, systematics and archaeology. *Journal of Anthropological Research* 38: 137-153. https://doi.org/10.1086/jar.38.2.3629594

Blas Cortina M.-A., González Morales M. R., Márquez Uría M. C. & Rodríguez Asensio J. A. 1978. — Picos Asturienses de yacimientos al aire libre en Asturias. *Boletín del Instituto de Estudios Asturianos* 32: 335-356.

Bronk Ramsay C. 2009. — Bayesian analysis of radiocarbon dates. *Radiocarbon* 51: 337-360. https://doi.org/10.1017/S0033822200033865

Bronk Ramsey C. & Lee S. 2013. — Recent and planned developments of the program OxCal. *Radiocarbon* 55: 720-730. https://doi.org/10.1017/S0033822200057878

Brotherton P., Haak W., Templeton J., Brandt G., Soubrier J., Adler C. J., Richards S. M., Der Sarkissian C., Ganslmeier R., Friederich S., Dresely V., van Oven M., Kenyon R., Van der Hoek M. B., Korlach J., Luong K., Ho S. Y. W., Quintana-Murci L., Behar D. M., Meller H., Alt K. W. & Cooper A. 2013. — Neolithic mitochondrial haplogroup H genomes and the genetic origins of Europeans. *Nature Communications* 4: 1-11. https://doi.org/10.1038/ncomms2656

Butzer K. & Bowman D. 1979. — Some sediments from Asturian archaeological levels from sites in Cantabrian Spain. *Quaternaria* 21: 287-291.

Cabrera Valdés V. & Bischoff J. 1989. — Accelerator ^{14}C ages for basal Aurignacian at El Castillo, Spain. *Journal of Archaeological Science* 16: 577-584. https://doi.org/10.1016/0305-4403(89)90023-X

Cano Pan J. 1997. — La cadena operativa lítica en el yacimiento de Portecelo (O Rosal, Pontevedra). *Gallaecia* 16: 191-200.

Cano Pan J. 2012. — Análisis historiográfico del Paleolítico en Galicia, *in* Beramendi J. G. (ed.), *Galicia e a Historiografía.* Tórculo Edicións, Santiago: 29-52.

Cano Pan J. & Vázquez Varela J. M. 1986. — Nuevas aportaciones al estudio de las industrias líticas del suroeste de Galicia: la prospección de 1984. *Studia Zamoriensa Historica* 7: 267-304.

Carlson A. 2010. — What caused the Younger Dryas cold event? *Geology* 38: 383-384. https://doi.org/10.1130/focus042010.1

Cava A. 2004. — Los 'procesos culturales' del comienzo del Holoceno en la cuenca del Ebro y su contextualización. *Saldvie: Estudios de Prehistoria y Arqueología* 4: 17-40.

Cava A., Almuzara A. & Ruíz A. 2004. — *La Ocupación Prehistórica de Kanpanoste (Virgala, Álava) en el Contexto de los Cazadores-Recolectores del Mesolítico.* Memorias de Yacimientos Álaveses 9, Diputación Foral de Álava, Vitoria, 179 p.

Chaput M. & Gajewski K. 2016. — Radiocarbon dates as estimates of ancient human population size. *Anthropocene* 15: 3-12. https://doi.org/10.1016/j.ancene.2015.10.002

Childe V. G. 1925. — *The Dawn of European Civilization.* Kegan Paul, London, 226 p.

Christenson A. 1980. — Change in the human food niche in response to population growth, *in* Earle T. & Christenson A. (eds), *Modeling Change in Prehistoric Subsistence Economies*. Academic Press, New York: 31-72.

Clark G. A. 1971. — *The Asturian of Cantabria: a Re-evaluation.* PhD dissertation, Department of Anthropology, University of Chicago, 660 p.

Clark G. A. 1975. — *Liencres: una Estación al Aire Libre de Estilo Asturiense cerca de Santander.* Universidad de Deusto, Cuadernos de Arqueología 3, Bilbao, 84 p.

Clark G. A. 1976. — *El Asturiense Cantábrico.* Biblioteca Prehistórica Hispana 13, Consejo Superior de Investigaciones Científicas, Madrid, 377 p.

Clark G. A. 1979. — Liencres – an open station of Asturian affinity near Santander, Spain. *Quaternaria* 21: 249-286, 300-304.

Clark G. A. 1982. — Quantifying archaeological research. *Advances in Archaeological Method and Theory* 4: 217-273. https://doi.org/10.1016/B978-0-12-003105-4.50011-X

Clark G. A. 1983a. — Boreal phase settlement-subsistence models in Cantabrian Spain, *in* Bailey G. N. (ed.), *Hunter-Gatherer Economy in Prehistory: a European Perspective*. Cambridge University Press, Cambridge: 96-110.

Clark G. A. 1983b. — *The Asturian of Cantabria: Early Holocene Hunter-Gatherers in Northern Spain.* University of Arizona Press, Tucson, 183 p.

Clark G. A. 1987. — From the Mousterian to the Metal Ages: long-term change in the human diet of Cantabrian Spain, *in* Soffer O. (ed.), *The Pleistocene Old World: Regional Perspectives.* Plenum Publishing Corporation, New York: 293-316. https://doi.org/10.1007/978-1-4613-1817-0_19

Clark G. A. 1989. — Site functional complementarity in the Mesolithic of northern Spain, *in* Bonsall C. (ed.), *The Mesolithic in Europe.* John Donald Publishers, Edinburgh: 589-603.

Clark G. A. 1993. — Paradigms in science and archaeology. *Journal of Archaeological Research* 1: 203-234. https://doi.org/10.1007/BF01326535

Clark G. A. 1994. — Aspectos epistemológicos de la interpretación del registro arqueológico: el papel del paradigma metafísico, *in* Lasheras J. (ed.), *Homenaje al Doctor Joaquín González Echegaray*. Ministerio de Cultura, Madrid: 1-12.

Clark G. A. 2000. — Intraregional variability in the Mesolithic of Atlantic coastal Iberia, *in* Peterkin G. & Price H. (eds), *Regional Approaches to Adaptation in Late Pleistocene Western Europe*. BAR Publishing (coll. International Series 896), Oxford: 205-220.

Clark G. A. 2001. — Discussion: the logic of inference in transition research, *in* Hays M. & Thacker P. (eds), *Questioning the Answers: Re-solving Fundamental Problems of the Early Upper Paleolithic.* BAR Publishing (coll. International Series 1005), Oxford: 39-48.

CLARK G. A. 2004. — The Iberian Mesolithic in the European context, *in* GONZÁLEZ MORALES M. R. & CLARK G. A. (eds), *The Mesolithic of the Atlantic Façade: Proceedings of the Santander Symposium*. Arizona State University Anthropological Research Papers 55, Tempe: 205-224.

CLARK G. A. 2009. — A Mesolithic tapestry – Holocene foragers prior to the Neolithic. *Journal of Island and Coastal Archaeology* 4: 249-255. https://doi.org/10.1080/15564890903083541

CLARK G. A. 2011. — Historical connection and formal convergence in the Lower Paleolithic of Eurasia, *in* YI S. (ed.), *Handaxes in the Imjin Basin: Diversity and Variability in the East Asian Paleolithic.* Seoul National University Press, Seoul: 37-82.

CLARK G. A. & MENÉNDEZ-AMOR J. 1979. — Pollen samples from Liencres: Levels 1 and 2. *Quaternaria* 21: 292-295.

CLARK G. A. & STRAUS L. G. 1983. — Late Pleistocene hunter-gatherer adaptations in Cantabrian Spain, *in* BAILEY G. N. (ed.), *Hunter-Gatherer Economy in Prehistory: a European Perspective*. Cambridge University Press, Cambridge: 131-148.

CLARK G. A. & RIEL-SALVATORE J. 2006. — Observations on systematics in paleolithic archaeology, *in* HOVERS E. & KUHN S. (eds), *Transitions before the Transition: Evolution and Stability in the Middle Paleolithic and the Middle Stone Age*. Springer, New York: 29-56. https://doi.org/10.1007/0-387-24661-4_3

CLARK G. A. & BARTON C. M. 2017. — Lithics, landscapes and *la longue durée* – curation and expediency as expressions of forager mobility. *Quaternary International* 450: 137-149. https://doi.org/10.1016/j.quaint.2016.08.002

CLARK G. A., BARTON C. M. & COHEN A. 1996. — Explaining art in the Franco-Cantabrian refugium: an information exchange model, *in* MEYER D., DAWSON P. & HANNA D. (eds), Debating Complexity – Proceedings of the 26th Annual Chacmool Conference, Archaeological Association of the University of Calgary, Calgary: 241-253.

CLARK G. A., BARTON C. M. & STRAUS L. G. 2019. — Landscapes, climate and forager mobility in the Upper Paleolithic of northern Spain. *Quaternary International* 515: 176-187. https://doi.org/10.1016/j.quaint.2018.04.037

CLARKE D. L. 1978. — *Mesolithic Europe: the Economic Basis.* Duckworth, London, 489 p.

CORBET G. 1966. — *The Terrestrial Mammals of Western Europe*. G. T. Foulis, London, 260 p.

CORTELL-NICOLAU A., GARCÍA-PUCHOL O., BARTON C. M., DIÉZ-CASTILLO A. & PARDO-GORDÓ S. 2019. — Wandering through the Mesolithic – an archaeostatistical approach to explore the mobility patterns in eastern Iberia. *Journal of Archaeological Science: Reports* 26: 101892. https://doi.org/10.1016/j.jasrep.2019.101892

CREMA E. & BEVAN A. 2018. — *rcarbon v1. 2.0: Methods for calibrating and analysing radiocarbon dates.*

CREMA E., HABU J., KOBAYASHI K. & MADELLA M. 2016. — Summed probability distribution of ^{14}C dates suggests regional divergence in population dynamics of the Jomon Period in eastern Japan. *PloS One* 11: e0154809. https://doi.org/10.1371/journal.pone.0154809

CREMA E., BEVAN A. & SHENNAN S. 2017. — Spatio-temporal approaches to archaeological radiocarbon dates. *Journal of Archaeological Science* 87: 1-9. https://doi.org/10.1016/j.jas.2017.09.007

CUBAS M., ALTUNA J., ÁLVAREZ-FERNÁNDEZ E., ARMENDARIZ A., FANO M.-Á., LÓPEZ-DÓRIGA I., MARIEZKURRENA K., TAPIA J.,TEIRA L. & ARIAS CABAL P. 2016. — Re-evaluating the Neolithic: the impact and consolidation of farming practices in the Cantabrian region (northern Spain). *Journal of World Prehistory* 29: 79-116. https://doi.org/10.1007/s10963-016-9091-2

CUENCA-SOLANA D., CLEMENTE CONTE I. & GUTIÉRREZ ZUGASTI I. 2010. — Utilización de instrumentos de concha durante el mesolítico y neolítico inicial en contextos litorales de la región Cantábrica: programa experimental para el análisis de huellas de uso en materiales malacológicos. *Trabajos de Prehistoria* 67: 211-225. https://doi.org/10.3989/tp.2010.10037

CUENCA-SOLANA D., GUTIÉRREZ ZUGASTI I. & CLEMENTE CONTE I. 2011. — Human groups: the contribution of ethnographical studies to research on Mesolithic and Early Neolithic technologies in northern Spain. *Journal of Anthropological Research* 67: 77-102. https://doi.org/10.3998/jar.0521004.0067.105

CUENCA-SOLANA D., GUTIÉRREZ-ZUGASTI F. I., GONZÁLEZ-MORALES M. R., SETIÉN-MARQUINEZ J., RUIZ-MARTINEZ E., GARCÍA-MORENO A. & CLEMENTE-CONTE I. 2013. — Shell technology, rock art, and the role of marine resources during the Upper Paleolithic. *Current Anthropology* 54: 370-380. https://doi.org/10.1086/670325

CUENCA-SOLANA D., GUTIÉRREZ-ZUGASTI I., CLEMENTE-CONTE I. & GONZÁLEZ-MORALES M. R. 2018. — Asturian picks from the Mesolithic shell midden of Mazaculos II (northern Spain): a functional interpretation, *in* The Russian Academy of Sciences, St. Petersburg: 170-173. https://doi.org/10.31600/978-5-907053-00-7-2018-170-173

DARLING F. F. 1963. — *A Herd of Red Deer: a Study in Animal Behaviour*. Oxford University Press, London, 213 p.

DEITH M. & SHACKLETON N. 1986. — Seasonal exploitation of marine molluscs: oxygen isotope analysis of shell from La Riera Cave, *in* STRAUS L. G. & CLARK G. A. (eds), *La Riera Cave – Stone Age Hunter-gatherer Adaptations in Northern Spain.* Arizona State University Anthropological Research Papers 36, Tempe: 299-313.

DÍAZ-ANDREU M. 2014. — Transnationalism and archaeology. The connecting origins of the main institutions dealing with prehistoric archaeology in Western Europe: the IPH, the CIPP and the CRPU (1910-1914), *in* GUIDI A. (ed.), *150 Anni di Preistoria e Protostoria in Italia.* IIPP, Firenze: 163-177.

DÍAZ-ANDREU M. & MORA G. 1995. — Arqueología y política: el desarrollo de la arqueología Española en su contexto histórico. *Trabajos de Prehistoria* 52: 25-38. https://doi.org/10.3989/tp.1995.v52.i1.429

DÍAZ-ANDREU M., MORA G. & CORTADELLA J. (eds) 2009. — *Diccionario Histórico de la Arqueología en España.* Museo Arqueológico Nacional, Madrid, 784 p.

DIÉZ CASTILLO A. 1995. — El asentamiento de la Peña Oviedo (Camaleño, Cantabria): la colonización de las áreas montañosas de la cornisa Cantábrica. *Cuadernos de Sección Prehistoria-Arqueología* 6: 105-120.

DOMANSKI M. & WEBB J. 2007. — A review of heat treatment research. *Lithic Technology* 32: 153-194. https://doi.org/10.1080/01977261.2007.11721052

DOMÍNGUEZ FONTELA J. 1925. — La estación paleolítica de La Guardia. *Boletín Arqueológico de la Comisión Provincial de Monumentos Históricos y Artísticos de Orense* 160: 241-244.

DOMÍNGUEZ-VILLAR D., FAIRCHILD I. J., ANDY BAKER, WANG X., EDWARDS R. L. & CHENG H. 2009. — Oxygen isotope precipitation anomaly in the North Atlantic region during the 8.2 ka event. *Geology* 37: 1095-1098. https://doi.org/10.1130/G30393A.1

FÁBREGAS VALCARCE R. & LOMBERA-HERMIDA A. DE 2010. — El Paleolítico superior en Galicia a la luz de las últimas investigaciones, *in* MANGADO X. (ed.), *El Paleolítico Superior Peninsular: Novedades del Siglo XXI.* Jornadas Internacionales sobre el Paleolítico Superior Peninsular, Barcelona: 255-270.

FÁBREGAS VALCARCE R., LAZUÉN T., LOMBERA-HERMIDA A. DE, PEÑA ALONSO J. A., PÉREZ ALBERTI A., RODRÍGUEZ X. P., RODRÍGUEZ RELLÁN C. & TERRADILLOS M. 2007. — Novos achados paleolíticos no interior de Galicia. A depresión de Monforte de Lemos e as súas industrias líticas. *Gallaecia* 26: 7-33.

FÁBREGAS VALCARCE R., ALONSO FERNÁNDEZ S., LAZUÉN T., LOMBERA-HERMIDA A. DE, PÉREZ ALBERTI A., RODRÍGUEZ X. P., RODRÍGUEZ RELLÁN C., TERRADILLOS M., SERNA GONZÁLEZ M. R. & VAQUERO RODRÍGUEZ M. 2008. — Aportacións ó estudo da prehistoria da cunca media do Miño. Os asentamentos en cova e ó aire libre. *Gallaecia* 27: 63-88.

Fábregas Valcarce R., Alonso Fernández S., Ameijenda Iglesias A., Grandal d'anglade A., Lazuén T., Lombera-Hermida de A., Pérez Alberti A., Pérez Rama M., Rodríguez Álvarez X.-P., Rodríguez Rellán C., Serna González M. R., Terradillos M. & Vaquero Rodríguez M. 2009. — Novos resultados das intervencións arqueolóxicas no sur lucense. Os xacementos paleolíticos da depresión de Monforte (Monforte de Lemos), Cova Eirós (Triacastela) e Valdavara (Becerreá). *Gallaecia* 28: 9-32.

Fábregas Valcarce R., Alonso Fernández S., Ameijenda Iglesias A., Grandal D'anglade A., Lazuén T., Lombera-Hermida A. de, Pérez Alberti A., Pérez Rama M., Rodríguez Álvarez X.-P., Serna González M. R. & Vaquero Rodríguez M. 2010. — Completando o mapa. Novas datacións absolutas para o Paleolítico e Mesolítico do interior Galego. *Gallaecia* 29: 5-28.

Fábregas Valcarce R. 2011. — A research program on the Palaeolithic settlement of inland Galicia (NW Spain), *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds.), To the West of Spanish Cantabria – The Palaeolithic Settlement of Galicia. BAR Publishing (coll. International Series 2283), Oxford: 73-80.

Fábregas Valcarce R. & Vilaseco Váquez X. I. 2013. — From west to west: the many lives of the Galician mounds, *in* O'Sullivan M., Scarre C. & Doyle M. (eds), *Tara – From the Past to the Future,* Wordwell, Wicklow: 502-509.

Fábregas Valcarce R., Faustino Carvalho A., Lombera-Hermida A. de, Cubas M., Lucquin A., Craig O. E. & Rodríguez-Álvarez X. P. 2019. — Vaso con decoración cardial de Cova Eirós (Triacastela, Lugo). *Trabajos de Prehistoria* 76: 147-161. https://doi.org/10.3989/tp.2019.12231

Fano M. 1998. — *El Hábitat Mesolítico en el Cantábrico Occidental. Transformaciones Ambientales y Medio Físico durante el Holoceno Antiguo.* BAR Publishing (coll. International Series 732), Oxford, 155 p.

Fano M. 2007a. — Un nuevo tiempo: el Mesolítico en la region Cantábrica, *in* Fano M. (ed.), *Las Sociedades del Paleolítico en la Región Cantábrica. Kobie* 8: 337-402.

Fano M. 2007b. — The use of marine resources by the Mesolithic and early Neolithic societies of Cantabrian Spain: the current evidence, *in* Milner N., Craig O. & Bailey G. N. (eds), *Shell Middens of Atlantic Europe.* Oxbow Books, Oxford: 136-149.

Fano M.-A., Cubas M. & Wood R. 2015. — The first farmers in Cantabrian Spain: contribution of numerical chronology to understand an historical process. *Quaternary International* 364: 153-161. https://doi.org/10.1016/j.quaint.2014.09.026

Fernández-Eraso J. 2011. — *Santimamiñe en la Prehistoria Vasca.* Excavaciones Arqueológicas en Bizkaia 1, Diputación Foral de Bizkaia, Bilbao: 393-400.

Fernández-Eraso J., Mujika J. & Tarriño A. 2005. — Relaciones entre la Cornisa Cantábrica y el valle del Ebro durante los inicios del Neolítico en el País Vasco, *in* Arias Cabal P., Ontañón R. & García-Moncó C. (eds), *Actas del III Congreso del Neolítico en la Península Ibérica.* Instituto Internacional de Investigaciones Prehistóricas de Cantabria, Monografía 1, Santander: 201-209.

Fernández-Eraso J., Mujika-Alustiza J. A., Zapata-Peña L., Iriarte-Chiapusso M.-J., Polo-Díaz A., Castaños P., Tarriño-Vinagre A., Cardoso S., Sesma-Sesma J. & García-Gazolaz J. 2015. — Beginnings, settlement and consolidation of the production economy in the Basque region. *Quaternary International* 364: 162-171. https://doi.org/10.1016/j.quaint.2014.09.070

Fernández-López J. & Gómez Puche M. 2009. — Climate change and population dynamics during the late Mesolithic and the Neolithic transition in Iberia. *Documenta Praehistorica* 36: 67-96. https://doi.org/10.4312/dp.36.4

Fernández-López J. & Barton C. M. 2015. — Bayesian estimation dating of lithic surface collections. *Journal of Archaeological Method and Theory* 22: 559-583. https://doi.org/10.1007/s10816-013-9198-z

Fernández-López J., Gutiérrez-Roig M., Gómez-Puche M., Mclaughlin R., Silva F. & Lozano S. 2019. — Palaeodemographic modelling supports a population bottleneck during the Pleistocene-Holocene transition in Iberia. *Nature Communications* 10: 1872. https://doi.org/10.1038/s41467-019-09833-3

Fernández Rodríguez C. 2000-2001. — Industria ósea prehistórica del noroeste de la península Ibérica. *Lancia* 4: 71-84.

Fernández Rodríguez C. 2011. — Environment and animal resources in the Upper Pleistocene and early Holocene of northwest Iberia, *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* Oxford, BAR Publishing (coll. International Series 2283): 43-52.

Fernández Rodríguez C., Villar Quinteiro R. & Llana Rodríguez C. 1993. — Prospección arqueológica de cavidades en la Sierra de la Encina de la Lastra (Rubía, Ourense): primeros resultados, *in Actas del XXII Congreso Nacional de Arqueología*: 43-48.

Fernández-Tresguerres J. 1980. — *El Aziliense en las Provincias de Asturias y Santander.* Centro de Investigación y Museo de Altamira, Monografías 2, Santander, 209 p.

Flenniken J. 1981. — *Replicative Systems Analysis: a Model Applied to the Vein Quartz Artifacts from the Hoko River Site.* Washington State University Laboratory of Anthropology, Pullman, 223 p.

Freeman L. G. 1968. — A theoretical framework for interpreting archaeological materials, *in* Lee R. & Devore E. (eds), *Man the Hunter.* Aldine, Chicago: 262-267.

Freeman L. G. 1973. — The significance of mammalian faunas from Paleolithic occupations in Cantabrian Spain. *American Antiquity* 38: 3-44. https://doi.org/10.2307/279309

Freeman L. G. 1981. — The fat of the land: notes on Paleolithic diet in Iberia, *in* Harding R. & Teleki G. (eds), *Omnivorous Primates – Gathering and Hunting in Human Evolution.* Columbia University Press, New York: 104-165.

Freeman L. G. 1994. — Kaleidoscope or tarnished mirror? Thirty years of Mousterian investigations in Cantabria, *in* Lasheras J. A. (ed.), *Homenaje al Dr. Joaqín González Echegaray.* Ministerio de Cultura, Madrid: 37-54.

Freeman L. G. & González Echegaray J. (eds). 1971. — *Cueva Morín: Excavaciones 1966-1968.* Publicaciones del Patronato de las Cuevas Prehistóricas de la Provincia de Santander 6, Santander, 452 p.

Freeman L. G. & González Echegaray J. (eds). 1973. — *Cueva Morín: Excavaciones 1969.* Publicaciones del Patronato de las Cuevas Prehistóricas de Provincia de Santander 10, Santander, 288 p.

Freeman L. G. & González Echegaray J. 2001. — *La Grotte d'Altamira.* Éditions du Seuil, Paris, 156 p.

Fretter V. & Graham A. 1962. — *British Prosobranch Molluscs. Their Functional Anatomy and Ecology.* Ray Society, London, 755 p.

Gallejo Lletjós N. 2013. — *El Mesolítico en la Península Ibérica. Historia Crítica de la Investigación y Estado Actual del Conocimiento.* Tésis doctoral, Departamento de Prehistoria, Universidad Complutense de Madrid, 795 p.

García O., Fregel R., Larruga J. M., Álvarez V., Yurrebaso I., Cabrera V. M. & González A. M. 2011. — Using mitochondrial DNA to test the hypothesis of a European post-glacial human recolonization from the Franco-Cantabrian refuge. *Heredity* 106: 37-45. https://doi.org/10.1038/hdy.2010.47

García-Escárzaga A. 2013. — El Mesolítico Asturiense en el occidente de Cantabria: revisión de la información disponible a través de una reflexión crítica. *Kobie* 32: 113-130.

García Guinea M.-A. 1985. — Las cuevas Azilienses de El Piélago (Mirones, Cantabria) y sus excavaciones de 1967-1969. *Sautuola* 4: 11-154.

García-Martínez De Lagrán Í. 2014. — La neolitización de la Meseta Norte y de la alta y media cuenca del Ebro (España): premisas teóricas, análisis del registro y planteamiento de hipótesis. *Zephyrus* 73: 83-107. https://doi.org/10.14201/zephyrus20147383107

García-Martínez De Lagrán Í., Fernández-Domínguez & Rojo M. 2018. — Solutions or illusions? An analysis of the palaeogenetic evidence at the origins of the Neolithic in the Iberian Peninsula. *Quaternary International* 470: 353-368. https://doi.org/10.1016/j.quaint.2017.07.012

García-Puchol O., Molina L., Aura J. E. & Bernabeu Aubán J. 2009. — From the Mesolithic to the Neolithic on the Mediterranean coast of the Iberian Peninsula: global action in human context. *Journal of Anthropological Research* 65: 237–251. https://doi.org/10.3998/jar.0521004.0065.205

García-Puchol O., Bernabeu-Aubán J., Barton C. M., Pardo-Gordó S., McClure S. B. & Diez-Castillo A. 2018. — A Bayesian approach for timing the neolithization in Mediterranean Iberia. *Radiocarbon* 60: 181-205. https://doi.org/10.1017/RDC.2017.61

Gaspar R., Ferreira J., Molina Hernández F., García-Vadillo F., Rebelo P. & Neto N. 2015. — Away from the edges: a new Solutrean site in interior Iberia (Foz do Medal Left Bank, Sabor Valley, northeast Portugal). *Journal of Anthropological Research* 71: 545-564. https://doi.org/10.3998/jar.0521004.0071.405

Gaspar R., Ferreira J., Carrondo J. & Silva M. J. 2016. — The use of quartz during the Upper Paleolithic and Mesolithic in Sabor Valley (NW Iberia): the Foz do Medal case. *Quaternary International* 424: 98-112. https://doi.org/10.1016/j.quaint.2015.10.095

González Echegaray J. & Freeman L. G. 1971. — *Cueva Morín: Excavaciones 1966-1968.* Publicaciones del Patronato de las Cuevas Prehistóricas de la Provincia de Santander Memoria 6, Santander, 452 p.

González Echegaray J. & Freeman L. G. 1973. — *Cueva Morín: Excavaciones 1969.* Publicaciones del Patronato de las Cuevas Prehistóricas de la Provincia de Santander Memoria 10, Santander, 288 p.

González-Gómez E., Carlos Fernández-Rodríguez C., Roselló-Izquierdo E., Llorente-Rodriguez L., Bejega-García V., Fuertes-Prieto N. & Morales-Muñiz A. 2019. — Fish and shellmiddens from Galicia (northwest Spain): reflections upon a neglected coastal cultural heritage from the Iberian Peninsula. *Humanities* 8 (2): 85. https://doi.org/10.3390/h8020085

González Morales M. R. 1982. — *El Asturiense y otras Culturas Locales.* Centro de Investigaciones y Museo de Altamira, Memoria 7, Santander, 287 p.

González Morales M. R. 1992. — Mesolíticos y megalíticos: la evidencia arqueológica de los cambios en las formas productivas en el paso al megalitismo en la costa Cantábrica, *in* Moure A. (ed.), *Elefantes, Ciervos y Ovicaprinos.* Universidad de Cantabria, Santander: 185-202.

González Morales M. R., Márquez Uría M. C., Diáz Gonzáles T. E., Ortea Rato J. A. & Volman K. C. 1980. — El conchero asturiense de la cueva de Mazaculos II (La Franca, Asturias). Campañas de 1976 a 1978. *Noticiario Arqueológico Hispanico* 9: 35-62.

González Morales M. R., Straus L. G., Diéz Castillo A. & Ruíz Cobo J. 1999. — Postglacial coast and inland: the Epipaleolithic-Mesolithic-Neolithic transitions in the Vasco-Cantabrian region. *Munibe* 56: 61-78.

González Morales M. R., Straus L. G., Diéz Castillo A. & Ruíz J. 2004. — Periglacial coast and inland. Epipaleolithic-Mesolithic-Neolithic transitions in Vasco-Cantabrian Spain. *Munibe* 56: 79-96.

González-Sampériz P., Utrilla P., Mazo C., Valero-Garcés B., Sopena M. C., 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. *Quaternary Research* 71: 121-132. https://doi.org/10.1016/j.yqres.2008.10.006

Grandal-D'anglade A. & Romaní J. 1997. — A population study on the cave bear (*Ursus spelaeus* Ros. Hein.) from Cova Eirós (Triacastela, Galicia, Spain. *Geobios* 30: 723-731. https://doi.org/10.1016/S0016-6995(97)80160-X

Grandal-D'anglade A., Pérez Rama M., García Vázquez A., Vidal Gorosquieta A. & González Fortes G. 2010. — Geocaracterización de yacimientos arqueológicos: conservación de restos paleontológicos y obtención de datos biogeoquímicos, *in* López Díaz A. & Ramil Rego E. (eds), *Arqueoloxía: Ciencia e Restauración*. Museo de Prehistoria e Arqueoloxía de Vilalba, Monografías 4: 57-70.

Guéret C. 2017. — Retoucher, pour quoi faire? Réflexions fonctionnelle et méthodologiques sur la place occupée par l'outillage brut dans l'économie du premier Mésolithique en Europe du Nord-Ouest. *Bulletin de la Société Préhistorique Française* 114: 339-370. https://doi.org/10.3406/bspf.2017.14776

Gutiérrez-Zugasti I. 2009. — *La Explotación de Moluscos y Otros Recursos Litorales en la Región Cantábrica durante el Pleistoceno Final y Holoceno Inicial*. Ediciones de la Universidad de Cantabria, Santander, 570 p.

Gutiérrez-Zugasti I., Andersen S., Araújo A., Dupont C., Milner N. & Monge-Soares A. 2011a. — Shell midden research in Atlantic Europe: state of the art, research problems and perspectives for the future. *Quaternary International* 239: 70-85. https://doi.org/10.1016/j.quaint.2011.02.031

Gutiérrez-Zugasti I., Cuenca Solana D., Clemente Conte I., González Sainz C. & López Quintana J. C. 2011b. — Instrumentos de trabajo y elementos de adorno en conchas de moluscos de la Cueva de Santimamiñe (Kortezubi, Bizkaia). *Kobie* 1: 155-170.

Hamilton M. & Walker R. 2018. — A stochastic density-dependent model of long-term population dynamics in hunter-gatherer populations. *Evolutionary Ecology Research* 19: 85-102.

Haslett J. & Parnell A. 2008. — A simple monotone process with application to radiocarbon-dated depth chronologies. *Journal of the Royal Statistical Society, Series C* 57: 399-418. https://doi.org/10.1111/j.1467-9876.2008.00623.x

Hassan F. 1981. — Demographic archaeology. *Advances in Archaeological Method & Theory* 4: 225-279.

Hernández C., Dugoujon J., Novelletto A., Rodríguez J., Cuesta P. & Calderón R. 2017. — The distribution of mitochondrial DNA haplogroup H in southern Iberian indicates ancient human genetic exchanges along the western edge of the Mediterranean. *BMC Genetics* 18: 46. https://doi.org/10.1186/s12863-017-0514-6

Hoyos Gómez M., Martínez Navarrete M. I. & Chapa Brunet T. 1980. — *La Cueva de la Paloma – Soto de las Regueras (Asturias)*. Excavaciones Arqueológicas en España 111, Ministerio de Cultura, Madrid, 246 p.

Iriarte-Chiapusso M.-J., Mujika J. & Tarriño A. 2005. — Herriko Barra (Zarzautz-Gipuzkoa). *Mémoires de la Société Préhistorique Française* 36: 127-136.

Iriarte-Chiapusso M.-J., Arrizabalaga Á., Etxeberria F., Herrasti L. & Álvarez-Fernández E. 2010. — Shell midden people in northern Iberia. New data from the Mesolithic rock shelter of J3 (Basque Country, Spain). *Zephyrus* 65: 117-127.

Jalut G., Turu i Michels V., Dedoubat J.-J., Otto T., Ezquerra J., Fontugne M., Beleta J. M., Bonnet L., García de Celis A., Redondo-Vega J. M., Vidal-Romaní J. R. & Santosh L. 2010. — Palaeoenvironmental studies in NW Iberia (Cantabrian range): vegetation history and synthetic approach of the last deglaciation phases in the western Mediterranean. *Palaeogeography, Palaeoclimatology, Palaeoecology* 297: 330-350. https://doi.org/10.1016/j.palaeo.2010.08.012

Johnson C. N. & Brook B. W. 2011. — Reconstructing the dynamics of ancient human populations from radiocarbon dates: 10,000 years of population growth in Australia. *Proceedings in Biological Science* 278: 3748-3754.

Jones J., Marín-Arroyo A. B., Straus L. G. & Richards M. P. 2020. — Adaptability, resilience and environmental buffering in European refugia during the Late Pleistocene: Insights from La Riera cave (Asturias, Cantabria, Spain). *Scientific Reports* 10: 1-17. https://doi.org/10.1038/s41598-020-57715-2

Kannegaard R. 2015. — *Quartz Crystal Microblade Function in the Salish Sea Region of Washington State During the Locarno Beach Phase (3500-2400 BP).* Unpublished Master's Thesis, Western Washington University, Bellingham, 273 p.

Kuhn S. L., Raichlen D. & Clark A. E. 2016. — What moves us? How mobility and movement are at the center of human evolution. *Evolutionary Anthropology* 25: 86-97.

Kuijt I. & Goring-Morris A. N. 2002. — Foraging, farming, and social complexity in the Pre-Pottery Neolithic of the southern Levant: a review and synthesis. *Journal of World Prehistory* 16: 361-440.

Leira M. & Santos L. 2002. — An early Holocene short climatic event in the northwest Iberian Peninsula inferred from pollen and diatoms. *Quaternary International* 93/94: 3-12.

Llana Rodríguez C. 2011. — Paleolithic research in Galicia, *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* BAR Publishing (coll. International Series 2283), Oxford: 1-10.

Llana Rodríguez C. & Soto Barreiro M. (eds). 1991. — *Cova da Valiña (Castroverde, Lugo): un Xacemento do Paleolítico Superior Inicial en Galicia.* Xunta de Galicia, Santiago de Compostela, 477 p.

Llana Rodríguez C., Martínez Cortízas M. & Ramil Rego P. 1992. — Algunas consideraciones acerca de la estratigrafía y del marco temporal para los yacimientos al aire libre del Paleolítico Final y Epipaleolítico en Galicia. *Zephyrus* 44/45: 155-166.

Llana Rodríguez C., Villar Quinteiro R. & Martínez Cortizas A. 1996. — Secuencia paleoambiental y cultural de la cueva de A Valiña (Castroverde, Lugo): Una ocupación Chatelperroniense en Galicia, *in* Perez M. (ed.), *Dinámica y Evolución de Medios Cuaternarios.* Xunta de Galicia, Santiago de Compostela: 97-112.

Lombera-Hermida A. de 2011. — Caves and people. Archaeological research at the eastern margins of NW Iberia, *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* BAR Publishing (coll. International Series 2283), Oxford: 111-122.

Lombera-Hermida A. de & Rodríguez-Rellán C. 2010. — Gestión y estrategias de abastecimiento de las materias primas locales (cuarzo, cuarcita y pizarra) en la prehistoria del NW peninsular, *in* Dominguez-Bella S., Ramos Muñoz J., Gutiérrez López J. M. & Pérez Rodríguez M. (eds), *Minerales y Rocas en las Sociedades en la Prehistoria.* Cádiz, Universidad de Cádiz: 49-60.

Lombera-Hermida A. de & Fábregas Valcarce R. (eds) 2011. — *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* BAR Publishing (coll. International Series 2283), Oxford, 151 p.

Lombera-Hermida A. de & Rodríguez-Rellán C. 2016. — Quartzes matter. Understanding the technological and behavioural complexity in quartz lithic assemblages. *Quaternary International* 424: 2-11. https://doi.org/10.1016/j.quaint.2016.11.039

Lombera-Hermida A. de, Rodríguez-Álvarez X. P., Fábregas-Valcarce R. & Lazuén-Fernández T. 2011. — The Palaeolithic settlement of the Monforte Basin (Lugo, Galicia), *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds.), *To the West of Spanish Cantabria – The Palaeolithic Settlement of Galicia*. BAR Publishing (coll. International Series 2283), Oxford: 93-110.

Lombera-Hermida A. de, Rodríguez Álvarez X.-P., Rabuñal Gayo X., Ameijenda Iglesias A., Martínez Gómez F., Soares Remiseiro M., Pérez Alberti A. & Fábregas Valcarce R. 2013. — El yacimiento de Valverde (Monforte de Lemos, Lugo, Galicia, España) y las primeras evidencias de poblamiento en el pleniglacial del noroeste de la Península Ibérica. *Espacio, Tiempo y Forma* 5: 363-382. https://doi.org/10.5944/etfi.5.5379

Lombera-Hermida A. de, Rodríguez X. P. & Fábregas Valcarce R. 2014. — Cova Eirós archaeo-palaeontological site, Triacastela, Lugo, *in* Sala Ramos R. (ed.), *Pleistocene and Holocene Hunter-Gatherers in Iberia and the Gibraltar Strait.* Servicio de Publicaciones de la Universidad de Burgos y la Fundación Atapuerca, Burgos: 18-25.

Lombera-Hermida A. de, Rodríguez-Rellán C. & Vaquiero Rodríguez M. 2016. — El silex en el NW de la Peninsula Ibérica. Un estado de la cuestión. *Cuadernos de Prehistoria y Arqueología de Granada* 26: 137-155. https://doi.org/10.30827/cpag.v26i0.7398

López Cordeiro M. 2003. — El yacimiento Epipaleolítico de Chan da Cruz (Valadouro, Lugo) – síntesis de los primeros resultados. *Complutum* 14: 39-54.

López De Pablo J. & Gómez Puche M. 2009. — Climate change and population dynamics during the Late Mesolithic and the Neolithic transition in Iberia. *Documenta Praehistorica* 36: 67-96. https://doi.org/10.4312/dp.36.4

Lorenzo F., Alonso A. & Pagés J. L. 2003. — Evolución y erosion comparada de tres sistemas playa/fleche en las Rías de Ortigueira, O Barquero y Viveiro (Galicia, España). *Revista Cuaternario y Geomorfología* 17: 75-89.

Lumley H. de 1966. — Les fouilles de Terra Amata à Nice. Premiers résultats. *Bulletin du Musée d'Anthropologie Préhistorique de Monaco* 13: 29-51.

Madariaga B. 1967. — El genero *Patella* en Ia bahía de Santander: características biológicas y bromatológicas. *Anales de la Facultad de Veterinaria de la Universidad de León* 13: 355-422.

Madariaga B.1976. — Consideraciones acerca de Ia utilización del 'pico marisquero' del Asturiense. *Cuadragésimo Aniversario del Centro de Estudios Montañeses* 3: 437-451.

Mariezkurrena K. & Altuna J. 1995. — Fauna de mamíferos del yacimiento costero de Herriko Barra. *Munibe* 47: 23-32.

Marín Arroyo A. 2013. — Human response to Holocene warming on the Cantabrian coast (northern Spain): an unexpected outcome. *Quaternary Science Reviews* 81: 1-11. https://doi.org/10.1016/j.quascirev.2013.09.006

Marín Arroyo A. & González Morales M. 2009. — Comportamiento económico de los últimos cazadores-recolectores y primeras evidencias de domesticación en el occidente de Asturias. La Cueva de Mazaculos II. *Trabajos de Prehistoria* 66: 47-74. https://doi.org/10.3989/tp.2009.09012

Meireles J. 1996. — *As Industrias Líticas Pré-Históricas do Litoral Minhoto*. Universidade do Minho, Braga, 207 p.

Meireles J. 2009. — Os primeiros povoadores. A pré-história antiga do Minho, *in Traços de Identidade*. Universidade do Minho, Braga: 20-66.

Méndez-Quintas E., Santonja M., Pérez-González A., Duval M., Demuro M. & Arnold L. 2018a. — First evidence of an extensive Acheulean large cutting tool accumulation in Europe from Porto Maior (Galicia, Spain). *Nature Scientific Reports* 8: 3082. https://doi.org/10.1038/s41598-018-21320-1

Méndez-Quintas E., Pérez-González A., Ledo Bernárdez M. & Serodio Domínguez A. 2018b. — La industria lítica del yacimiento Achelense de Arbo (Pontevedra). Variables del paleolítico antiguo de Galicia en el contexto peninsular. *Zephyrus* 82: 3-34. https://doi.org/10.14201/zephyrus201882334

Méndez-Quintas E., Demuro M., Arnold L., Duval M., Pérez González A. & Santonja M. 2019. — Insights into the late stages of the Acheulean technocomplex of Western Iberia from the Arbo site (Galicia, Spain). *Journal of Archaeological Science: Reports* 27. https://doi.org/10.1016/j.jasrep.2019.101934

Miller A. & Barton C. M. 2008. — Exploring the land: a comparison of land-use patterns in the Middle and Upper Paleolithic of the western Mediterranean. *Journal of Archaeological Science* 35: 1427-1437. https://doi.org/10.1016/j.jas.2007.10.007

Montes L., Utrilla P. & Mazo C. 2006. — El Epipaleolítico macrolítico en Aragón en el contexto del Valle del Ebro y la Cataluña costera, i*n* Alday A. (ed.), *El Mesolítico de Muescas y Denticulados en la Cuenca del Ebro y el litoral Mediterráneo peninsular*. Diputación Foral de Álava, Departamento de Cultura, Álava: 193-219.

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. *Quaternary International* 403: 133-150. https://doi.org/10.1016/j.quaint.2015.05.041

Morris D. 1965. — *The Mammals: a Guide to Living Species*. Hodder & Staughton, London, 448 p.

Naughton F., Sanchez-Goñí M. F., Rodrigues T., Salgueiro E., Costas S., Desprat S., Duprat J., Michel E., Rossignol L., Zaragosi S., Voelker A. H. & Abrantes F. 2016. — Climate variability across the last deglaciation in NW Iberia and its margin. *Quaternary international* 414: 9-22. https://doi.org/10.1016/j.quaint.2015.08.073

Neira Campos A., Fuertes Prieto N. & Herrero Alonso D. 2016. — The Mesolithic with geometrics south of the 'Picos de Europa' (northern Iberian Peninsula): the main characteristics of the lithic industry and raw material procurement. *Quaternary International* 402: 90-99. https://doi.org/10.1016/j.quaint.2015.10.065

Neulieb T., Levac E., Southon J., Lewis M., Florin Pendea I. & Chmura G. L. 2013. — Potential pitfalls of pollen dating. *Radiocarbon* 55: 1142-1155. https://doi.org/10.1017/S0033822200048050

Noval A. 1976. — *La Fauna Salvaje Asturiana.* Ediciones Ayalga, Salinas, 457 p.

Olalde Í. 2016. — *From the Mesolithic to the Bronze Age: Unraveling 5,000 years of European Population History with Paleogenomics.* PhD Thesis, Departament de Ciències Experimentals I de la Salut, Universitat Pompeu Fabra, Barcelona, 270 p.

Olalde Í., Allentoft M. E., Sánchez-Quinto F., Santpere G., Chiang C. W. K., DeGiorgio M., Prado-Martinez Rodríguez J. A., Rasmussen S., Quilez J., Ramírez O., Marigorta U. M., Fernández-Callejo M., Encina Prada M., Vidal Encinas J. M., Nielsen R., Netea M. G., Novembre J., Sturm R. A., Sabeti P., Marquès-Bonet T., Navarro A., Willerslev E. & Lalueza-Fox C. 2014. — Derived immune and ancestral pigmentation alleles in a 7,000-year-old Mesolithic European. *Nature* 507: 225-228. https://doi.org/10.1038/nature12960

Olalde Í., Mallick S., […] & Reich D. 2019. — The genomic history of the Iberian Peninsula over the past 8000 years. *Science* 363: 1230-1234. https://doi.org/10.1126/science.aav4040

Ortea J. 1986. — The malacology of La Riera cave, *in* Straus L. G. & Clark G. A. (eds), *La Riera Cave – Stone Age Hunter-Gatherer Adaptations in Northern Spain.* Arizona State University Anthropological Research Papers 36, Tempe: 289-298.

Papalas C., Clark G. A. & Kintigh K. 2003. — Liencres revisited: the significance of spatial patterning revealed by unconstrained clustering, *in* Larsson L., Kindgren H., Knutsson K., Loeffler D. & Åkerlund A. (eds), *Mesolithic on the Move.* Oxbow Books, Oxford: 253-261.

Pardo-Gordó S., Bernabeu Aubán J., García-Puchol O., Barton C. M. & Bergin S. M. 2015. — The origins of agriculture in Iberia: a computational model. *Documenta Praehistorica* 42: 117-131.

Pardo-Gordó S., Bergin S. M., Bernabeu Aubán J. & Barton C. M. 2017. — Alternative stories of agricultural origins: the Neolithic spread in the Iberian peninsula, *in* García-Puchol O. & Salazar García (eds), *Times of Neolithic Transition along the Western Mediterranean.* Springer, Cham: 101-131.

Pardo-Gordó S., García O., Bernabeu Auban J. & Diéz Castillo A. 2018. — *Radiocarbon dates for the Mesolithic-Neolithic transition in Iberia* (vers. 1) [Data set]. Zenodo: http://doi.org/10.5281/zenodo.3241958

Pardo-Gordó S., García O., Bernabeu J. & Diéz-Castillo A. 2019. — Timing the Mesolithic-Neolithic transition in the Iberian Peninsula: the radiocarbon dataset. *Journal of Open Archaeology Data* 7: 4. https://doi.org/10.5334/joad.49

Pargeter J. & de la Peña P. 2017. — Milky quartz bipolar reduction and lithic miniaturization: experimental results and archaeological implications. *Journal of Field Archaeology* 42: 551-565. https://doi.org/10.1080/00934690.2017.1391649

Parnell A., Haslett J., Allen J. R. M., Buck C. & Huntley B. 2008. — A flexible approach to assessing synchroneity of past events using Bayesian reconstructions of sedimentation history. *Quaternary Science Reviews* 27: 1872-1885. https://doi.org/10.1016/j.quascirev.2008.07.009

Parnell A., Buck C. & Doan T. 2011. — A review of statistical chronology models for high-resolution, proxy-based Holocene palaeoenvironmental reconstruction. *Quaternary Science Reviews* 30: 2948-2960. https://doi.org/10.1016/j.quascirev.2011.07.024

Peña-Chocarro L., Zapata Peña L., García Gazólaz J., González Morales M. R., Sesma J. & Straus L. G. 2005a. — The spread of agriculture in northern Iberia: new archaeobotanical data from El Mirón cave (Cantabria) and the open-air site of Los Cascajos (Navarra). *Vegetation History and Archaeobotany* 14: 268-278. https://doi.org/10.1007/s00334-005-0078-7

Peña-Chocarro L., Zapata Peña L., Iriarte M. J., González Morales M. R. & Straus L. G. 2005b. — The oldest agriculture in northern Atlantic Spain: new evidence from El Mirón cave. *Journal of Archaeological Science* 32: 579-587. https://doi.org/10.1016/j.jas.2004.12.001

Peña-Chocarro L. 2012. — Neolithic, Chalcolithic and Bronze Age plant remains from El Mirón cave: evidence on the first farming communities in the Cantabrian region, *in* Straus L. G. & González Morales R. (eds), *El Mirón Cave, Cantabrian Spain. The Site and its Holocene Archaeological Record*. University of New Mexico Press, Albuquerque: 148-173.

Pérez Alberti A. 2011. — Evolución paleoambiental de Galicia durante el Pleistoceno reciente: una aproximación desde la geomorfología, *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* BAR Publishing (coll. International Series 2283), Oxford: 13-26.

Pérez Alberti A., Martini P., Chesworth W. & Martínez Cortizas A. 2000. — Dinámica y evolución de medios Cuaternarios. *Lancia* 4: 97-112.

Plisson H., Dubreuil L. & Guilbert R. 2008. — The functional significance of Sauveterrian microlithic assemblages: broadening the focus of investigation. *Prehistoric Technology* 40: 147-157.

Prieto Martínez M. P. 2005. — La cerámica neolítica en Galicia. Estudio de síntesis desde la perspectiva de la arqueología del paisaje, *in* Arias Cabal P., Ontañón Peredo R. & García-Monco C. G. (eds), *Actas del III Congreso del Neolítico en la Península Ibérica. Monografías del Instituto Internacional de Investigaciones Prehistóricas de Cantabria* 1, Santander: 337-348.

Prior R. 1968. — *The Roe Deer of Cranborne Chase: an Ecological Survey.* Oxford University Press, New York & Toronto, 222 p.

R Core Team 2016. — *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna. https://www.R-project.org/

Ramil Rego E., Orellana L. G., Sobrino C. M. & Chiapusso M. 2005. — Cambio climático y dinámica temporal del paisaje y los habitats en las ecoregiones del NW de la Peninsula Ibérica durante el Pleistoceno superior. *Munibe* 57: 537-551.

Ramil Rego E., Blanco Sanmartín P. & Rodríguez Pérez M. 2016. — Los últimos cazadores-recolectores en el occidente Cantábrico. *Portugalia* 37: 151-162.

Ramil Soneira J. 1973. — Paradero de Reiro. *Cuaderno de Estudios Gallegos* 28: 23-31.

Rasmussen S., Bigle M., Blockley S. P., Blunier T., Buchardt S. L., Clausen H. B., Cvijanovic I., Dahl-Jensen D., Johnsen S. J., Fischer H., Gkinis V., Guillevic M., Hoek W. Z., Low J. J., Pedro J. B., Popp T., Seierstad I. K., Steffensen J. P., Svensson A. M., Vallelonga P., Vinther B. M., Walker M. J. C., Wheatley J. J. & Winstrup M. 2014. — A stratigraphic framework for abrupt climatic changes during the Last Glacial period based on three synchronized Greenland ice-core records: refining and extending the INTIMATE event stratigraphy. *Quaternary Science Reviews* 106: 14-28. https://doi.org/10.1016/j.quascirev.2014.09.007

Redding R. 1988. — A general explanation of subsistence change: from hunting and gathering to food production. *Journal of Anthropological Archaeology* 7: 56-97. https://doi.org/10.1016/0278-4165(88)90007-4

Reher C. & Frison G. 1991. — Rarity, clarity, symmetry: quartz crystal utilization in hunter-gatherer stone tool assemblages, *in* Montet-White A. & Holen S. (eds), *Raw Material Economies Among Prehistoric Hunter-Gatherers.* University of Kansas, Kansas City: 375-397.

Reimer P. J., Edouard Bard E., Bayliss A., Beck J. W., Blackwell P. G., Bronk Ramsey C., Buck C. E., Cheng H., Edwards R. L., Friedrich M., Grootes P. M., Guilderson T. P., Haflidason H., Hajdas I., Hatté C., Heaton T. J., Hoffmann D. L., Hogg A. G., Hughen K. A., Kaiser K., Kromer B., Manning S. W., Niu M., Reimer R. W., Richards D. A., Scott E. M., John R Southon J. R., Staff R. A., Turney C. S. M. & van der Plicht J. 2013. — IntCal13 and Marine13 radiocarbon age calibration curves 0-50,000 cal BP. *Radiocarbon* 55: 1869-1887. https://doi.org/10.2458/azu_js_rc.55.16947

Rey-Rodríguez I., López-García J.-M., Bennàsar M., Bañuls-Cardona S., Blain H.-A., Blanco-Lapaz A., Rodríguez-Álvarez X.-P., Lombera-Hermida A. de, Díaz-Rodríguez M., Ameijenda-Iglesias A., Agustí J. & Fábregas-Valcarce R. 2016. — Last Neanderthals and first anatomically modern humans in the NW Iberian Peninsula: climatic and environmental conditions inferred from the Cova Eirós small-vertebrate assemblage during MIS 3. *Quaternary Science Reviews* 151: 185-197. https://doi.org/10.1016/j.quascirev.2016.08.030

Rick J. W. 1987. — Dates as data: an examination of the Peruvian preceramic radiocarbon record. *American Antiquity* 52: 55-73. https://doi.org/10.2307/281060

Riel-Salvatore J. & Barton C. M. 2004. — Late Pleistocene technology, economic behaviour, and land-use dynamics in southern Italy. *American Antiquity* 69: 273-290. 10.2307/4128419 https://doi.org/10.2307/4128419

Riel-Salvatore J. & Clark G. A. 2001. — Grave markers: Middle and early Upper Paleolithic burials and the use of chronotypology in contemporary paleolithic research. *Current Anthropology* 42: 449-460, 470-479. https://doi.org/10.1086/321801

Roberts N. 2019. — How humans changed the face of Earth. *Science* 365: 865-866. https://doi.org/10.1126/science.aay4627

Rodríguez Álvarez X. P., Fábregas R., Lazuén T., Lombera Hermida A. de, Pérez-Alberti A., Peña J. A., Rodríguez. C., Terradillos M., Ameijenda A. & Rodríguez E. 2008. — Nuevos yacimientos paleolíticos en la depresión de Monforte de Lemos (Lugo, Galicia, España). *Cuaternario y Geomorfología* 22: 71-92.

Rodríguez Álvarez X. P., Lombera-Hermida A. de, Fábregas Valcarce R. & Lazuén Fernández T. 2011. — The Upper Pleistocene site of Cova Eirós (Triacastela, Lugo, Galicia), *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia*. BAR Publishing (coll. International Series 2383), Oxford: 123-132.

Rodríguez Asensio J. A. 1978a. — Nota préliminar sobre las excavaciones en el yacimiento de Bañugues (Gozón-Asturias). *Boletín del Instituto de Estudios Asturianos* 32: 357-368.

Rodríguez Asensio J. A. 1978b. — The early Paleolithic site of Bañugues (Gozón, Asturias, Spain). *Current Anthropology* 19: 615-616. https://doi.org/10.1086/202152

Rodríguez-Rellán C. 2016. — Variability of the rebound hardness as a proxy for detecting the levels of continuity and isotropy in archaeological quartz. *Quaternary International* 424: 191-211. https://doi.org/10.1016/j.quaint.2015.12.085

Rogers J. 1920. — *The Shell Book.* Doubleday, Page & Co., New York, 483 p.

Rohling E. J. & Pälike H. 2005. — Centennial-scale climate cooling with a sudden cold event around 8,200 years ago. *Nature* 434: 975-979 (+ Supplements). https://doi.org/10.1038/nature03421

Rojo-Guerra Í., García-Martínez J. & Royo-Guillén I. 2018. — The beginning of the Neolithic in the mid-Ebro valley and in Iberia's inland (northern and southern submeseta), Spain. *Quaternary International* 470: 398-438. https://doi.org/10.1016/j.quaint.2017.12.037

Rollefson G. O. & Köhler-Rollefson I. 1993. — PPNC adaptations in the first half of the 6th millennium BC. *Paléorient* 19: 33-42 https://doi.org/10.3406/paleo.1993.4581

Roucoux K., Abreu L. de, Shackleton N. J. & Tzedakisa P. C. 2005. — The response of NW Iberian vegetation to North Atlantic climate oscillations during the last 65 kyr. *Quaternary Science Reviews* 24: 1637-1653. https://doi.org/10.1016/j.quascirev.2004.08.022

Rowley-Conwy P. 2004. — Complexity in the Mesolithic of the Atlantic Façade: development or adaptation, *in* González Morales M. & Clark G. A. (eds), *The Mesolithic of the Atlantic Façade: Proceedings of the Santander Symposium.* Arizona State University Anthropological Research Papers 55, Tempe: 1-12.

Salas A., Comas D., Lareu M. V., Bertranpetit J. & Carracedo A. 1998. — mtDNA analysis of the Galician population: a genetic edge of European variation. European *Journal of Human Genetics* 6: 365-375. https://doi.org/10.1038/sj.ejhg.5200202

Sánchez-Quinto F., Schroeder H., Ramirez O., Ávila-Arcos M., Pybus M., Olalde Í., Velazquez A., Prada Marcos M., Vidal Encinas J. M., Bertranpetit J., Orlando L., Gilbert M. T. P. & Lalueza-Fox C. 2012. — Genetic affinities of two 7,000-year-old Iberian hunter-gatherers. *Current Biology* 22: 1494-1499. https://doi.org/10.1016/j.cub.2012.06.005

Sarasketa-Gartzia I., Villalba-Mouco V., Le Roux P., Arrizabalaga Á. & Salazar-García D. 2018. — Late Neolithic-Chalcolithic socio-economical dynamics in Northern Iberia. A multi-isotope study on diet and provenance from Santimamiñe and Pico Ramos archaeological sites (Basque Country, Spain). *Quaternary International* 481:14-27. https://doi.org/10.1016/j.quaint.2017.05.049

Scheitlin T. & Clark G. A. 1978. — Three-dimensional surface representations of lithic categories at Liencres. *Newsletter of Computer Archaeology* 13: 1-13.

Shennan S., Downey S., Timpson A., Edinborough K., Colledge S., Kerig T., Manning K. & Thomas M. 2013. — Regional population collapse followed initial agriculture booms in mid-Holocene Europe. *Nature Communications* 4: 2486. https://doi.org/10.1038/ncomms3486

Shott M. J. 1994. — Size and form in the analysis of flake debris: review and recent approaches. *Journal of Archaeological Method and Theory* 1: 69-110. https://doi.org/10.1007/BF02229424

Shott M. J. 2003. — Chaîne opératoire and reduction sequence. *Lithic Technology* 28: 95-105. https://www.jstor.org/stable/23273410

Shott M. J. 2010. — Size dependence in assemblage measures: essentialism, materialism, and "SHE" analysis in archaeology. *American Antiquity* 75: 886-906. https://doi.org/10.7183/0002-7316.75.4.886

Snitker G., Diez Castillo A.,Barton C. M., Bernabeu Aubán J., García Puchol O. & Pardo-Gordó S. 2018. — Patch-based survey methods for studying prehistoric human land-use in agriculturally modified landscapes: a case study from the Canal de Navarrés, eastern Spain. *Quaternary International* 483: 5-22. https://doi.org/10.1016/j.quaint.2018.01.034

Soffer O. (ed.) 1987. — *The Pleistocene Old World: Regional Perspectives*. New York, Plenum, 380 p.

Soto A., Alday A., Montés L., Utrilla P., Perales U. & Domingo R. 2015. — Epipaleolithic assemblages in the western Ebro Basin (Spain): the difficult identification of cultural entities. *Quaternary International* 364: 144-152. https://doi.org/10.1016/j.quaint.2014.05.041

Speth J. D. 1987. — Early hominid subsistence strategies in seasonal habitats. *Journal of Archaeological Science* 14: 13-29. https://doi.org/10.1016/S0305-4403(87)80003-1

Speth J. D. & Spielmann K. A. 1983. — Energy source, protein metabolism, and hunter-gatherer subsistence strategies. *Journal of Anthropological Archaeology* 2: 1-31. https://doi.org/10.1016/0278-4165(83)90006-5

Straus L. G. 1979. — Mesolithic adaptations along the northern coast of Spain. *Quaternaria* 21: 305-327.

Straus L. G. 1986. — The end of the Paleolithic in Cantabrian Spain and Gascony, *in* Straus L. G. (ed.), *The End of the Paleolithic in the Old World*. British Archaeological Reports S-284, Oxford: 81-116.

Straus L. G. 1991. — Southwestern Europe at the Last Glacial Maximum. *Current Anthropology* 32: 189-199. https://doi.org/10.1086/203940

Straus L. G. 1992. — *Iberia Before the Iberians.* University of New Mexico Press, Albuquerque, 336 p.

Straus L. G. 2008. — The Mesolithic of Atlantic Iberia, *in* Spikins P. & Bailey G. N. (eds). *Mesolithic Europe*. Cambridge University Press, Cambridge: 302-327.

Straus L. G. 2012. — Were there human responses to Younger Dryas in Cantabrian Spain? *Quaternary International* 242: 328-335. https://doi.org/10.1016/j.quaint.2011.02.041

Straus L. G. 2018a. — Environmental and cultural changes across the Pleistocene-Holocene transition in Cantabrian Spain. *Quaternary International* 465: 222-233. https://doi.org/10.1016/j.quaint.2016.10.005

Straus L. G. 2018b. — The Pleistocene-Holocene transition in Cantabrian Spain: current reflections on culture change. *Journal of Quaternary Science* 33: 346-352. https://doi.org/10.1002/jqs.2943

Straus L. G. & Clark G. A. (eds). 1986. — *La Riera Cave: Stone Age Hunter-Gatherer Adaptations in Northern Spain.* Arizona State University Anthropological Research Papers 36, Tempe, 499 p.

Straus L. G., Clark G. A., Altuna J. & Ortea J. 1980. — Ice Age subsistence in northern Spain. *Scientific American* 242: 142-152. https://doi.org/10.1038/scientificamerican0680-142

Straus L. G., Altuna J., Clark G. A., Gonzalez Morales M., Laville H., Leroi-Gourhan A., Menendez de la Hoz M., Ortea J. A., Bahn P. G., Clottes J., Iain Davidson I., W. R. Farrand W. R., Michael A. García Guinea M. A., José M. Gómez-Tabanera J. M., J. González Echegaray J., Albert C. Goodyear A. C. & Rigaud J.-Ph. 1981. — Paleoecology at La Riera (Asturias, Spain). *Current Anthropology* 22: 655-682. https://doi.org/10.1086/202750

Straus L. G., González Morales M. & Carretero J. M. 2011. — Lower Magdalenian secondary human burial in El Mirón Cave, Cantabria, Spain. *Antiquity* 85: 1151-1164. https://doi.org/10.1017/S0003598X00061974

Suárez Otero J. 1997. — Del yacimiento de A Cunchosa al Neolítico en Galicia. Primera aproximación al contexto cultural de la aparición del Megalitismo en Galicia, *in* Rodríguez Casal A. (ed.), *O Neolítico Atlántico e as Orixes do Megalitismo.* Universidade de Santiago de Compostela, Servizo de Publicacións e Intercambio Científico: 485-506.

Tardy N., Vosges J. & Varoutsikos B. 2016. — Micro-blade production on hyaline quartz during the Late Neolithic of northern Greece (5400–4600 cal. BC): examples from Dikili Tash and Promachonas-Topolniča. *Quaternary International* 424: 212-231. https://doi.org/10.1016/j.quaint.2015.11.139

Thomas E., Wolff E., Mulvaney R., Steffensen J., Johnsen S., Arrowsmith C., White J., Vaughn B. & Popp T. 2007. — The 8.2 ka event from Greenland ice cores. *Quaternary Science Review* 26: 70-81. https://doi.org/10.1016/j.quascirev.2006.07.017

Valcarlos Pagés J. L. 2000. — Origen y evolución geomorfológica de las rías atlánticas de Galicia. *Revista de la Sociedad Geológica de España* 13: 393-403.

Valdeyron N. 1994. — *Le Sauveterrien: cultures et sociétés mésolithiques dans la France du sud durant le X*e *et le IX*e *millénaire BP*. Unpublished PhD Thesis, 2 Vols, Toulouse, 584 p., 141 fig., 1 carte h.t.

Valdeyron N. 2008. — Sauveterrien et Sauveterriano: unité ou diversité du premier mésolithique en France méridionale et en Italie du nord. *Pallas* 76: 247-259. https://hal.archives-ouvertes.fr/hal-00498849

Valverde L., Illescas M. J., Villaescusa P., Gotor A. M., García A., Cardoso S., Algorta J., Catarino S., Rouault K., Férec C., Hardiman O., Zarrabeitia M., Jiménez S., Pinheiro M. F., Jarreta B. M., Olofsson J., Morling N. & de Pancorbo M. M. 2016. — New clues to the evolutionary history of the main European paternal lineage M269: dissection of the Y-SNP S116 in Atlantic Europe and Iberia. *European Journal of Human Genetics* 24: 437-441. https://doi.org/10.1038/ejhg.2015.114

Van den Brink F. 1967. — *A Field Guide to the Mammals of Britain and Europe*. William Collins & Sons, London, 225 p.

Vaquero Rodríguéz M., Alonso-Fernández S., Alonso-Fernández C., Ameijenda Iglesias A., Blain H.-A., Fábregas R., Gómez Merino G., Lombera Hermida A. de, López- García J., Lorenzo Merino C., Lozano Ruiz M., Rodríguez Rellán C., Rosell I Ardèvol J. & Serna González M. R. 2009. — Nuevas fechas radiométricas para la Prehistoria del noroeste de la Península Ibérica: la cueva de Valdavara (Becerreá, Lugo). *Trabajos de Prehistoria* 66: 99-113. https://doi.org/10.3989/tp.2009.09014

Vaquero Lastres J. 1999. — *Les extrêmes distincts. La configuration de l'espace dans les societés ayant bâti des tertres funéraires dans le Nord-Ouest ibérique*. BAR Publishing (coll. International Series 821), Oxford, 212 p.

Vaquero Rodríguéz M., Alonso-Fernández S. & Ameijenda-Iglesias A. 2011. — Archaeological excavations in the Becerreá sites (eastern Lugo): Valdavara cave and Valdavara 3, *in* Lombera-Hermida A. de & Fábregas Valcarce R. (eds), *To the West of Spanish Cantabria: the Palaeolithic Settlement of Galicia.* BAR Publishing (coll. International Series 2283), Oxford: 133-145.

Vaquero Rodríguéz M., van der Made J., Blaina H.-A., Ibáñez N.,López-García J. L., Rivals F., Alonso S., Ameijenda A., Bennàsar M., Fernández-García M., Lombera-Hermida A. de & Valverde I. 2018. — Fauna, environment and human presence during MIS 5 in the north of Spain: the new site of Valdavara 3. *Comptes Rendus Palevol* 17: 557-593. https://doi.org/10.1016/j.crpv.2018.03.004

Vaquero Rodríguez M., Costas Vázquez R. & Costas Suárez D. 2017. — Características morfológicas de la Sima del Uro (noroeste España). *Revista de Xeoloxía Galega e do Hercínico Peninsular* 39: 23-34.

Vázquez Varela J. M. 2018. — Paleolítico y Mesolítico en Galicia: estado actual de la cuestión, Problemas y perspectivas. Port*ugalia* 39: 21-25.

Vega del Sella Conde de la 1914. — *La Cueva del Penicial (Asturias).* Comisión de Investigaciones Paleontológicas y Prehistoricas, Memoria 4. Museo Nacional de Ciencias Naturales. Madrid, 28 p.

Vega del Sella Conde de la 1923. — *El Asturiense, nueva industria Pre-neolítica*, *Comisión de Investigaciones Paleontológicas y Prehistoricas*. Museo Nacional de Ciencias Naturales, Memoria 32, Madrid, 56 p.

Vega del Sella Conde de la 1930. — *Las Cuevas de La Riera y Balmori, Comisión de Investigaciones Paleontológicas y Prehistoricas*. Museo Nacional de Ciencias Naturales, Memoria 38, Madrid, 116 p.

Vidal Encinas J. M. 2010. — *Los hombres Mesolíticos de La Braña-Arintero (Valdelugueros, León): el hallazgo, situación, aspectos arqueo-antropológicos, cronología y contexto cultural.* Ph.D. dissertation, Universidad de León, León, 532 p.

Vidal Encinas J. M. & Fuertes-Prieto M. N. 2008. — Los hombres Mesolíticos de la Braña-Arintero (Valdelugueros, León): un hallazgo funerario excepcional en la vertiente meridional de la Cordillera Cantábrica. *Férvedes* 5: 153-164.
Vidal Romaní J. R. & Sanjurjo-Sánchez J. 2010. — Geocaracterización de yacimientos arqueológicos en medio sedimentario: cronología absoluta y relativa, *in* López Diaz A. J. & Ramil Rego E. (eds), *Arqueoloxía: Ciencia e Restauración*. Museo de Prehistoria e Arqueoloxía, Monografías 4, Vilalba: 7-19.
Villar Quinteiro R. 1997. — El Paleolítico Superior y Epipaleolítico en Galicia. *Zephyrus* 50: 71-106.
Villar Quinteiro R. 2007. — La cueva de Rei Cintolo (Lugo, Galicia). Algunos datos cronoarqueológicos de la galleria superior. *Gallaecia* 26: 31-53.
Walker E. 1968. — *Mammals of the World* (2nd edition). John Hopkins University Press, Baltimore, 2015 p.
Walker M. J., Berkelhammer M., Björck S., Cwynar L. C., Fisher D. A., Long A. J., Lowe J. J., Newnham R. M., Rasmussen S. O. & Weiss H. 2012. — Formal subdivision of the Holocene Series/Epoch: a Discussion Paper by a Working Group of INTIMATE (Integration of ice-core, marine and terrestrial records) and the Sub-Commission on Quaternary Stratigraphy (International Commission on Stratigraphy). *Journal of Quaternary Science* 27: 649-659. https://doi.org/10.1002/jqs.2565
Willermet C. M. & Hill B. 1997. — Fuzzy set theory and its implications for speciation models, *in* Clark G. A. & Willermet C. M. (eds), *Conceptual Issues in Modern Human Origins Research*. Aldine de Gruyter, New York: 77-88.
Williams A. 2012. — The use of summed radiocarbon probability distributions in archaeology: a review of methods. *Journal of Archaeological Science* 39: 578-589. https://doi.org/10.1016/j.jas.2011.07.014
Wurzer G., Kowarik K. & Reschreiter H. (eds). 2015. — *Agent-based Modeling and Simulation in Archaeology*. Springer International, New York, 276 p.
Zapata L., Ibañez J. & González J. 1997. — El yacimiento de la Cueva de Kobaederra. *Munibe* 49: 51-63.
Zapata L., Cava A., Iriarte M. J., Baraybar J. P. & de la Rua C. 2002. — Mesolithic plant use in the western Pyrenees: implications for vegetation change, use of wood and human diet, *in* Mason S. L. & Hather J. (eds), *Hunter-gatherer Archaeobotany – Perspectives from the Northern Temperate Zone*. University College, London: 96-107.
Zilhão J. 2001. — Radiocarbon evidence for maritime pioneer colonization at the origins of farming in west Mediterranean Europe. *Proceedings of the National Academy of Sciences* 98: 14180-14185. https://doi.org/10.1073/pnas.241522898
Zilhão J. 2011. — Time is on my side, *in* Hadjikoumis A., Robinson E. & Viner S. (eds), *The Dynamics of Neolithisation in Europe: Studies in Honour of Andrew Sherratt*. Oxbow Books, Oxford: 46-65.
Zvelebil M. 1983. — Site catchment analysis and hunter-gatherer resource use, *in* Bronitsky G. (ed.), *Ecological Models in Economic Prehistory*. Arizona State University Anthropological Research Papers 29, Tempe: 73-114.
Zvelebil M. 1986. — Mesolithic societies and the transition to farming: problems of time, scale and organization, *in* Zvelebil M. (ed.), *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and Their Transition to Farming*. Cambridge University Press, Cambridge: 167-188.
Zvelebil M. & Rowley-Conwy P. 1986. — Foragers and farmers in Atlantic Europe, *in* Zvelebil M. (ed.), *Hunters in Transition: Mesolithic Societies of Temperate Eurasia and their Transition to Farming*. Cambridge University Press, Cambridge: 67-93.

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APPENDICES

Appendix 1. — Northern Spain by zones – all calibrated dates combined (610 dates): https://doi.org/10.5852/cr-palevol2022v21a3_s1

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Aguila	conchero	7705	50	0,006	UBAR-794	shell	marine13	8162	Asturian	Cantabria
NA	Allorú	conchero	8360	70	0,008	UBAR-781	shell	marine13	8922	Asturian	Cantabria
NA	Andrín	conchero	9736	1077	0,111	AND-1	AAR date	normal	9736	Mesolithic	Cantabria
NA	Arangas	3	8195	60	0,007	OxA-7149	bone	intcal13	9190	Mesolithic	Cantabria
NA	Arangas	3	8300	50	0,006	OxA-6887	charcoal	intcal13	9258	Mesolithic	Cantabria
NA	Arangas	4	8280	55	0,007	OxA-6888	charcoal	intcal13	9251	Mesolithic	Cantabria
NA	Arangas	2B	8025	80	0,010	OxA-7160	bone	intcal13	8922	Mesolithic	Cantabria
NA	Arangas	E2	7150	470	0,066	UBAR-465	charcoal	intcal13	8017	Mesolithic	Cantabria
88	Arenillas	conchero	6075	30	0,005	UBAR-775	shell	marine13	6507	Mesolithic	Cantabria
NA	Arenillas	conchero	6455	60	0,009	UBAR-775	shell	marine13	6945	Mesolithic	Cantabria
89	Arenillas	NA	5580	80	0,014	GrN-19596	charcoal	intcal13	6343	Mesolithic	Cantabria
1847	Azules	3d	9540	120	0,013	CSI-C-260	charcoal	intcal13	10782	Mesolithic	Cantabria
1848	Azules	3d	9430	120	0,013	CSI-C-216	charcoal	intcal13	10725	Mesolithic	Cantabria
139	Barcenilla	V	7020	30	0,004	Poz-18849	charcoal	intcal13	7832	Mesolithic	Cantabria
140	Barcenilla	V	6380	40	0,006	Poz-18850	charcoal	intcal13	7298	Mesolithic	Cantabria
NA	Barra	conchero	6979	1539	0,221	BAR-2	AAR date	normal	6979	Mesolithic	Cantabria
NA	Barra	conchero	7121	964	0,135	BAR-1	AAR date	normal	7121	Mesolithic	Cantabria
NA	Berroberría	B	8580	80	0,009	GrN-18423	bone	intcal13	9644	Mesolithic	Cantabria
NA	Berroberría	B	8800	80	0,009	GrN-18422	bone	intcal13	9880	Mesolithic	Cantabria
NA	Berroberría	B base	8470	80	0,009	GrN-16619	bone	intcal13	9414	Mesolithic	Cantabria
NA	Berroberría	C	8510	90	0,011	GrN-16618	bone	intcal13	9502	Mesolithic	Cantabria
NA	Berroberría	C	8630	70	0,008	GrN-18426	bone	intcal13	9742	Mesolithic	Cantabria
NA	Berroberría	C	8860	100	0,011	GrN-18425	bone	intcal13	9913	Mesolithic	Cantabria
NA	Braña	Homo burial 1	7030	50	0,007	NA	NA	intcal13	7844	Mesolithic	Cantabria
NA	Braña	Homo burial 2	6980	50	0,007	NA	NA	intcal13	7810	Mesolithic	Cantabria
NA	Bricia	A	7095	481	0,068	BRI-2	AAR date	normal	7095	Asturian	Cantabria
NA	Bricia	conchero	6800	160	0,024	GaK-2908	charcoal	intcal13	7672	Asturian	Cantabria
NA	Bricia	conchero	8862	1403	0,158	BRI-1	AAR date	normal	8862	Asturian	Cantabria
NA	Cabrera	conchero	9795	1494	0,153	LCB-2	AAR date	normal	9795	Mesolithic	Cantabria
34	Calvera	1	8640	50	0,006	PO-5	charcoal	intcal13	9691	Mesolithic	Cantabria
35	Calvera	2	8950	50	0,006	PO-4	charcoal	intcal13	9989	Mesolithic	Cantabria
NA	Calvera	2	8640	50	0,006	NA	NA	intcal13	9691	Mesolithic	Cantabria
NA	Calvera	3	9620	60	0,006	GrA-6994	charcoal	intcal13	10940	Mesolithic	Cantabria
NA	Cámara	conchero	7878	2485	0,315	CAM-1	AAR date	normal	7878	Mesolithic	Cantabria
271	Campa	Roca madre	9290	50	0,005	PO-3	charcoal	intcal13	10477	Mesolithic	Cantabria
NA	Canes	69,5408163265	6815	65	0,010	AA-5296	human bone	intcal13	7690	Mesolithic	Cantabria
NA	Canes	6-I	6160	55	0,009	OxA-7148	human bone	intcal13	7030	Mesolithic	Cantabria
NA	Canes	6-I (F)	6265	75	0,012	AA-5294	human bone	intcal13	7130	Mesolithic	Cantabria
694	Canes	6-II	6860	65	0,009	AA-5295	human bone	intcal13	7724	Mesolithic	Cantabria
695	Canes	6-II	6770	65	0,010	AA-5296	human bone	intcal13	7640	Mesolithic	Cantabria
NA	Canes	6-II	7025	80	0,011	AA-11744	human bone	intcal13	7876	Mesolithic	Cantabria
NA	Canes	6-III (K)	6930	95	0,014	AA-6071	human bone	intcal13	7760	Mesolithic	Cantabria
698	Canes	NA	5865	70	0,012	AA-5788	charcoal	intcal13	6696	Mesolithic	Cantabria
1787	Carabión	1	5440	40	0,007	Poz-30592	bone	intcal13	6200	Neolithic	Cantabria
1816	Carabión	1	5750	40	0,007	Poz-18372	charcoal	intcal13	6565	Mesolithic	Cantabria
1817	Carabión	1	7800	50	0,006	Poz-32691	bone	intcal13	8686	Mesolithic	Cantabria
1818	Carabión	1	10310	60	0,006	Poz-30594	bone	intcal13	12122	Mesolithic	Cantabria
NA	Carmona	conchero	9885	1094	0,111	CAR-1	AAR date	normal	9885	Mesolithic	Cantabria
NA	Ceñil	conchero	8921	1105	0,124	CŜâL-1	AAR date	normal	8921	Mesolithic	Cantabria
NA	Chora	conchero interior	6360	80	0,013	GrN-20961	charcoal	intcal13	7242	Mesolithic	Cantabria
NA	Coberizas	1b	7100	70	0,010	GaK-2907	charcoal	intcal13	7926	Asturian	Cantabria
NA	Coberizas	conchero	7100	170	0,024	NA	charcoal	intcal13	7930	Asturian	Cantabria
NA	Coberizas	conchero, corte B	6799	573	0,084	COB-1	AAR date	normal	6799	Asturian	Cantabria
442	Cofresnedo	Conchero	6865	45	0,007	GrA-20146	bone	intcal13	7733	Mesolithic	Cantabria
NA	Cofresnedo	VO	7680	50	0,007	GrA-20146	bone	intcal13	8488	Mesolithic	Cantabria
NA	Collamosa	conchero	7638	726	0,095	COL-1	AAR date	normal	7638	Asturian	Cantabria
444	Colomba	NA	7090	60	0,008	TO-10223	human bone	intcal13	7923	Mesolithic	Cantabria
NA	Columba	conchero	7020	90	0,013	UBAR-833	charcoal	intcal13	7874	Asturian	Cantabria
NA	Columba	conchero	7090	60	0,008	TO-10233	bone	intcal13	7923	Asturian	Cantabria
NA	Columba	conchero	7450	120	0,016	UBAR-795	shell	marine13	7930	Asturian	Cantabria
NA	Columba	conchero	7550	140	0,019	UBAR-782	shell	marine13	8023	Asturian	Cantabria
1839	Corvas	Hogar, roca madre	4973	37	0,007	DSH-5056	charcoal	intcal13	5746	Neolithic	Cantabria
1840	Corvas	Hogar, roca madre	4447	39	0,009	DSH-5057	charcoal	intcal13	5083	Neolithic	Cantabria
1838	Corvas	NA	4770	31	0,006	DSH-3620	charcoal	intcal13	5476	Neolithic	Cantabria
NA	Cosfresnedo	conchero	6865	45	0,007	NA	NA	intcal13	7733	Mesolithic	Cantabria

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Covajorno	conchero	7440	955	0,128	COV-1	AAR date	normal	7440	Mesolithic	Cantabria
NA	Covajorno	conchero	7540	100	0,013	UBAR-773	shell	marine13	8005	Asturian	Cantabria
NA	Covajorno	conchero	7580	60	0,008	UBAR-774	shell	marine13	8058	Asturian	Cantabria
NA	Cubio Redondo	conchero	6630	50	0,008	Beta-10650	bone	intcal13	7534	Mesolithic	Cantabria
657	Cubio Redondo	NA	5780	50	0,009	Beta-106049	charcoal	intcal13	6594	Mesolithic	Cantabria
NA	Cueto Molino	conchero	7552	1178	0,156	CML-1	AAR date	normal	7552	Mesolithic	Cantabria
NA	Cuetu la Hoz	conchero	7690	130	0,017	UBAR-792	shell	marine13	8138	Asturian	Cantabria
NA	Cuetu la Hoz	conchero	9101	1141	0,125	CLZ-1	AAR date	normal	9101	Mesolithic	Cantabria
699	Los Canes	NA	5980	80	0,013	TO-11219	human bone	intcal13	6834	Mesolithic	Cantabria
NA	Cueva dMar	conchero aislado	7860	60	0,008	AA-45572	charcoal	intcal13	8712	Mesolithic	Cantabria
NA	Cueva dMar	conchero base	7225	45	0,006	AA-45575	charcoal	intcal13	8050	Asturian	Cantabria
NA	Cueva dMar	conchero medio	7015	40	0,006	AA-45573	charcoal	intcal13	7828	Asturian	Cantabria
NA	Cueva dMar	conchero superior	6725	50	0,007	AA-45576	charcoal	intcal13	7582	Asturian	Cantabria
785	Cueva dMar	Medio	6825	41	0,006	AA-45573	charcoal	intcal13	7700	Mesolithic	Cantabria
787	Cueva dMar	NA	7013	42	0,006	AA-45572	charcoal	intcal13	7828	Mesolithic	Cantabria
794	Portillo Arenal	NA	5743	111	0,019	AA-20043	bone	intcal13	6592	Neolithic	Cantabria
1786	Portillo Arenal	NA	4560	35	0,008	Poz-39141	human bone	intcal13	5210	Neolithic	Cantabria
1788	Portillo Arenal	NA	4443	104	0,023	AA-20044	bone	intcal13	5076	Neolithic	Cantabria
1815	Portillo Arenal	NA	9950	50	0,005	Poz-39140	bone	intcal13	11484	Epipaleolítico	Cantabria
1844	Cueva Morín	1,3	9000	150	0,017	I-5150	charcoal	intcal13	10130	Mesolithic	Cantabria
1842	Cueva Oscura	NA	9440	90	0,010	CSI-C--362	charcoal	intcal13	10724	Mesolithic	Cantabria
1864	Cueva Oscura	NA	9280	230	0,025	Ly-2938	n.d	intcal13	10468	Mesolithic	Cantabria
NA	Espertín	2	7790	120	0,015	Gif-10053	NA	intcal13	8657	Mesolithic	Cantabria
NA	Fragua	A4/1inferior	7530	75	0,010	GrN-20965	charcoal	intcal13	8310	Mesolithic	Cantabria
NA	Fragua	A4/1medio	6860	60	0,009	GrN-20964	charcoal	intcal13	7732	Mesolithic	Cantabria
NA	Fragua	A4/1superior	6650	120	0,018	GrN-20963	charcoal	intcal13	7549	Mesolithic	Cantabria
1841	Fragua	I bajo	9600	140	0,015	GrN-20966	charcoal	intcal13	10934	Mesolithic	Cantabria
NA	Garma A	estrato 1	8448	1987	0,235	MAD-646	carbonate	intcal13	9943	Mesolithic	Cantabria
NA	Garma A	estrato 1	9165	1088	0,119	MAD-436	carbonate	intcal13	10527	Mesolithic	Cantabria
NA	Garma A	estrato 2	6870	50	0,007	OxA-7150	bone	intcal13	7744	Mesolithic	Cantabria
NA	Garma A	estrato 2	6920	50	0,007	OxA-6889	bone	intcal13	7766	Mesolithic	Cantabria
NA	Garma A	estrato 2	7685	65	0,008	OxA-7284	bone	intcal13	8504	Mesolithic	Cantabria
NA	Garma A	estrato 2	7710	90	0,012	OxA-7495	bone	intcal13	8590	Mesolithic	Cantabria
NA	Garma A	estrato 2	8165	65	0,008	UBAR-656	shell	marine13	8688	Mesolithic	Cantabria
NA	Garma A	estrato 2	8175	65	0,008	UBAR-657	NA	intcal13	9115	Mesolithic	Cantabria
NA	Garma A	estrato 2	8295	65	0,008	UBAR-655	shell	marine13	8832	Mesolithic	Cantabria
NA	Garma B	NA	7165	65	0,009	OxA-7300	human bone	intcal13	7965	Mesolithic	Cantabria
1235	Gitanos	A3	5945	55	0,009	AA-29113	bone	intcal13	6761	Neolithic	Cantabria
1236	Gitanos	A3	5150	100	0,019	UBAR-521	charcoal	intcal13	5939	Neolithic	Cantabria
1237	Gitanos	A4	5490	200	0,036	UBAR-693	charcoal	intcal13	6308	Neolithic	Cantabria
NA	Horadada	conchero	7929	424	0,053	HOR-1	AAR date	normal	7929	Mesolithic	Cantabria
NA	Ilso de Hayas	sondeo IH-3	8440	130	0,015	GrN-21231	charcoal	intcal13	9512	Mesolithic	Cantabria
NA	Kobeaga II	Amek-h	7690	270	0,035	GrN-27480	charcoal	intcal13	8601	Mesolithic	Cantabria
1834	l'Hortal	NA	4518	53	0,012	DSH-3618	charcoal	intcal13	5160	Neolithic	Cantabria
1835	l'Hortal	NA	4350	29	0,007	DSH-3619	charcoal	intcal13	4946	Neolithic	Cantabria
NA	Llamorey	conchero	8329	947	0,114	LMY-1	AAR date	normal	8329	Mesolithic	Cantabria
NA	Marizulo	IV	6820	50	0,007	I-16190	bone	intcal13	7683	Mesolithic	Cantabria
NA	Mary	conchero	8572	1030	0,120	MRY-1	AAR date	normal	8572	Mesolithic	Cantabria
NA	Mazaculos	1,1	7280	220	0,030	GaK-8162	charcoal	intcal13	8212	Asturian	Cantabria
NA	Mazaculos	3,3	9290	440	0,047	GaK-6884	charcoal	intcal13	10772	Asturian	Cantabria
1856	Mazaculos	A2	5050	120	0,024	GaK-15221	charcoal	intcal13	5809	Neolithic	Cantabria
NA	Mazaculos	A3	7030	120	0,017	GaK-15222	charcoal	intcal13	7906	Asturian	Cantabria
NA	Mazo	inner, SU-105	7640	30	0,004	UGAM-S5408	charcoal	intcal13	8455	Asturian	Cantabria
NA	Mazo	outer, SU-3	6790	30	0,004	UGAM-S5407	NA	intcal13	7641	Asturian	Cantabria
NA	Mirón	10,1	8380	175	0,021	GX-24463	charcoal	intcal13	9385	Mesolithic	Cantabria
NA	Mirón	10,1	8700	40	0,005	GX-25852	charcoal	intcal13	9722	Mesolithic	Cantabria
NA	Mirón	10,1	9550	50	0,005	GX-24464	charcoal	intcal13	10884	Mesolithic	Cantabria
904	Mirón	Cabin 9	5170	170	0,033	GX-22128	charcoal	intcal13	5906	Neolithic	Cantabria
898	Mirón	NA	5690	50	0,009	GX-23413	charcoal	intcal13	6485	Neolithic	Cantabria
899	Mirón	NA	5570	50	0,009	GX-23414	charcoal	intcal13	6376	Neolithic	Cantabria
900	Mirón	NA	5500	90	0,016	GX-25854	charcoal	intcal13	6288	Neolithic	Cantabria
901	Mirón	NA	5520	70	0,013	GX-25855	charcoal	intcal13	6302	Neolithic	Cantabria
902	Mirón	NA	5790	90	0,016	GX-25856	charcoal	intcal13	6630	Neolithic	Cantabria
903	Mirón	NA	5550	40	0,007	GX-309010	seed	intcal13	6353	Neolithic	Cantabria
907	Mirón	Trench 98 a	4910	80	0,016	GX-28211	charcoal	intcal13	5626	Neolithic	Cantabria
NA	Molino	conchero	6611	1093	0,165	MOL-1	AAR date	normal	6611	Mesolithic	Cantabria
1391	Paré Nogales	NA	7365	36	0,005	OxA-X2399926	human bone	intcal13	8182	Mesolithic	Cantabria
1425	Peña Oviedo	Nivel 1	4820	50	0,010	GrN-19048	charcoal	intcal13	5530	Neolithic	Cantabria
1426	Peña Oviedo	Nivel 5	5195	25	0,005	GrN-18782	charcoal	intcal13	5970	Neolithic	Cantabria

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Pendueles	conchero	7080	80	0,011	UBAR-793	shell	marine13	7573	Asturian	Cantabria
NA	Penicial	conchero	7972	885	0,111	PEN-1	AAR date	normal	7972	Asturian	Cantabria
NA	Penicial	conchero	8650	185	0,021	GaK-2906	charcoal	intcal13	9730	Asturian	Cantabria
1843	Perro	1,3	9260	110	0,012	GrN-18115	charcoal	intcal13	10551	Mesolithic	Cantabria
NA	Perro	1,3	9260	110	0,012	GrN-18116	charcoal	intcal13	10551	Mesolithic	Cantabria
NA	Poza l'Egua	2	8550	80	0,009	TO-10222	bone	intcal13	9588	Asturian	Cantabria
NA	Quintana	conchero	7063	1858	0,263	QUT-1	AAR date	normal	7063	Mesolithic	Cantabria
NA	Riera	28	9230	90	0,010	Q-2933	shell	marine13	9974	Asturian	Cantabria
1846	Riera	29 lower	6500	200	0,031	GaK--3046	charcoal	intcal13	7316	Mesolithic	Cantabria
NA	Riera	29 lower	8650	300	0,035	GaK-2909	charcoal	intcal13	9734	Asturian	Cantabria
NA	Riera	conchero	7516	588	0,078	RIE-1	AAR date	normal	7516	Asturian	Cantabria
1836	Sienra	sobre la roca madre	4091	28	0,007	DSH-2224	charcoal	intcal13	4627	Neolithic	Cantabria
1837	Sienra	sobre la roca madre	1238	30	0,024	DSH-2223	charcoal	intcal13	1160	Neolithic	Cantabria
NA	Sierra Plana	1C	7550	190	0,025	UGRA-209	charcoal	intcal13	8423	Asturian	Cantabria
1579	Sierra Plana	NA	5230	50	0,010	OxA-6914	charcoal	intcal13	6010	Neolithic	Cantabria
NA	Sierra Plana	paleoSolutrean	6830	55	0,008	OxA-6916	charcoal	intcal13	7700	Mesolithic	Cantabria
NA	Sonrasa	conchero	7263	82	0,011	SON-1	NA	intcal13	8088	Mesolithic	Cantabria
NA	TarrerÇün	III	5780	120	0,021	I-4030	charcoal	intcal13	6674	Mesolithic	Cantabria
NA	Tito Bustillo	enterramiento	8470	50	0,006	Beta-197042	tooth	intcal13	9420	Mesolithic	Cantabria
NA	Toral	21	7080	30	0,004	NA	NA	intcal13	7900	Asturian	Cantabria
NA	Toral	13A	7000	40	0,006	NA	NA	intcal13	7822	Asturian	Cantabria
921	Toral III	Zona B M9	7080	30	0,004	UGAM-S5400	human bone	intcal13	7900	Mesolithic	Cantabria
922	Toral III	Zona B M9	6750	30	0,004	UGAM-S5401	charcoal	intcal13	7604	Mesolithic	Cantabria
923	Toral III	Zona B M9	6810	30	0,004	UGAM-S5402	charcoal	intcal13	7660	Mesolithic	Cantabria
924	Toral III	Zona B O8	6430	30	0,005	UGAM-S5403	charcoal	intcal13	7346	Mesolithic	Cantabria
NA	Toralete	conchero	7060	80	0,011	UBAR-777	shell	marine13	7555	Asturian	Cantabria
NA	Toralete	conchero	7680	50	0,007	UBAR-776	shell	marine13	8144	Asturian	Cantabria
NA	Toralete	conchero	7890	80	0,010	UBAR-780	shell	marine13	8335	Asturian	Cantabria
1589	Torca l'Arroyu	TA-3A	4930	70	0,014	UBAR-803	bone	intcal13	5658	Neolithic	Cantabria
1858	Trecha	NA	5430	70	0,013	URU-0050	charcoal	intcal13	6195	Mesolithic	Cantabria
1859	Trecha	NA	5600	610	0,109	URU-0051	charcoal	intcal13	6209	Mesolithic	Cantabria
NA	Trecha	zona 2 - conchero	6240	100	0,016	URU-0039	shell	marine13	6716	Mesolithic	Cantabria
NA	Trecha	zona 4/CC6/1	7500	70	0,009	URU-0038	shell	marine13	7948	Mesolithic	Cantabria
NA	Truchiro	conchero	6470	70	0,011	TO-10912	bone	intcal13	7374	Mesolithic	Cantabria
	Cantabria:		**7223**	**231**	**0,030**				**7973**		
3	Abauntz	b4	5390	120	0,022	I-11309	charcoal	intcal13	6162	Neolithic	Ebro
4	Abauntz	C	6910	450	0,065	I-11537	charcoal	intcal13	7799	Neolithic	Ebro
1850	Abauntz	D	9530	300	0,031	Ly-1964	charcoal	intcal13	10976	Mesolithic	Ebro
1851	Abauntz	D	6600	50	0,008	Ly-1964b	charcoal	intcal13	7472	Mesolithic	Ebro
NA	Abauntz	Iir	5820	40	0,007	GrN-21010	charcoal	intcal13	6618	Neolithic	Ebro
NA	Aizpea	I	7160	70	0,010	GrN-16621	NA	intcal13	7960	Mesolithic	Ebro
NA	Aizpea	I	7790	70	0,009	GrN-16620	NA	intcal13	8686	Mesolithic	Ebro
NA	Aizpea	II	6600	50	0,008	GrA-779	NA	intcal13	7472	Mesolithic	Ebro
NA	Aizpea	II	6830	70	0,010	GrN-16622	NA	intcal13	7700	Mesolithic	Ebro
NA	Aizpea	NA	6370	70	0,011	BrN-18421	NA	intcal13	7250	Neolithic	Ebro
NA	Aizpea	NA	8000	80	0,010	GrN-25999	NA	intcal13	8905	Mesolithic	Ebro
NA	Alonso Norte	NA	6069	27	0,004	D-AMS 018640	NA	intcal13	6932	Neolithic	Ebro
NA	Alto Rodilla	NA	6171	55	0,009	CSIC-1967	NA	intcal13	7033	Neolithic	Ebro
NA	Áng1	NA	5220	80	0,015	GrA-22825	NA	intcal13	5974	Neolithic	Ebro
NA	Áng1	NA	7435	45	0,006	GrA-27274	NA	intcal13	8222	Mesolithic	Ebro
NA	Áng2	NA	6390	40	0,006	Beta-254048	NA	intcal13	7300	Mesolithic	Ebro
NA	Áng2	NA	7955	45	0,006	GrA-27278	NA	intcal13	8804	Mesolithic	Ebro
NA	Áng3	NA	6610	40	0,006	Beta-286819	NA	intcal13	7515	Mesolithic	Ebro
NA	Áng3	NA	8390	60	0,007	GrA-22826	NA	intcal13	9314	Mesolithic	Ebro
NA	Áng4	NA	6990	50	0,007	Beta-266112	NA	intcal13	7820	Mesolithic	Ebro
NA	Áng5	NA	7120	50	0,007	Beta-286820	NA	intcal13	7952	Mesolithic	Ebro
NA	Áng6	NA	8310	60	0,007	GrA-22836	NA	intcal13	9270	Mesolithic	Ebro
NA	Artegieta	NA	8055	50	0,006	GrA-28311	NA	intcal13	8944	Mesolithic	Ebro
NA	Artusia	NA	7680	40	0,005	Beta-374431	NA	intcal13	8484	Mesolithic	Ebro
NA	Artusia	NA	7790	40	0,005	Beta-374432	NA	intcal13	8592	Mesolithic	Ebro
NA	Artusia	NA	8260	40	0,005	Beta-374433	NA	intcal13	9240	Mesolithic	Ebro
106	Atxoste	D	8840	50	0,006	GrA-13473	bone	intcal13	9880	Mesolithic	Ebro
105	Atxoste	IIIb	6220	60	0,010	GrA-9789	bone	intcal13	7118	Neolithic	Ebro
107	Atxoste	IIIb2	6710	50	0,007	A*1	bone	intcal13	7566	Mesolithic	Ebro
108	Atxoste	IIIb2	6940	40	0,006	GrA-13415	bone	intcal13	7779	Mesolithic	Ebro
NA	Atxoste	IIIb2	7140	50	0,007	GrA-13468	bone	intcal13	7979	Mesolithic	Ebro

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Atxoste	IV	7340	70	0,010	GrA-13418	bone	intcal13	8167	Mesolithic	Ebro
NA	Atxoste	IV	7480	50	0,007	GrA-13469	bone	intcal13	8276	Mesolithic	Ebro
99	Atxoste	NA	7830	50	0,006	GrA-13472	bone	intcal13	8704	Mesolithic	Ebro
100	Atxoste	NA	8760	50	0,006	GrA-15699	bone	intcal13	9855	Mesolithic	Ebro
NA	Atxoste	NA	6970	40	0,006	GrA-13419	NA	intcal13	7810	Mesolithic	Ebro
NA	Atxoste	NA	7810	40	0,005	GrA-13447	bone	intcal13	8630	Mesolithic	Ebro
NA	Atxoste	NA	8510	80	0,009	GrA-15700	bone	intcal13	9512	Mesolithic	Ebro
NA	Atxoste	V	8030	50	0,006	GrA-13448	bone	intcal13	8868	Mesolithic	Ebro
NA	Balm. Guilanyà	NA	8640	50	0,006	Beta-210730	NA	intcal13	9691	Mesolithic	Ebro
NA	Balm. Guilanyà	NA	8680	50	0,006	Beta-185046	NA	intcal13	9732	Mesolithic	Ebro
NA	Balm. Margineda	NA	6410	40	0,006	Beta-325682	NA	intcal13	7307	Neolithic	Ebro
NA	Baños	NA	7350	50	0,007	GrA-21550	NA	intcal13	8173	Mesolithic	Ebro
NA	Baños	NA	7550	50	0,007	GrA-21551	NA	intcal13	8360	Mesolithic	Ebro
NA	Baños	NA	7570	100	0,013	GrN-24300	NA	intcal13	8374	Mesolithic	Ebro
NA	Baños	NA	7740	50	0,006	GrA-21552	NA	intcal13	8551	Mesolithic	Ebro
NA	Baños	NA	7840	100	0,013	GrN-24299	NA	intcal13	8734	Mesolithic	Ebro
NA	Baños	NA	8040	50	0,006	GrA-21556	NA	intcal13	8910	Mesolithic	Ebro
NA	Botiquería	NA	6040	50	0,008	GrA-13268	NA	intcal13	6916	Neolithic	Ebro
NA	Botiquería	NA	6240	50	0,008	GrA-13270	NA	intcal13	7128	Neolithic	Ebro
NA	Botiquería	NA	6830	50	0,007	GrA-13267	NA	intcal13	7699	Mesolithic	Ebro
NA	Botiquería	NA	7600	50	0,007	GrA-13265	NA	intcal13	8392	Mesolithic	Ebro
NA	Cabezo la Cruz	NA	7150	70	0,010	GrN-29135	NA	intcal13	7946	Mesolithic	Ebro
NA	Camp Colomer	NA	5300	30	0,006	Beta-325685	NA	intcal13	6086	Neolithic	Ebro
NA	Camp Colomer	NA	5350	40	0,007	Beta-325684	NA	intcal13	6114	Neolithic	Ebro
NA	Camp Colomer	NA	5630	40	0,007	Beta-325686	NA	intcal13	6452	Neolithic	Ebro
NA	Carlos Álvarez	NA	7013	38	0,005	KIA-27671	NA	intcal13	7826	Mesolithic	Ebro
NA	Cascajos	NA	5100	60	0,012	GrA-16204	NA	intcal13	5870	Neolithic	Ebro
NA	Cascajos	NA	5100	50	0,010	GrA-16942	NA	intcal13	5817	Neolithic	Ebro
NA	Cascajos	NA	5250	50	0,010	GrA-16208	NA	intcal13	6048	Neolithic	Ebro
NA	Cascajos	NA	5300	60	0,011	GrA-16210	NA	intcal13	6094	Neolithic	Ebro
NA	Cascajos	NA	5330	60	0,011	GrA-16211	NA	intcal13	6107	Neolithic	Ebro
NA	Cascajos	NA	5450	85	0,016	UA16203	NA	intcal13	6232	Neolithic	Ebro
NA	Cascajos	NA	5640	35	0,006	UA-1625	NA	intcal13	6438	Neolithic	Ebro
NA	Cascajos	NA	5720	90	0,016	UA-17793	NA	intcal13	6561	Neolithic	Ebro
NA	Cascajos	NA	5830	60	0,010	GrA-16209	NA	intcal13	6650	Neolithic	Ebro
NA	Cascajos	NA	5945	95	0,016	UA-24423	NA	intcal13	6822	Neolithic	Ebro
NA	Cascajos	NA	6125	80	0,013	UA-17995	NA	intcal13	6992	Neolithic	Ebro
NA	Cascajos	NA	6145	45	0,007	UA-24425	NA	intcal13	7024	Neolithic	Ebro
NA	Cascajos	NA	6185	75	0,012	UA-16024	NA	intcal13	7079	Neolithic	Ebro
NA	Cascajos	NA	6230	50	0,008	UA-24427	NA	intcal13	7109	Neolithic	Ebro
NA	Cascajos	NA	6250	50	0,008	UA-24426	NA	intcal13	7166	Neolithic	Ebro
NA	Cascajos	NA	6380	60	0,009	UA-24424	NA	intcal13	7262	Mesolithic	Ebro
NA	Cascajos	NA	6435	35	0,005	UA-24428	NA	intcal13	7357	Neolithic	Ebro
NA	Chaves	NA	6120	70	0,011	CSIC-381	NA	intcal13	6974	Neolithic	Ebro
NA	Chaves	NA	6230	70	0,011	CSIC-379	NA	intcal13	7108	Neolithic	Ebro
NA	Chaves	NA	6230	45	0,007	GrA-26912	NA	intcal13	7124	Neolithic	Ebro
NA	Chaves	NA	6260	100	0,016	GrN-13603	NA	intcal13	7118	Neolithic	Ebro
NA	Chaves	NA	6330	90	0,014	GrN-13602	NA	intcal13	7198	Neolithic	Ebro
NA	Chaves	NA	6330	70	0,011	GrN-13605	NA	intcal13	7210	Neolithic	Ebro
NA	Chaves	NA	6335	40	0,006	GrA-34256	NA	intcal13	7259	Neolithic	Ebro
NA	Chaves	NA	6380	40	0,006	GrA-28341	NA	intcal13	7298	Neolithic	Ebro
NA	Chaves	NA	6410	40	0,006	GrA-34257	NA	intcal13	7307	Mesolithic	Ebro
NA	Chaves	NA	6460	70	0,011	CSIC-378	NA	intcal13	7370	Mesolithic	Ebro
NA	Chaves	NA	6470	25	0,004	UCIAMS-66317	NA	intcal13	7369	Neolithic	Ebro
NA	Chaves	NA	6490	40	0,006	GrN-13604	NA	intcal13	7404	Neolithic	Ebro
NA	Chaves	NA	6530	40	0,006	GrA-34258	NA	intcal13	7424	Mesolithic	Ebro
NA	Chaves	NA	6580	35	0,005	GrA-38022	NA	intcal13	7494	Mesolithic	Ebro
NA	Chaves	NA	6650	80	0,012	GrN-12683	NA	intcal13	7528	Mesolithic	Ebro
NA	Chaves	NA	6770	70	0,010	GrN-12658	NA	intcal13	7657	Mesolithic	Ebro
NA	Col. Puiggrós	NA	5345	45	0,008	UBAR-891	NA	intcal13	6111	Neolithic	Ebro
NA	Col. Puiggrós	NA	5480	45	0,008	UBAR-892	NA	intcal13	6247	Neolithic	Ebro
NA	Coro Trasito	NA	5850	35	0,006	CNA.2520.1.1	NA	intcal13	6647	Neolithic	Ebro
NA	Coro Trasito	NA	5990	40	0,007	Beta-358571	NA	intcal13	6832	Neolithic	Ebro
NA	Coro Trasito	NA	6159	40	0,006	Beta-366546	NA	intcal13	7055	Neolithic	Ebro
NA	Costalena	NA	5480	50	0,009	GrA-13264	NA	intcal13	6224	Neolithic	Ebro
NA	Costalena	NA	7053	27	0,004	MAMS-29828	NA	intcal13	7879	Mesolithic	Ebro
NA	Cova Colomera	NA	6020	50	0,008	Beta-248523	NA	intcal13	6910	Neolithic	Ebro
NA	Cova Colomera	NA	6150	40	0,007	Beta-240551	NA	intcal13	7045	Neolithic	Ebro
NA	Cova Colomera	NA	6170	30	0,005	OxA-23634	NA	intcal13	7078	Neolithic	Ebro

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Cova Colomera	NA	6180	40	0,006	Beta-279478	NA	intcal13	7075	Neolithic	Ebro
NA	C. Montanissell	NA	5680	50	0,009	Beta-213109	NA	intcal13	6482	Neolithic	Ebro
NA	Cova Sardo	NA	5000	30	0,006	K/5833/40816	NA	intcal13	5754	Neolithic	Ebro
NA	Cova Sardo	NA	5060	40	0,008	K/K3484/26248	NA	intcal13	5782	Neolithic	Ebro
NA	Cova Sardo	NA	5245	40	0,008	K/K4381/32340	NA	intcal13	6060	Neolithic	Ebro
NA	Cova Sardo	NA	5635	35	0,006	K/K5832/40815	NA	intcal13	6430	Neolithic	Ebro
NA	Cova Sardo	NA	5645	25	0,004	K/K5860/41134	NA	intcal13	6420	Neolithic	Ebro
NA	Cova Sardo	NA	5695	35	0,006	K/K5002/36935	NA	intcal13	6486	Neolithic	Ebro
NA	Cova Sardo	NA	5715	35	0,006	K/K5785/40878	NA	intcal13	6517	Neolithic	Ebro
NA	Cova Sardo	NA	5850	40	0,007	K/K5038/37690	NA	intcal13	6660	Neolithic	Ebro
NA	Cova Sardo	NA	6525	45	0,007	K/K5037/37689	NA	intcal13	7422	Mesolithic	Ebro
NA	Cova Sardo	NA	6586	35	0,005	K/K5834/40817	NA	intcal13	7500	Mesolithic	Ebro
NA	Cova Vidre	NA	6181	35	0,006	OXA-26064	NA	intcal13	7076	Neolithic	Ebro
NA	Cova Vidre	NA	6189	90	0,015	Beta-58934	NA	intcal13	7050	Neolithic	Ebro
NA	Cova Vidre	NA	6248	33	0,005	OXA-26005	NA	intcal13	7142	Neolithic	Ebro
NA	Cova Vidre	NA	7290	70	0,010	UBAR-832	NA	intcal13	8132	Mesolithic	Ebro
NA	Cova Fosca	NA	5715	80	0,014	I-9867	NA	intcal13	6550	Neolithic	Ebro
NA	Cova Fosca	NA	5820	40	0,007	Beta-148998	NA	intcal13	6618	Neolithic	Ebro
NA	Cova Fosca	NA	5820	40	0,007	Beta-18993	NA	intcal13	6618	Neolithic	Ebro
NA	Cova Fosca	NA	5850	70	0,012	Beta-148996	NA	intcal13	6682	Neolithic	Ebro
NA	Cova Fosca	NA	5870	80	0,014	Beta-148997	NA	intcal13	6706	Neolithic	Ebro
NA	Cova Fosca	NA	5980	70	0,012	Beta-148994	NA	intcal13	6831	Neolithic	Ebro
NA	Cova Fosca	NA	5980	70	0,012	Beta-148999	NA	intcal13	6831	Neolithic	Ebro
NA	Cova Fosca	NA	6070	80	0,013	Beta-149005	NA	intcal13	6946	Neolithic	Ebro
NA	Cova Fosca	NA	6080	80	0,013	Beta-149000	NA	intcal13	6954	Neolithic	Ebro
NA	Cova Fosca	NA	6130	60	0,010	Beta-149007	NA	intcal13	7003	Neolithic	Ebro
NA	Cova Fosca	NA	6140	90	0,015	Beta-149001	NA	intcal13	7037	Neolithic	Ebro
NA	Cova Fosca	NA	6150	70	0,011	Beta-149004	NA	intcal13	7024	Neolithic	Ebro
NA	Cova Fosca	NA	6250	80	0,013	Beta-149006	NA	intcal13	7110	Neolithic	Ebro
NA	Cova Fosca	NA	6390	40	0,006	Beta-149009	NA	intcal13	7300	Neolithic	Ebro
NA	Cova Fosca	NA	6413	33	0,005	OXA-26074	NA	intcal13	7341	Neolithic	Ebro
NA	Cova Fosca	NA	7100	70	0,010	CSIC-356	NA	intcal13	7926	Mesolithic	Ebro
NA	Cova Fosca	NA	7210	70	0,010	CSIC-357	NA	intcal13	8058	Mesolithic	Ebro
NA	Cova Gran	NA	5250	40	0,008	Beta-233605	NA	intcal13	6064	Neolithic	Ebro
NA	Cova Gran	NA	6020	50	0,008	Beta-265982	NA	intcal13	6910	Neolithic	Ebro
NA	Cueva d'Gato 2	NA	6240	50	0,008	GrA-22525	NA	intcal13	7128	Neolithic	Ebro
NA	Cueva Drólica	NA	5855	40	0,007	GrA-33914	NA	intcal13	6668	Neolithic	Ebro
NA	Cueva Lóbrega	III inferior	6220	100	0,016	GrN-16110	bone	intcal13	7068	Neolithic	Ebro
NA	Cueva Pacencia	NA	5795	45	0,008	GrA-17666	NA	intcal13	6597	Neolithic	Ebro
NA	Espantalobos	NA	7390	40	0,005	Beta-361624	NA	intcal13	8199	Mesolithic	Ebro
NA	Espantalobos	NA	7900	50	0,006	Beta-361625	NA	intcal13	8762	Mesolithic	Ebro
NA	Esp. Puyascada	NA	5580	70	0,013	CSIS-382	NA	intcal13	6400	Neolithic	Ebro
NA	Esp. Puyascada	NA	5930	60	0,010	CSIC-384	NA	intcal13	6757	Neolithic	Ebro
NA	Esplugón	NA	5970	30	0,005	Beta-338509	NA	intcal13	6808	Neolithic	Ebro
NA	Esplugón	NA	6120	40	0,007	Beta-283899	NA	intcal13	6994	Neolithic	Ebro
NA	Esplugón	NA	6730	40	0,006	Beta-313517	NA	intcal13	7578	Mesolithic	Ebro
NA	Esplugón	NA	6950	50	0,007	Beta-306723	NA	intcal13	7786	Mesolithic	Ebro
NA	Esplugón	NA	7620	40	0,005	GrA-59632	NA	intcal13	8450	Mesolithic	Ebro
NA	Esplugón	NA	7715	45	0,006	GrA-59634	NA	intcal13	8508	Mesolithic	Ebro
NA	Esplugón	NA	7860	40	0,005	Beta-306725	NA	intcal13	8728	Mesolithic	Ebro
NA	Esplugón	NA	8015	45	0,006	GrA-59633	NA	intcal13	8864	Mesolithic	Ebro
NA	Esplugón	NA	8380	40	0,005	Beta 306722	NA	intcal13	9364	Mesolithic	Ebro
NA	Estany la Coveta	NA	7845	45	0,006	KIA-29818	NA	intcal13	8710	Mesolithic	Ebro
NA	Filador	NA	8150	90	0,011	AA-13411	NA	intcal13	9042	Mesolithic	Ebro
NA	Filador	NA	8515	60	0,007	OxA-8658	NA	intcal13	9494	Mesolithic	Ebro
NA	Forcas II	NA	5240	40	0,008	Beta-247406	NA	intcal13	6051	Neolithic	Ebro
NA	Forcas II	NA	6740	40	0,006	Beta-247405	NA	intcal13	7585	Mesolithic	Ebro
NA	Forcas II	NA	6750	40	0,006	Beta-247404	NA	intcal13	7595	Mesolithic	Ebro
NA	Forcas II	NA	6900	45	0,007	GrN-22688	NA	intcal13	7758	Mesolithic	Ebro
NA	Forcas II	NA	6940	90	0,013	Beta-60773	NA	intcal13	7771	Mesolithic	Ebro
NA	Forcas II	NA	7000	40	0,006	Beta-290932	NA	intcal13	7822	Mesolithic	Ebro
NA	Forcas II	NA	7150	40	0,006	Beta-250944	NA	intcal13	7999	Mesolithic	Ebro
NA	Forcas II	NA	7240	40	0,006	GrN-22686	NA	intcal13	8063	Mesolithic	Ebro
NA	Forcas II	NA	8650	70	0,008	Beta-59997	NA	intcal13	9788	Mesolithic	Ebro
996	Fuente Hoz	I (16)	6120	280	0,046	I-12084	charcoal	intcal13	6909	Neolithic	Ebro
994	Fuente Hoz	I-a	5240	110	0,021	I-11588	bone	intcal13	6000	Neolithic	Ebro
995	Fuente Hoz	I-b	5160	110	0,021	I-11589	bone	intcal13	5934	Neolithic	Ebro
NA	Fuente Hoz	III	7880	120	0,015	I-13496	charcoal	intcal13	8810	Mesolithic	Ebro
NA	Fuente Hoz	III (21)	7840	130	0,017	I-12083	charcoal	intcal13	8740	Mesolithic	Ebro

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Fuente Hoz	III (23)	7140	120	0,017	I-12778	charcoal	intcal13	7982	Mesolithic	Ebro
NA	Fuente Hoz	III (28)	8120	240	0,030	I-12985	NA	intcal13	9088	Mesolithic	Ebro
NA	Huerto Raso	NA	6310	60	0,010	GrA-21360	NA	intcal13	7190	Neolithic	Ebro
NA	Husos I	NA	5810	60	0,010	Beta-161881	NA	intcal13	6638	Neolithic	Ebro
1243	Husos I	XV	5810	60	0,010	Beta-161181	bone	intcal13	6638	Neolithic	Ebro
NA	Husos I	XV	5630	60	0,011	Beta-161179	bone	intcal13	6452	Neolithic	Ebro
NA	Husos I	XV	6130	60	0,010	Beta-161180	bone	intcal13	7003	Neolithic	Ebro
NA	Husos I	XVI	6240	60	0,010	Beta-161182	bone	intcal13	7151	Neolithic	Ebro
1244	Husos II	IV	4910	60	0,012	Beta-208848	bone	intcal13	5654	Neolithic	Ebro
1245	Husos II	IV	4930	40	0,008	Beta-208849	bone	intcal13	5723	Neolithic	Ebro
NA	Husos II	IX	6040	40	0,007	Beta-221642	bone	intcal13	6933	Neolithic	Ebro
NA	Husos II	NA	5300	40	0,008	Beta-161884	NA	intcal13	6098	Neolithic	Ebro
NA	Husos II	NA	5790	40	0,007	Beta-221641	NA	intcal13	6582	Neolithic	Ebro
1248	Husos II	V	5300	40	0,008	Beta-161184	bone	intcal13	6098	Neolithic	Ebro
NA	Husos II	V	5280	40	0,008	Beta-208850	NA	intcal13	6086	Neolithic	Ebro
NA	Husos II	V	5430	60	0,011	Beta-161185	bone	intcal13	6186	Neolithic	Ebro
NA	Husos II	V	5490	40	0,007	Beta-208851	bone	intcal13	6290	Neolithic	Ebro
NA	Husos II	VI	5520	40	0,007	Beta-208853	bone	intcal13	6318	Neolithic	Ebro
NA	Husos II	VII	6050	40	0,007	Beta-221640	bone	intcal13	6945	Neolithic	Ebro
NA	Kanpanoste	Lanhi base	7920	100	0,013	GrN-22442	bone	intcal13	8830	Mesolithic	Ebro
NA	Kanpanoste	Lanhs	7620	70	0,009	GrN-22440	bone	intcal13	8408	Mesolithic	Ebro
NA	Kanpanoste	NA	8200	70	0,009	GrN-22441	NA	intcal13	9126	Mesolithic	Ebro
NA	Kan. Goikoa	III	6550	260	0,040	GrN-20289	bone	intcal13	7338	Mesolithic	Ebro
NA	Kan. Goikoa	III inferior	7620	80	0,010	GrN-20215	bone	intcal13	8434	Mesolithic	Ebro
NA	Kan. Goikoa	III lower	7860	330	0,042	GrN-20455	bone	intcal13	8834	Mesolithic	Ebro
NA	Kan. Goikoa	III Superior	6360	70	0,011	GrN-20214	bone	intcal13	7232	Neolithic	Ebro
NA	Lámpara	NA	6055	34	0,006	KIA-6789	NA	intcal13	6950	Neolithic	Ebro
NA	Lámpara	NA	6125	33	0,005	KIA-21348	NA	intcal13	7002	Neolithic	Ebro
NA	Lámpara	NA	6144	46	0,007	KIA-6790	NA	intcal13	7024	Neolithic	Ebro
NA	Lámpara	NA	6280	33	0,005	KIA-21352	NA	intcal13	7174	Neolithic	Ebro
NA	Lámpara	NA	6280	50	0,008	UtC-13346	NA	intcal13	7186	Neolithic	Ebro
NA	Lámpara	NA	6390	60	0,009	KIA-4780	NA	intcal13	7277	Neolithic	Ebro
NA	Lámpara	NA	6407	34	0,005	KIA-21347	NA	intcal13	7334	Neolithic	Ebro
NA	Lámpara	NA	6421	30	0,005	KIA-8874	NA	intcal13	7343	Neolithic	Ebro
NA	Lámpara	NA	6522	44	0,007	KIA-16567	NA	intcal13	7421	Mesolithic	Ebro
NA	Lámpara	NA	6608	35	0,005	KIA-16571	NA	intcal13	7506	Mesolithic	Ebro
NA	Lámpara	NA	6610	32	0,005	KIA-16579	NA	intcal13	7505	Mesolithic	Ebro
NA	Lámpara	NA	6729	45	0,007	KIA-16574	NA	intcal13	7572	Mesolithic	Ebro
NA	Lámpara	NA	6744	33	0,005	KIA-16575	NA	intcal13	7593	Mesolithic	Ebro
NA	Lámpara	NA	6833	34	0,005	KIA-16566	NA	intcal13	7684	Mesolithic	Ebro
NA	Lámpara	NA	6871	33	0,005	KIA-21350	NA	intcal13	7714	Mesolithic	Ebro
NA	Lámpara	NA	6915	33	0,005	KIA-16577	NA	intcal13	7758	Mesolithic	Ebro
NA	Lámpara	NA	6920	50	0,007	KIA-16569	NA	intcal13	7766	Mesolithic	Ebro
NA	Lámpara	NA	6956	39	0,006	KIA-16570	NA	intcal13	7802	Mesolithic	Ebro
NA	Lámpara	NA	6975	32	0,005	KIA-16578	NA	intcal13	7808	Mesolithic	Ebro
NA	Lámpara	NA	6989	48	0,007	KIA-16580	NA	intcal13	7818	Mesolithic	Ebro
NA	Lámpara	NA	7000	32	0,005	KIA-16568	NA	intcal13	7821	Mesolithic	Ebro
NA	Lámpara	NA	7075	44	0,006	KIA-16581	NA	intcal13	7864	Mesolithic	Ebro
NA	Lámpara	NA	7108	34	0,005	KIA-16573	NA	intcal13	7910	Mesolithic	Ebro
NA	Lámpara	NA	7136	33	0,005	KIA-16576	NA	intcal13	7942	Mesolithic	Ebro
NA	Larrenke N	NA	5180	100	0,019	NA	NA	intcal13	5946	Neolithic	Ebro
NA	Larrenke N	NA	5210	100	0,019	NA	NA	intcal13	5956	Neolithic	Ebro
NA	Legunova	NA	8800	40	0,005	GrA-24294	NA	intcal13	9864	Mesolithic	Ebro
NA	Martinarri	NA	7350	30	0,004	Beta-410010	NA	intcal13	8173	Mesolithic	Ebro
NA	Martinarri	NA	8455	45	0,005	GrA-46014	NA	intcal13	9417	Mesolithic	Ebro
NA	Mas Cremat	NA	6020	50	0,008	Beta-232340	NA	intcal13	6910	Neolithic	Ebro
NA	Mas Cremat	NA	6780	50	0,007	Beta-232342	NA	intcal13	7640	Mesolithic	Ebro
NA	Mas Cremat	NA	6800	50	0,007	Beta-232341	NA	intcal13	7664	Mesolithic	Ebro
NA	Mas Nou	NA	6760	40	0,006	Beta-170713	NA	intcal13	7608	Mesolithic	Ebro
NA	Mas Nou	NA	6800	70	0,010	Beta-136676	NA	intcal13	7676	Mesolithic	Ebro
NA	Mas Nou	NA	6900	70	0,010	Beta-136677	NA	intcal13	7752	Mesolithic	Ebro
NA	Mas Nou	NA	6910	40	0,006	Beta-170714	NA	intcal13	7763	Mesolithic	Ebro
NA	Mas Nou	NA	6920	40	0,006	Beta-170715	NA	intcal13	7772	Mesolithic	Ebro
NA	Mas Nou	NA	7010	40	0,006	Beta 170714	NA	intcal13	7826	Mesolithic	Ebro
NA	Mendandia	IV	7780	60	0,008	GrN-22745	NA	intcal13	8682	Mesolithic	Ebro
NA	Mendandia	IV	7810	50	0,006	GrN-22744	NA	intcal13	8696	Mesolithic	Ebro
NA	Mendandia	NA	6440	40	0,006	GrN-22740	NA	intcal13	7364	Neolithic	Ebro
NA	Mendandia	NA	6540	70	0,011	GrN-22741	NA	intcal13	7446	Mesolithic	Ebro
NA	Mendandia	NA	7180	45	0,006	GrN-22742	NA	intcal13	8010	Mesolithic	Ebro

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Mendandia	NA	7210	80	0,011	GrN-19658	NA	intcal13	8038	Mesolithic	Ebro
NA	Mendandia	NA	7265	70	0,010	UA-34366	NA	intcal13	8104	Mesolithic	Ebro
NA	Mendandia	NA	7620	50	0,007	GrN-22743	NA	intcal13	8410	Mesolithic	Ebro
NA	Mendandia	NA	8500	60	0,007	GrA-6874	NA	intcal13	9484	Mesolithic	Ebro
NA	Mirador	NA	5090	40	0,008	Beta-220912	NA	intcal13	5822	Neolithic	Ebro
NA	Mirador	NA	5360	50	0,009	Beta-181087	NA	intcal13	6116	Neolithic	Ebro
NA	Mirador	NA	5470	40	0,007	Beta-208131	NA	intcal13	6248	Neolithic	Ebro
NA	Mirador	NA	5480	40	0,007	Beta-220913	NA	intcal13	6267	Neolithic	Ebro
NA	Mirador	NA	5700	70	0,012	Beta-181088	NA	intcal13	6530	Neolithic	Ebro
NA	Mirador	NA	6100	50	0,008	Beta-197384	NA	intcal13	6992	Neolithic	Ebro
NA	Mirador	NA	6110	40	0,007	Beta-220914	NA	intcal13	6980	Neolithic	Ebro
NA	Mirador	NA	6120	40	0,007	Beta-208132	NA	intcal13	6994	Neolithic	Ebro
NA	Mirador	NA	6130	50	0,008	Beta-182040	NA	intcal13	7014	Neolithic	Ebro
NA	Mirador	NA	6150	40	0,007	Beta-208133	NA	intcal13	7045	Neolithic	Ebro
NA	Mirador	NA	6320	50	0,008	Beta-208134	NA	intcal13	7213	Neolithic	Ebro
NA	Mirador	NA	6380	40	0,006	Beta-197385	NA	intcal13	7298	Neolithic	Ebro
NA	Mirador	NA	7060	40	0,006	Beta-197386	NA	intcal13	7858	Mesolithic	Ebro
NA	Orcillas	NA	8610	50	0,006	Beta-252434	NA	intcal13	9676	Mesolithic	Ebro
NA	Paco Pons	NA	6010	45	0,007	Gra-19294	NA	intcal13	6874	Neolithic	Ebro
NA	Paco Pons	NA	6045	45	0,007	Gra-19295	NA	intcal13	6918	Neolithic	Ebro
NA	Padre Areso	NA	5380	100	0,019	GrN-14599	NA	intcal13	6122	Neolithic	Ebro
NA	Padre Areso	NA	5400	100	0,019	GrN-14599	NA	intcal13	6161	Neolithic	Ebro
NA	Parco	NA	5970	60	0,010	CSIC403	NA	intcal13	6848	Neolithic	Ebro
NA	Parco	NA	6120	90	0,015	GrN-20058	NA	intcal13	7010	Neolithic	Ebro
NA	Parco	NA	6170	70	0,011	CSIC-281	NA	intcal13	7037	Neolithic	Ebro
NA	Paternanbidea	NA	5960	40	0,007	GrA-13675	NA	intcal13	6808	Neolithic	Ebro
NA	Paternanbidea	NA	6090	40	0,007	GrA-13673	NA	intcal13	6960	Neolithic	Ebro
NA	Peña 14	NA	7660	90	0,012	GrN-25094	NA	intcal13	8563	Mesolithic	Ebro
NA	Peña 14	NA	8000	90	0,011	GrN-25998	NA	intcal13	8880	Mesolithic	Ebro
NA	Peña Marañón	d	7890	120	0,015	BM-2363	NA	intcal13	8818	Mesolithic	Ebro
1419	Peña Larga	IV	5830	110	0,019	I-14909	bone	intcal13	6721	Neolithic	Ebro
1420	Peña Larga	IV	6150	230	0,037	I-15150	bone	intcal13	6966	Neolithic	Ebro
1422	Peña Larga	IV	5010	40	0,008	PL*1	n.d	intcal13	5756	Neolithic	Ebro
1423	Peña Larga	IV	4890	50	0,010	Beta-242781	bone	intcal13	5654	Neolithic	Ebro
NA	Peña Larga	IV	5720	49	0,009	Beta-242782	bone	intcal13	6520	Neolithic	Ebro
NA	Peña Larga	IV	6720	40	0,006	Beta-242783	bone	intcal13	7564	Mesolithic	Ebro
NA	Plano Pulido	NA	5040	40	0,008	Beta-258559	NA	intcal13	5766	Neolithic	Ebro
NA	Pontet	NA	5644	42	0,007	D-AMS 020207	NA	intcal13	6464	Neolithic	Ebro
NA	Pontet	NA	6369	41	0,006	D-AMS 020209	NA	intcal13	7296	Neolithic	Ebro
NA	Pontet	NA	6370	70	0,011	GrN-14241	NA	intcal13	7250	Neolithic	Ebro
NA	Pontet	NA	6963	32	0,005	D-AMS 020208	NA	intcal13	7805	Mesolithic	Ebro
NA	Pontet	NA	7340	70	0,010	GrN-16313	NA	intcal13	8167	Mesolithic	Ebro
NA	Pontet	NA	7341	32	0,004	D-AMS 020210	NA	intcal13	8169	Mesolithic	Ebro
NA	Pontet	NA	7941	65	0,008	D-AMS 020211	NA	intcal13	8792	Mesolithic	Ebro
NA	Portalón	NA	5230	40	0,008	Beta-184842	NA	intcal13	6026	Neolithic	Ebro
NA	Portalón	NA	6100	50	0,008	Beta-222339	NA	intcal13	6992	Neolithic	Ebro
NA	Portalón	NA	6270	40	0,006	Beta-222340	NA	intcal13	7164	Neolithic	Ebro
NA	Prado	NA	5640	40	0,007	Beta-312351	NA	intcal13	6462	Neolithic	Ebro
NA	Prado	NA	5880	30	0,005	Beta-366569	NA	intcal13	6694	Neolithic	Ebro
NA	Prado	NA	6050	40	0,007	Beta-312352	NA	intcal13	6945	Neolithic	Ebro
NA	R. Legunova	NA	5175	40	0,008	GrA-52086	NA	intcal13	5952	Neolithic	Ebro
NA	R. Legunova	NA	5440	35	0,006	GrA-51860	NA	intcal13	6208	Neolithic	Ebro
NA	R. Legunova	NA	5670	60	0,011	GrA-52691	NA	intcal13	6499	Neolithic	Ebro
NA	R. Legunova	NA	6295	40	0,006	GrA-51971	NA	intcal13	7210	Neolithic	Ebro
NA	R. Legunova	NA	7225	40	0,006	GrA-64001	NA	intcal13	8058	Mesolithic	Ebro
NA	R. Legunova	NA	7235	45	0,006	GrA-47886	NA	intcal13	8058	Mesolithic	Ebro
NA	R. Legunova	NA	7260	45	0,006	GrA-61768	NA	intcal13	8088	Mesolithic	Ebro
NA	R. Legunova	NA	8200	50	0,006	GrA-24292	NA	intcal13	9212	Mesolithic	Ebro
NA	R. Legunova	NA	8250	60	0,007	GrA-22086	NA	intcal13	9241	Mesolithic	Ebro
NA	Revilla	NA	5642	96	0,017	KIA-13943	NA	intcal13	6426	Neolithic	Ebro
NA	Revilla	NA	6120	60	0,010	UtC-13348	NA	intcal13	6999	Neolithic	Ebro
NA	Revilla	NA	6156	33	0,005	KIA-21353	NA	intcal13	7066	Neolithic	Ebro
NA	Revilla	NA	6158	31	0,005	KIA-21349	NA	intcal13	7058	Neolithic	Ebro
NA	Revilla	NA	6177	31	0,005	KIA-21354	NA	intcal13	7090	Neolithic	Ebro
NA	Revilla	NA	6202	31	0,005	KIA-21346	NA	intcal13	7102	Neolithic	Ebro
NA	Revilla	NA	6210	60	0,010	UtC-13350	NA	intcal13	7092	Neolithic	Ebro
NA	Revilla	NA	6230	30	0,005	KIA-21355	NA	intcal13	7123	Neolithic	Ebro
NA	Revilla	NA	6240	50	0,008	UtC-13294	NA	intcal13	7128	Neolithic	Ebro
NA	Revilla	NA	6245	34	0,005	KIA-21359	NA	intcal13	7138	Neolithic	Ebro

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
NA	Revilla	NA	6250	50	0,008	UtC-13295	NA	intcal13	7166	Neolithic	Ebro
NA	Revilla	NA	6250	50	0,008	UtC-13296	NA	intcal13	7166	Neolithic	Ebro
NA	Revilla	NA	6271	31	0,005	KIA-21357	NA	intcal13	7169	Neolithic	Ebro
NA	Revilla	NA	6289	31	0,005	KIA-21351	NA	intcal13	7187	Neolithic	Ebro
NA	Revilla	NA	6313	48	0,008	UtC-13347	NA	intcal13	7212	Neolithic	Ebro
NA	Revilla	NA	6355	30	0,005	KIA-21356	NA	intcal13	7294	Neolithic	Ebro
NA	Revilla	NA	6365	36	0,006	KIA-21358	NA	intcal13	7296	Neolithic	Ebro
NA	Revilla	NA	6385	35	0,005	KIA-13932	NA	intcal13	7300	Neolithic	Ebro
NA	Revilla	NA	6405	36	0,006	KIA-13937	NA	intcal13	7314	Neolithic	Ebro
NA	Revilla	NA	6415	36	0,006	KIA-13942	NA	intcal13	7338	Neolithic	Ebro
NA	Revilla	NA	6446	39	0,006	KIA-13945	NA	intcal13	7367	Neolithic	Ebro
NA	Revilla	NA	6449	37	0,006	KIA-13948	NA	intcal13	7367	Neolithic	Ebro
NA	Revilla	NA	6468	40	0,006	KIA-13933	NA	intcal13	7386	Neolithic	Ebro
NA	Revilla	NA	6499	42	0,006	KIA-13938	NA	intcal13	7415	Neolithic	Ebro
NA	Revilla	NA	6568	37	0,006	KIA-13940	NA	intcal13	7460	Mesolithic	Ebro
NA	Revilla	NA	6691	48	0,007	KIA-13946	NA	intcal13	7557	Mesolithic	Ebro
NA	Revilla	NA	6755	57	0,008	KIA-13939	NA	intcal13	7620	Mesolithic	Ebro
NA	Revilla	NA	6772	47	0,007	KIA-13934	NA	intcal13	7634	Mesolithic	Ebro
NA	Revilla	NA	6809	37	0,005	KIA-13947	NA	intcal13	7678	Mesolithic	Ebro
NA	Revilla	NA	6983	45	0,006	KIA-13935	NA	intcal13	7816	Mesolithic	Ebro
NA	Revilla	NA	7014	37	0,005	KIA-13944	NA	intcal13	7826	Mesolithic	Ebro
NA	Revilla	NA	7165	37	0,005	KIA-13941	NA	intcal13	8006	Mesolithic	Ebro
NA	Riols	NA	6040	100	0,017	GrN-13976	NA	intcal13	6894	Neolithic	Ebro
NA	Samitiel	NA	5130	20	0,004	GrN-26150	NA	intcal13	5864	Neolithic	Ebro
NA	San Cristóbal	NA	5100	30	0,006	Beta-307800	NA	intcal13	5836	Neolithic	Ebro
NA	San Cristóbal	NA	5320	30	0,006	Beta-337632	NA	intcal13	6104	Neolithic	Ebro
NA	San Cristóbal	NA	5410	30	0,006	Beta-373276	NA	intcal13	6160	Neolithic	Ebro
NA	San Cristóbal	NA	5460	30	0,005	Beta-373277	NA	intcal13	6272	Neolithic	Ebro
NA	San Cristóbal	NA	5490	30	0,005	Beta-373275	NA	intcal13	6296	Neolithic	Ebro
NA	San Cristóbal	NA	5500	30	0,005	Beta-373631	NA	intcal13	6298	Neolithic	Ebro
NA	Socuevas	NA	7590	45	0,006	GrA-46015	NA	intcal13	8374	Mesolithic	Ebro
NA	Torrazas	NA	5570	60	0,011	GrN-18320	NA	intcal13	6408	Neolithic	Ebro
NA	Trocs	NA	5005	27	0,005	Mams-14856	NA	intcal13	5755	Neolithic	Ebro
NA	Trocs	NA	5008	27	0,005	Mams-16160	NA	intcal13	5756	Neolithic	Ebro
NA	Trocs	NA	5035	23	0,005	Mams-16165	NA	intcal13	5782	Neolithic	Ebro
NA	Trocs	NA	5580	40	0,007	Beta-319513	NA	intcal13	6380	Neolithic	Ebro
NA	Trocs	NA	5590	40	0,007	Beta-316511	NA	intcal13	6391	Neolithic	Ebro
NA	Trocs	NA	6050	40	0,007	Beta-316514	NA	intcal13	6945	Neolithic	Ebro
NA	Trocs	NA	6060	40	0,007	Beta-295782	NA	intcal13	6948	Neolithic	Ebro
NA	Trocs	NA	6070	40	0,007	Beta-284150	NA	intcal13	6952	Neolithic	Ebro
NA	Trocs	NA	6080	40	0,007	Beta-326512	NA	intcal13	6954	Neolithic	Ebro
NA	Trocs	NA	6217	25	0,004	Mams-16161	NA	intcal13	7121	Neolithic	Ebro
NA	Trocs	NA	6218	24	0,004	Mams-16162	NA	intcal13	7124	Neolithic	Ebro
NA	Trocs	NA	6234	28	0,004	Mams-16166	NA	intcal13	7130	Neolithic	Ebro
NA	Trocs	NA	6249	25	0,004	Mams-16164	NA	intcal13	7144	Neolithic	Ebro
NA	Trocs	NA	6249	20	0,003	Mams-16168	NA	intcal13	7158	Neolithic	Ebro
NA	Trocs	NA	6280	25	0,004	Mams-16159	NA	intcal13	7224	Neolithic	Ebro
NA	Trocs	NA	6285	25	0,004	Mams-16163	NA	intcal13	7234	Neolithic	Ebro
NA	Valcervera	NA	6815	45	0,007	GrA-27876	NA	intcal13	7684	Mesolithic	Ebro
NA	Valcervera	NA	6995	40	0,006	GrA-45783	NA	intcal13	7820	Mesolithic	Ebro
NA	Valcervera	NA	7035	45	0,006	GrA-45763	NA	intcal13	7845	Mesolithic	Ebro
NA	Valmayor XI	NA	6090	30	0,005	Beta-341167	NA	intcal13	6976	Neolithic	Ebro
NA	Valmayor XI	NA	6570	30	0,005	Beta-341168	NA	intcal13	7495	Mesolithic	Ebro
NA	Zatoya	Ib	8150	170	0,021	Ly-1398	bone	intcal13	9030	Mesolithic	Ebro
NA	Zatoya	Ib	8250	550	0,067	Ly-1457	bone	intcal13	9394	Mesolithic	Ebro
	Ebro:		**6526**	**58**	**0,009**				**7388**		
NA	Braña-Arintero	burial	6980	50	0,007	Beta-226472	charcoal	intcal13	7810	Mesolithic	Galicia
1	A Gándara	EC 1	5356	49	0,009	CSI-C-1263	charcoal	intcal13	6114	Neolithic	Galicia
2	A Gándara	EC 2	5412	42	0,008	CSI-C-1264	charcoal	intcal13	6166	Neolithic	Galicia
73	Alto Barreira	NA	6030	30	0,005	CSI-C-1039	charcoal	intcal13	6875	Neolithic	Galicia
76	Anta Serramo	NA	6050	110	0,018	Cams88195	pigment	intcal13	6903	Neolithic	Galicia
274	Campurras	Base cabaña	5140	80	0,016	Beta-220080	charcoal	intcal13	5929	Neolithic	Galicia
275	Campurras	Base cabaña	4890	100	0,020	Beta-220081	charcoal	intcal13	5641	Neolithic	Galicia
276	Campurras	Paleosuelo	5160	60	0,012	Beta-220082	seed	intcal13	5928	Neolithic	Galicia
NA	Chan Lindeiro	burial ?	7995	70	0,009	Ua-13398	charcoal	intcal13	8894	Mesolithic	Galicia
NA	Chan Lindeiro	burial ?	8236	51	0,006	Ua-38115	charcoal	intcal13	9233	Mesolithic	Galicia
834	Devesa do Rei	Horizonte B	5190	55	0,011	UA-20011	charcoal	intcal13	5970	Neolithic	Galicia
NA	Fiales	NA	6590	70	0,011	NA	charcoal	intcal13	7470	Mesolithic	Galicia

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
1343	Monte Remedios	Hogar, roca madre	5385	50	0,009	UA-33141	charcoal	intcal13	6134	Neolithic	Galicia
1344	Monte Remedios	Hogar, roca madre	5285	50	0,009	UA-33142	charcoal	intcal13	6092	Neolithic	Galicia
1345	Monte Remedios	Silo con molinos	5780	40	0,007	UA-32670	organic material	intcal13	6576	Neolithic	Galicia
1346	Monte Remedios	Zanja perimetral	5000	40	0,008	UA-32666	organic material	intcal13	5754	Neolithic	Galicia
1347	Monte Remedios	Zanja perimetral	5015	40	0,008	UA-32667	organic material	intcal13	5758	Neolithic	Galicia
1348	Monte Remedios	Zanja perimetral	4725	40	0,008	UA-32669	charcoal	intcal13	5454	Neolithic	Galicia
NA	O Rei Cintolo	camerín	7735	60	0,008	Lyon-2731	charcoal	intcal13	8574	Mesolithic	Galicia
1357	O Reiro	NA	6590	70	0,011	CSI-C-508	charcoal	intcal13	7470	Mesolithic	Galicia
NA	O Reiro	NA	7554	89	0,012	CSIC-508	NA	intcal13	8328	Mesolithic	Galicia
1468	Porto dos Valos	NA	5572	32	0,006	CSI-C-1112	bone	intcal13	6380	Neolithic	Galicia
NA	Valdavara 1/2	C	8890	60	0,007	Beta-259199	charcoal	intcal13	9918	Mesolithic	Galicia
NA	Valdavara 1/2	C	8920	50	0,006	Beta-257850	charcoal	intcal13	9968	Mesolithic	Galicia
NA	Xestido III	hearth	7310	160	0,022	GrN-16839	charcoal	intcal13	8110	Mesolithic	Galicia
	Galicia:		**6533**	**65**	**0,010**				**7394**		
82	Arenaza	I-C1	4965	195	0,039	I-8630	charcoal	intcal13	5631	Neolithic	País Vasco
83	Arenaza	I-C2	5755	65	0,011	OxA-7156	bone	intcal13	6556	Neolithic	País Vasco
84	Arenaza	I-C2	6040	75	0,012	OxA-7157	bone	intcal13	6912	Neolithic	País Vasco
1863	Arenaza	NA	9600	180	0,019	CSI-C-173	n.d	intcal13	11045	Mesolithic	País Vasco
777	Santimamiñe	17G / S2 (nivel III)	5450	50	0,009	Beta-240898	charcoal	intcal13	6202	Neolithic	País Vasco
778	Santimamiñe	17G / S6 (nivel III)	5010	40	0,008	Beta-240897	charcoal	intcal13	5756	Neolithic	País Vasco
779	Santimamiñe	IV	7580	50	0,007	Beta-240899	charcoal	intcal13	8372	Mesolithic	País Vasco
847	Ekain	II	4960	60	0,012	UA-36855	human bone	intcal13	5709	Neolithic	País Vasco
848	Ekain	Nivel 2	6897	35	0,005	UA-38966	n.d	intcal13	7747	Neolithic	País Vasco
1819	Ekain	Nivel II	9540	210	0,022	I-i1666	n.d	intcal13	10970	Mesolithic	País Vasco
1820	Ekain	Nivel Ivbs	9460	185	0,020	I-9239	n.d	intcal13	10780	Mesolithic	País Vasco
1007	Herriko Barra	B	5810	170	0,029	HB*1	organic material	intcal13	6642	Neolithic	País Vasco
1004	Herriko Barra	C	6010	90	0,015	UA-4820	bone	intcal13	6870	Mesolithic	País Vasco
1005	Herriko Barra	C	5710	110	0,019	HB*2	charcoal	intcal13	6552	Mesolithic	País Vasco
1010	Herriko Barra	C	5960	95	0,016	UA-4821	bone	intcal13	6828	Mesolithic	País Vasco
1008	Herriko Barra	D	5730	110	0,019	I-15350	charcoal	intcal13	6581	Mesolithic	País Vasco
1009	Herriko Barra	D	5800	110	0,019	I-15351	organic material	intcal13	6697	Mesolithic	País Vasco
1006	Herriko Barra	Nivel esteril	4920	100	0,020	I-15249	charcoal	intcal13	5651	Neolithic	País Vasco
NA	J3	D inferior	8300	50	0,006	GrA-23733	human bone	intcal13	9258	Mesolithic	País Vasco
1027	J3	D superior	7770	50	0,006	GrA-25774	charcoal	intcal13	8592	Mesolithic	País Vasco
NA	Jaizkib3	F	7780	130	0,017	GrN-28008	shell	marine13	8266	Mesolithic	País Vasco
NA	Jaizkib3	F	8190	100	0,012	GrN-27984	charcoal	intcal13	9066	Mesolithic	País Vasco
1734	Jaizkib3	G superior	8470	50	0,006	GrN-25776	charcoal	intcal13	9420	Mesolithic	País Vasco
1733	Jaizkib4	G	8470	100	0,012	GrN-28387	charcoal	intcal13	9460	Mesolithic	País Vasco
1039	Kobaederra	II	5460	60	0,011	Beta-126686	charcoal	intcal13	6220	Neolithic	País Vasco
1040	Kobaederra	II	4965	70	0,014	K*1	charcoal	intcal13	5710	Neolithic	País Vasco
1036	Kobaederra	III	5820	240	0,041	UBAR-471	charcoal	intcal13	6630	Neolithic	País Vasco
1037	Kobaederra	IV	5375	90	0,017	AA-29110	seed	intcal13	6142	Neolithic	País Vasco
1038	Kobaederra	IV	5630	100	0,018	UBAR-470	charcoal	intcal13	6398	Neolithic	País Vasco
NA	Kobeaga II	Amek-h	7790	70	0,009	UA-4286	bone	intcal13	8686	Mesolithic	País Vasco
1041	Kobeaga II	NA	6945	65	0,009	UA-4286	bone	intcal13	7787	Mesolithic	País Vasco
NA	Linatzeta	child burial	7315	35	0,005	KIA-33193	human bone	intcal13	8154	Mesolithic	País Vasco
NA	Linatzeta	child burial	8110	50	0,006	KIA-33193	human bone	intcal13	9007	Mesolithic	País Vasco
NA	Linatzeta	hearth 1	6110	30	0,005	KIA-30181	charcoal	intcal13	6996	Mesolithic	País Vasco
691	Linatzeta	hearth 2	6810	30	0,004	KIA-34976	charcoal	intcal13	7660	Mesolithic	País Vasco
NA	Linatzeta	hearth 4D/5D	7650	30	0,004	KIA-34976	charcoal	intcal13	8461	Mesolithic	País Vasco
1267	Lumentxa	Lecho 10. Niv. II-III	5095	75	0,015	UA-12663	charcoal	intcal13	5888	Neolithic	País Vasco
1268	Lumentxa	Lecho 9. Niv. II-III	5180	70	0,014	UA-12662	charcoal	intcal13	5962	Neolithic	País Vasco
1266	Lumentxa	NA	6122	38	0,006	OxA-18236	human bone	intcal13	6990	Neolithic	País Vasco
1276	Marizulo	Enterramiento	5315	100	0,019	UA-4818	human bone	intcal13	6052	Neolithic	País Vasco
1277	Marizulo	Enterramiento	5285	65	0,012	GrN-5992	bone	intcal13	6044	Neolithic	País Vasco
NA	Marizulo	I-base	6425	85	0,013	UA-10272	NA	intcal13	7286	Mesolithic	País Vasco
1278	Marizulo	II superior	6035	100	0,017	UA-4819	bone	intcal13	6889	Mesolithic	País Vasco
1280	Marizulo	Nivel I	5235	75	0,014	UA-10375	bone	intcal13	5978	Neolithic	País Vasco
NA	Pareko Landa	I-smk	6650	130	0,020	GrN-22429	charcoal	intcal13	7554	Mesolithic	País Vasco
NA	Pareko Landa	I-smk	7510	100	0,013	GrN-24782	charcoal	intcal13	8300	Mesolithic	País Vasco
1429	Pico Ramos	IV	6850	75	0,011	Beta-191083	bone	intcal13	7710	Mesolithic	País Vasco
1431	Pico Ramos	IV	4790	110	0,023	I-16798	bone	intcal13	5447	Neolithic	País Vasco
1432	Pico Ramos	IV	5370	40	0,007	Beta-181689	seed	intcal13	6130	Neolithic	País Vasco

Appendix 1. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S Dev	C14 CV	Lab no.	Material	Calib curve	Cal BP median	Group	Region
1433	Pico Ramos	IV	6040	90	0,015	Beta-193569	shell	marine13	6498	Mesolithic	País Vasco
NA	Pico Ramos	IV	5860	65	0,011	UA-3051	bone	intcal13	6680	Mesolithic	País Vasco
NA	Pico Ramos	IV	6040	90	0,015	NA	NA	intcal13	6884	Mesolithic	País Vasco
NA	Pico Ramos	IV	6840	75	0,011	NA	NA	intcal13	7700	Mesolithic	País Vasco
NA	Urratxa	nivel fertíl	6940	75	0,011	UA-11434	bone	intcal13	7790	Mesolithic	País Vasco
NA	Urratxa	nivel fertíl	6955	80	0,012	UA-11435	bone	intcal13	7796	Mesolithic	País Vasco
	País Vasco:		**6605**	**89**	**0,014**				**7463**		

Appendix 2. — Northern Spain by zones – Mesolithic dates (334 dates): https://doi.org/10.5852/cr-palevol2022v21a3_s2

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib Curve	Cal BP Median	Group	Region
34	Abrigo Calavera	1	8640	50	0,006	PO-5	charcoal	intcal13	9691	Mesolithic	Cantabria
35	Abrigo Calavera	2	8950	50	0,006	PO-4	charcoal	intcal13	9989	Mesolithic	Cantabria
	Andrín	conchero	9736	1077	0,111	AND-1	AAR date	normal	9736	Mesolithic	Cantabria
	Allorú	conchero	8360	70	0,008	UBAR-781	shell	marine13	8922	Asturian	Cantabria
	Andrín	conchero	9736	1077	0,111	AND-1	AAR date	normal	9736	Mesolithic	Cantabria
	Arangas	3	8195	60	0,007	OxA-7149	bone	intcal13	9190	Mesolithic	Cantabria
	Arangas	3	8300	50	0,006	OxA-6887	charcoal	intcal13	9258	Mesolithic	Cantabria
	Arangas	4	8280	55	0,007	OxA-6888	charcoal	intcal13	9251	Mesolithic	Cantabria
	Arangas	2B	8025	80	0,010	OxA-7160	bone	intcal13	8922	Mesolithic	Cantabria
	Arangas	E2	7150	470	0,066	UBAR-465	charcoal	intcal13	8017	Mesolithic	Cantabria
89	Arenillas	–	5580	80	0,014	GrN-19596	charcoal	intcal13	6343	Mesolithic	Cantabria
88	Arenillas	conchero	6075	30	0,005	UBAR-775	shell	marine13	6507	Mesolithic	Cantabria
	Arenillas	conchero	6455	60	0,009	UBAR-775	shell	marine13	6945	Mesolithic	Cantabria
140	Barcenilla	V	6380	40	0,006	Poz-18850	charcoal	intcal13	7298	Mesolithic	Cantabria
139	Barcenilla	V	7020	30	0,004	Poz-18849	charcoal	intcal13	7832	Mesolithic	Cantabria
	Barra	conchero	6979	1539	0,221	BAR-2	AAR date	normal	6979	Mesolithic	Cantabria
	Barra	conchero	7121	964	0,135	BAR-1	AAR date	normal	7121	Mesolithic	Cantabria
	Berroberría	B	8580	80	0,009	GrN-18423	bone	intcal13	9644	Mesolithic	Cantabria
	Berroberría	B	8800	80	0,009	GrN-18422	bone	intcal13	9880	Mesolithic	Cantabria
	Berroberría	B base	8470	80	0,009	GrN-16619	bone	intcal13	9414	Mesolithic	Cantabria
	Berroberría	C	8510	90	0,011	GrN-16618	bone	intcal13	9502	Mesolithic	Cantabria
	Berroberría	C	8630	70	0,008	GrN-18426	bone	intcal13	9742	Mesolithic	Cantabria
	Berroberría	C	8860	100	0,011	GrN-18425	bone	intcal13	9913	Mesolithic	Cantabria
	Bricia	A	7095	481	0,068	BRI-2	AAR date	normal	7095	Asturian	Cantabria
	Bricia	conchero	6800	160	0,024	GaK-2908	charcoal	intcal13	7672	Asturian	Cantabria
	Bricia	conchero	8862	1403	0,158	BRI-1	AAR date	normal	8862	Asturian	Cantabria
	Cámara	conchero	7878	2485	0,315	CAM-1	AAR date	normal	7878	Mesolithic	Cantabria
271	Campa	bedrock	9290	50	0,005	PO-3	charcoal	intcal13	10477	Mesolithic	Cantabria
1816	Carabión	1	5750	40	0,007	Poz-18372	charcoal	intcal13	6565	Mesolithic	Cantabria
1817	Carabión	1	7800	50	0,006	Poz-32691	bone	intcal13	8686	Mesolithic	Cantabria
1818	Carabión	1	10310	60	0,006	Poz-30594	bone	intcal13	12122	Mesolithic	Cantabria
	Carmona	conchero	9885	1094	0,111	CAR-1	AAR date	normal	9885	Mesolithic	Cantabria
	Ceñil	conchero	8921	1105	0,124	C□âL-1	AAR date	normal	8921	Mesolithic	Cantabria
	Coberizas	1b	7100	70	0,010	GaK-2907	charcoal	intcal13	7926	Asturian	Cantabria
	Coberizas	conchero	7100	170	0,024	NA	charcoal	intcal13	7930	Asturian	Cantabria
	Coberizas	conchero	6799	573	0,084	COB-1	AAR date	normal	6799	Asturian	Cantabria
442	Cofresnedo	Conchero	6865	45	0,007	GrA-20146	bone	intcal13	7733	Mesolithic	Cantabria
	Cofresnedo	VO	7680	50	0,007	GrA-20146	bone	intcal13	8488	Mesolithic	Cantabria
	Collamosa	conchero	7638	726	0,095	COL-1	AAR date	normal	7638	Asturian	Cantabria
444	Colomba	–	7090	60	0,008	TO-10223	human bone	intcal13	7923	Mesolithic	Cantabria
	Columba	conchero	7020	90	0,013	UBAR-833	charcoal	intcal13	7874	Asturian	Cantabria
	Columba	conchero	7090	60	0,008	TO-10233	bone	intcal13	7923	Asturian	Cantabria
	Columba	conchero	7450	120	0,016	UBAR-795	shell	marine13	7930	Asturian	Cantabria
	Columba	conchero	7550	140	0,019	UBAR-782	shell	marine13	8023	Asturian	Cantabria
	Cosfresnedo	conchero	6865	45	0,007	NA	NA	intcal13	7733	Mesolithic	Cantabria
	Covajorno	conchero	7440	955	0,128	COV-1	AAR date	normal	7440	Mesolithic	Cantabria
	Covajorno	conchero	7540	100	0,013	UBAR-773	shell	marine13	8005	Asturian	Cantabria
	Covajorno	conchero	7580	60	0,008	UBAR-774	shell	marine13	8058	Asturian	Cantabria
657	Cubio Redondo	–	5780	50	0,009	Beta-106049	charcoal	intcal13	6594	Mesolithic	Cantabria
	Cubio Redondo	conchero	6630	50	0,008	Beta-10650	bone	intcal13	7534	Mesolithic	Cantabria
	Cueto Molino	conchero	7552	1178	0,156	CML-1	AAR date	normal	7552	Mesolithic	Cantabria
	Cuetu la Hoz	conchero	7690	130	0,017	UBAR-792	shell	marine13	8138	Asturian	Cantabria
	Cuetu la Hoz	conchero	9101	1141	0,125	CLZ-1	AAR date	normal	9101	Mesolithic	Cantabria
699	Cueva los Canes	–	5980	80	0,013	TO-11219	human bone	intcal13	6834	Mesolithic	Cantabria
787	Cueva del Mar	–	7013	42	0,006	AA-45572	charcoal	intcal13	7828	Mesolithic	Cantabria
	Cueva del Mar	conch. aisl.	7860	60	0,008	AA-45572	charcoal	intcal13	8712	Mesolithic	Cantabria
	Cueva del Mar	conch. base	7225	45	0,006	AA-45575	charcoal	intcal13	8050	Asturian	Cantabria
	Cueva del Mar	conch. med.	7015	40	0,006	AA-45573	charcoal	intcal13	7828	Asturian	Cantabria
	Cueva del Mar	conch. sup,	6725	50	0,007	AA-45576	charcoal	intcal13	7582	Asturian	Cantabria
785	Cueva del Mar	medio	6825	41	0,006	AA-45573	charcoal	intcal13	7700	Mesolithic	Cantabria
1815	Portillo del Arenal	NA	9950	50	0,005	Poz-39140	bone	intcal13	11484	Epipaleolítico	Cantabria
1844	Cueva Morín	1,3	9000	150	0,017	I-5150	charcoal	intcal13	10130	Mesolithic	Cantabria
1864	Cueva Oscura	NA	9280	230	0,025	Ly-2938	n.d	intcal13	10468	Mesolithic	Cantabria
1842	Cueva Oscura	NA	9440	90	0,010	CSI-C--362	charcoal	intcal13	10724	Mesolithic	Cantabria
	El Aguila	conchero	7705	50	0,006	UBAR-794	shell	marine13	8162	Asturian	Cantabria
	El Mazo	inner SU-105	7640	30	0,004	UGAM-S5408	charcoal	intcal13	8455	Asturian	Cantabria
	El Mazo	outer SU-3	6790	30	0,004	UGAM-S5407	NA	intcal13	7641	Asturian	Cantabria
1843	El Perro	1,3	9260	110	0,012	GrN-18115	charcoal	intcal13	10551	Mesolithic	Cantabria

Appendix 2. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib Curve	Cal BP Median	Group	Region
	El Perro	1,3	9260	110	0,012	GrN-18116	charcoal	intcal13	10551	Mesolithic	Cantabria
	El Toral	21	7080	30	0,004	NA	NA	intcal13	7900	Asturian	Cantabria
	El Toral	13A	7000	40	0,006	NA	NA	intcal13	7822	Asturian	Cantabria
922	El Toral III	Zona B M9	6750	30	0,004	UGAM-S5401	charcoal	intcal13	7604	Mesolithic	Cantabria
923	El Toral III	Zona B M9	6810	30	0,004	UGAM-S5402	charcoal	intcal13	7660	Mesolithic	Cantabria
921	El Toral III	Zona B M9	7080	30	0,004	UGAM-S5400	human bone	intcal13	7900	Mesolithic	Cantabria
924	El Toral III	Zona B O8	6430	30	0,005	UGAM-S5403	charcoal	intcal13	7346	Mesolithic	Cantabria
	El Toralete	conchero	7060	80	0,011	UBAR-777	shell	marine13	7555	Asturian	Cantabria
	El Toralete	conchero	7680	50	0,007	UBAR-776	shell	marine13	8144	Asturian	Cantabria
	El Toralete	conchero	7890	80	0,010	UBAR-780	shell	marine13	8335	Asturian	Cantabria
	El Truchiro	conchero	6470	70	0,011	TO-10912	bone	intcal13	7374	Mesolithic	Cantabria
	Espertín	2	7790	120	0,015	Gif-10053	NA	intcal13	8657	Mesolithic	Cantabria
	Horadada	conchero	7929	424	0,053	HOR-1	AAR date	normal	7929	Mesolithic	Cantabria
	Ilso de Hayas	sond. IH-3	8440	130	0,015	GrN-21231	charcoal	intcal13	9512	Mesolithic	Cantabria
	Kobeaga II	Amek-h	7690	270	0,035	GrN-27480	charcoal	intcal13	8601	Mesolithic	Cantabria
	La Braña	burial 1	7030	50	0,007	NA	NA	intcal13	7844	Mesolithic	Cantabria
	La Braña	burial 2	6980	50	0,007	NA	NA	intcal13	7810	Mesolithic	Cantabria
	La Cabrera	conchero	9795	1494	0,153	LCB-2	AAR date	normal	9795	Mesolithic	Cantabria
	La Calvera	2	8640	50	0,006	NA	NA	intcal13	9691	Mesolithic	Cantabria
	La Calvera	3	9620	60	0,006	GrA-6994	charcoal	intcal13	10940	Mesolithic	Cantabria
	La Chora	conch. int.	6360	80	0,013	GrN-20961	charcoal	intcal13	7242	Mesolithic	Cantabria
	La Fragua	A4/1 inf.	7530	75	0,010	GrN-20965	charcoal	intcal13	8310	Mesolithic	Cantabria
	La Fragua	A4/1 med.	6860	60	0,009	GrN-20964	charcoal	intcal13	7732	Mesolithic	Cantabria
	La Fragua	A4/1 sup.	6650	120	0,018	GrN-20963	charcoal	intcal13	7549	Mesolithic	Cantabria
1841	La Fragua	I- bajo	9600	140	0,015	GrN-20966	charcoal	intcal13	10934	Mesolithic	Cantabria
	La Garma A	estrato 1	8448	1987	0,235	MAD-646	carbonate	intcal13	9943	Mesolithic	Cantabria
	La Garma A	estrato 1	9165	1088	0,119	MAD-436	carbonate	intcal13	10527	Mesolithic	Cantabria
	La Garma A	estrato 2	6870	50	0,007	OxA-7150	bone	intcal13	7744	Mesolithic	Cantabria
	La Garma A	estrato 2	6920	50	0,007	OxA-6889	bone	intcal13	7766	Mesolithic	Cantabria
	La Garma A	estrato 2	7685	65	0,008	OxA-7284	bone	intcal13	8504	Mesolithic	Cantabria
	La Garma A	estrato 2	7710	90	0,012	OxA-7495	bone	intcal13	8590	Mesolithic	Cantabria
	La Garma A	estrato 2	8165	65	0,008	UBAR-656	shell	marine13	8688	Mesolithic	Cantabria
	La Garma A	estrato 2	8175	65	0,008	UBAR-657	NA	intcal13	9115	Mesolithic	Cantabria
	La Garma A	estrato 2	8295	65	0,008	UBAR-655	shell	marine13	8832	Mesolithic	Cantabria
	La Garma B	?	7165	65	0,009	OxA-7300	human bone	intcal13	7965	Mesolithic	Cantabria
	La Riera	28	9230	90	0,010	Q-2933	shell	marine13	9974	Asturian	Cantabria
1846	La Riera	29 lower	6500	200	0,031	GaK--3046	charcoal	intcal13	7316	Mesolithic	Cantabria
	La Riera	29 lower	8650	300	0,035	GaK-2909	charcoal	intcal13	9734	Asturian	Cantabria
	La Riera	conchero	7516	588	0,078	RIE-1	AAR date	normal	7516	Asturian	Cantabria
1858	La Trecha	–	5430	70	0,013	URU-0050	charcoal	intcal13	6195	Mesolithic	Cantabria
1859	La Trecha	–	5600	610	0,109	URU-0051	charcoal	intcal13	6209	Mesolithic	Cantabria
	La Trecha	Z2 conch.	6240	100	0,016	URU-0039	shell	marine13	6716	Mesolithic	Cantabria
	La Trecha	Z4/CC6/1	7500	70	0,009	URU-0038	shell	marine13	7948	Mesolithic	Cantabria
	Llamorey	conchero	8329	947	0,114	LMY-1	AAR date	normal	8329	Mesolithic	Cantabria
1848	Los Azules	3d	9430	120	0,013	CSI-C-216	charcoal	intcal13	10725	Mesolithic	Cantabria
1847	Los Azules	3d	9540	120	0,013	CSI-C-260	charcoal	intcal13	10782	Mesolithic	Cantabria
	Los Canes	69,5408	6815	65	0,010	AA-5296	human bone	intcal13	7690	Mesolithic	Cantabria
698	Los Canes	–	5865	70	0,012	AA-5788	charcoal	intcal13	6696	Mesolithic	Cantabria
	Los Canes	6-I	6160	55	0,009	OxA-7148	human bone	intcal13	7030	Mesolithic	Cantabria
	Los Canes	6-I (F)	6265	75	0,012	AA-5294	human bone	intcal13	7130	Mesolithic	Cantabria
695	Los Canes	6-II	6770	65	0,010	AA-5296	human bone	intcal13	7640	Mesolithic	Cantabria
694	Los Canes	6-II	6860	65	0,009	AA-5295	human bone	intcal13	7724	Mesolithic	Cantabria
	Los Canes	6-II	7025	80	0,011	AA-11744	human bone	intcal13	7876	Mesolithic	Cantabria
	Los Canes	6-III (K)	6930	95	0,014	AA-6071	human bone	intcal13	7760	Mesolithic	Cantabria
	Marizulo	IV	6820	50	0,007	I-16190	bone	intcal13	7683	Mesolithic	Cantabria
	Mary	conchero	8572	1030	0,120	MRY-1	AAR date	normal	8572	Mesolithic	Cantabria
	Mazaculos	1,1	7280	220	0,030	GaK-8162	charcoal	intcal13	8212	Asturian	Cantabria
	Mazaculos	3,3	9290	440	0,047	GaK-6884	charcoal	intcal13	10772	Asturian	Cantabria
	Mazaculos	A3	7030	120	0,017	GaK-15222	charcoal	intcal13	7906	Asturian	Cantabria
	Mirón	10,1	8380	175	0,021	GX-24463	charcoal	intcal13	9385	Mesolithic	Cantabria
	Mirón	10,1	8700	40	0,005	GX-25852	charcoal	intcal13	9722	Mesolithic	Cantabria
	Mirón	10,1	9550	50	0,005	GX-24464	charcoal	intcal13	10884	Mesolithic	Cantabria
	Molino	conchero	6611	1093	0,165	MOL-1	AAR date	normal	6611	Mesolithic	Cantabria
1391	Paré Nogales	–	7365	36	0,005	OxA-X2399926	human bone	intcal13	8182	Mesolithic	Cantabria
	Pendueles	conchero	7080	80	0,011	UBAR-793	shell	marine13	7573	Asturian	Cantabria
	Penicial	conchero	7972	885	0,111	PEN-1	AAR date	normal	7972	Asturian	Cantabria
	Penicial	conchero	8650	185	0,021	GaK-2906	charcoal	intcal13	9730	Asturian	Cantabria
	Poza l'Egua	2	8550	80	0,009	TO-10222	bone	intcal13	9588	Asturian	Cantabria
	Quintana	conchero	7063	1858	0,263	QUT-1	AAR date	normal	7063	Mesolithic	Cantabria

Appendix 2. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib Curve	Cal BP Median	Group	Region
	Sierra Plana	1C	7550	190	0,025	UGRA-209	charcoal	intcal13	8423	Asturian	Cantabria
	Sierra Plana	pal. Sol.	6830	55	0,008	OxA-6916	charcoal	intcal13	7700	Mesolithic	Cantabria
	Sonrasa	conchero	7263	82	0,011	SON-1	NA	intcal13	8088	Mesolithic	Cantabria
	Tarrerón	III	5780	120	0,021	I-4030	charcoal	intcal13	6674	Mesolithic	Cantabria
	Tito Bustillo	burial	8470	50	0,006	Beta-197042	tooth	intcal13	9420	Mesolithic	Cantabria
	Cantabria:		**7725**	**270**	**0,034**				**8423**		
1851	Abauntz	D	6600	50	0,01	Ly-1964b	charcoal	intcal13	7472	Mesolithic	Ebro
1850	Abauntz	D	9530	300	0,03	Ly-1964	charcoal	intcal13	10976	Mesolithic	Ebro
	Aizpea	I	7160	70	0,01	GrN-16621	NA	intcal13	7960	Mesolithic	Ebro
	Aizpea	I	7790	70	0,01	GrN-16620	NA	intcal13	8686	Mesolithic	Ebro
	Aizpea	II	6600	50	0,01	GrA-779	NA	intcal13	7472	Mesolithic	Ebro
	Aizpea	II	6830	70	0,01	GrN-16622	NA	intcal13	7700	Mesolithic	Ebro
	Aizpea	NA	8000	80	0,01	GrN-25999	NA	intcal13	8905	Mesolithic	Ebro
	Ángel 1	NA	7435	45	0,01	GrA-27274	NA	intcal13	8222	Mesolithic	Ebro
	Ángel 2	NA	6390	40	0,01	Beta-254048	NA	intcal13	7300	Mesolithic	Ebro
	Ángel 2	NA	7955	45	0,01	GrA-27278	NA	intcal13	8804	Mesolithic	Ebro
	Ángel 3	NA	6610	40	0,01	Beta-286819	NA	intcal13	7515	Mesolithic	Ebro
	Ángel 3	NA	8390	60	0,01	GrA-22826	NA	intcal13	9314	Mesolithic	Ebro
	Ángel 4	NA	6990	50	0,01	Beta-266112	NA	intcal13	7820	Mesolithic	Ebro
	Ángel 5	NA	7120	50	0,01	Beta-286820	NA	intcal13	7952	Mesolithic	Ebro
	Ángel 6	NA	8310	60	0,01	GrA-22836	NA	intcal13	9270	Mesolithic	Ebro
	Artegieta	NA	8055	50	0,01	GrA-28311	NA	intcal13	8944	Mesolithic	Ebro
	Artusia	NA	7680	40	0,01	Beta-374431	NA	intcal13	8484	Mesolithic	Ebro
	Artusia	NA	7790	40	0,01	Beta-374432	NA	intcal13	8592	Mesolithic	Ebro
	Artusia	NA	8260	40	0,01	Beta-374433	NA	intcal13	9240	Mesolithic	Ebro
99	Atxoste	–	7830	50	0,01	GrA-13472	bone	intcal13	8704	Mesolithic	Ebro
100	Atxoste	–	8760	50	0,01	GrA-15699	bone	intcal13	9855	Mesolithic	Ebro
106	Atxoste	D	8840	50	0,01	GrA-13473	bone	intcal13	7880	Mesolithic	Ebro
107	Atxoste	IIIb / II	6710	50	0,01	A*1	bone	intcal13	7566	Mesolithic	Ebro
108	Atxoste	IIIb / II	6940	40	0,01	GrA-13415	bone	intcal13	7779	Mesolithic	Ebro
	Atxoste	IIIb2	7140	50	0,01	GrA-13468	bone	intcal13	7979	Mesolithic	Ebro
	Atxoste	IV	7340	70	0,01	GrA-13418	bone	intcal13	8167	Mesolithic	Ebro
	Atxoste	IV	7480	50	0,01	GrA-13469	bone	intcal13	8276	Mesolithic	Ebro
	Atxoste	NA	6970	40	0,01	GrA-13419	NA	intcal13	7810	Mesolithic	Ebro
	Atxoste	NA	7810	40	0,01	GrA-13447	bone	intcal13	8630	Mesolithic	Ebro
	Atxoste	NA	8510	80	0,01	GrA-15700	bone	intcal13	9512	Mesolithic	Ebro
	Atxoste	V	8030	50	0,01	GrA-13448	bone	intcal13	8868	Mesolithic	Ebro
	Balm. Guilanyà	NA	8640	50	0,01	Beta-210730	NA	intcal13	9691	Mesolithic	Ebro
	Balm. Guilanyà	NA	8680	50	0,01	Beta-185046	NA	intcal13	9732	Mesolithic	Ebro
	Baños	NA	7350	50	0,01	GrA-21550	NA	intcal13	8173	Mesolithic	Ebro
	Baños	NA	7550	50	0,01	GrA-21551	NA	intcal13	8360	Mesolithic	Ebro
	Baños	NA	7570	100	0,01	GrN-24300	NA	intcal13	8374	Mesolithic	Ebro
	Baños	NA	7740	50	0,01	GrA-21552	NA	intcal13	8551	Mesolithic	Ebro
	Baños	NA	7840	100	0,01	GrN-24299	NA	intcal13	8734	Mesolithic	Ebro
	Baños	NA	8040	50	0,01	GrA-21556	NA	intcal13	8910	Mesolithic	Ebro
	Botiquería	NA	6830	50	0,01	GrA-13267	NA	intcal13	7699	Mesolithic	Ebro
	Botiquería	NA	7600	50	0,01	GrA-13265	NA	intcal13	8392	Mesolithic	Ebro
	Cabezo la Cruz	NA	7150	70	0,01	GrN-29135	NA	intcal13	7946	Mesolithic	Ebro
	Carlos Álvarez	NA	7013	38	0,01	KIA-27671	NA	intcal13	7826	Mesolithic	Ebro
	Cascajos	NA	6380	60	0,01	UA-24424	NA	intcal13	7262	Mesolithic	Ebro
	Chaves	NA	6410	40	0,01	GrA-34257	NA	intcal13	7307	Mesolithic	Ebro
	Chaves	NA	6460	70	0,01	CSIC-378	NA	intcal13	7370	Mesolithic	Ebro
	Chaves	NA	6530	40	0,01	GrA-34258	NA	intcal13	7424	Mesolithic	Ebro
	Chaves	NA	6580	35	0,01	GrA-38022	NA	intcal13	7494	Mesolithic	Ebro
	Chaves	NA	6650	80	0,01	GrN-12683	NA	intcal13	7528	Mesolithic	Ebro
	Chaves	NA	6770	70	0,01	GrN-12658	NA	intcal13	7657	Mesolithic	Ebro
	Costalena	NA	7053	27	0,00	MAMS-29828	NA	intcal13	7879	Mesolithic	Ebro
	Cova Sardo	NA	6525	45	0,01	K/K5037/37689	NA	intcal13	7422	Mesolithic	Ebro
	Cova Sardo	NA	6586	35	0,01	K/K5834/40817	NA	intcal13	7500	Mesolithic	Ebro
	Cova Vidre	NA	7290	70	0,01	UBAR-832	NA	intcal13	8132	Mesolithic	Ebro
	Cova Fosca	NA	7100	70	0,01	CSIC-356	NA	intcal13	7926	Mesolithic	Ebro
	Cova Fosca	NA	7210	70	0,01	CSIC-357	NA	intcal13	8058	Mesolithic	Ebro
	Espantalobos	NA	7390	40	0,01	Beta-361624	NA	intcal13	8199	Mesolithic	Ebro
	Espantalobos	NA	7900	50	0,01	Beta-361625	NA	intcal13	8762	Mesolithic	Ebro
	Esplugón	NA	6730	40	0,01	Beta-313517	NA	intcal13	7578	Mesolithic	Ebro
	Esplugón	NA	6950	50	0,01	Beta-306723	NA	intcal13	7786	Mesolithic	Ebro
	Esplugón	NA	7620	40	0,01	GrA-59632	NA	intcal13	8450	Mesolithic	Ebro
	Esplugón	NA	7715	45	0,01	GrA-59634	NA	intcal13	8508	Mesolithic	Ebro

APPENDIX 2. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib Curve	Cal BP Median	Group	Region
	Esplugón	NA	7860	40	0,01	Beta-306725	NA	intcal13	8728	Mesolithic	Ebro
	Esplugón	NA	8015	45	0,01	GrA-59633	NA	intcal13	8864	Mesolithic	Ebro
	Esplugón	NA	8380	40	0,01	Beta 306722	NA	intcal13	9364	Mesolithic	Ebro
	Est. la Coveta	NA	7845	45	0,01	KIA-29818	NA	intcal13	8710	Mesolithic	Ebro
	Filador	NA	8150	90	0,01	AA-13411	NA	intcal13	9042	Mesolithic	Ebro
	Filador	NA	8515	60	0,01	OxA-8658	NA	intcal13	9494	Mesolithic	Ebro
	Forcas II	NA	6740	40	0,01	Beta-247405	NA	intcal13	7585	Mesolithic	Ebro
	Forcas II	NA	6750	40	0,01	Beta-247404	NA	intcal13	7595	Mesolithic	Ebro
	Forcas II	NA	6900	45	0,01	GrN-22688	NA	intcal13	7758	Mesolithic	Ebro
	Forcas II	NA	6940	90	0,01	Beta-60773	NA	intcal13	7771	Mesolithic	Ebro
	Forcas II	NA	7000	40	0,01	Beta-290932	NA	intcal13	7822	Mesolithic	Ebro
	Forcas II	NA	7150	40	0,01	Beta-250944	NA	intcal13	7999	Mesolithic	Ebro
	Forcas II	NA	7240	40	0,01	GrN-22686	NA	intcal13	8063	Mesolithic	Ebro
	Forcas II	NA	8650	70	0,01	Beta-59997	NA	intcal13	9788	Mesolithic	Ebro
	Fuente Hoz	III (21)	7840	130	0,02	I-12083	charcoal	intcal13	8740	Mesolithic	Ebro
	Fuente Hoz	III (23)	7140	120	0,02	I-12778	charcoal	intcal13	7982	Mesolithic	Ebro
	Fuente Hoz	III (28)	8120	240	0,03	I-12985	NA	intcal13	9088	Mesolithic	Ebro
	Fuente Hoz	III-	7880	120	0,02	I-13496	charcoal	intcal13	8810	Mesolithic	Ebro
	Kanpanoste	Lanhi b	7920	100	0,01	GrN-22442	bone	intcal13	8830	Mesolithic	Ebro
	Kanpanoste	Lanhi s	7620	70	0,01	GrN-22440	bone	intcal13	8408	Mesolithic	Ebro
	Kanpanoste	NA	8200	70	0,01	GrN-22441	NA	intcal13	9126	Mesolithic	Ebro
	Kan. Goikoa	III	6550	260	0,04	GrN-20289	bone	intcal13	7338	Mesolithic	Ebro
	Kan. Goikoa	III lower	7620	80	0,01	GrN-20215	bone	intcal13	8434	Mesolithic	Ebro
	Kan. Goikoa	III lower	7860	330	0,04	GrN-20455	bone	intcal13	8834	Mesolithic	Ebro
	Lámpara	NA	6522	44	0,01	KIA-16567	NA	intcal13	7421	Mesolithic	Ebro
	Lámpara	NA	6608	35	0,01	KIA-16571	NA	intcal13	7506	Mesolithic	Ebro
	Lámpara	NA	6610	32	0,01	KIA-16579	NA	intcal13	7505	Mesolithic	Ebro
	Lámpara	NA	6729	45	0,01	KIA-16574	NA	intcal13	7572	Mesolithic	Ebro
	Lámpara	NA	6744	33	0,01	KIA-16575	NA	intcal13	7593	Mesolithic	Ebro
	Lámpara	NA	6833	34	0,01	KIA-16566	NA	intcal13	7684	Mesolithic	Ebro
	Lámpara	NA	6871	33	0,01	KIA-21350	NA	intcal13	7714	Mesolithic	Ebro
	Lámpara	NA	6915	33	0,01	KIA-16577	NA	intcal13	7758	Mesolithic	Ebro
	Lámpara	NA	6920	50	0,01	KIA-16569	NA	intcal13	7766	Mesolithic	Ebro
	Lámpara	NA	6956	39	0,01	KIA-16570	NA	intcal13	7802	Mesolithic	Ebro
	Lámpara	NA	6975	32	0,01	KIA-16578	NA	intcal13	7808	Mesolithic	Ebro
	Lámpara	NA	6989	48	0,01	KIA-16580	NA	intcal13	7818	Mesolithic	Ebro
	Lámpara	NA	7000	32	0,01	KIA-16568	NA	intcal13	7821	Mesolithic	Ebro
	Lámpara	NA	7075	44	0,01	KIA-16581	NA	intcal13	7864	Mesolithic	Ebro
	Lámpara	NA	7108	34	0,01	KIA-16573	NA	intcal13	7910	Mesolithic	Ebro
	Lámpara	NA	7136	33	0,01	KIA-16576	NA	intcal13	7942	Mesolithic	Ebro
	Legunova	NA	8800	40	0,01	GrA-24294	NA	intcal13	9864	Mesolithic	Ebro
	Martinarri	NA	7350	30	0,00	Beta-410010	NA	intcal13	8173	Mesolithic	Ebro
	Martinarri	NA	8455	45	0,01	GrA-46014	NA	intcal13	9417	Mesolithic	Ebro
	Mas Cremat	NA	6780	50	0,01	Beta-232342	NA	intcal13	7640	Mesolithic	Ebro
	Mas Cremat	NA	6800	50	0,01	Beta-232341	NA	intcal13	7664	Mesolithic	Ebro
	Mas Nou	NA	6760	40	0,01	Beta-170713	NA	intcal13	7608	Mesolithic	Ebro
	Mas Nou	NA	6800	70	0,01	Beta-136676	NA	intcal13	7676	Mesolithic	Ebro
	Mas Nou	NA	6900	70	0,01	Beta-136677	NA	intcal13	7752	Mesolithic	Ebro
	Mas Nou	NA	6910	40	0,01	Beta-170714	NA	intcal13	7763	Mesolithic	Ebro
	Mas Nou	NA	6920	40	0,01	Beta-170715	NA	intcal13	7772	Mesolithic	Ebro
	Mas Nou	NA	7010	40	0,01	Beta 170714	NA	intcal13	7826	Mesolithic	Ebro
	Mendandia	IV	7780	60	0,01	GrN-22745	NA	intcal13	8682	Mesolithic	Ebro
	Mendandia	IV	7810	50	0,01	GrN-22744	NA	intcal13	8696	Mesolithic	Ebro
	Mendandia	NA	6540	70	0,01	GrN-22741	NA	intcal13	7446	Mesolithic	Ebro
	Mendandia	NA	7180	45	0,01	GrN-22742	NA	intcal13	8010	Mesolithic	Ebro
	Mendandia	NA	7210	80	0,01	GrN-19658	NA	intcal13	8038	Mesolithic	Ebro
	Mendandia	NA	7265	70	0,01	UA-34366	NA	intcal13	8104	Mesolithic	Ebro
	Mendandia	NA	7620	50	0,01	GrN-22743	NA	intcal13	8410	Mesolithic	Ebro
	Mendandia	NA	8500	60	0,01	GrA-6874	NA	intcal13	9484	Mesolithic	Ebro
	Mirador	NA	7060	40	0,01	Beta-197386	NA	intcal13	7858	Mesolithic	Ebro
	Orcillas	NA	8610	50	0,01	Beta-252434	NA	intcal13	9676	Mesolithic	Ebro
	Peña 14	NA	7660	90	1,01	GrN-25094	NA	intcal13	8563	Mesolithic	Ebro
	Peña 14	NA	8000	90	2,01	GrN-25998	NA	intcal13	8880	Mesolithic	Ebro
	Peña Marañón	d	7890	120	0,02	BM-2363	NA	intcal13	8818	Mesolithic	Ebro
	Peña Larga	IV	6720	40	0,01	Beta-242783	bone	intcal13	7564	Mesolithic	Ebro
	Pontet	NA	6963	32	0,01	D-AMS 020208	NA	intcal13	7805	Mesolithic	Ebro
	Pontet	NA	7340	70	0,01	GrN-16313	NA	intcal13	8167	Mesolithic	Ebro
	Pontet	NA	7341	32	0,00	D-AMS 020210	NA	intcal13	8169	Mesolithic	Ebro
	Pontet	NA	7941	65	0,01	D-AMS 020211	NA	intcal13	8792	Mesolithic	Ebro

Appendix 2. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib Curve	Cal BP Median	Group	Region
	Ram. Legunova	NA	7225	40	0,01	GrA-64001	NA	intcal13	8058	Mesolithic	Ebro
	Ram. Legunova	NA	7235	45	0,01	GrA-47886	NA	intcal13	8058	Mesolithic	Ebro
	Ram. Legunova	NA	7260	45	0,01	GrA-61768	NA	intcal13	8088	Mesolithic	Ebro
	Ram. Legunova	NA	8200	50	0,01	GrA-24292	NA	intcal13	9212	Mesolithic	Ebro
	Ram. Legunova	NA	8250	60	0,01	GrA-22086	NA	intcal13	9241	Mesolithic	Ebro
	Revilla	NA	6568	37	0,01	KIA-13940	NA	intcal13	7460	Mesolithic	Ebro
	Revilla	NA	6691	48	0,01	KIA-13946	NA	intcal13	7557	Mesolithic	Ebro
	Revilla	NA	6755	57	0,01	KIA-13939	NA	intcal13	7620	Mesolithic	Ebro
	Revilla	NA	6772	47	0,01	KIA-13934	NA	intcal13	7634	Mesolithic	Ebro
	Revilla	NA	6809	37	0,01	KIA-13947	NA	intcal13	7678	Mesolithic	Ebro
	Revilla	NA	6983	45	0,01	KIA-13935	NA	intcal13	7816	Mesolithic	Ebro
	Revilla	NA	7014	37	0,01	KIA-13944	NA	intcal13	7826	Mesolithic	Ebro
	Revilla	NA	7165	37	0,01	KIA-13941	NA	intcal13	8006	Mesolithic	Ebro
	Socuevas	NA	7590	45	0,01	GrA-46015	NA	intcal13	8374	Mesolithic	Ebro
	Valcervera	NA	6815	45	0,01	GrA-27876	NA	intcal13	7684	Mesolithic	Ebro
	Valcervera	NA	6995	40	0,01	GrA-45783	NA	intcal13	7820	Mesolithic	Ebro
	Valcervera	NA	7035	45	0,01	GrA-45763	NA	intcal13	7845	Mesolithic	Ebro
	Valmayor XI	NA	6570	30	0,01	Beta-341168	NA	intcal13	7495	Mesolithic	Ebro
	Zatoya	Ib	8150	170	0,02	Ly-1398	bone	intcal13	9030	Mesolithic	Ebro
	Zatoya	Ib	8250	550	0,07	Ly-1457	bone	intcal13	9394	Mesolithic	Ebro
	Ebro:		**7412**	**64**	**0,029**				**8281**		
	Braña-Arintero	burial	6980	50	0,01	Beta-226472	charcoal	intcal13	7810	Mesolithic	Galicia
	Chan do Lindeiro	burial ?	7995	70	0,01	Ua-13398	charcoal	intcal13	8894	Mesolithic	Galicia
	Chan do Lindeiro	burial ?	8236	51	0,01	Ua-38115	charcoal	intcal13	9233	Mesolithic	Galicia
	Fiales	NA	6590	70	0,01	NA	charcoal	intcal13	7470	Mesolithic	Galicia
	O Rei Cintolo	camerín	7735	60	0,01	Lyon-2731	charcoal	intcal13	8574	Mesolithic	Galicia
1357	O Reiro	–	6590	70	0,01	CSI-C-508	charcoal	intcal13	7470	Mesolithic	Galicia
	O Reiro	NA	7554	89	0,01	CSIC-508	NA	intcal13	8328	Mesolithic	Galicia
	Valdavara 1/2	C	8890	60	0,01	Beta-259199	NA	intcal13	9918	Mesolithic	Galicia
	Valdavara 1/2	C	8920	50	0,01	Beta-257850	charcoal	intcal13	9968	Mesolithic	Galicia
	Xestido III	hearth	7310	160	0,02	GrN-16839	NA	intcal13	8110	Mesolithic	Galicia
	Galicia:		**7680,0**	**73,0**	**0,010**				**8578**		
1863	Arenaza	NA	9600	180	0,02	CSI-C-173	n.d	intcal13	11045	Mesolithic	País Vasco
779	Santimamiñe	IV	7580	50	0,01	Beta-240899	charcoal	intcal13	8372	Mesolithic	País Vasco
1819	Ekain	niv. II	9540	210	0,02	I-i1666	n.d	intcal13	10970	Mesolithic	País Vasco
1820	Ekain	niv. I vbs	9460	185	0,02	I-9239	n.d	intcal13	10780	Mesolithic	País Vasco
1005	Herriko Barra	C	5710	110	0,02	HB*2	charcoal	intcal13	6552	Mesolithic	País Vasco
1010	Herriko Barra	C	5960	95	0,02	UA-4821	bone	intcal13	6828	Mesolithic	País Vasco
1004	Herriko Barra	C	6010	90	0,02	UA-4820	bone	intcal13	6870	Mesolithic	País Vasco
1008	Herriko Barra	D	5730	110	0,02	I-15350	charcoal	intcal13	6581	Mesolithic	País Vasco
1009	Herriko Barra	D	5800	110	0,02	I-15351	organic material	intcal13	6697	Mesolithic	País Vasco
	Jaizkibel 3	D inf.	8300	50	0,01	GrA-23733	human bone	intcal13	9258	Mesolithic	País Vasco
1027	Jaizkibel 3	D sup.	7770	50	0,01	GrA-25774	charcoal	intcal13	8592	Mesolithic	País Vasco
	Jaizkibel 3	F	7780	130	0,02	GrN-28008	shell	marine13	8266	Mesolithic	País Vasco
	Jaizkibel 3	F	8190	100	0,01	GrN-27984	charcoal	intcal13	9066	Mesolithic	País Vasco
1734	Jaizkibel 3	G sup.	8470	50	0,01	GrN-25776	charcoal	intcal13	9420	Mesolithic	País Vasco
1733	Jaizkibel 4	G	8470	100	0,01	GrN-28387	charcoal	intcal13	9460	Mesolithic	País Vasco
1041	Kobeaga II	–	6945	65	0,01	UA-4286	bone	intcal13	7787	Mesolithic	País Vasco
	Kobeaga II	Amek-h	7790	70	0,01	UA-4286	bone	intcal13	8686	Mesolithic	País Vasco
	Linatzeta	child burial	7315	35	0,01	KIA-33193	human bone	intcal13	8154	Mesolithic	País Vasco
	Linatzeta	child burial	8110	50	0,01	KIA-33193	human bone	intcal13	9007	Mesolithic	País Vasco
	Linatzeta	hearth 1	6110	30	0,01	KIA-30181	charcoal	intcal13	6996	Mesolithic	País Vasco
691	Linatzeta	hearth 2	6810	30	0,00	KIA-34976	charcoal	intcal13	7660	Mesolithic	País Vasco
	Linatzeta	hearth 4/5	7650	30	0,00	KIA-34976	charcoal	intcal13	8461	Mesolithic	País Vasco
	Marizulo	I-base	6425	85	0,01	UA-10272	NA	intcal13	7286	Mesolithic	País Vasco
1278	Marizulo	II superior	6035	100	0,02	UA-4819	bone	intcal13	6889	Mesolithic	País Vasco
	Pareko Landa	I-smk	6650	130	0,02	GrN-22429	charcoal	intcal13	7554	Mesolithic	País Vasco
	Pareko Landa	I-smk	7510	100	0,01	GrN-24782	charcoal	intcal13	8300	Mesolithic	País Vasco
	Pico Ramos	IV	5860	65	0,01	UA-3051	bone	intcal13	6680	Mesolithic	País Vasco
1433	Pico Ramos	IV	6040	90	0,02	Beta-193569	shell	marine13	6498	Mesolithic	País Vasco
1429	Pico Ramos	IV	6850	75	0,01	Beta-191083	bone	intcal13	7710	Mesolithic	País Vasco
	Pico/Ramos	IV	6040	90	0,02	NA	NA	intcal13	6884	Mesolithic	País Vasco
	Pico/Ramos	IV	6840	75	0,01	NA	NA	intcal13	7700	Mesolithic	País Vasco
	Urratxa	nivel fertíl	6940	75	0,01	UA-11434	bone	intcal13	7790	Mesolithic	País Vasco
	Urratxa	nivel fertíl	6955	80	0,01	UA-11435	bone	intcal13	7796	Mesolithic	País Vasco
	País Vasco:		**7414**	**90**	**0,013**				**8331**		

Appendix 3. — Northern Spain by zones – Neolithic dates (271 dates): https://doi.org/10.5852/cr-palevol2022v21a3_s3

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib curve	Cal Bp Median	Group	Region
1787	Carabión	1	5440	40	0,01	Poz-30592	bone	intcal13	6200	Neolithic	Cantabria
1788	Portillo del Arenal	NA	4443	104	0,02	AA-20044	bone	intcal13	5076	Neolithic	Cantabria
1786	Portillo del Arenal	NA	4560	35	0,01	Poz-39141	human bone	intcal13	5210	Neolithic	Cantabria
794	Portillo del Arenal	NA	5743	111	0,02	AA-20043	bone	intcal13	6592	Neolithic	Cantabria
1835	l'Hortal	NA	4350	29	0,01	DSH-3619	charcoal	intcal13	4946	Neolithic	Cantabria
1834	l'Hortal	NA	4518	53	0,01	DSH-3618	charcoal	intcal13	5160	Neolithic	Cantabria
1837	La Sienra	on bedrock	1238	30	0,02	DSH-2223	charcoal	intcal13	1160	Neolithic	Cantabria
1836	La Sienra	on bedrock	4091	28	0,01	DSH-2224	charcoal	intcal13	4627	Neolithic	Cantabria
1840	Las Corvas	hearth/bed.	4447	39	0,01	DSH-5057	charcoal	intcal13	5083	Neolithic	Cantabria
1839	Las Corvas	hearth/bed.	4973	37	0,01	DSH-5056	charcoal	intcal13	5746	Neolithic	Cantabria
1838	Las Corvas	NA	4770	31	0,01	DSH-3620	charcoal	intcal13	5476	Neolithic	Cantabria
1236	Los Gitanos	A3	5150	100	0,02	UBAR-521	charcoal	intcal13	5939	Neolithic	Cantabria
1235	Los Gitanos	A3	5945	55	0,01	AA-29113	bone	intcal13	6761	Neolithic	Cantabria
1237	Los Gitanos	A4	5490	200	0,04	UBAR-693	charcoal	intcal13	6308	Neolithic	Cantabria
1856	Mazaculos	A2	5050	120	0,02	GaK-15221	charcoal	intcal13	5809	Neolithic	Cantabria
900	Mirón	–	5500	90	0,02	GX-25854	charcoal	intcal13	6288	Neolithic	Cantabria
901	Mirón	–	5520	70	0,01	GX-25855	charcoal	intcal13	6302	Neolithic	Cantabria
903	Mirón	–	5550	40	0,01	GX-309010	seed	intcal13	6353	Neolithic	Cantabria
899	Mirón	–	5570	50	0,01	GX-23414	charcoal	intcal13	6376	Neolithic	Cantabria
898	Mirón	–	5690	50	0,01	GX-23413	charcoal	intcal13	6485	Neolithic	Cantabria
902	Mirón	–	5790	90	0,02	GX-25856	charcoal	intcal13	6630	Neolithic	Cantabria
904	Mirón	Cabin 9	5170	170	0,03	GX-22128	charcoal	intcal13	5906	Neolithic	Cantabria
907	Mirón	Trch 98a	4910	80	0,02	GX-28211	charcoal	intcal13	5626	Neolithic	Cantabria
1425	Peña Oviedo	Nivel 1	4820	50	0,01	GrN-19048	charcoal	intcal13	5530	Neolithic	Cantabria
1426	Peña Oviedo	Nivel 5	5195	25	0,01	GrN-18782	charcoal	intcal13	5970	Neolithic	Cantabria
1579	Sierra Plana	–	5230	50	0,01	OxA-6914	charcoal	intcal13	6010	Neolithic	Cantabria
1589	Torca l'Arroyu	TA-3A	4930	70	0,01	UBAR-803	bone	intcal13	5658	Neolithic	Cantabria
	Cantabria:		**5157**	**71**	**0,014**				**5893**		
3	Abauntz	b4	5390	120	0,02	I-11309	charcoal	intcal13	–	Neolithic	Ebro
4	Abauntz	C	6910	450	0,07	I-11537	charcoal	intcal13	–	Neolithic	Ebro
	Abauntz	Iir	5820	40	0,01	GrN-21010	charcoal	intcal13	6618	Neolithic	Ebro
	Aizpea	NA	6370	70	0,01	BrN-18421	NA	intcal13	7250	Neolithic	Ebro
	Alonso Norte	NA	6069	27	0,00	D-AMS 018640	NA	intcal13	6932	Neolithic	Ebro
	Alto Rodilla	NA	6171	55	0,01	CSIC-1967	NA	intcal13	7033	Neolithic	Ebro
	Ángel 1	NA	5220	80	0,02	GrA-22825	NA	intcal13	5974	Neolithic	Ebro
105	Atxoste	IIIb	6220	60	0,01	GrA-9789	bone	intcal13	–	Neolithic	Ebro
	Balm. Margineda	NA	6410	40	0,01	Beta-325682	NA	intcal13	7307	Neolithic	Ebro
	Botiquería	NA	6040	50	0,01	GrA-13268	NA	intcal13	6916	Neolithic	Ebro
	Botiquería	NA	6240	50	0,01	GrA-13270	NA	intcal13	7128	Neolithic	Ebro
	Camp Colomer	NA	5300	30	0,01	Beta-325685	NA	intcal13	6086	Neolithic	Ebro
	Camp Colomer	NA	5350	40	0,01	Beta-325684	NA	intcal13	6114	Neolithic	Ebro
	Camp Colomer	NA	5630	40	0,01	Beta-325686	NA	intcal13	6452	Neolithic	Ebro
	Cascajos	NA	5100	60	0,01	GrA-16204	NA	intcal13	5870	Neolithic	Ebro
	Cascajos	NA	5100	50	0,01	GrA-16942	NA	intcal13	5817	Neolithic	Ebro
	Cascajos	NA	5250	50	0,01	GrA-16208	NA	intcal13	6048	Neolithic	Ebro
	Cascajos	NA	5300	60	0,01	GrA-16210	NA	intcal13	6094	Neolithic	Ebro
	Cascajos	NA	5330	60	0,01	GrA-16211	NA	intcal13	6107	Neolithic	Ebro
	Cascajos	NA	5450	85	0,02	UA16203	NA	intcal13	6232	Neolithic	Ebro
	Cascajos	NA	5640	35	0,01	UA-1625	NA	intcal13	6438	Neolithic	Ebro
	Cascajos	NA	5720	90	0,02	UA-17793	NA	intcal13	6561	Neolithic	Ebro
	Cascajos	NA	5830	60	0,01	GrA-16209	NA	intcal13	6650	Neolithic	Ebro
	Cascajos	NA	5945	95	0,02	UA-24423	NA	intcal13	6822	Neolithic	Ebro
	Cascajos	NA	6125	80	0,01	UA-17995	NA	intcal13	6992	Neolithic	Ebro
	Cascajos	NA	6145	45	0,01	UA-24425	NA	intcal13	7024	Neolithic	Ebro
	Cascajos	NA	6185	75	0,01	UA-16024	NA	intcal13	7079	Neolithic	Ebro
	Cascajos	NA	6230	50	0,01	UA-24427	NA	intcal13	7109	Neolithic	Ebro
	Cascajos	NA	6250	50	0,01	UA-24426	NA	intcal13	7166	Neolithic	Ebro
	Cascajos	NA	6435	35	0,01	UA-24428	NA	intcal13	7357	Neolithic	Ebro
	Chaves	NA	6120	70	0,01	CSIC-381	NA	intcal13	6974	Neolithic	Ebro
	Chaves	NA	6230	70	0,01	CSIC-379	NA	intcal13	7108	Neolithic	Ebro
	Chaves	NA	6230	45	0,01	GrA-26912	NA	intcal13	7124	Neolithic	Ebro
	Chaves	NA	6260	100	0,02	GrN-13603	NA	intcal13	7118	Neolithic	Ebro
	Chaves	NA	6330	90	0,01	GrN-13602	NA	intcal13	7198	Neolithic	Ebro
	Chaves	NA	6330	70	0,01	GrN-13605	NA	intcal13	7210	Neolithic	Ebro
	Chaves	NA	6335	40	0,01	GrA-34256	NA	intcal13	7259	Neolithic	Ebro
	Chaves	NA	6380	40	0,01	GrA-28341	NA	intcal13	7298	Neolithic	Ebro
	Chaves	NA	6470	25	0,00	UCIAMS-66317	NA	intcal13	7369	Neolithic	Ebro
	Chaves	NA	6490	40	0,01	GrN-13604	NA	intcal13	7404	Neolithic	Ebro

Appendix 3. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib curve	Cal Bp Median	Group	Region
	Collet Puiggrós	NA	5345	45	0,01	UBAR-891	NA	intcal13	6111	Neolithic	Ebro
	Collet Puiggrós	NA	5480	45	0,01	UBAR-892	NA	intcal13	6247	Neolithic	Ebro
	Coro Trasito	NA	5850	35	0,01	CNA.2520.1.1	NA	intcal13	6647	Neolithic	Ebro
	Coro Trasito	NA	5990	40	0,01	Beta-358571	NA	intcal13	6832	Neolithic	Ebro
	Coro Trasito	NA	6159	40	0,01	Beta-366546	NA	intcal13	7055	Neolithic	Ebro
	Costalena	NA	5480	50	0,01	GrA-13264	NA	intcal13	6224	Neolithic	Ebro
	Cova Colomera	NA	6020	50	0,01	Beta-248523	NA	intcal13	6910	Neolithic	Ebro
	Cova Colomera	NA	6150	40	0,01	Beta-240551	NA	intcal13	7045	Neolithic	Ebro
	Cova Colomera	NA	6170	30	0,01	OxA-23634	NA	intcal13	7078	Neolithic	Ebro
	Cova Colomera	NA	6180	40	0,01	Beta-279478	NA	intcal13	7075	Neolithic	Ebro
	C. Montanissell	NA	5680	50	0,01	Beta-213109	NA	intcal13	6482	Neolithic	Ebro
	Cova del Sardo	NA	5000	30	0,01	K/5833/40816	NA	intcal13	5754	Neolithic	Ebro
	Cova del Sardo	NA	5060	40	0,01	K/K3484/26248	NA	intcal13	5782	Neolithic	Ebro
	Cova del Sardo	NA	5245	40	0,01	K/K4381/32340	NA	intcal13	6060	Neolithic	Ebro
	Cova del Sardo	NA	5635	35	0,01	K/K5832/40815	NA	intcal13	6430	Neolithic	Ebro
	Cova del Sardo	NA	5645	25	0,00	K/K5860/41134	NA	intcal13	6420	Neolithic	Ebro
	Cova del Sardo	NA	5695	35	0,01	K/K5002/36935	NA	intcal13	6486	Neolithic	Ebro
	Cova del Sardo	NA	5715	35	0,01	K/K5785/40878	NA	intcal13	6517	Neolithic	Ebro
	Cova del Sardo	NA	5850	40	0,01	K/K5038/37690	NA	intcal13	6660	Neolithic	Ebro
	Cova del Vidre	NA	6181	35	0,01	OXA-26064	NA	intcal13	7076	Neolithic	Ebro
	Cova del Vidre	NA	6189	90	0,02	Beta-58934	NA	intcal13	7050	Neolithic	Ebro
	Cova del Vidre	NA	6248	33	0,01	OXA-26005	NA	intcal13	7142	Neolithic	Ebro
	Cova Fosca	NA	5715	80	0,01	I-9867	NA	intcal13	6550	Neolithic	Ebro
	Cova Fosca	NA	5820	40	0,01	Beta-148998	NA	intcal13	6618	Neolithic	Ebro
	Cova Fosca	NA	5820	40	0,01	Beta-18993	NA	intcal13	6618	Neolithic	Ebro
	Cova Fosca	NA	5850	70	0,01	Beta-148996	NA	intcal13	6682	Neolithic	Ebro
	Cova Fosca	NA	5870	80	0,01	Beta-148997	NA	intcal13	6706	Neolithic	Ebro
	Cova Fosca	NA	5980	70	0,01	Beta-148994	NA	intcal13	6831	Neolithic	Ebro
	Cova Fosca	NA	5980	70	0,01	Beta-148999	NA	intcal13	6831	Neolithic	Ebro
	Cova Fosca	NA	6070	80	0,01	Beta-149005	NA	intcal13	6946	Neolithic	Ebro
	Cova Fosca	NA	6080	80	0,01	Beta-149000	NA	intcal13	6954	Neolithic	Ebro
	Cova Fosca	NA	6130	60	0,01	Beta-149007	NA	intcal13	7003	Neolithic	Ebro
	Cova Fosca	NA	6140	90	0,02	Beta-149001	NA	intcal13	7037	Neolithic	Ebro
	Cova Fosca	NA	6150	70	0,01	Beta-149004	NA	intcal13	7024	Neolithic	Ebro
	Cova Fosca	NA	6250	80	0,01	Beta-149006	NA	intcal13	7110	Neolithic	Ebro
	Cova Fosca	NA	6390	40	0,01	Beta-149009	NA	intcal13	7300	Neolithic	Ebro
	Cova Fosca	NA	6413	33	0,01	OXA-26074	NA	intcal13	7341	Neolithic	Ebro
	Cova Gran	NA	5250	40	0,01	Beta-233605	NA	intcal13	6064	Neolithic	Ebro
	Cova Gran	NA	6020	50	0,01	Beta-265982	NA	intcal13	6910	Neolithic	Ebro
	Cueva del Gato 2	NA	6240	50	0,01	GrA-22525	NA	intcal13	7128	Neolithic	Ebro
	Cueva Drólica	NA	5855	40	0,01	GrA-33914	NA	intcal13	6668	Neolithic	Ebro
	Cueva Lóbrega	III inf.	6220	100	0,02	GrN-16110	bone	intcal13	7068	Neolithic	Ebro
	Cueva Pacencia	NA	5795	45	0,01	GrA-17666	NA	intcal13	6597	Neolithic	Ebro
	El Prado	NA	5640	40	0,01	Beta-312351	NA	intcal13	6462	Neolithic	Ebro
	El Prado	NA	5880	30	0,01	Beta-366569	NA	intcal13	6694	Neolithic	Ebro
	El Prado	NA	6050	40	0,01	Beta-312352	NA	intcal13	6945	Neolithic	Ebro
	Esp. Puyascada	NA	5580	70	0,01	CSIS-382	NA	intcal13	6400	Neolithic	Ebro
	Esp. Puyascada	NA	5930	60	0,01	CSIC-384	NA	intcal13	6757	Neolithic	Ebro
	Esplugón	NA	5970	30	0,01	Beta-338509	NA	intcal13	6808	Neolithic	Ebro
	Esplugón	NA	6120	40	0,01	Beta-283899	NA	intcal13	6994	Neolithic	Ebro
996	Fuente Hoz	I (16)	6120	280	0,05	I-12084	charcoal	intcal13	–	Neolithic	Ebro
994	Fuente Hoz	I-a	5240	110	0,02	I-11588	bone	intcal13	–	Neolithic	Ebro
995	Fuente Hoz	I-b	5160	110	0,02	I-11589	bone	intcal13	–	Neolithic	Ebro
	Huerto Raso	NA	6310	60	0,01	GrA-21360	NA	intcal13	7190	Neolithic	Ebro
	Husos I	NA	5810	60	0,01	Beta-161881	NA	intcal13	6638	Neolithic	Ebro
	Husos I	XV	5630	60	0,01	Beta-161179	bone	intcal13	6452	Neolithic	Ebro
1243	Husos I	XV	5810	60	0,01	Beta-161181	bone	intcal13	–	Neolithic	Ebro
	Husos I	XV	6130	60	0,01	Beta-161180	bone	intcal13	7003	Neolithic	Ebro
	Husos I	XVI	6240	60	0,01	Beta-161182	bone	intcal13	7151	Neolithic	Ebro
	Husos II	I-X	6040	40	0,01	Beta-221642	bone	intcal13	6933	Neolithic	Ebro
1244	Husos II	IV	4910	60	0,01	Beta-208848	bone	intcal13	–	Neolithic	Ebro
1245	Husos II	IV	4930	40	0,01	Beta-208849	bone	intcal13	–	Neolithic	Ebro
	Husos II	NA	5300	40	0,01	Beta-161884	NA	intcal13	6098	Neolithic	Ebro
	Husos II	NA	5790	40	0,01	Beta-221641	NA	intcal13	6582	Neolithic	Ebro
	Husos II	V	5280	40	0,01	Beta-208850	NA	intcal13	6086	Neolithic	Ebro
1248	Husos II	V	5300	40	0,01	Beta-161184	bone	intcal13	–	Neolithic	Ebro
	Husos II	V	5430	60	0,01	Beta-161185	bone	intcal13	6186	Neolithic	Ebro
	Husos II	V	5490	40	0,01	Beta-208851	bone	intcal13	6290	Neolithic	Ebro
	Husos II	VI	5520	40	0,01	Beta-208853	bone	intcal13	6318	Neolithic	Ebro

Appendix 3. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib curve	Cal Bp Median	Group	Region
	Husos II	VII	6050	40	0,01	Beta-221640	bone	intcal13	6945	Neolithic	Ebro
	Kan. Goikoa	III sup.	6360	70	0,01	GrN-20214	bone	intcal13	7232	Neolithic	Ebro
	Lámpara	NA	6055	34	0,01	KIA-6789	NA	intcal13	6950	Neolithic	Ebro
	Lámpara	NA	6125	33	0,01	KIA-21348	NA	intcal13	7002	Neolithic	Ebro
	Lámpara	NA	6144	46	0,01	KIA-6790	NA	intcal13	7024	Neolithic	Ebro
	Lámpara	NA	6280	33	0,01	KIA-21352	NA	intcal13	7174	Neolithic	Ebro
	Lámpara	NA	6280	50	0,01	UtC-13346	NA	intcal13	7186	Neolithic	Ebro
	Lámpara	NA	6390	60	0,01	KIA-4780	NA	intcal13	7277	Neolithic	Ebro
	Lámpara	NA	6407	34	0,01	KIA-21347	NA	intcal13	7334	Neolithic	Ebro
	Lámpara	NA	6421	30	0,01	KIA-8874	NA	intcal13	7343	Neolithic	Ebro
	Larrenke N	NA	5180	100	0,02	NA	NA	intcal13	5946	Neolithic	Ebro
	Larrenke N	NA	5210	100	0,02	NA	NA	intcal13	5956	Neolithic	Ebro
	Mas Cremat	NA	6020	50	0,01	Beta-232340	NA	intcal13	6910	Neolithic	Ebro
	Mendandia	NA	6440	40	0,01	GrN-22740	NA	intcal13	7364	Neolithic	Ebro
	Mirador	NA	5090	40	0,01	Beta-220912	NA	intcal13	5822	Neolithic	Ebro
	Mirador	NA	5360	50	0,01	Beta-181087	NA	intcal13	6116	Neolithic	Ebro
	Mirador	NA	5470	40	0,01	Beta-208131	NA	intcal13	6248	Neolithic	Ebro
	Mirador	NA	5480	40	0,01	Beta-220913	NA	intcal13	6267	Neolithic	Ebro
	Mirador	NA	5700	70	0,01	Beta-181088	NA	intcal13	6530	Neolithic	Ebro
	Mirador	NA	6100	50	0,01	Beta-197384	NA	intcal13	6992	Neolithic	Ebro
	Mirador	NA	6110	40	0,01	Beta-220914	NA	intcal13	6980	Neolithic	Ebro
	Mirador	NA	6120	40	0,01	Beta-208132	NA	intcal13	6994	Neolithic	Ebro
	Mirador	NA	6130	50	0,01	Beta-182040	NA	intcal13	7014	Neolithic	Ebro
	Mirador	NA	6150	40	0,01	Beta-208133	NA	intcal13	7045	Neolithic	Ebro
	Mirador	NA	6320	50	0,01	Beta-208134	NA	intcal13	7213	Neolithic	Ebro
	Mirador	NA	6380	40	0,01	Beta-197385	NA	intcal13	7298	Neolithic	Ebro
	Paco Pons	NA	6010	45	0,01	Gra-19294	NA	intcal13	6874	Neolithic	Ebro
	Paco Pons	NA	6045	45	0,01	Gra-19295	NA	intcal13	6918	Neolithic	Ebro
	Padre Areso	NA	5380	100	0,02	GrN-14599	NA	intcal13	6122	Neolithic	Ebro
	Padre Areso	NA	5400	100	0,02	GrN-14599	NA	intcal13	6161	Neolithic	Ebro
	Parco	NA	5970	60	0,01	CSIC403	NA	intcal13	6848	Neolithic	Ebro
	Parco	NA	6120	90	0,02	GrN-20058	NA	intcal13	7010	Neolithic	Ebro
	Parco	NA	6170	70	0,01	CSIC-281	NA	intcal13	7037	Neolithic	Ebro
	Paternanbidea	NA	5960	40	0,01	GrA-13675	NA	intcal13	6808	Neolithic	Ebro
	Paternanbidea	NA	6090	40	0,01	GrA-13673	NA	intcal13	6960	Neolithic	Ebro
1423	Peña Larga	IV	4890	50	0,01	Beta-242781	bone	intcal13	–	Neolithic	Ebro
1422	Peña Larga	IV	5010	40	0,01	PL*1	n.d	intcal13	–	Neolithic	Ebro
	Peña Larga	IV	5720	49	0,01	Beta-242782	bone	intcal13	6520	Neolithic	Ebro
1419	Peña Larga	IV	5830	110	0,02	I-14909	bone	intcal13	–	Neolithic	Ebro
1420	Peña Larga	IV	6150	230	0,04	I-15150	bone	intcal13	–	Neolithic	Ebro
	Plano Pulido	NA	5040	40	0,01	Beta-258559	NA	intcal13	5766	Neolithic	Ebro
	Pontet	NA	5644	42	0,01	D-AMS 020207	NA	intcal13	6464	Neolithic	Ebro
	Pontet	NA	6369	41	0,01	D-AMS 020209	NA	intcal13	7296	Neolithic	Ebro
	Pontet	NA	6370	70	0,01	GrN-14241	NA	intcal13	7250	Neolithic	Ebro
	Portalón	NA	5230	40	0,01	Beta-184842	NA	intcal13	6026	Neolithic	Ebro
	Portalón	NA	6100	50	0,01	Beta-222339	NA	intcal13	6992	Neolithic	Ebro
	Portalón	NA	6270	40	0,01	Beta-222340	NA	intcal13	7164	Neolithic	Ebro
	Ram. Legunova	NA	5175	40	0,01	GrA-52086	NA	intcal13	5952	Neolithic	Ebro
	Ram. Legunova	NA	5440	35	0,01	GrA-51860	NA	intcal13	6208	Neolithic	Ebro
	Ram. Legunova	NA	5670	60	0,01	GrA-52691	NA	intcal13	6499	Neolithic	Ebro
	Ram. Legunova	NA	6295	40	0,01	GrA-51971	NA	intcal13	7210	Neolithic	Ebro
	Revilla	NA	5642	96	0,02	KIA-13943	NA	intcal13	6426	Neolithic	Ebro
	Revilla	NA	6120	60	0,01	UtC-13348	NA	intcal13	6999	Neolithic	Ebro
	Revilla	NA	6156	33	0,01	KIA-21353	NA	intcal13	7066	Neolithic	Ebro
	Revilla	NA	6158	31	0,01	KIA-21349	NA	intcal13	7058	Neolithic	Ebro
	Revilla	NA	6177	31	0,01	KIA-21354	NA	intcal13	7090	Neolithic	Ebro
	Revilla	NA	6202	31	0,01	KIA-21346	NA	intcal13	7102	Neolithic	Ebro
	Revilla	NA	6210	60	0,01	UtC-13350	NA	intcal13	7092	Neolithic	Ebro
	Revilla	NA	6230	30	0,01	KIA-21355	NA	intcal13	7123	Neolithic	Ebro
	Revilla	NA	6240	50	0,01	UtC-13294	NA	intcal13	7128	Neolithic	Ebro
	Revilla	NA	6245	34	0,01	KIA-21359	NA	intcal13	7138	Neolithic	Ebro
	Revilla	NA	6250	50	0,01	UtC-13295	NA	intcal13	7166	Neolithic	Ebro
	Revilla	NA	6250	50	0,01	UtC-13296	NA	intcal13	7166	Neolithic	Ebro
	Revilla	NA	6271	31	0,01	KIA-21357	NA	intcal13	7169	Neolithic	Ebro
	Revilla	NA	6289	31	0,01	KIA-21351	NA	intcal13	7187	Neolithic	Ebro
	Revilla	NA	6313	48	0,01	UtC-13347	NA	intcal13	7212	Neolithic	Ebro
	Revilla	NA	6355	30	0,01	KIA-21356	NA	intcal13	7294	Neolithic	Ebro
	Revilla	NA	6365	36	0,01	KIA-21358	NA	intcal13	7296	Neolithic	Ebro
	Revilla	NA	6385	35	0,01	KIA-13932	NA	intcal13	7300	Neolithic	Ebro

Appendix 3. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib curve	Cal Bp Median	Group	Region
	Revilla	NA	6405	36	0,01	KIA-13937	NA	intcal13	7314	Neolithic	Ebro
	Revilla	NA	6415	36	0,01	KIA-13942	NA	intcal13	7338	Neolithic	Ebro
	Revilla	NA	6446	39	0,01	KIA-13945	NA	intcal13	7367	Neolithic	Ebro
	Revilla	NA	6449	37	0,01	KIA-13948	NA	intcal13	7367	Neolithic	Ebro
	Revilla	NA	6468	40	0,01	KIA-13933	NA	intcal13	7386	Neolithic	Ebro
	Revilla	NA	6499	42	0,01	KIA-13938	NA	intcal13	7415	Neolithic	Ebro
	Riols	NA	6040	100	0,02	GrN-13976	NA	intcal13	6894	Neolithic	Ebro
	Samitiel	NA	5130	20	0,00	GrN-26150	NA	intcal13	5864	Neolithic	Ebro
	San Cristóbal	NA	5100	30	0,01	Beta-307800	NA	intcal13	5836	Neolithic	Ebro
	San Cristóbal	NA	5320	30	0,01	Beta-337632	NA	intcal13	6104	Neolithic	Ebro
	San Cristóbal	NA	5410	30	0,01	Beta-373276	NA	intcal13	6160	Neolithic	Ebro
	San Cristóbal	NA	5460	30	0,01	Beta-373277	NA	intcal13	6272	Neolithic	Ebro
	San Cristóbal	NA	5490	30	0,01	Beta-373275	NA	intcal13	6296	Neolithic	Ebro
	San Cristóbal	NA	5500	30	0,01	Beta-373631	NA	intcal13	6298	Neolithic	Ebro
	Torrazas	NA	5570	60	0,01	GrN-18320	NA	intcal13	6408	Neolithic	Ebro
	Trocs	NA	5005	27	0,01	Mams-14856	NA	intcal13	5755	Neolithic	Ebro
	Trocs	NA	5008	27	0,01	Mams-16160	NA	intcal13	5756	Neolithic	Ebro
	Trocs	NA	5035	23	0,01	Mams-16165	NA	intcal13	5782	Neolithic	Ebro
	Trocs	NA	5580	40	0,01	Beta-319513	NA	intcal13	6380	Neolithic	Ebro
	Trocs	NA	5590	40	0,01	Beta-316511	NA	intcal13	6391	Neolithic	Ebro
	Trocs	NA	6050	40	0,01	Beta-316514	NA	intcal13	6945	Neolithic	Ebro
	Trocs	NA	6060	40	0,01	Beta-295782	NA	intcal13	6948	Neolithic	Ebro
	Trocs	NA	6070	40	0,01	Beta-284150	NA	intcal13	6952	Neolithic	Ebro
	Trocs	NA	6080	40	0,01	Beta-326512	NA	intcal13	6954	Neolithic	Ebro
	Trocs	NA	6217	25	0,00	Mams-16161	NA	intcal13	7121	Neolithic	Ebro
	Trocs	NA	6218	24	0,00	Mams-16162	NA	intcal13	7124	Neolithic	Ebro
	Trocs	NA	6234	28	0,00	Mams-16166	NA	intcal13	7130	Neolithic	Ebro
	Trocs	NA	6249	25	0,00	Mams-16164	NA	intcal13	7144	Neolithic	Ebro
	Trocs	NA	6249	20	0,00	Mams-16168	NA	intcal13	7158	Neolithic	Ebro
	Trocs	NA	6280	25	0,00	Mams-16159	NA	intcal13	7224	Neolithic	Ebro
	Trocs	NA	6285	25	0,00	Mams-16163	NA	intcal13	7234	Neolithic	Ebro
	Valmayor XI	NA	6090	30	0,01	Beta-341167	NA	intcal13	6976	Neolithic	Ebro
	Ebro:		**5928,0**	**53,9**	**0,009**				**6353,3**		
1	A Gándara	EC 1	5356	49	0,01	CSI-C-1263	charcoal	intcal13	6114	Neolithic	Galicia
2	A Gándara	EC 2	5412	42	0,01	CSI-C-1264	charcoal	intcal13	6166	Neolithic	Galicia
73	Alto Barreira	NA	6030	30	0,01	CSI-C-1039	charcoal	intcal13	6875	Neolithic	Galicia
76	Anta Serramo	NA	6050	110	0,02	Cams88195	pigment	intcal13	6903	Neolithic	Galicia
275	Campurras	base cabaña	4890	100	0,02	Beta-220081	charcoal	intcal13	5641	Neolithic	Galicia
274	Campurras	base cabaña	5140	80	0,02	Beta-220080	charcoal	intcal13	5929	Neolithic	Galicia
276	Campurras	paleosuelo	5160	60	0,01	Beta-220082	seed	intcal13	5928	Neolithic	Galicia
834	Devesa do Rei	Horizonte B	5190	55	0,01	UA-20011	charcoal	intcal13	5940	Neolithic	Galicia
1344	Monte Remedios	hearth	5285	50	0,01	UA-33142	charcoal	intcal13	6092	Neolithic	Galicia
1343	Monte Remedios	hearth	5385	50	0,01	UA-33141	charcoal	intcal13	6134	Neolithic	Galicia
1345	Monte Remedios	grinding slab	5780	40	0,01	UA-32670	organic material	intcal13	6576	Neolithic	Galicia
1348	Monte Remedios	perim. trench	4725	40	0,01	UA-32669	charcoal	intcal13	5454	Neolithic	Galicia
1346	Monte Remedios	perim. trench	5000	40	0,01	UA-32666	organic material	intcal13	5754	Neolithic	Galicia
1347	Monte Remedios	perim. trench	5015	40	0,01	UA-32667	organic material	intcal13	5758	Neolithic	Galicia
1468	Porto dos Valos	NA	5572	32	0,01	CSI-C-1112	bone	intcal13	6380	Neolithic	Galicia
	Galicia:		**5714**	**58**	**0,011**				**6546**		
82	Arenaza	I-C1	4965	195	0,04	I-8630	charcoal	intcal13	5631	Neolithic	País Vasco
83	Arenaza	I-C2	5755	65	0,01	OxA-7156	bone	intcal13	6556	Neolithic	País Vasco
84	Arenaza	I-C2	6040	75	0,01	OxA-7157	bone	intcal13	6912	Neolithic	País Vasco
777	Santimamiñe	17G/S2 niv.III	5450	50	0,01	Beta-240898	charcoal	intcal13	6202	Neolithic	País Vasco
778	Santimamiñe	17G/S6 niv.III	5010	40	0,01	Beta-240897	charcoal	intcal13	5756	Neolithic	País Vasco
847	Ekain	II	4960	60	0,01	UA-36855	human bone	intcal13	5709	Neolithic	País Vasco
848	Ekain	Nivel 2	6897	35	0,01	UA-38966	n.d	intcal13	7747	Neolithic	País Vasco
1007	Herriko Barra	B	5810	170	0,03	HB*1	organic material	intcal13	6642	Neolithic	País Vasco
1006	Herriko Barra	nivel esteril	4920	100	0,02	I-15249	charcoal	intcal13	5651	Neolithic	País Vasco
1040	Kobaederra	II	4965	70	0,01	K*1	charcoal	intcal13	5710	Neolithic	País Vasco
1039	Kobaederra	II	5460	60	0,01	Beta-126686	charcoal	intcal13	6220	Neolithic	País Vasco
1036	Kobaederra	III	5820	240	0,04	UBAR-471	charcoal	intcal13	6630	Neolithic	País Vasco
1037	Kobaederra	IV	5375	90	0,02	AA-29110	seed	intcal13	6142	Neolithic	País Vasco
1038	Kobaederra	IV	5630	100	0,02	UBAR-470	charcoal	intcal13	6398	Neolithic	País Vasco

Appendix 3. — Continuation.

Pg.id	Site	Level	C14 Mean	C14 S DEV	C14 CV	Lab no.	Material	Calib curve	Cal Bp Median	Group	Region
1267	Lumentxa	bed 10 niv. II-III	5095	75	0,02	UA-12663	charcoal	intcal13	5888	Neolithic	País Vasco
1268	Lumentxa	bed 9. niv. II-III	5180	70	0,01	UA-12662	charcoal	intcal13	5962	Neolithic	País Vasco
1266	Lumentxa	NA	6122	38	0,01	OxA-18236	human bone	intcal13	6990	Neolithic	País Vasco
1277	Marizulo	burial	5285	65	0,01	GrN-5992	bone	intcal13	6044	Neolithic	País Vasco
1276	Marizulo	burial	5315	100	0,02	UA-4818	human bone	intcal13	6052	Neolithic	País Vasco
1280	Marizulo	nivel 1	5235	75	0,01	UA-10375	bone	intcal13	5978	Neolithic	País Vasco
1431	Pico Ramos	IV	4790	110	0,02	I-16798	bone	intcal13	5447	Neolithic	País Vasco
1432	Pico Ramos	IV	5370	40	0,01	Beta-181689	seed	intcal13	6130	Neolithic	País Vasco