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Radiocarbon dates, climatic events, and social dynamics during the Early Neolithic in Mediterranean Iberia

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ABSTRACT

Our goal in this paper is to examine the socioecological dynamics of the Early Neolithic period in Iberia in order to test the usefulness of temporal probability curves built from dated sites as a relative proxy for exploring possible links between trends in population patterns and climatic fluctuations. We compare the information for the entire Iberian Peninsula with four Mediterranean regions, investigating the climate–population relationships that emerge when we zoom into particular regions. We evaluate climatic and other possible causes of similarities in the shapes of temporal probability curves across the Peninsula, associated with demographic changes in the Early Neolithic sequence. Changes in subsistence patterns identified in empirical data from sites like Cendres cave (Alicante province), together with computational modeling that simulates long-term socio-ecological processes, suggest key variables that can help account for local dynamics. Theoretical approaches from Complex System Theory and Evolutionary Archaeology can help us to better understand evolutionary processes including the spread of farming.

1. Introduction

Research on European Neolithic sequences has underlined the potential of both global exogenic (mainly climatic Holocene events) and/or endogenic forces behind major changes in social evolutionary processes. Authors such as Gronenborn (2009, 2010) have focused on the role of climatic fluctuations detected in the Holocene marine and terrestrial climate records for the spread of farming from the Near East to Europe at a supra-regional level. He also emphasizes the need to zoom in to compare chronologies of local and regional fine-resolution data. Shennan et al. (2013) calculated summed ^{14}C probability densities from multiple sites at pan-European and regional scales as a relative demographic proxy to be compared with other general and fine-resolution climatic proxies. Both authors agree about the importance of carefully examining the relationships between particular abrupt climatic fluctuations and shifts in cultural sequences that occur at roughly the same time. Specifically the chronology for the end of the Early Neolithic in Central Europe (LBK) is used to explore alternative hypotheses related to the effects of climatic events (7.1 k event–5b IRD event) (Gronenborn, 2009) or endogenous drivers (Shennan, 2013; Shennan et al., 2013) on social change. Shennan et al. (2013) take a more expansive geographic perspective in recent work that examines radiocarbon probability curves as demographic proxies for the entirety of Western Europe excluding southern regions (Iberia and Italy). These authors identify a general pattern of a population boom coincident with the arrival of food production economies, followed by a rapid decline some centuries later in multiple European regions. Comparing these population proxies with paleoclimate proxies of the middle Holocene, they conclude that fluctuations in population densities were not directly linked with the main climatic events. Instead, they propose that endogenous causes are more probable for these patterns in evolutionary socioeconomic processes at the beginning of the Neolithic period, perhaps related to a rapid population increase that lead to unsustainable levels, or other hypothetical internal causes (Shennan et al., 2013).

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Recently, we tried to analyze similar relationships between relative Summed Calibrated Data Probability Distribution (SCDPD) of radiocarbon dates and climatic events in Iberia (Bernabeu Aubán et al., 2014). We examined its utility to observe trends in population dynamics for the Iberian Peninsula at a general scale, and within several sub-regions. We also compared demographic patterns with global and regional climatic proxies. As with the patterns reported by Shennan and colleagues from other areas of Europe, our analyses indicate a population boom that emerged after the arrival of the Neolithic in Iberia around 7650 cal BP, followed by a bust coincident with the end of the Early Neolithic sequences (Impressed Ware Culture) following the end of the VIII millennium cal BP. Additionally, we concluded that despite a general correspondence between climatic events at 8.2 and 7.1 cal BP (5a and 5b IRD events) and fluctuations in SCDPD, important discrepancies appear when we zoom into regional and local scales. In this paper, we take a longer-term perspective of socio-ecological changes by extending SCDPD from the Mesolithic to the Middle Neolithic. This allows us to examine the demographic trends of the Neolithic in the context of the longer history of human settlement in Iberia by focusing particularly on the Mediterranean zone of the Iberian Peninsula.

2. Regional setting

The Iberian Peninsula, around 580.000 km^2 in area, includes two main bioclimatic regions characterized by continental and Mediterranean ecological conditions respectively. This creates a mosaic of diverse ecosystems depending on altitude, latitude, and the distance to the sea. Since the beginning of the Holocene, progressive climatic amelioration has been reflected in the palynological and charcoal records (Carrión et al., 2010). The warmer and wetter conditions at the beginning of the Holocene are indicated by the increase of deciduous forest (oak) and the upward migration of conifers (*pinus sp* and *juniperus sp*). The Mediterranean area of Iberia is traversed by two main corridors, the Mediterranean Sea and the Ebro river, that facilitated human interaction and social networks as seen in similarities in prehistoric artifact assemblages.

The Mesolithic precursors to the Neolithic appear in the material culture as a regional manifestation of the broader Castelnovian Tradition, characterized by the microblade geometric microlithic technology with trapezes that appeared in the first half of the IX millennium cal BP (Utrilla and Montes, 2009). Several centuries later, at the beginning of the VIII millennium cal BP, triangles began to dominate the geometric microlith assemblages.

The first domesticates in Iberia appear in the Early Neolithic around 7650 cal BP at sites located in core areas such as the Llobregat valley in Catalonia (Guixeres de Vilobí: OxA26068, 6655, 45 and El Cavet: OxA26061, 6536, 36—Oms et al., 2014), and Southern Valencia region (Cova d'En Pardo: Beta231880, 6660, 40—García Atiénzar, 2009; Cova de les Cendres: Beta239377, 6510, 40—Bernabeu and Molina, 2009; Barranquet: Beta221431, 6510, 50—Bernabeu et al., 2009; Cova de l'Or—UCIAMS66316, 6475, 25—Martí, 2011; Mas d'Is: Beta162092, 6600, 50 and Beta166727, 6600, 50—Bernabeu, 2006; Sarsa: OxA26076, 6506, 32—García Borja et al., 2012; Falguera: 6510, 80—García Puchol et al., 2009), in addition to other inland sites as Chaves in the Ebro valley (GrA38022, 6580, 35—Baldellou, 2012) or Carigüela in Eastern Andalusia (Col1565, 6749, 39—Medved, 2013) Belonging to the impressed ware cultural complex, the Early Neolithic presents common material characteristics throughout western Mediterranean region. The rapid spread of the Neolithic way of life, documented by direct radiocarbon dates of domestic species, has been attributed to a process of maritime pioneer colonization (Zilhão, 2001). A mixed model that combines endogenous expansion of farming groups with a still poorly understood contribution of local hunter-gatherer groups is the most widely accepted hypothesis for Neolithic dispersals inland (see García Puchol et al., 2009; Juan Cabanilles and García Puchol, 2013; Bernabeu and Martí, 2014). In recent years, new archaeological discoveries have added data that connect some stylistic aspects of initial Neolithic ceramics with southern France and Ligurian impressed pottery (e.g., Barranquet and Mas d'Is, located in Valencia region—Bernabeu et al., 2009).

3. Material and methods

Following protocols established in previous studies (Gamble et al., 2005, Shennan et al., 2013; Timpson et al., 2014), we calculated SCDPD curves as a relative demographic proxy to observe long-term trends in population. Williams (2012) notes several problems that potentially affect the validity of this method, based on the assumption that the number of archaeological sites can be linked to the number of available radiocarbon dates; and that a sufficiently large number of dates can mitigate biasing effects in the samples. He suggests filtering the radiocarbon dates to use in this way by excluding those with large standard deviations (SD) in order to reduce some of these problems. In the aforementioned paper (Bernabeu Aubán et al., 2014), we compiled all radiocarbon dates for Iberia, except for those in the northwestern regions of Cantabria and Galicia. In this contribution we have extended the compilation of radiocarbon dates to the entire Iberian Peninsula, and temporally from the beginning of the IX millennium until the end of the VII millennium cal BP with the goal of obtaining a broader chronological perspective. This dataset, compiled from published works and other publically-available radiocarbon data (Juan Cabanilles and Martí, 2002;; Bernabeu, 2006;; Carvalho, 2008; Catalunya C14,; Rojo et al., 2012;; Fano et al., 2014), contains 1271 radiocarbon dates between 8000 and 5000 BP. Table 1 details the radiocarbon dates classified by materials and regions. For calculating SCDPD curves, we only use radiocarbon dates with a standard deviation ≤200, and exclude dates on shell due to potential problems related to the marine reservoir effect (Ascough et al., 2005). Nonetheless, this filtered dataset includes a large number of dates, covering the entire Iberian Peninsula, and is comparable to other recently published work (Balsera et al., 2015).

Table 1
List of radiocarbon dates by materials and regions. SD (standard deviation average).

	Iberia	Northeast	Ebro valley	East	East/Southeast
All dates	1271	172	195	77	128
Sites	359	60	35	18	32
Charcoal	563	98	82	38	45
Bone	410	46	95	35	46
Seed/fruit	131	23	15	4	23
Shell	112	0	0	0	6
Other	22	0	0	0	7
Indeterminate	33	5	3	0	1
Dates selected	1108	158	186	75	114
Sites	324	58	34	18	27
SD	65.8	75.1	55.4	65.1	66.8

An aspect of this approach that has been criticized is that bias can be introduced by variability in the number of dates for each site, together with differences in the research interests of archaeologists by region, as well as the different visibility of sites and structures (Crombé and Robinson, 2014). In recent work, several kinds of correction factors have been introduced in order to mitigate this bias through combining dates from a single site according to different criteria (Shennan et al., 2013; Balsera et al., 2015). While this approach can moderate this particular kind of error, it also can introduce other biases relating to the criteria used for combining