Quaternary International xxx (2017) 1–12

Contents lists available at ScienceDirect

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Palaeoecological implications of Neanderthal occupation at Unit Xb of El Salt (Alcoi, eastern Spain) during MIS 3 using small mammals proxy

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ARTICLE INFO

Article history:
Received 28 February 2017
Received in revised form
9 August 2017
Accepted 25 October 2017
Available online xxx

Keywords:
El Salt
Late Pleistocene
Middle Palaeolithic
Small mammals
Palaeoecology
Neanderthals

ABSTRACT

Nearly 250 small mammal remains from Unit Xb of El Salt Middle Palaeolithic site have been studied in order to reconstruct the palaeoecological conditions during a phase of Neanderthal occupation in this locality at 52.3 ± 4.6 ka. A total of 7rodents (*Microtus arvalis*, *M. agrestis*, *M.* (*Terricola*) *duodecimcostatus*, *Microtus* (*Iberomys*) *cabrerae*, *Arvicola sapidus*, *Eliomys quercinus* and *Apodemus sylvaticus*), 4 insectivores (*Erinaceus* cf. *europaeus*, *Crocidura* sp., *Sorex* sp. and Talpidae indet.) and 1 lagomorph (*Oryctolagus* cf. *cuniculus*) have been identified. Applying the Mutual Ecogeographic Range and Habitat Weighting methods, Unit Xb may correspond to a relatively cold (−3.3 °C in comparison with present values) and slightly more humid (+113.3 mm in comparison with present values) period. The environment was mainly composed of open woodlands (58%) followed by dry (20%) and humid (14%) meadows. These results suggest that supramediterranean conditions were present in the surroundings of the site at 52.3 ± 4.6 ka instead of mesomediterranean conditions present today.

1. Introduction

The Late Pleistocene (ca. 126–11.7 ka) is known to have been a period of time marked by numerous climatic, faunistic and cultural changes (Heinrich, 1988; Bond et al., 1997; Cacho et al., 1999; Sánchez-Goñi and d'Errico, 2005; Cuenca-Bescós et al., 2010). The climatic history of the Late Pleistocene has been inferred from a wide range of proxies: deep-sea and lake sediments, ice cores, glacial landforms, coral reefs, ancient groundwater, cave records, loess deposits, fossil pollen and relative sea-level reconstructions (Marshall, 2009 and references therein). Ice cores from Greenland and ocean sediment cores or benthic organisms proxies have revealed that the Late Pleistocene, and more concretely the Last Glacial (Marine Isotope Stages 4, 3 and 2) was characterized by millennial-scale climate oscillations of irregular periodicity (Cacho et al., 2006).

The Greenland ^{18}O-isotopic curve revealed large and abrupt oscillations (Dansgaard-Oeschger events; D-O events) during the last 123,000 years (Dansgaard et al., 1993), among which several cold phases called Heinrich Events (HE) had taken place (Heinrich, 1988). The HE events are characterized by a concentration of Iceberg Rafted Debris as a consequence of an influx of icebergs to the Iberian Atlantic Shores (Cacho et al., 1999; Sánchez-Goñi et al., 2000). Marine Isotope Stage 3 (MIS 3) (ca. 60–30 ka) was a period

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https://doi.org/10.1016/j.quaint.2017.10.024
1040-6182/

of maximum variability in forest population (Fletcher et al., 2010), being characterized by a dynamic alternating forest development and expansion of semi-arid areas in accordance with the warming and cooling, respectively, of the sea-surface temperatures (Fletcher and Sánchez-Goñi, 2008). Palaeoecological characterization of that period has been stimulated to know the context of the replacement of Neanderthals by the Anatomically Modern Humans (e.g. d'Errico and Sánchez-Goñi, 2003; Bar-Yosef et al., 2006; Mellars, 2006; Mallol et al., 2012).

Knowledge about the ecology of past environments is a prerequisite for understanding human dispersion and extinction (Finlayson et al., 2014). According to Holmes et al. (2010), "Although large-scale reconstructions using, for example, marine sediments provide a valuable environmental context for hominin evolution, they must be complemented by smaller-scale, site-specific environmental investigations from localities closer or where the hominin remains have found". In this sense, small mammals, which currently constitute around 80% of current and past mammal species richness (Fernández-Jalvo et al., 2016), are tightly linked to environmental variations and have precise ecological requirements (Delany, 1976; Stoddart, 1979), constitute a powerful tool for palaeoclimatic and palaeoenvironmental approaches in archaeological sites (Chaline, 1988; Cuenca-Bescós et al., 2009), especially in rapidly changing periods as the one studied here.

In this work, we carry out a revision and extension of the small mammal preliminary study done at the Unit Xb of El Salt (eastern of Iberian Peninsula) (Fagoaga et al., 2015; Fagoaga Moreno et al., 2015), focusing on the climatic and environmental characterization of a moment with recurrent Neanderthal occupation.

1.1. El Salt

The middle Palaeolithic site of El Salt is located in the municipality of Alcoi (Alicante), at 680 m above sea level and its 6.3 m-thick stratified deposit rests against a 38 m-high Palaeocene limestone wall, formed at a reverse fault and covered with tufa and travertine (Fig. 1a). Since 1986, El Salt has been studied systematically from an interdisciplinary perspective, focused on the first human settlement of this region (Galván et al., 2006; Machado et al., 2011; Sistiaga et al., 2011; Mallol et al., 2013; Garralda et al., 2014; Sistiaga et al., 2014; Rodríguez-Cintas and Cabanes, 2015; Machado and Pérez, 2016; Molina, 2016; Vidal-Matutano, 2016; Pérez et al., 2017). The stratigraphic sequence was divided into 13 lithostratigraphic units (XIII-I) by Fumanal (1994), and can be grouped into five different segments according to their macroscopic textural appearance and archaeological content (Galván et al., 2014a) (Fig. 1b). From the bottom to the top, Unit XIII consists on a subhorizontal travertine platform archaeologically sterile. On the contrary, horizontally bedded fine sand from the Units XII to IX contains the highest concentration of archaeological remains and combustion features (Fig. 1c). From the Unit VIII to the middle of Unit V it can be seen a more spatially reduced evidence of human input and its progressive decreasing (Galván et al., 2014b).

At the base of Unit V, a maxilla with six teeth of possibly a Neanderthal juvenile or young adult was recovered (Garralda et al., 2014). According to Galván et al. (2014b), "These specimens could represent an individual from one of the last Neanderthal groups that occupied the site and perhaps the region". The upper part of Unit V is archaeologically sterile although two small flint blades, a few undifferentiated debitage flakes and a small combustion feature were recovered at the top of the unit (Garralda et al., 2014). Holocene Units IV to I consist on different levels of gravels in second position and separated by erosive contacts, containing Neolithic pottery and late Upper Palaeolithic, Epipalaeolithic and Mesolithic lithic remains (Fig. 1b) (Galván et al., 2014a).

The small mammal remains analyzed in this study belong to the lower part of the stratigraphic unit X (Xb) dated by thermoluminescence methods at 52.3 ± 4.6 ka (Galván et al., 2014b) (Fig. 1b–c). It consists of horizontally bedded dark brown fine sand containing a high presence of combustion features (Sistiaga et al., 2011; Mallol et al., 2013), reaching a total of 61 in the whole unit X (Galvan et al., 2014a,b). These hearths are placed near the travertine wall and present abundant faunal remains, flint flakes and anthropogenically modified cobbles, forming a dense palimpsest of recurrent human occupations (Fig. 1b). Lithic remains come from siliceous raw materials acquired within a 25 km distance-radius, being Serreta silex the most used in the site gathered from blocks released by erosion of older sediments (Galván et al., 2014b). Among the large mammals, spanish ibex (*Capra pyrenaica*), red deer (*Cervus elaphus*) and wild horse (*Equus ferus*/*hydruntinus*) are the most abundant, and exhibit a high quantity of anthropogenic alterations such as cut-marks, percussion-marks, thermal alteration, etc. Other taxa with this kind of alterations, although less abundant, are aurochs (*Boss primigenius*), wild boar (*Sus scrofa*) and Mediterranean tortoise (*Testudo hermanni*). Other faunal remains without evidence of human manipulation have been recovered, as those belonging to Rhinocerotidae, *Panthera pardus*, *Cuon* sp. and *Lynx* sp. (Sanchis et al., 2015; Pérez et al., 2017).

A scarce exploitation of the European rabbit (*Oryctolagus cuniculus* Linnaeus, 1758) has been documented in this locality, being these remains mainly deposited by bird raptors and small carnivores (Galván et al., 2014b; Pérez et al., 2015). A preliminary study of small mammals from Unit Xb have documented a faunal list comprising the species *Microtus arvalis*, *M. Terricola duodecimcostatus*, *M. cabrerae*, *Arvicola sapidus*, *Eliomys quercinus, Apodemus sylvaticus*, *Erinaceus europaeus, Crocidura* sp., *Sorex* sp., Talpidae indet and *Oryctolagus* cf. *cuniculus* (Fagoaga et al., 2015, Fagoaga Moreno et al., 2015).

2. Material, methods and abbreviations

The small-mammal fossil remains studied in this work consist of isolated dental fragments collected in 2013 excavation campaign at El Salt. The dental remains came from an occupation surface detected during the excavation. The fossils were processed, sorted and classified using a Leica MS5 binocular microscope. Measurements were taken on a Leica MZ75 binocular microscope, by means of displacement of a mechanical stage, connected to a Sony Magnescale measuring equipment. Photographs were taken with a scanning electron microscope at Central Support Facility for Experimental Research (SCSIE) of the Universitat de València.

Fossils were identified following the anatomical nomenclature and measure methods given by van der Meulen (1973), Rabeder (1981) and Jeannet (2000) for arvicolines, van der Weerd (1976) for murids, Daams (1981) for glirids, Reumer (1984) for soricids and finally Furió (2007) for erinaceids. The taxonomic classification follows the one given by Wilson and Reeder (2005). Within arvicolines, subgeneric classification follows Jaarola et al. (2004).

In order to identify the predator responsible of the accumulation and allowing palaeoecological interpretations of the fossil assemblage (Andrews, 1983, 1990; Andrews and Evans, 1983; Fernandez-Jalvo and Andrews, 1992), a preliminary taphonomical study has been undertaken. Based in the descriptive-systematic method developed by Andrews (1990), Fernández-Jalvo and Andrews (1992), and Fernández-Jalvo et al. (2016), digestion has been analyzed for teeth (molars and incisors) and femurs. Following Andrews (1990) and Fernández-Jalvo et al. (2016), lagomorphs and glirids have been excluded from this analysis.

Abundance of each species was estimated through using the minimum number of individuals (MNI). This index was calculated

Please cite this article in press as: Fagoaga, A., et al., Palaeoecological implications of Neanderthal occupation at Unit Xb of El Salt (Alcoi, eastern Spain) during MIS 3 using small mammals proxy, Quaternary International (2017), https://doi.org/10.1016/j.quaint.2017.10.024