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Manzanares Valley (Madrid, Spain): A good country for Proboscideans and Neanderthals

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ABSTRACT

This paper presents the findings from four sites with proboscidean remains associated with Middle Palaeolithic stone tools from the Manzanares Valley Complex Terrace of Butarque (CTB), which has been dated to between the final Middle Pleistocene (MIS 6, 190–130 ka) and the early Late Pleistocene (MIS 5, 130-74-71 ka). We review the direct and indirect evidence of proboscidean exploitation in the Middle Paleolithic sites of Europe, and provide information on Lower Paleolithic European sites with proboscidean remains and stone tools. Geological, chronological, bio-stratigraphic and climatic data of the CTB are provided, and the sites with proboscidean remains and Middle Palaeolithic stone tools are described in detail.

Systematic exploitation of large mammals during the Middle Palaeolithic, and even their regular hunting, is widely accepted. However, the exploitation of proboscideans is not as evident in the archaeological record of this period. The exploitation of proboscideans cannot be considered as merely occasional before the Upper Palaeolithic, and although there is more evidence of the exploitation of these mega-herbivores during the Lower than during the Middle Palaeolithic, the discoveries from the Manzanares Valley state that, at least in this area, proboscideans continued to play an important role with regards to the exploitation of the environmental resources.

1. Introduction

Since the 18th Century, when elephant remains were first discovered along the River Manzanares as it passed through Madrid, recurrent discoveries of proboscideans have been found within the Pleistocene deposits of the river. Early identification of lithic tools and elephant bones were made at Cerro de San Isidro (Verneuil and Lartet, 1863; Prado, 1864), making this site one of the first in Europe where evidence of lithic industry was found in association with the remains of extinct fauna. Since then, several tens of sites containing remains of proboscideans have been found in the Manzanares Valley (Sesé and Soto, 2002).

Elephants modify their own ecosystems to such extent that many palaeoecologists consider them to be keystone (Owen-Smith, 1987, 1988, 1999; Robinson et al., 2003; Haynes, 2012). Groups of hunter-gatherers would have greatly benefited from observing elephant behaviour. It has even been suggested that elephants could have facilitated the exploitation of resources and the dispersal of human groups during the Pleistocene (Haynes, 2001, 2006). Furthermore, their disappearance has been interpreted as the direct cause of technological changes in the elaboration of lithic tools (Ben-Dor et al., 2011). Elephant movements are greatly influenced by the availability and dispersal of water (Stokke and Du Toit, 2002; Shannon et al., 2009). The most frequently visited ecosystems are riversides, where they can find not only water but also a variety of vegetation (Shannon et al., 2006). This is especially true for the cows, which are more restricted by the social and nutritional demands of the group (Duffy et al., 2011). Elephants know the location of water, mineral and plant resources, as well as

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gathering places, thanks to their complex mental maps (Douglas-Hamilton, 1972; Moss, 1982; Sukumar, 1989). These also provide them with easily traceable travel routes, which are followed by other mammals in their search for water during periods of drought, by carnivores in search of vulnerable prey and by human groups looking for the same resources. Additionally, by looking at their excrement, these human groups can infer relevant information such as their size, age, speed and health status (Haynes, 2006). Moreover, these routes connect strategic landmarks and are repeatedly used on a seasonal basis, as it has been suggested by the discovery of mammoth tracks through 60 cm of the Aeolian sediments in a paleovalley in Alberta, Canada. AMS obtained dates show that herds of mammoths followed the same trails for at least 200 years (McNeil et al., 2005).

Riverside ecosystems form authentic ecological corridors that connect different ecosystems and facilitate the movement of several vertebrate species (Forman, 1995). This becomes obvious towards the final reach of the River Manzanares Valley, where the river runs through a gypsum area whose saline substrate restricts the development of animal and plant species. Such an ecosystem contrasts with the highly varied biodiversity that can be observed at the riverbanks of the River Manzanares. This would have been even greater during the Pleistocene, when the landscape had not yet been changed by humans. This biodiversity could be one of the reasons why the area was regularly visited by elephants and hominins throughout the Pleistocene, as tens of proboscidean bone remains and Palaeolithical sites recorded throughout the river terraces have revealed (Panera and Rubio-Jara, 2002; Rubio-Jara, 2011).

The association between lithic tools and proboscidean remains has been a recurrent topic within Palaeolithic research (Villa, 1990; Haynes, 1991; Martos, 1998; Gaudzinski et al., 2005; Mussi, 2005; Villa et al., 2005). Some authors have argued that it is not clear whether this association is the result of a particular relationship between humans and elephants, the result of a bias in preservation due to the size of these mega-herbivore remains, or that perhaps this relationship did not become well established until the Upper Palaeolithic (Frison and Todd, 1986; Frison, 1989; Fosse, 1998; Gaudzinski et al., 2005; Surovell and Waguespack, 2008). This view is currently under scrutiny, firstly due to the discovery of new sites and secondly because new analysis is being carried out on already known sites. This new data has increased the number of instances of the exploitation of proboscidean by humans during the Lower and Middle Palaeolithic (Mussi and Villa, 2008; Yravedra et al., 2010, 2012; Ben-Dor et al., 2011; Slimak et al., 2011; Germonpré et al., 2012; Rabinovich et al., 2012; Saccà, 2012; Smith, 2012).

A significant number of Lower Palaeolithic sites containing lithic industry and elephant remains have been found in the Manzanares Valley (Meléndez and Aguirre, 1958; Santonja et al., 1980; Baena Preysler et al., 2010). To the end of the Middle Pleistocene (MIS 6, 190–130 ka) and the early Late Pleistocene (MIS 5, 130-74 ka), the remains of proboscideans and lithic industry found in the Complex Terrace of Butarque (CTB), in some cases with cut and percussion marks or green-bone fractures (Rus and Vega Toscano, 1984; Manzano et al., 2010; Yravedra et al., 2012), show that elephants were consistently exploided as a resource during the Middle Palaeolithic. This paper highlights that during this period, the final reach of the River Manzanares Valley made up a network of different ecosystems, within which there was more than just an occasional relationship between Neanderthals and proboscideans.

2. Neanderthal–Proboscidean relationship

There is evidence from a number of Middle Palaeolithic sites that may suggest the hunting of proboscideans. The remains of twenty individuals of *Mammuthus primigenius* and several of *Coelodonta antiquitatis* from MIS 6 have been recorded at La Cotte de St Brelade, Jersey, Channel Islands. According to Scott (1980: 146), the animals, herded by a human group, were thrown over a granite promontory rock. At Lehringen, Germany, dated to the Eemian, a 281 cm by 2.5 cm spear was found in association with the remains of a 45 year-old elephant and 27 flakes, some of them Levallois, a number of which had been refitted (Movius, 1950; Adam, 1951; Tode, 1954; Thieme and Veil, 1985). However, the lack of photographic and drawing records has hindered the widespread acceptance of this theory (Gamble, 1999). Nevertheless, it has been pointed out that traditional hunting of African elephants was mainly carried out with spears (Hobley, 1903; Trilles, 1932; Janmart, 1952; Bahuchet, 1987, cited in; Germonpré et al., 2012), and several 400 ka wooden spears found at Schöningen, Germany have been interpreted as unequivocal hunting tools which were used to hunt horses (Thieme, 2005). At the cave of Spy, Belgium, several cranial elements of short-aged *M. primigenius* were found in two main levels from MIS 3, 43 and 36 ka respectively. Having ruled out that these remains were the result of carnivore activity, Germonpré et al. (2012) suggest that the presence of newborn mammoths indicate selective hunting of young individuals by hominins, which would have occurred during the cold season. The skeletal remains of a c. 32–35 year-old female *M. primigenius* (Reggiani and Sala, 1992; Reggiani, 2005), found at Pagnano d'Asolo, Northeastern Italy, at the end of the 19th century and dated to MIS 4 or 3 (Venzo, 1977; Mussi and Villa, 2008) showed no evidence of either human-made fractures or true cut marks. Apart from these remains, one non-retouched Levallois flake, one proximal flake fragment and three non-retouched Levallois points were found. One of these points showed an impact fracture at the tip, which has been interpreted as possible damage due to use as a spearhead, perhaps for killing the mammoth (Mussi and Villa, 2008). Villa and Lenoir (2009: 71) have pointed out the shortage of detailed studies about pointed forms (Mousterian points, elongated Mousterian points, convergent and *déjeté* scrapers) in Western Europe, which together with microwear analyses could add some relevant reasoning to this mega-herbivores hunting-scavenging debate. At Molodova I, Ukraine, in a Mousterian layer dated to MIS 3 containing 40,000 lithics and a minimum number of 15 mammoths, one projectile impact and a second possible one were observed in two mammoth ribs (Demay et al., 2012: 219). Finally in Santo Antao do Tojal, Portugal, two small flint flakes were located embedded in a femur fragment of *Elephas (Palaeoloxodon) antiquus* (Zbyszewski, 1943), although given the fluvial context of the site, they could well have been found in such a position due to post-depositional sedimentary processes (Sousa and Figueiredo, 2001).

Cut marks on mammoth bones have been described at La Cotte de St Brelade, at the proximal base of tusks, where the tusk meets the bone sheath of the skull (Scott, 1980, 1986); at Byzovaya, Russia, associated with lithic industry, dated to 28,500 BP (Slimak et al., 2011); one cut mark on an *E. (Palaeoloxodon) antiquus* bone was recorded from level XII of the Bolomor cave, Spain, and dated to 253 ka (Blasco and Fernández Peris, 2012, Table 5); at Molodova I, and at Kulna Cave, Czech Republic. These last two sites present a number of problems. At Molodova I, striations due to cutting processes have been recorded on three zygomatic bones, one cervical vertebra, nineteen rib body fragments (on both sides), three innominates, one femur, six long bone epiphyses and diaphysis and four indeterminate bones (Demay et al., 2012). If these striations were human-made, Molodova I would show a higher concentration of marks than all the other European Pleistocene sites put together. Thus, at least some of these marks could have been produced during excavation, as suggested by Nowell and d'Errico (2007). The cut marks depicted in Figure 12f of Demay et al. (2012: 223) are

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quite shallow, so despite being parallel they may be due to trampling. The marks shown on 12e are quite similar to those shown by Nowell and d'Errico (2007) to be the result of excavation tools, and 12d is slightly open and wide, so care should be taken in ascertaining its origin. In Kulna cave, level 11 contained a microlithic assemblage from MIS 5 and the beginning of MIS 4, as well as the remains of *M. primigenius* (Moncel, 2001). According to Valoch (1988), a number of the mammoth bones show human-made cut marks, although these are currently being reviewed (Neruda, 2010).

Indirect evidence was also found at Gröbern, Germany, a site dated to MIS 5a. The almost complete skeleton of a 35–40 year-old *E. (Palaeoloxodon) antiquus* was found associated with 26 non-retouched flakes, mostly large (Mania et al., 1990), 9 of which showed use-wear traces, which suggest meat processing (Weber, 2000). At Spy and Saint-Césaire, France, stable isotope analyses carried out on Neanderthal remains have shown that consumption of extremely large herbivores such as mammoth and woolly rhinoceros played an important part in their diet (Bocherens, 2011).

Other sites have uncovered lithic tools and proboscidean remains with no evidence of human intervention. On the one hand, cut marks are rarely produced when defleshing or disarticulating elephants (Crader, 1983; Haynes and Krasinski, 2010). On the other hand, the association of lithic industry and proboscidean remains found in natural deposits with other large mammals could be accidental (Domínguez-Rodrigo, 2008). At Lynford, England, on the boundary between MIS 4/3, 11 individuals of *M. primigenius* (MNI), and artefacts of Mousterian of Acheulean Tradition have been interpreted as evidence of Neanderthal hunting and butchery (Schreve, 2006). However, the absence of cut or percussion marks on the mammoth remains, and the fact that they accumulated over a long period of time, by natural causes according to Smith (2012), and otherwise according to Brothwell and Schrve (2012), has limited the role of hominines to just occasional exploitation, although these authors do not rule out the possibility that the animals could have been hunted. An 18–20 year-old female individual of *E. (Paleoloxodon) antiquus* was found within the Middle–Final Pleistocene deposits at Cava Campitello, Italy, as well as three flakes with remains of resin, which has been interpreted as hafting adhesive (Martini and Maza in Mussi, 2005: 413–414). Remains of six species of larger mammals including mammoth and 37 lithic artefacts probably dating to the MIS 6 were found at Ariendorf 2, Germany (Turner, 1997).

Finally, only a few Middle Palaeolithic sites show evidence of the intentional use of mammoth bones as raw-material. At the MIS 3 open-air site Salzgitter-Lebenstedt, Germany, 161 rib fragments, measuring from 10 cm to more than 1 m in length, from a minimum of 17 individuals of *M. primigenius*, were found. Twenty of these remains reveal human-made activities such as distal ends intentionally pointed and/or flattened (Gaudzinski, 1999). At Molodova I, in Layer 4, there are 5 areas, one of which is a circular structure constructed from specially selected mammoth bones (long and flat bones, tusks, connected vertebrae) measuring 5 by 8 m internally and 7 by 10 m externally (Chernysh, 1982; Demay et al., 2012). Tools and hearths were recorded at the centre of the structure, which has been variously interpreted as a dwelling, a hunting blind, natural accumulation, a symbolic structure, garbage around the settlement, or a wind break (Binford, 1983; Chernysh, 1989; Stringer and Gamble, 1993; Klein, 1999; Kolen, 1999; Hoffecker, 2002; Svoboda et al., 2005). Recently, Demay et al. (2012) suggested that this is a domestic structure, with a cooking activity area and flint workshops inside, and that Layer 4 of Molodova I could be a recurrent camp for numerous people. Other Neanderthal structures made of mammoth bones have been described as dwellings in Ripiceni-Izvor, Romania (Paunescu, 1992). However this site was excavated before the development of taphonomy and site formation process analysis. Additionally, at Molodova I Layer 4 the symbolic use of mammoth bones has been suggested as some examples were covered by ochre (Chernysh, 1982), and others show a series of parallel striations not characteristic of butchery activities. These marks have been identified as damage produced during the excavation process (Nowell and d'Errico, 2007).

3. Geological setting of the Complex Terrace of Butarque (CTB) in the River Manzanares

The area of study is a fluvial terrace located on the lower segment of the River Manzanares, to the southeast of Madrid, Spain (Fig. 1A, B). Geologically, this valley section lies in the continental tertiary basin of Madrid, in the area of transition between intermediate detritic facies (gravels and sands) and central facies (marls to evaporite-gypsum). This fluvial system is affected by synsedimentary subsidence due to the karstic dissolution of the gypsum in the substrate, a well-known process in the large tertiary continental basins in Spain, such as the Ebro basin (Benito et al., 1998, 2000), and the nearby valley of the River Jarama, where Pérez-González (1971) described these sinking phenomena due to adaptation or collapse for the first time (Portero and Pérez-González, 1990; Pérez-González and Uribelarrea del Val, 2002). The main anomalous morphostratigraphical features that produce this type of subsidence include great thickening of fluvial deposits and superposition of the deposits correlative to different terrace levels, which can reach over 40 m (Pérez-González, 1971; Pérez-González et al., 2008).

Thus, upstream from the city of Madrid laid over siliciclastic bedrock, twelve levels of stepped alluvial terraces have been identified (+8 m, +10 m, +12–15 m, +18–20 m, +25–30 m, +35–40 m, +44–46 m, +52–54 m, +60 m, +68–72 m, +80–85 and 95 m), with a maximum thickness of 6–7 m (Pérez-González, 1994). Downstream, the terraces formed over evaporitic rocks +25–30 m, +18–20 m and +12–15 m, are overlapped and affected by the synsedimentary subsidence resulting in a huge thickness increase of tens of meters. These terraces constitute the so-called Terrace Complex of Butarque (CTB) (Goy et al., 1989). Silva (2003) names this as the Manzanares Complex Terrace (TCMZ). On this terrace, a large number of paleontological and archaeological sites have been excavated since the mid-20th century (Panera and Rubio-Jara, 2002). Some of these were buried under overbank facies composed of silty-clay, which are very common in these sedimentary environments.

The CTB sedimentation models have been addressed by Carrillo et al. (1978) and Arche (1983) at PRERESA, an open quarry front, 14 m in depth, where they have established up to five fluvial cycles, starting with deposits of gravel and channel sand, and ending with mud-floodplain facies, characteristic of meandering rivers. A minimum of five cycles have been acknowledged, although the final number may vary along the terraces due to autocyclic or allocyclic mechanisms. Up to six fining-upward cycles have been described on the left bank of the lower course of the River Manzanares, most of which contain Pleistocene faunal remains and lithic industry (Gaibar Puertas, 1974). At Los Estragales, the CTB is composed of two alluvial sequences that can reach up to 35 m in thickness, and are divided by substantial hiatus representing thousands of years (Pérez-González et al., 2008). The oldest sequence, which includes Middle Palaeolithic sites, consists of up to 8 m of mud featuring, to the top, a Ck nodular horizon over 1 m thick wherever it has not been eroded by channels of flint gravels and tertiary carbonates; the earlier sequence, overlying the first one, consists of several fining-upwards sequences (Pérez-González et al., 2008).

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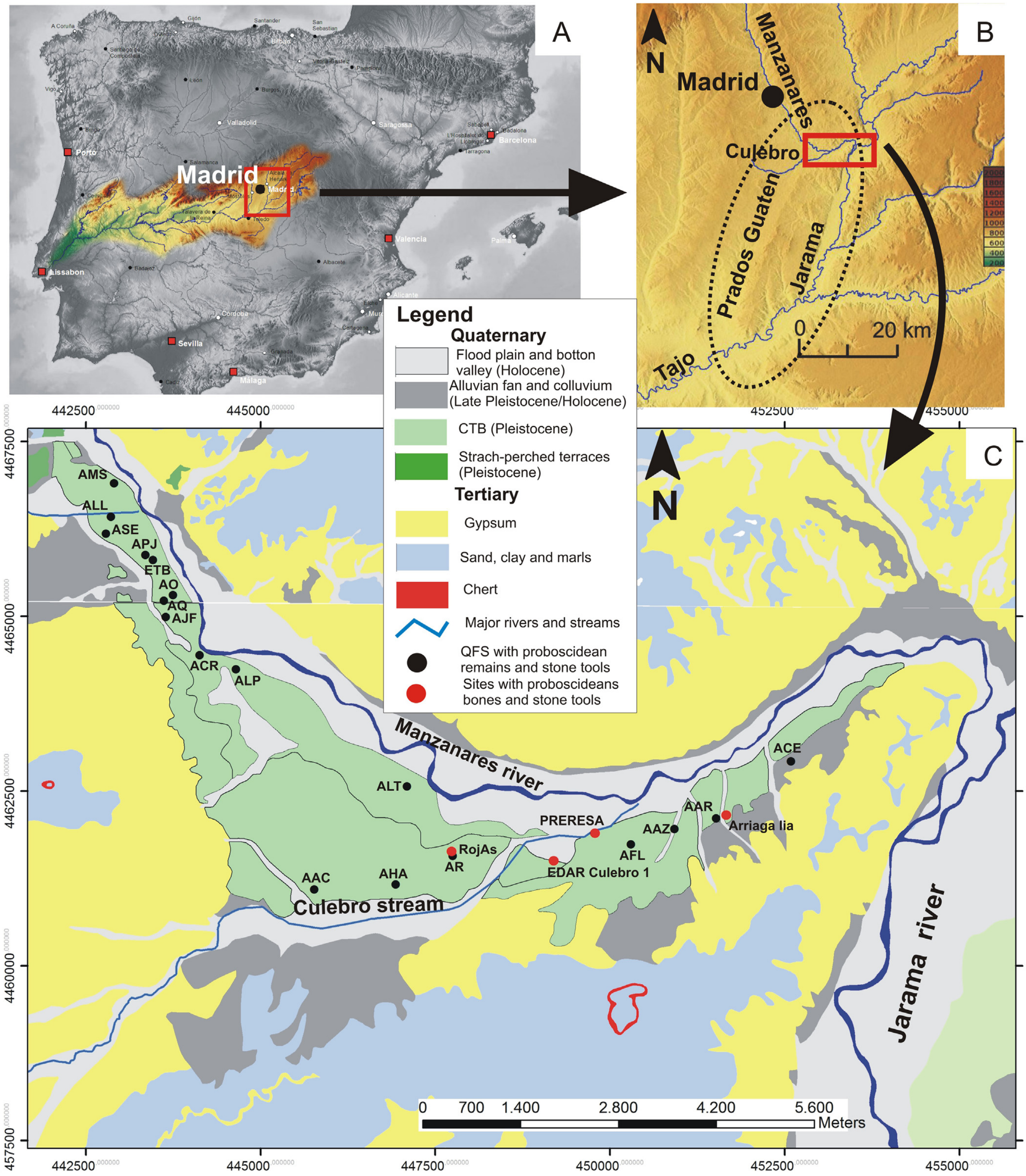

Fig. 1. A. Location of the Tajo basin, Iberian Peninsula. B. Relief of the Manzanares Valley, Jarama Valley and Prados-Guaten Depression (generated from the DEM SRTM-3, source: NASA). C. Geological sketch of the River Manzanares Valley around Madrid city and position of the sites with proboscidean remains in the Complex Terrace of Butarque (CTB). Location of quarry fluvial sands at the CTB with proboscideans remains and lithic industry, and archaeological sites (based on the map, published by Gamazo, 1982: 10–11). Abbreviations: QFS, quarry fluvial sands; AMS, Arenero de Manuel Soto; ALL, Arenero de Los Llanos; ASE, Arenero de Santa Elena; APJ, Arenero de Pedro Jaro; ETB: Estanque de Tormentas de Butarque; AO: Arenero de Oxígeno; AQ: Arenero del Quemadero; AJF: Arenero de Jesús Fernández; ACR: Arenero de Constantino del Río; ALP: Arenero de Los Pinos; ALT: Arenero de La Torrecilla; ACC: Arenero del arroyo Culebro; AHA: Arenero de Los Hijos de Aguado (o de Ramón Soto); AR: Arenero de Rojas; AFL: Arenero Fábrica de los Ladrillos; AAZ: Arenero de Arcaraz; AAR: Arenero de Arriaga; ACE: Arenero de Casa Eulogio.

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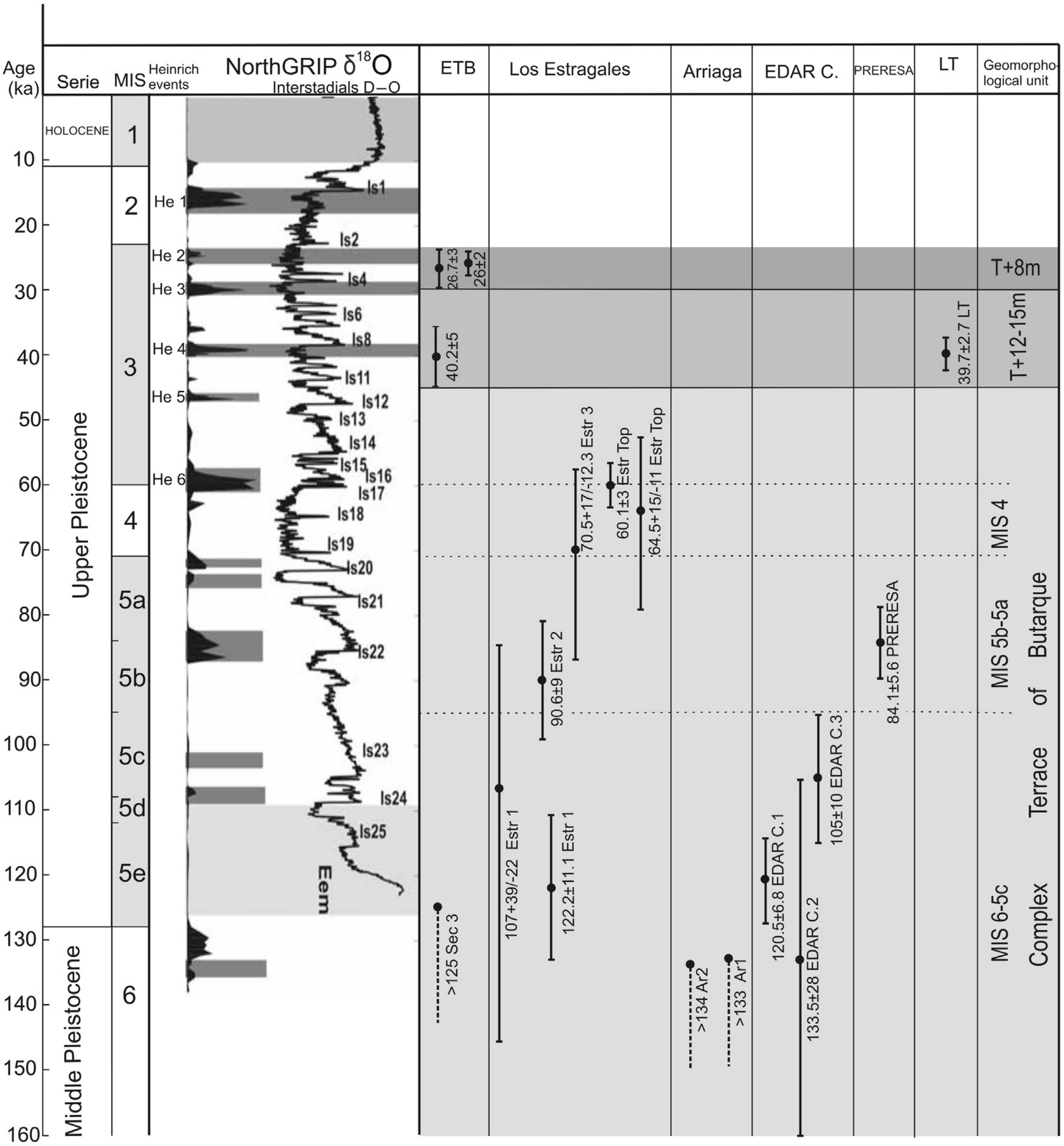

Fig. 2. Groenlandia ice curve NorthGRIP ($\delta^{18}O$) and TL, OSL and Amino Acid Racemization BP (×1000) chronologies from palaeolithic sites and alluvial deposits of the Manzanares Valley Complex Terrace of Butarque: ETB, Estanque de Tormentas de Butarque (Domínguez Alonso et al., 2007, 2009); Los Estragales (Pérez-González et al., 2008); Arriaga (Silva et al., 2012b); EDAR Culebro (Manzano et al., 2010; Silva et al., 2012a); LT, La Torrecilla (Pérez-González et al., 2008).

4. CTB numerical time frame

The availability of luminescence-based numerical dates, taken from four sites spread along the CTB, suggests that the visible extent of this deposit spans from MIS 6 to MIS 4 (Fig. 2). Two sites with remains of *E. (Paleoloxodon) antiquus* and Middle Palaeolithic industry fit into MIS 6. At the lower sequence of Estanque de Tormentas de Butarque, an assemblage of nearly 3000 pieces of lithic industry was discovered (Rubio-Jara, 2011) as well as a proboscidean tusk dated to final Middle Pleistocene according to micromammals (C. Laplana pers. comm). At Arriaga, remains of *E. (Paleoloxodon) antiquus* as well as lithic industry of the Middle Palaeolithic (Rus and Vega Toscano, 1984) have provided minimum TL dates of 133 ka and 134 ka respectively (Silva et al., 2012b). The species represented within the micromammal assemblage and especially the evolved stage of *Microtus brecciensis* and *Arvicola* aff. *sapidus* point to a date within the end of the Middle Pleistocene (Sesé and López Martínez, 2013).

With regard to the early MIS 5, a series of numerical dates associated with sites containing Middle Palaeolithic lithic industry and the remains of mammoth in one case, fit into this period. The top of the lower alluvial sequence of Los Estragales, which has been eroded by channels filled with flint gravels, tertiary carbonates and plentiful lithic industry (Rubio-Jara, 2011), provides two dates that overlie each other within MIS 5e, 107 + 39/−22 ka and 122.1 ± 11.1 ka (Pérez-González et al., 2008). At EDAR Culebro 1, where the remains of *Mammuthus* cf. *intermedius* as well as lithic

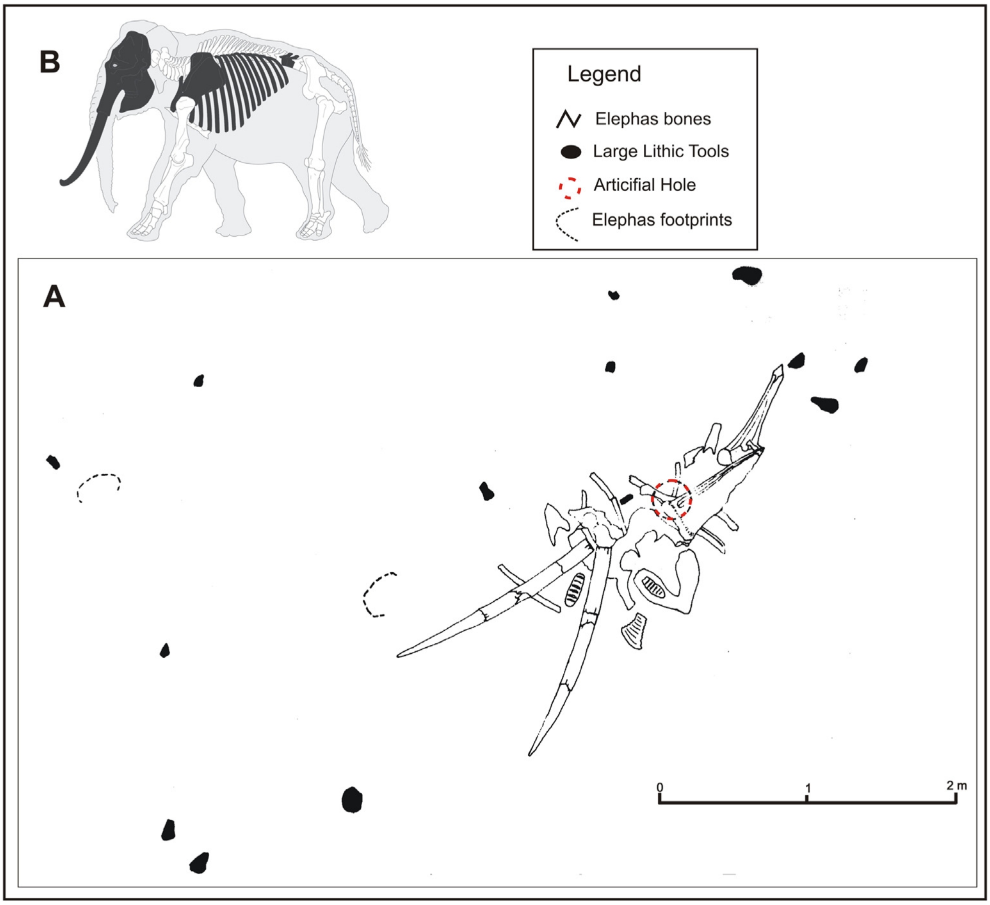

Fig. 3. A. Arriaga IIa spatial dispersion of *Elephas (Paleoloxodon) antiquus* remains and lithic industry (Based on Rus and Vega Toscano, 1984). B. Anatomic representation of the elephant remains uncovered at Arriaga IIa.

industry have been recorded, an OSL date of 120.541 ± 6.851 ka has been obtained (Manzano et al., 2010; Silva et al., 2012a). Additionally, Amino-Acid Racemization (AAR) techniques carried out on an *Equus* sp. molar have provided dates of 133 ± 28 and 105 ± 10 ka BP (Silva et al., 2012b).

The middle parts of the CTB outcrops fit chronologically between the MIS 5c and 5a. The site of PRERESA, where proboscidean remains have been found alongside lithic industry (Rubio-Jara, 2011; Yravedra et al., 2012), has been dated to 84,126 ± 5633 ka by OSL (LDR). This date is consistent with the micromammals recorded from the site: the presence of *Microtus cabrerae* (descendant of the Middle Pleistocene *M. brecciensis)* and the evolved stage of this species as well as of *Arvicola* aff. *sapidus* suggests a Late Pleistocene date (Sesé and Sevilla, 1996; Sesé et al., 2011). At Arriaga, a TL date of 96 + 21/−13 ka was obtained from the top of the preserved fluvial deposits (Silva et al., 2012b). At Los Estragales, a lacustrine deposit containing over 11,000 lithic pieces, which have provided a TL date of 90.6 ± 9.1 ka, was found within the hiatus recorded between the two alluvial sequences (Pérez-González et al., 2008).

At Los Estragales, the non-eroded tops of the CTB have been dated to the MIS 4 with two TL dates of 64.5 + 15.2/11.3 ka and 60.1 ± 3.4 ka (Pérez-González et al., 2008). The +12–15 m is a fill-in terrace over the CTB. Some preserved deposits have been dated to the mid MIS 3 at La Torrecilla and Estanque de Tormentas de Butarque (Domínguez Alonso et al., 2007, 2009; Pérez-González et al., 2008).

5. CTB sites with proboscidean remains

Several sand quarries have been established in the fluvial deposits that form the CTB since the middle of the 20th century, boosting the discovery of many lithic and faunal assemblages (Fig. 1C). Only the upper 10 or 12 m of the total 35 m that can be reached by the CTB are exploited in these sand quarries. According to the available numerical dates, this would affect the Middle Pleistocene and Early Late Pleistocene (MIS 5-MIS 4) deposits. Table 1 shows the sand quarries of the CTB where remains of proboscideans have been recorded, as well as the quantity of lithic pieces retrieved from each site (Cacho and Martos, 2002; Gamazo, 2002; Sesé and Soto, 2002). The faunal associations found have been biostratigraphically assigned to the Middle and Late Pleistocene. Middle Pleistocene associations feature *E. (Paleoloxodon) antiquus*, *Bos primigenius* and *Dicerorhinus hemitoechus* (Sesé and Soto, 2002b) and Late Pleistocene deposits include *Megaceros* cf. *giganteus*, *Mammuthus* cf. *intermedius* and *Coelodonta antiquitatis* (Sesé and Soto, 2002b). In most sand quarries where proboscidean remains have been found, the faunal assemblage has been assigned to the Middle Pleistocene. However, this does not necessarily mean that the whole of the lithic industry found in the sand quarry fits within this period, as worked lithic pieces might come from different stratigraphic levels and could equally belong to the Final Middle Pleistocene or to the Early Late Pleistocene. This would explain the fact that faunal ensembles of the Final Middle Pleistocene and the Early Late have been found together in the same sand quarry.

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Table 1
Quarry fluvial sands at the CTB with proboscideans remains and quantities of lithic pieces recovered from the sand deposits. Taxa abbreviations: Cai.: Carnivora indet.; Pi.:Proboscidea indet.; cfE(P)a.: cf. *Elephas (Palaeoloxodon) antiquus*; E(P)a.: *Elephas (Palaeoloxodon) antiqus*; Mcfi: *Mammuthus* cf. *intermedius*; Mcft: *Mammuthus trogontherii*; Mcfp.: *Mammuthus* cf. *primigenius*; Mp.: *Mammuthus primigenius*; Msp.: *Mammuthus* sp.; Ei: Elephantidae indet.; Dh.: *Dicerorhinus hemitoechus*; Ca.: *Coelodonta antiquitatis*; Ri.: Rhinocerotidae indet.; Ec.: *Equus caballus*; Ecfh.: *Equus* cf. *hydruntinus*; Esp.: *Equus* sp.; Ssp: *Sus* sp; Ss: *Sus scropha*; Csp.: *Cervus* sp.; Ce.: *Cervus elaphus*; Dsp: *Dama* sp.; Mcfg.: *Megaceros* cf. *giganteus;* Ci.: Cervidae indet.; cfBp.: cf. *Bos primigenius*; Bp: *Bos primigenius*; B/B: *Bos/Bison*; Bicf.: Bovidae indet. cf.

Quarry fluvial sands	Taxa	Biochronology	Lithic industry	Source
Arenero de Manuel Soto	cfE(P)a.; Ri.; Ec.; Csp.; Dsp.; Bicf.B/B.; Cai.	Middle Pleistocene	Several pieces	Sesé and Soto, 2002; Gamazo, 1982; Baena Preysler et al., 2002; Cobo et al., 1979; Gamazo and Cobo, 1983
Arenero de Los Llanos	E(P)a.; Ec.; Ci.; cfBp.	Middle Pleistocene	1429 pieces	Sesé and Soto, 2002; Gamazo, 1982; Priego et al., 1979; Gamazo, 2002
Arenero de Santa Elena	E(P)a.; Ri.; Ec.; Ci.; Bicf.B/B.	Middle Pleistocene	4921 pieces	Sesé and Soto, 2002; Gamazo, 1982; Santonja and Querol, 1980; Gamazo, 2002; Cacho and Martos, 2002
Arenero de Pedro Jaro	E(P)a.; Ri.; Ec.; Ci.; Bicf.B/B.	Middle Pleistocene	187 pieces	Sesé and Soto, 2002; Priego et al., 1979; Gamazo, 1982; Gamazo, 2002
Estanque de Tormentas de Butarque	Mp./E(P)a.; Dh.; Ec.; Ecfh.; Ss.; Ce.; Bp; B/B	Later Middle Pleistocene	2302 pieces	Álvarez-Lao and García, 2010, 2011; 2012; Ros-Montoya, 2010; Laplana, personal communication; De los Arcos et al., 2008, 2010.
Arenero de Oxígeno	E(P)a.; Ec.; Ci.; Bicf.B/B.	Middle Pleistocene	10,416 pieces	Sesé and Soto, 2002; Gamazo, 1982; Rus and Querol, 1981; Gamazo, 2002; Cacho and Martos, 2002
Arenero del Quemadero	E(P)a.; Ec.; Ecfh Bicf.B/B.	Middle Pleistocene	3809 pieces	Sesé and Soto, 2002; Gamazo, 1982; Gamazo, 2002
Arenero de Jesús Fernández	Pi.; Ce.; Bp.	Uncertain	1555 pieces	Sesé and Soto, 2002; Gamazo, 1982; Priego et al., 1979; Gamazo, 2002
Arenero de Constantino del Río	Ei.; Ec.; Ssp	Uncertain	2731 pieces	Sesé and Soto, 2002; Gamazo, 1982; Gamazo, 2002
Arenero de Los Pinos	Ei.; Ri; Ec; Ecfh.; Ce.; Bicf.B/B.	Middle Pleistocene	5868 pieces	Sesé and Soto, 2002; Gamazo, 1982; Priego et al., 1979; Gamazo, 2002; Cacho and Martos, 2002
Arenero de La Torrecilla	Ei.; Ci.	Uncertain	1748 pieces	Sesé and Soto, 2002; Gamazo, 1982; Cobo et al., 1979; Gamazo and Cobo, 1983; Gamazo, 2002; Cacho and Martos, 2002
Arenero del arroyo Culebro	E(P)a.; Ei.; Ri; Ec; Ce.; Bi. Ca.; Mcfg.	Middle Pleistocene Late Pleistocene	863 pieces	Soto and Sesé, 1991; Sesé and Soto, 2000; Sesé and Soto, 2002; Gamazo, 1982; Álvarez-Lao and García, 2011b; Cobo et al., 1979; Gamazo, 2002
Arenero de Los Hijos de Aguado (o de Ramón Soto)	E(P)a.; Msp; Ec.	Middle Pleistocene	1318 pieces	Sesé and Soto, 2002; Cobo et al., 1979; Gamazo, 1982; Gamazo and Cobo, 1983; Gamazo, 2002
Arenero de Rojas	E(P)a.; Ec.; Ecfh.; Bicf.B/B. Mcfi	Middle Pleistocene Late Pleistocene	3004 pieces	Sesé and Soto, 2002; Gamazo, 1982; Gamazo, 2002
Arenero de La Fábrica de Ladrillos	E(P)a.; Dh.; Ec.; Ce.; Bp. Mcfi	Middle Pleistocene Late Pleistocene	1074 pieces	Sesé and Soto, 2002; Gamazo, 1982; Gamazo, 2002
Arenero de Arcaraz	E(P)a. Mcfi.; Ec.; Mcfg.	Middle Pleistocene Late Pleistocene	1424 pieces	Sesé and Soto, 2002; Cobo et al., 1979; Gamazo, 1982; Gamazo, 2002
Arenero de Arriaga	E(P)a.; Msp.; Dh.; Ec.; Ecfh.; Dsp.; Ce; Ci.; Bp Bicf.B/B.	Middle Pleistocene	3088 pieces	Soto at Rus, 1989; Sesé and Soto, 2002; Álvarez-Lao and García, 2012; Rus and Vega Toscano, 1984; Gamazo, 2002; Cacho and Martos, 2002
Arenero de casa Eulogio	Ei.; Mcft.; Esp.; Ci.; Bp.; Mcfp.; Ec.; Ce.	Middle Pleistocene	228 pieces	Sesé and Soto, 2002; Álvarez-Lao and García, 2010, 2012; Gamazo, 1982; Cobo et al., 1979; Gamazo, 2002; Cacho and Martos, 2002

6. CTB proboscidean remains with human intervention

The four sites with remains of proboscideans found in the CTB are located along 4 km of the final reach of the Manzanares Valley (Fig. 1C). Along this reach, which runs between the confluence with the Arroyo Culebro stream and its mouth at the River Jarama, the river deepens to about 100 m within the gypsum bedrock and forms a 2.5–1.5 km wide valley. The River Jarama and the Prados-Guatén Depression which connects with Arroyo Culebro, where remains of these mega-herbivores have also been found (Santonja et al., 1980), are also fluvial nets belonging to the right bank of one of the main rivers of the Iberian Peninsula, the River Tagus (Fig. 1B). This forms the final reach of the Manzanares Valley, a crossroads that could have been considered a special case of the concentrate resources model (Haggett et al., 1977; Butzer, 1982).

6.1. *Arriaga IIa*

The site is located to the top of the CTB, within a level of fine sand overlying marls and muds (Silva et al., 2012b, Fig. 4), which have been interpreted as the established surface of an old flood-plain (Rus and Vega Toscano, 1984). It has been dated to the end of the Middle Pleistocene, judging by the available numerical dates (see above) (Silva et al., 2012b) and the evolved stage of *Microtus brecciensis* and *Arvicola* aff. *sapidus* (Sesé and López Martínez, i.p.). These remains and dates were obtained from secure stratigraphic contexts, directly overlying and underlying the site.

The excavation covered an area of 56 m^2 (Fig. 3A) where 43 lithic pieces associated with the remains of an adult female individual of *E. (Paleoloxodon) antiquus* were recorded from within a sandy layer. All the remains discovered were grouped in a 7–8 m^2 area. The skull was upside-down; both tusks were preserved (Fig. 3B), as well as the lower jaw with M3, upper molars, right scapula, vertebrae and ribs (Rus and Vega Toscano, 1984; Santonja et al., 2001). Taphonomic study of the bone remains (which has been carried out by the author J.Y.) revealed just one contentious mark found on a proboscidean rib. This mark appears to have a V-section, but there are doubts about its nature due to its slightly wide and irregular shape, its small size, and its isolated position, which suggests that it could have been the result of trampling.

Semicircular features recorded at this site, with diameters below 17–22 cm, have been interpreted as elephant footprints (Silva et al., 2012b). A circular pit 25 cm in diameter and 50 cm in depth was located below the elephant remains, and this was interpreted as a human-made structure (Rus and Enamorado, 1991; Santonja et al., 2001), although more recently it has been suggested that it may be a hole made by elephants while trying to get water from the dry riverbed (Rus and Santonja, 2011).

A total of 43 lithic pieces surrounded the elephant remains. Their distribution suggests a possible activity surface of some 35 m^2. The lithic industry, composed of cores, bifaces, scrapers and flakes, was worked from local flint nodules, and is characterised by its low degree of elaboration, small amount of retouched pieces, and scarce levallois products (Rus and Vega Toscano, 1984). Most pieces were between 7 cm and 10 cm long (bifaces, scrapers, choppers and flint cores). They showed sharp edges and were extracted from the same nodule, which suggests that they were associated with the elephant (Rus and Enamorado, 1991). Smaller flint pieces displaying slight fluvial rolling, the same size as pebbles moved by the River Manzanares (3–4 cm), have been interpreted as being deposited by a stream that would have simultaneously moved pieces smaller than 3 cm. However no such small pieces were found (Rus and Vega Toscano, 1984). The 43 pieces- assemblage has not been the subject of a detailed publication. As regards to the available information, their association with the Acheulean industry cannot be ruled out, although they have been associated with the Upper Acheulean (Rus and Vega Toscano, 1984: 396) and it has been pointed out that they show the same characteristics as the assemblage of ~1000 pieces found in a sand level overlying Arriaga IIa, which was identified with an Early Middle Palaeolithic phase (Vega Toscano et al., 1999; Silva et al., 2012b).

The association of micromammals found at Arriaga: *Crocidura* sp., *Talpa* sp., *Eliomys quercinus*, *Apodemus* sp., *M. brecciensis*, *Microtus arvalis*, *Microtus duodecimcostatus*, *Arvicola* aff. *Sapidus*, and *Oryctolagus cuniculus*, suggests temperate weather conditions and an open landscape (80%), where very wet and wet meadows with plenty of bush vegetation would have predominated. Some less wet areas with bush vegetation would equally be important, and there would also be a substantial amount of forests (20%). All these characteristics: numerous wet areas and good development of vegetation, whether herbaceous, bush or forest, point not only to the wetness requirements linked to the proximity of a river, but also the presence of a moist environment which would favour it (Sesé and López Martínez, 2013).

6.2. *Arenero de Rojas Finca de la Aldehuela*

One skull with both tusks of *E. (Paleoloxodon) antiquus* were found in a sandy level, 4 m below the top of the CTB, which allows it to be chronologically located between MIS 6 and MIS 5, as well as 29 worked lithic pieces (S. Quero, personal communication), probably associated with elephant processing. The cortical surface of the elephant skull, which was studied by one of the authors (J. Y.), is too badly preserved to allow the identification of any anthropogenic marks.

The lithic assemblage found with the elephant, which has also been studied by two of the authors (S. R-J. and J. P.), is composed of 29 flint pieces, three cores, one chunk and 25 flakes. The edges of five of those flakes, measuring between 23 and 36 mm length, have been altered due to fluvial rolling, whereas the remaining flakes show sharp or slightly altered edges, suggesting that they could be related to the proboscidean.

The largest of the three cores found (103 × 75 × 39 mm) is of recurrent centripetal Levallois type (Böeda, 1993). It is not too exhausted and shows eight negative scars per surface. The other two cores are of medium size and are exploited to exhaustion. The flakes are of medium size (45 × 39 × 13 mm in average). One Levallois flake (71 × 58 × 13 mm), one Levallois point (43 × 30 × 5 mm), and two resharpening flakes, one from a tool and another one possibly from a biface (34 × 43 × 12 mm), are remarkable. There are 13 retouched flakes which are larger than the whole flake assemblage (52 × 44 × 13 mm). Four scrapers and one awl show a well-shaped retouch, whereas the remaining flakes show a less powerful retouch: these are four retouched flakes, two single-blow notches and one complex notch, as well as a tool fragment. The assemblage stands out due to the presence of Levallois elements (including one point), the high percentage of retouched tools and the presence of resharpening (a biface and a retouched tool), which is consistent with having been used and abandoned on site.

6.3. *EDAR Culebro 1*

This site was identified in a 40 cm thick sandy level, 2 m below the top of the CTB, which has been eroded in this sector by the Arroyo Culebro stream. The date of 120.541 ± 6.851 ka obtained by OSL (Manzano et al., 2010) would assign the site to the Eemian. The chronological frame, however, has been extended due to the range obtained via Amino-Acid Racemization (AAR) techniques on *Equus*

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sp. molar, 133 ± 28 and 105 ± 10 ka, which place this site between MIS 6 and MIS 5c (Silva et al., 2012b).

Some 150 m^2 were excavated. Remains of a sub-adult male *Mammuthus* cf. *intermedius* (Manzano et al., 2010) or *M. primigenius* (Álvarez-Lao and García, 2011b) were found in 60 m^2 (Fig. 4A). The identified remains consisted of a lower jaw, six ribs, one fragment of the right humerus and one of left humerus, several fragments of diaphysis and of tusks (Fig. 4B). Green-bone fracture patterns have been identified on these bones, indicating that this process was human-made (Yravedra at Manzano et al., 2010). Several lithic pieces and remains of *Equus* sp. and Cervidae were also found in this level.

The lithic assemblage, which was made of local flint, consisted of two discoidal cores, one bifacial and one polyhedric; flakes, some of which may have been the product of resharpening; and a number of tools and knapping remains. Macro-tools and percussion elements were not recorded. The absence of highly rolled pieces suggest that the lithic assemblage, despite having been found in a level of sand, did not undergo much transportation (Manzano et al., 2010).

As micromammal remains were not recorded, climatic data has been inferred from the pollen association recorded in the same level where the remains of mammoth were found. These reveal a temperate, dry Mediterranean climate, and a landscape featuring a scarce forest surface composed of *Olea* and *Ulmus*, with *Juniperus* and *Rosacea* defining the bush stratum, and with dominant herbaceous plants such as *Chenopodiaceae*, *Poaceae*, *Solanaceae*, *Plantago* and *Rumex*. There were no aquatic elements in the sample (Manzano et al., 2010).

6.4. PRERESA

This site is located between two fluvial sequences, 5.5 m below the top of the CTB, deposited during the second half of MIS 5, according to the numerical date of 84.126 ± 5.633 ka obtained by OSL in feldspar grains. The evolved stage of *Microtus cabrerae* and *Arvicola* aff. *sapidus* suggests an Early Late Pleistocene association, which is consistent with the numerical date (Sesé et al., 2011).

An area of 255 m^2 was excavated. There were recorded 754 lithic pieces, as well as an important association of micromammals and the remains of *Vulpes vulpes*, *Lynx pardinus*, *Meles meles*, *Canis lupus*, Proboscidea indet., *Equus* sp., *Cervus elaphus*, *Dama* sp., *Capreolus capreolus*, and *Bos primigenius*. 82 bones of proboscidean, belonging to one individual, were also recovered. These included carpals, tarsals, phalanges, fragments of tusk, metapodials, vertebrae, ribs, one complete scapula, one partial ulna, and several fragments of long diaphysis and tibiae (Fig. 5B).

Taphonomic analysis shows that preservation conditions of the fauna was excellent. The exploitation of proboscideans has been observed through the identification of cut marks on six diaphysis fragments. Additionally, the intentional breaking of bones is suggested by the presence of percussion marks and green-bone fractures found on other bone fragments, confirming that the bone marrow of these taxa was also consumed (Yravedra et al., 2012).

The lithic assemblage consists of 754 pieces, all worked from flint apart from six pieces of quartz, showing very sharp edges. The flint *chaînes operatoires* are complete. Cores were exhaustively exploited. Short operative chains prevail, as well as flakes greater in width than in length. The lack of macro-tools and the low occurrence of retouched tools is remarkable. Among these, the most common are retouched flakes, denticulates and compound tools. A scraper and a burin were also recorded. The presence of knapping remains and refits demonstrate that these flakes were shaped in situ (Rubio-Jara, 2011) and probably used, judging by the presence of cut marks on the bones. The scattering and arrangement of the faunal remains, together with the characteristics and distribution of the lithic industry, as well as the cut and percussion marks on the elephant bones recovered from the site, suggest that parts of these animals were subject to processing by humans.

The elephant remains were scattered over a 130 m^2 surface, although the highest concentration of industry and faunal remains was found in a 36 m^2 area (Fig. 5A). Only 182 lithic pieces are longer than 3 cm, and only 75 of those are longer than 5 cm.

The herpetological assemblage recovered in PRERESA, consisting of *Pelobates cultripes*, *Pelodytes* sp., *Bufo bufo*, *Bufo calamita*, *Hyla*

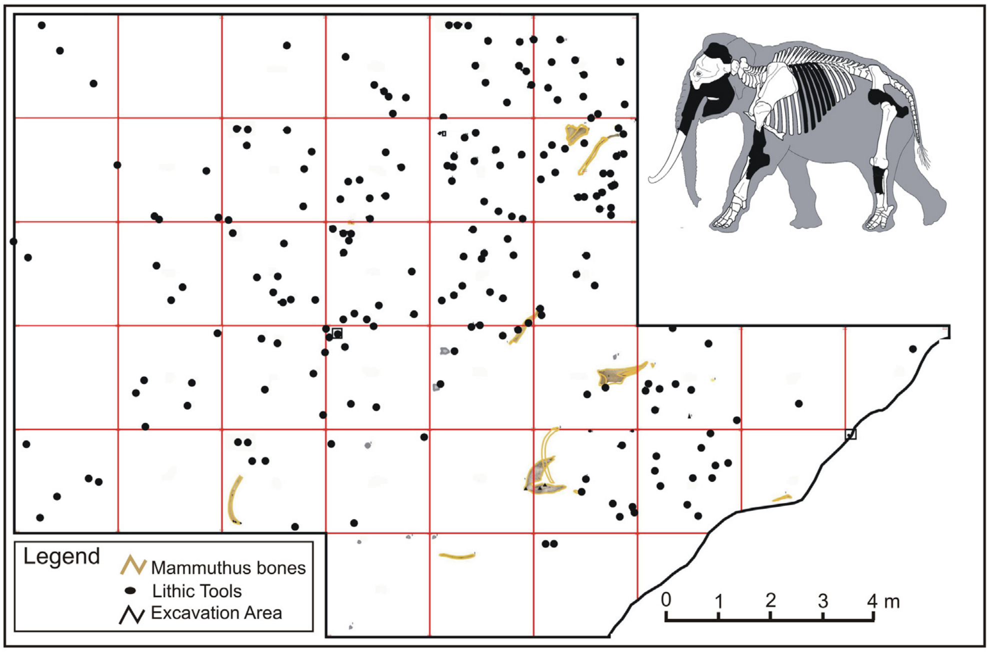

Fig. 4. A. EDAR Culebro spatial dispersion of *Mammuthus cf. intermedius/Mammuthus primigenius* remains and lithic industry (Based on Manzano et al., 2010). B. Anatomic representation of the mammoth remains found at EDAR Culebro.

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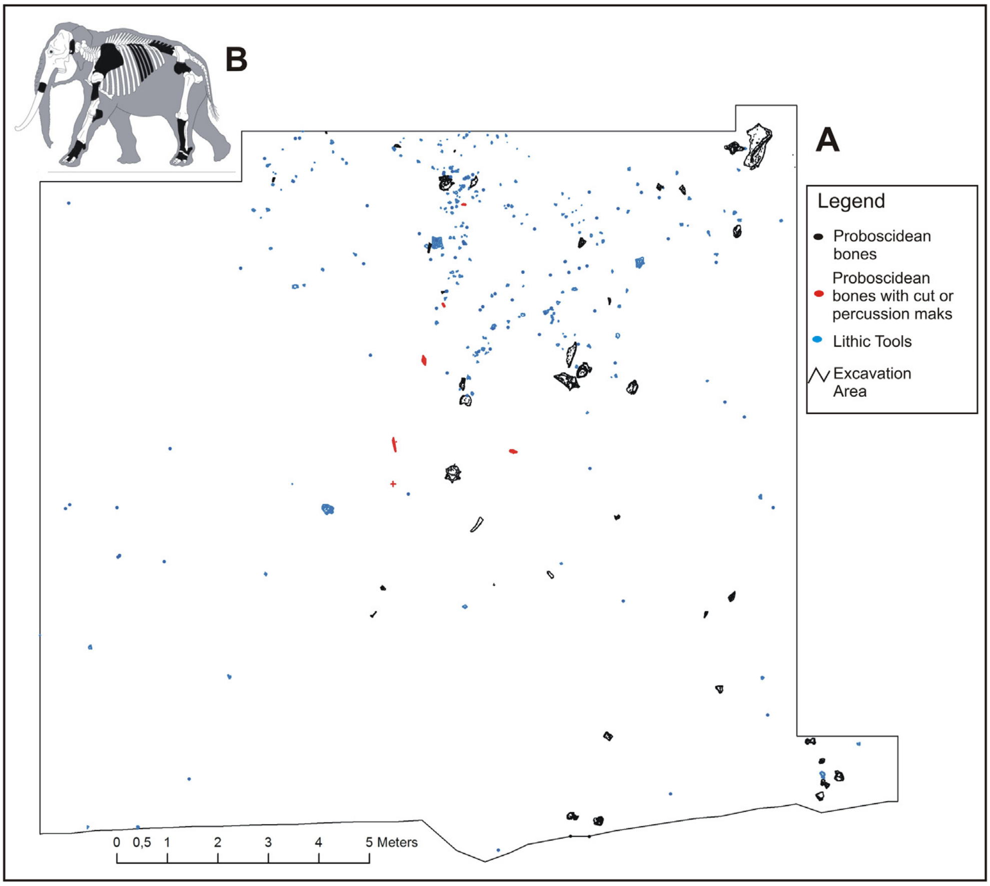

Fig. 5. A. PRERESA spatial dispersion of proboscidean remains and lithic industry. B. Anatomic representation of the proboscidean remains found at PRERESA.

sp. and *Pelophylax perezi*, Testudinoidea indet., *Blanus* sp., *Timon lepidus*, *Psammodromus* cf. *algirus*, *Natri maura*, *Coronella* sp. and *Vipera latastei,* reveals a climate of Mediterranean type, with four months of aridity during the summer and beginning of fall, identical to or even warmer than the current one, with more abundant rainfalls during winter and spring; and a lesser continentality, linked with a certain increase of winter temperatures (Blain et al., 2013). The micromammal assemblage, consisting of *Erinaceus europaeus*, *Crocidura russula*, *Rhinolophus ferrumequinum*, *Eliomys quercinus quercinus*, *Apodemus* sp., *Cricetulus* (*Allocricetus*) *bursae*, *Arvicola* aff. *sapidus*, *M. cabrerae*, *M. duodecimcostatus* and *O. cuniculus*, suggests that forest areas would have been poorly represented (8.3%), and the landscape would have been mainly open, with some areas of forest edge and meadow (1.2%) with wetlands and riverbank vegetation (56.8%). The remaining landscape would have been composed of wet and dry meadows (29%), dry meadows (1.8%) and dry meadows or steppes (2.4%). Therefore, the landscape could well have consisted of woodland or riverbank forest, with plenty of riverbank vegetation and wetlands, which would change to more open areas with bush vegetation and wet meadows, and finally dry meadows and steppes in the furthest areas from the riverbanks (Sesé et al., 2011).

7. Discussion

Evidence from stable isotope studies of Neanderthal remains indicate that in several regions of Europe, between 120 and 37 ka, Neanderthals were top-level carnivores, receiving most of their protein from large mammals (Richards and Trinkaus, 2009), and even at times from extremely large mammals such as rhinoceros and mammoths (Bocherens et al., 2005; Bocherens, 2011). Several of these zooarchaeological studies confirm that the systematic exploitation of large mammals during the Middle Palaeolithic occurred, and it is accepted that they were regularly hunted (Gaudzinski, 1996; Gaudzinski and Roebroeks, 2000). However, in contrast to Lower Palaeolithic records, the exploitation of proboscideans is not as obvious in the Middle Palaeolithic (Gaudzinski and Kindler, 2012).

The clearest evidence of Neanderthals exploiting proboscideans is limited to the sites of La Cotte de St Brelade, Bolomor, Byzovaya, Spy, Saint-Césaire, and Salzgitter-Lebenstedt. Bone remains with definite cut marks were found at the first three sites, as well as at Molodova I and Kulna, although the evidence from these last two sites is not as clear. At Spy and Saint-Césaire, stable isotope analysis on Neanderthal remains has indicated the consumption of mammoths. Bones of this animal were used as raw material in Salzgitter-Lebenstedt and possibly at Molodova I. Nine flakes with use-wear traces, associated with a carcass of *Elephas* (*Palaeoloxodon) antiquus,* found in Gröbern, are also solid proof of elephant consumption. Such solid evidence has not been found in Pagnano d'Asolo, Lehringen nor in Ariendorf 2, however, enough indications have been recorded for them to be included within the group mentioned above. Cava Campitello, Santo Antao do Tojal (Zbyszewski, 1943), and Lynford present more problems: no detailed publication is available for the first two sites, and the last is actually a palimpsest and so it is not clear whether humans did indeed exploit mammoths or just other mammals.

European sites which show evidence of proboscidean exploitation are substantially greater in number during the Lower Palaeolithic. Cut marks were identified in Aridos 2, Spain (Yravedra et al.,

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2010), Isernia La Pineta, Italy (Mussi, 2005), Castel di Guido, Italy (Radmilli and Boschian, 1996; Anconetani and Boschian, 1998; Saccà, 2012), and Bilzingsleben, Germany (Mania, 1990). They were also possibly identified at Ambrona, Spain (Villa et al., 2005) and Notarchirico, Italy (Mussi, 2005). With regards to the Middle East, cut marks were identified at Gesher Benot Ya'Akov, Israel (Goren-Inbar et al., 1994), and Revadim, Israel (Rabinovich et al., 2012). There are also a number of sites where proboscidean bones have been used as a raw material: Castel di Guido, Italy (Radmilli and Boschian, 1996; Villa et al., 2005; Saccà, 2012), La Polledrara, Italy (Villa et al., 1999; Anzidei et al., 2004; Anzidei et al., 2012), Fontana Ranuccio, Italy (Segre and Ascenzi, 1984), Malagrotta, Italy (Cassoli et al., 1982), Casal de Pazzi, Italy (Anzidei and Ruffo, 1985; Anzidei et al., 1999), Verteszölös, Hungary (Dobosi, 2001), Bilzingsleven, Germany (Mania and Weber, 1986) and Revadim, Israel (Rabinovich et al., 2012). In Áridos 1 and Áridos 2, Spain (Santonja et al., 1980; Ollé, 2005), as well as in La Polledrara, Italy (Anzidei et al., 2012) use-wear traces from meat and/or skin extraction have been associated with elephant remains. Finally, lithic industry and faunal remains found together have been described since the oldest European archaeological record in Fuente Nueva III (Patrocinio et al., 2013), as well as the beginning of the Middle Pleistocene in La Boella, Spain (Saladié et al., 2008; Vallverdú et al., 2009), and to the middle of the Middle Pleistocene in TRANSFESA, Spain (Meléndez and Aguirre, 1958; Andrés and Aguirre, 1974), TAFESA, Spain (Baena Preysler and Baquedano, 2004; Baena Preysler et al., 2010), Torralba, Spain (Howell, 1966; Freeman, 1994; Santonja and Pérez-González, 2005), Kärlich-Seeufer, Germany (Kröger et al., 1991; Gaudzinski, 1996), San Isidro, Spain (Santonja et al., 2001) and Stanton Harcourt, England (Scott, 2001).

Despite sites with proboscidean exploitation occurring more frequently during the Lower Palaeolithic, there is a scarcity of sites with evidence of hunting of these mega- herbivorous belonging to the Middle Palaeolithic. These are La Cotte de St Brelade, Spy and Molodova I, and also probably at Pagnano d'Asolo and Lehringen. The ability of Neanderthals to capture these pachyderms does not seem to be consistent with the decrease in the archaeological record of sites with evidence of elephant exploitation, especially keeping in mind the fact that they provide a substantial amount of meat and fat. Animal protein was an essential part on the diet of these hominins (Richards and Trinkaus, 2009), and the inclusion of large amounts of animal protein requires greater ingestion of fat and/or carbohydrate to prevent protein toxicity (Speth, 1991; Cordain et al., 2000). Moreover, proboscideans are easy to find due to their clearly identifiable travel routes, the way in which they modify the landscape and the implicit information given by their excrement (McNeil et al., 2005; Haynes, 2006, 2012; Shannon et al., 2009). Finally, they offer human groups a series of advantages with which to exploit the ecosystems that they frequent (Haynes, 2001, 2006).

Management of resources could explain, at least in part, the lower number of Middle Palaeolithic sites showing proboscidean exploitation. During this period most of the archaeological record is located within caves and rock shelters, places where remains of mega-herbivores have seldom been found. This could be explained by the fact that large boneless pieces of elephant meat could have been transported, as it has been stated in St. Cesaire and Spy. Without the stable isotope studies from these sites it would have been impossible to infer from the archaeological record that mammoth was an important part in the diet of the Neanderthals who lived in these sites.

According to the information provided by the micromammals, the landscape of the CTB at the time of Arriaga and PRERESA would have been mainly open, with a predominance of wet meadows with herbaceous or bush vegetation, and drier areas with bush, and also some forest. This type of vegetation would have required not only wet conditions linked to the proximity of a river, but also wet environmental conditions (Sesé and López Martínez, i.p.; Sesé et al., 2011). Therefore, the CTB would have provided the Neanderthals with a mixed habitat, mainly open and partially forested, where plant foods could have played an important role in their diet, as is suggested by the occlusal molar microwear analysis of 19 adult Neanderthals from western Eurasian sites (El Zaatari et al., 2011). Although these hominins had a predominantly carnivorous diet, plant resources played a more important role in mixed forest areas than in open-steppe areas.

The microvertebrates and pollen from Arriaga, EDAR Culebro and PRERESA reveal a temperate climate of Mediterranean type. The herpetological assemblage from PRERESA suggests four months of aridity during the summer and the beginning of fall. This is an identical, indeed warmer, climate than the current one, with more abundant rainfalls during winter and spring, and a lesser continentality, linked with a certain increase of winter temperatures (Blain et al., 2013). Moreover, the CTB and the lower course of the River Jarama run through a gypsum saline substrate, limiting the development of plant species. Thus, the summer drought period would favour the use of these valleys as ecological corridors. Therefore, it seems probable that macromammals, including proboscideans, concentrated along the riverbanks, as can be currently observed at the East African reserve parks. Due to the lack of accumulation of several individuals at the same site in the fossil record, it is not possible to consider extreme drought periods, as can be seen in the present day where elephant carcasses are accumulated in the same place (Haynes, 1991). However, the concentration of fauna during dry months would greatly facilitate hunting and scavenging.

The discovery of four sites with evidence of proboscidean exploitation occurring between MIS 6 and MIS 5 in the CTB, suggests that there was no substantial change of subsistence strategies between the Lower and Middle Palaeolithic with regard to these mammals, at least at the Manzanares Valley. Here, there is a significant amount of Acheulean sites showing lithic industry together with elephant remains: San Isidro, TRANSFESA, TAFESA, and other sites very nearby in the Jarama Valley such as Áridos 1 and Áridos 2. Additionally, climatic and landscape data inferred from the micromammals and macromammals found reveal that to the end of the Middle Pleistocene and early Late Pleistocene the available plant and animal resources would have been similar to those available during the Acheulean. The combination of resource management, climate and ecosystem could explain the large number of proboscidean carcasses found together with lithic industry dating to the Middle Palaeolithic found at the CTB.

8. Conclusions

Proboscideans have been considered a 'keystone' species (Owen-Smith, 1999; Robinson et al., 2003). The ecosystems that they frequented could have facilitated the exploitation of resources for human groups during the Pleistocene (Haynes, 2006). Additionally, proboscideans provide a substantial amount of meat and fat, and hunting these animals does not necessarily require sophisticated technology (Ben-Dor et al., 2011).

It has been discussed whether the association of proboscidean remains and lithic tools before the Upper Palaeolithic is meaningful or simply a bias produced by their better preservation due to the size of the remains (Haynes, 1991; Gaudzinski et al., 2005; Villa et al., 2005). However, recent publication of new data points out that exploitation of proboscideans cannot be considered an unusual activity before the Upper Palaeolithic, and that there is more

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evidence of exploitation during the Lower than the Middle Palaeolithic (Mussi and Villa, 2008; Yravedra et al., 2010, 2012; Slimak et al., 2011; Ben-Dor et al., 2011; Germonpré et al., 2012; Rabinovich et al., 2012; Saccà, 2012; Smith, 2012).

A large number of proboscidean remains dating to the final Middle Pleistocene and early Late Pleistocene have been recorded in the CTB of the Manzanares Valley (Sesé and Soto, 2002). The geographical location of this area, the Mediterranean climate characteristics identified during this period (Sesé et al., 2011; Blain et al., 2013) as well as its surrounding ecosystems, could have favoured the presence of large mammals along the riverbanks of the final reach of the river, especially during the summer drought period, establishing a special case of the concentrate resources model (Haggett et al., 1977; Butzer, 1982).

Many Acheulean sites containing lithic industry together with elephant remains have been found in the Manzanares Valley (Meléndez and Aguirre, 1958; Santonja et al., 1980; Baena Preysler et al., 2010). To the end of the Middle Pleistocene and the beginning of the Late Pleistocene, the remains of proboscideans associated with lithic industry found in the CTB (in some cases with cut and percussion marks and green-bone fractures) (Rus and Vega Toscano, 1984; Manzano et al., 2010; Yravedra et al., 2012) show that these mega-herbivores were constantly exploited as a resource during the Middle Palaeolithic. This does not seem to have any relation to changes in the availability of animal or plant resources, which would propitiate a greater interest on proboscideans, but with the advantages which they offered to groups of hunters-gatherers.

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