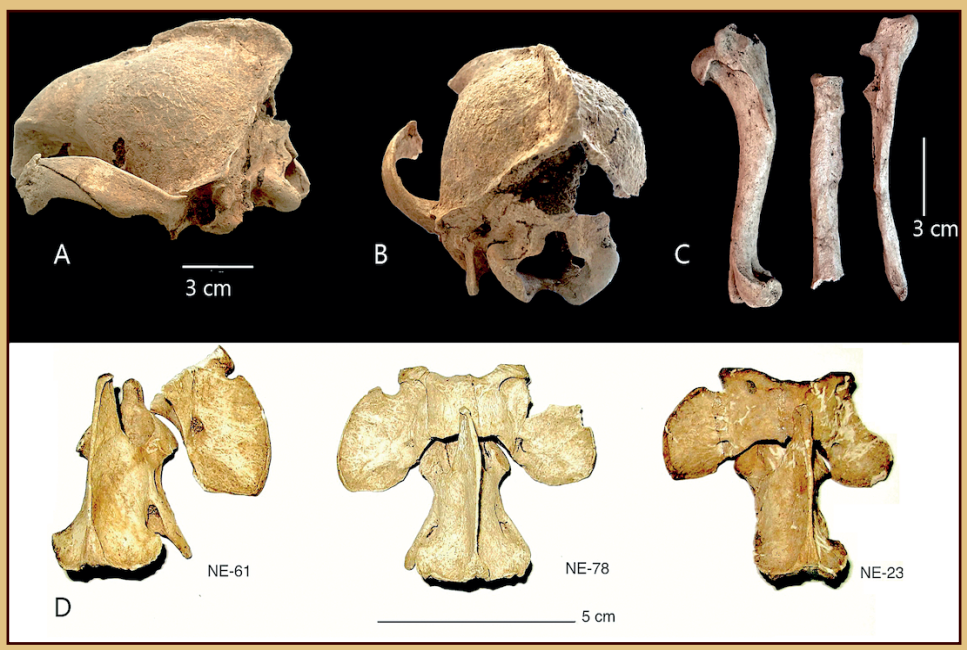
ARCHAEOFAUNA

INTERNATIONAL JOURNAL OF ARCHAEOZOOLOGY



2020

2ND IBERIAN ZOOARCHAEOLOGY MEETING
23RD-25TH JUNE 2021

Assistant editors for this volume:
Laura Llorente Rodríguez, Arantxa Daza-Perea,
Elena López-Romero González de la Aleja & Iratxe Boneta Jiménez

VOLUME 32(1) **https://doi.org/10.15366/archaeofauna2023.32.1** **October 2023**

ARCHAEOFAUNA

ARCHAEOFAUNA es una revista anual que publica trabajos originales relacionados con cualquier aspecto del estudio de restos animales recuperados en yacimientos arqueológicos. Los manuscritos deben enviarse a:

ARCHAEOFAUNA is an annual journal that publishes original papers dealing with aspects related to the study of animal remains from archaeological sites. Manuscripts should be sent to:

EUFRASIA ROSELLÓ IZQUIERDO
Laboratorio de Arqueozoología. Dpto. Biología. Universidad Autónoma de Madrid
28049 Madrid. España (Spain)

Para la elaboración de manuscritos, que serán evaluados por un mínimo de dos recensores externos, consultar las instrucciones de la contraportada. Todos los manuscritos no conformes con las normas de publicación serán automáticamente devueltos a los autores. Cada autor o grupo de autores recibirán un pdf de su trabajo.

For preparation of manuscripts, that will be evaluated by a minimum of two external referees, please follow the instructions to authors. All manuscripts no conforming to these instructions will be automatically returned to the authors. Each author (or group of authors) will receive a pdf of his/her (their) work.

Director: ARTURO MORALES MUÑIZ
Laboratorio de Arqueozoología. Dpto. Biología. Universidad Autónoma de Madrid
28049 Madrid. España (Spain)

Revista incluida en las bases de datos ICYT (CINDOC), Catálogo Latindex, Zoological Record, The Arts & Humanities Citation Index y Current Contents / Arts & Humanities (JCR)

ARCHAEOFAUNA
Laboratorio de Arqueozoología. Depto. Biología.
Universidad Autónoma de Madrid
Cantoblanco 28049. Madrid. España

Editor: Eufrasia Roselló Izquierdo
Editor Adjunto / Assitant Editor: Laura Llorente Rodríguez
Faculty of Archaeology, Universiteit Leiden, The Netherlands. l.llorente.rodriguez@arch.leidenuniv.nl

MUSEO ARQUEOLÓGICO Y PALEONTOLÓGICO

Diseño y maquetación:
Ismael Sánchez Castro
Tel.: 670 763 012
ismasan76@gmail.com

Imprime:
Impresores Digitales S.L.

FRONTISPIECE: A y B: restos craneales del ejemplar NE 78. C: húmero (vista lateral), radio (vista posterior) y ulna (vista lateral). D: atlas y axis de los tres perros de la necrópolis de Empúries.

ISSN - 1132-6891

ARCHAEOFAUNA

INTERNATIONAL JOURNAL OF ARCHAEOZOOLOGY

Volume 32(1) http://www.doi.org/10.15366/archaeofauna2023.32.1 Octubre 2023

Depósito Legal: M. 30872-1992

Diseño y maquetación:
Ismael Sánchez Castro
Tel.: 670 763 012
ismasan76@gmail.com

Imprime:
Impresores Digitales S.L.

23-25 JUNIO 2021
2º Encuentro de Zooarqueología Ibérica

2nd Iberian Zooarchaeology Meeting
23rd-25th JUNE 2021

Comité organizador · Organizing committee

Arturo Moralez Muñiz[1]; Marta Moreno García[2]; Corina Liesau von Lettow-Vorbeck[3]; Laura Llorente Rodríguez[1,5]; Arantxa Daza-Perea[6]; Elena López-Romero González de la Aleja[2]; Iratxe Boneta Jiménez[3]; Enrique Baquedano[4] & Susana Consuegra[2]

[1]LAZ-UAM: Laboratorio de Arqueozoología-UAM

[2]Laboratorio de Arqueobiología del Instituto de Historia-CSIC

[3]Depto. de Prehistoria y Arqueología UAM.
Grupo de Investigación Prehistoria en el interior Peninsular

[4]MARPA: Museo Arqueológico y Paleontológico de la Comunidad de Madrid

[5]Laboratory for Archaeozoological Studies-Universidad de Leiden, Países Bajos

[6]UNIARQ - Centro de Arqueologia da Universidade de Lisboa - Alumni UAM

Índices/Contents

Archaeofauna 32(1) (2023): 129-143

Hornos de la Peña (Northern Iberia): New excavations, chronological and subsistence data of the Middle-to-Upper Palaeolithic transition

ALICIA SANZ-ROYO[1], ANA B. MARÍN-ARROYO[1], OLIVIA RIVERO[2] & JOSEBA RIOS-GARAIZAR[3]

[1]Grupo de I+D+i EVOADAPTA (Evolución Humana y Adaptaciones durante la Prehistoria). Dpto. Ciencias Históricas. Universidad de Cantabria. Avda. Los Castros 44, 39005 Santander, Spain.
aliciasanzr@gmail.com

[2]Dpto. Prehistoria, Historia Antigua y Arqueología, Universidad de Salamanca, 37008 Salamanca, Spain.

[3]Bizkaiko Arkeologi Museoa, Calzadas de Mallona 2, 48006, Bilbao, Spain.

(Received *15 February 2022*; Revised *19 October 2022*; Accepted *27 October 2022*)

ABSTRACT: The study of the Middle to Upper Palaeolithic transition is one of the topics of more interest in the field of human evolution, where the differences in the subsistence strategies carried out by Neanderthals and Anatomically Modern Humans have generated numerous debates during recent years. Hornos de la Peña cave (Cantabria, Northern Iberia), excavated during 1909-1910, contains archaeological levels attributed to this transition, which have provided several publications about the human groups that occupied the cave. However, the stratigraphic sequence proposed by Obermaier at the beginning of the 20th century has been questioned due, among others, to the lack of reliable dating. From 2016 to the present, new excavation works are being carried out to review the integrity of the stratigraphic sequence and its chronology and to analyze the new faunal remains. In this article, we present the first radiocarbon dates performed on the levels attributed to the Middle to Upper Palaeolithic transition, as well as the archaeozoological and taphonomic results of the macrofauna recovered. Our results have revealed the complexity of the stratigraphic sequence, confirming that the previous stratigraphy proposed by Obermaier must be reconsidered. For that reason, although the activity of human groups inside the cave has been proved due to the presence of different anthropogenic modifications (mainly in horses, red deer and large bovids), it is not possible to construct hypotheses about their subsistence strategies. In summary, this new study has made it possible to reassess the stratigraphic sequence and provide new data on the chronology and the activities carried out by the human groups that occupied the cavity. In addition, this work highlights the importance of reviewing and dating levels from ancient excavations without reliable dating.

KEYWORDS: MIDDLE PALAEOLITHIC, EARLY UPPER PALAEOLITHIC, SUBSISTENCE STRATEGIES, ARCHAEOZOOLOGY, RADIOCARBON DATING, IBERIA

RESUMEN: El estudio de la transición del Paleolítico medio al superior es uno de los temas de mayor interés en el campo de la evolución humana, donde las diferencias en las estrategias de subsistencia que llevaron a cabo los neandertales y los humanos anatómicamente modernos han generado numerosos debates en los últimos años. La cueva de Hornos de la Peña (Cantabria), excavada durante los años 1909-1910, contiene niveles arqueológicos atribuidos a este período de transición, cuyo estudio ha proporcionado diversas publicaciones sobre los grupos humanos que ocuparon la cavidad. Sin embargo, la secuencia estratigráfica propuesta por Obermaier a principios del siglo XX ha sido debatida debido, entre otras cuestiones, a la ausencia de datacio-

http://www.doi.org/10.15366/archaeofauna2023.32.1.008

nes fiables. Desde 2016, se están llevando a cabo nuevos trabajos de excavación con el objetivo de revisar la integridad de la secuencia estratigráfica y su cronología, así como el análisis de los materiales faunísticos inéditos. En este artículo, presentamos las primeras dataciones de radiocarbono con ultrafiltración realizadas en los niveles atribuidos a la transición Paleolítico medio-superior, así como los resultados arqueozoológicos y tafonómicos de la macrofauna recuperada. Nuestros resultados han revelado la complejidad de la secuencia estratigráfica, confirmando que la estratigrafía propuesta previamente por Obermaier ha de ser reconsiderada. Por ese motivo, aunque la actividad de los grupos humanos en el interior de la cueva ha sido demostrada por la presencia de diversas modificaciones antrópicas (principalmente en caballos, ciervos y grandes bóvidos), no es posible realizar hipótesis sobre sus estrategias de subsistencia. En resumen, este nuevo estudio ha permitido reevaluar la secuencia estratigráfica y aportar nuevos datos sobre la cronología y las actividades realizadas por los grupos humanos que ocuparon la cavidad. Además, este trabajo remarca la necesidad de revisar y datar los niveles de excavaciones antiguas sin dataciones fiables.

PALABRAS CLAVE: PALEOLÍTICO MEDIO, PALEOLÍTICO SUPERIOR INICIAL, ESTRATEGIAS DE SUBSISTENCIA, ARQUEOZOOLOGÍA, CARBONO 14, IBERIA

INTRODUCTION

Hornos de la Peña cave (Cantabria, Northern Iberia) was discovered by Alcalde del Río in 1903. For the first time, he described the cave engravings and paintings (Alcalde del Río, 1906) and carried out an initial excavation in the intermediate gallery, as the entrance hall had been previously emptied by phosphate diggers (Rios-Garaizar *et al.*, 2020). Between 1909 and 1910 and during 1912, members of the Institut de Paléontologie Humaine (IPH), led by H. Breuil, H. Obermaier and J. Bouyssonie, continued with the excavation works in the first cave gallery, immediately after the vestibule (Breuil & Obermaier, 1912). Between 1936 and 1939 the cave was used as a refuge during the Spanish Civil War (Ontañón, 2009) and, in the 1950s, the site was affected by some civil works to wall up the cave entrance and facilitate tourist visits (Montes Barquín & Muñoz Fernández, 1995). Those continuous alterations caused only a few stratigraphic sections remain unaltered today (Rios-Garaizar *et al.*, 2020). In 2008 the cave was declared World Heritage Humanity by UNESCO due to the outstanding rock-art assemblage (Alcalde del Río *et al.*, 1911; Rivero & Garate, 2013) and the long stratigraphic sequence that covers from the Middle Palaeolithic to the Neolithic.

Breuil and Obermaier (Breuil & Obermaier, 1912; Obermaier, 1925) identified five stratigraphic levels: Mousterian level A (also called Level III), Aurignacian level B and Solutrean level C (both grouped as Level II), Magdalenian level D (or Level I) and Neolithic level E. Different scholars have investigated Hornos de la Peña cave producing several publications about Palaeolithic rock art (Alcalde del Río *et al.*, 1911; Ucko, 1987, 1989; González Sainz, 2000; Rivero & Garate, 2013), portable art (Breuil & Obermaier, 1912; Obermaier, 1925; Barandiarán, 1973; Utrilla, 1981; Corchón, 1986; Tejero *et al.*, 2008; Rivero, 2010; Rivero *et al.*, 2021), lithic industry (Freeman, 1966, 1969-70; Bernaldo de Quirós, 1982; Carrión, 2002; Tejero *et al.*, 2008; Rios-Garaizar *et al.*, 2013), fauna (Freeman, 1973; Straus, 1976, 1977; Bernaldo de Quirós, 1982; Yravedra, 2010) and stratigraphy (Butzer, 1981). Despite these works, doubts remained about the integrity and definition of the stratigraphic sequence and its chronology (Alcalde del Río *et al.*, 1911; Straus, 1983; Carrión, 2002). In 1980, four bone samples were dated (Burleigh *et al.*, 1982; Bowman *et al.*, 1990), but the exact location of those samples is unknown and they were dated without an ultrafiltration pretreatment (Burleigh *et al.*, 1982; Straus, 1992; Soto Barreiro, 2003).

Recent dating assessments of Northern Iberian sites, attributed from the Middle to Upper Palaeolithic transition, have shown uncertainties with the cultural attribution of non-dated levels (Higham *et al*., 2014; Marín-Arroyo *et al.*, 2018; Wood *et al*., 2018) or levels with old dating methods lacking the improved methodological protocols, like AMS, ultrafiltration or ABOX (Bronk Ramsey *et al.*, 2004; Higham *et al.*, 2006; Talamo & Richards, 2011, among others). Therefore, more research is

needed to clarify the integrity and chronology of the stratigraphic sequence of Hornos de la Peña.

In 2016, a multidisciplinary research project led by O. Rivero focused its work on the non-altered section left by Obermaier's excavation, located between the vestibule and the main gallery. These works had a double aim: to review the stratigraphy previously identified by Obermaier and excavate unaltered areas to date. The preliminary results were published by Rios-Garaizar *et al.* (2020), revealing a complex stratigraphic sequence equivalent to the descriptions made by Obermaier, with a basal flowstone dated to the Marine Isotope Stage (MIS) 7. Above it, 15 stratigraphic levels covering from the Middle Palaeolithic (levels 15 to 13) to the early Upper Palaeolithic (levels 12 to 7) with a possible Gravettian on the top, and other six modern levels from Late Gravettian/Early Solutrean to Magdalenian and, probably, also Recent Prehistory. The ongoing excavation works have been focused on the 14 to 12 levels attributed to the Middle/Upper Palaeolithic transition that yielded a considerable amount of lithic and faunal remains.

During the last decades, a topic of great interest and debate has been the differences or similarities in the environmental exploitation and the subsistence strategies undertaken by Neanderthals and Anatomically Modern Humans (AMH). In this context, Yravedra (2010), who analyzed the faunal remains from the attributed Mousterian and Aurignacian levels from the old excavations, proposed a continuity in the subsistence strategies between both human species focused on the exploitation of large ungulates, while carnivores acted as the main accumulators of smaller herbivores, such as chamois. This conclusion coincides with other scholars who do not observe relevant subsistence changes until the end of the Upper Palaeolithic (Clark & Lindly, 1989 a, b; Hoffecker & Gleghron, 2000; Patou-Mathis, 2000; Yravedra *et al.*, 2016). However, Yravedra (2010) was aware that his interpretations must be taken with caution due to the bias on the material studied, caused by the selective collection of the most diagnostic elements during the old excavations and other problems mentioned above, mainly the absence of reliable chronological dates.

In this paper, we present the research advances at Hornos de la Peña, with new radiocarbon dates that allow a re-evaluation of the stratigraphy and chronology, but also with new archaeozoological and taphonomical results of the macrofauna recovered from the Middle to Upper Palaeolithic levels during the modern excavations.

This work will provide new insights into the timing of Neanderthal and AMH occupations at Hornos de la Peña. The archaeozoological and taphonomical results obtained from ultrafiltered dated levels of the modern excavations will contribute to a better understanding of the activity carried out by both human species, but also by carnivores, and will allow testing the hypotheses about the subsistence strategies proposed previously at this cave.

MATERIALS AND METHODS

Hornos de la Peña (San Felices de Buelna, Cantabria) is located in a small tributary valley on the right margin of the Besaya river basin. The cave is South-oriented and has a large shelter, followed by the entrance and a first wide vestibule. Later, a narrow gallery begins with a long corridor and ends in two chambers where most engravings are found.

This work is focused on levels 14, 13 and 12 corresponding to the Middle and early Upper Palaeolithic. From 2016 to 2020, these levels were excavated in a small unaltered section of Obermaier's excavation, located between the entrance chamber and the main passage. This section was cleaned and excavated in extension (without grid limits), following a methodology adapted to the reduced area and the irregular nature of the preserved levels (Rios-Garaizar *et al.*, 2020).

The archaeostratigraphy of the excavated area was defined in the field, attending to shifts in sediment composition, colour and fabric. These attributions have been revised after carefully examining the sections and comparing the level distribution with the spatial projection of the findings.

The archaeozoological and taphonomic analyses have been carried out on identifiable and non-identifiable macrofaunal remains recovered from the levels mentioned above. All the elements were coordinated using a total topographic station. Remains smaller than 1 cm were grouped into 'general bone' bags and were also studied and included in this work.

The anatomic and taxonomic identification was conducted using the comparative osteological collections deposited at EvoAdapta Group at the University of Cantabria (Santander, Spain) and di-

fferent osteological atlases (Schmid, 1972; Barone, 1976; Pales & García, 1981; Varela & Rodríguez, 2004, among others). Measurements were taken following the standards of Driesch (1976). Specifically for equids, the taxonomic identification has been carried out following the methodology indicated in Sanz-Royo *et al.* (2020). All the remains that could not be identified taxonomically have been grouped into five weight size classes, according to the criteria proposed by Bunn (1986): Size 1- small-sized mammals as mustelids and rodents; Size 2- lagomorphs and small carnivores; Size 3- medium-sized animals weighing between 20 and 30 kg as *Capreolus capreolus* or *Canis lupus*; Size 4- medium-large sized animals weighing between 30 and 160 Kg like *Cervus elaphus* and *Capra pyrenaica*; and Size 5- larger over 300 Kg as *Bos primigenius* or *Equus ferus*. The age of death of the animals and the seasonality of the formation of the assemblage were estimated based on the deciduous/permanent teeth representation, their dental wear and the degree of bone fusion for postcranial elements, following Couturier (1962), Harris (1978), Silver (1980), Pflieger (1982), Mariezkurrena (1983), Habermehl (1992), Stiner (1998), Gipson *et al.*, (2000), Tomé & Vigne (2003), Weinstock (2009), Azorit (2011) and Geiger *et al.* (2016). We considered four age classes: fetus/newborn (deciduous teeth and epiphyses unfused), juvenile (worn deciduous teeth and/or permanent teeth emerging and epiphyses unfused or fusing), adult (permanent teeth and fused epiphyses) and senile (very worn permanent teeth).

The elements were quantified using the following measures: NR (Number of Remains), NISP (Number of Identified Specimens), MNE (Minimum Number of Elements) and MNI (Minimum Number of Individuals) (Grayson, 1984; Klein & Cruz-Uribe, 1984; Lyman, 1994).

For the taphonomic analyses, specialized bibliography and taphonomic atlases were consulted (Behrensmeyer, 1978; Blumenschine *et al.*, 1996; Fernández-Jalvo & Andrews 2003, 2016, among others). Evidence of anthropogenic modifications on the faunal remains includes cutmarks (Binford, 1981; Potts & Shipman, 1981; Shipman & Rose, 1983; Lyman, 2008), thermoalterations, which were classified by colours (Stiner *et al.*, 1995; Cáceres, 2002), and the intentional bone breakage (differentiating among fresh, dry or indeterminate fractures) and percussion marks (Villa & Mahieu, 1991; Capaldo & Blumenschine, 1994; Galán *et al.*, 2009; Sala *et al.*, 2015; Vettese *et al.*, 2017, 2020). Carnivore modifications were documented when tooth marks, different marks related to chewing activity and digested bones were present (Domínguez-Rodrigo & Piqueras, 2003; Sala, 2012). Other post-depositional alterations comprise the presence/absence of root marks, fungi/bacteria, modifications made by rodents, weathering, trampling, water dissolution, concretion, abrasion and manganese (Behrensmeyer, 1978; Hill, 1982; Lyman, 1994; Shahack-Gross *et al.*, 1997; Cukrowska *et al.*, 2005; Marín-Arroyo *et al.*, 2008; Fernández-Jalvo & Andrews, 2016, among others). When necessary, microscopic analyses and image captures were carried out using a Leica S8APO (10x-80x magnification range).

In addition, six mammal bones from levels 14, 13 and 12 were selected for radiocarbon dating at the Oxford Radiocarbon Accelerator Unit (ORAU), within the ERC-Subsilience Project. The main objective of radiocarbon dating was to confirm the chronology and the integrity of these levels. For that reason, this selection was more focused on Level 13, where Mousterian industry with the presence of bladelets and elongated chips (belonging to the Upper Palaeolithic) were previously documented (Rios-Garaizar *et al.*, 2020). For the sampling selection, remains identified taxonomically with anthropogenic modifications were a priority. Unfortunately, the high fragmentation and poor conservation of the faunal remains forced us to select some indeterminate bones.

RESULTS

Stratigraphy and chronology

The radiocarbon dating results carried out on six bone samples from levels 14, 13 and 12 are shown in Table 1.

A re-evaluation of the current excavation levels, presented previously by Rios-Garaizar *et al.* (2020), and the results obtained by the radiocarbon dating are presented here as follows, from base to the top:

– Level 14B: is a red silty-clay unit with speleothems fragments, ferruginous concretions and some faunal remains. Although only one Level 14 was previously identified, during the last campaign

Excavation year	Cultural attribuittion	Level	Sample	Material	Species	Element	Taphonomic marks	OxA	Dates (BP)	±	%C	d13C	d15N	C:N
2018	"Upper Palaeolithic"	12	57	Bone	Indeterminate	Long bone	No	OxA-40857	21720	140	341.6	-20.9	3.5	3.2
2018	Mousterian	13A	13	Bone	Size 4	Long bone	Cut marks	OxA-40737	32040	430	50.4	-20.1	6.8	3.2
2019	Mousterian	13D	121	Bone	Indeterminate	Indeterminate	Flake	OxA-40738	22540	130	48.7	-20.8	3.2	3.2
2017	Mousterian	13	1653	Bone	Indeterminate	Indeterminate	No	OxA-40945	>45000		38.4	-20.5	4.2	3.3
2019	Mousterian	14	80	Bone	Indeterminate	Indeterminate	No	OxA-40740	28310	270	46.4	-20.2	3.6	3.2
2018	Mousterian	14	18	Bone	*Bos/Bison*	Hyoid	Cut marks	OxA-40739	34620	610	46.1	-19.9	6.0	3.2

TABLE 1

New radiocarbon dating results from levels 14, 13 and 12 from recent excavation campaigns.

in 2020 it was observed stratigraphically that this level was composed of two well-differentiated levels: an older lower one, now called 14B and, above it, Level 14, of similar composition but with a less reddish colour. Level 14B presents a thickness of around 5 cm and is placed at some points on the stalagmitic plate (dated to 222,920 ± 10,090 BP) (Rios-Garaizar *et al.*, 2020), filling the irregular surface of the basal flowstone, and in other areas above Level 15 (still unexcavated). This level was preliminarily attributed to the late Middle Pleistocene. In 2021, Level 14B was excavated, providing more faunal and a few lithic remains, still under study.

– Levels 14-13: a deposit of ca. 25 cm thick was excavated above Level 14B. Initially, Level 14, Level 13-14 and Level 13 were differentiated during the excavations due to slight changes in the sediments. Two radiocarbon dating were taken in Level 14 (Table 1): one in an indeterminate bone that provided a date of 28,310 ± 270 BP (OxA-40740), and one on a large bovid hyoid that yielded a date of 34,620 ± 610 BP (OxA-40739). In Level 13 the new dating results cover a wide time range. At the base of the level, a flake bone gave a result of 22,540 ± 130 BP (OxA-40738), an indeterminate bone provided a date of >45,000 BP (OxA-40945) in the middle part of the level, while in the upper part of the level, a bone diaphysis with cut marks provided a date of 32,040 ± 430 BP (OxA-40737). When in 2021 the whole deposit was excavated, it was then possible to analyze in detail the sequence section, observing that the excavated levels between 2018 and 2021 dipped towards the inside of the cave, but also the presence of bioturbations on some of the excavated areas. These sloppings were not recognized until 2021, and thus, levels were not probably well-individualized at the excavation time. As a result, levels 14, 13-14 and 13 could contain an admixture of different occupations, which might explain: 1) the mixed character of the industries, with Middle and early Upper Palaeolithic typical tools; and 2) the apparent inconsistency of the obtained radiocarbon dates (Table 1). On the contrary, the surface excavated in 2016-2017 seems to be more homogeneous and less affected by the aforementioned problems. Thus, this section can be considered a stable Middle Palaeolithic level [despite some admixture, being documented two Dufour bladelets on Level 13 during 2016 (Rios-Garaizar *et al.*, 2020)]. These results show that levels 14, 13-14 and 13 (corresponding roughly to Level III and the lower part of Level II of Breuil and Obermaier's excavations) range from the Late Gravettian, through the Early Gravettian, and the Early Aurignacian, incorporating also Middle Palaeolithic materials in the base of the deposit, founded in the area excavated in 2016-2017, dated older than 45,000 BP. For the reasons above, this level is called Level 14-13.

– Level 12: is a fluvial level above Level 14-13 with an unconformity contact, where some faunal and lithic remains were recovered. One long mammal bone provided a date of 21,720 ± 140 BP (OxA-40857) (Table 1). This date fits into the chronological framework of the Late Gravettian-Early Solutrean in the Cantabrian Region (Marín-Arroyo *et al.*, 2018).

Archaeozoological and taphonomical analysis

The assemblage of levels 14B, 14-13 and 12 is composed of 6,250 faunal remains. Of them, 96% correspond to non-identifiable elements, and only 4% were identified taxonomically, at least, to mammal size level. The faunal remains are characterized by a high fragmentation, being the majority of them smaller than 4 cm. In addition, the high pre-

sence of abrasion and/or polishing alterations made very difficult taxonomic identification.

No remarkable differences were observed among the different levels regarding anatomical (Table 3) and taxonomical representation (Table 2). Ungulates are predominant within the whole faunal assemblage, being represented by *Bos/Bison* sp., *Equus ferus, Cervus elaphus, Capra pyrenaica, Capreolus capreolus* and *Rupicapra rupicapra*. Carnivores, although less abundant, are also represented by species such as *Ursus* sp., *Panthera pardus, Vulpes vulpes, Canis lupus, Martes martes* and *Mustela* sp.

At Level 14B *C. elaphus*, *R. rupicapra*, *C. capreolus* and *Ursus* sp. were identified. Due to the radiocarbon dates obtained and the aforementioned issues in the initially identified levels 14, 13-14 and 13, these levels were considered as a single unit for the archaeozoological analysis. Level 14-13 is the most abundant and diversified in faunal remains, where *C. elaphus* and *R. rupicapra* are the most represented species. Several carnivores and some fish remains (salmonid size) were also identified in this unit. In Level 12 only *E. ferus*, *C. elaphus* and *C. lupus* were taxonomically identified.

The equid remains from levels 14-13 and 12 show size and morphology similar to caballine species and the presence of *Equus hydruntinus* has been discarded. Large bovid remains from Level 14-13 are not diagnostic to be able to differentiate between *Bos* and *Bison*. None of the ursid remains from levels 14B and 14-13 have allowed further progress in their taxonomic identification. Among the remains that could not be determined at the species level, mammal size 3 (chamois size) predominates.

Species	14B							14-13							12						
	NR	NISP	MNE	MNI				NR	NISP	MNE	MNI				NR	NISP	MNE	MNI			
				NB	J	A	S				NB	J	A	S				NB	J	A	S
***Bos/Bison* sp.**								2	2	2			1								
Equus ferus								7	7	6		1	1		3	3	2			1	
Cervus elaphus	2	2	1			1		30	30	16	1		2		1	1	1			1	
Capra pyrenaica								3	3	3			2								
Rupicapra rupicapra	2	2	2			1		14	14	11		1	3								
Capreolus capreolus	3	3	3			1		7	7	5	1		1								
Capra/Cervus								2	2						1	1					
Rupicapra/Capreolus								5	5												
Cervidae indet.								2	2												
Caprinae indet.								8	8												
Ungulata size 4-5								5													
Ungulata size 3-4								7							3						
Total ungulates	7	7	6			3		92	80	43	2	2	10		8	5	3			2	
***Ursus* sp.**	5	5	3			1		4	4	3			1	1							
Panthera pardus								1	1	1			1								
Canis lupus															1	1	1			1	
Vulpes vulpes								2	2	2			1								
Martes martes								1	1	1			1								
***Mustela* sp.**								1	1	1			1								
Total carnivores	5	5	3			1		9	9	8			5	1	1	1	1			1	
Fish								3													
Mammal size 5								8													
Mammal size 4								20							5						
Mammal size 3	3							58							7						
Mammal size 2								14							3						
Mammal size 1								1													
Non-identifiable	482							5144							379						
Total	**498**	**12**	**10**			**4**		**5349**	**89**	**52**	**2**	**2**	**15**	**1**	**403**	**6**	**4**			**3**	

TABLE 2

Number of skeletal Remains (NR), Number of Identified Specimens (NISP), Minimum Number of Elements (MNE) and Minimum Number of Individuals (MNI) (NB=newborn, J=juvenile, A=adult, S= senile), from levels 14B, 14-13 and 12.

Anatomical element	Level 14B				Level 14-13										Level 12			
	Cc		Ur		Eqfe		Ce		Cc		Ruru		Ur		Eqfe		Calu	
	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE	NISP	MNE
Antler/Horn																		
Cranium																		
Hyoid																		
Mandible	1	1																
Lower teeth	2	2	1	1	3	2	6	3	1	1	6	3	1	1				
Upper teeth			1	1	1	1	1	1	2	1	1	1	2	2			1	1
Indet teeth			3	1			7		1				1					
Atlas																		
Axis																		
Clavicle																		
Sacrum																		
Vt. Cervical																		
Vt. Thoracic																		
Vt. Lumbar																		
Vt. Caudal																		
Rib					1	1												
Sternum																		
Scapula																		
Humerus																		
Radius							2	2	1	1	1	1						
Radius/Ulna					1	1												
Ulna																		
Metacarpal							2	1										
Carpals																		
Baculum																		
Pelvis																		
Femur															1	1		
Tibia					1	1												
Fibula																		
Patella																		
Tarsals							2	2										
Astragalus																		
Calcaneus																		
Metatarsal							2	1										
Metapod indet.							1				1	1			2	1		
Phalanx I							3	2										
Phalanx II							1	1	1	1								
Phalanx III											1	1						
Atrophic phal. I									1	1								
Atrophic phal. II																		
Atrophic phal. III																		
Small sesamoid											4	4						
Large sesamoid							3	3										
Total	**3**	**3**	**5**	**3**	**7**	**6**	**30**	**16**	**7**	**5**	**14**	**11**	**4**	**3**	**3**	**2**	**1**	**1**

TABLE 3

Number of Identified Specimens (NISP) and Minimum Number of Elements (MNE) calculated for the most abundant species (ungulates and carnivores) in levels 14B, 14-13 and 12. (*Cc = Capreolus capreolus, Ce = Cervus elaphus, Eqfe = Equus ferus, Ruru = Rupicapra rupicapra, Ur = Ursus sp., Calu = Canis lupus*).

Adult individuals predominate in the whole assemblage (Table 2). At Level 14-13, two newborn individuals have been also identified by two deciduous incisives belonging to a red deer and a roe deer. These elements indicate a spring seasonality at the time of the animals' death. Regarding the anatomical elements identified, dental remains and long bones are the most represented (Table 3).

Most of the documented fractures are indeterminate, and only on a few remains it has been able to confirm fresh fractures related to bone marrow extraction (Figure 1c).

The most common anthropogenic modifications of the assemblage are thermoalterations (Table 4), which are present in 29% of the total remains from Level 14B, 38,5% of Level 14-13 and 22% of Level 12. These modifications were mainly observed on spongy bones, affecting mostly the entire bones. They present a large variety of colours, although black and white remains predominate (Figure 2b), reflecting different temperatures received and exposure time supported. Cut marks (Figure 1a) and percussion marks are scarce. They were primarily found in Level 14-13, mainly on long bones of adult ungulates, of which *E. ferus*, *C. elaphus* and *Bos*/*Bison* sp. were taxonomically identified. The distribution, orientation and morphology of cut marks have provided evidence of defleshing activity on horses and disarticulation activity on red deer. Some percussion marks on horses and red deer and a possible worked bone (Figure 1b) were also identified at this level. In Level 12, only two remains with cut marks have been observed, one of them on a horse atrophic metapod. At Level 14B there is no presence of cut marks or percussion marks.

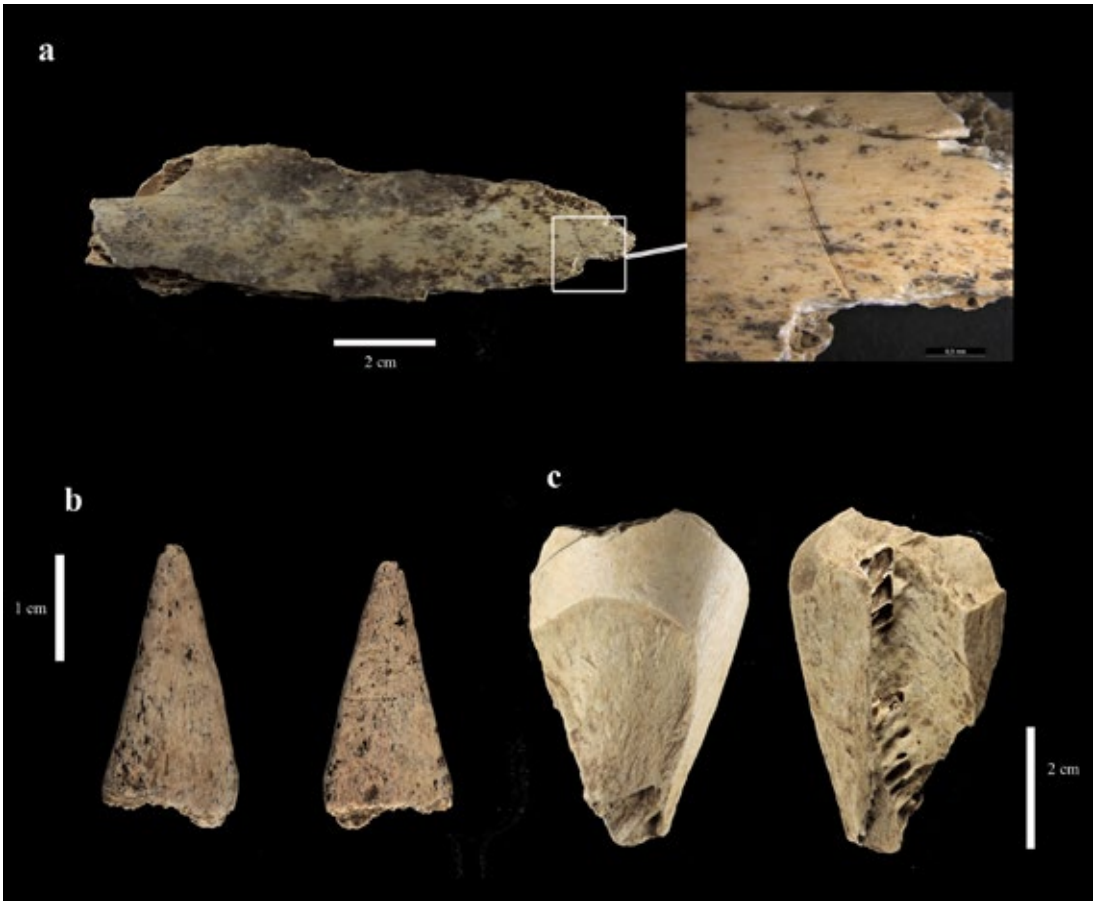


FIGURE 1

Anthropogenic modifications observed on the macrofaunal remains recovered at levels 14B, 14-13 and 12: **1.a.** Cut mark on a rib from an ungulate size 4-5; **1.b.** Indeterminate worked bone; **1.c.** Humerus from an ungulate size 4-5 with fresh fracture.

Anthropogenic modifications												
Level	Cut marks		Percussion marks		PM+CM		Worked bone		Thermoalterations		Total	
	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR
12	2	0,5							85	21,09	87	21,59
14-13	26	0,5	10	0,2	5	0,1	1	0,02	2065	38,53	2107	39,39
14B									145	29,12	145	29,12

TABLE 4

Number of Remains (NR and %NR) with anthropogenic modifications (cut marks, percussion marks, PM+CM=percussion marks+-cut-marks, worked bones and thermoalterations) observed on the macrofaunal remains from levels 14B, 14-13 and 12.

On the other hand, carnivore modifications (Figure 2a) are very limited in the assemblage. These modifications have not been observed in Level 14B, while at levels 14-13 and 12 appear in a very low percentage (less than 1%), most of them chewing activity and pits.

Manganese is present in more than 60% of the remains in all the studied levels. Especially in level 14B, where 94% of the remains have manganese dendrites and even some of them are completely covered by this mineral (Figure 2c). This could be related to the presence of water and humidity inside the cave. Although not very abundant, other post-depositional modifications observed throughout the sequence are weathering, water dissolution, fungi/bacteria and root marks (Table 5). Also, the presence of trampling, strong abrasion and polishing marks on the remains, which could be due to a possible transit of different animals inside the cave over time, such as bears and human groups, without discarding occasional water slow-flows into the cavity. All of these alterations have affected the legibility of the bone surface, making it arduous the identification of cut marks and carnivore marks on some occasions.

FIGURE 2

Taphonomic modifications observed on the macrofaunal remains recovered at levels 14B, 14-13 and 12: **2.a.** Carnivore modifications on an *Equus ferus* radius/ulna (scores and crenulated edges); **2.b.** Burnt bone with black-white colour; **2.c.** Left lower P_2 of *Capreolus capreolus*, covered by manganese.

Level	Non-human modifications																	
	Carnivores		Rodents		Bacteria		Roots		Trampling		Weathering		Water dissolution		Manganese		Concretion	
	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR	NR	%NR
12	1	0,2	1	0,25	2	0,50	8	1,99	26	6,45	20	4,96	8	1,99	323	80,15		
14-13	10	0,2	2	0,04	21	0,39	79	1,48	767	14,34	587	10,97	122	2,28	3235	60,48	11	0,21
14B					3	0,60	6	1,20	5	1,00	46	9,24	1	0,20	471	94,58	5	1

TABLE 5

Number of remains (NR and %NR) with non-human modifications (biological and non-biological) observed on the macrofaunal remains from levels 14B, 14-13 and 12.

DISCUSSION

Previous authors (Alcalde del Río *et al.*, 1911; Straus, 1983; Carrión, 2002; Rios-Garaizar *et al.*, 2020) already indicated that the stratigraphy inside the cave was not as simple as Obermaier had proposed. Nevertheless, the absence of reliable dating did not allow to contrast it, until today. After the advances in the research inside the cave, together with the new radiocarbon dates and the analysis of the archaeological finds, it can be confirmed that the stratigraphic sequence proposed by Obermaier, attributed to the Middle to Upper Palaeolithic transition, was not entirely correct. The modern excavations have revealed a more complex sequence, with additional stratigraphic levels than previously identified.

According to our reassessment of the stratigraphic sequence (from the bottom to the top): Level 14B, identified during recent excavation campaigns, would correspond to an older stage, surely late Middle Pleistocene. Above it, Level 14-13, which possibly corresponds to Level III (Mousterian) in Obermaier's excavation (Rios-Garaizar *et al.*, 2020), contains an admixture of different levels. The new five radiocarbon dates (Table 1) taken throughout this level in the undisturbed section during the ongoing excavations do not match with the Mousterian chronology proposed for the Cantabrian Region (Marín-Arroyo *et al.*, 2018), going from the Late Gravettian chronology (22,540 ± 130 BP) to beyond the radiocarbon limit (>45,000 BP). This apparent inconsistency on the obtained ages and the mixed character of the industries (with Middle and early Upper Palaeolithic tools) indicate stratigraphic issues throughout the studied levels. The sloping observed towards the inside of the cave, unrecognized previously, possibly caused difficulties in the delimitation of the archaeological levels, affecting mainly the area excavated between 2018 and 2021 in some parts of the section. In addition, the presence of some small burrows may also have altered the integrity of Level 14-13. Finally, Level 12 was proposed as corresponding to Obermaier's Level II (Aurignacian) (Rios-Garaizar *et al.*, 2020). Nevertheless, the new radiocarbon date presented in this work of 21,720 ± 140 BP (Table 1) fits with the Late Gravettian in the Cantabrian Region. This date from Level 12 and that one from Level 8 (OxA-36546) obtained previously (Rios-Garaizar *et al.*, 2020), together with some Gravettian diagnostic materials, suggest a likely Gravettian occupation at Hornos de la Peña. The material dated in the 1980s came, supposedly, from the Mousterian level A [24,340 ± 470 BP (BM-1884)] and the Aurignacian level B [20,930 ± 370 BP (BM-1883)] of Obermaier's excavations (Burleigh *et al.*, 1982; Bowman *et al.*, 1990). Both dates fit within the Gravettian chronology and not with the previously proposed cultural attribution. These data provide additional evidence that the Middle to Upper Palaeolithic transition sequence, attributed since the early XX century, is somehow incoherent. The archaeological materials recovered then had probably the same stratigraphic problems as observed in this study. Considering this argumentation, the previous hypotheses about Neanderthal and Anamotically Modern Humans (AMH) occupations in these levels must be reviewed.

Our archaeozoological and taphonomical results differ slightly from those published by Yravedra (2010), focused on the old collections of the Obermaier's excavation. In this work, we have not been able to confirm the presence of *Mammuthus- Palaeoloxodon, Lynx pardinus, Felis silvestris* and *Lepus* sp., identified by this author in the Mousterian and Aurignacian attributed levels. Furthermore, our results indicate that the most

abundant species in Level 14-13 is red deer followed by chamois, while the horse is scarcely represented. On the contrary to what was indicated by Yravedra (2010) in the equivalent level, who proposed chamois followed by equids as the predominant species. We agree with Yravedra (2010) that human groups would have intercepted mainly large ungulates. The most significant difference with our results is that this author observed a high carnivore activity on smaller mammals, which would have been the main accumulator agent. This conclusion contrasts strongly with the presented results, in which carnivore activity is limited. It cannot be discarded that these differences could be motivated by the biased sample studied by the author, caused by a selective recovery of the most diagnostic remains (mainly teeth) during early excavation works. Or maybe by the damage on the bone surfaces caused by post-depositional modifications, which could have hidden these marks.

According to our results, the evidences of human activity, mainly thermoalterations, but also some cut marks, percussion marks, fresh fractures and a worked bone, together with the scarcity of carnivore modifications on the faunal remains, suggest that human groups were the main accumulator agent throughout the entire sequence. Our stratigraphic and archaeological analysis have revealed several admixtures of materials at Level 14-13, from the Mousterian to the Late Gravettian. Therefore, although the presence of human groups inside the cave is evident at this level, it is not reliable to construct hypotheses about the subsistence strategies they were carrying out.

Yravedra (2010) proposed a continuity between the subsistence strategies achieved by Mousterian and Aurignacian groups that occupied the cavity. The author coincides with other works carried out in the region, like those made in Covalejos (Yravedra *et al.*, 2016) or El Castillo (Luret *et al.*, 2020), in agreement. Also with some scholars who did not observe relevant changes in the subsistence strategies until the end of the Upper Palaeolithic (Clark & Lindly, 1989a, b; Hoffecker & Gleghron, 2000; Patou-Mathis, 2000). However, according to the results presented here, it is difficult to precise the exact cultural attribution of the collections studied by Yravedra, and we consider that, for the moment, a continuation of the subsistence strategies carried out by Neanderthals and AMH of Hornos de la Peña cannot be confirmed.

CONCLUSIONS

The research carried out in the unaltered section excavated from 2016 to the present at Hornos de la Peña (Northern Iberia), have provided an outstanding opportunity to reassess the stratigraphy, chronology and cave use, allowing continued advances in the research of the Middle and Upper Palaeolithic. The results have confirmed that the stratigraphic sequence proposed by Obermaier must be reconsidered. The recent excavation works and radiocarbon dating have revealed a more complex sequence identifying stratigraphic levels previously unidentified. Thus, Level 14B would correspond to an older stage, probably the late Middle Pleistocene. Level 14-13 (corresponding to Mousterian level in Obermaier's excavation) is a set of different levels ranging from the Middle Palaeolithic to Late Gravettian, and Level 12 (the Aurignacian level in Obermaier's excavation) would correspond to a Late Gravettian. These results indicate that the data and hypotheses constructed from the archaeological materials recovered during the ancient excavations, and attributed to the Middle and early Upper Palaeolithic for more than a hundred years ago, are not reliable to address issues related to Neanderthal and early *Homo sapiens* populations, including their subsistence strategies. For that reason, the previous hypothesis proposed about continuity in the subsistence strategies achieved by both human species at this site can not be confirmed. This work also highlights the problem of studying the archaeological materials at non-dated levels and remarks the importance of new excavations, technological, archaeozoological and taphonomical studies and updating radiocarbon methods to support the cultural attribution of any archaeological level.

ACKNOWLEDGEMENTS

The authors wish to thank the Consejería de Educación, Cultura y Deporte of the Cantabria Government for funding the multidisciplinary study project "Estudio del arte parietal paleolítico de la Cueva de Hornos de la Peña" directed by Dr. Olivia Rivero and "Creation and perception in Anatomically Modern Humans: analysis of the biological, cognitive and social skills linked to the production of Palaeolithic art (ArtMindHuman)" (PID2021-125166OB-I00), funded by the Ministry

of Science, Innovation and Universities (Spain). The present study has been carried out within the framework of this project. The radiocarbon dating is funded by the ERC-SUBSILIENCE Project (European Research Council under the European Union's Horizon 2020, Research and Innovation Programme. Grant agreement No. 818299) and ASR's PhD is supported by this project. Special thanks to G. Terlato (EvoAdapta Group, University of Cantabria) for the assistance and support during the archaeozoological analysis, to L. Agudo (EvoAdapta Group, University of Cantabria) for the photography assistance and members of the LabTec team (University of Salamanca) for their collaboration in the archaeological excavations.

REFERENCES

Alcalde Del Río, H. 1906: *Las pinturas y grabados de las cavernas prehistóricas de la provincia de Santander. Altamira – Covalanas – Hornos de la Peña – Castillo*. Blanchard y Arce, Santander.

Alcalde Del Río, H.; Breuil, H.; & Sierra, L. 1911: *Les Cavernes de la Région Cantabrique*. Chêne, Mónaco.

Azorit Casas, C. 2011: Guía para la determinación de la edad del ciervo ibérico (*Cervus elaphus hispanicus*) a través de su dentición: revisión metodológica y técnicas de elección. *Anales de la Real Academia de Ciencias Veterinarias de Andalucía Oriental* 24: 235-264.

Barandiarán, I. 1973: *Arte mueble del Paleolítico Cantábrico*. Zaragoza.

Barone, R. 1976: *Anatomie Comparée des Mammifères Domestiques*. Tome I: Atlas y texto. Ostéologie. Vigot Fréres, París.

Behrensmeyer, A.K. 1978: Taphonomic and ecologic information from bone weathering. *Paleobiology* 4(2): 150-162.

Bernaldo De Quirós, F. 1982: *Los inicios del Paleolítico superior cantábrico*. Ministerio de Cultura, Dirección General de Bellas Artes y Archivos, Madrid.

Binford, L.R. 1981: *Bones, ancient men and modern myths*. Academic Press, New York.

Blumenschine, R.J.; Marean, C.W. & Capaldo, S.D. 1996: Blind tests of interanalyst correspondence and accuracy in the identification of cut marks, percussion marks, and carnivore tooth marks on bone surfaces. *Journal of Archaeological Science* 23: 493-507.

Bowman, S.G.E.; Ambers, J.C. & Leese, M.N. 1990: Re-evaluation of British Museum radiocarbon dates issued between 1980 and 1984. *Radiocarbon* 32: 59-79.

Breuil, H. & Obermaier, H. 1912: Les premiers travaux de l'Institut de Paleontologie humaine. *L'Anthropologie* t. XXIII.

Bronk Ramsey, C.; Higham, T.F.G.; Bowles, A. & Hedges, R. 2004: *Radiocarbon* 46: 155-163. https://doi.org/10.1017/S0033822200039473

Bunn, H.T. 1986: Patterns of skeletal representation and hominid subsistence activities at Olduvai Gorge, Tanzania, and Koobi Fora, Kenya. *Journal of Human Evolution* 15: 673-690.

Burleigh, R.; Ambers, J. & Matthews, K. 1982: British Museum natural radiocarbon measuments XV. *Radiocarbon* 24(3): 262-290. doi: 10.1017/S0033822200005154

Butzer, K.W. 1981: Cave sediments, Upper Pleistocene stratigraphy and Mousterian facies in Cantabrian Spain. *Journal of Archaeological Science* 8(2): 133–183.

Cáceres, I. 2002: *Tafonomía de yacimientos antrópicos en karst. Complejo Galerçia (Sierra de Atapuerca, Burgos), Vanguard cave (Gibraltar) y Abric Romaní (Capellades, Barcelona)*. Tesis doctoral. Tarragona.

Capaldo, S.D. & Blumenschine, R.J. 1994: A quantitative diagnosis of notches made by hammerstone percussion and carnivore gnawing on bovid long bones. *American Antiquity* 59: 724-748.

Carrión, E. 2002: *Variabilidad técnica en el Musteriense de Cantab*ria. Tesis doctoral. Universidad Autónoma de Madrid, Madrid.

Clark, G.A.; Lindly, J. 1989a: The case of continuity: Observations of the biocultural transition in Europe and western Asia. In: Mellars, P. & Stringer, C. (eds.): *The human revolution: behavioural and biological perspectives on the origins of modern humans*: 626-676. Edinburgh University Press, Edinburgh.

— 1989b: Modern humans origins in the Levant and Western Asia. The fossil and archaeological evidence. *American Anthropology* 91: 962-985.

Corchón, Ma. S. 1986: *El arte mueble paleolítico cantábrico; contexto y análisis interno*. Centro de Investigación y Museo de Altamira, Monografías 16. Madrid.

Couturier, M.A.J. 1962: *Le bouquetin des Alpes: Capra aegagrus ibex ibex*. L., Part 1. ed. Impr. Allier.

Cukrowska, E.M.; Mccarthy, T.S.; Pole, S.; Backwell, L. & Steininger, C. 2005: The chemical removal of manganese dioxide coatings from fossil bones from the Cradle of Humankind, South Africa. *South African Journal of Science* 101: 101-103.

Domínguez-Rodrigo, M. & Piqueras, A. 2003: The use of tooth pits to identify carnivore taxa in tooth-marked ar-

cheofaunas and their relevance to reconstruct hominid carcass processing behaviours. *Journal of Archaeological Science* 30: 1385-1391.

Driesch, A. von den 1976: *A Guide to the measurement of animal bones from archaeological sites*. Peabody Museum Bulletin. Harvard University, Cambridge MA.

Fernández-Jalvo, Y. & Andrews, P. 2003: Experimental effects of water abrasion on bone fragments. *Journal of Taphonomy* 1: 147-163.

— 2016: *Atlas of Taphonomic Identifications. Vertebrate Paleobiology and Paleoanthropology*. Springer, Dordrecht.

Freeman, L.G. 1966: The nature of Mousterian facies in Cantabrian Spain. *American Anthropologist* 68: 230-237.

— 1969-1970: El Musteriense cantábrico: nuevas perspectivas. *Ampurias* 31-32: 55-69.

— 1973: The significance of mammalians faunas from Palaeolithic occupations in Cantabrian Spain. *American Antiquity* 38: 13-44.

Galán, B.; Rodríguez, M.; De Juana, S. & Domínguez-Rodrigo, M. 2009: A new experimental study on percussion marks and notches and their bearing on the interpretation of hammerstone-broken faunal assemblages. *Journal of Archaeologial Science* 36: 776-784.

Geiger, M.; Gendron, K.; Willmitzer, F. & Sánchez-Villagra, M.R. 2016: Unaltered sequence of dental, skeletal, and sexual maturity in domestic dogs compared to the wolf. *Zoological Letters* 2: 1-8. doi:10.1186/s40851-016-0055-2.

Gipson, P.S.; Ballard, W.B.; Nowak, R.M. & Mech, L.D. 2000: Accuracy and precision of estimating age of gray wolves by tooth wear. *The Journal of Wildlife Management* 64: 752. doi:10.2307/3802745.

González Sainz, C. 2000: Representaciones arcaicas de bisonte en la región cantábrica. *SPAL* 9: 257-277.

Grayson, D.K. 1984: *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas*. Academic Press, Orlando.

Habermehl, K.H. 1992: Die Altersbeurteilung beim weiblichen Steinwild (*Capra ibex ibex* L.) anhand der Skelettentwicklung. Anatomía, Histología, Embriología. *Journal of Veterinary Medicine Series* C 21: 193-198.

Harris, S. 1978: Age determination in the Red fox (*Vulpes vulpes*), an evaluation of technique efficiency as applied to a sample of suburban foxes. *Journal of Zoology* 184: 91-117.

Higham, T.; Jacobi, R. & Bronk Ramsey, C. 2006: AMS radiocarbon dating of ancient bone using ultrafiltration. *Radiocarbon* 48: 179-195. https://doi.org/10.1017/S0033822200066388

Higham, T.; Douka, K.; Wood, R.; Ramsey, C.B.; Brock, F.; Basell, L.; Camps, M.; Arrizabalaga, A.; Baena, J.; Barroso-Ruiz, C.; Bergman, C.; Boitard, C.; Boscato, P.; Caparros, M.; Conard, N.J.; Draily, C.; Froment, A.; Galvan, B.; Gambassini, P.; García-Moreno, A.; Grimaldi, S.; Haesaerts, P.; Holt, B.; Iriarte-Chiapusso, M.J.; Jelinek, A.; Jordá Pardo, J.F.; Maillo-Fernández, J.M.; Marom, A.; Maroto, J.; Menéndez, M.; Metz, L.; Morin, E.; Moroni, A.; Negrino, F.; Panagopoulou, E.; Peresani, M.; Pirson, S.; La Rasilla, M. De; Riel-Salvatore, J.; Ronchitelli, A.; Santamaria, D.; Semal, P.; Slimak, L.; Soler, J.; Soler, N.; Villaluenga, A.; Pinhasi, R. & Jacobi, R. 2014: The timing and spatiotemporal patterning of Neanderthal disappearance. *Nature* 512: 306-309. doi:10.1038/nature13621.

Hill, C.A. 1982: Origin of black deposits in caves. *National Speleological Society Bulletin* 44: 15-19.

Hoffecker, J.F. & Glechron, N. 2000: Mousterian hunting in the Northwestern Caucasus and the ecology of the Neanderthals. *International Journal of Osteoarchaeology* 10: 368-378.

Klein, R.G. & Cruz-Uribe, K. 1984: *The Analysis of animal bones from archaeological sites*. University of Chicago Press, Chicago.

Luret, M.; Burke, A.; Bernaldo De Quirós, F. & Besse, M. 2020: El Castillo cave (Cantabria, Spain): Archeozoological comparison between the Mousterian occupation level (unit 20) and the "Aurignacien de transition de type El Castillo" (unit 18). *Journal of Archaeological Science: Reports* 3. doi:10.1016/j.jasrep.2020.102339

Lyman, R.L. 1994: *Vertebrate Taphonomy*. Cambridge University Press, Cambridge.

— 2008: *Quantitative Paleozoology*. Cambridge University Press, Cambridge.

Mariezkurrena Gastearena, K. 1983: Contribución al conocimiento del desarrollo de la dentición y el esqueleto poscraneal de *Cervus elaphus*. *Munibe Antropologia – Arkeologia*: 149-202.

Marín-Arroyo, A.B.; Landete Ruiz, M.D.; Vidal Bernabeu, G.; Seva Roman, R.; González Morales, M.R. & Straus, L.G. 2008: Archaeological implications of human-derived manganese coatings: a study of blackened bones in El Mirón Cave, Cantabrian Spain. *Journal of Archaeological Science* 35: 801-813. doi:10.1016/j.jas.2007.06.007

Marín-Arroyo, A.B.; Rios-Garaizar, J.; Straus, L.G.; Jones, J.; De La Rasilla, M.; González Morales, M.R.; Richards, M.; Altuna, J.; Mariezkurrena, K. & Ocio, D. 2018: Chronological reassessment of the Middle to Upper Paleolithic transition and Early Upper Paleolithic cultures in Cantabrian Spain. *PlosOne* 13: 1–20.

Montes Barquín, R. & Muñoz Fernández, E. 1995: *La Cueva de Hornos de la Peña, Tárriba-San Felices de Buelna, Cantabria*. Memorias 1993-1995 de la A. C.D.P.S.: 63-66.

Obermaier, H. 1925: *El hombre fósil*. Comisión de Investigaciones Paleontológicas y Prehistóricas, Madrid.

Ontañón, R. 2009: Cueva de Hornos de la Peña. En: Ontañón, R. (scientific editor): *Cuevas con arte en Cantabria*: 227-231. Diario Montañés/Gobierno de Cantabria, Santander.

Pales, L. & García, M.A. 1981: *Atlas ostéologique pour servir à l'identification des mammifères du Quaternaire*. París.

Patou-Mathis, M. 2000: Neanderthal subsistence behaviours in Europe. *International Journal of Osteoarchaeology* 10: 379-395.

Pflieger, R.H.P. 1982: Le chamois, son identification et sa vie. *Grand Gibier*.

Potts, R. & Shipman, P. 1981: Cutmarks made by stone tools on bones from Olduvai Gorge, Tanzania. *Nature* 291: 577-580. doi:10.1038/291577a0.

Rios-Garaizar, J.; De La Peña, P. & Maillo-Fernández, J.M. 2013: El final del Auriñaciense y el comienzo del Gravetiense en la región cantábrica: una visión tecno-tipológica. En: de las Heras, C.; Lasheras, J.A.; Arrizabalaga, A.; De la Rasilla, M. (eds.): *Pensando El Gravetiense: Nuevos datos para la región cantábrica en su contexto peninsular y pirenaico*: 369-382. Monografías del Museo Nacional y Centro de Investigación de Altamira 23. Ministerio de Educación y Cultura, Madrid.

Rios-Garaizar, J.; Maillo-Fernández, J.M.; Marín-Arroyo, A.B.; Sánchez Carro, M.A.; Salazar, S.; Medina-Alcaide, M.A.; San Emeterio, A.; Martínez De Pinillos, L.; Garate, D. & Rivero, O. 2020: Revisiting Hornos de la Peña 100 years after. *Journal of Archaeological Science Reports* 31.

Rivero, O. 2010: *La movilidad de los grupos humanos del Magdaleniense Cantábrico y Pirenaico: Una visión a través del arte*. Tesis doctoral. Universidad de Salamanca, Salamanca.

Rivero, O. & Garate, D. 2013: Arte parietal paleolítico en la cueva de Hornos de la Peña (Cantabria): Nuevos datos sobre su conjunto exterior. *Zephyrus* LXXII: 59-72.

Rivero, O.; Salazar, S.; Mateo-Pellitero, A.M.; García Bustos, P.; Garate, D. & Rios-Garaizar, J. 2021: To be or not to be: reassessing the origins of portable art in the Cantabrian Region (Northern Spain). *Archaeological and Anthropological Sciences* 14: 18. https://doi.org/10.1007/s12520-021-01488-w

Sala, M.T.N. 2012: *Tafonomía de yacimientos kársticas de carnívoros en el Pleistoceno*. Tesis Doctoral. Universidad Complutense de Madrid, Madrid.

Sala, N.; Arsuaga, J.L.; Martínez, I. & Gracia-téllez, A. 2015: Breakage patterns in Sima de los Huesos (Atapuerca, Spain) hominin sample. *Journal of Archaeological Science* 55: 113-121.

Sanz-Royo, A.; Sanz, M. & Daura, J. 2020: Upper Pleistocene equids from Terrasses de la riera dels Canyars (NE Iberian Peninsula): The presence of *Equus ferus* and *Equus hydruntinus* based on dental criteria and their implications for palaeontological identification and palaeoenvironmental reconstruction. *Quaternary International* 566-567: 78-90.

Schmid, E. 1972: *Atlas of animal bones for prehistorians, Archaeologists and Quaternary Geologists*. Elsevier Publishing Company, Amsterdam.

Shahack-Gross, R.; Bar-Yosef, O. & Weiner, S. 1997: Black-coloured bones in Hayonim Cave, Israel: Differentiating between burning and oxide staining. *Journal of Archaeological Science* 24: 439-446. doi:10.1006/jasc.1996.0128.

Shipman, P. & Rose, J. 1983: Early hominid hunting, butchering, and carcass-processing behaviors: Approaches to the fossil record. *Journal of Anthropological Archaeology* 2: 57-98.

doi:10.1016/0278-4165(83)90008-9.

Silver, I.A. 1980: La determinación de la edad en los animales domésticos. En: Brothwell, D.R. & Higgs, E. (eds.): *Ciencia en arqueología*: 290-301. Fondo Económica, Madrid.

Soto Barreiro, M.J. 2003: *Cronología radiométrica, ecología y clima del paleolítico cantábrico*. Ministerio de Educación, Cultura y Deporte, Madrid.

Stiner, M. 1998: Mortality analysis of Pleistocene bears and its paleoanthropological relevance. *Journal of Human Evolution* 34: 303-326.

Stiner, M.C.; Kuhn S.L.; Weiner S. & Bar-Yosef, O. 1995: Differential burning, recrystallization and fragmentation of archaeological bone. *Journal of Archaeological Science* 22: 223-237.

Straus, L.G. 1976: Análisis de la fauna arqueológico del norte de la Península Ibérica. *Munibe* 28: 277-285.

— 1977: Of deerslayers and mountain men: Palaeolithic faunal exploitation in Cantabrian Spain. In: Binford, L. (ed.): *For theory building in Archaeology*: 41-78. Academic Press, New York.

— 1983: *El Solutrense Vasco-cantábrico. Una nueva perspectiva. Centro de Investigación y Museo de Altamira*. Monografías10. Santander.

— 1992: Iberia before the Iberians. *The Stone Age Prehistory of Cantabrian Spain*. University of New México Press, Albuquerque.

Talamo, S. & Richards, M. 2011: A comparison of bone pretreatment methods for AMS dating of samples >30,000 BP. *Radiocarbon* 53(3): 443-449.

Tejero, J.M.; Cacho, C. & Bernaldo De Quirós, F. 2008: Arte mueble en el auriñaciense cantábrico. Nuevas aportaciones a la contextualización del frontal grabado de la cueva de Hornos de la Peña (San Felices de Buelna, Cantabria). *Trabajos de Prehistoria* 65: 115-123. doi: https://doi.org/10.3989/tp.2008.v65.i1.138.

Tomé, C. & Vigne, J.D. 2003: Roe deer (*Capreolus capreolus*) age at death estimates: New methods and modern reference data for tooth eruption and wear, and for epiphyseal fusion. *Archaeofauna* 12: 157-173.

Ucko, P.J. 1987: Débuts illusoires dans l'étude de la tradition artistique. *Préhistoire Ariegeoise* 42: 15-81.

— 1989: *La subjetividad y el estudio del arte parietal paleolítico. Cien años después de Sautuola*: 283-358. Santander.

Utrilla, P. 1981: El Magdaleniense Inferior y Medio en la costa cantábrica. *Monografias del Centro de Investigación y Museo de Altamira* 4. Ministerio de Cultura, Dirección General de Bellas Artes, Archivos y Bibliotecas, Santander.

Varela, S. & Rodríguez, J. 2004: *Carnívoros ibéricos*. Atlas osteológico. Madrid.

Vettese, D.; Daujeard, C.; Blasco, R.; Boreal, A.; Caceres, I. & Moncel, M.H. 2017: Neandertal long bone breakage process: standardized or random patterns? The example of Abri du Maras (southeastern France, MIS 3). *Journal of Archaeological Science: Reports* 13: 151-163.

Vettese, D.; Blasco, R.; Cáceres, I.; Gaudzinski-Windheuser, S.; Moncel, M.h.; Thun Hohenstein, U. & Daujeard, C. 2020: Towards an understanding of hominin marrow extraction strategies: a proposal for a percussion mark terminology. *Archaeological and Anthropological Science* 12: 48.

Villa, P. & Mahieu, È. 1991: Breakage patterns of human long bones. *Journal of Human Evolution* 21: 27-48.

Weinstock, J. 2009: Epiphyseal fusion in brown bears: a population study of grizzlies (*Ursus arctos horribilis*) from Montana and Wyoming. *International Journal of Osteoarchaeology* 19: 416-423.

Wood, R.; Bernaldo De Quirós, F.; Maillo-Fernández, J.M.; Tejero, J.M.; Neira, A. & Higham, T. 2018: El Castillo (Cantabria, northern Iberia) and the Transitional Aurignacian: Using radiocarbon dating to assess site taphonomy. *Quaternary International* 474: 56-70. doi:10.1016/j.quaint.2016.03.005

Yravedra, J. 2010: Zooarqueología y tafonomía del yacimiento de Hornos de la Peña (San Felices de Buelna, Cantabria). *Complutum* 21: 69–86.

Yravedra, J.; Gómez-Castanedo, A.; Aramendi-Picado, J.; Montes-Barquin, R. & Sanguino-González, J. 2016: Neanderthal and Homo sapiens subsistence strategies in the Cantabrian region of northern Spain. *Archaeological and Anthropological Sciences* 8: 779-803.

INFORMACIÓN A LOS AUTORES

a) Los originales pueden redactarse en español, inglés, alemán o francés. Los editores pueden considerar, en determinadas circunstancias, la publicación de originales en otros idiomas. En cualquier caso se proporcionará un resumen y palabras clave en español y en inglés.

b) Los originales no deberían sobrepasar 20 páginas A4 (29,5 x 21 cm) incluyendo tablas y figuras. En caso de trabajos más extensos contáctese con el editor. Los manuscritos deberán remitirse a arturo.morales@uam.es.

c) Las figuras y tablas deberán ser originales y de gran calidad. Las leyendas de figuras y de tablas deberán remitirse, numeradas, en ficheros independientes y serán concisas e informativas.

d) Estructuración del manuscrito. El orden requerido en los manuscritos de carácter experimental es el siguiente: Título del trabajo; Autor(es) y Centro(s) de trabajo; Resumen y Palabras Clave; Abstract y keywords; Introducción; Discusión; Conclusiones; Agradecimientos (optativo); Referencias. Si el trabajo así lo requiere, resultados y discusión pueden agruparse en el mismo epígrafe. En manuscritos no experimentales, la estructuración del trabajo se deja a la libre decisión del(de los) autor(es).

e) las citas bibliográficas en el texto incluirán autor y año de publicación, por ejemplo (Smithm 1992) o (Smith & Jones, 1992). En trabajos con tres o más autores usar (Martín *et al*., 1993). En trabajos del(de los) mismo(s) autor(es) y año, se procederá a identificar cada trabajo con letras (a, b, c, etc…) tras la fecha.

f) Referencias. Sólo se incluirán aquellas citadas en el texto y se hará del siguiente modo:

PÉREZ, C.; RODRÍGUEZ, P. & DÍAZ, J. 1960: Ecologican factors and family size. *Journal of Bioethics 21:* 13-24.

RUIZ, L. 1980: *The ecology of infectious diseases*. Siglo XXI, Madrid.

g) Los autores son los únicos responsables de los contenidos de sus artículos.

INFORMATION FOR AUTHORS

a) Manuscripts can be submitted in Spanish, English, German and French. Under certain circumstances papers may also be published in other European Community languages. All papers will include an abstract and keywords in English and Spanish.

b) Manuscripts should usually not exceed 20 A4 printed pages (29,5 x 21 cm), including figures and tables. For longer manuscripts, contact the editor. Manuscripts should be submitted to arturo.morales@uam.es.

c) Figures and tables must be original and hight quality. Figure legends should be numbered with arabic numerals and given on a separate file. Figure and table legends should be concise and informative.

d) Papers should be organized as follows: Title, name and mailing address(es) of author(s). Abstract, Keywords, Introduction, Materials and Methods, Results, Discussion, Conclusions, Acknowledgements, References. Results and Discussion may be treated together if this is appropiate. Non-experimental works can be organized in the way whicht th author(s) think(s) is the most appropiate one.

e) Citations in the text should be with author and date of publication, e. g., (Smith, 1992) or (Smith & Jones, 1992) with comma between author and date; for two-author papers, cite both authors; for papers by three or more authors, use Martín *et al*., 1993. For two or more papers with the same author(s) and date, use, a, b, c, etc., after the date.

f) References: only papers cited in the text should be includen; they should be arranged as indicated in point «f» of the other column.

g) Authors are responsible for the contents of their manuscripts.

ÍNDICE / CONTENTS