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RESEARCH ARTICLE

Neanderthal use of animal bones as retouchers at the Level XV of the Sopeña rock shelter (Asturias, northern Spain)

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Abstract

Bone retouchers are a technological appliance used to perfect lithic tools efficiently. They are most frequently found in Middle Palaeolithic contexts. In this paper, we present a group of bone retouchers from the Mousterian Level XV of the Sopeña rock shelter (Asturias, Spain). The bone part preferred was the middle part of the shaft of long bones: Most of them are on metacarpals, followed by metatarsals, femurs, and tibias. The most used animal species is adult red deer. These retouchers have either one, two, or three active areas, with a central disposition. The impact marks are close together; oval pits are common, as well as straight, sinuous, and irregular grooves. The surfaces on these marks appear pitted and scaled. There are indications that the bones employed were relatively fresh. The length, width, and thickness of those bone fragments seem to be the determining factor when choosing them to be used as retouchers in the process of finishing lithic tools. The formats documented in Sopeña Level XV are similar to those found in other Mousterian sites in Iberia, although there is a certain variability regarding their width. The Neanderthals of Sopeña acquired the raw material for these retouchers from the faunal remains generated in the process of butchering and eating the animals. These retouchers were used as implements to perfect lithic tools made mainly on quartzite, and they were used repeatedly and maybe for a long time.

KEYWORDS
bone retouchers, bone technology, Cantabrian region, Middle Palaeolithic, Mousterian, Neanderthal

1 | INTRODUCTION

1.1 | State of the art

The concept of minimally or scarcely elaborated bone tools is common in the scientific literature that analyzes assemblages of Lower and Middle Palaeolithic bone tools (Barandiarán, 1987; Mozota, 2012). It is present in a large part of European historiography (e.g., Aguirre, 2005/2006; Patou-Mathis, 1999) and includes bones that show marks of human manipulation or use (Backwell & D'Errico, 2001, 2005). In the past, putative "bone tools" have been the subject of heated scientific debate, as was the case with the "osteodontokeratic culture" proposed for australopithecines by Dart (1957), which was proved erroneous with the rise of taphonomic

studies in the 1980s (Binford, 1981; Brain, 1980, 1981). Indeed, taphonomic analyses revealed that there are natural agents that can produce "pseudo-artefacts" (Brain, 1980; D'Errico & Giacobini, 1988; Villa & D'Errico, 2001). However, today, we know that undoubtedly bones were sometimes employed as tools after minimal or null prior modification: the digging sticks from Swartkrans are a good example (D'Errico & Backwell, 2003), and other cases have been published for the Lower and Middle Palaeolithic, both in Europe and in Africa (Barham et al., 2000, 2002; D'Errico, 2007; Mozota, 2014).

Among scarcely elaborated bone tools, according to Mozota (2012:22), are the objects known as retouchers (Armand & Delagnes, 1998; Barandiarán, 1987; Hutson et al., 2018; Valensi, 2002). The term appears firstly as a denomination for certain objects on bone, found by Cotte (1917) in the Aldouste Cave (Asturias, Spain). Bone retouchers are bone fragments (shaft fragments mainly) that were used to strike a stone flake and transform it in a retouched tool (Alonso-García et al., 2020; Mallye et al., 2012). It is a very expeditious technological appliance usually discarded after use, and more frequently associated with the Middle Palaeolithic (Barandiarán, 1987; Baumann et al., 2023; Hutson et al., 2018; Mozota, 2012, 2015; Romandini et al., 2015; Vincent, 1993), although some have also been recorded in the African Middle Stone Age (MSA), and are a recurring object in a variety of epochs and contexts (e.g., Doyon et al., 2018; Mallye et al., 2012; Martellotta et al., 2021; Rosell et al., 2015; Tejero et al., 2016). Commonly shaft fragments of ungulates are used, but there are other instances including even the use of human remains (Verna & D'Errico, 2011).

The most ancient recorded bone retoucher appeared in the MIS 9 site of the Gran Dolina of Atapuerca (Level TD10-1) (Burgos, Spain) (Rosell et al., 2011, 2015). However, Middle Palaeolithic retouchers are best known, since they appear in a good number of sites in the Iberian Peninsula, including Peña Miel (La Rioja), Covalejos (Cantabria), Morín (Cantabria), Axlor (Vizcaya), Prado Vargas (Burgos), Teixoneres (Cataluña), and El Salt (Alicante), among others (Alonso-García et al., 2020; Barandiarán, 1987; Mateo-Lomba et al., 2019; Mozota, 2015; Pérez et al., 2019).

In this work, we introduce new evidences of bones used as retouchers in the Mousterian Level XV of the Sopeña rock-shelter (Asturias), and these constitute the first records in the western area of the Cantabrian region. Up to now, there are no other known samples

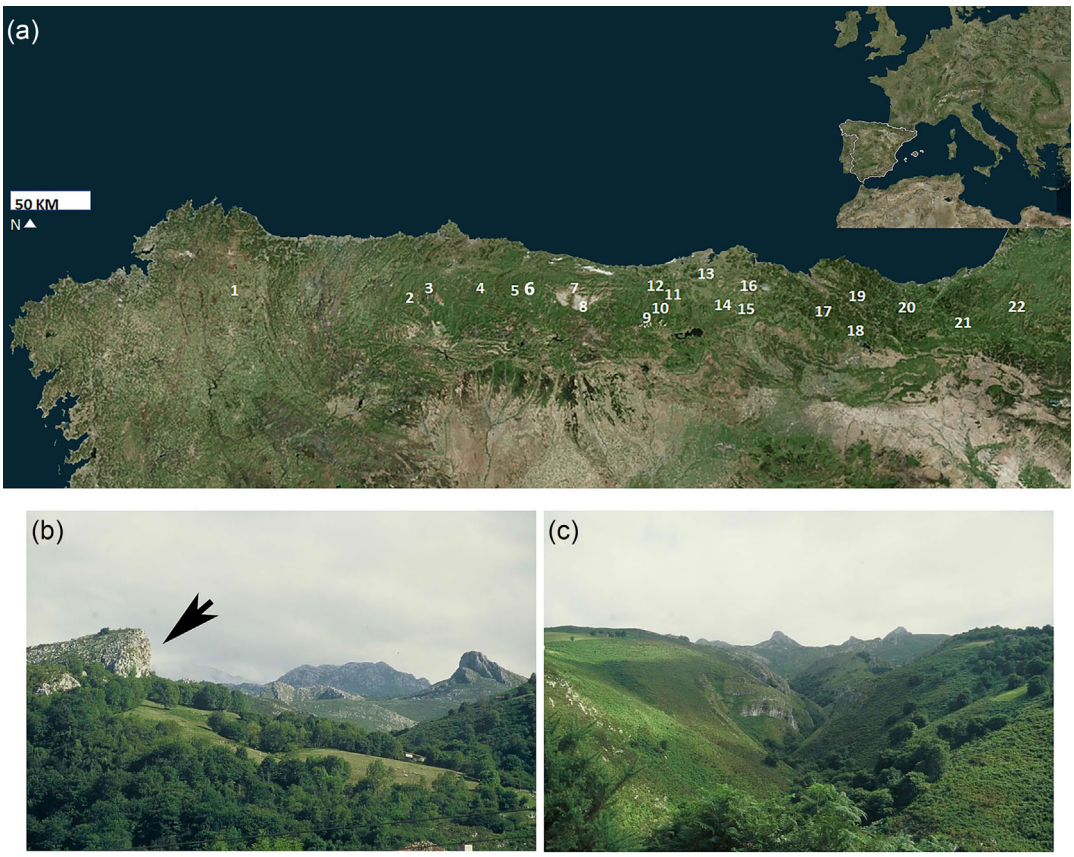

FIGURE 1 (a) Location of Sopeña and other Mousterian sites of similar age in the northern Iberian Peninsula (1, Cova Eiros; 2, El Conde; 3, La Viña; 4, El Sidrón; 5, La Güelga; 6, Sopeña; 7, Llonin; 8, Esquilleu; 9, Hornos de la Peña; 10, El Castillo; 11, Morín; 12, Pendo, Covalejos, El Ruso; 13, El Otero; 14, El Mirón, Venta la Perra; 15, Cofresnedo; 16, El Cuco; 17, Axlor; 18, Lezetxiki; 19, Arrillor; 20, Amalda; 21, Abaunt; 22, Gatzarria). (b) A view of the Sopeña rock-shelter and its environment. (c) Sopeña opens in a limestone outcrop. From Pinto-Llona and Grandal-d'Anglade (2022). [Colour figure can be viewed at wileyonlinelibrary.com]

of such use in neither the Asturias nor in the Galicia regions of northern Spain.

1.2 | The archaeological site of the Sopeña rock-shelter (Onís, Asturias, northern Spain)

The Sopeña rock-shelter is located in the village of Avin (Concejo de Onís, Asturias, Spain, Lat 43°19′16″ N long 4°56′48″ W) (Figure 1). It is a rocky shelter, perhaps remnant of a larger now buried cave. Placed in the northern slopes of the Picos de Europa mountain range, the shelter opens toward the SW. It stands out in the landscape, at some 450 m over sea level, as a rocky outcrop overlooking the wider valley of the river Güeña, tributary to the Sella River.

A 2 × 1 m test excavation was carried out at Sopeña in 2002 (Figure 2), which uncovered a notable in situ stratigraphic and archaeological sequence (Figure 3), with levels ranging from the later Middle Palaeolithic to the initial Upper Palaeolithic, described elsewhere (e.g., Pinto-Llona et al., 2012; Pinto-Llona & Grandal-d'Anglade, 2022). The bottom of the sequence was not reached. All of these levels were rich in both lithic and faunal remains. Regarding Sopeña Mousterian Level XV, it yielded some 319 lithics and 5567 faunal remains (Pinto-Llona, 2014). Given the richness of finds, current excavations digging on a larger surface are progressing slowly down through the sequence.

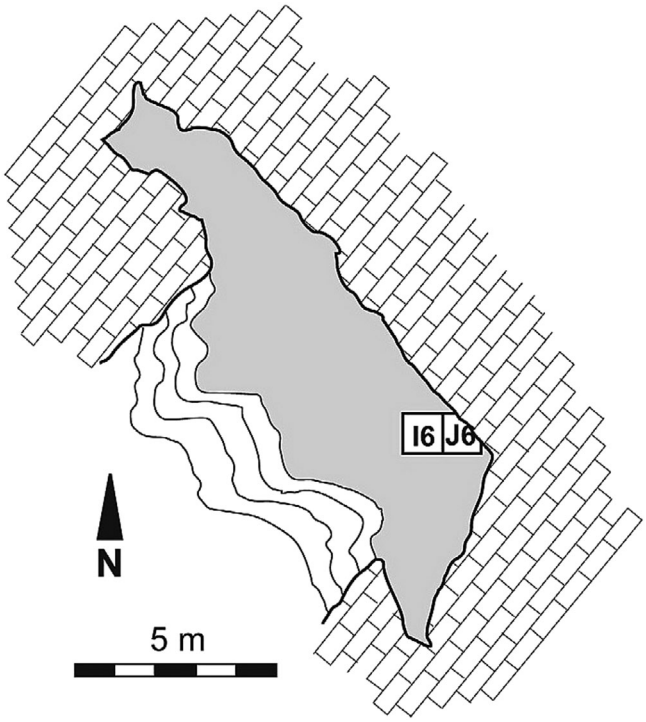

FIGURE 2 Plan map of Sopeña. The curvy lines to the SW mark the cave entrance, partly obstructed by large blocks fallen from the ceiling and covered by a thick layered flowstone formed when the shelter was a larger cave. The test trench consisting of squares I6 and J6 is by the east wall and by the angle produced by the main fault (Pinto-Llona & Grandal-d'Anglade, 2019).

The dominant lithic raw material throughout the sequence is fine- or middle-grained local quartzite, although flint is also present both in the Middle and in the Early Upper Palaeolithic (EUP) and Upper Palaeolithic deposits. Diagnostic Mousterian tools include numerous sidescrappers and some Mousterian points. It is worth noting here that no Aurignacian diagnostic tools have been up to now recorded for the EUP of Sopeña, although this is a blade dominated obviously EUP industry. No tools diagnostic of a Chatelperronian presence have been documented so far at the site (Pinto-Llona et al., 2009, 2012; Pinto-Llona et al., 2022; Pinto-Llona & Grandal-d'Anglade, 2022).

The zooarchaeological and taphonomic analyses of faunal remains from Level XV (Yravedra & Pinto-Llona, n.d.) shows very strong human action on the remains, and Neanderthals appear as the leading agent in the accumulation of the remains of prey at the site. *Cervus elaphus*, *Capra pyrenaica*, and *Rupicapra pyrenaica* were the species hunted most frequently, and other animals are also present albeit in smaller numbers, such as large bovids (*Bos* and *Bison*), *Equus ferus*, and *Capreolus capreolus*.

These species reflect an exploitation of animal resources that lived near the shelter. Sopeña occupies a strategic position, overlooking the valley of the river Güeña, and this would allow easily controlling red deer populations roaming there. Located on the slopes of the Picos de Europa mountain range, it is very close to some mountain peaks, which is the environment favored by ibex and chamois. Maybe it is the closeness to those landscapes that favored that red deer, ibex, and chamois were taken whole to the shelter, as appears by the skeletal profiles recorded (Yravedra & Pinto-Llona, n.d.). As for horses and large bovids, only appendicular elements have been found at the site.

A chrono-cultural overview of the Sopeña archaeological deposits can be summarized in three parts as follows, from top to bottom: Gravettian (Levels I to VII), EUP (Levels VIII to XI), and Mousterian (Levels XII to XV). A good number of 14C dates, both AMS and ultrafiltered, have been published for the sequence (Pinto-Llona & Grandal-d'Anglade, 2019, 2022) (Table 1).

We are concerned here with Level XV, and a sample (#72083) from this level yielded >43,500 BP (Beta-580500). We have carried out Zoom's analyses on this specimen (Buckley et al., 2009). It can be concluded that it is a red deer (García-Vázquez et al., 2023; Mariezkurrena, 2011; Welker et al., 2016).

Taphonomic analyses has shown that human activity focused on the use of animal species present as food, and this is suggested by the frequencies and distribution of cut-marks (Yravedra & Pinto-Llona, n.d.). Cut-marks have been recorded reflecting activities of evisceration, skinning, filleting, and disarticulation.

Along with meat consumption, the presence of percussion marks and bone flakes, as well as the predominance of bones that were broken when fresh, signals that the bone marrow was also extracted and consumed, contributing these activities to the high fragmentation of the bone assemblage.

Summarizing, the Mousterian Level XV of Sopeña displays intense human action on the fossil remains and Neanderthals there carried out an intensive exploitation of local animal resources.

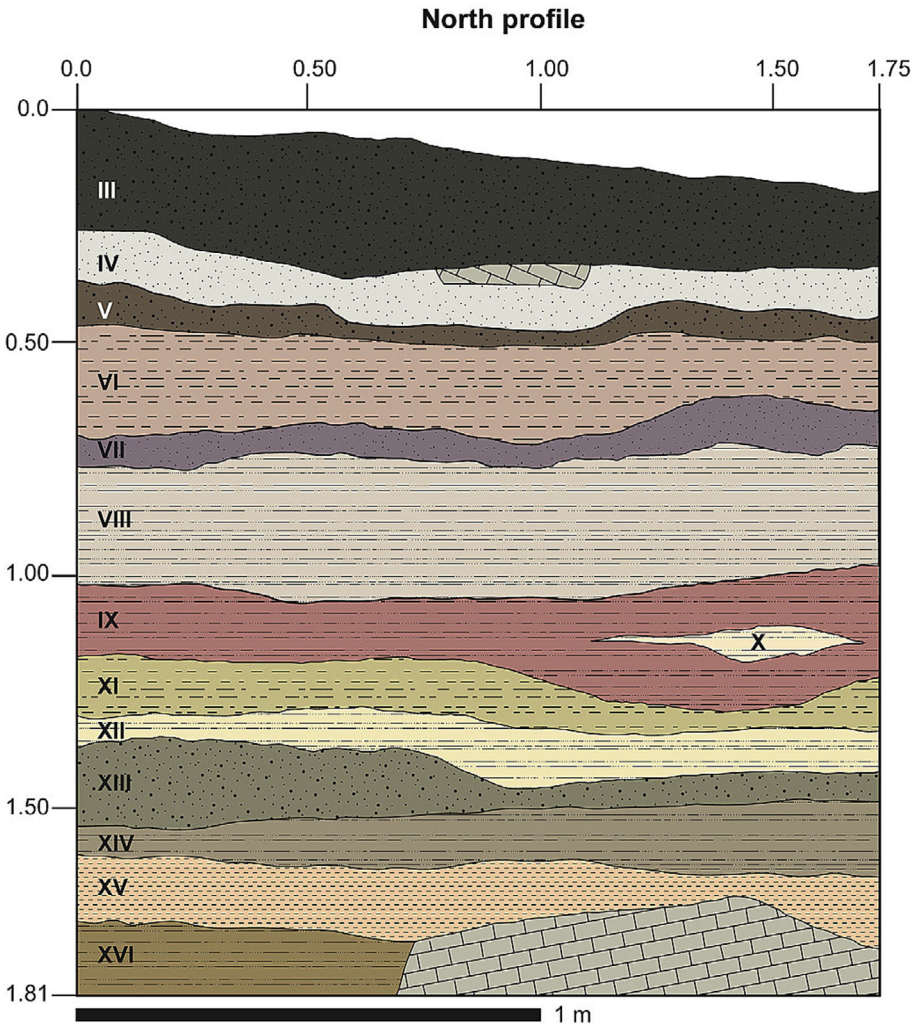

FIGURE 3 North profile of the Sopeña test excavation. The sequence contains Gravettian (Levels III–VII), Early Upper Palaeolithic (Levels VIII–XI), and Mousterian (Levels XII–XV) (Pinto-Llona & Grandal-d'Anglade, 2019). [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Dating of the site. Data from Pinto-Llona et al. (2022).

Year	Level	Technocomplex	Method	Sample	Lab. ref.	C14 years BP
2012	III	Gravettian	C14 AMS	SPÑ02-45124	Beta-198144	21,020 ± 100
2005	XI	EUP	C14 AMS	SPÑ02-06/07-I6	Beta-171157	32,870 ± 530
2019	XI	EUP	C14 AMS	SPÑ02-17/07-85388-I6	Beta-470470	40,215 ± 310
2019	XI	EUP	Ultrafiltration	SPÑ02-17/07-85388-I6	Beta-470467	38,445 ± 250
2012	XI	EUP	C14 AMS	SPÑ02-85391-I6	GrA-39,760	34,470 ± 650–450
2012	XI	EUP	ESR-LU		Williams 2005SP02	40,300 ± 4800
2012	XII	Mousterian	C14 AMS	SPÑ02-87583-I6	GrA-39761	35,500 ± 650–450
2009	XII	Mousterian	C14 AMS	SPÑ02-18/07-J6	Beta-198146	38,630 ± 800
2019	XII	Mousterian	C14 AMS	SPÑ02-17/07-87743-I6	Beta-470471	39390 ± 280
2019	XII	Mousterian	Ultrafiltration	SPÑ02-17/07-87743-I6	Beta-470468	33,100 ± 150
2019	XII	Mousterian	C14 AMS	SPÑ02-17/07-87758-I6	Beta-470472	48,830 ± 480
2019	XII	Mousterian	Ultrafiltration	SPÑ02-17/07-87758-I6	Beta-470469	45,040 ± 550
2012	XII	Mousterian	ESR-LU		Williams 2005SP03	49,300 ± 5300
2012	XIII	Mousterian	ESR-LU		Williams 2005SP05	57,100 ± 12,500
2012	XIV	Mousterian	ESR-LU		Williams 2005SP08	50,400 ± 8700
2012	XV	Mousterian	ESR-LU		Williams 2005SP10	57,200 ± 12,300

2 | MATERIALS AND METHODS

In this work, we registered all the bones from the Mousterian Level XV of Sopeña showing evidences of having been used as bone retouchers when knapping lithic tools (Alonso-García et al., 2020; Armand & Delagnes, 1998; Mallye et al., 2012; Mozota, 2012; Valensi, 2002). This methodology is a second part of a previous taphonomic and zooarchaeological work (Yravedra & Pinto-Llona, n.d.).

Out of the 5567 faunal remains recovered in the 2 × 1 m 2002 Test Excavation of Sopeña Mousterian Level XV, we have identified 25 bone retouchers, that is, bones or bone fragments that show impact marks consistent with their use as retouchers for the finer finishing in the manufacture of lithic tools (Table 2).

Different lithic raw materials will produce different marks on bone, and a preliminary analysis of raw materials by weight (Pinto-Llona et al., 2012) recorded 86.09% quartzite, 6.96% flint, 3.91% limestone, and 3.04% undetermined, with no quartz, for Mousterian Level XV. Flint is present along the Sopeña Mousterian sequence (L. XV 6.96%, L. XV/XIV 14.10%, L. XIV 13.4%, L. XIII 7.50%) in proportions that are similar to those in the EUP levels (L. XI 8.25%, L. X 7.81%, L. IX 12.50%, L. VIII 11.30%). Flint presence grows steadily along the Gravettian sequence.

The observation of bone surfaces was carried out with a hand magnifier (8–15×). We also took one general picture of each retoucher, as well as detailed pictures of each one of the areas showing the marks produced in retouching by using a macro-objective 100×. Measurements were taken with a digital caliper.

In addition to data proceeding from excavation records (specimen number and Level of provenance), we compiled all the observations relevant to a taphonomic and zooarchaeological analyses (Lyman, 1994, 2008), recorded in the prior analyses of the complete faunal assemblage carried out by Yravedra and Pinto-Llona (n.d.).

Our analyses were conducted in two steps: (a) In the first step, we recorded data on each bone fragment used as retoucher, such as animal species, skeletal part, section of the anatomy etc.; and (b) the second step consisted in analyzing each of the surface areas with modifications consistent with their use as retouchers.

Additionally, for each registered item, we recorded the traits below:

TABLE 2 Sopeña bone retouchers from Level XV and their principal traits.

ID	Level	N°	Bone	Dist/ Prox	Face	Laterality	Taxa	L	W	Max. T	N° A	CM	SM	FF
1	XV	74,519	Metacarpus	Med	A	Right	*Cervus elaphus*	114	31	11.6	3	1		
2	XV	74,609	Metatarsal	Med	A	Left	*C. elaphus*	77	28	11.5	1	1		
3	XV	74,604	Femur	Prox	P	Right	*C. elaphus*	120	21	8	2	1		
4	XV	73,432	Humerus	Med	M	Left	*C. elaphus*	55	27	4.5	1			
5	XV	72,100	Tibia	Med	M	Right	*C. elaphus*	63	24	9	2	1		1
6	XV	72,081	Radius	Med			Indet	130	16	11.1	2			
7	XV	75,097	Ulna	Med	Cr	Left	*C. elaphus*	94	38	7	1	1		
8	XV	75,084	Metacarpus	Med	Cr		*C. elaphus*	57	18	4.2	1	1		
9	XV	75,247	Metacarpus	Med	Cr		*C. elaphus*	47	29	6	1	1		1
10	XV	75,222	Tibia	Med	Cr		*C. elaphus*	47	26	6.8	1			1
11	XV	75,244	Femur	Med	C	Left	*C. elaphus*	106	23	6	2			1
12	XV	75,051	Femur	Med	C	Left	*C. elaphus*	92	28	5.8	2	1		1
13	XV	74,470	Indet				Medium sized	49	18	5.8	1			
14	XV	75,060 + 75,070	Tibia	Med	M	Right	*C. elaphus*	89	37	9	2	1		1
15	XV	74,985	Humerus	Med	L	Right	*C. elaphus*	121	35	11	2			1
16	XV	75,029	Metacarpus	Med	Cr	Right	*C. elaphus*	78	26	10	1			1
17	XV	74,513	Metatarsal	Med	Cr	Right	*C. elaphus*	102	26	9.4	3	1		1
18	XV	74,517	Indet				Indet	47	26	9.5	2			1
19	XV	74,546	Radius	Med	Cr	Right	*C. elaphus*	77	23	7.8	1	1		1
20	XV	75,056 + 75,057	Metatarsal	Med	C		*C. elaphus*	108	25	13	1	1		
21	XV	75,058	Metatarsal	Med	Cr		*C. elaphus*	78	26	6	1	1		1
22	XV	74,587	Indet				Indet	58	*	6.8	2			1
23	XV	74,783	Metacarpus	Med	L		*Capra pyrenaica*	75	19	8	1	1		1
24	XV	74,627	Tibia				Indet	69	30	4.8	1	1	1	
25	XV	74,703 + 74,588	Femur	Med			Indet	99	31	9.4	1	1		1

Abbreviations: CM, cut-marks; FF, fresh fracture; L, length; max. T, maximum thickness; N°A, N° of active areas; SM, scraping marks; W, width.

a. Anatomical element with evidences of its use as retoucher (femur, tibia etc.).
b. Anatomical section: diaphysis, epiphysis, proximal, medial, or distal diaphysis.
c. Side of the element (left, right).
d. Taxon as far as it can be determined (genus, species, size, or undeterminated) (Brain, 1981; Bunn, 1982; Díez, 1992).
e. Measures: length, width, and maximum thickness (in millimeters).
f. Number of areas that were used as retouchers for each specimen.
g. We also made a point of recording some particularly relevant taphonomic evidences, such as the presence of anthropic modifications (cut-marks, fresh bone fractures, or exposition to fire), following the work by Yravedra and Pinto-Llona (n.d.).

Furthermore, for each surface area with retouching marks in each specimen, we noted, following Mallye et al. (2012), and our own criteria, the following features:

a. Side on which appears the surface used as retoucher: anterior, posterior, medial, lateral, proximal, or distal.
b. Thickness of the bone in these surfaces.
c. Precise location of the area, following Mallye et al. (2012): apical, centered, covering, and lateral (p. 1133).
d. Distribution: isolated, dispersed, concentrated, and concentrated and superposed (Mallye et al., 2012).
e. Length (maximum axis) and width (axis perpendicular to the maximum axis) of each area.
f. Pit type (considering triangular and ovoid pits) and scores (straight and sinuous as well as rough and smooth) (Mallye et al., 2012, p. 1134).
g. Type of the surface of each area: hatched, pitted, and scaled (Mallye et al., 2012, p. 1134).
h. Finally, we also recorded whether there were overlappings that could be relevant to our study, mainly scrapes (Binford, 1981; Noe-Nygaard, 1989) under the area used as retoucher, as well as cut-marks either under or over these areas.

3 | RESULTS

Our analyses included 25 bone fragments that were used as retouchers in Level XV (Table 2), that is, 0.60% of the total NR (number of remains). The length of the fragments used as retouchers is between 130 and 47 mm, and the width ranges between 16 and 47 mm. The maximum thickness of the cortical surface ranges between 4.2 and 13 mm (Figure 4). Most of these retouchers are between the two cohorts of longest bones remains of the total bone assemblage (Figure 5).

Almost all these retouchers are on long bones: Metacarpals are the most frequent support, followed by metatarsals, femurs, and tibiae

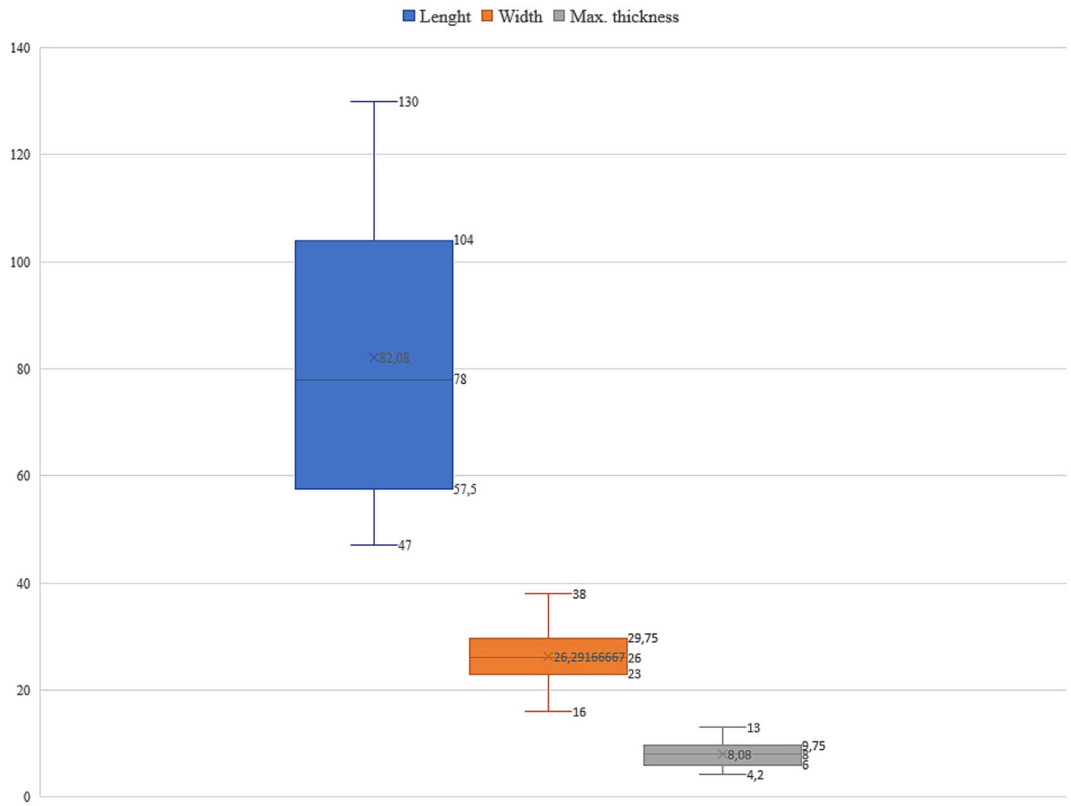

FIGURE 4 Box graph indicating maximum length, width and thickness of the bones employed as retouchers in Sopeña Level XV. [Colour figure can be viewed at wileyonlinelibrary.com]

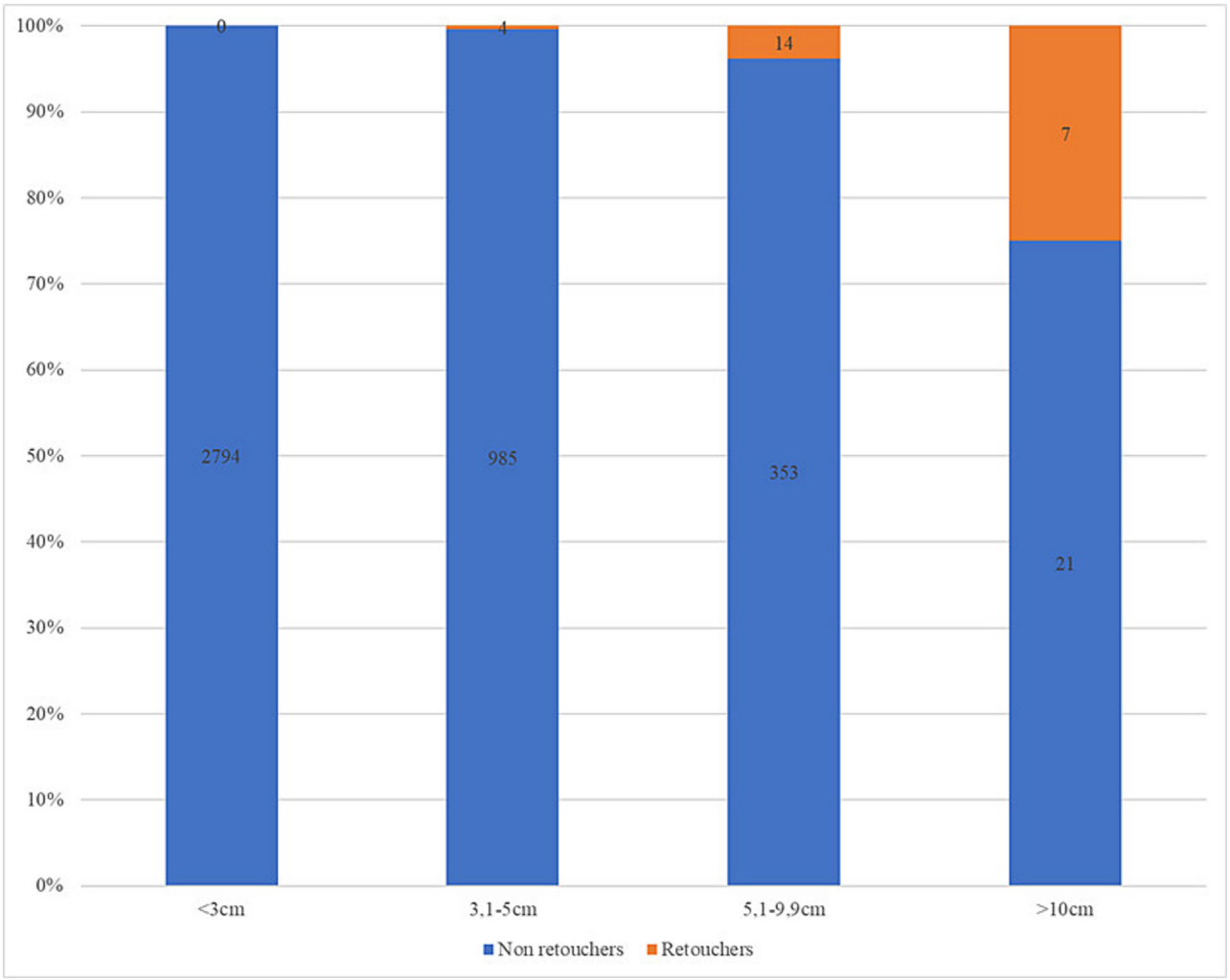

FIGURE 5 Presence of retouchers amongst faunal remains according to length, Sopeña Level XV. [Colour figure can be viewed at wileyonlinelibrary.com]

(the last three appear in the same proportion) (Figure 6). The proportion of the supports chosen to be used as retouches does not coincide with the proportion of long bones represented in the total assemblage.

Although the areas used for retouching (Figures 7 and 8) almost always are in the medial part of the shaft, we found in our sample that there is a tendency to favor some sides of the bone: Retouchers that use as base the cranial side of long bones are frequent (32%, n = 8).

Almost in every case, the retouchers are made on remains of *C. elaphus* (Figure 9). There are only two specimens on bones of *C. pyrenaica*; five specimens could not be determined, and one of them is on a bone of a middle-sized ungulate—which could possibly be a red deer, seeing the taxonomic profile of the total assemblage. Although *R. pyrenaica* is aboundingly present in this level, their bones have not been used as retouchers. It is worth noting here that the bones used as retouchers belong to adult specimens in every case, with the exception of a juvenile red deer metatarsal.

Regarding other taphonomic observations, most retouchers have cut-marks (64%, $n = 16$) and/or fresh bone fractures (60%, $n = 15$). Among the retouchers with cut-marks, only one specimen shows scrapping; none of these marks are below the active areas. We have not recorded any burnt surface in any of them.

More than half of the retouchers have only one active area (56%, $n = 14$), and over a third has two active areas (36%, $n = 9$). Less frequent are specimens with three active areas (8%, $n = 2$). There is a certain variability in the retouchers on red deer bones, but both specimens on ibex bones have only one active area.

Not always the active areas are found exactly on the thickest part of the bone. Although bones with a thickness of around 8.4 mm are preferred, the modified areas appear usually in parts where the thickness is around 7.1 mm (Figure 10).

Out of the 37 active areas recorded in our analyses, more than half are located in the central zone (51.3%, $n = 19$); also, many are present on the lateral side (40.5%, $n = 15$) and less frequently on the apical fringe (8.1%, $n = 3$).

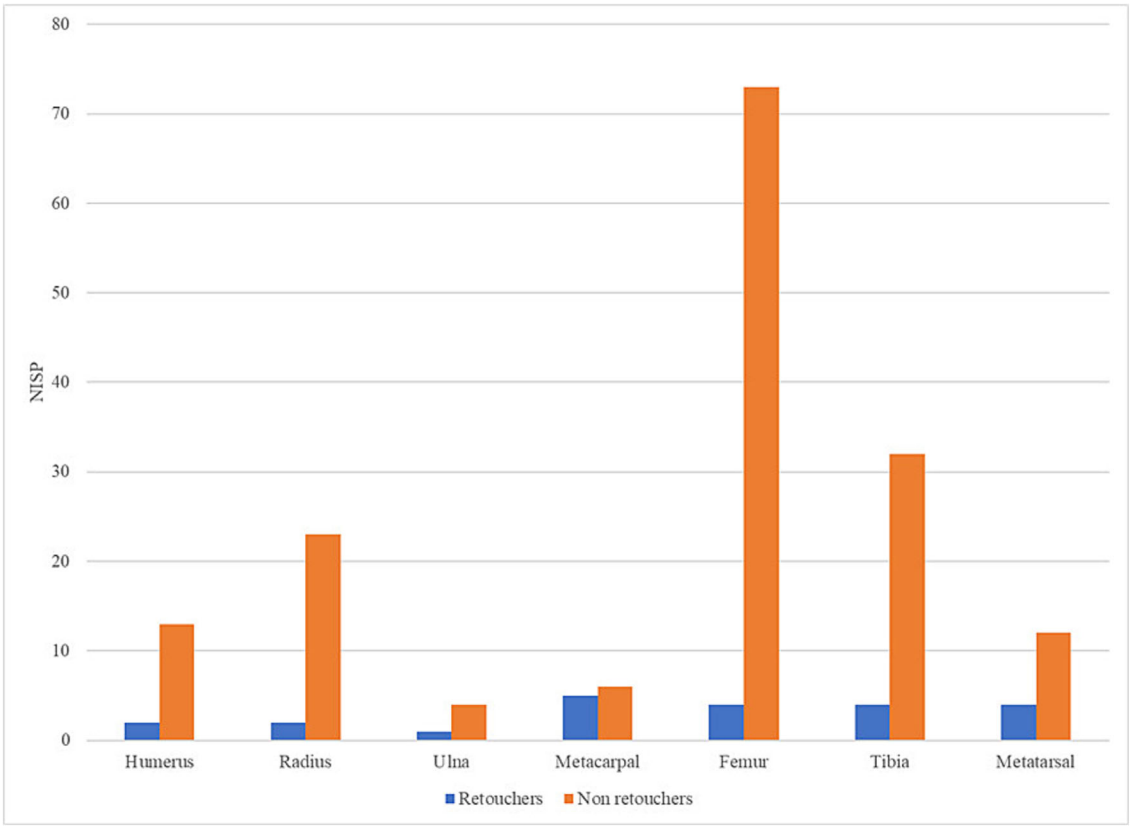

FIGURE 6 Presence of retouchers by anatomical elements (NISP). Sopeña Level XV. [Colour figure can be viewed at wileyonlinelibrary.com]

The impact marks recorded on active areas appear more frequently concentrated (45.9%, $n = 17$), and scattered in a smaller number of specimens (29.7%, $n = 11$); concentrated and overlapping are less frequent (16.2%, $n = 6$), and there are some isolated marks (8.1%, $n = 3$). In the two retouchers on *C. pyrenaica* bones, the impacts are scattered.

The size of the active surfaces ranges between 2.95 and 67.5 mm length (with a tendency towards a maximum length of around 21.9 mm) and between 1.5 and 22.2 mm width (more frequently around 10.5 mm) (Figure 11).

Finally, we recorded all types of pits, scores, and areas as defined by Mallye et al. (2012) in each of the active areas recorded (Table 3). Ovoid pits are frequent; straight and winding scores appear in equal numbers, and there are pitted and scaled surfaces. Many retouchers combine several of these modifications, not only on the same specimen but on the same active area.

4 | DISCUSSION

This collection of 25 bone retouchers from the Mousterian Level XV of Sopeña offers data permitting to reflect on the technological application of bone tools by Neanderthal societies.

Confirming what was already suggested by other works (e.g., Alonso-García et al., 2020; Mallye et al., 2012; Mozota, 2015; Romandini et al., 2015), the anatomical elements most suitable for their use as tools when knapping lithics, are the shafts of long bones. In Sopeña Level XV abound the diaphyses of metacarpals, metatarsals, tibia, and femora. Less frequently other elements are also employed, such as *Bos/Bison* ribs or caprid horns (Martellotta et al., 2021; Mozota, 2012, 2015). Those elements appear in some sites alongside with stone retouchers (Pérez et al., 2019). However, in Sopeña Level XV, retouchers appear exclusively on long bones. Although a more in-depth analysis of lithics from this level is currently in course, earlier works did not record there any lithic percutor (Pinto-Llona et al., 2012).

Length, width, and thickness are the determining features for the use of bones as retouchers when finishing lithic products. In Sopeña Level XV, the dimensions recorded are similar to those published for other sites (Alonso-García et al., 2020; Mozota, 2012), which fits the standard size for retouchers from the Middle Paleolithic of the Iberian Peninsula.

The elongated shape of the retouchers allows the knapper to hold the tool, controlling visually the action of percuting on the lithic material and predicting the result of each strike. From a mechanical point of view, it allows to gain greater acceleration thus increasing striking power (Mozota, 2012, p. 327). This is consistent with the observations at Sopeña, since all the bones used with a technological aim are proportionally elongated.

On the other hand, the width of the retoucher permits to encompass a bigger front when hitting on the stone that wants retouching, avoiding its breakage. It is likely that the natural curve of bone relates to the successful completion of this technological task.

FIGURE 7 Sopeña Mousterian Level XV, some bone retouchers. (a) Retoucher with three active areas on *Cervus elaphus* metacarpal (specimen #74519). (b) Retoucher with two active areas on *C. elaphus* humerus (specimen #74985). (c) Retoucher with one active area on a metatarsal bone of *C. elaphus* (specimen #75058). (d) Retoucher with two active areas on *C. elaphus* femur (specimen #75051). [Colour figure can be viewed at wileyonlinelibrary.com]

Both length and width follow a clear pattern in the Mousterian sites from the Iberian Peninsula (Table 4, Figure 12). We found similarities between Middle Palaeolithic sites and levels having 24 or more retouchers, including Peña Miel G, Prado Vargas 4, Morín 17, Covalejos J, Covalejos K, Axlor B, Axlor D, Axlor F, Axlor M, Axlor N (Alonso-García et al., 2020; Mozota, 2015; Pérez et al., 2019) and Sopeña Level XV: Length is very similar in all these contexts. There is greater variability regarding average width, but always fitting the in general pattern. We suggest that such variability is due to particular activities being undertaken and also to the lithic tools to be perfected and lithic raw materials available in each site.

We can affirm that Middle Palaeolithic retouchers are standardized products both in time and space. For this reason, the technological applications of bone, the aims regarding the final products of knapping, the access to animal carcasses, and even the cultural models of Neanderthal population from these sites must have been similar.

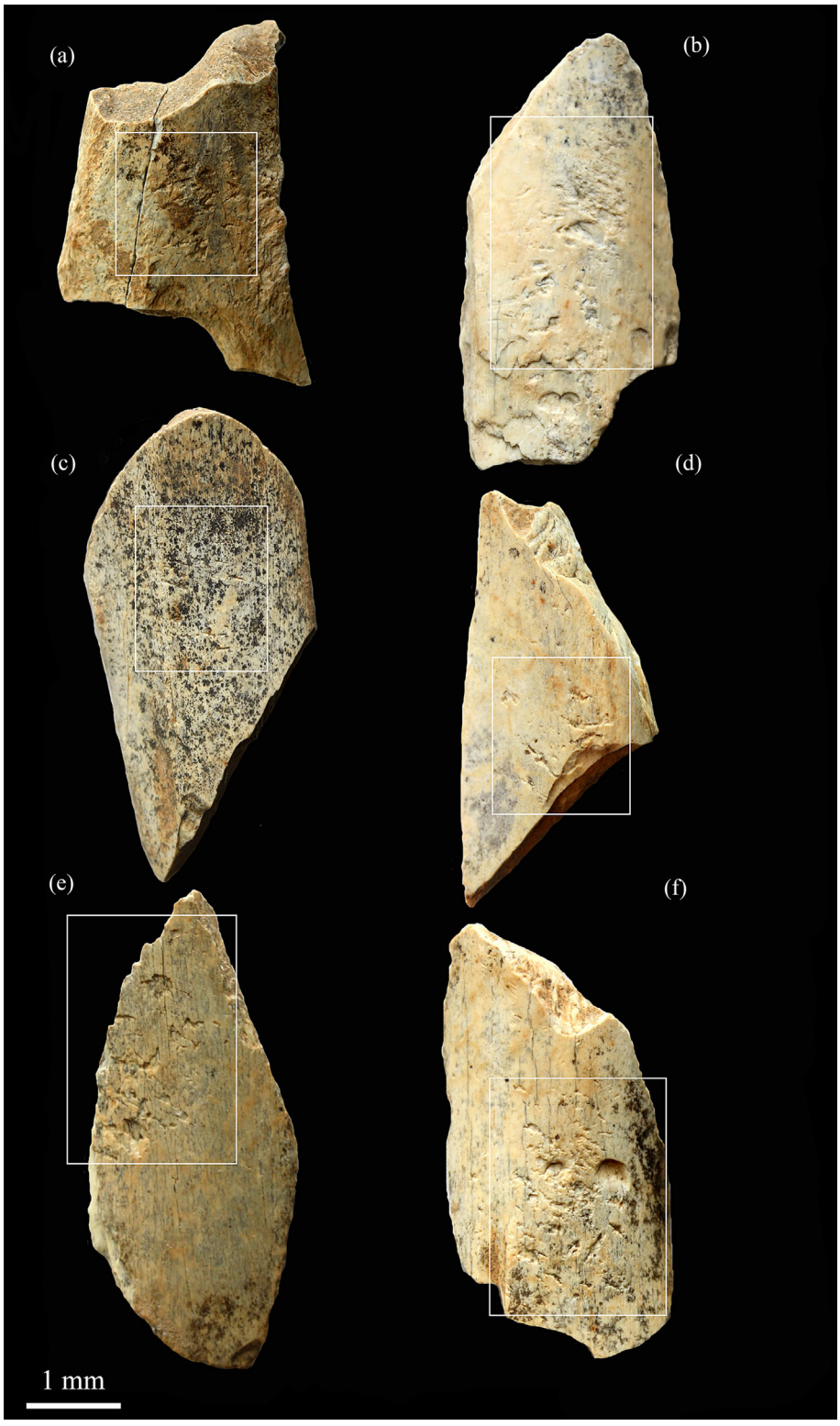

FIGURE 8 Some bone retouchers of Sopeña Mousterian Level XV. (a) Retoucher on indeterminate femur (specimen #74588). (b) Retoucher on humerus of *Cervus elaphus* (specimen #73432). (c) Retoucher on tibia of *C. elaphus* (specimen #72100). (d) Retoucher on tibia of *C. elaphus* (specimen #75222). (e) Retoucher on indeterminate bone of medium-sized mammal (specimen #74470). (f) Retoucher on metacarpal bone of *C. elaphus* (specimen #75247). [Colour figure can be viewed at wileyonlinelibrary.com]

The thickness of the cortical bone appears also as a determining factor. According to our data, if well the active areas are not always exactly on the thickest part, a generally thick cortical makes the retoucher compact enough to resist repeated strikes against the stone to be modified.

The traits and values above constrict the search for given formats to animal species whose bones can be used in the process of knapping stone tools, and even circumscribing their age. Most retouchers from Sopeña Level XV are on limb bones elements of adult red deer. Although ibex and chamois are frequent in the site, the use of their bones is rare, and probably was very limited and even unsuccessful, judging by their rarity and the scattering of impacts in them.

In Europe, most bone retouchers are on the bones of robust animals, be it red deer (Alonso-García et al., 2020; Martellotta

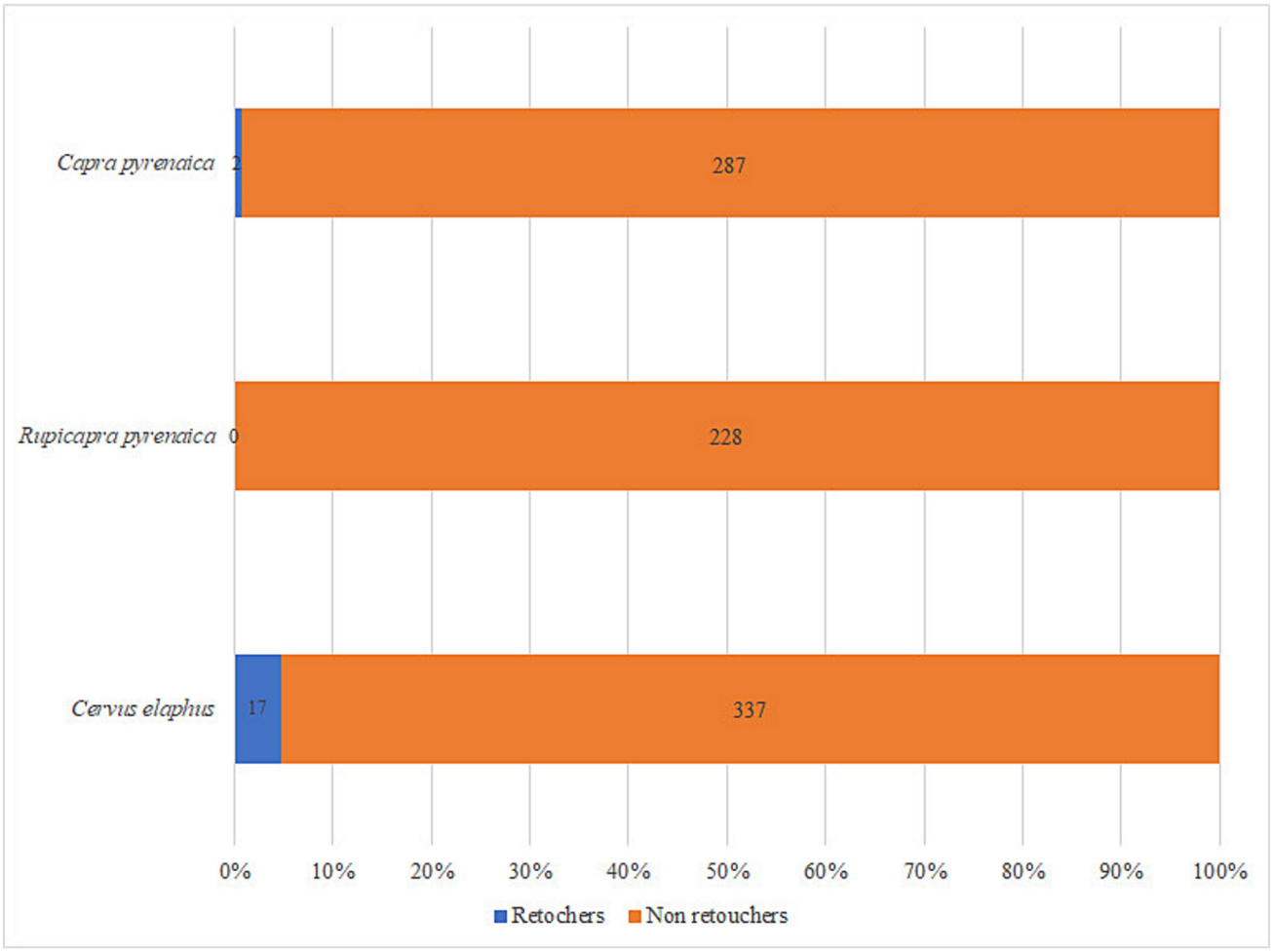

FIGURE 9 Presence of bone retouchers on the most frequent taxa (NISP) recorded at Sopeña Level XV. [Colour figure can be viewed at wileyonlinelibrary.com]

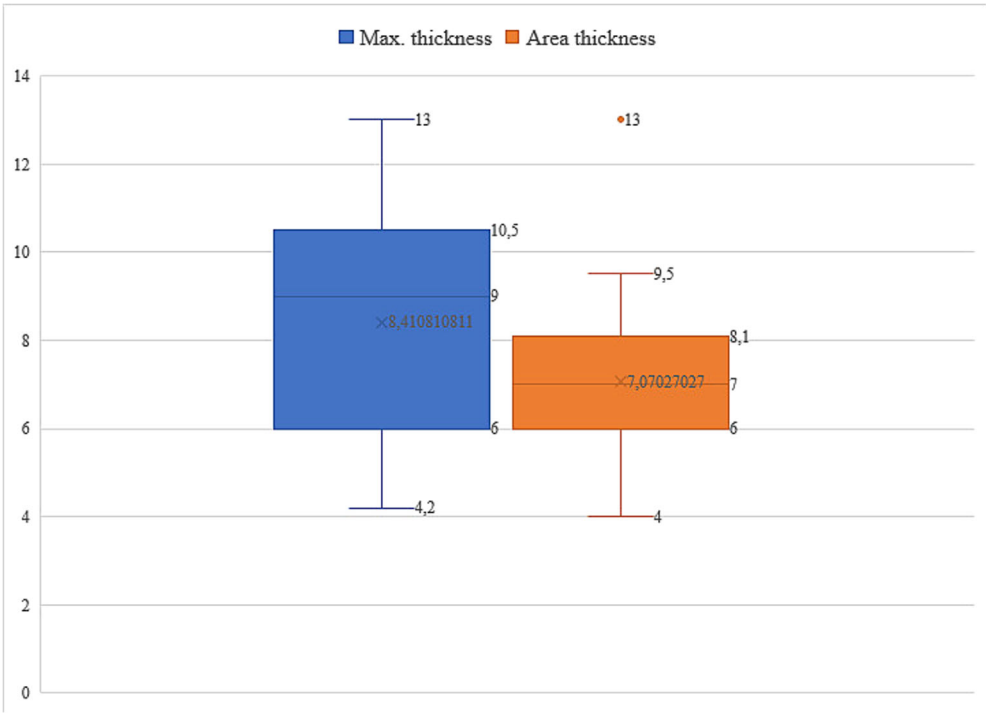

FIGURE 10 Maximum thickness of bone retouchers and thickness of active areas at Sopeña Level XV. [Colour figure can be viewed at wileyonlinelibrary.com]

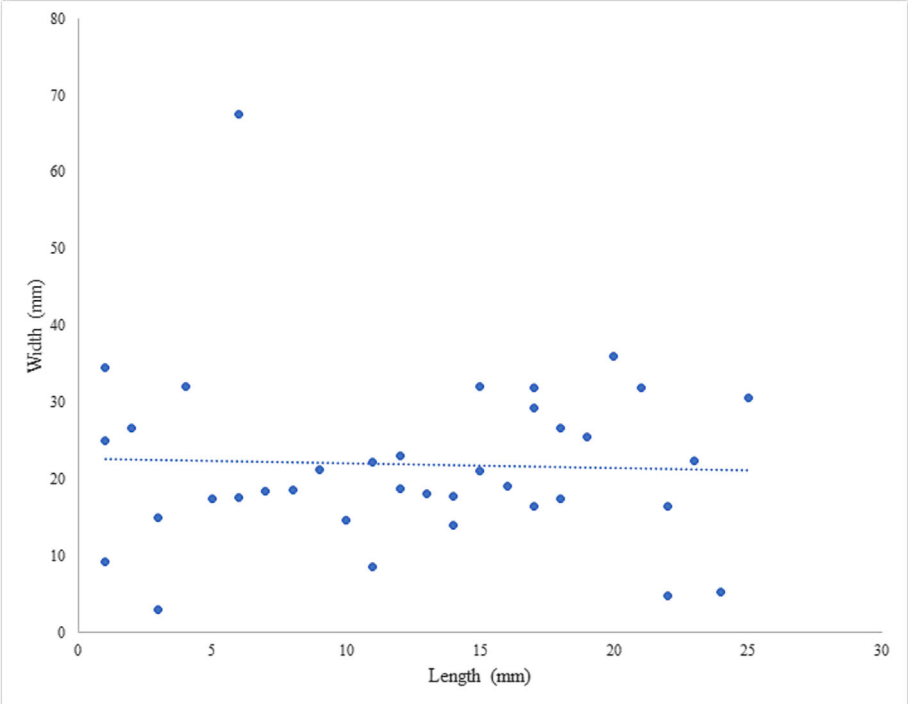

FIGURE 11 Dimensions (length and width) of active areas in the Sopeña Level XV bone retouchers. [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Presence of triangular and ovoid pits, straight and sinuous grooves, smooth, rough and hatched furrows, pitted and scaled areas, in the bone retouchers of Sopeña Level XV.

	Retoucher areas	%Retoucher areas
Triangular pits	13	35.14%
Ovoid pits	27	72.97%
Rectilinear scores	14	37.84%
Sinuous scores	15	40.54%
Smooth scores	9	24.32%
Rough scores	19	51.35%
Hatched area	10	27.03%
Pitted area	15	40.54%
Scaled area	17	45.95%
Total areas	37	100.00%

TABLE 4 Average dimensions (length and width) of sets of bone retouchers from Peña Miel G, Prado Vargas 4, Morín 17, Covalejos J, Covalejos K, Axlor B, Axlor D, Axlor F, Axlor M, Axlor N y Sopeña XV. After Mozota (2015) and Alonso-García et al. (2020).

	Length	Width
Peña Miel G	76.9	25.9
Prado Vargas 4	67.1	25.5
Morín 17	98	32.3
Covalejos J	89.09	33
Covalejos K	84.8	29.2
Axlor B	91.32	31.19
Axlor D	86.96	30.13
Axlor F	76.84	29.51
Axlor M	82.76	28.49
Axlor N	73.77	26.24
Sopeña XV	82.08	26.29
General average	82.69	28.89

et al., 2020), horse (Pérez et al., 2019), large bovids (Mozota, 2015), *Megaloceros* (Martellotta et al., 2021), or mammoth (Neruda & Lázničková-Galetová, 2018). In fact, M. Mozota points out that bone retouchers are scarce in sites with small sized faunas, such as Esquilleu (Mozota, 2012, p. 327).

The presence of a good quantity of evidences of human action on the retouchers—such as cut-marks and fresh bone breakage, as well as the overlapping of retouching marks on cut-marks (Figure 13) indicate that the Neanderthal communities involved with the formation of Sopeña Level XV reused animal waste products resulting from butchering and consumption of meat and bone marrow. Far from being anecdotal, other authors (e.g., Mozota, 2012; Pérez et al., 2019) point out that the recycling of bone waste products is a habitual behavior. It makes sense, since subsistence is a priority for any society, and the production of lithic tools from the technological application of bones is an activity of a derived type, opportunistic in making use of the shaft of long bones.

The presence relatively frequent of two or three active areas on the bones employed as retouchers indicates that Neanderthals were using them intensively, or at least, more consistently than in other sites such as Prado Vargas 4 (Alonso-García et al., 2020). If well not common, in Sopeña, we find retouchers with up to three active areas. This is similar to what has been recorded in sites as Peña Miel G, Axlor B, Fumane, La Ferrassie, and Les Praderes, among others (Costamagno et al., 2018; Daujeard et al., 2014, 2018; Mozota, 2012).

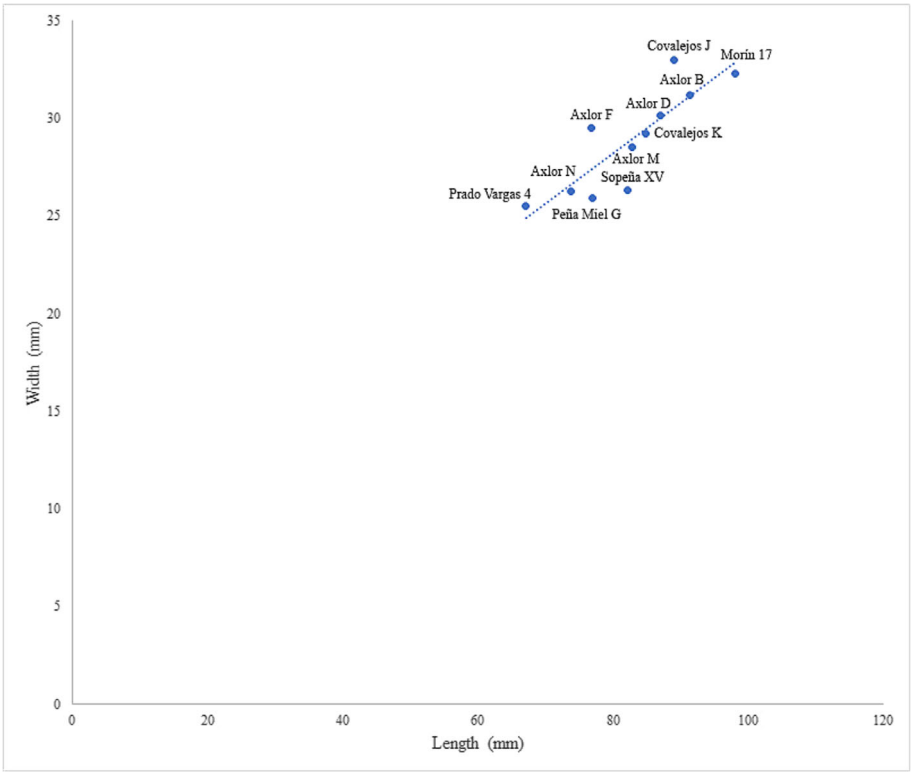

FIGURE 12 Comparison of the average dimensions (length and width) of the Sopeña bone retouchers versus similar Middle Palaeolithic tools from other sites at the Iberian Peninsula, after Mozota (2015) and Alonso-García et al. (2020). [Colour figure can be viewed at wileyonlinelibrary.com]

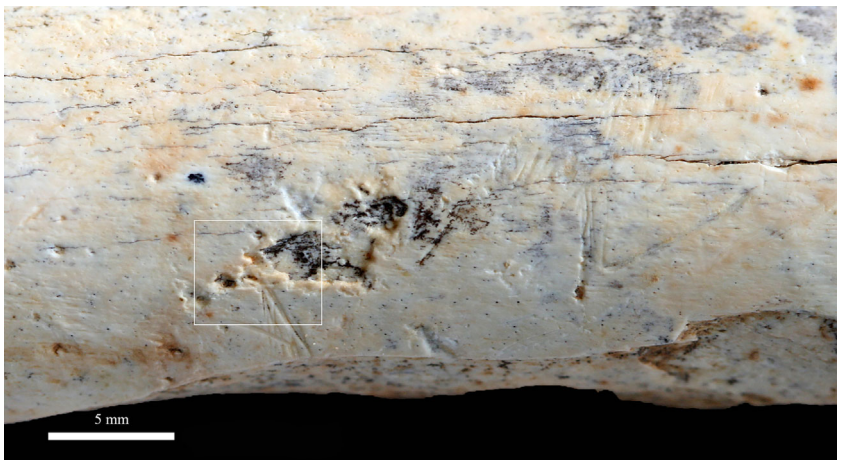

FIGURE 13 Superposition of retouch impact marks on cut-marks on a *Cervus elaphus* metatarsal (specimen #74513). [Colour figure can be viewed at wileyonlinelibrary.com]

The knapper proceeds, in these instances, to rotate the bone tool, whenever its size and characteristics permit it. Sometimes, there is a second rotation, turning in the direction of the transversal axis and thus generating a third active area (Mozota, 2012).

The fact that those 25 retouchers have been recovered in only a 2 × 1 m trench suggests that they were a very frequent and important part of the technological repertoire at Sopeña Mousterian Level XV.

Regarding reuse, we have not detected any scrapping marks on the active areas of the retouchers. Scrapping marks are common on retouchers (Mozota, 2012) and are usually produced either when cleaning the fat that may stick to the surface or when reviving them for further use. The absence of such marks can be read in two different ways: Either the bones used did not have any surface fat, and thus, their freshness would be only relative, or any existing fat did not impede their use for knapping lithic tools, which could suggest their use in industrial tasks of a massive type, such as decorticating pebbles. The first one of these interpretations could be related with a possible reuse of these bone tools for long spans of time, or even in recurring visits to the site.

On the other hand, the combination of different pits, scores, and active areas types (Mallye et al., 2012) suggests that there was a reuse of those retouchers that were most suited to the production of different lithic tools. In the literature, the presence of retouchers is associated either with the presence of tools with Quina-type retouch (Baumann et al., 2023; Mozota, 2012) or with discoid-type tools (Martellotta et al., 2020). Experimental work (Mallye et al., 2012) has shown that there is a relationship between straight and smooth grooves with working on flint, whereas that sinuous grooves point to tasks on quartzite.

Likewise, triangular pits and hatched areas are produced when knapping flint, while that ovoid pits and pitted active areas are produced when knapping on quartzite. Scaled surfaces may be present in either case.

It is remarkable however that in Sopeña Level XV, we have retouchers with straight and smooth grooves, as well as hatched areas, both relating to flint knapping according to Mallye et al. (2012). We have seen above that although quartzite is the dominant raw material in Level XV, flint is also present (Pinto-Llona et al., 2012); thus, these modifications can relate either or both, to the smaller-scale work on flint using the same retouchers, or/and the nature of the quartzite employed, that is frequently rather fine-grained.

Seeing all the above, it seems plausible to suggest that Neanderthals from Sopeña Level XV used the same retouchers to work indistinctly either lithic raw material. However, according to our analysis, work on quartzite was more frequent, and this agrees with the larger proportion of this raw material in this level (Pinto-Llona et al., 2012; Pinto-Llona et al., 2022).

5 | CONCLUSIONS

The Neanderthal societies using Sopeña Level XV had an interest in using bone retouchers with standardized formats that are similar to those employed in other Mousterian sites in the Iberian Peninsula. They show certain variability in their width that could have an origin in the technological processes being carried out in each of these sites.

It seems clear that they were reusing as retouchers bones that were the remnants of prey that had been dismembered, defleshed, and consumed, selecting those specimens that were seen as optimal for this technological application. Although in other sites bone retouchers appear frequently along soft and hard hammers of different types and raw materials, the Neanderthals from Sopeña Level XV seem to basically have provided to most of their stone tool making needs with these bone retouchers, although we must bear in mind that those specimens were recovered in a trench and that excavations in course may alter this perception.

For the task, the anatomical elements most frequently chosen were metacarpal, metatarsal, tibia, and femur bones of adult red deer. With their help, the Neanderthals of Sopeña-shaped lithic tools mainly on quartzite but also on flint.

Bone retouchers seem to have been much more used in Sopeña Level XV than in other sites. Neanderthals did not reactivate the active areas, suggesting that the chosen bones could have been only relatively fresh and, fat being absent, not need cleaning and reactivating. It seems that bone retouchers were used repeatedly, perhaps for a long time and along several visits to the site.

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DATA AVAILABILITY STATEMENT

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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